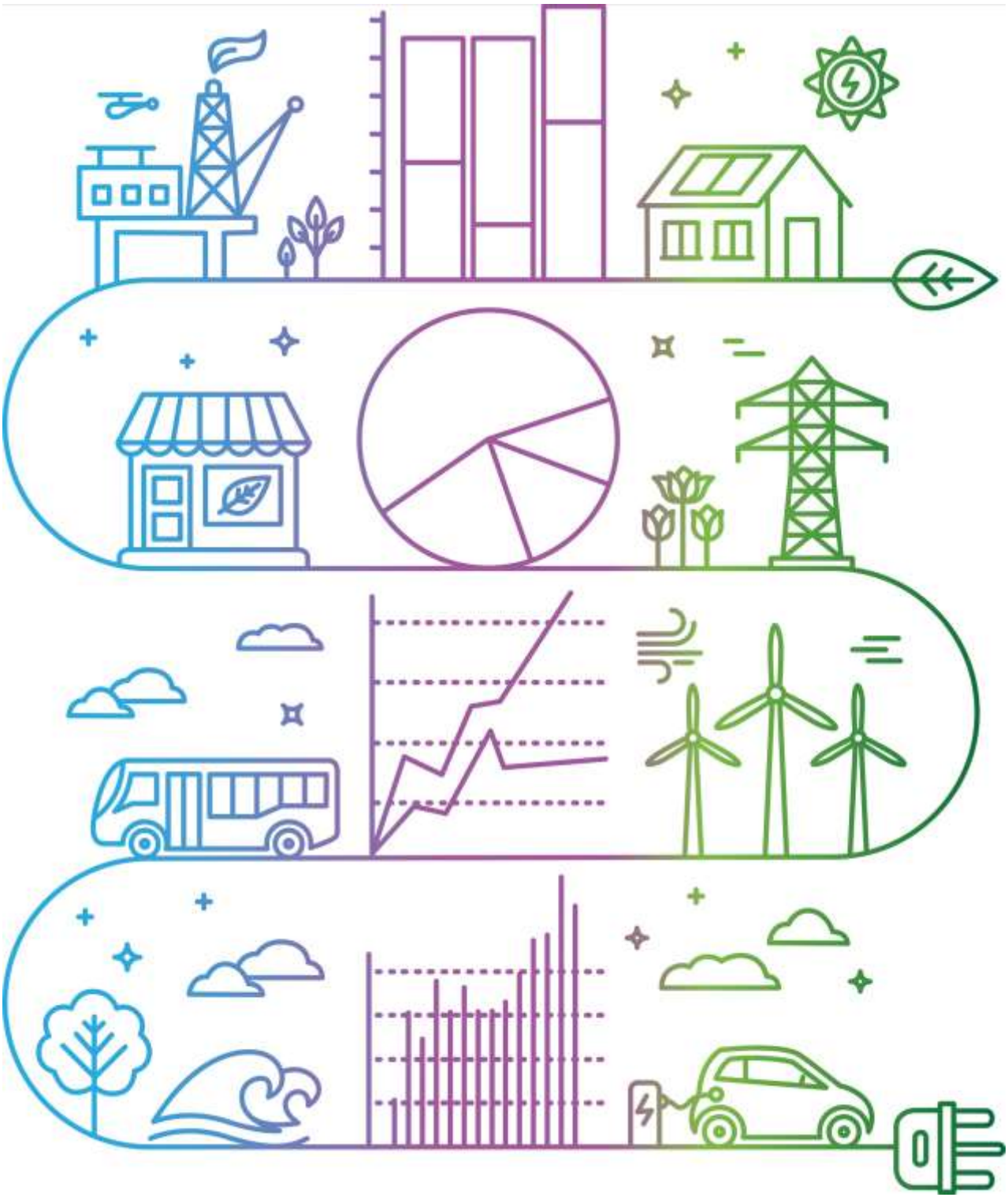
Energy in Scotland 2017



February 2017

Scottish Government
Riaghaltas na h-Alba
gov.scot

Energy in Scotland 2017 provides an overview of energy statistics for Scotland. All statistics presented in the report are from published sources, including publications by the UK Department for Business, Energy & Industrial Strategy (BEIS) and the Scottish Government. All notes and references in the publication are listed in Annex D.

Other products accompanying the main publication this year are listed below:

- A Key Facts booklet to give users, at a glance, the headline statistics and key information for each of the main topic areas covered in this publication. Please see the key facts booklet here:

  http://www.gov.scot/Topics/Statistics/Browse/Business/Energy/EIS/EIS2017keyfacts

- A supplementary excel workbook to accompany the main publication (with all data tables, charts, and source references) is available at the following link:

  http://www.gov.scot/Topics/Statistics/Browse/Business/Energy/EIS/EIS2017data

- A number of online tools have also been published and can be found at the following link:

  http://www.gov.scot/Topics/Statistics/Browse/Business/Energy/onlinetools

We welcome any comments or suggestions regarding this publication. Please email any feedback to: energystatistics@gov.scot

If you would like to be consulted about new or existing statistical collections or receive notification of forthcoming statistical publications, please register your interest on the Scottish Government ScotStat website at:

http://www.gov.scot/Topics/Statistics/scotstat

Contents

Contents

CHAPTER 1

ENERGY IN SCOTLAND OVERVIEW

‘ Over 15% of Scotland’s total final energy consumption came from renewable sources in 2014’

ENERGY IN SCOTLAND OVERVIEW

KEY FACTS

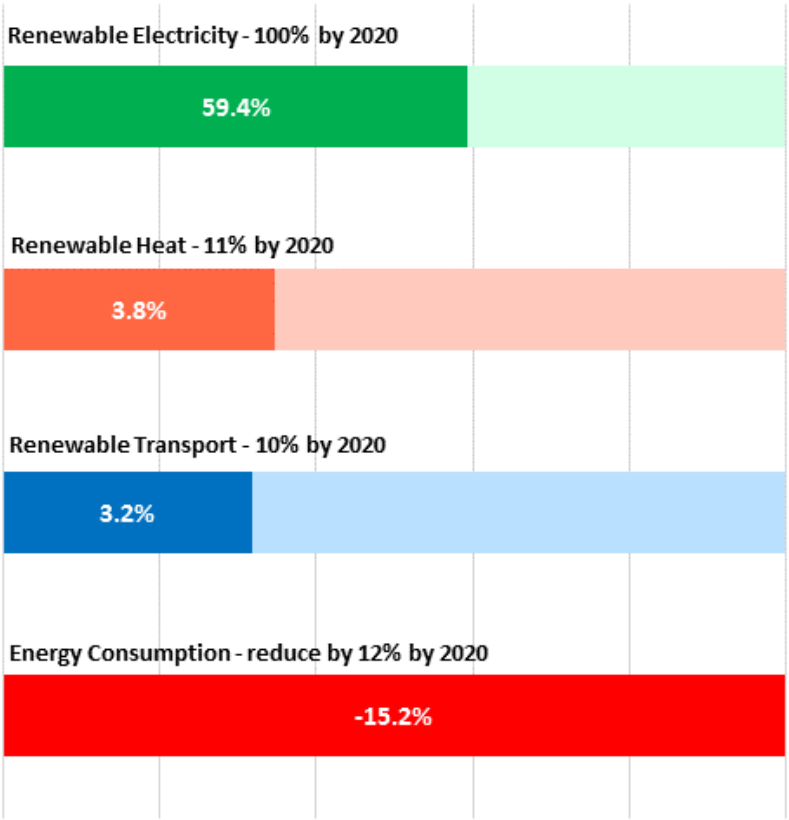
"The Scottish Government has a well-established framework for energy policy including ambitious renewable targets, clear plans to boost energy efficiency and some of the most stretching emissions-reduction targets in the world."

SCOTLAND ACCOUNTS FOR...

10%

...OF UK ENERGY CONSUMPTION

RENEWABLE ENERGY TARGETS - SUMMARY OF LATEST PROGRESS



ENERGY GROWTH SECTOR

EXPORTS IN 2015

£ **16 BILLION**

20% OF ALL SCOTTISH EXPORTS

73%

OF ALL PRIMARY ENERGY IN SCOTLAND IS

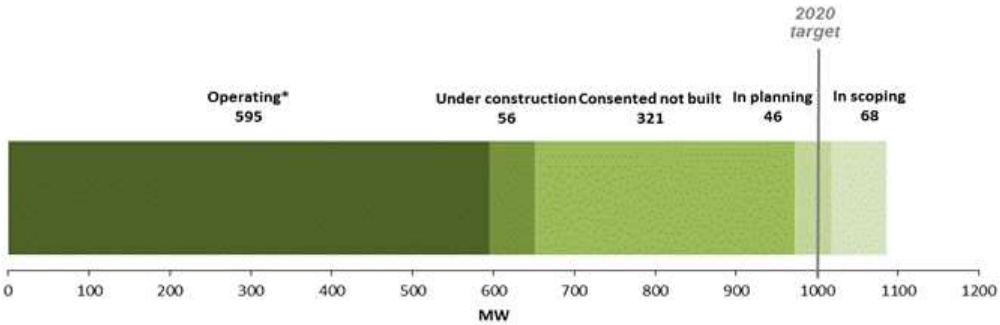
EXPORTED

87% OF TOTAL PRIMARY ENERGY IN 2014 CAME FROM OIL AND GAS

15.2%

...OF TOTAL SCOTTISH ENERGY CONSUMPTION CAME FROM RENEWABLES IN 2014

Community and locally owned renewable energy capacity in Scotland...



* Totals may not equal sums due to rounding. These figures also do not include the capacity of installations recorded as being combined heat and power.

Introduction

In day-to-day life, people and businesses are heavily reliant on energy. Simple actions like switching on the kettle in the morning to turning on the bedside lamp at night are often taken for granted. However, none of this could happen without the complex process of creating and delivering consumable energy.

Scotland has long benefited from its substantial energy reserves. As a centre of the industrial revolution, Scotland was at the forefront of the development of the coal industry, and, since the 1970s, has grown to become an international centre of expertise in oil and gas subsea engineering. Scotland accounts for around 10% of the UK's total energy consumption but is rich in energy resources, accounting for 60% of the UK's indigenously produced primary energy.

The Scottish Government's approach recognises that energy is an important contributor to our efforts to promote sustainable growth, tackle inequalities and deliver on our climate change ambitions. By showing strong leadership in the transition to a low-carbon economy, energy policy can help to deliver this across a range of priorities set by Scotland's National Performance Framework.

The Scottish Government has a well-established framework for energy policy including ambitious renewable targets, clear plans to boost energy efficiency and some of the most stretching emissions-reduction targets in the world.

Today, Scotland is a knowledge hub for energy exploration and production, for power system engineering and a host of modern, renewable energy technologies and systems – placing Scotland at the forefront of the challenge to decarbonise the global economy.

Over the last decade there has been notable consistency to the Scottish Government's approach to energy, leading to dramatic changes to Scotland's energy system:

- Scottish renewable electricity output has **more than trebled** since the end of 2006 and is now equivalent to over half of the electricity consumed in Scotland;
- Already **met the 2020 target** to install 500 MW of community and locally owned renewable generation capacity;
- There has been **unprecedented investment** in the Scottish transmission network, permitting substantial flows of power to the rest of the UK;
- Renewable heat output is **nearly 5 times** the level it was in 2008/09;
- There have been reductions in final energy demand in Scotland, driven by **on-going improvements** to energy efficiency;
- The proportion of transport petrol and diesel consumption from biofuels has **more than trebled** since 2007;
- For the third year in a row, international sales from the Scottish oil and gas supply chain have **increased**;
- The fuel poverty rate in 2015 is the **lowest rate** recorded since 2008;
- Greenhouse gas emissions in Scotland have reduced by **nearly 40%** since 1990; and
- **43,500 jobs** are supported by the **low carbon and renewable energy sector** in Scotland, generating a **turnover of £10.7 billion.**

Developing a new Energy Strategy for Scotland

The draft Energy Strategy for Scotland sets out the Scottish Government's vision for the future energy system in Scotland for the period to 2050. It describes the priorities for an integrated approach to delivering a low carbon energy system and considers both the use and the supply of energy for heat, power and transport.

SCOTTISH GOVERNMENT DRAFT ENERGY STRATEGY

The Scottish Government's 2050 energy vision is aligned to three themes:

- **A whole-system view** - consideration of Scotland's energy supply and consumption as equal priorities, and building a genuinely integrated approach to power, transport and heat;

- **A stable, managed energy transition** - ensuring Scotland has secure and affordable energy supplies as we decarbonise our energy system in line with Scotland's long term climate change targets; where Scottish government continues to support innovation and expertise from oil and gas, the deployment of renewable energy technologies, and the development of more innovative and low-cost ways of producing, storing and transmitting energy; and

- **A smarter model of local energy provision** - promoting local energy, planned with community involvement and offering community ownership of energy generation.

To see the full draft Energy Strategy for Scotland please go to:

http://www.gov.scot/Resource/0051/00513324.pdf

"A modern, integrated, clean energy system, delivering reliable energy supplies at an affordable price in a market that treats all consumers fairly."

SCOTTISH ENERGY STRATEGY, JANUARY 2017

Central to the continued inclusive growth of the Scottish economy is the need for secure, reliable and affordable energy supplies. The Scottish Government has consistently made better energy provision a guiding objective.

This draft Scottish Energy Strategy seeks to build on Scotland's strengths in energy. It explores the choices we face about Scotland's future energy system, against the requirements of:

- the continued, sustainable and inclusive growth of Scotland's economy;
- secure, reliable supplies of energy when they are required;
- achieving better outcomes for consumers of energy with more affordable energy requirements; and
- long-term, sustained decarbonisation - as set out by Scotland's 2050 climate change targets.

The draft Energy Strategy seeks views on the following key issues:

Meeting our Energy Needs:

- Ambitious new 2030 target of 50% of Scotland's energy consumption to be met by renewable energy. This is an ambitious but achievable goal - demonstrating the Scottish Government's commitment to a renewable future and to the continued growth of a successful renewable energy sector in Scotland.
- Getting the market right for renewables as the costs continue to fall – particularly in onshore and offshore wind; providing certainty and leadership despite changes to UK Government's support for the sector.
- Building on the success of our existing energy industries and exploring the role of new forms of energy – Scotland's oil and gas industry is the engineering and technical bedrock for our wider energy transition.

There are opportunities to develop new energy sources and technologies in Scotland, like Hydrogen and Carbon Capture and Storage.

Transforming Energy Use

- A renewed focus on energy efficiency – taking a targeted approach to reducing demand and improving the energy efficiency of Scotland's homes and buildings through Scotland's Energy Efficiency Programme. This will make our homes, shops and hospitals warmer and easier to heat, and by reducing energy demand, we can help tackle fuel poverty, help businesses improve their competitiveness and release savings in the public sector.
- We consult upon the method by which we set a new energy efficiency target for 2030 to best reflect the ambition set by the proposed European Union's 2030 energy efficiency target of 30%.
- We want to see an energy market that works for everyone – the role of regulation, Smart Meters and other innovative technologies, and new business models to support enhanced consumer engagement – particularly for the most vulnerable in society.

Smart local energy systems

- We remain committed to creating vibrant local energy economies, as part of a varied and proportionate response to the transformation of Scotland's energy system. Since 2013, £35 million has been made available to support community and local energy projects.
- We will take a strategic, local approach to planning for energy—supported by a separate consultation on local heat and energy efficiency strategies—and explore the role of a Government Owned Energy Company and the creation of a Scottish Green Energy Bond to support renewable energy projects.

The draft Energy Strategy is open for consultation until **30 May 2017**, the results of which will then be analysed and considered in the development of the final strategy.

Scottish Renewable Energy Targets

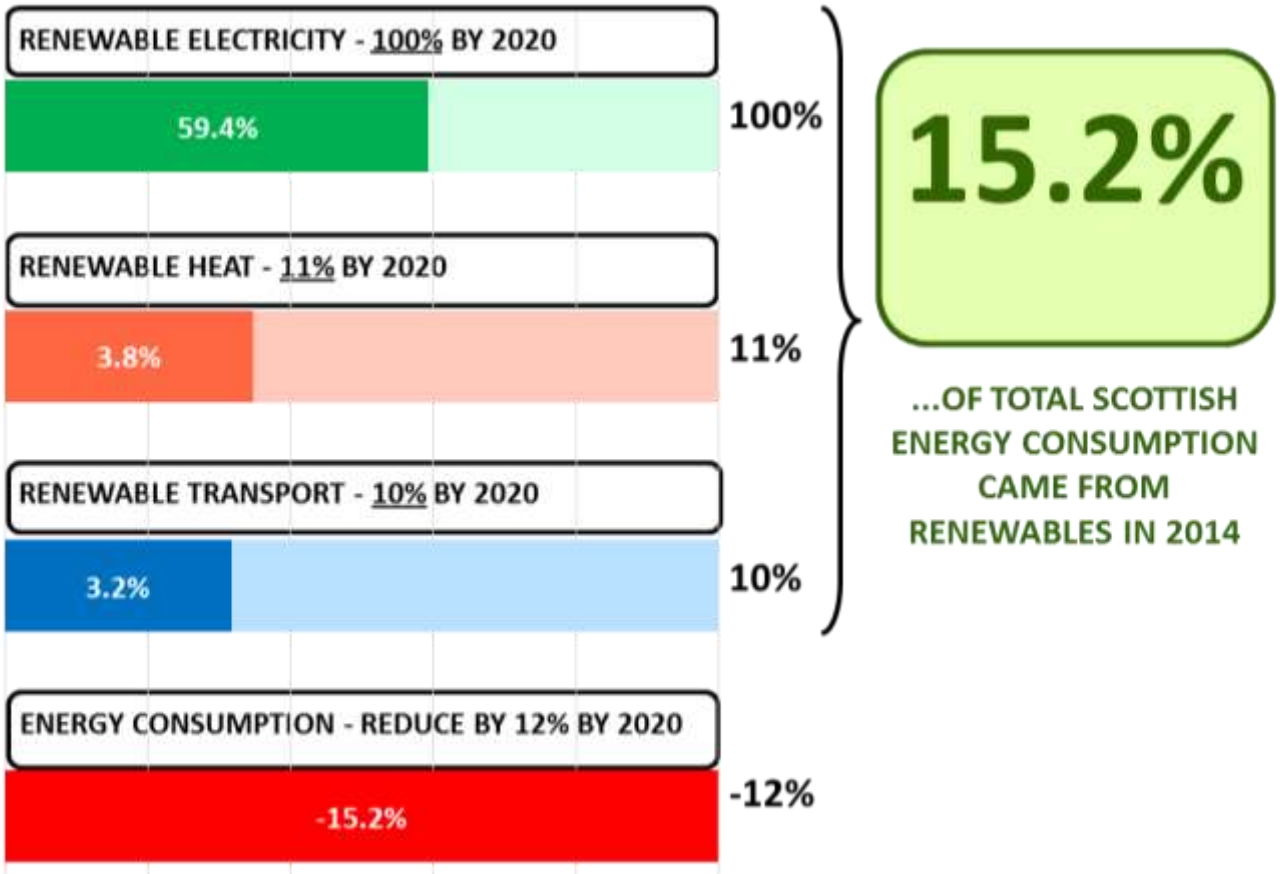
The Scottish Government published the draft Scottish Energy Strategy in January 2017, and remains committed to an overall renewable energy target of 30% by 2020. To achieve this overall energy target, individual targets for renewable electricity, heat and transport are in place. A proposed new 2030 'all-energy' target for the equivalent of 50% of Scotland's heat, transport and electricity consumption to be supplied from renewable sources, captures the ambition of the new strategy adopting a system-wide approach .

Renewable Energy Target – 30% of total Scottish energy consumption from renewables by 2020

As the data availability at a Scotland level has improved, more robust methodological options for measuring each of the Scottish Government's renewable energy targets have become available. A key development has been bringing together each of these methodologies to provide a consistent and transparent measure for monitoring the **overall renewable energy target**. This was one of Audit Scotland's recommendations as part of their report on renewable energy published in September 2013.

Figure 1.1 shows that in 2014, **15.2%** of total Scottish energy consumption came from renewable sources, up from 12.9% in 2013.

FIGURE 1.1: RENEWABLE ENERGY TARGETS - SUMMARY OF LATEST PROGRESS

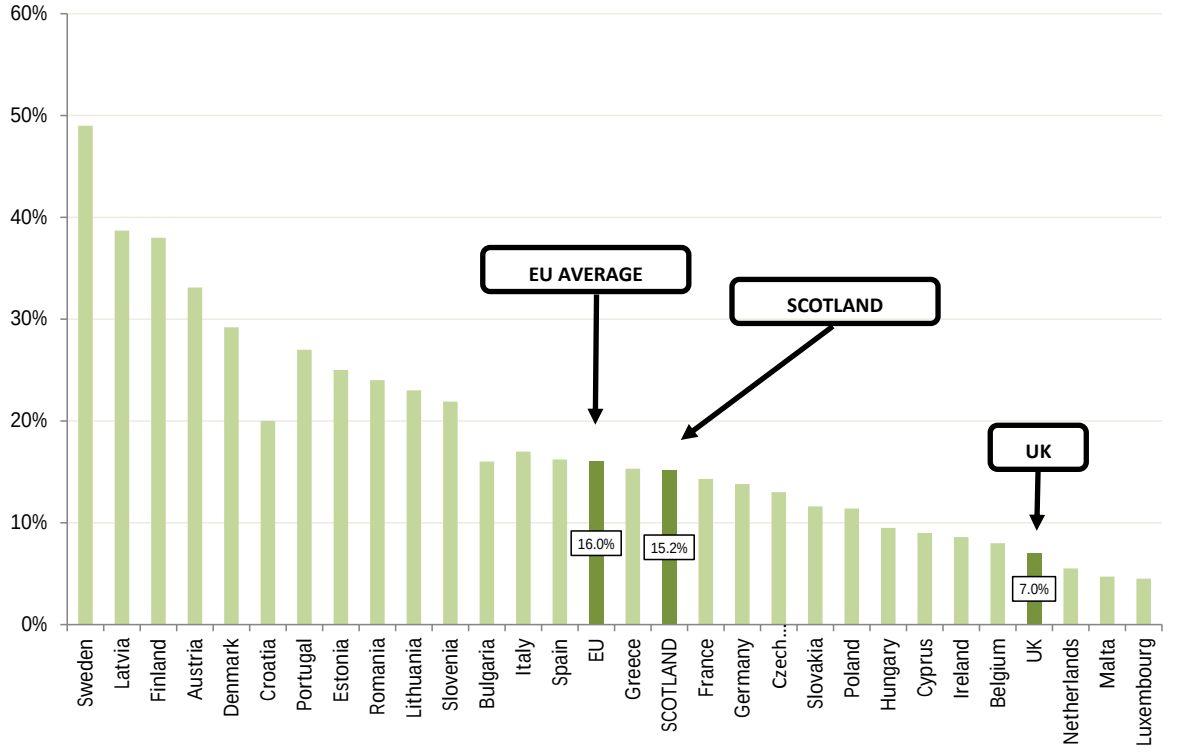


Please note that the most recent figures available for electricity and transport are for 2015. The latest data available to calculate progress on the overall renewable energy target is for 2014.

Sources: Department for Business, Energy and Industrial Strategy, Energy Savings Trust, Scottish Government

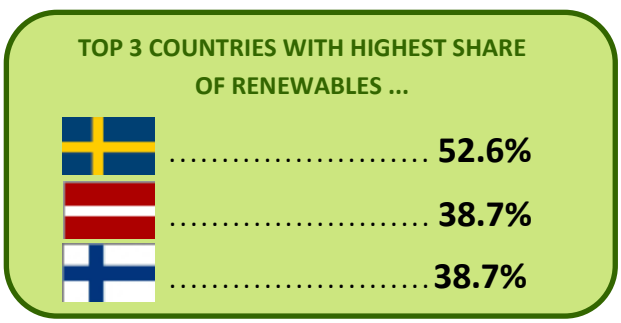
The European (EU) seeks to have a 20% share of its gross final energy consumption from renewable sources by 2020; this target is distributed between the Member States with national action plans designed to plot a pathway for the development of renewable energy. Furthermore, by 2030 the EU aim to cut greenhouse gas emissions by 40%, relative to 1990, which in turn should encourage a greater share of renewable energy in the EU and assist in meeting the 2030 renewables target of 27%. Figure 1.2 shows the latest data available for the share of renewable energy in gross final energy consumption across the EU[1]. The EU average in 2014 was **16.0%** - 0.8 percentage points higher than Scotland and 9 percentage points higher than the UK.

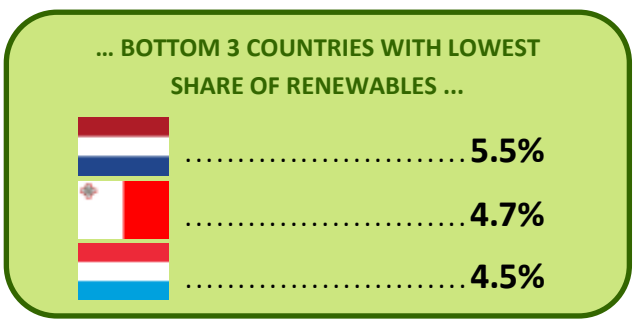
Figure 1.2: Share of renewable energy in gross final energy consumption across the EU, 2014



Sources: Eurostat, Scottish Government

Since 2005, the share of renewable sources in gross final consumption of energy grew significantly in all Member States, with twelve Member States having at least doubled their share of renewables over the last 10 years. In 2014, Sweden had by far the highest share of energy from renewable sources in its gross final consumption of energy (52.6%), ahead of Latvia (38.7%), Finland (38.7%) and Austria (33.1%). In contrast, the lowest proportions of renewables were found in Luxembourg (4.5%), Malta (4.7%), the Netherlands (5.5%) and the United Kingdom (7.0%).

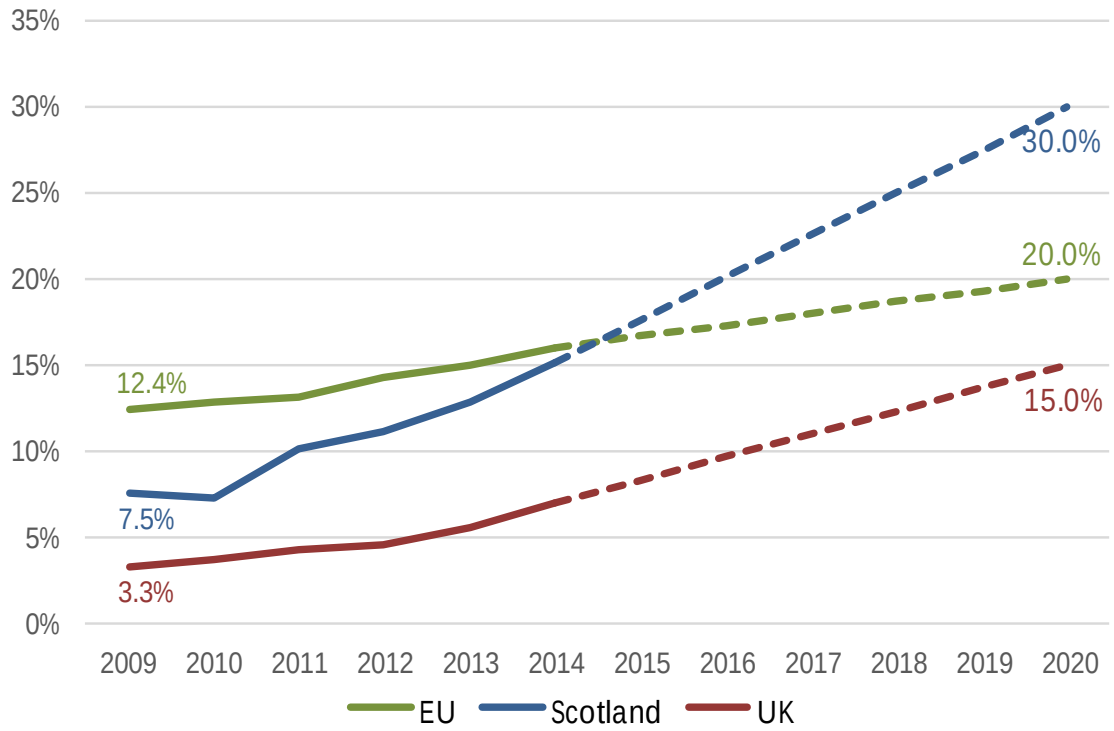




Nine out of the 28 EU Member States have already reached the level required to meet their national 2020 targets: Bulgaria, Croatia, Czech Republic, Estonia, Finland, Italy, Lithuania, Romania and Sweden. At the opposite end of the scale, the United Kingdom (8.0 percentage points from reaching its national 2020 objective), the Netherlands (8.5 pp), France (8.7 pp) and Ireland (7.4 pp) are the furthest away from their target.

Relative to 2009 baselines, Scotland have had the second largest increase in renewables share behind Denmark.

Figure 1.3: Share of renewable energy in gross final energy consumption across the EU, 2009 - 2014[1]



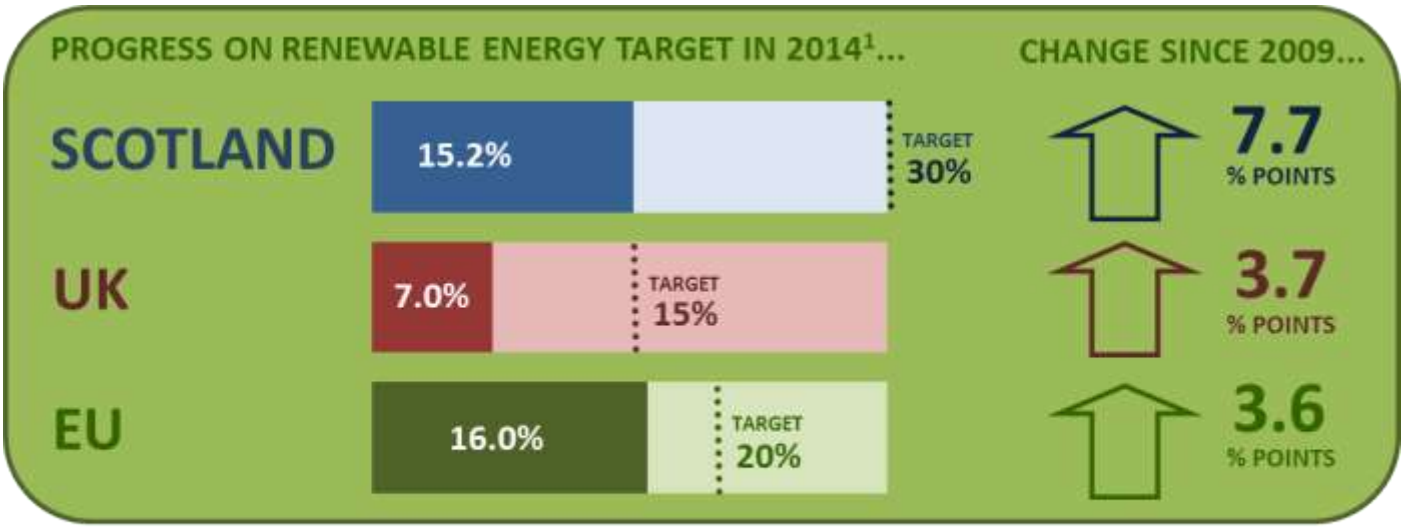
Sources: Eurostat, Scottish Government

Figure 1.3 shows the progress made by Scotland, the UK, and the EU as a whole since 2009, when the EU Renewables Directive was introduced.

It also shows what is required by 2020 in order to meet the respective targets.

Although Scotland's renewable energy share remains lower than the EU average, Scotland has made relatively better progress since 2009 - increasing the share by 7.7% points (7.5% - 15.2%).

The UK has increased its share by 3.7% points since 2009 (3.3% - 7.0%), with the EU average going up by 3.6% points (12.4% - 16.0%).



ELECTRICITY – Renewable electricity generation to be the equivalent of 100% of gross electricity consumption by 2020

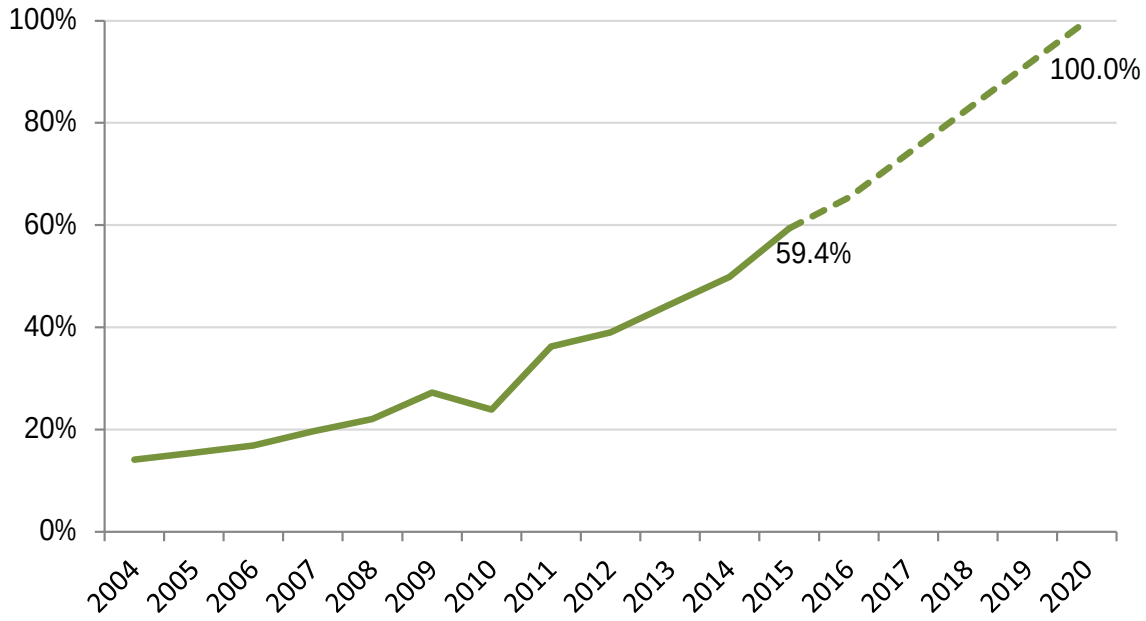
59.4%
IN 2015

The Scottish Government renewable electricity target is to generate the equivalent of 100% of Scotland's own electricity demand from renewable resources by 2020, a target which will require the market to deliver an estimated 14-16 GW of installed renewable capacity. This does not mean that Scotland will be 100% dependent on renewables generation, but rather that renewables will form the key part of a wider, balanced electricity mix.

DEFINITION

Gross Electricity Consumption = Total electricity generation plus imports minus exports

Figure 1.4: Share of renewable electricity in gross electricity consumption, Scotland, 2004-2015



Source: Department for Business, Energy and Industrial Strategy

In 2015, the equivalent of 59.4% of gross electricity consumption was from renewable sources, up from 49.9% in 2014. This is explored in more detail in Chapter 3. Figure 1.4 shows the continuation of the rising trend in renewable electricity generation in Scotland since 2004, with the exception of 2010.

The lower level of renewable electricity generation experienced in 2010 was a result of a fall in hydro generation due to much lower rainfall that year. Scotland has since gone on to surpass the two interim renewable electricity generation targets of 31% by 2011 and 50% by 2015.

TARGET DERIVATION

Please see page 56 for more information on how the renewable electricity target is measured.

"Renewable electricity capacity in quarter three of 2016 is 8% greater than in quarter three of 2015"

HOW DOES SCOTLAND COMPARE[1]...
(latest data 2014)

SCOTLAND.....49.9%

UK.....17.8%

EU.....27.5%

HEAT – 11% of non-electrical heat demand to be met from renewable sources by 2020

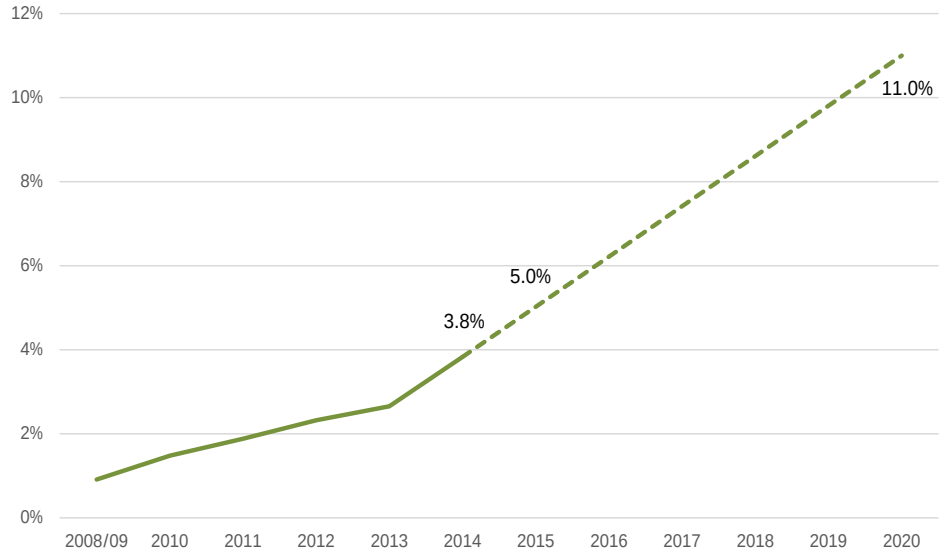
3.8%
IN 2014

In 2014, the equivalent of 3.8% of non-electrical heat demand was met from renewable sources. This is up from 2.7% in 2013. Over the year to 2014, renewable heat generation increased by 36%, while non-electrical heat demand decreased by 5.5%.

Renewable heat generation data for 2015 show a 37% increase compared with 2014. In 2015, Scotland generated an estimated 5.3%-5.6% of its non-electrical heat demand from renewable sources.

Please see page 78 for more information regarding the measurement of heat demand in Scotland.

Figure 1.5: Share of renewable heat in non-electrical heat demand, Scotland, 2008/09 - 2014



Sources: Department for Business, Energy and Industrial Strategy, Energy Savings Trust, Scottish Government

Figure 1.5 shows that steady progress has been made since 2008/09 with the proportion of renewable heat generation in Scotland. From a baseline 845 GWh in 2008/09, generation is **nearly 5 times higher** - to 4,165 GWh in 2015.

Nearly 90% of the renewable heat output in 2015 came from installations which used biomass primary combustion or biomass combined heat and power.

By considering potential scenarios of what the level of non-electrical heat demand may be in 2020, it is possible to estimate the range of renewable heat generation required to meet the 11% renewable heat target. This is currently estimated to be between 7,000 and 9,000 GWh.

TARGET METHODOLOGY

Please see page 80 for more information on the renewable heat target methodology.

"Renewable heat generation increased by 37% between 2014 and 2015"

HOW DOES SCOTLAND COMPARE[1]...
(latest data 2014)

SCOTLAND.....3.8%

UK.....4.5%

EU.....17.7%

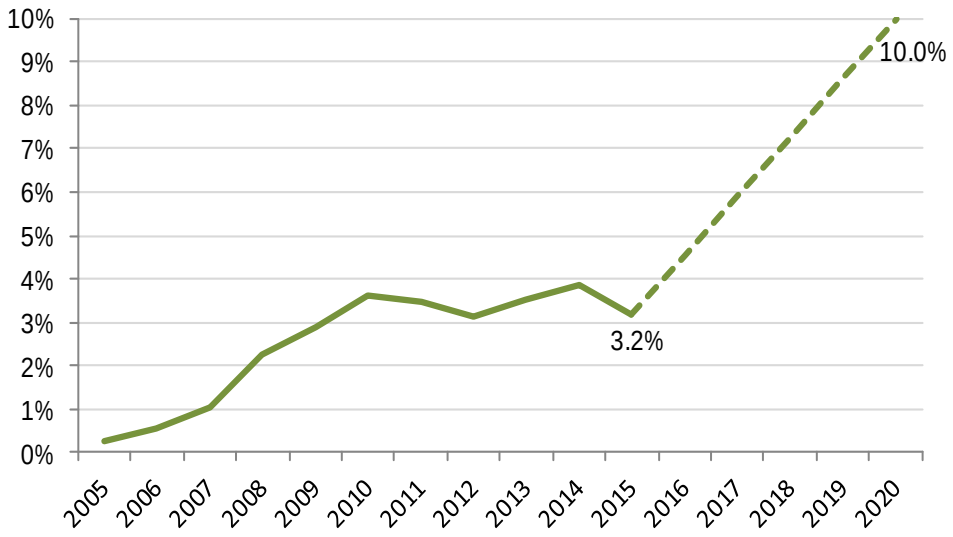
TRANSPORT – 10% share of biofuels in transport petrol and diesel consumption by 2020

3.2%
IN 2015

Biofuels had a 3.2% share of road fuels in the UK as a whole in 2015, down from 3.9% in 2014.

Data is not available separately for Scotland, so the UK proportion is assumed. Please see Chapter 5 for more information on transport energy use in Scotland.

Figure 1.6: Share of biofuels in transport petrol and diesel consumption, Scotland, 2005 - 2015



Source: Department for Business, Energy and Industrial Strategy

UK trends in liquid biofuel consumption for transport

In 2015, 1,464 million litres of liquid biofuels were consumed in transport in the UK, a **fall of 17.1%** on the total for 2014. However, this is over 12 times higher than that consumed in 2005.

Liquid Biofuels are broken down into two categories: Bioethanol (used with Petrol) and Biodiesel (used with Diesel):

- Bioethanol consumption decreased by 2.1% to 795 million litres between 2014 and 2015 - accounting for 54% of all liquid biofuels.
- Biodiesel consumption decreased by 29.9% to 669 million litres between 2014 and 2015 - accounting for 46% of all liquid biofuels.

Using the latest data, for the third quarter of 2016, bioethanol accounted for 4.4% of motor spirit, and Biodiesel 2.8% of diesel (DERV). The combined contribution was 3.4%, an increase of 0.1 percentage points compared to Q3 2015.

"Latest data for Q3 2016 shows that biofuels made up 3.4% of all road fuels in the UK"

TARGET DATA SOURCES

BEIS publish the data on liquid biofuels used for transport as part of their quarterly Energy Trends publication. Table ET 6.2 is published here:

https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/65860/et6_2.xls

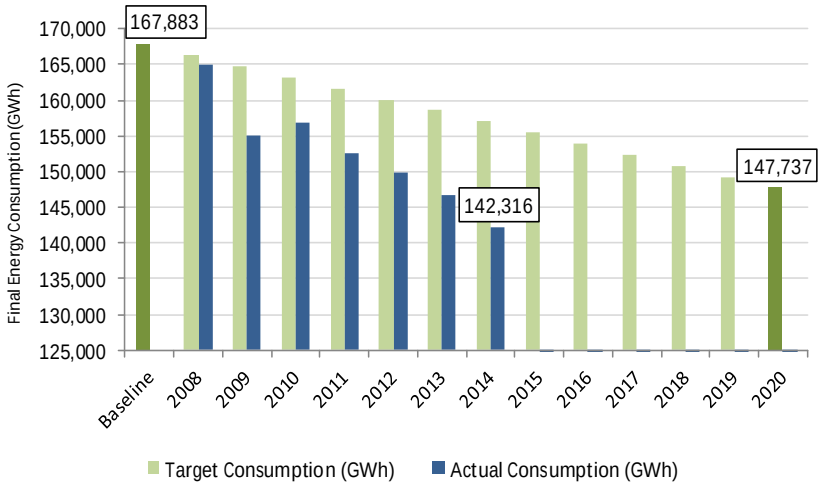
ENERGY CONSUMPTION – 12% reduction in total final energy consumption by 2020

IN 2014
-15.2%
SINCE BASELINE 2005-2007

The Scottish Government published the "Conserve and Save: Energy Efficiency Action Plan" in October 2010. This action plan introduced a headline target to reduce Scottish final energy consumption by 12% by 2020 from a 2005 to 2007 baseline.

Consumption in 2014 was 3.0% lower than in 2013, and 15.2% lower than the 2005-2007 baseline against which the 12% Energy Efficiency Target is measured. More information on this is available in Chapter 2.

Figure 1.7: Final energy consumption, Scotland, Baseline (2005-2007) - 2014



Source: Department for Business, Energy and Industrial Strategy

Recognising the importance of economic cycles and weather patterns to energy consumption levels, the energy efficiency target was defined to allow for fluctuations within the longer term trend. Figure 1.7 shows the progress since the baseline and the annual maximum consumption values associated with the 2020 target. **The 15.2% fall from the baseline is already below the 2020 target**.

Since the 2005-2007 baseline, each consuming sector has reduced their energy consumption, but to varying degrees. The non-domestic sector has experienced the largest decrease (-23.0%), with the domestic sector (-19.0%) and transport sector (-3.6%) whilst energy productivity in Scotland has increased by approximately 28% between 2005 and 2014.

Initial data from BEIS shows that, between 2014 and 2015, gas consumption in Scotland declined by 1.8% and electricity consumption rose by 2.3%. However, data on the total impact across all fuels and sectors in Scotland is not available until September 2017.

DATA NOTE - ENERGY CONSUMPTION TARGET

The total final energy consumption time series, published by BEIS, is subject to revision as far back as 2005. More detail is available in the data revisions box on page 20.

HOW DOES SCOTLAND COMPARE[1]...
(change between baseline and 2014)

SCOTLAND.....-15.2%

UK.....-13.7%

EU.....-10.0%

Community and locally owned renewables

Alongside the headline renewable energy ambition, our draft Energy Strategy, published in January 2017, reaffirms our manifesto commitment of new targets to increase the capacity of community and locally owned renewable energy.

Community Renewable Energy Targets

- ***1 GW of community and locally-owned renewable energy by 2020***
- ***2 GW of community and locally-owned renewable energy by 2030***
- ***At least half of newly consented renewable energy projects to have an element of shared ownership by 2020***

The Scottish Government wishes to maximise the benefits for communities from renewable energy, and believe that a community can gain from renewables projects, over and above the energy generated and financial benefits. For example:

- increased community cohesion and confidence
- skills development
- support for local economic regeneration.

The latest report published in December 2016 found that:

The **500 MW target has been reached 5 years early**, with an estimated minimum of 595 MW of community and locally owned renewable energy capacity operational in Scotland as at June 2016.

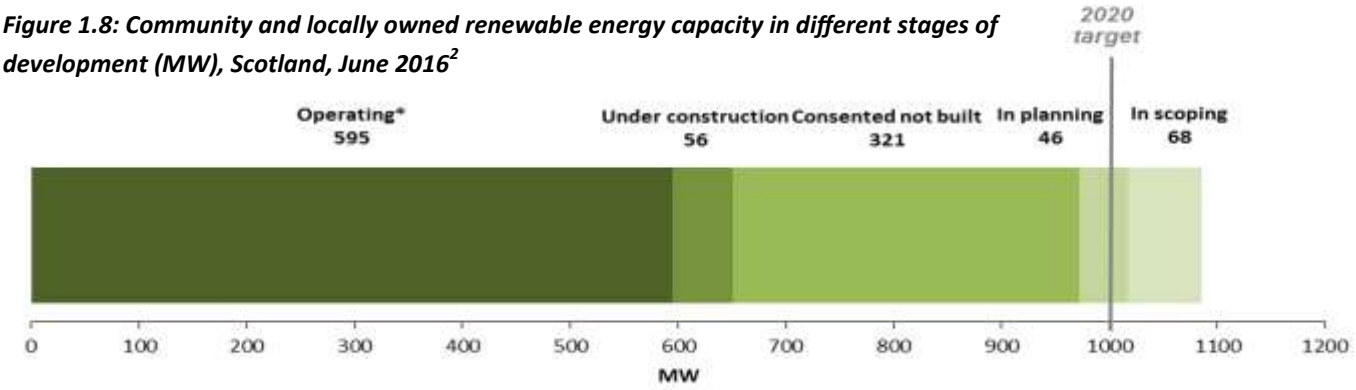
- This is a 17% increase on the last report, when the operating capacity was estimated at 508 MW at September 2015.
- The estimated operational capacity was 19% over the Scottish Government target of 500 MW of operational capacity in community and local ownership by 2020.
- The operating capacity resulted from around 15,570 individual renewable energy installations.

Looking forward, the community and locally owned database will continue to be used to monitor progress towards our new targets. For more information on this database please see the box on page 16.

Development pipeline

As Figure 1.8 shows, a further 491 MW of community or locally owned renewable energy capacity is estimated to be in different stages of development (under construction, consented but not built, in planning, or in scoping).

Figure 1.8: Community and locally owned renewable energy capacity in different stages of development (MW), Scotland, June 2016[2]



Source: Energy Saving Trust

THE LOCAL ENERGY CHALLENGE FUND

The Local Energy Challenge Fund was launched in August 2014 to demonstrate the value and benefit of local low carbon energy economies. The Local Energy Challenge Fund is part of the Scottish Government's CARES programme, managed by Local Energy Scotland.

The Challenge Fund aims to support large-scale local low carbon demonstrator projects which show a local energy economy approach linking local energy generation to local 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. Projects which are funded through the Local Energy Challenge Fund should be able to demonstrate partnership and collaborative working, innovation and added local value.

Projects funded to date are across a range of themes including new fuel development, local use of local energy generation, energy storage, electric vehicles, hydrogen production and storage, new tariff development and demand side management. There is more information about the Local Energy Challenge Fund and the projects supported available at:

www.localenergyscotland.org/challenge

Local Energy Scotland provide free and impartial support and advice to communities, non-profit distributing organisations and rural businesses who wish to generate their own energy and benefit from commercial operations. Through CARES, Local Energy Scotland can provide communities and qualifying businesses and organisations with grant and loan funding to support renewable energy generation projects.

Case studies available here:

http://www.localenergyscotland.org/funding-resources/resources-advice/case-studies/

Details of funding available here:

http://www.localenergyscotland.org/funding-resources/funding/applying-to-cares/

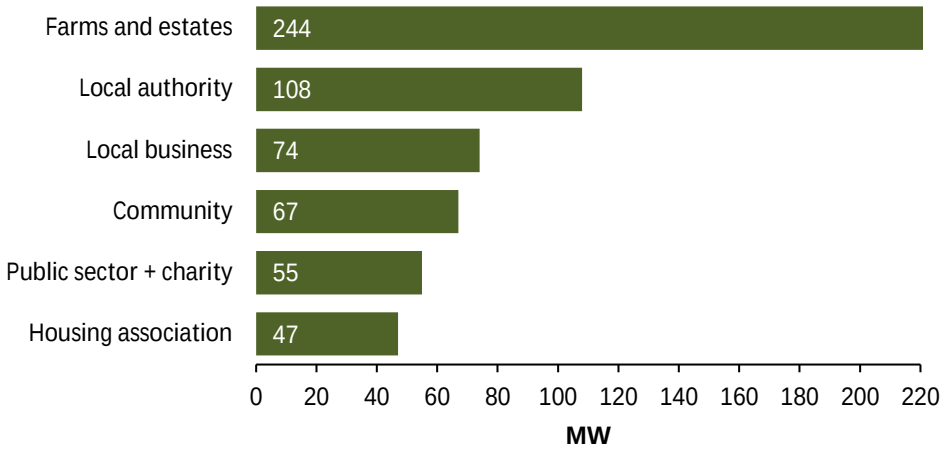
A map of community and locally owned renewable energy projects across Scotland has been created. The interactive map shows the projects that are contributing to Scottish targets for community and locally owned energy. The map can be viewed here:

http://www.localenergyscotland.org/projects/

Categories of ownership

A breakdown of operational capacity by type of owner is shown in Figure 1.9. The largest proportion of operational capacity is on Scottish farms and estates (244 MW, or 41%). Community groups own 11% of total operational capacity (67 MW). The largest numbers of individual installations (13,520) are in local authority and housing association ownership, together accounting for over 87% of individual installations.

Figure 1.9: Estimated capacity of operational community and locally owned renewable installations by ownership category (MW), Scotland, June 2016

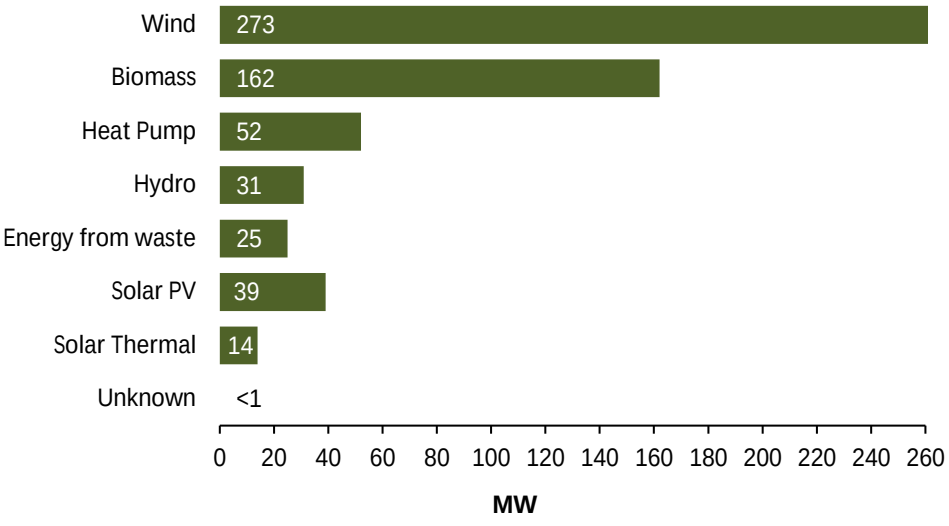


Source: Energy Saving Trust

Installed technologies

The majority of capacity in operation in June 2016 was from wind turbines (273 MW), and from biomass (162 MW). These two technologies account for about 73% of overall operational capacity in June 2016. A breakdown by technology type is shown in Figure 1.10.

Figure 1.10: Capacity of operational community and locally owned renewable installations by technology (MW), Scotland, June 2016



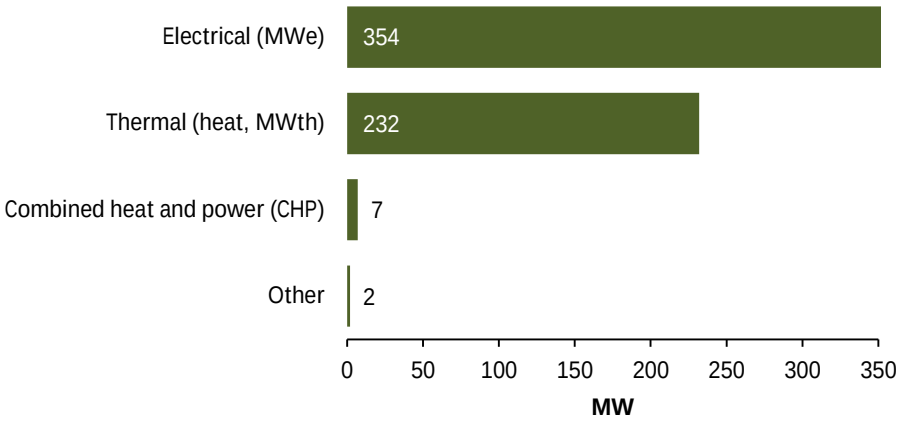
Source: Energy Saving Trust

Type of Output

The 595 MW of total operational capacity is split between approximately 59% (354 MW) of electrical capacity (MWe) and 39% (232 MW) of thermal (heat) capacity (MWth). The other 2% of capacity (9 MW) is covered by combined heat and power (CHP) capacity and unspecified technologies.

Over the course of a year, community and locally owned renewable energy installations identified here could be expected to produce around 1,479 GWh of renewable energy.

Figure 1.11: Capacity of operational community and locally owned renewable installations by output type (MW), Scotland, June 2016



Source: Energy Saving Trust

COMMUNITY AND LOCALLY OWNED RENEWABLES DATABASE

Since 2011, the Energy Saving Trust has produced a database of all community and locally owned renewable energy installations in Scotland for the Scottish Government. The objective of this work was to monitor progress toward the target of 500 MW of community and locally owned renewable energy capacity operating in Scotland by 2020. This work will continue with progress monitored towards our new targets.

This database has since been updated annually and includes all installations known to be operating under construction, or in earlier stages of development as of June 2016.

The latest report, and all previous reports can be found here:

http://www.energysavingtrust.org.uk/community-energy-reports

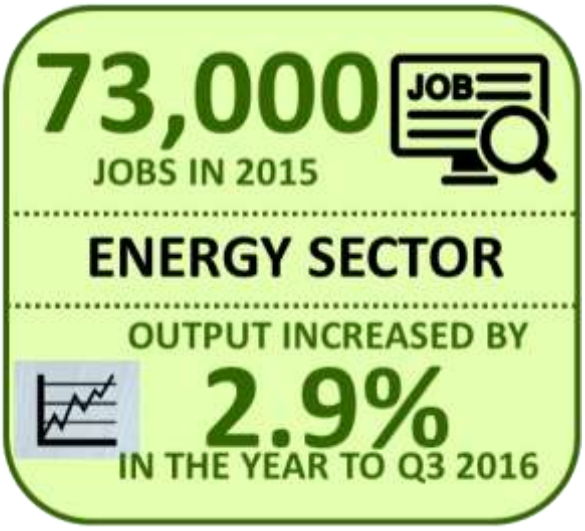
Maps

The 2016 report also includes a series of maps illustrate the distribution of operational community and locally owned renewable energy capacity throughout Scotland at June 2016, by ownership category.

Each map shows the location of a renewable energy installation and the size of each circle indicates the capacity of the installation in MW, and the colour indicates the technology type. The size of the circle indicates the renewable capacity owned by the community or local owner, rather than the full size of the installation.

Scottish Energy Industry

Scotland's Energy (including renewables) sector was identified in Scotland's Economic Strategy as one of the growth sectors in which Scotland can build on existing comparative advantage and increase productivity and growth. Since the 1970s, the North Sea oil and gas industry has supported thousands of jobs, both directly and in the wider supply chain. At the same time, Scotland has long been a net exporter of electricity and in the past decade, has seen rapid expansion of wind power, added to existing output from hydroelectric plants.



As explained in previous Energy in Scotland publications, official statistics on the employment and Gross Value Added (GVA) of the energy sector are based on the Standard Industrial Classification (SIC) system which does not lend itself to measuring non-traditional or new sectors that straddle a number of different industries – like the low carbon economy and renewable energy sector. This is explored in more detail in the data note in Chapter 9 on page 168. **The results in this chapter are based on the growth sector definition of the energy sector**, but other information is available throughout the publication using alternative definitions.

Employment

Employment in the Energy growth sector stood at 73,000 in 2015, representing an increase from 2014 (up 1,000 jobs). In Scotland, the sector accounts for 2.9% of employment, whilst across Great Britain as a whole, the Scottish sector accounts for 23.5% of GB employment in Energy, and for 69.4% of all GB employment in Extraction of crude petroleum and natural gas.

Employment in the Energy growth sector is highly concentrated, with 56.4% of employment being located in Aberdeen City (42.2%) and Aberdeenshire (14.2%) local authority areas.

GDP

The latest GDP data shows that output in the Energy growth sector increased by 2.9% in the third quarter of 2016, increasing by 0.8% in year on year terms.

Across the economy as a whole, in the third quarter of 2016 output grew by 0.2% (0.7% in year on year terms).

Since 2009, output in the Energy growth sector has increased by 17% between the first quarter of 2009 and the third quarter of 2016, whilst in the economy as a whole output increased by 8.7%.

DATA NOTE - ENERGY GROWTH SECTOR DEFINITION

Note that the Energy growth sector is one of a number of measures used to quantify the energy sector. **Please see box on page 168 for more detail**. The Energy growth sector is defined by the Standard Industrialisation Classification (SIC) 2007 codes:

SIC 05: Mining of coal and lignite

SIC 06: Extraction of crude petroleum and natural gas

SIC 09: Mining support service activities

SIC 19: Manufacture of coke and refined petroleum products

SIC 20.14: Manufacture of other organic based chemicals

SIC 35: Electricity, gas, steam and air conditioning supply

SIC 36: Water collection, treatment and supply

SIC 38.22: Treatment and disposal of hazardous waste

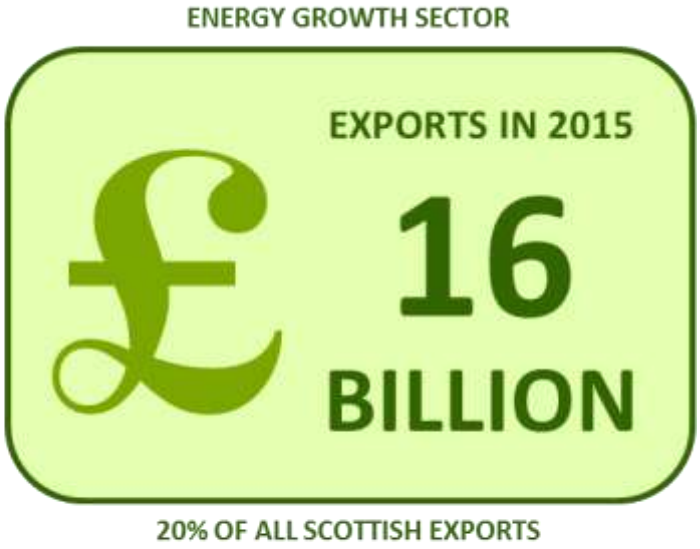
SIC 71.12/2: Engineering related scientific and technical consulting activities

SIC 74.90/1: Environmental consulting activities

Enterprises

In March 2016, there were 3,990 registered enterprises operating in the Energy growth sector, representing 2.3% of all registered businesses operating in Scotland. The Scottish Energy growth sector is characterised by small businesses. In 2016, 96.1% of registered enterprises in the Scottish Energy growth sector were small (0-49 employees), although these accounted for only 12.2% of employment in the sector. In contrast, large enterprises (250+ employees) which accounted for just 1.9% of registered enterprises, accounted for 80.0% of employment in the sector.

The majority of enterprises in the sector are ultimately based in Scotland (94.1%), but these accounted for 37.2% of employment in 2016. Although only 4.4% of businesses in the sector were foreign-owned, they accounted for 48.3% of employment in 2016.



Exports

Total exports from the Energy growth sector stood at £15.9 billion in 2015, accounting for 20.3% of Scotland's total exports. Exports from the sector were up 19.2% in real terms from their 2014 level.

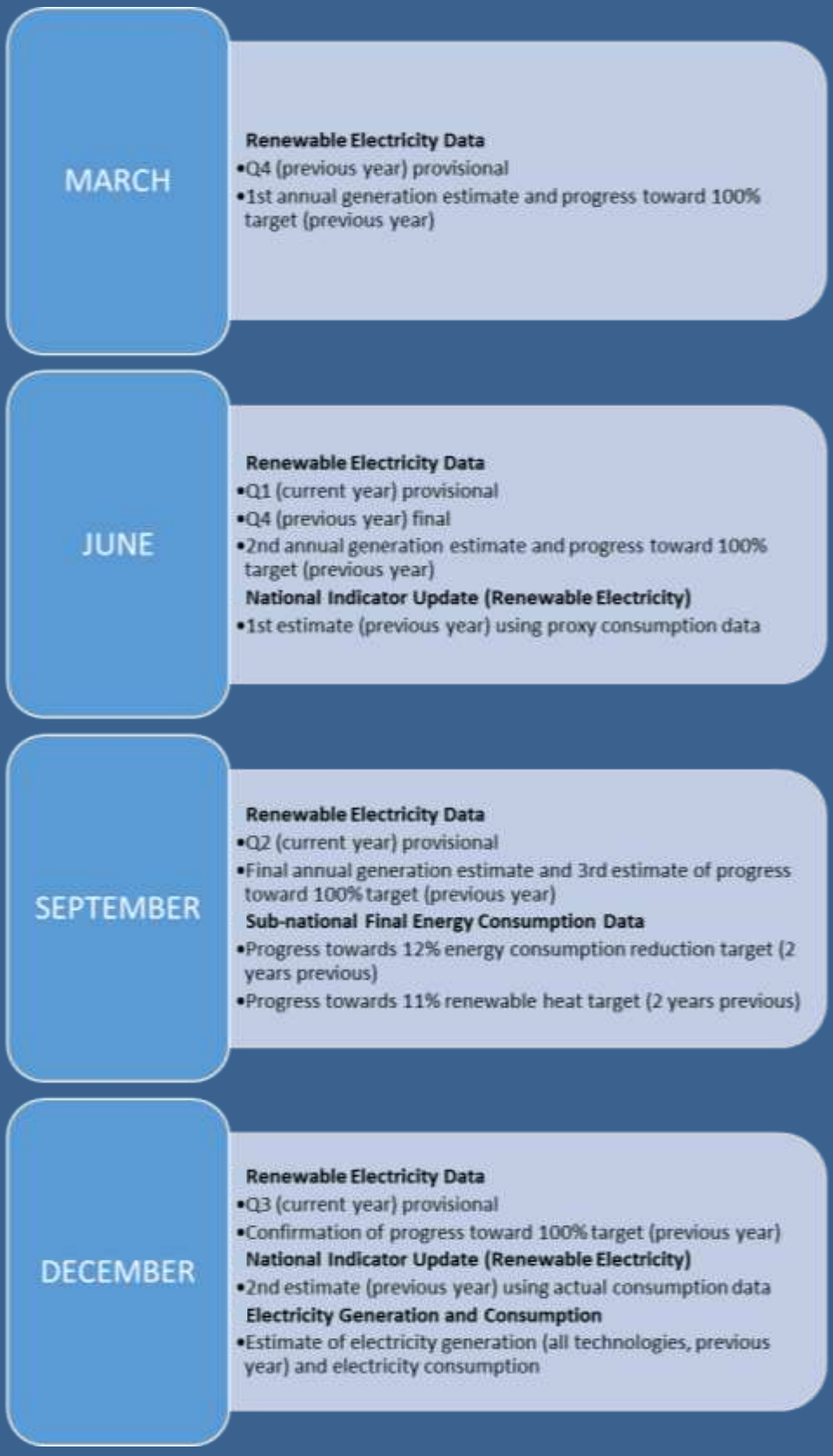
Exports to the Rest of the UK stood at £10.8 billion in 2015 and accounted for 68% of total Energy exports. Exports to the Rest of the World stood at £5.1 billion and accounted for 32% of total Energy exports.

Turnover/Gross Value Added (GVA)[3]

In 2014, total turnover in the Energy growth sector was £51.3 billion, down 9.9% in nominal terms on 2013. A large share of this turnover was generated by extraction of crude petroleum and natural gas (34.0%). Gross Value Added for the Energy growth sector totalled £17.0 billion, down 24.3% in nominal terms on 2013. The drop in GVA between 2013 and 2014 has been largely driven by the decline in the oil price over this period.

ENERGY DATA UPDATES

There are frequent updates to the energy data for Scotland throughout the calendar year, primarily published by the Department for Business, Energy and Industrial Strategy (BEIS). The figure below shows the key quarterly updates and how they impact on the Scottish Government target monitoring.



ENERGY DATA REVISIONS

It is important to note that the energy data used to monitor the Scottish Government energy targets are subject to regular revision by BEIS. Time series data can change from year to year as more accurate source data from suppliers become available to BEIS, therefore the latest data must always be used when considering changes over time. The list below summarises how some of the energy targets can be affected:

Renewable Electricity Target

Provisional quarterly renewable generation is made available after 3 months, with final estimates available after 6 months. Renewable generation time series data is subject to revision annually in September. Electricity generation and consumption time series data is subject to revision annually in December.

National Indicator (Renewable Electricity)

This indicator is updated twice annually – June and December. Both these updates monitor the previous year's renewable electricity generation, but June uses a proxy figure for electricity consumption, while in December the actual consumption figure is published.

This means that an indication of progress is available earlier in the year on the Scotland Performs website, but does mean that revisions to the progress reported in June could take place in December each year.

Energy Consumption Target

Sub-national final energy consumption data is published annually in September. This data is used to monitor both final energy consumption and non-electrical heat consumption in Scotland.

Data can be revised back annually in September as far back as 2005. This is primarily due to forecasted values being replaced with actual data, where actual figures were not available at the time of publication. In particular, annual revisions are made to the road transport, residuals and total final energy publications.

Further detail on the methodology and revisions policy of BEIS regarding their sub-national consumption statistics are available here:

https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/579258/Sub-national_Methology_and_Guidance_Booklet_2016.pdf

Renewable Heat Target

The renewable heat target is also subject to any revisions to the final energy consumption data (as mentioned above). Also, the data collected by the Energy Saving Trust to estimate renewable heat generation in Scotland was revised in 2015. Please see page 80 for more information on the Heat target methodology.

SCOTLAND ENERGY BALANCE

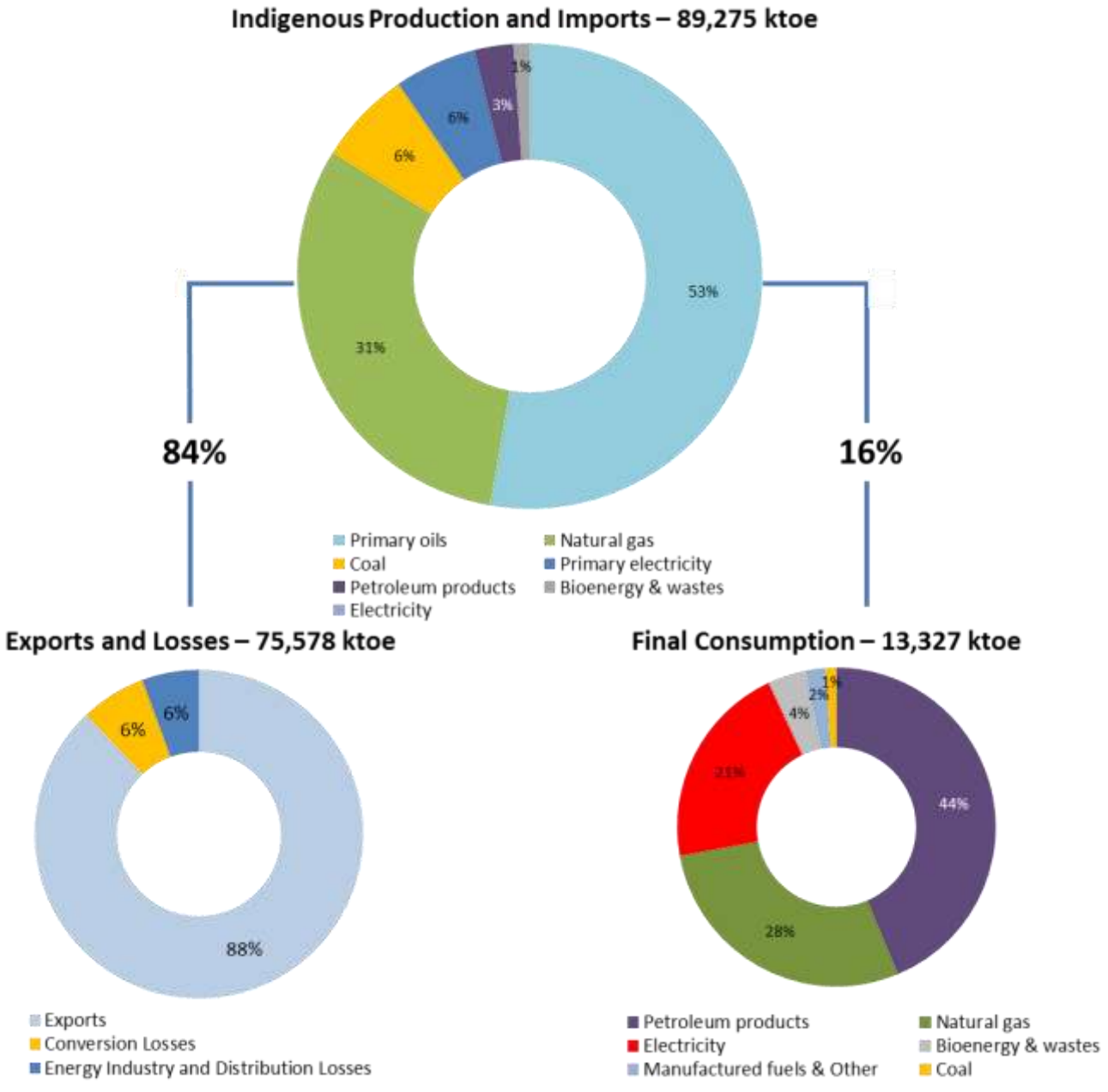
What is an energy balance?

An energy balance provides a global picture of energy in a given country in one common measurement unit and allows the quantification and visualisation of the energy produced, transformed and consumed. This publication uses Gross Calorific Values (GCVs) to convert fuel from their original units to tonnes of oil equivalent (toe). This is consistent with the UK aggregate balance and energy flow published by BEIS, as part of DUKES, at the following link:

https://www.gov.uk/government/collections/digest-of-uk-energy-statistics-dukes

Figure 1.12 below shows a simplified energy flow chart which gives the proportions of fuel used as primary energy in Scotland's energy balance and the proportions of fuel that are consumed, taking into account exports and losses from conversion and distribution.

Figure 1.12: Simplified Energy Flow Chart, Scotland, 2014



Source: Scottish Government

What is an energy flow?

An energy flow (or energy sankey diagram) is a simplification of the energy balance figures, illustrating the flow of primary fuels from the point at which they become available from home production or imports (on the left) to their eventual final consumption (on the right).

It demonstrates the amount of energy used in its original state, as well as the amount being converted into different kinds of energy by secondary fuel producers. The flows are measured in million tonnes of oil equivalent, with the widths of the bands approximately proportional to the size of the flow they represent (see page 24 for the full flow diagram).

What are the benefits?

Sankey diagrams put a visual emphasis on the major transfers or flows within a system. They are helpful in identifying interesting or significant aspects of an energy system such as: dominant fuels, energy 'lost' in conversion, import and export trade and important end-use sectors. This allows priority areas to be identified and focus to be given to the most important areas within a particular energy system.

DATA DEVELOPMENT

This is the third year an energy balance has been included in the Energy in Scotland publication.

The publication of an energy balance for Scotland is a significant development, providing an innovative way of gaining an overall summary of the key flows through the entire energy system in Scotland.

This development work has been carried out in response to a user consultation undertaken in 2014 in which a number of users expressed a demand for a clear way of quantifying the energy sector in Scotland.

Please note that these energy balance figures are **experimental statistics** and are subject to change in the future as this work evolves through access to more comprehensive data sources and improvements to assumptions in the methodology.

If you have any feedback or queries please contact us at:

energystatistics@gov.uk

In 2014, indigenous production and imports totalled 89,275 thousand tonnes of oil equivalent (ktoe). Approximately 73% of this was exported or used in marine bunkers, a further 10% was 'lost' in transformation, distribution, energy industry use and conversion from primary energy to electricity and other energy products.

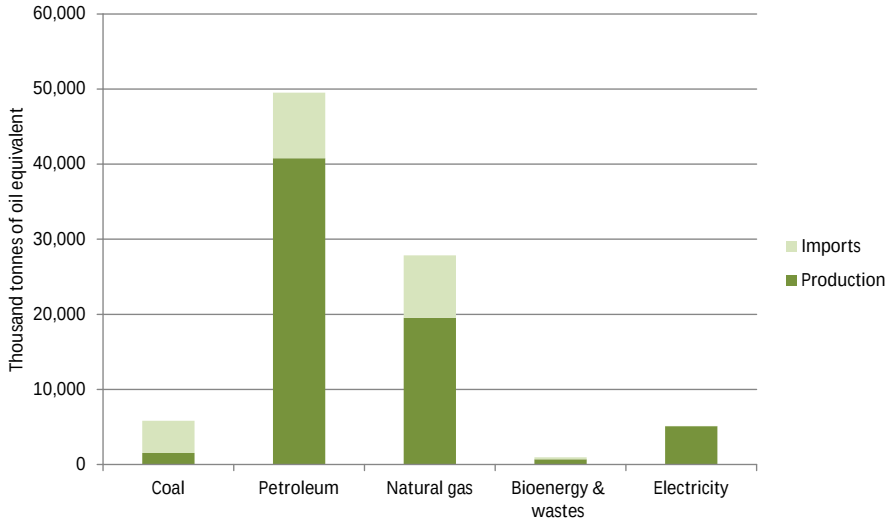
The remaining 17% was accounted for by final end use consumption (including energy transformation). Non-energy use accounted for a tenth of final consumption.

DATA NOTE

Commodity balances for petroleum products, primary oil and natural gas that feed into the energy balance can be found at the following link:

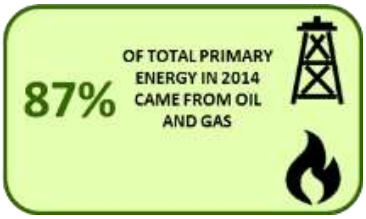
http://www.gov.scot/Topics/Statistics/Browse/Economy/oilgas

Figure 1.13: Indigenous production and imports by fuel, 2014



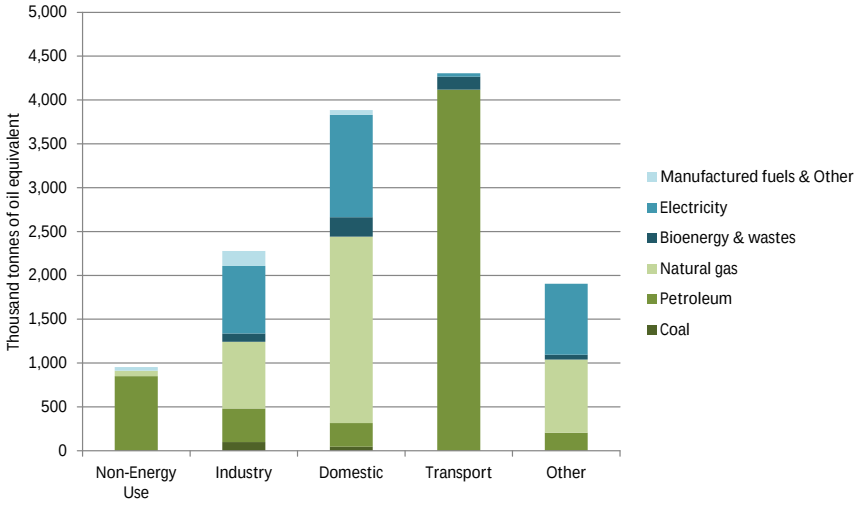
Source: Scottish Government

Of the 89,275 ktoe of primary energy in 2014 - indigenous production accounted for 67,673 ktoe (76%) and imports accounted for 21,603 ktoe (24%). Oil and gas makes the largest contribution, accounting for a combined value of 87% of total primary energy in 2014.



Final consumption, including non-energy use, was at 13,327 ktoe in 2014. The transport sector consumed the largest proportion of energy - around 32% of energy consumption, followed by domestic which consumed 29% and then industry which consumed 17%.

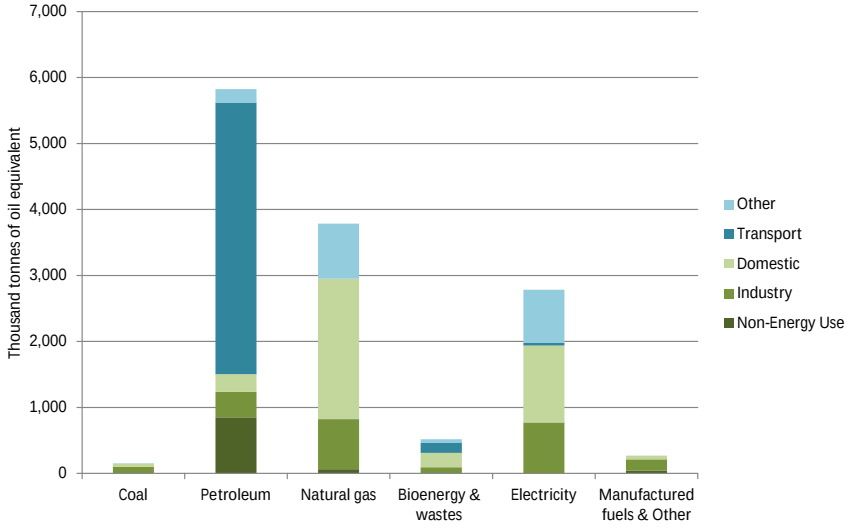
Figure 1.14: Final energy consumption by consuming sector, 2014



Source: Scottish Government

Figure 1.15 shows the end use split by fuel. Petroleum is the largest consumed fuel with around 44% of consumption, followed by natural gas at 28% and electricity at 21%.

Figure 1.15: Final energy consumption by fuel, 2014



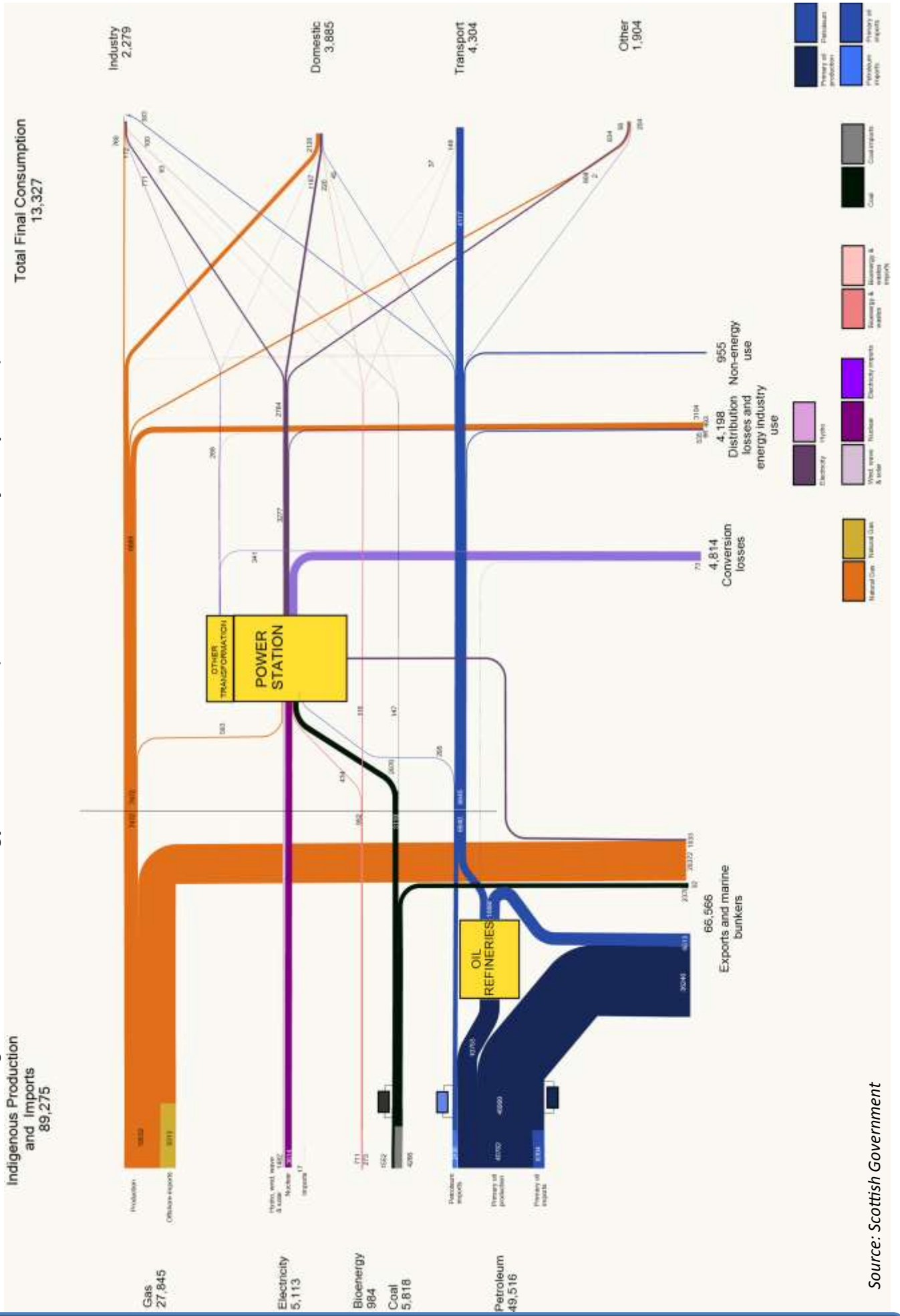
Source: Scottish Government

DATA DEVELOPMENT

In response to user feedback an interactive conversion calculator is available online at the following link:

http://www.gov.scot/Topics/Statistics/Browse/Business/Energy/onlinetools

Figure 1.16: Scotland Energy Flow Chart, 2014 (thousand tonnes of oil equivalent)



Source: Scottish Government

Please see Annex A for full aggregate energy balance and supplementary notes

CHAPTER 2

ENERGY CONSUMPTION

'Scotland's total energy consumption has decreased by 17% since 2005'

ENERGY CONSUMPTION

KEY FACTS

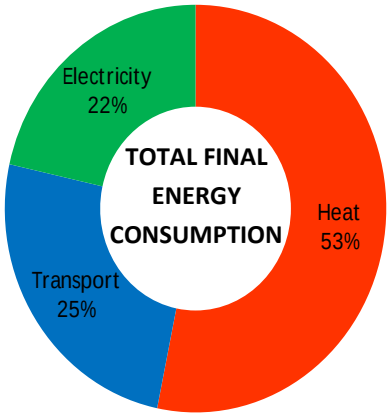
IN 2014 THE AMOUNT OF ENERGY CONSUMED IN SCOTLAND WAS...

142 TWh

Equivalent to the energy required for approximately...

23,000

...flights around the world



ENERGY CONSUMPTION IN SCOTLAND

-15.2%

SINCE BASELINE 2005-2007

TARGET –12% BY 2020

AVERAGE ENERGY EFFICIENCY RATING OF THE SCOTTISH HOUSING STOCK, 2010 - 2015

ENERGY EFFICIENCY IMPROVEMENTS IN THE SCOTTISH HOUSING STOCK. IN 2014...

92%

...HAVE AT LEAST 100mm OF LOFT INSULATION INSTALLED

HOW DOES SCOTLAND COMPARE[1]...

energy consumption change between baseline (2005-2007) and 2014

SCOTLAND...-15.2%

UK.....-13.7%

EU.....-10.0%

EXCLUDING TRANSPORT...

43%

OF ENERGY CONSUMED DOMESTICALLY

57%

OF ENERGY CONSUMED BY INDUSTRY/ COMMERCE

SINCE THE 2005-2007 BASELINE ENERGY CONSUMPTION HAS DECREASED...

DOMESTIC -19% NON-DOMESTIC –23% TRANSPORT –4%

Total Energy Consumption in Scotland

We currently use energy to heat and light homes, to run businesses and public services, to power appliances and cooling systems, and to transport goods and people. In 2014, Scotland consumed approximately 142 TWh of energy.

Figure 2.1: Scotland Energy Comparisons

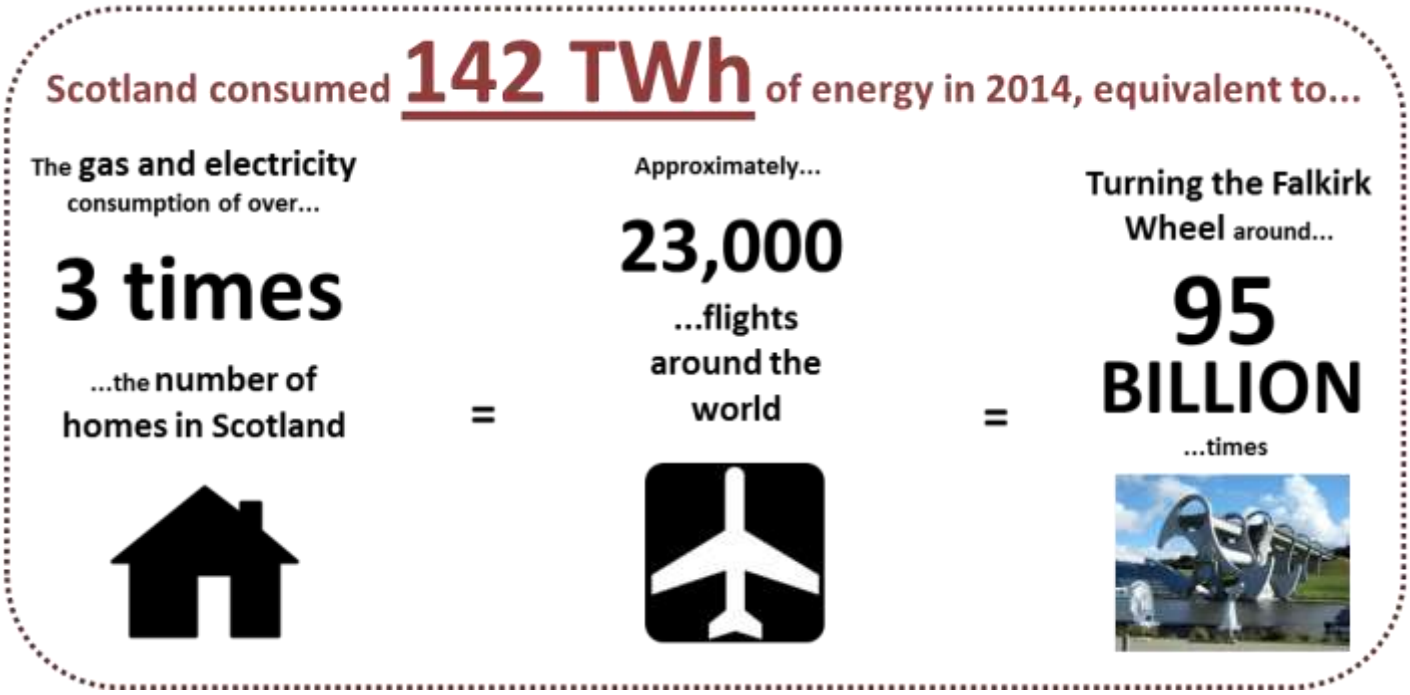
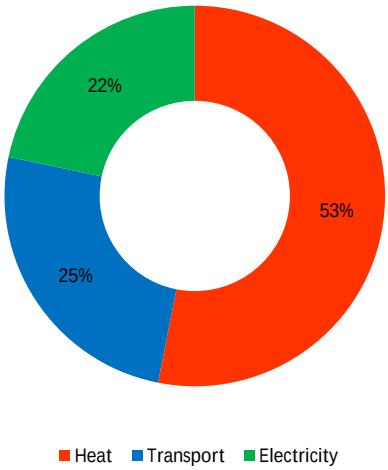


Figure 2.2 shows that the majority of final energy consumption in Scotland is used for heat (53%). Transport is the next largest consuming sector accounting for a quarter of total energy, with electricity consumption responsible for just 22%.

Figure 2.2: Total final energy consumption by sector, Scotland, 2014



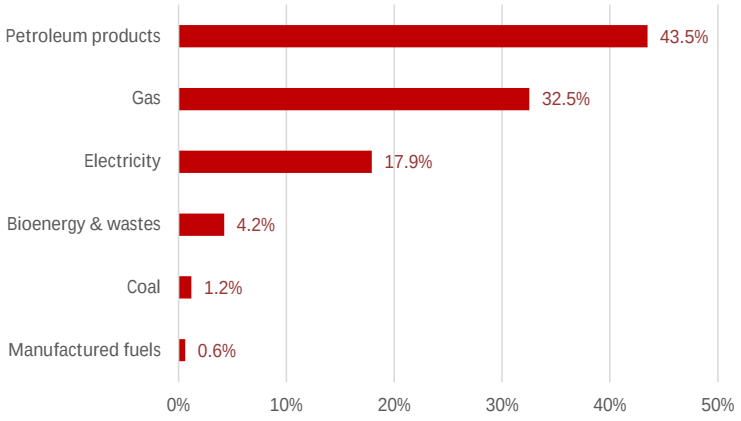
Sources: BEIS, Scottish Government

DATA NOTE

Please note that the proportion of electricity differs in Figures 2.2 and 2.3. Figure 2.2 includes an adjustment made for electricity to account for differences in the BEIS dataset used to monitor the renewable electricity target.

Figure 2.3 shows the proportion that each fuel type makes up final energy consumption in Scotland in 2014. Petroleum Products and Gas dominate the final consumption, accounting for 76% of all final energy consumption. Electricity is the other major consumption with a near 18% share of final consumption (see data note below). As it is final consumption this table does not take account of the fuel used to generate the electricity consumed.

Figure 2.3: Final energy consumption by fuel type, Scotland, 2014



Source: BEIS

The share of final energy consumption in Scotland can be split into the three main consuming sectors:

- Domestic
- Non-domestic (Industrial and commercial use)
- Transport

Excluding the transport sector, approximately 43% of total energy consumption (electricity and heat) is consumed domestically and 57% in the non-domestic sector.

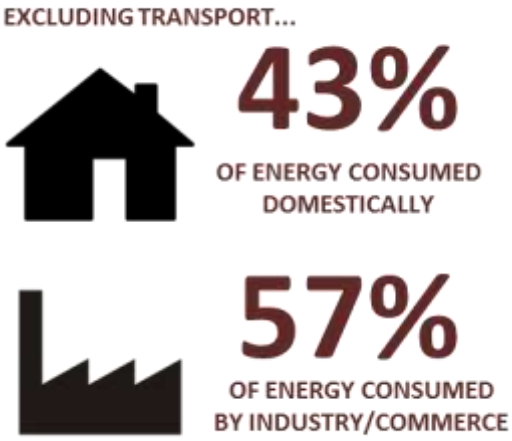
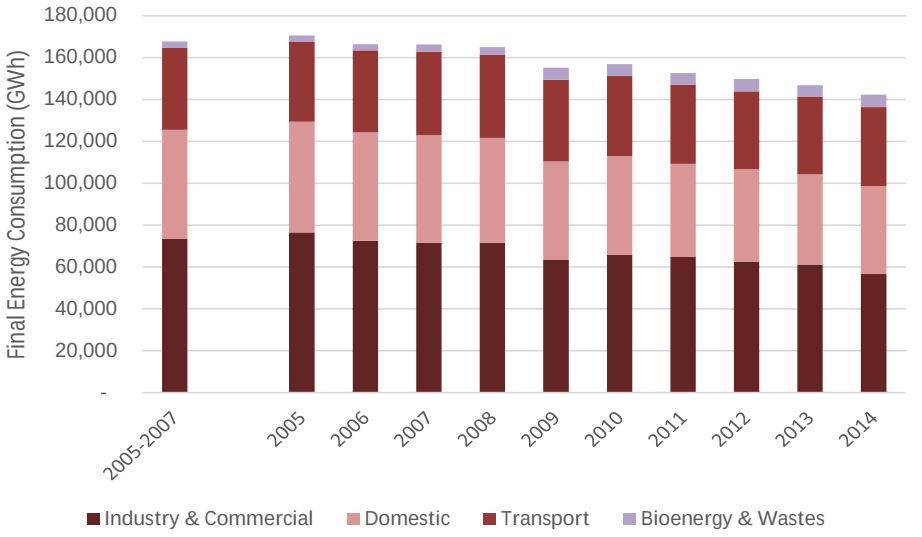


Figure 2.4 shows that over the year to end of 2014, final energy consumption decreased by 3.0%. Also, final energy consumption was 15.2% lower than the 2005-2007 baseline adopted for the Scottish Government's 12% energy consumption reduction target.

Since the 2005-2007 baseline, each consuming sector has reduced their energy consumption, but to varying degrees. Both the domestic and non-domestic sectors have experienced the largest decreases, -19% and -23% respectively, with the transport sector lower at - 4%.

Figure 2.4: Total final energy consumption by consuming sector, Scotland, 2005 - 2014

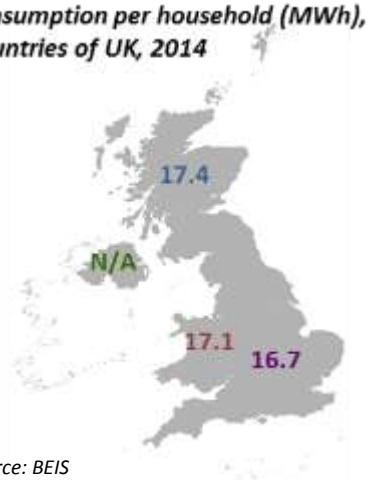


Source: BEIS

So how does Scotland's energy consumption compare with the other countries of the UK?

In 2014, Scotland accounted for 9.6% of the UK's final energy consumption. This proportion has remained fairly stable, varying between 9.6% and 10.2% since 2005.

Figure 2.5: Average final energy consumption per household (MWh), Countries of UK, 2014



Source: BEIS

In terms of average final energy consumption per household, the comparison across the UK in 2014 is as follows:

WALES.....**17.1 MWh**

SCOTLAND.....**17.4 MWh**

ENGLAND.....**16.7 MWh**

NORTHERN IRELAND.....**N/A**[4]

GB.....**16.9 MWh**

4. Final energy consumption estimates for Northern Ireland are not comparable as gas and electricity consumption within NI is excluded due to differences in market structure.

SINCE THE 2005-2007 BASELINE ENERGY CONSUMPTION HAS DECREASED...

DOMESTIC -19% NON-DOMESTIC –23% TRANSPORT –4%

Figure 2.6: Domestic Energy Consumption LA Area Proportion of Scotland Total, 2014

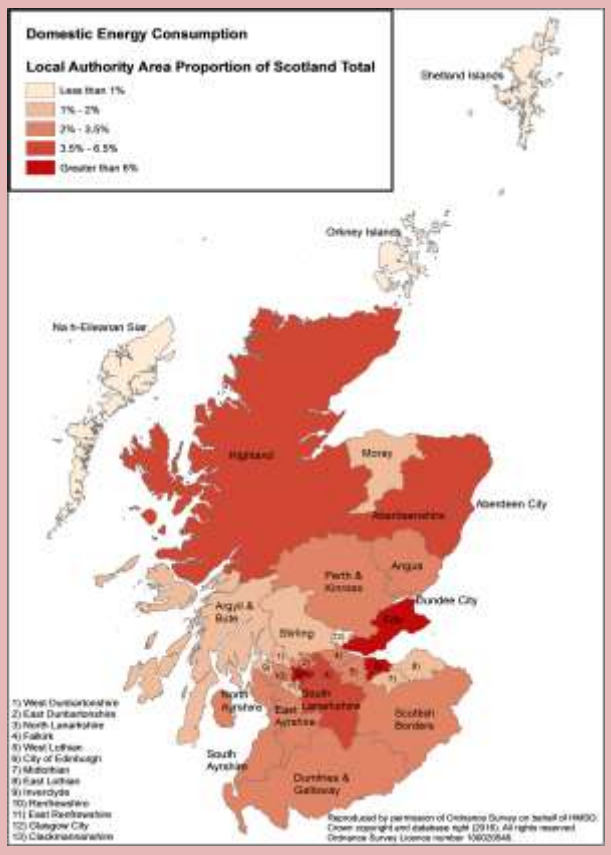


Figure 2.7: Non-Domestic Energy Consumption LA Area Proportion of Scotland Total, 2014

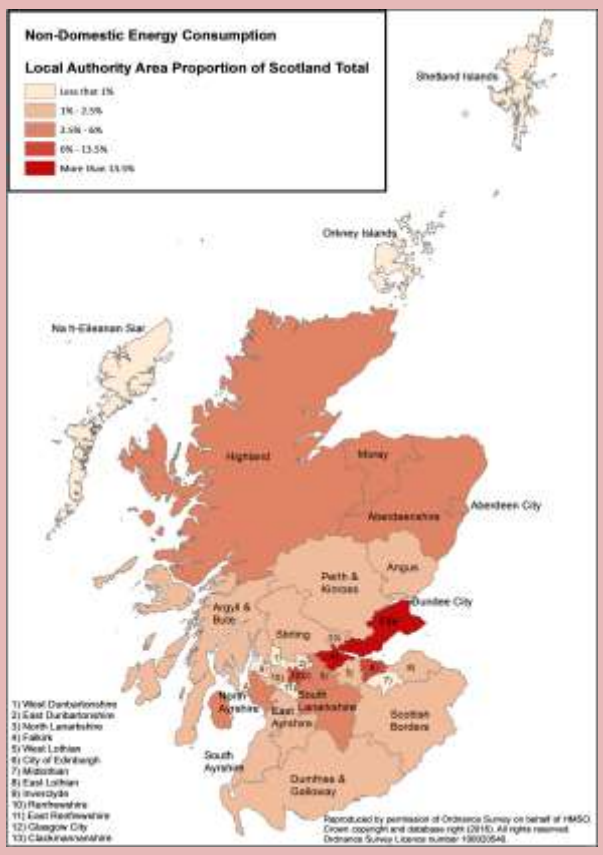
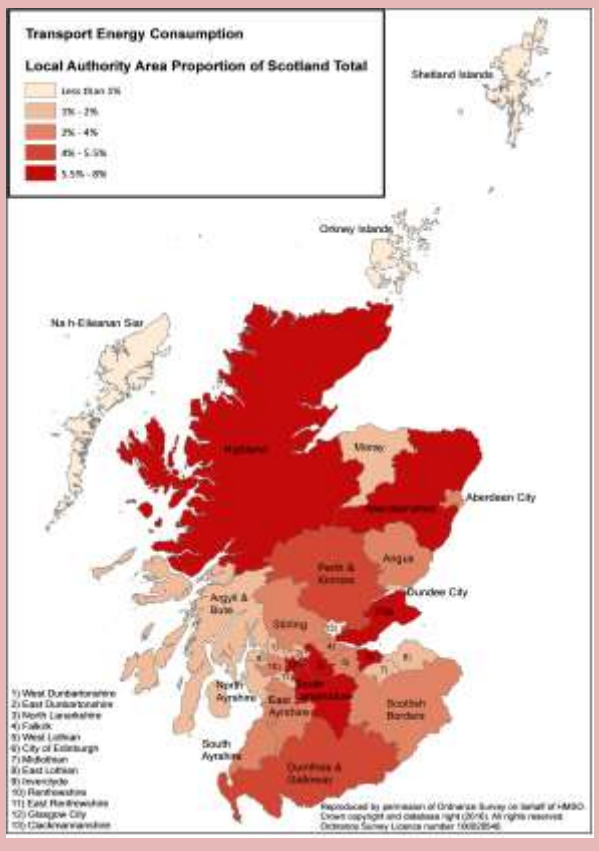


Figure 2.8: Transport Energy Consumption LA Area Proportion of Scotland Total, 2014



Figures 2.6, 2.7 and 2.8 present total final energy consumption in 2014 for each local authority (LA) in Scotland for domestic, non-domestic, and transport use. Please note these figures exclude bioenergy & wastes. Table 2.1 presents the largest 3 energy consuming local authorities in Scotland in 2014 (including bioenergy & wastes).

Table 2.1: Total final energy consumption, by local authority in Scotland, 2014

	TOTAL FINAL ENERGY CONSUMPTION (GWh)	% OF SCOTLAND TOTAL
1. FALKIRK	15,216	11%
2. FIFE	13,075	10%
3. GLASGOW CITY	11,200	8%

Source: BEIS

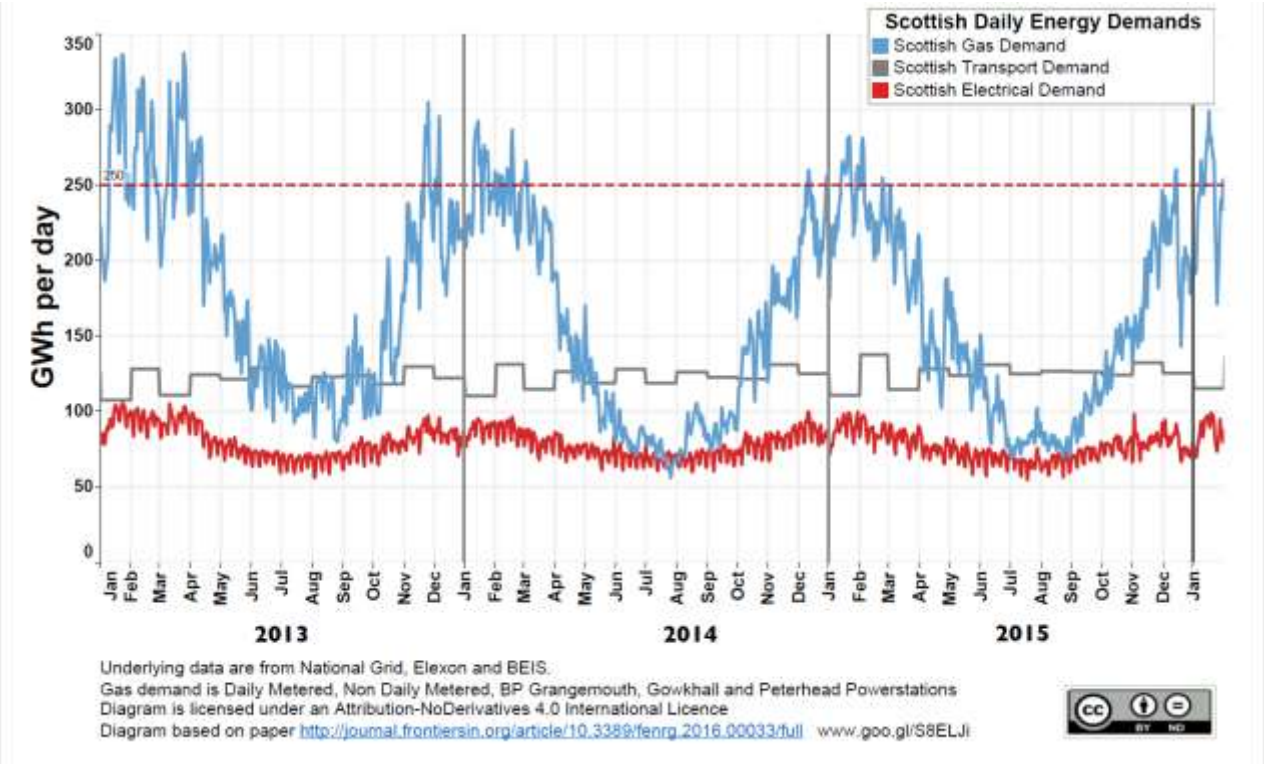
It is interesting to see how each area's consumption varies dependent on sector. For example, Falkirk has a very large non-domestic consumption (12.6 TWh) - 22% of the total Scottish non-domestic consumption - largely due to the presence of the petro-chemical and refinery sites in Grangemouth. However, domestically, Falkirk accounts for 1.2 TWh of energy consumption, 3% of the total domestic consumption in Scotland.

How energy consumption varies over the year

"Demand for gas in the winter can be as much as three times the demand for electricity"

Figure 2.9 below shows historical daily energy flows through Scotland's electrical and gas transmission networks , as well as transport energy demand, from 2013 to 2015. This illustrates important differences in the characteristics of the gas and electricity demand including the quantity of energy delivered through the networks on a daily basis, the scale of variability in the gas demand over the seasons and the relative stability and predictability of the electrical demand.

Figure 2.9: Energy use in Scotland per day, 2013-2015



The peaks and troughs in gas demand (both within a day and across the seasons) are far greater than the variations in electrical demand. They create a challenge for electricity generating assets and networks which, in the absence of storage, may be underutilised for long periods if electricity is used to meet heat and transport demands.

The pattern of heat use is clearly illustrated in Figure 2.9, showing that demand for gas in the winter can be as much as three times the demand for electricity. The pattern of our energy use over the year demonstrates the value of gas in managing the large swings in energy consumption, as the seasons drive our energy use up in the winter. This pattern also demonstrates the potential value in storing energy, within days and seasons, to offset energy demand at peak times. Energy can be stored in different ways including as potential energy in pumped hydro storage facilities, as chemical energy such as batteries, biomass or hydrogen or as thermal energy in individual properties (such as a hot water tank or a battery) or a large-scale store used with a heat network. The appropriate storage system will depend on factors including costs, geographic opportunities, how that energy needs to be used, and level of flexibility necessary.

The Scottish Government Heat Policy Statement published in 2015 sets out our future policy direction for addressing the 3 key aspects of the heat system: how we use heat (reducing heat demand), how we distribute and store it (heat network and heat storage) and where our heat comes from (heat generation). Reducing the need for heat is at the top of our heat hierarchy.

For more information see page 81 in the Heat chapter.

Energy Efficiency

Energy use underpins activity across all sectors in Scotland - business, domestic and public. It is also responsible for the major share of Scotland's greenhouse gas emissions, which contribute to climate change.

By maximising the output from Scotland's energy inputs, energy efficiency and productivity offer a way to curb energy consumption without limiting growth and hence to reduce emissions whilst still growing the Scottish economy.

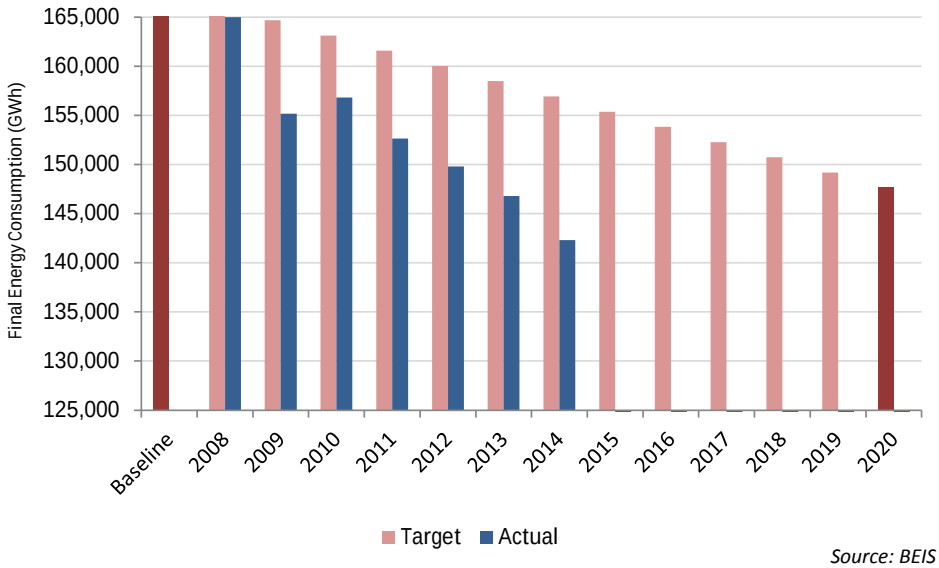
Energy Consumption Target (12% reduction by 2020)

Energy consumption in 2014 was 15.2% lower than the 2005-2007 baseline against which the Scottish Government's 12% Energy Efficiency Target is measured.

Over the year to 2014, final energy consumption decreased by 3.0%.

Recognising the importance of economic cycles and weather patterns to energy consumption levels, the energy efficiency target was defined to allow for fluctuations within the longer term trend.

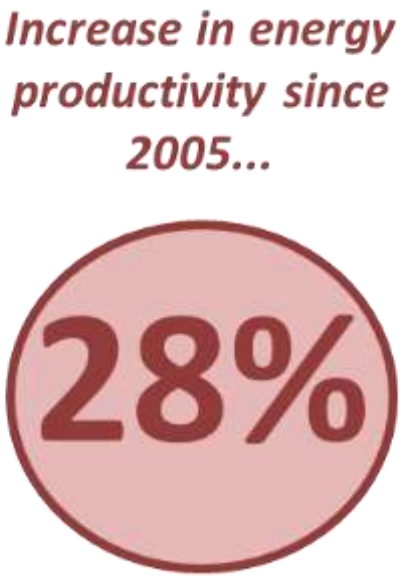
Figure 2.10: Final energy consumption, Scotland, Baseline (2005-2007) - 2014



Source: BEIS

To complement the energy efficiency target, we also measure how productively energy is being used in the economy. Energy productivity expresses the gross value added achieved in the economy from the input of one unit of energy. Increasing energy productivity means 'squeezing' more out of every unit of energy consumed.

This is measured as the level of GVA per GWh of final energy consumed in Scotland. Energy productivity in Scotland has increased by approximately 28% between 2005 and 2014.



Energy Intensity

Energy intensity is a recognised measure of the energy efficiency of a nation's economy. It is important to be able to capture changes in the intensity of our energy use which takes account of the effect of, for example, economic cycles, energy prices and weather patterns on our energy consumption patterns.

Energy intensity is the amount of energy required to produce one unit of output. A reduction in intensity could imply an improvement in energy efficiency.

The analysis below looks at the final energy consumption of Scotland split into three sectors:

- Industrial and Commercial
- Transport
- Domestic

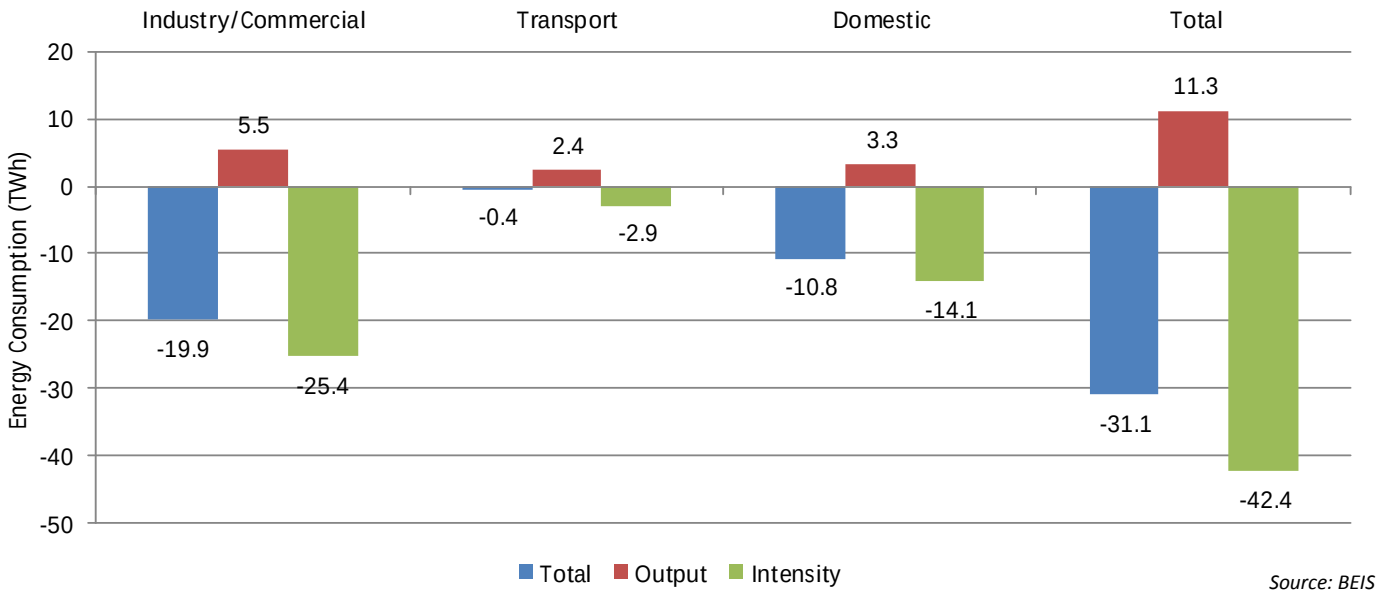
Figure 2.11 shows estimates of the factors (intensity and output) affecting the energy consumption of each sector since 2005.

DEFINITIONS

OUTPUT is a term used to describe the growth (or the decline) in the quantity of goods or services produced in a particular sector. For example, in the case of the industrial and services sectors, gross value added is used as a measure of output. As industrial output increases, then it is intuitive that energy consumption will also increase e.g. in manufacturing, the more goods that are produced then the more energy that is used.

INTENSITY is defined as the amount of energy consumed per unit of output. A fall in intensity in a particular sector could indicate an improvement in energy efficiency or a move to less energy consuming activities.

Figure 2.11: Final energy consumption by sector and affecting factors, Scotland, 2005 - 2014



Source: BEIS

Between 2005 and 2014, total final energy consumption in Scotland fell by 31,091 GWh, a reduction of 19%.

It has been estimated that if efficiency had remained at 2005 levels, 11,267 GWh more energy would have been needed to produce the same amount of output.

Therefore, it is estimated that an increase in output of 7% has added to final energy consumption, with energy intensity improvements accounting for a 25% reduction to offset this.

Industrial and Commercial Energy Intensity

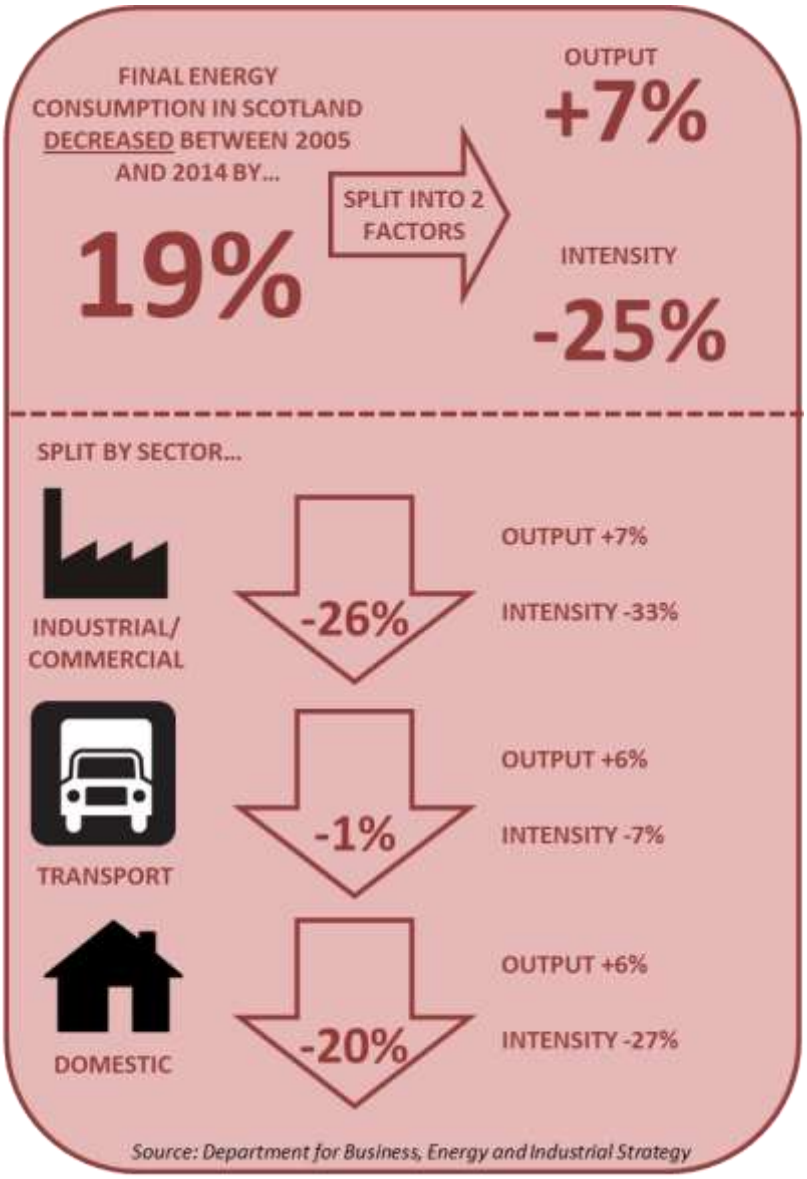
In 2014, the industrial and commercial sector accounted for 42% of total final energy consumption in Scotland (excluding bioenergy & waste).

Final consumption in this sector fell by 19,879 GWh (26%) between 2005 and 2014 to 56,637 GWh, the lowest level since the series began in 2005. Using Scottish GVA as a proxy for Industrial and commercial output, it is estimated that if industrial/commercial energy efficiency had remained at 2005 levels, 5,510 GWh more energy would have been needed to produce the same amount of output. Therefore, it is estimated that an increase in output of 7% has added to industrial/commercial energy consumption, with energy intensity improvements accounting for a 33% reduction to offset this.

Transport Energy Intensity

In 2014, the transport sector accounted for 28% of total final energy consumption in Scotland (excluding bioenergy & waste).

Final consumption in this sector fell by 440 GWh (1%) between 2005 and 2014 to 37,598 GWh. Using road and rail passenger/ freight kilometres as a proxy for transport output, it is estimated that if transport energy efficiency had remained at 2005 levels, 2,410 GWh more energy would have been needed to produce the same amount of output. Therefore, it is estimated that an increase in output of 6% has added to transport energy consumption, with energy intensity improvements accounting for a 7% reduction to offset this.



Domestic Energy Intensity

In 2014, the domestic sector accounted for 31% of total final energy consumption in Scotland (excluding bioenergy & waste).

Final consumption in this sector fell by 10,771 GWh (20%) between 2005 and 2014 to 42,056 GWh, the lowest level since the series began in 2005. Using number of households as a proxy for domestic output, it is estimated that if domestic energy efficiency had remained at 2005 levels, 3,346 GWh more energy would have been needed to produce the same amount of output. Therefore, it is estimated that an increase in output of 6% has added to domestic energy consumption, with energy intensity improvements accounting for a 27% reduction to offset this.

SCOTLAND'S ENERGY EFFICIENCY PROGRAMME (SEEP)

The Scottish Energy Strategy sets out a whole-system view of energy policy, examining where our energy comes from and how we use it – for power (electricity), heat and transport. This integrated approach recognises the interactions and effects that the elements of the energy system have on each other.

The 'whole-system' approach is best represented by the introduction of Scotland's Energy Efficiency Programme (SEEP). SEEP highlights a renewed emphasis on energy efficiency as a strategic priority, designated as National Infrastructure Priority in June 2015; recognising the significant economic benefits of energy efficiency investment and the importance of tackling fuel poverty.

SEEP is a long-term (15-20 year) programme designed to improve the energy efficiency of both domestic and non-domestic buildings with the ultimate aim of decarbonising heat supply; making energy more affordable and reducing carbon emissions from the built environment.

Improved energy efficiency helps households and businesses to have more control over their fuel bills, which will contribute to tackling fuel poverty through reduced costs and achieve health improvement benefits through people having warmer homes. By reducing the costs of energy to Scottish businesses, we know productivity, and therefore economic competitiveness, is likely to improve. Further, by building a Scottish supply chain to harness investment in energy efficiency measures, we can deliver new growth and jobs to the Scottish economy.

SEEP 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.

SEEP is currently in the design phase and is discussed in more detail in the accompanying consultation document. This initial consultation will inform the final design of the Programme.

http://www.gov.scot/Publications/2017/01/2195

While SEEP is a cornerstone of the Scottish Government's 'whole-system' approach to energy policy, in all areas of our energy system, a suite of new policies and programmes will be required. In particular, as more of our heat and transport needs are met by electrically-powered technologies (such as heat pumps and electric cars), we must plan for the new skills and new investment required to meet the extra demands on the electricity grid and energy networks.

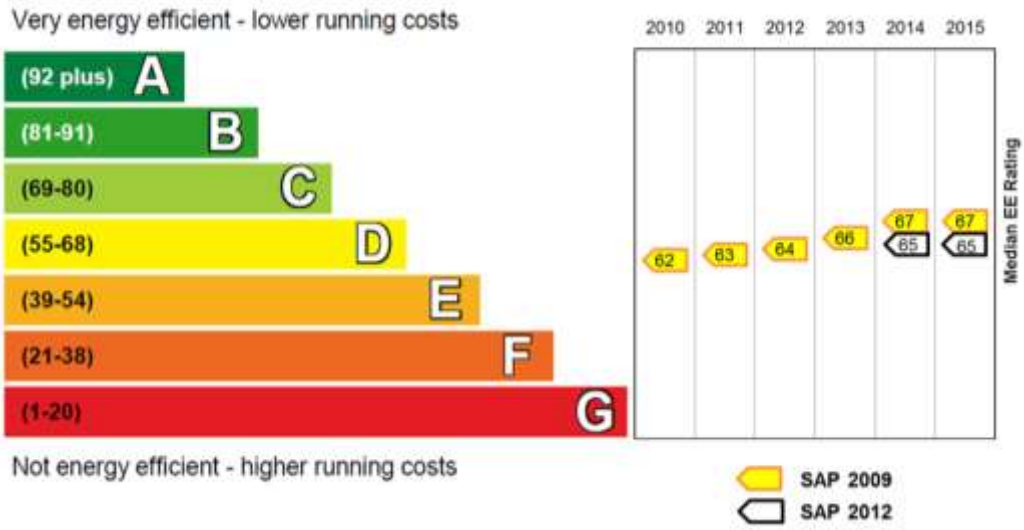
The Programme for Government commits to investing more than half a billion pounds to SEEP over the next four years setting out a clear commitment to develop this programme with substantial annual funding. By 2035, through SEEP we will have transformed the energy efficiency and heating of our buildings so that, wherever technically feasible, and practical, buildings are near zero carbon.

Domestic Energy Consumption

The energy efficiency levels in the Scottish housing stock are monitored using the Scottish House Conditions Survey (SHCS) using the Standard Assessment Procedure (SAP) and expressed as an Energy Efficiency Rating (EER). These ratings are based on the cost of space and water heating, ventilation and lighting per square metre of floor area. EERs are banded from A to G, where A is a very efficient dwelling with low running costs and G denotes high energy costs (and low energy efficiency).

Evidence from the SHCS shows continual improvement in the overall energy efficiency of the Scottish housing stock. Half of all Scottish dwellings are now rated 67 or higher, using the 2009 edition of SAP, compared to a rating of 62 in 2010 for the average Scottish dwelling.

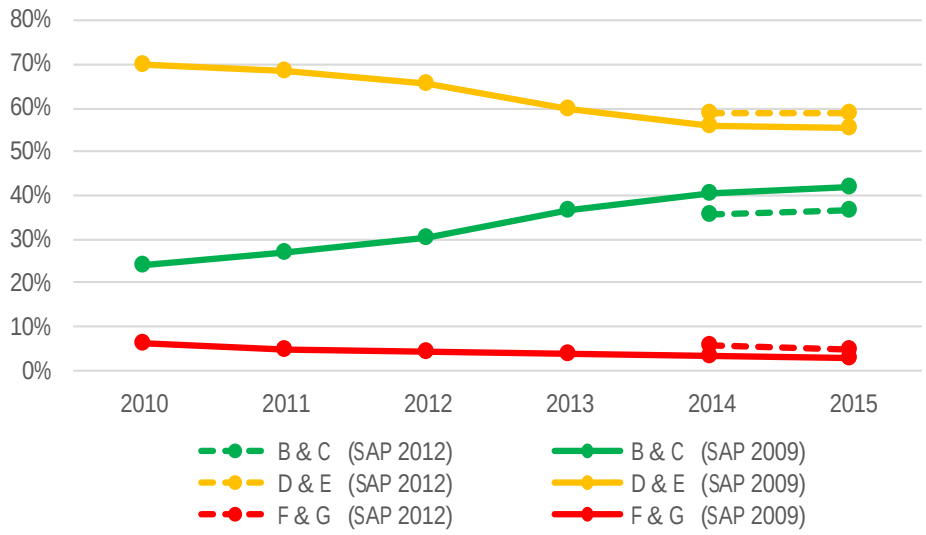
Figure 2.12: Average energy efficiency levels of dwellings, Scotland, 2010-2015, SAP 2009



Source: Scottish Household Condition Survey

Figure 2.13 shows that, in 2015, 37% of Scottish homes were in EPC band C or better (SAP 2012); this is similar to 2014. Using SAP 2009 shows strong improvement in the energy efficiency profile of the Scottish housing stock in the last five years; there was a 74% increase in the share of the most energy efficient dwellings (rated C or above) between 2010 and 2015.

Figure 2.13: Grouped Energy Efficiency Ratings, Scotland, 2010-2015



Source: Scottish Household Condition Survey

Social rented dwellings are among the most energy efficient in the Scottish stock; 38% of Local Authority housing and 65% of Housing Associations are rated B or C under SAP 2012 compared to 32% in the private housing sector. This is likely the result of the characteristics of social sector dwellings – in particular a greater proportion of newer flats which tend to retain heat better than older dwellings and houses – and the improvements mandated under the Scottish Housing Quality Standard (SHQS).

There have been improvements in efficiency more generally across the housing stock. As of 2015, at least 100 mm of loft insulation had been installed in 92% of lofts, an increase of 10 percentage points on 2010 levels, and 32% of lofts were insulated to 300 mm or more, an increase of 5 percentage points in the last year alone.

In 2015, around 71% of cavity wall dwellings and 11% of solid wall dwellings were insulated, both similar to the previous year; the share of dwellings with insulated cavity walls increased by 9 percentage points, from 62% to 71%, on 2010 levels.

As a result of higher standards for replacement boilers, the efficiency of central heating systems is also improving; 56% used condensing gas or oil boilers for heating and/or hot water in 2015, compared with just 7% in 2007.

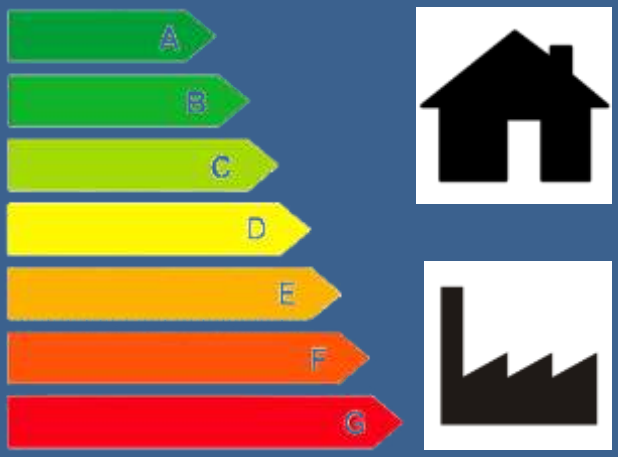
ENERGY PERFORMANCE CERTIFICATES (EPCs) AND ENERGY PERFORMANCE DATA

With few exceptions, all buildings that are constructed, sold, or rented to a new tenant require an Energy Performance Certificate (EPC).

There is also a requirement to display EPCs in larger buildings visited by the public. This document, required under Scottish regulations which implement Directive 2010/31/EU on the Energy Performance of Buildings, provides information on the energy and emissions performance of a building, calculated using an agreed UK methodology. The EPC enables people to compare the performance of buildings and also illustrates the potential for better performance through building improvement work.

ENERGY PERFORMANCE CERTIFICATES (EPCs) AND ENERGY PERFORMANCE DATA (cont.)

EPCs have been recorded on a central register since December 2008 (for existing dwellings) and January 2013 (for existing non-domestic buildings and for all new buildings). As of October 2016, there were approximately **1.7 million domestic** EPCs and **27,000 non-domestic** EPCs held on the Scottish EPC register.



Further information on EPCs and the EU Directive can be found at:

www.gov.scot/epc

People can search for individual EPCs by building address, postcode or the EPC 'report reference number' which is unique to each certificate.

This facility is available online at:

www.scottishepcregister.org.uk

The Scottish Government is also in the process of collating EPC data to support wider research and statistical work. The Scottish Government is working with the Energy Saving Trust to produce an extract of EPC data from central register. A dataset for both domestic and non domestic buildings will be published in early 2017, containing each data element used to produce the certificate and recommendations report. The data file will be restricted to postcode sector. Publication of further data is being considered as part of policy development across Government.

National Energy Efficiency Data Framework (NEED)

What is NEED?

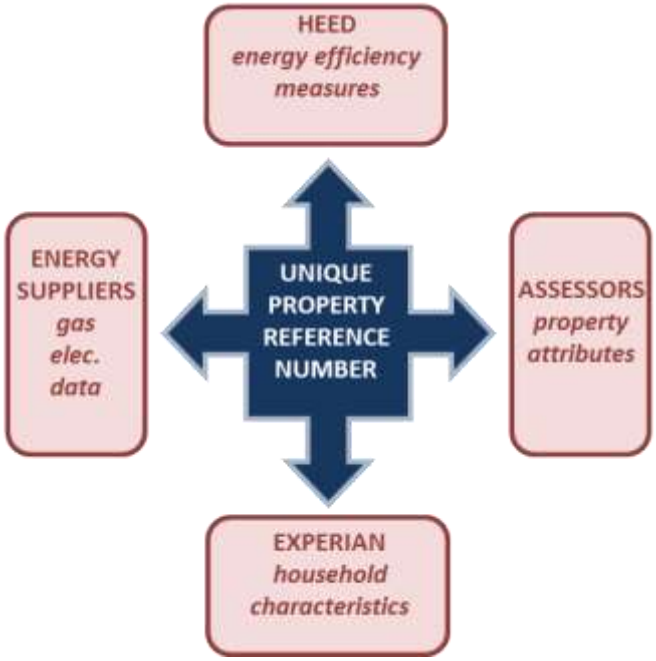
The National Energy Efficiency Data-Framework (NEED) was set up by the Department for Business, Energy and Industrial Strategy (BEIS) to provide a better understanding of energy use and energy efficiency in domestic and non-domestic buildings in Great Britain (currently only covers England and Wales). It combines data from multiple sources to provide insights into how energy is used and what the impact of energy efficiency measures is for different types of property and household.

Why is NEED important?

NEED provides the largest source of data available for analysis of energy consumption; previous evidence has been derived from surveys and small technical monitoring trials. NEED forms an important element of BEIS's evidence base and already plays a key role in development and evaluation of BEIS policies, including the Green Deal.

BEIS Data for Scotland

BEIS published results for Scotland in June 2016, in an Annex as part of their annual NEED publication. These figures remain provisional while BEIS pursue access to more accurate Scottish property information available from the Scottish Assessors Association.



The figure above shows how data are combined to form NEED. The address information in each dataset is used to assign a unique property reference number (UPRN) to each record within the dataset. Data from different sources can then be matched to each other via the UPRN.

The average (median) gas consumption for properties in Scotland was 12,900 kWh with average (median) electricity consumption at 3,600 kWh. Typical consumption in Scotland is slightly higher than in England & Wales for both gas (+8%) and electricity (+9%). This is consistent with other previous estimates of energy consumption across GB.

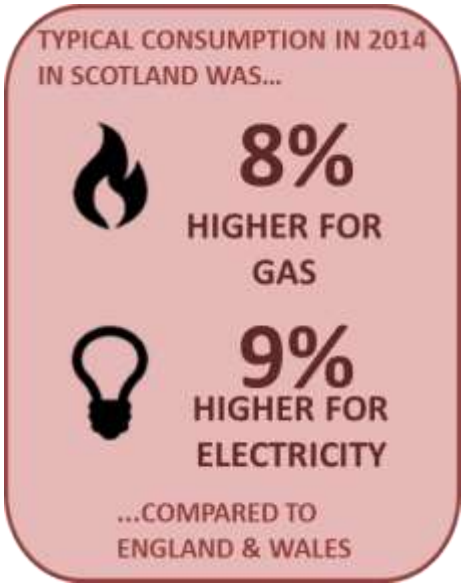
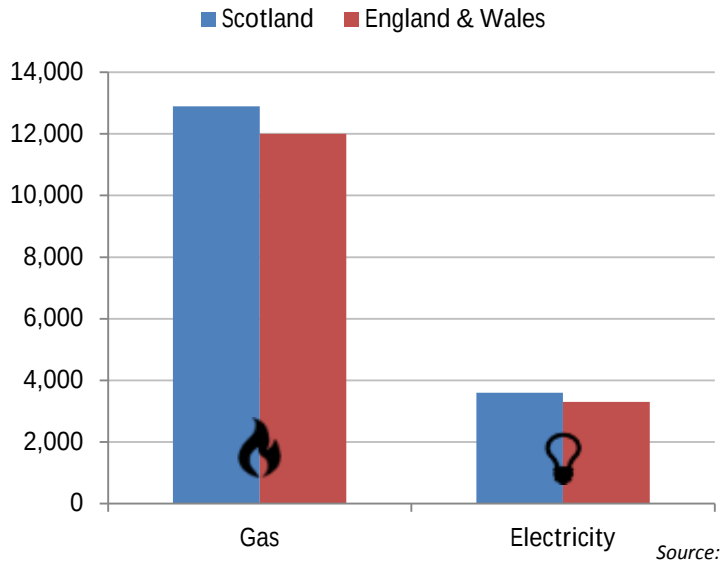


Figure 2.14: Annual Energy Consumption, kWh, Scotland, 2014



Source: BEIS

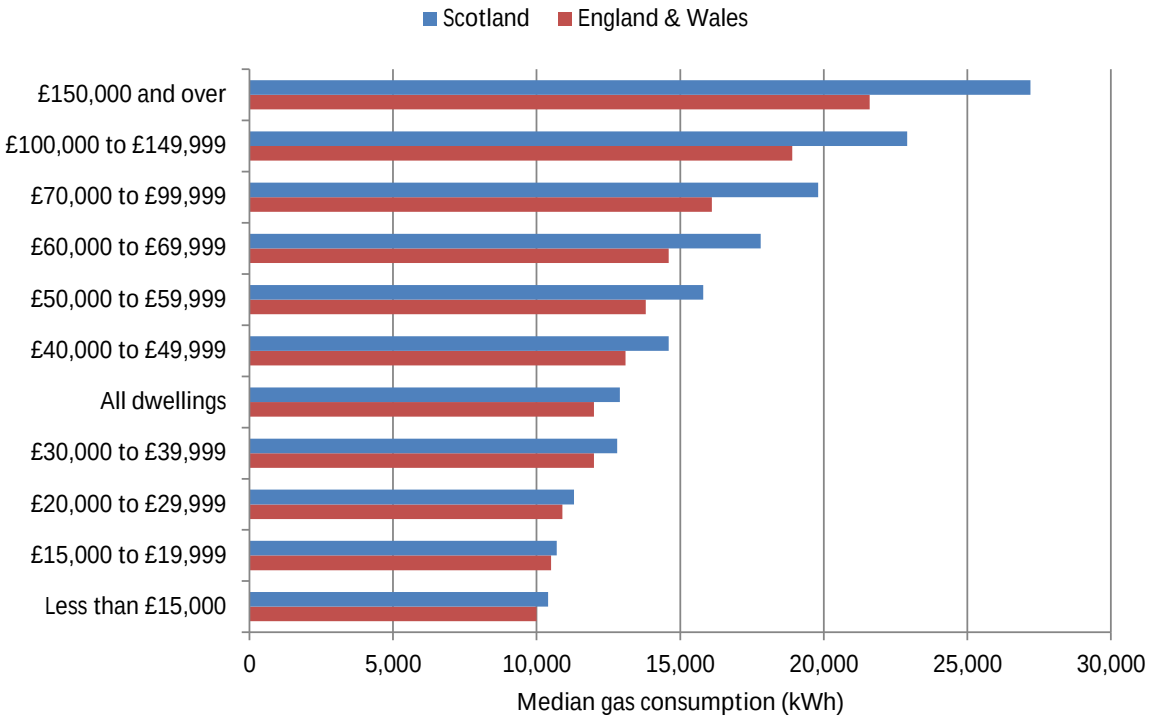
DATA NOTE

The full list of documents related to the latest BEIS NEED publication can be found at the following link: BEIS - NEED Data homepage

With the breakdown of consumption statistics by character and attributes found here:

BEIS - NEED Consumption headline tables

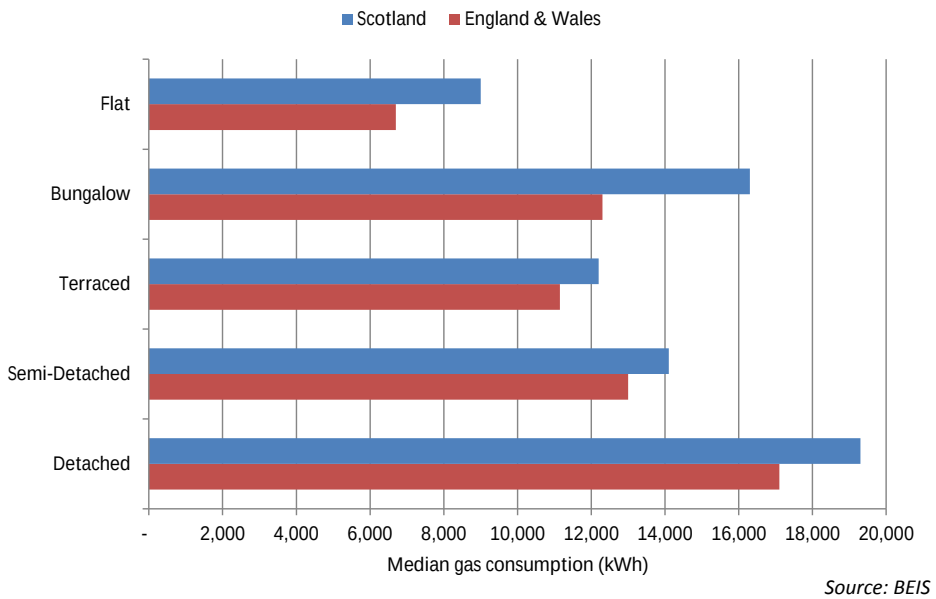
Figure 2.15: Median domestic gas consumption (kWh) by household income, 2014



Source: BEIS

The NEED allows for an indication of how energy is used by domestic consumers. The analysis carried out by BEIS for Scotland includes a breakdown of energy consumption by certain household characteristics. Figure 2.15 shows the median gas consumption by household income in 2014 for both Scotland and the rest of GB. It can be seen that Scotland has a higher gas consumption compared to England & Wales, for every household income band. Overall consumption increases as household income rises, as does the difference in consumption between Scotland and England & Wales. The greatest difference in consumption is 26% for the greater than £150,000 income band, whereas for those households earning less that £15,000 the difference is 4%. On average, electricity consumption for each income band follows a very similar pattern to gas consumption. Figure 2.16 shows the 2014 gas consumption for both Scotland and the rest of GB by property type. Detached properties have the highest gas and electricity consumption in all countries. In Scotland, Bungalows have the second highest consumption for gas and electricity.

Figure 2.16: Median domestic gas consumption (kWh) by household property type, 2014



Source: BEIS

In England & Wales however, semi-detached properties have the second highest consumption. There is a 25% difference in consumption by bungalows between Scotland and the rest of GB. This is because Scotland has proportionally more larger sized bungalows compared to England & Wales, where there are more semi-detached properties.

NEED for Scotland

National Energy Efficiency Data Framework for Scotland

The Scottish Government continues to work closely with the colleagues at BEIS to improve the range and accuracy of data published for Scotland as part of BEIS's wider NEED publication.

This process has led to the Scottish Government developing the NEED for Scotland. The Scottish government have secured access to a range of additional datasets to improve the accuracy and usefulness of the outputs. This has allowed greater flexibility and focus on bespoke analysis for Scotland, improving the evidence available for Scottish energy efficiency policy development.

The NEED Scotland data are published here by the Scottish Government:

http://www.gov.scot/Topics/Statistics/Browse/Business/Energy/NEED

NEED Scotland Methodology

NEED Scotland currently covers domestic properties in Scotland only. It combines data from existing sources (administrative and commercial) to develop an insight into how energy is used and the impact of energy efficiency measures in Scotland.

Each domestic household is assigned a unique property reference number (UPRN) where possible. Data from different sources can then be matched to each other via the UPRN.

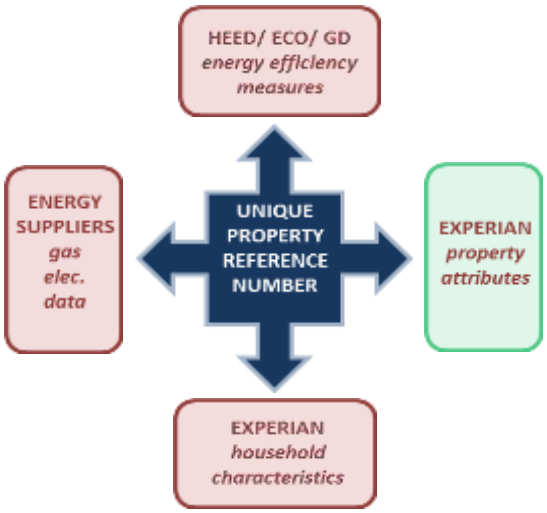
Scope and Data Sources

The NEED Scotland analysis contains the following main data sources:

- meter point gas and electricity consumption data
- the Homes Energy Efficiency Database (HEED), Energy Company Obligations (ECO) and Green Deal (GD), containing data on energy efficiency measures installed
- modelled data from Experian on household characteristics and property attributes

Table 2.2 Scope of Domestic NEED for Scotland

CATEGORY	SOURCE	DESCRIPTION
Premises	AddressBase	Contains a unique identifier for each address in Scotland which is matched to each of the data sources in NEED and then used to link data together.
Energy consumption	Energy suppliers and Gemserv, Xoserve Independent Gas Transporters	Gas and electricity consumption data for all domestic meters in Scotland, 2005-2013 and meter profile for electricity meters. Gas data are weather corrected. As published in BEIS's sub-national consumption publications
Measures installed	Home Energy Efficiency Database (HEED), Green Deal (GD), Energy Company Obligation (ECO)	Information on energy efficiency measure installed through government schemes (including EEC, CERT and CESP).
Property attributes	Experian	Modelled data for property attributes such as floor area.
Household characteristics	Experian	Modelled data for household characteristics such as income and tenure.



The figure opposite shows how data are combined to form the NEED Scotland. The full scope of what data is included in the NEED Scotland can be seen in Table 2.2 on page 40. The main difference compared to BEIS's publication for England & Wales is that Experian data is used for property attributes, in the absence of assessor data for Scotland. The figures that BEIS have come up with for Scotland remain provisional while they pursue access to more accurate Scottish property information. The results presented by the Scottish Government in the NEED for Scotland, build on this analysis by BEIS.

Differences between the two NEED analyses

The main differences between the NEED Scotland analysis and BEIS' NEED analysis for England & Wales are as follows:

- Modelled data from Experian have been used for property attributes due to quality issues with Scottish Assessors data. BEIS use Valuation Office Agency (VOA) property attribute data.
- Data for Feed in Tariffs (FITS) is not currently available for Scotland so is not used in the NEED Scotland analysis.
- Address matching methodologies are different, which allows for slight differences in final estimates.
- Due to the large number of households, BEIS uses a sample of the properties in England and Wales to estimate the impact of energy efficiency measures. The NEED Scotland analysis uses the full population of households available in the database.
- BEIS' NEED publication contains the most recent data from 2014 whereas the Scotland NEED publication analyses data for 2013. However, NEED Scotland allows for a more detailed analysis of the data. For example, breakdowns by urban rural classification and deprivation index.

Results from NEED Scotland

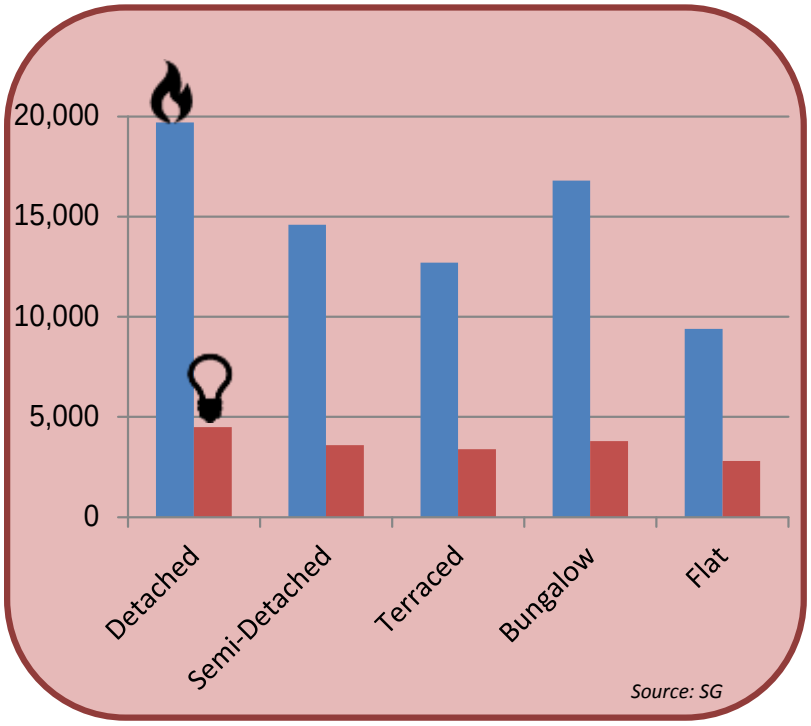
The NEED Scotland provides us with the potential to carry out two different types of analysis:

- **Analysis of gas and electricity consumption**. The consumption figures available range from 2004 to 2013. The main headline figures published are for the years 2011—2013. Matching these energy consumption figures with household characteristics and attributes, allows for a greater insight into how energy is used by domestic properties. Consumption trends based on specific property attributes and characteristics are analysed.
- **Analysis of the impact of energy efficiency measures**. Energy efficiency measures such as loft and cavity wall insulation can be isolated from other measures that may affect energy consumption and therefore the impact of each individual measure can be analysed.

NEED Scotland Energy Consumption Statistics

Figure 2.17 shows Scottish domestic energy consumption in 2013, based on property type. The highest consuming property type for both gas and electricity is the detached house. A detached property in Scotland has a median gas consumption of 19,700 kWh and a median electricity consumption of 4,500 kWh. The lowest consuming property type is the Flat, which has a median gas consumption of 9,400 kWh and median electricity consumption of 2,800 kWh. On average a detached property consumes 110% more gas and 61% more electricity compared to a flat. This could be due to the fact that detached properties tend to be larger than flats and stand alone.

Figure 2.17: Energy consumption by property type, kWh, 2013



Detached households have the highest consumption of both electricity and gas followed by bungalows

Figure 2.18: Energy consumption by property age, kWh, 2013

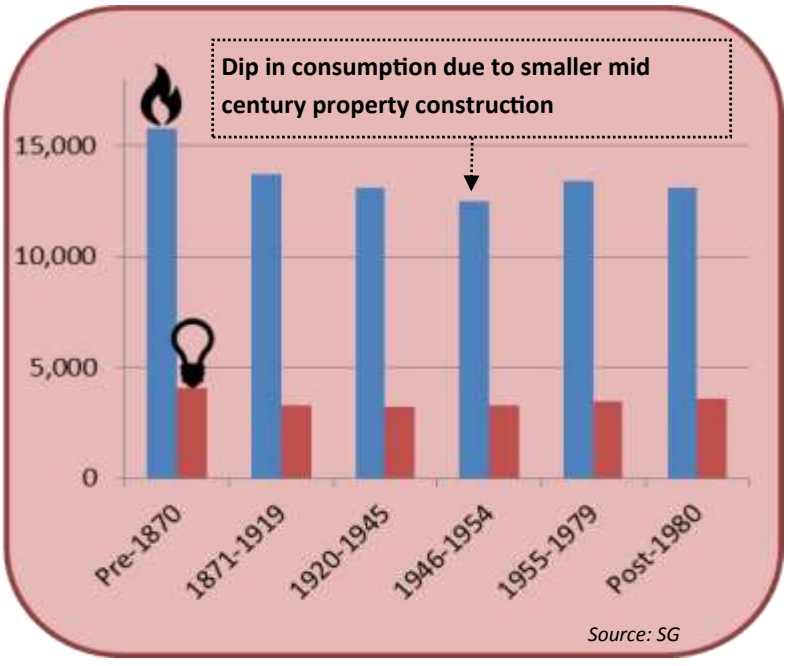
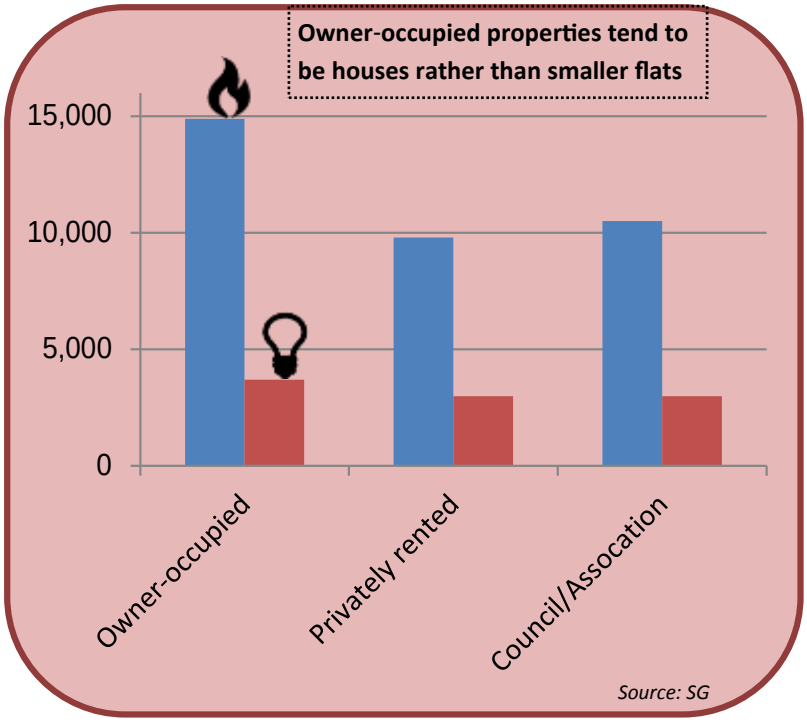


Figure 2.18 shows Scottish domestic energy consumption in 2013, based on property age. The properties with the highest consumption for both gas and electricity are those built pre-1870. A property in Scotland built pre-1870 has a median gas consumption of 15,800 kWh and a median electricity consumption of 4,100 kWh. Internal floor space has implications for the heating requirements of a property. Larger properties will have a greater heat requirement. According to the Scottish house condition survey 2014; properties built before 1920 and after 1980 are 25% larger than those built between this period. This could explain the dip in energy consumption that can be seen in mid 20th century properties.

Figure 2.19 shows Scottish domestic energy consumption in 2013, based on property tenure. The properties with the highest energy consumption for both gas and electricity are owner occupied properties. An owner occupied property in Scotland has a median gas consumption of 14,900 kWh and a median electricity consumption of 3,700 kWh. The lowest consumption properties by tenure are privately rented, which are similar to council/Association housing. These properties have a median gas consumption of 9,800 kWh and a median electricity consumption of 3,000 kWh. On average an owner occupied property consumes 52% more gas and 23% more electricity compared to a privately rented property.

Figure 2.19: Energy consumption by property tenure, kWh,



Results from the Scottish house condition survey 2014 state that 82% of properties that are owner-occupied are houses. Whereas, only 33% of properties that are privately rented are houses. Due to the larger floor area of houses in comparison to flats, this could explain why owner-occupied properties have on average a higher consumption compared to privately rented or council/association housing.

Impact Evaluation of Energy Efficiency Measures

Why is it important?

The intended outcome from installing energy efficiency measures on Scottish domestic households, is to reduce energy consumption. Assessing whether or not these measures have achieved the intended outcome is important to continually help improve policy making. There are multiple reasons why energy consumption in domestic properties could fall. Attributing this decrease in consumption to energy efficiency measures may not necessarily be a correct assumption. The following impact evaluation techniques can help to identify the true effect of energy efficiency measures such as loft and cavity wall insulation.

How is it done?

When assessing the impact of an intervention or policy, it is necessary to compare the group that has received the intervention against a group that has not received the intervention. The process of creating this 'control' group is known as 'matching'. The NEED contains both households that received and did not receive energy efficiency measures. A control group is constructed from the NEED, which is made up of non-intervention households that are similar to the intervention group in terms of household characteristics and attributes.

Energy efficiency measures in domestic properties around Scotland were not installed at random, but rather installed by households who volunteered to have the intervention carried out. Also, the NEED contains households with multiple characteristics which makes exact matching difficult. To allow for both of these issues an advanced form of matching known as Propensity Score Matching (PSM) is required. This creates a probability score that a household would elect to have an intervention installed, based on observing the characteristics of the households who volunteered to receive the intervention. This ensures the households that are most similar to the intervention group are then used as the control group.

PSM can be used in conjunction with Difference in Differences (DiD) to allow for a more robust analysis of the impact of measures installed. Simply comparing the before and after energy consumption of the households in the intervention group, does not give an accurate estimate of the impact of installing energy efficiency measures. Having used PSM to create the control group, the difference between the before and after changes in the intervention group is compared to the difference between the before and after changes in the control group.

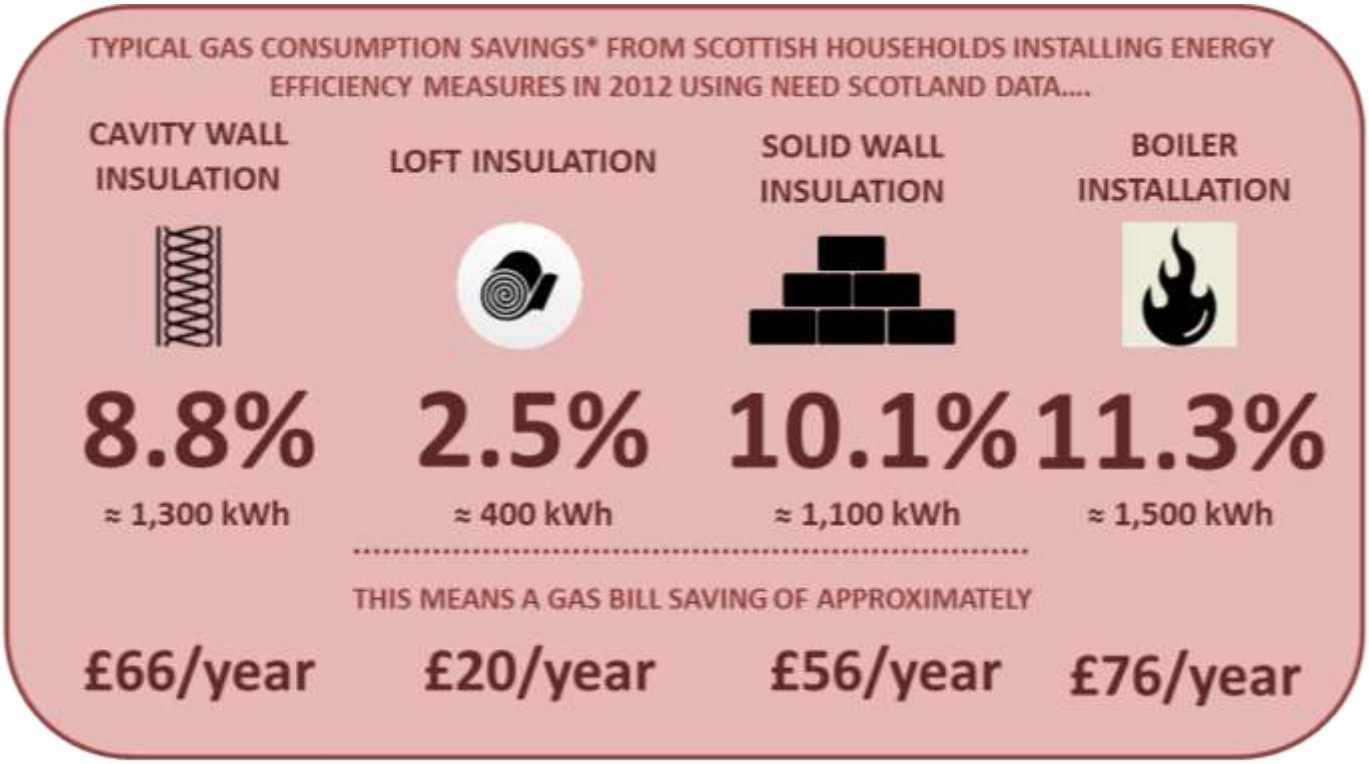
What does it show?

Combining both PSM and DiD techniques allows us to isolate the impact of a single energy efficiency intervention. It takes into account any unobserved factors that might affect the outcome. For example, a trend of warmer winters would have an effect of decreasing energy consumption due to less energy being used for heating purposes. This impact evaluation method shows the effect of an energy efficiency measure while still allowing for a trend such as milder winters. For more information please see NEED for Scotland Methodology.

NEED Scotland—Impact of Energy Efficiency Measures

The NEED Scotland analysis also quantifies the impact of energy efficiency measures that have been installed in households around Scotland. An impact evaluation has been carried out on these energy efficiency measures. These include loft insulation, cavity wall insulation, solid wall insulation and boiler installation. This impact evaluation includes properties that have only a single measure installed, so that the impact of this measure can be isolated from other measures.

In 2012, an estimated 69,000 properties received just loft insulation and almost 15,000 received just cavity wall insulation. The NEED also measures the impact of solid wall insulation and boiler installation programs. In 2012, there were 830 properties that received only solid wall insulation and 40 properties that had only boiler installations. Using the gas and electricity consumption and the property characteristics data, an estimation of the impacts of these energy efficiency measures can be calculated.



*level of saving is relevant to sample size for each specific energy efficiency measure

The NEED Scotland data shows that in 2012 the median energy consumption saving from installing cavity wall insulation and loft insulation are 8.8% and 2.5% respectively. This equates to an annual energy saving of 1,300 kWh for households that installed cavity wall insulation and 400 kWh for households that installed loft insulation. At 2015 gas prices (see Table 7.3 in the energy prices chapter) this would translate to a saving on gas bills of £66 per year for cavity wall insulation and £20 per year for loft insulation.

Estimates of the impact of installing solid wall insulation and boiler installation have also been estimated using the NEED Scotland framework, showing an energy saving of 10.1% and 11.3% respectively. However, the sample rates for solid wall insulation and boiler installation measures are relatively small, so these estimates should be used with caution.

The NEED Scotland framework developed by the Scottish Government will allow for a deeper understanding of the impact of energy efficiency measures in Scotland. The quality of the analysis can be further improved by using property attribute information from Scottish Assessors. The Scottish government will continue to collaborate with BEIS to develop the NEED analysis so that it can more accurately be used to influence future energy efficiency polices implemented in Scotland.

Rebound Effect

What is the Rebound Effect?

When a domestic energy efficiency measure is installed, it reduces the amount of energy that is required by the consumer to achieve the same outcome. i.e. space heating within the home or heating water to the same level; but by using less energy to do so. The rebound effect describes the consumers behavioural change to this increased efficiency. It is where the reduction in energy consumption isn't as great as expected due to the consumer increasing their consumption because of the monetary savings they are seeing.

How does this affect the NEED?

The impact evaluation of the energy efficiency measures detailed in the NEED take into account this rebound effect. The estimated energy consumption after a measure has been carried out represents the actual consumption of the consumer rather than the technical efficiency saving. For example, if loft insulation is installed in a house, the householder could potentially save more than the 2.5% in gas consumption estimated by the impact evaluation above. This percentage saving takes into account the change in the householders consumption behaviour. The potential technical saving due to the loft insulation may have been up to 3%. In this case, the rebound effect is measured as the difference between the two. So the change of the householders behaviour could be said to negatively impact energy consumption by 0.5%.

Non-domestic NEED

The National Energy Efficiency Data-Framework (ND-NEED) Framework was set up by BEIS to provide a better understanding of energy use in both domestic and non-domestic buildings in Great Britain, but work on the non-domestic framework is more complicated than its domestic counterpart due to limitations in address matching. Results for England and Wales have been published but remain experimental at this stage.

The purpose of the non-domestic NEED Framework is to match information about buildings to metered electricity and gas consumption data. Buildings data are gathered from the Valuation Office Agency's (VOA) Non-domestic Ratings List (NDR), whilst energy consumption data are supplied to BEIS at a meter point level. In the first report less than 30 per cent of electricity meters were matched to buildings data, but since then work has been done to improve the address matching and construction of the ND-NEED dataset and the coverage is now just below 50 per cent of non-domestic buildings, this represents a significant improvement over the previous version.

BEIS have developed the Building Energy Efficiency Survey, which also covers only England & Wales, and use this as the main evidence base for energy use and abatement potential in non-domestic buildings.

The ND-NEED dataset is substantial and useful for large scale analysis. For example, it was used in the evaluation of the CRC energy efficiency scheme.

The latest progress made with ND-NEED was published in March 2015.

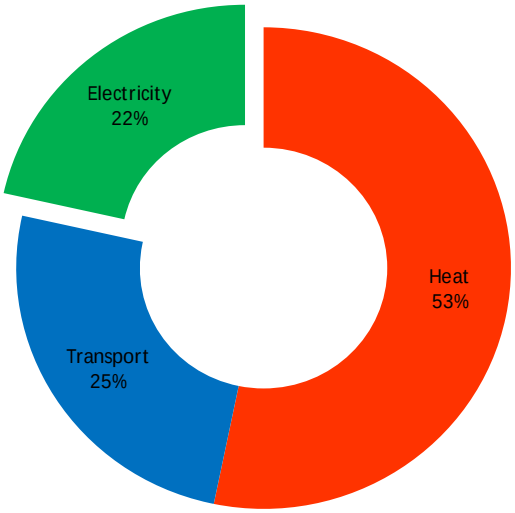
CHAPTER 3

ELECTRICITY

'Renewable sources delivered 59.4% of gross electricity consumption in 2015'

ELECTRICITY

KEY FACTS



Renewable sources generated...

59.4%

...of gross electricity consumption in 2015. The target is 100% by 2020

In Scotland, 22% of total energy consumption is accounted for by electricity demand.

61%

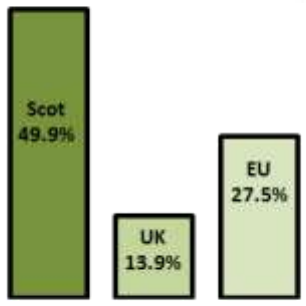
of energy was lost in the electricity conversion process in 2014

Electricity Generation Mix, (GWh, 2015)

Renewables	21,627	42%
Nuclear	17,763	35%
Coal	8,538	17%
Gas	1,913	4%
Oil	836	2%

Scotland is a net exporter of electricity to the rest of the UK - 29% of total generation in 2015.

Renewable electricity as a proportion of gross consumption in 2014[1]



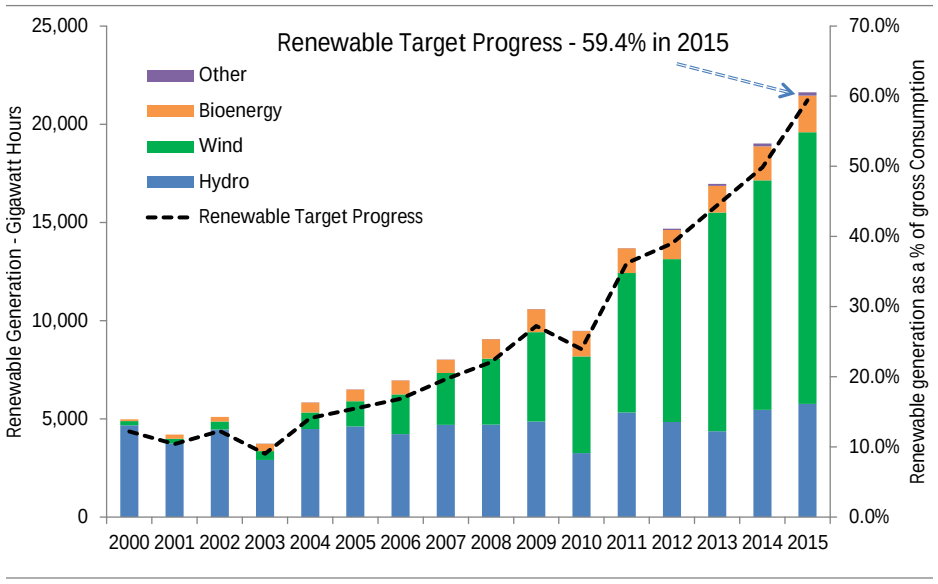
SCOTTISH RENEWABLES SINCE 2000...

Electricity generated (GWh) from renewable sources in Scotland, 2000-2015

In 2015, the two largest renewable electricity generators were:

wind 64%

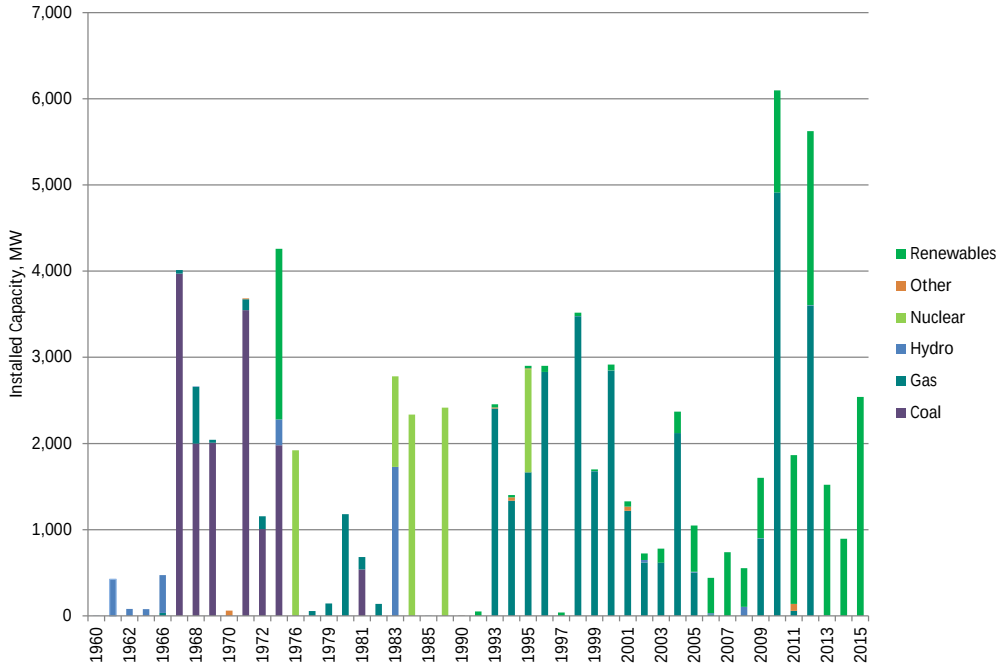
hydro 27%



Evolution of Electricity Generation in the UK and Scotland

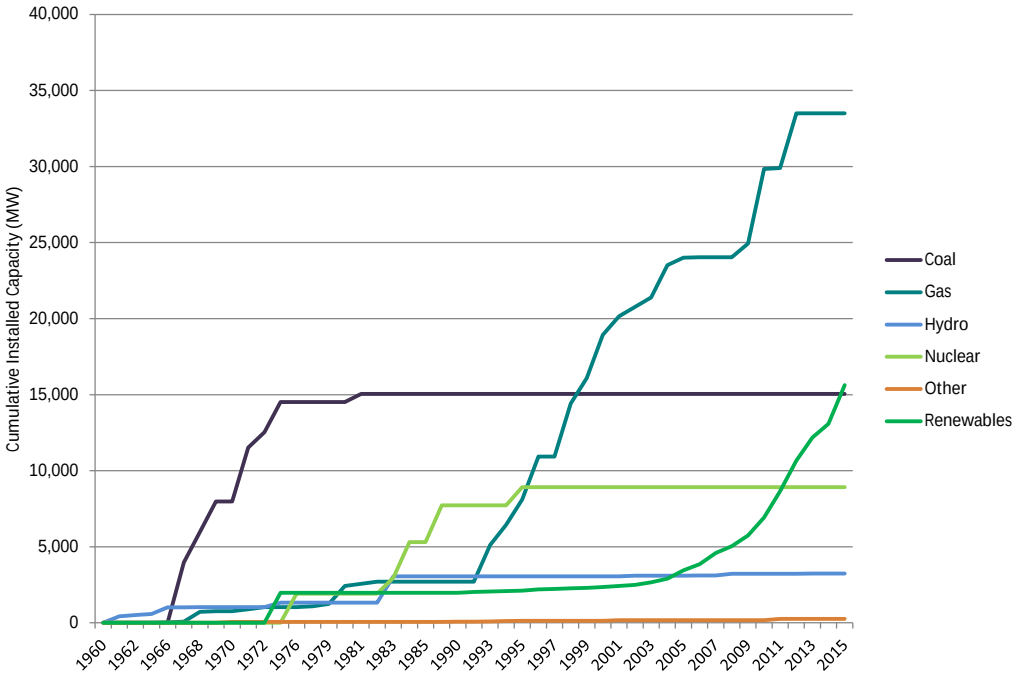
In recent years, Scotland has added many renewable power schemes to its existing fleet of coal, nuclear and gas plants. It is interesting to look at how Scotland's electricity generation capacity has evolved sine the 1960s. Figure 3.1 and Figure 3.2 show the evolution of electricity generation in the UK from 1960 - 2015. By the time major hydro development ended in the mid 1960s, Scotland could boast of 56 dams. The late 60s to late 70s saw a large focus on the construction of coal power stations, with an increase of around 15,000 MW in installed capacity from coal over roughly a 10 year period. In the mid-70s investment in nuclear power rose with an increase of around 9,000 MW of installed capacity from 1976 to 1995, when the last nuclear power station was constructed. The 90s saw a huge rise in the construction of gas power stations in what is known as the "dash for gas" due to the privatisation of the British Gas Corporation in 1986. The construction of gas power stations continued steadily until 2013 and has levelled off over the past few years.

Figure 3.1: Installed Capacity of Power Station Openings by Year (MW), UK, 1960-2015



Source: BEIS

Figure 3.2: Cumulative Installed Capacity of Opened Power Stations (MW), UK, 1960-2015

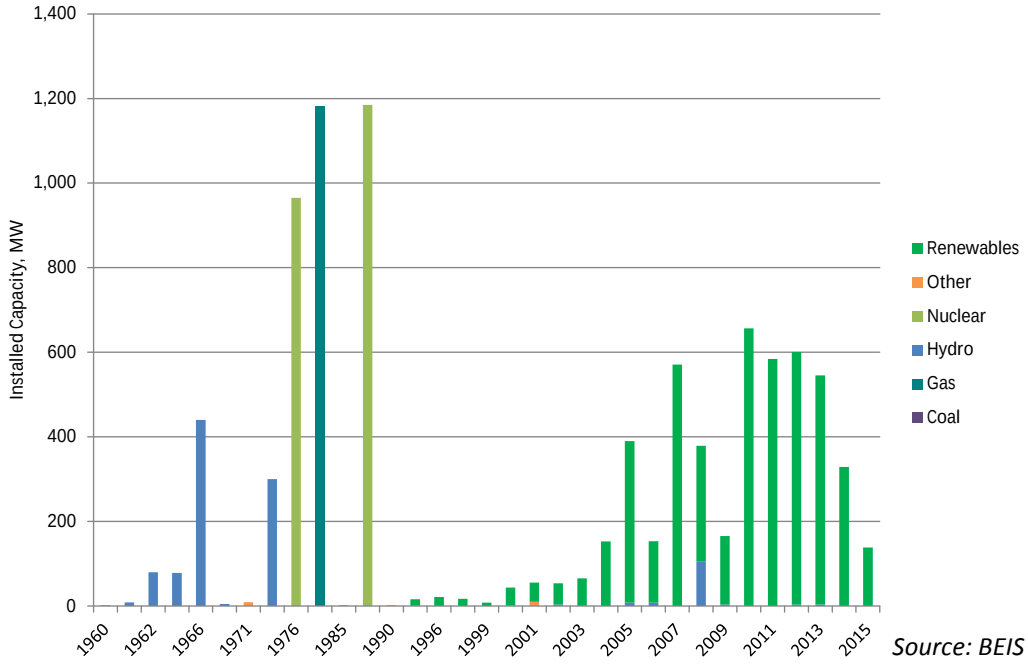


Source: BEIS

The construction of renewable energy power stations has grown exponentially from 1975 to present with an increase of around 15,500 MW of installed capacity, around 9,000 MW of which is accounted for in the last 5 years. From 1960 to 2015, gas is the only fuel that exceeds renewable sources in installed capacity.

Figure 3.3 and Figure 3.4 isolate the evolution of electricity generation in Scotland from 1960 to 2015. The trends are similar when compared to the UK, however from 2000 onwards there is a sharp uplift in the installed capacity of renewable power stations, highlighting Scotland's drive to increase electricity generation from renewables. There was around 45 times more installed capacity in 2015 than in 2000.

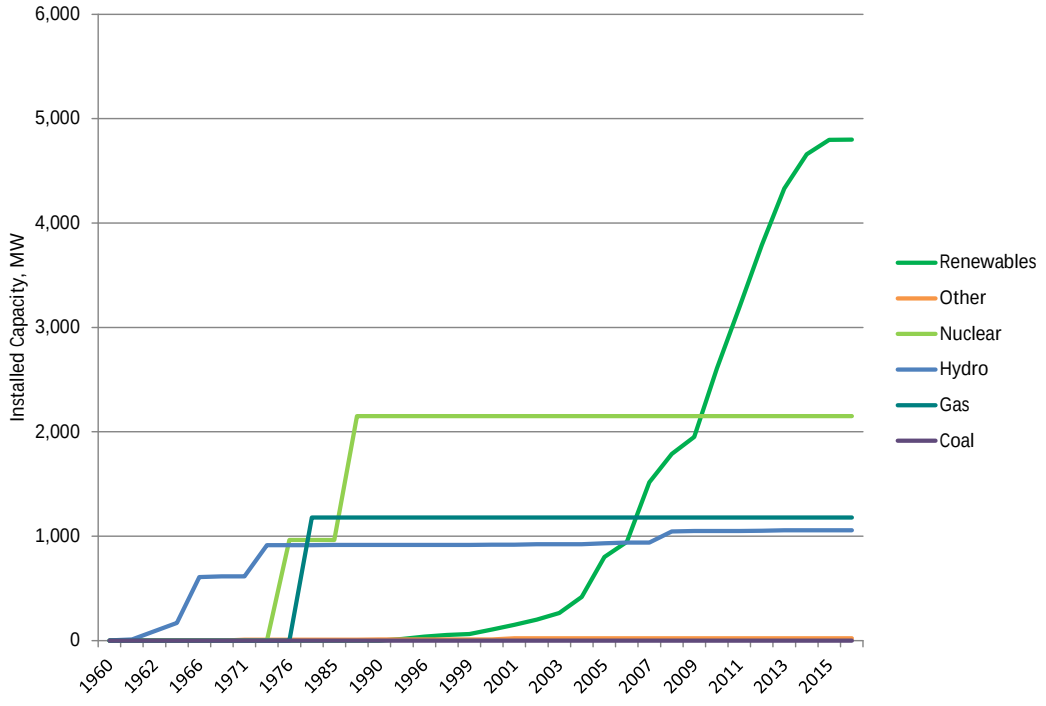
Figure 3.3: Installed Capacity of Power Station Openings by Year (MW), Scotland, 1960-2015



Source: BEIS

In Scotland, renewable electricity accounted for 96% of all new installed capacity built between 2000 and 2015

Figure 3.4: Cumulative Installed Capacity of Opened Power Stations (MW), Scotland, 1960-2015



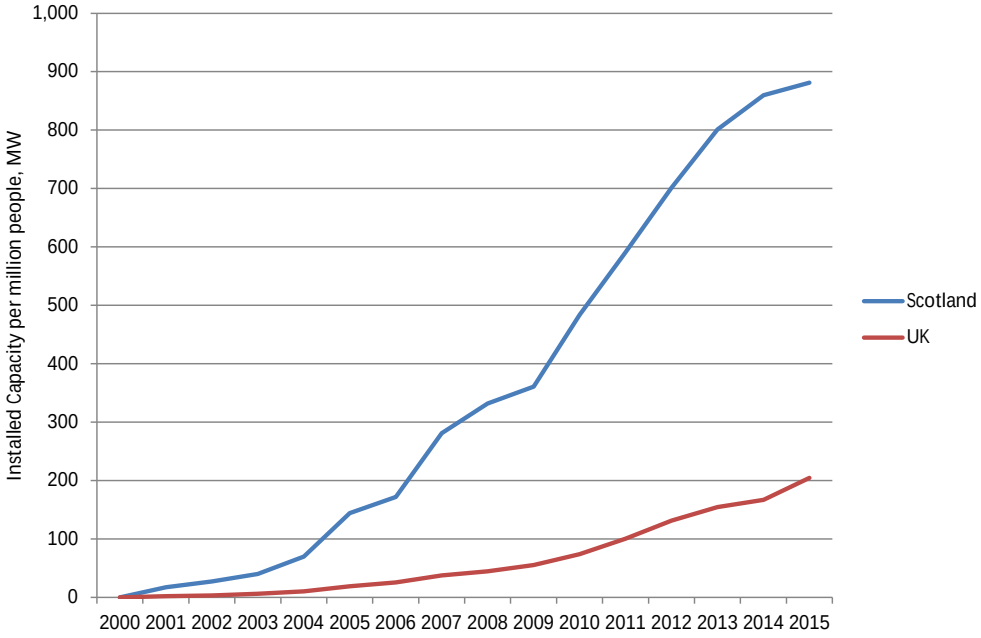
As of 2015, the installed capacity of renewables power stations opened from 1960 exceeded all other forms of electricity generation. Renewables installed capacity is over double the amount of nuclear, which had the second largest installed capacity in 2015.

Source: BEIS

Renewable Generation - Scotland compared to UK

Figure 3.5 presents the installed capacity per million people from renewables for both Scotland and the UK since 2000. Over this period, Scotland's installed capacity has grown to almost 900 MW per million people in 2015. Proportionally, this is over 4 time greater than the UK. This highlights Scotland's relative progress in increasing the amount of electricity generated from renewables , with the target to deliver the equivalent of 100% of gross electricity consumption through renewable sources by 2020.

Figure 3.5: Renewables Installed Capacity, per million people, Scotland, 2000—2015



Source: BEIS

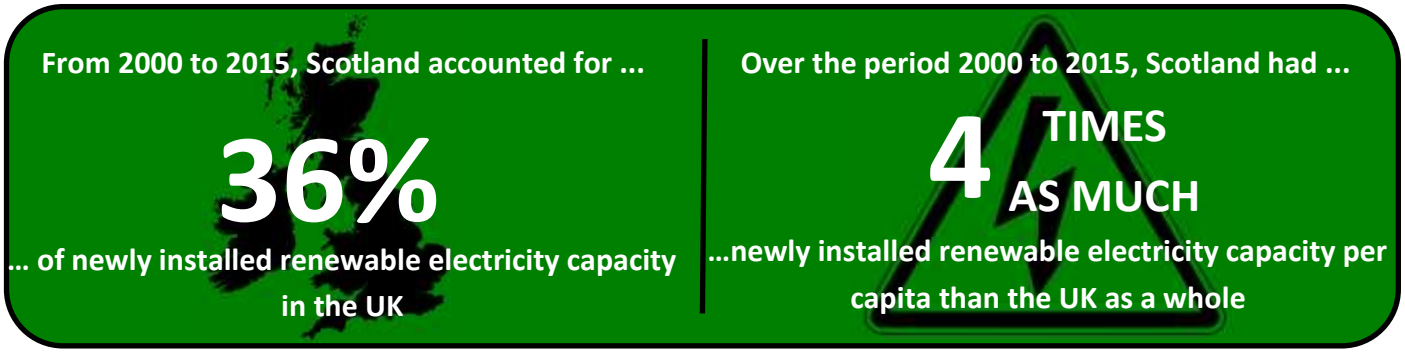
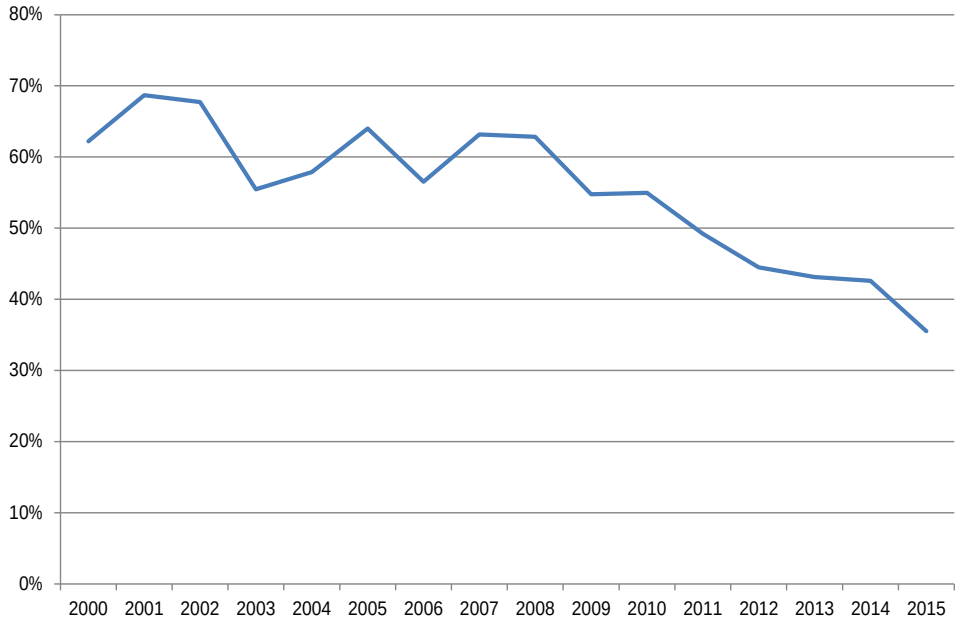


Figure 3.6 presents the proportion of the UK's renewable electricity generated in Scotland. With the rest of the UK also increasing their investment in renewable electricity generation, this percentage has dropped to 36%. However, proportionally, Scotland still generates significantly more electricity from renewables than the UK.

Figure 3.6: Proportion of UK's renewable electricity generated in Scotland, 2000—2015



Source: BEIS

Latest Statistics on Electricity Generation

In 2015, renewables were again the single largest contributor to electricity generation in Scotland.

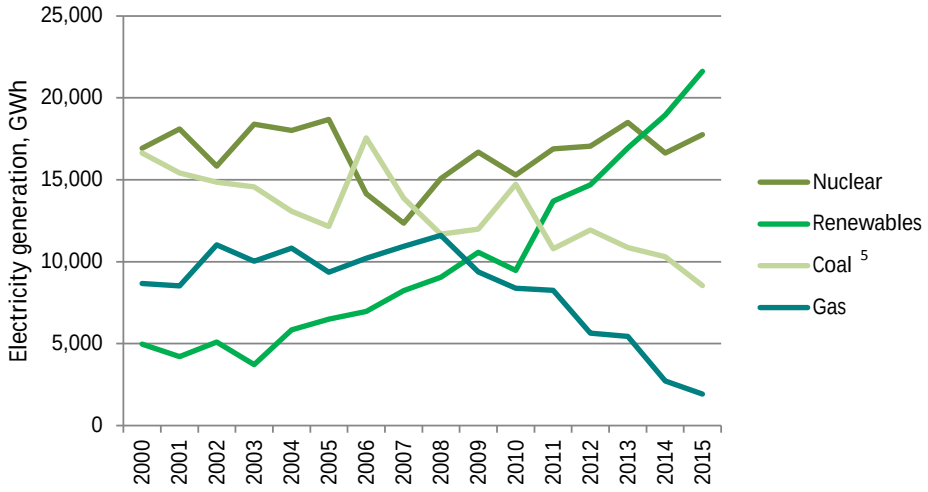
Renewables were again the single largest source of electricity generated in Scotland in 2015 (42%), higher than both nuclear generation (35%) and fossil fuel generation (22%). Scotland continued to be a net exporter of electricity, exporting 29% of total generation in 2015, up from 24% in 2014. Overall electricity generation in Scotland increased by 1,225 GWh to 51,200 GWh in 2015.

Renewable electricity generation delivered 21,627 GWh in 2015, up 14% on 2014 (previous record year for renewables). Figures 3.7 and 3.8 show electricity generated in Scotland and UK, respectively, by fuel type (GWh) for 2000 to 2015. Since 2000, both Scotland and the UK as a whole have seen a decline in coal and gas electricity generation and an increase in generation from renewables.

Nuclear

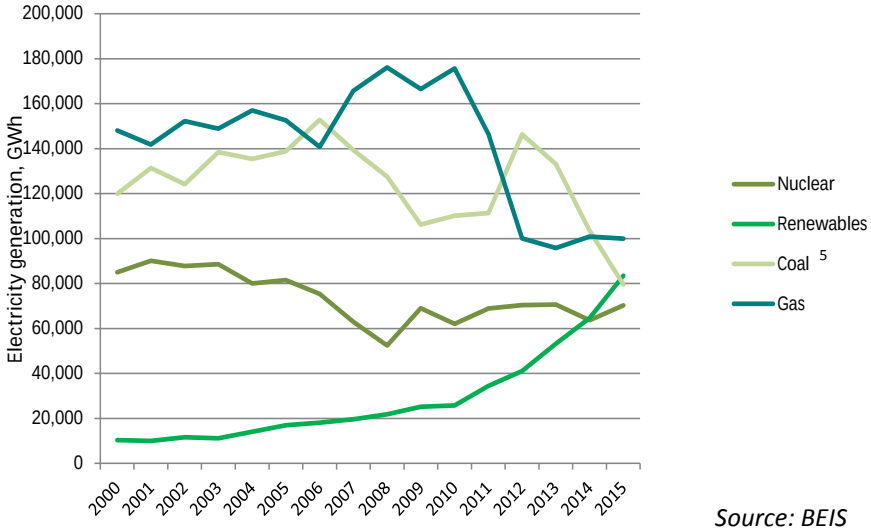
Nuclear power output in Scotland as a proportion of overall electricity generation increased from 33% in 2014 to 35% in 2015. This upwards trend was reflected in the UK as a whole with nuclear output increasing from 19% to 21% of overall electricity generation over the course of 2015.

Figure 3.7: Electricity Generation by Fuel (GWh), Scotland, 2000-2015



Source: BEIS

Figure 3.8: Electricity Generation by Fuel (GWh), UK, 2000-2015



Source: BEIS

Coal

In 2015, the proportion of electricity generated from coal decreased to 17%, down from 21% in 2014. In the UK as a whole electricity generation from coal decreased from 31% in 2014 to 24%. Scotland had two coal fired power stations in 2013, Longannet in Fife and Cockenzie in East Lothian. However, Cockenzie closed in March 2013 due to the Large Plant Combustion Directive (LPCD) and Scottish Power closed Longannet in March 2016.

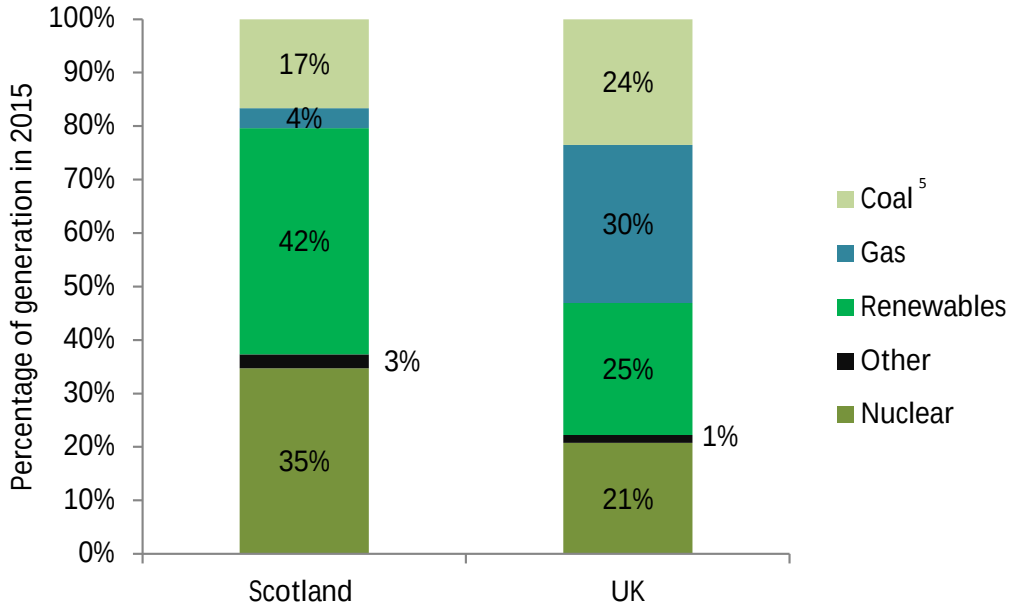
5. Coal includes a small quantity of non-renewable wastes.

Gas

The proportion of electricity generation from gas continued to fall - from 5.5% in 2014 to 3.7% in 2015. The main gas-fired power station in Scotland is at Peterhead in Aberdeenshire. The proportion of electricity generated by gas in the UK as a whole decreased very marginally in 2015.

Figure 3.9 shows the proportion of electricity generated by fuel for Scotland and the UK in 2015, where renewable generation is defined as 'Hydro Natural Flow' and 'Other Renewables' combined.

Figure 3.9: Electricity Generation Mix (%) - Scotland and UK, 2015



5. Coal includes a small quantity of non-renewable wastes.

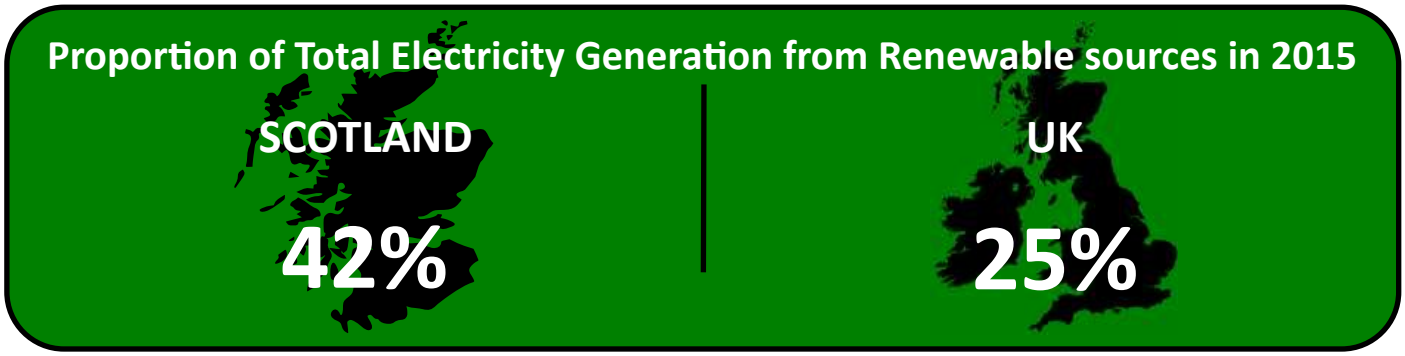
Source: BEIS

Fossil Fuels

Fossil fuel generation as a whole, in Scotland, has decreased from 27.7% in 2014 to 22% in 2015, while generation from renewables has increased from 38.0% to 42.2%. This is partly due to the increase in capacity of renewable technologies and the Scottish Government's commitment to achieving the 100% renewable electricity target (this is discussed in more detail in the renewable generation section on page 54).

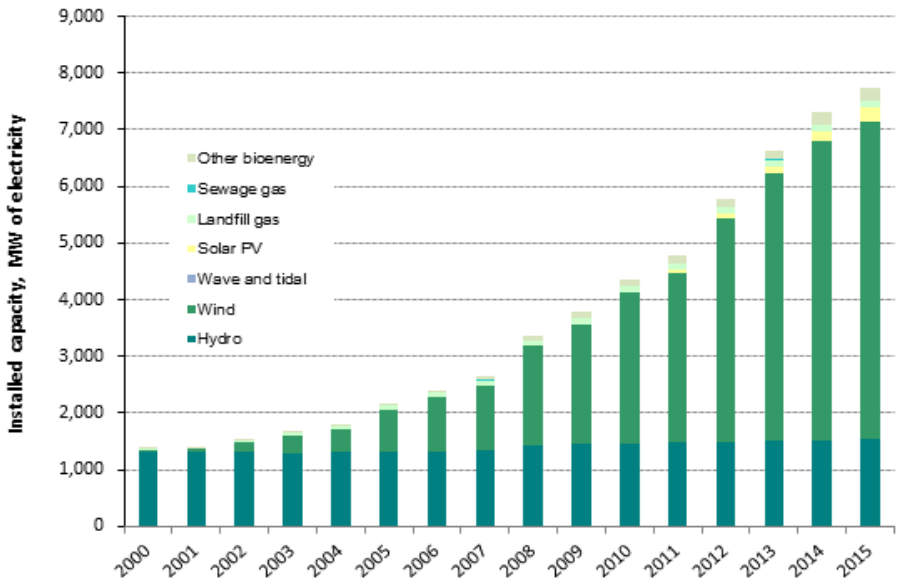
The UK generated 338,407 GWh of electricity in total in 2015. Between 2014 and 2015 Scotland's share of total UK electricity generation increased from 14.8% to 15.1%. For the UK as a whole, renewable generation made up 25% of total generation in 2015.

For renewable generation only, the proportion generated in Scotland accounted for 26% of total UK renewable generation – down from 29% in 2014.



Renewable Electricity

Figure 3.10: Installed capacity of sites (MWe) generating electricity from renewable sources, Scotland, 2000-2015



Installed renewable capacity has risen year on year since 2000 and, as shown in Figure 3.10, there has been an increase from around 1,400 MW in 2000 to around 8,000 MW in 2015. This overall increase can be largely attributed to the significant increase in operational wind sites. 2015 saw an increase in renewable installed capacity of 433 MW, up approximately 6% from 2014.

Source: BEIS

DATA DEVELOPMENT

An accompanying **calculations tool** be found at the following link:

Renewable Electricity Output Calculator

This allows users to easily calculate the equivalent number of households powered by a particular capacity of site.

Renewable Generation

Generation of renewable electricity from non-hydro sources has grown year on year since the start of the century from a starting point of almost zero as shown in Figure 3.10. Building upon a long established base of hydro generation, the growth in deployment thus far has been predominantly through onshore wind. However, the planning pipeline demonstrates that Scotland has significant growth opportunities across the renewables sector, with the potential to make an effective contribution to achieving renewable and long-term decarbonisation targets.

*The Scottish Government has a target to deliver the equivalent of 100% of **gross electricity consumption** through renewable sources in 2020, as part of a wider, balanced electricity mix, with thermal generation playing an important role. The 2015 50% target has now been met.*

The renewable electricity generation figures for Scotland show that generation during 2015 was 21,627 GWh – up 14% on 2014 (the previous record year for renewables), with the equivalent of 59.4% of gross consumption in Scotland met using renewable sources (see Monitoring the 100% Electricity Target Box on page 56).

Common Electricity Calculations

Generating output is the actual generated electricity delivered by a generating plant over a period of time

Installed capacity is the maximum power output at which an electricity generating plant can operate

Capacity factor is the actual output as a proportion of the theoretical maximum output

Generating output can be calculated by multiplying the installed capacity of the plant by the number of hours in a year, and then by the capacity (or load) factor for that technology.

In 2015, a 3 MW onshore wind turbine located in Scotland had, on average, a 26.6% capacity (or load) factor;

$$3MW \times 365\ days \times 24\ hours \times 29.1\% = 7{,}647\ MWh$$

Which equates to, on average, 6,990 MWh per year generated by a 3 MW onshore wind turbine located in Scotland.*

The equivalent number of domestic households the 3 MW onshore wind turbine could power over a year can be calculated by taking account of distribution and transmission losses and dividing by the average domestic household electricity consumption in Scotland.

$$\frac{3MW \quad x \quad 365\ days \quad x \quad 24\ hours \quad x \quad 29.1\% \ x \ 94.8\%\ (taking\ account\ of\ losses)}{4{,}353\ KWh\ (the\ average\ household\ consumption\ in\ Scotland\ in\ 2015)} = 1{,}665\ households$$

A 3 MW onshore turbine could generate enough electricity to power the equivalent of approximately 1,665 domestic households in Scotland for a year.*

* This calculation is for illustrative purposes only.

Provisional data from the BEIS regional quarterly generation statistics show that renewable electricity

DATA DEVELOPMENT

Quarterly Renewable Electricity Generation Data

Given the substantial interest in the renewable generation figures in Scotland, we are continually improving our analytical summary note every quarter. This provides an overview of the Scotland specific key facts and trends emerging from the publication of quarterly renewable electricity generation statistics, including reporting the progress of the Scottish Government renewable targets. Gaining access to further breakdowns by renewable technology and more regular annual estimates of generation throughout the year has allowed more extensive commentary to aid interpretation of the data. These reports are published alongside other key Scottish energy statistics and information at:

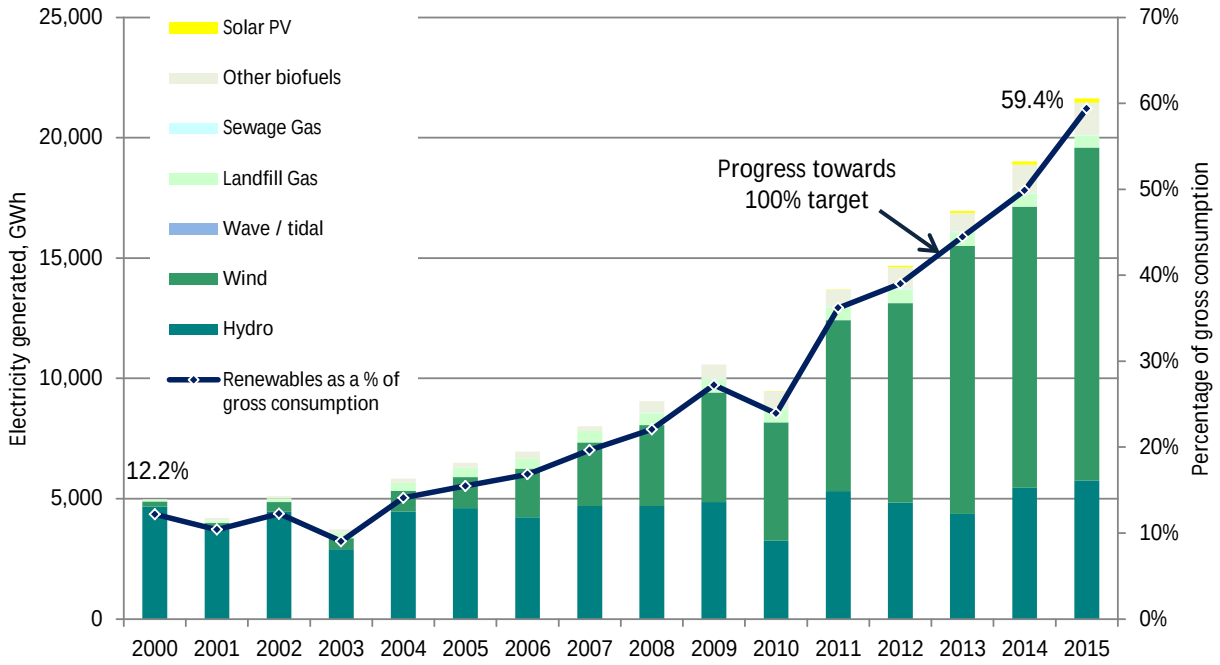
www.scotland.gov.uk/Topics/Statistics/Browse/Business/Energy

Figure 3.11 below shows renewable generation output by technology on the left axis and the percentage of gross consumption on the right axis. The chart highlights the year on year growth in wind output - from 2010 onwards wind has generated more electricity than hydro in each year.

DATA NOTE

BEIS's quarterly regional data will provide an early indication of progress towards the output levels required to deliver the target of 100% by 2020 in March 2017. However, it will not be possible to officially report against the target until the Scottish electricity gross consumption data is published in December 2017.

Figure 3.11: Electricity generated (GWh) from renewable sources, Scotland, 2000-2015



Source: BEIS

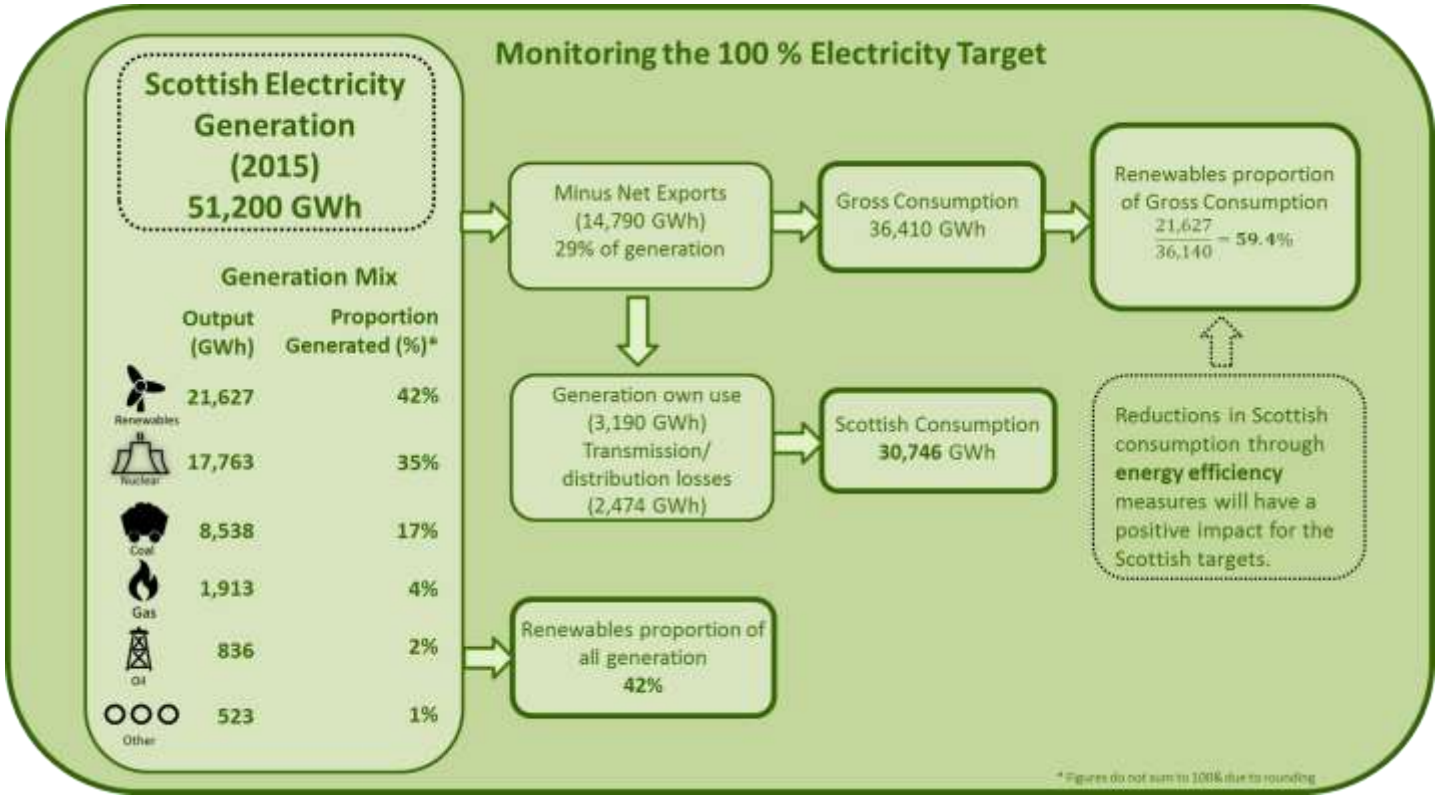
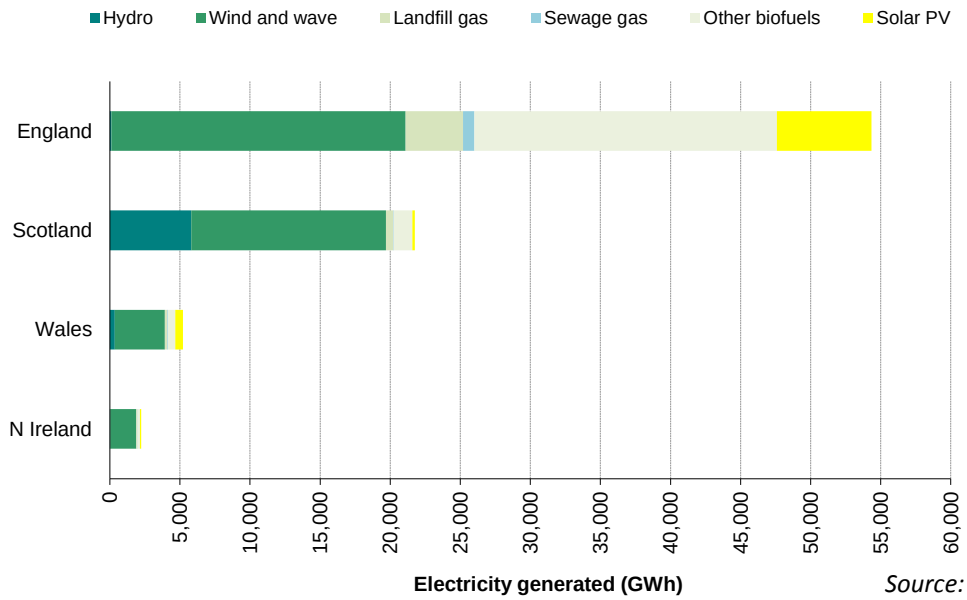


Figure 3.12: Generation of electricity (GWh) from renewable sources by UK country, 2015



Source: BEIS

Figure 3.12 shows renewable electricity generation broken down by country and by energy source. In 2015, Scotland is the primary location for hydro generation accounting for around 88% of installed capacity and 92% of UK hydro output. Scotland also accounts for 34% of UK wind output (39% of capacity)[6]. Overall, Scotland accounts for 26% of total UK renewable electricity output in 2015.

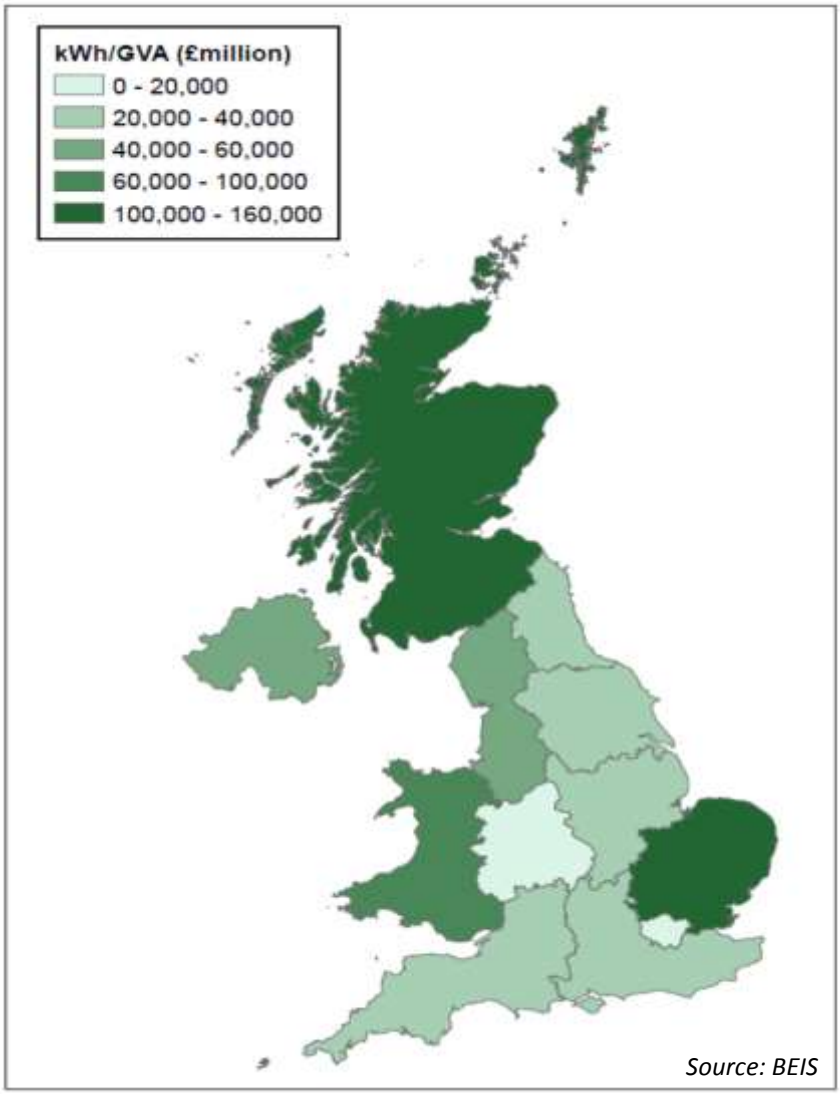
Scotland accounts for 92% of UK hydro output

Scotland has by far the greatest electricity generation from renewables per unit of economic activity compared with UK regions as illustrated in Figure 3.13 (GVA is used as a proxy for economic activity).

Scotland's ratio of renewable electricity generated per unit of economic activity is over 4.5 times larger than that of the UK as a whole, and 55% higher than that of the country/region in second place (East of England).

In 2015, Scotland accounted for 34% of UK wind output

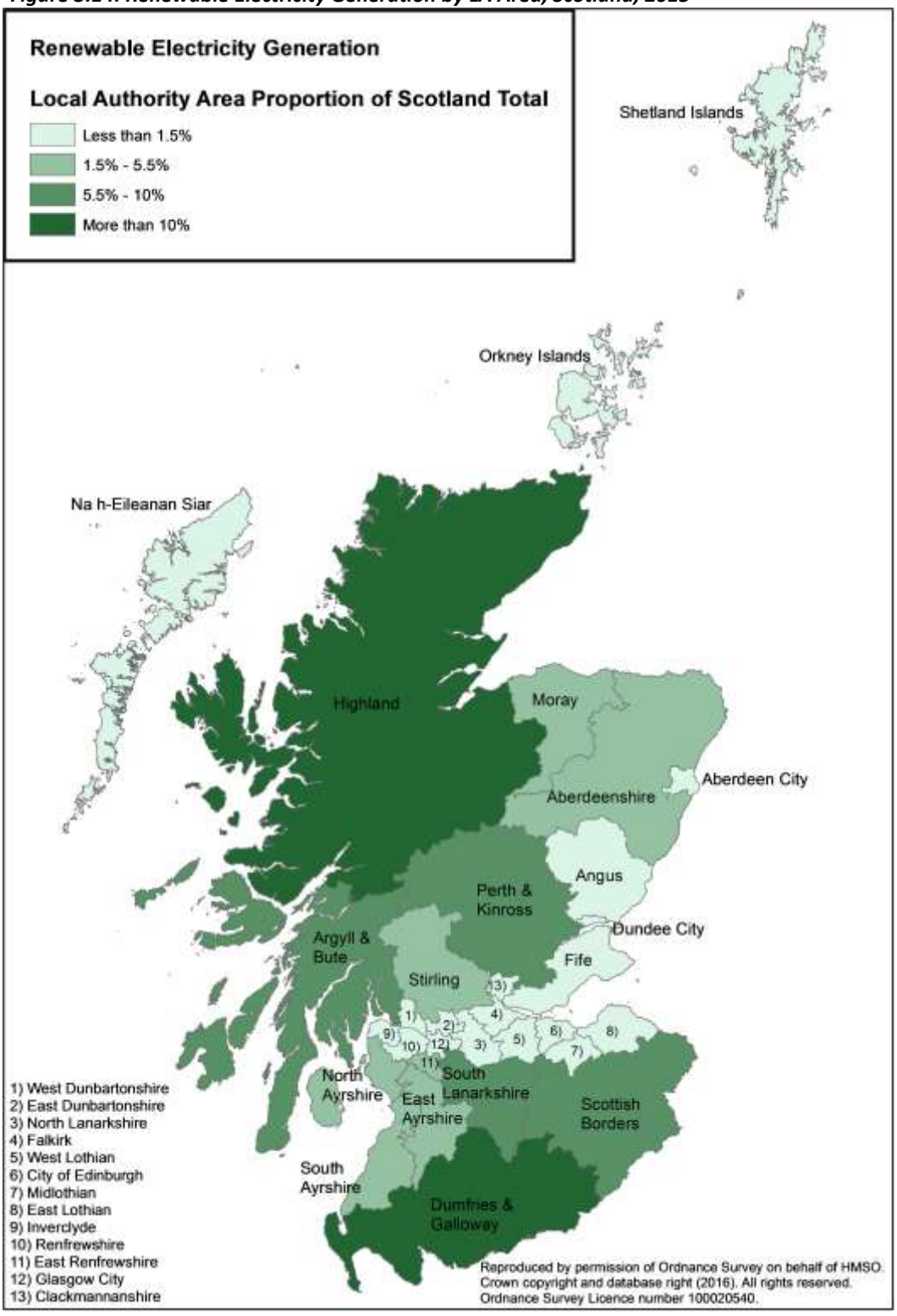
Figure 3.13: Renewables electricity generation per unit of economic activity (kWh/ GVA £million), by UK Region, 2015



Source: BEIS

6. The difference in Scotland's proportion of wind output and wind capacity is explained by the fact that the UK has a higher proportion of wind capacity from offshore sites. As offshore sites tend to experience higher load factors, the overall average generation is higher.

Figure 3.14: Renewable Electricity Generation by LA Area, Scotland, 2015[7]



HIGHEST 3 RENEWABLE ELECTRICITY GENERATING LOCAL AUTHORITIES AREAS...

	Local authority name	Renewable electricity generation (GWh)	Renewable electricity generation as a proportion of total (%)
1st	Highland	5,751	27%
2nd	Dumfries and Galloway	2,170	10%
3rd	South Lanarkshire	1,916	9%

Highland generates the highest proportion of Scottish renewable generation (27%), followed by Dumfries and Galloway (10%) and South Lanarkshire (9%).

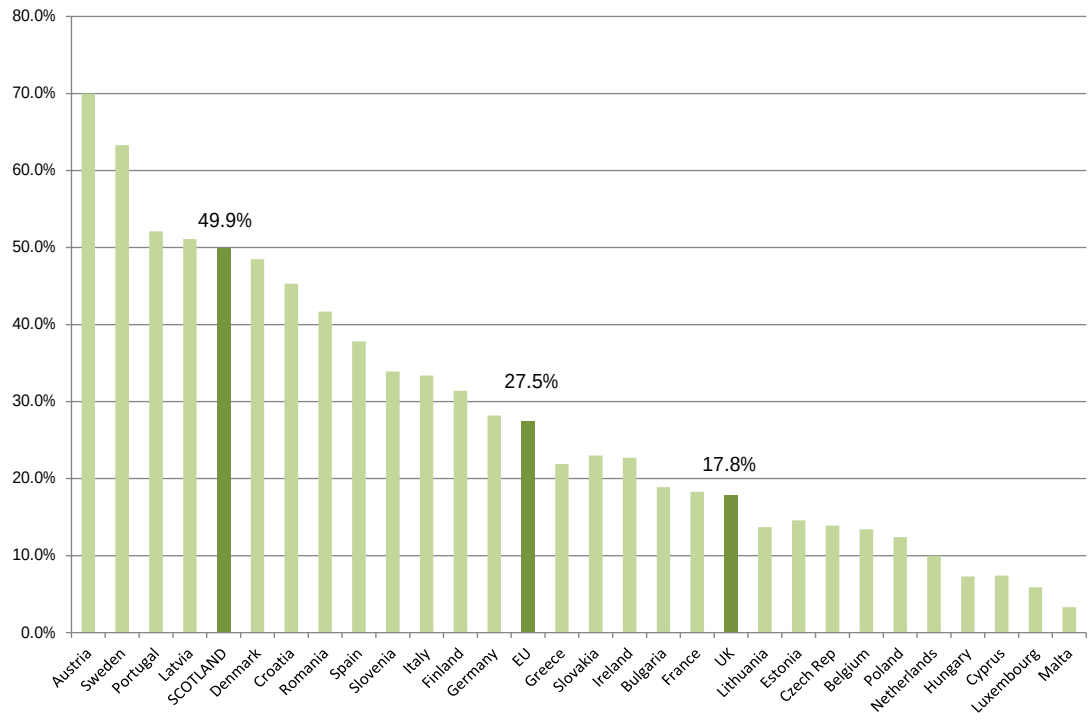
DATA NOTE

This methodology looks at total generation in an LA and does not take into consideration the relative geographical area or population density of each LA.

7. There are a number of sites where generation is not available at LA level. Therefore the sum of total renewable electricity generated by LA will not be consistent with the total included in other BEIS publications.

Figure 3.15[1] shows renewable electricity as a percentage of gross consumption for EU countries in 2014. Austria ranks first with 70.0%. Scotland ranks fifth, with the equivalent of 49.9% of gross consumption generated from renewable sources, which was ahead of both the UK (ranked 19th with 17.8%) and the EU average of 27.5%.

Figure 3.15: Renewable electricity as a percentage of gross consumption for EU countries, 2014



Source: Eurostat

BEIS published their third progress report (2014 data) on 21 January 2016 on meeting EU 2020 targets. Every 2 years, member states are required to submit progress reports to the European Commission on performance towards their interim renewable energy targets. See link above for more information.

What are renewables?

Renewables are energy forms which are essentially inexhaustible, unlike fossil fuel sources, which are finite. Renewable energy sources include wind (onshore and offshore), hydro, wave, tidal, biomass, solar, and geothermal. Renewable energy can be used for heating and transport as well as electricity generation.

Why renewables?

The earth's fossil fuel supplies (oil, gas, and coal) are limited and will be depleted over time. As this process continues, remaining reserves will become increasingly difficult to access. The scientific consensus is that warming of the Earth's climate system is unequivocal and that it is extremely likely that human influence has been the dominant cause of this warming since the mid-20th century. By using increasing amounts of renewable energy (as well as by conserving as much energy as possible), we are acting sustainably and helping to protect our environment. Renewable energy can also create opportunities for economic growth.

DATA DEVELOPMENT

Renewable Planning Statistics

Renewable energy is a key component of the Scottish Government's strategic priority to move to a low carbon economy and meet our obligations under the **Climate Change (Scotland) Act**. Further development of planning and consenting data will help to monitor the deployment of renewable projects and enable the publication of more comprehensive analysis regarding the progress towards meeting Scotland's renewable targets.

The Economy, Energy and Tourism Committee report published in November 2012 highlighted the importance of assessing progress at local levels towards the National renewable energy targets. The report said "it is critical that we can establish a baseline and trend data for the numbers of projects either operating, in development or at the planning stage in each of the 32 local authority areas."

The Scottish Government worked with various bodies including BEIS, Scottish Renewables and Scottish Natural Heritage (SNH), to develop a consistent, reliable, and publically available renewable planning database for Scotland.

Using Scottish extracts from the **Renewable Energy Planning Database (REPD)**, the Scottish Government have been publishing quarterly reports since March 2013 providing a breakdown of renewables capacity by stage of development (for example, in planning, consented, under construction, or operational) and local authority area in Scotland.

Since November 2014, REPD now only collects, tracks and publishes data on renewable electricity projects with a capacity of 1 MW and greater (previously 10 kW and above).

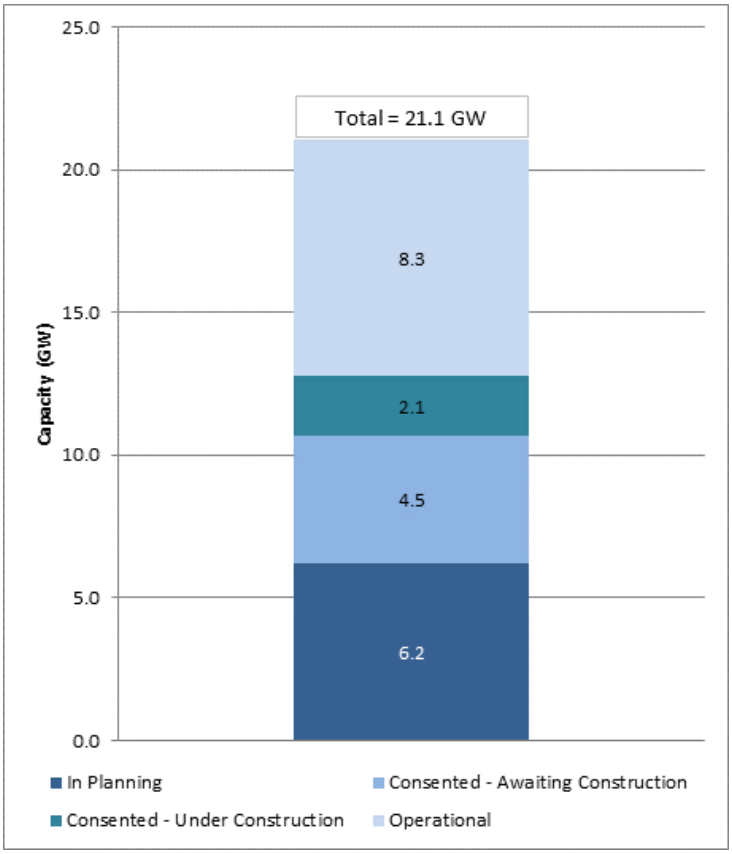
For the latest information (published in December 2016) and more information on the impact of the REPD change of scope please see:

http://www.gov.scot/Topics/Statistics/Browse/Business/Energy/RenPlanData

The Scottish Government continues to engage with key partners regularly to enhance the depth and quality of this data, primarily to ensure that there is a comprehensive and robust database for all key stakeholders to access information at a national and local level. For example, exploring options for improving the presentation of renewable project data through mapping tools and linking with other relevant datasets to enhance the coverage and range of information that can be provided quarterly.

Renewable Electricity Planning Pipeline

Figure 3.16: Renewable capacity in Scotland by planning stage (GW), September 2016



As at September 2016, Scotland had 8.3 GW of installed renewable electricity generation capacity, with an additional 12.8 GW of capacity either under construction or consented, the majority of which is expected from wind generation.

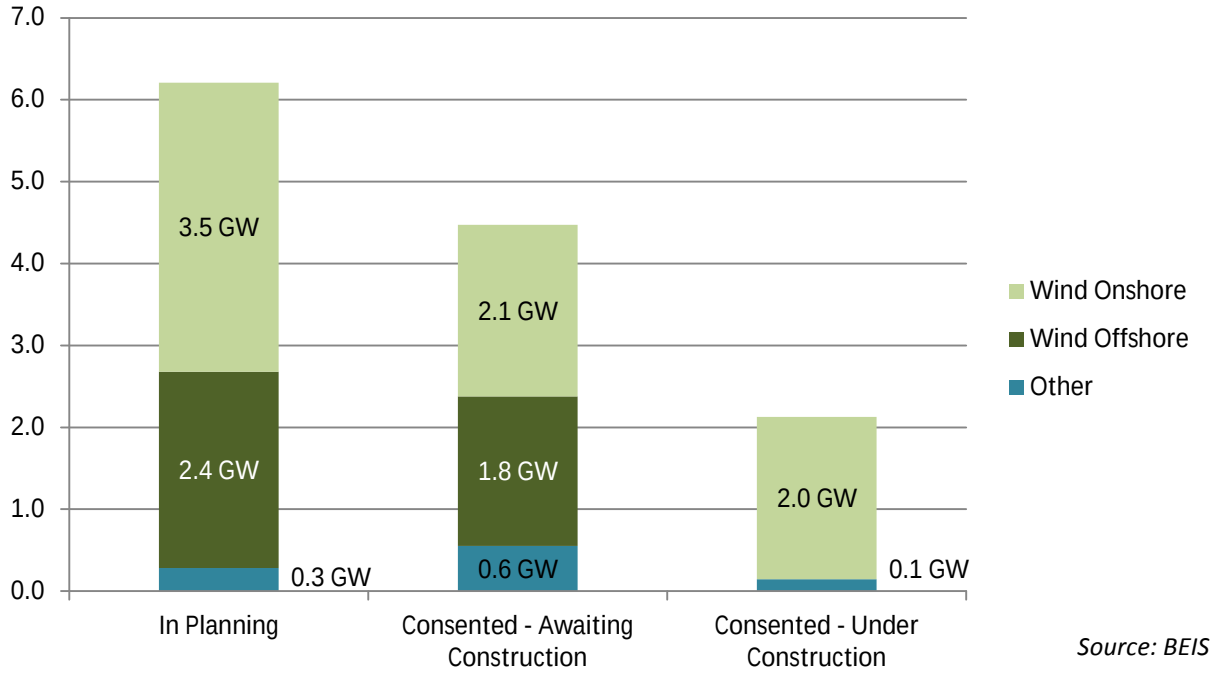
Taking into account pipeline projects in planning, this figure totals 21.1 GW - see Figure 3.16.

The Scottish Government recognises that there are a number of factors which mean that not all the projects consented will progress to commissioning, and the renewable electricity targets remains challenging.

DATA NOTE

The data for those projects 'in planning', 'awaiting construction', and 'under construction' are sourced from an extract from the Renewable Energy Planning Database (September 2016). The 'operational' capacity figure is the provisional Q3 2016 figure sourced from BEIS's quarterly energy trends publication. The REPD 'operational' figure excludes projects not going through the formal planning system, Large scale hydro, and projects that are generating but not fully completed. For more information on the scope of each of the datasets please see note 8 in Annex D.

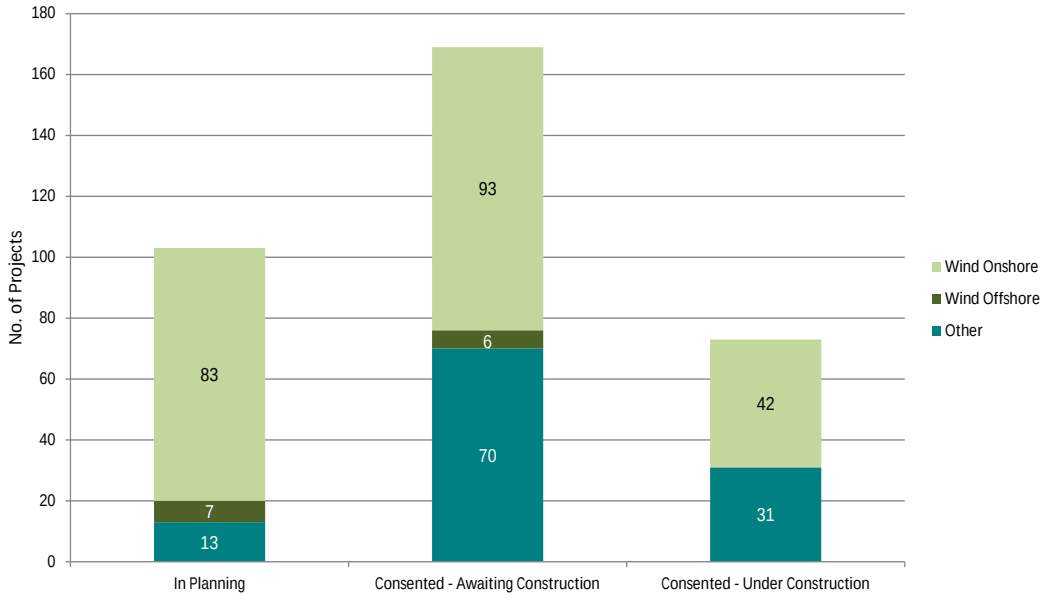
Figure 3.17: Capacity of pipeline renewable projects (GW), Scotland, September 2016



Source: BEIS

Figures 3.17 and 3.18 show the capacity (GW) and number of projects split by planning status and technology ('other' includes biomass, Hydro, Bioenergy and wastes, Solar and Wave and tidal).

Figure 3.18: Number of pipeline renewable projects in Scotland, September 2016



Source: BEIS

Renewable Electricity Projects in the Planning System (Excluding Operational Sites)

Projects in Planning **6.2 GW**	Projects in planning (pre-consent) account for 48% of all installed capacity in the planning system	81% of projects in planning are onshore wind
Consented and Awaiting Construction **4.5 GW**	Consented projects account for 35% of all installed capacity in the planning system	47% of capacity is accounted for by offshore wind and 41% by onshore wind
Under Construction **2.1 GW**	Projects under construction account for 17% of all installed capacity in the planning system	93% of projects under construction are onshore wind
Overall **12.8 GW**	63% of capacity is accounted for by offshore wind and 31% by onshore wind	Solar photovoltaic dominates the remaining 6%

Fossil Fuel Generation

In 2015, fossil fuels accounted for 22% of Scotland's electricity generation, down from 27% in 2014. This is the lowest production since the series began in 2000. Coal and gas make up the majority of fossil fuels used for electricity generation with oil used to a lesser extent. 2015 saw the lowest contributions to the overall percentage of electricity generated from gas since at least the year 2000 (see Figure 3.19).

In 2015, coal generated 8,538 GWh of electricity (which accounted for 17% of total generation), down from 10,310 GWh in 2014. Overall there is a decrease in the amount of fossil fuels used to generate electricity. Of these fossil fuels, coal contributes a higher proportion to electricity generation than gas.

Cockenzie power station used up its remaining operating hours under the Large Plant Combustion Directive (LPCD) and closed in early 2013 leaving Scotland with around 3.4 GW of installed fossil fuel capacity with coal fired Longannet and the gas fired power station at Peterhead accounting for the majority of this capacity. Note that Scottish Power has since closed Longannet in March 2016.

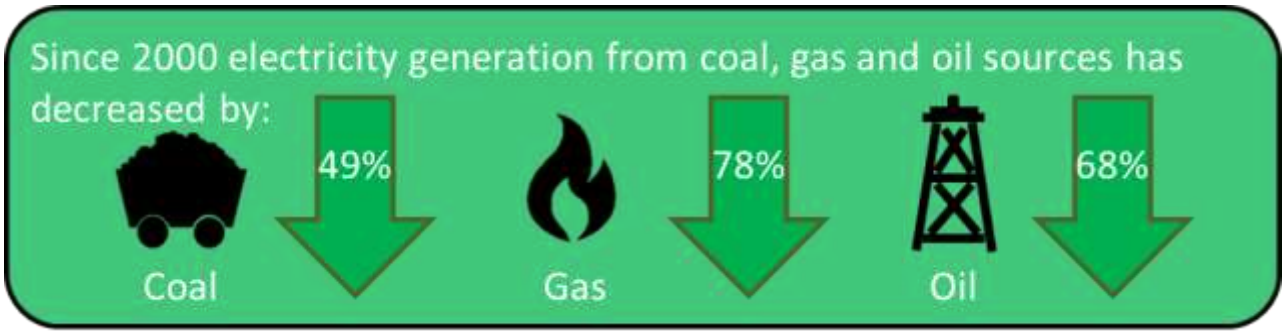
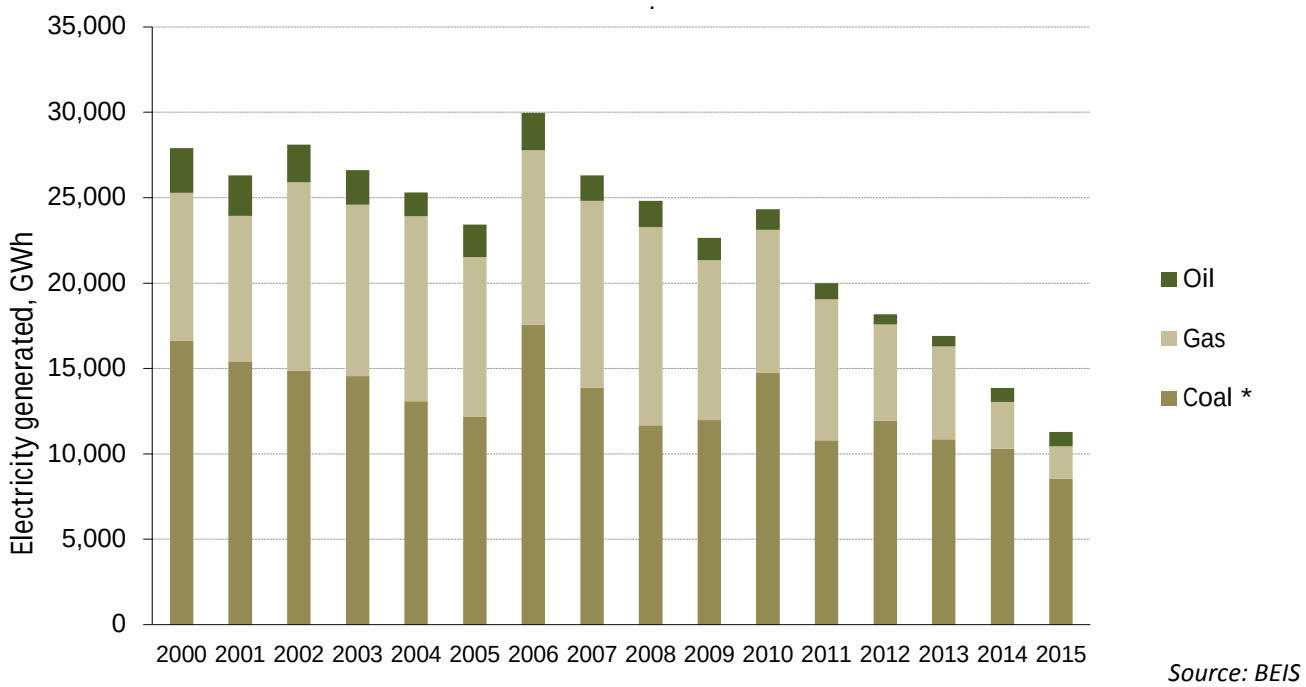


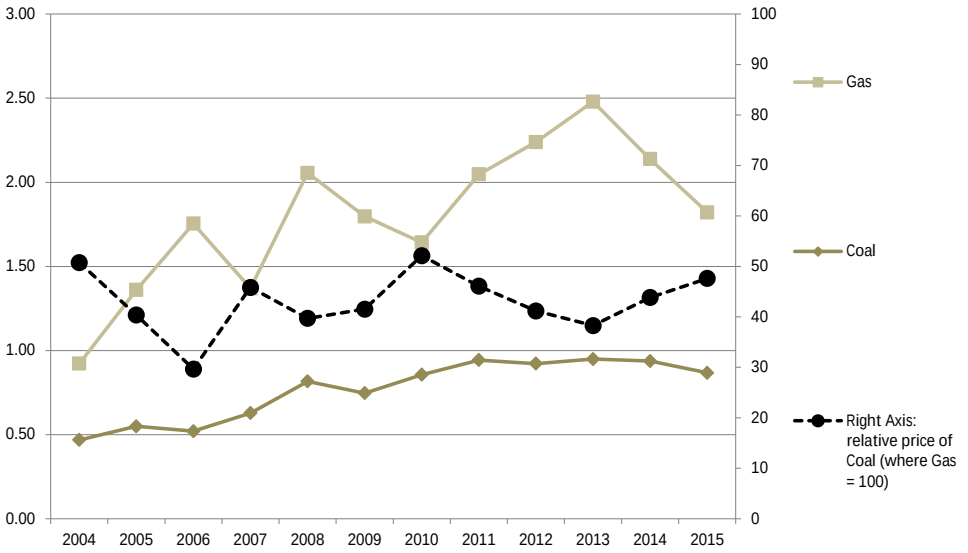
Figure 3.19: Electricity generated in Scotland from fossil fuels (GWh), 2000-2015



Source: BEIS

* Coal includes a small quantity of non-renewable wastes.

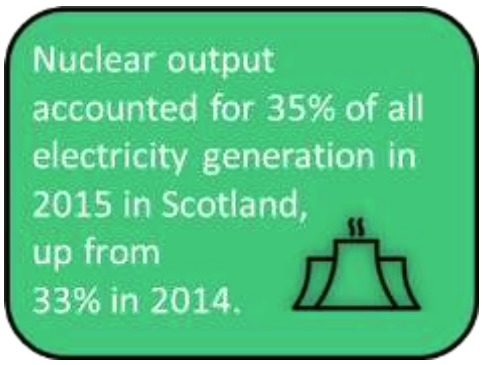
Figure 3.20: Gas and Coal prices (p/kWh) for large users in the UK, 2004-2015



Source: BEIS

Figure 3.20 shows the gas and coal prices for large users in the UK. The left axis shows the price per kWh and the right axis shows the relative price of coal (where gas = 100). The decline in gas prices between 2013 and 2015 was linked to the fall of oil prices. Other potential reasons include weak international competition for imports which helped boost the diversity of supply.

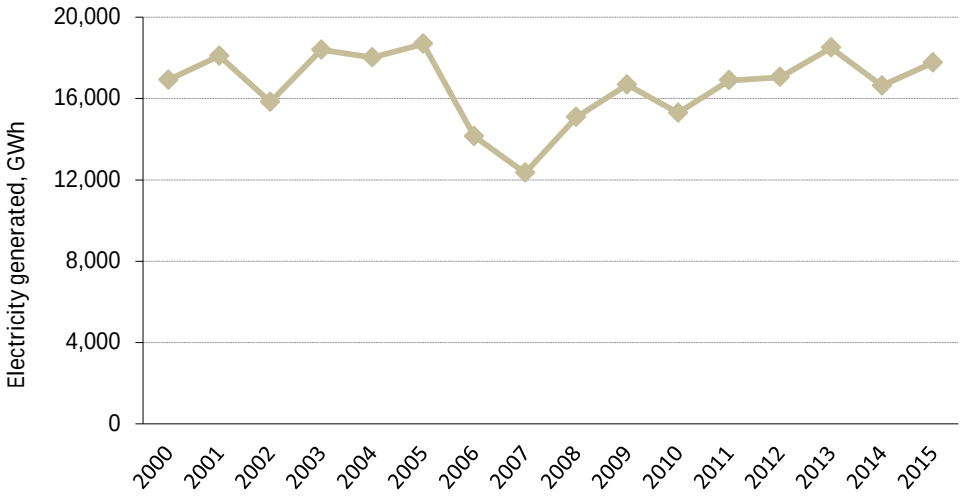
Nuclear Generation



There was just over 2 GW of installed and operational nuclear capacity in Scotland, consisting of Torness (1185 MW) and Hunterston B (965 MW) nuclear generating stations at end of May 2016, according to UK government data.

In 2015, 35% of electricity generated in Scotland came from the two Nuclear power stations, up from 33% in 2014. Figure 3.21 below shows the output from nuclear generation since 2000, ranging from a high of 18,681 GWh in 2005 to a low of 12,344 GWh just two years later following unplanned outages in 2006 and 2007.

Figure 3.21: Nuclear electricity generation in Scotland (GWh), 2000-2015



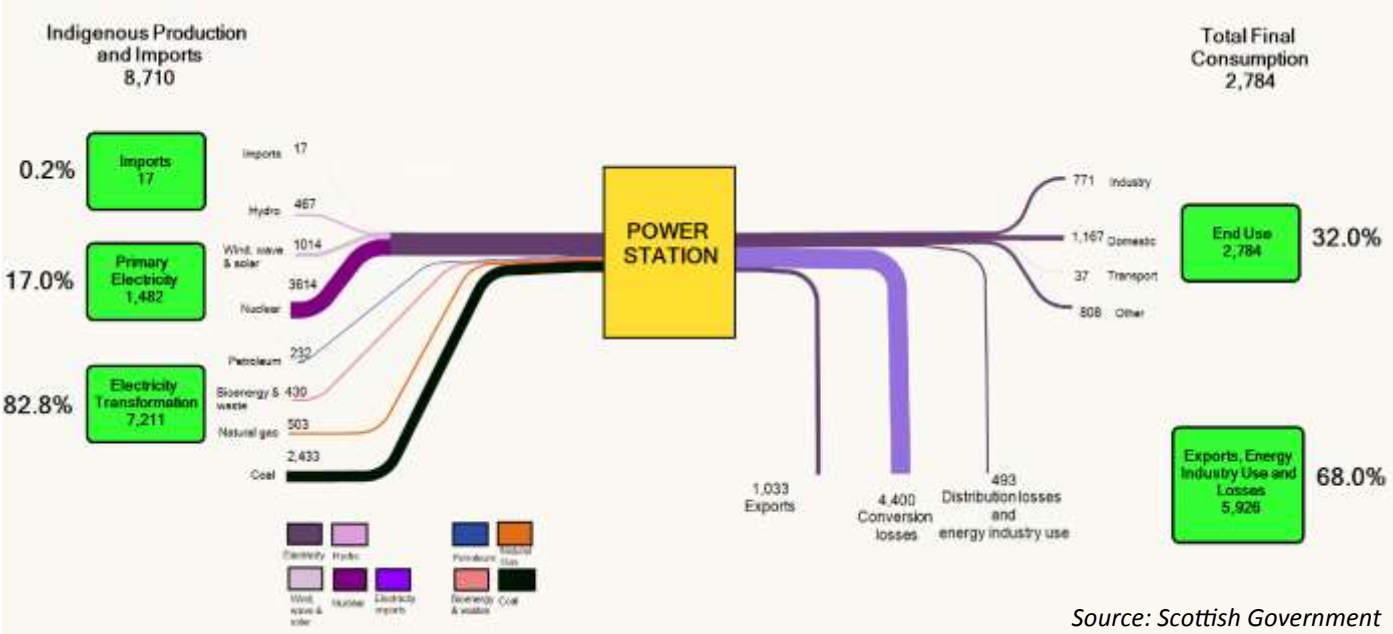
Source: BEIS

Hunterston B is due to continue in operation until 2023, having received a 7 year life extension from its original decommissioning date of 2016. Torness is also due to operate until 2023 although its owners may also apply for a plant extension if the appropriate health and safety requirements can be evidenced. The Scottish Government does not support the development of new nuclear power stations in Scotland. Further detail on this can be found in the Scottish Government's draft energy strategy.

Electricity Balance for Scotland

The diagram below shows the flow of energy from primary fuel inputs through to electricity consumed in Scotland in 2014. Simplifying the aggregate energy balance shown in Annex A by focussing on the electricity sector alone. Figure 3.22 illustrates the flow of primary fuels from the point at which they become available for the production of electricity (on the left) to the eventual final use of the electricity produced (on the right). This includes exported electricity, as well as the energy lost in conversion, transmission and distribution.

Figure 3.22: Electricity Flow Chart, Scotland, 2014 (thousand tonnes of oil equivalent)



Electricity Balance - Key Facts

Primary Energy

- Imports accounted for a small proportion of primary energy - less than 0.2%, whereas exports accounted for the equivalent of 12% of total primary energy.
- Of the 8,710 ktoe total primary energy, 32% was used within Scotland, 12% was exported and the rest was lost in conversion, distribution or consumed within the energy industry.

Transformation

- In 2014, nuclear was the largest contributor to the electricity transformation process (50%) and coal the second largest contributor (34%).
- Around 61% of the total primary energy is lost in electricity conversion.
- 6% of total primary energy was used within the energy industry or lost through distribution.

42% of end use electricity was consumed domestically

50% of energy used in electricity transformation is nuclear

End Use

- 42% of end use electricity was consumed domestically, 29% was consumed by 'other' sectors, 28% was consumed by industry and 1% was consumed by transport.

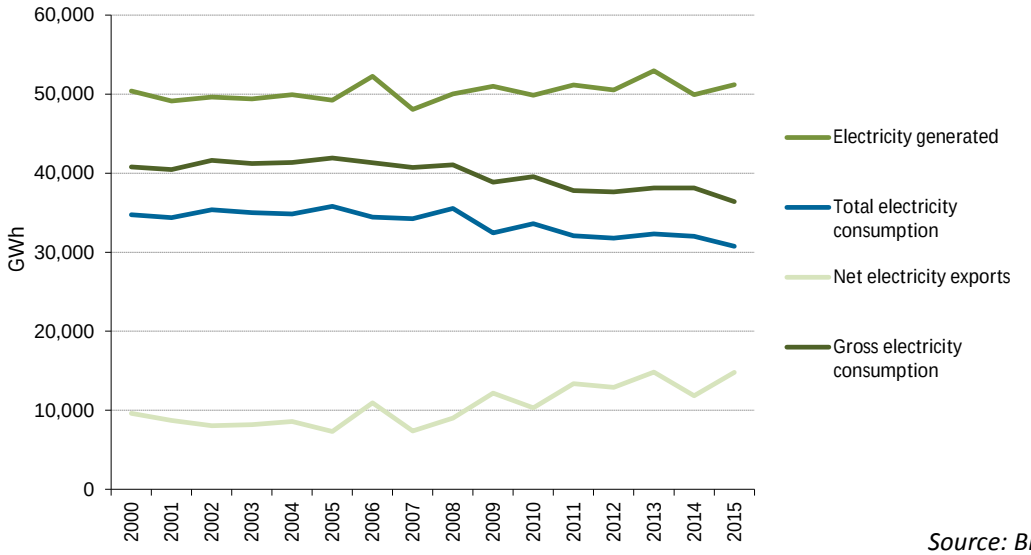
Electricity Exports

Scotland typically generates around 50,000 GWh of electricity, as shown in Figure 3.23, while typically consuming around 40,000 GWh. As a result, Scotland is a net exporter of electricity and has been for a number of years. In 2015, net exports to England and Northern Ireland accounted for 29% of total generation.

Figure 3.23 shows two measures of electricity consumption – both measures are illustrated in more detail in the box on page 56.

Total electricity consumption is calculated as total generation, minus generators' own use, losses, and exports. Total electricity consumption in Scotland was 30,746 GWh in 2015.

Figure 3.23: Electricity generated, consumed and exported, Scotland, 2000 - 2015



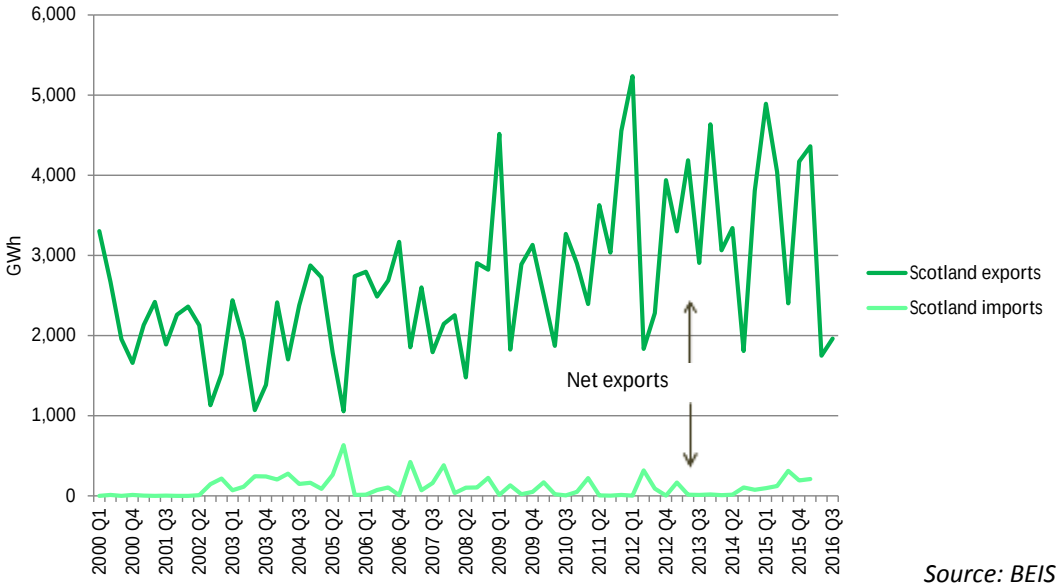
Source: BEIS

Gross electricity consumption measures total generation minus net exports. It is equivalent to total consumption plus generators' own use plus losses. Gross electricity consumption in Scotland was 36,410 GWh in 2015. **Scotland's renewable electricity target uses this measure.**

Scotland is connected to two electricity markets—Great Britain and Ireland—the link to Ireland's Single Electricity Market is via the Moyle interconnector.

As Figure 3.24 shows, total exports increased by 29% from 12,015 GWh in 2014 to 15,508 GWh in 2015, while total imports also increased from 210 GWh to 718 GWh. Since 2000 there has been an overall increasing trend in Scotland's electricity exports, varying between 6,830 GWh (2003) and 15,508 GWh (2015) over the period.

Figure 3.24: Electricity imports and exports (GWh), Scotland, 2000 - Q3 2016

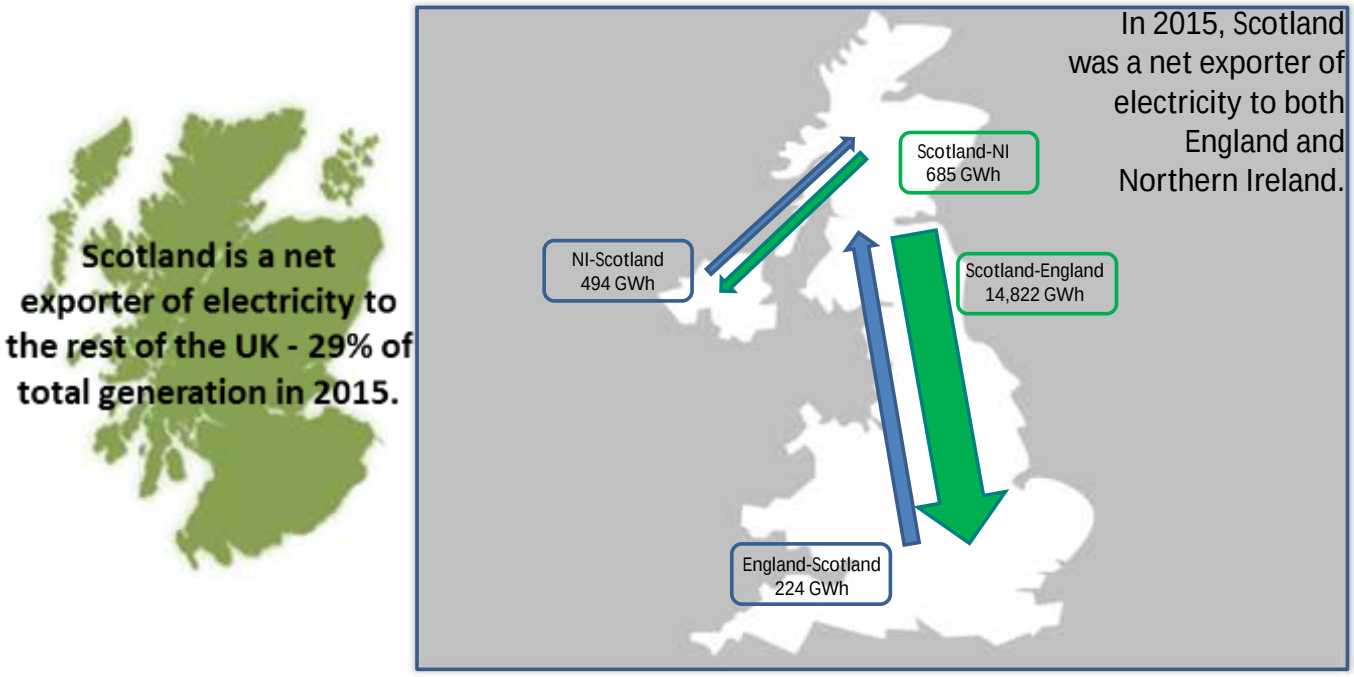


Source: BEIS

Latest provisional figures show that for the first three quarters of 2016 Scotland imported 698 GWh of electricity, an increase of a third compared to the same period in 2015. Over the same period Scotland exported 8,071 GWh, a decrease of 29% on first three quarters of 2015.

Figure 3.25 shows Scotland's electricity imports and exports to GB and Irish markets in 2015.

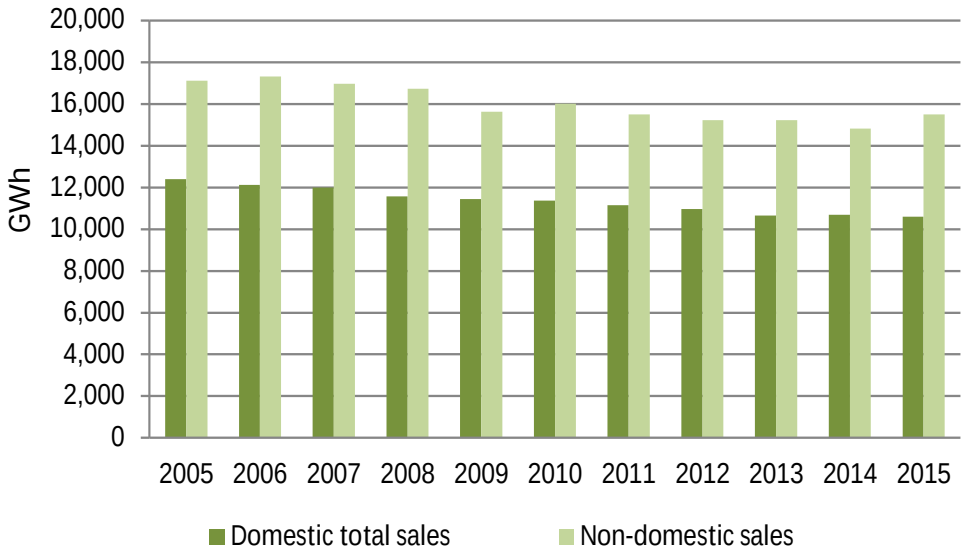
Figure 3.25: Electricity imports and exports (GWh), Scotland-England and Scotland—NI, 2015



Source: BEIS

Total domestic consumption of electricity fell by 15% between 2005 and 2015, as shown in Figure 3.26. Over the same period, there was a 9% fall in non-domestic electricity consumption – with a particularly significant drop between 2008 and 2009, which in part may have been driven by wider economic factors. In 2015, total domestic consumption, decreased by 1% from 2014 and non-domestic consumption increased by 4.6% over the year.

Figure 3.26: Total electricity sales (GWh), by sector, Scotland, 2005-2015



Source: BEIS

Figure 3.27. shows that domestic electricity consumption per household in Scotland in 2015 was estimated to be the highest in Great Britain, at 4.4 MWh, East England had the second highest average consumption at 4.3 MWh. The GB average was 4.0 MWh.*

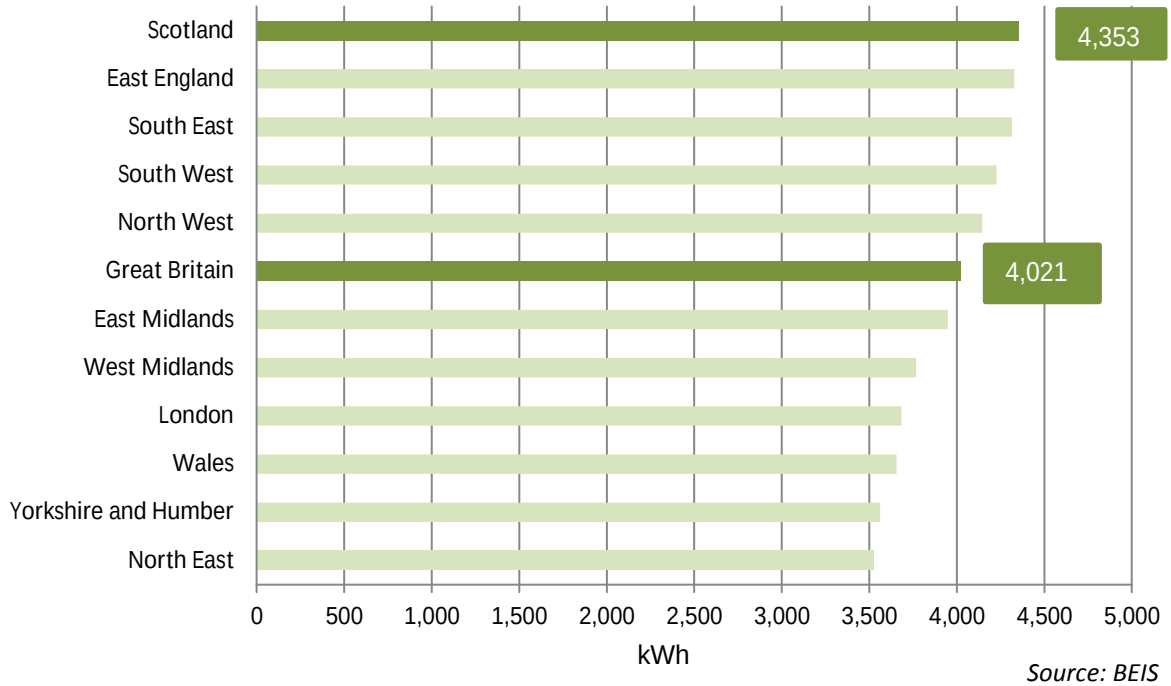
Total consumption of electricity in Scotland 2005—2015

DOMESTIC ↓ 15% NON DOMESTIC ↓ 9%

Figure 3.27: Average domestic electricity consumption per household (kWh), by GB Region, 2015

DATA NOTE

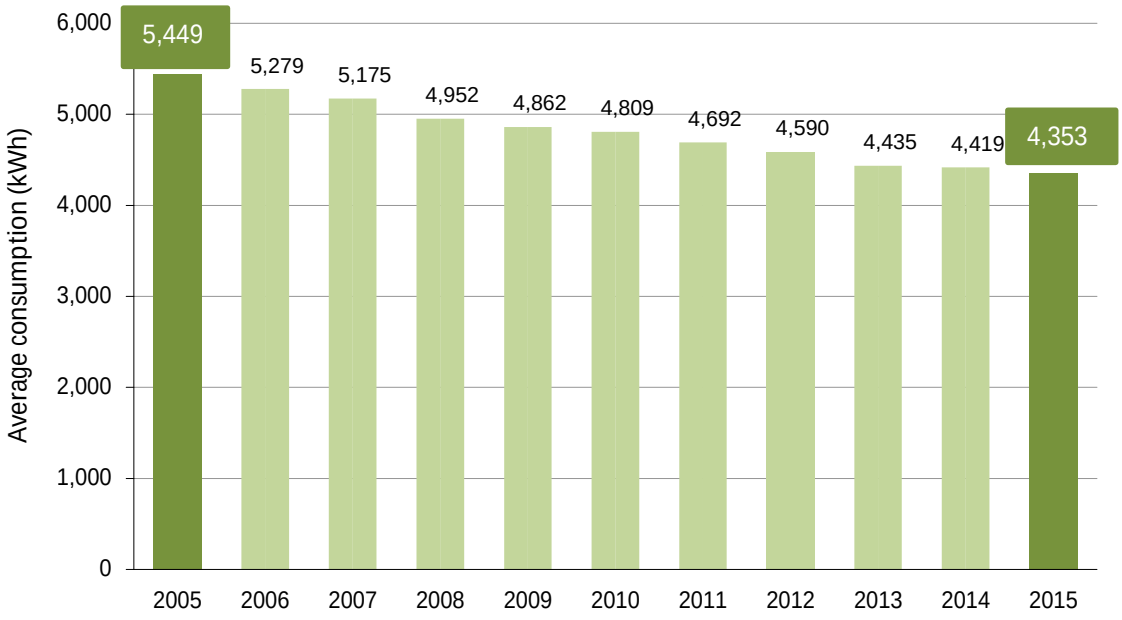
Note that the data presented for electricity consumption are calculated by dividing total domestic consumption by number of households. The alternative of consumption per meter is not used because some dwellings, such as those on an Economy 7 tariff (which provides cheaper off-peak electricity for seven hours each night), have more than one meter.



Source: BEIS

Figure 3.28 shows that average domestic electricity consumption per household in Scotland decreased by 20% between 2005 and 2015, with a 2% fall between 2014 and 2015. Key drivers of this overall decrease include increased prices and improved energy efficiency of appliances.

Figure 3.28: Average domestic electricity consumption in Scotland (kWh), per household, 2005-2015



Source: BEIS

Figure 3.29: Domestic Electricity Consumption - Average Consumption (kWh per meter), Scotland by Intermediate Geographic Zone, 2015

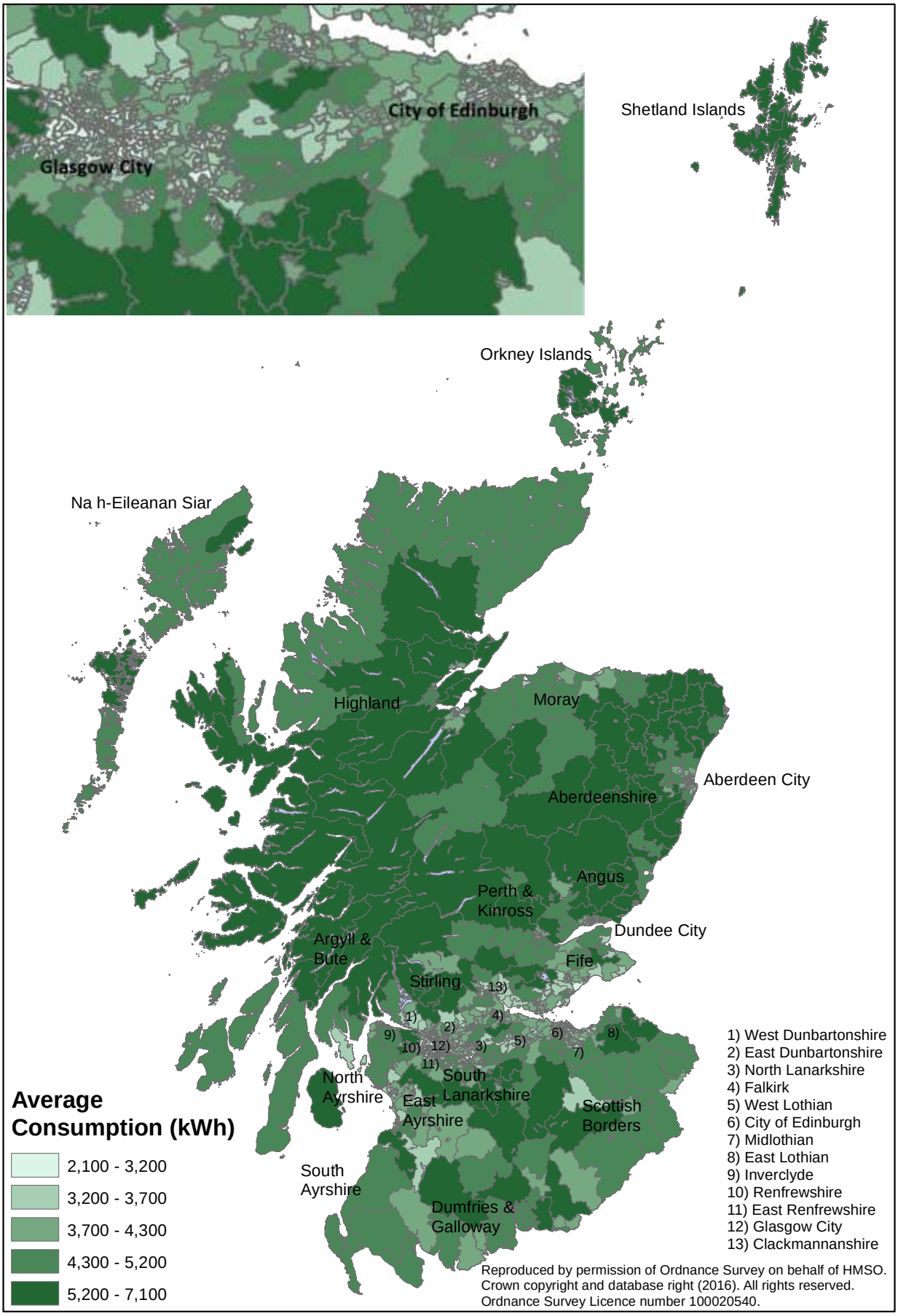
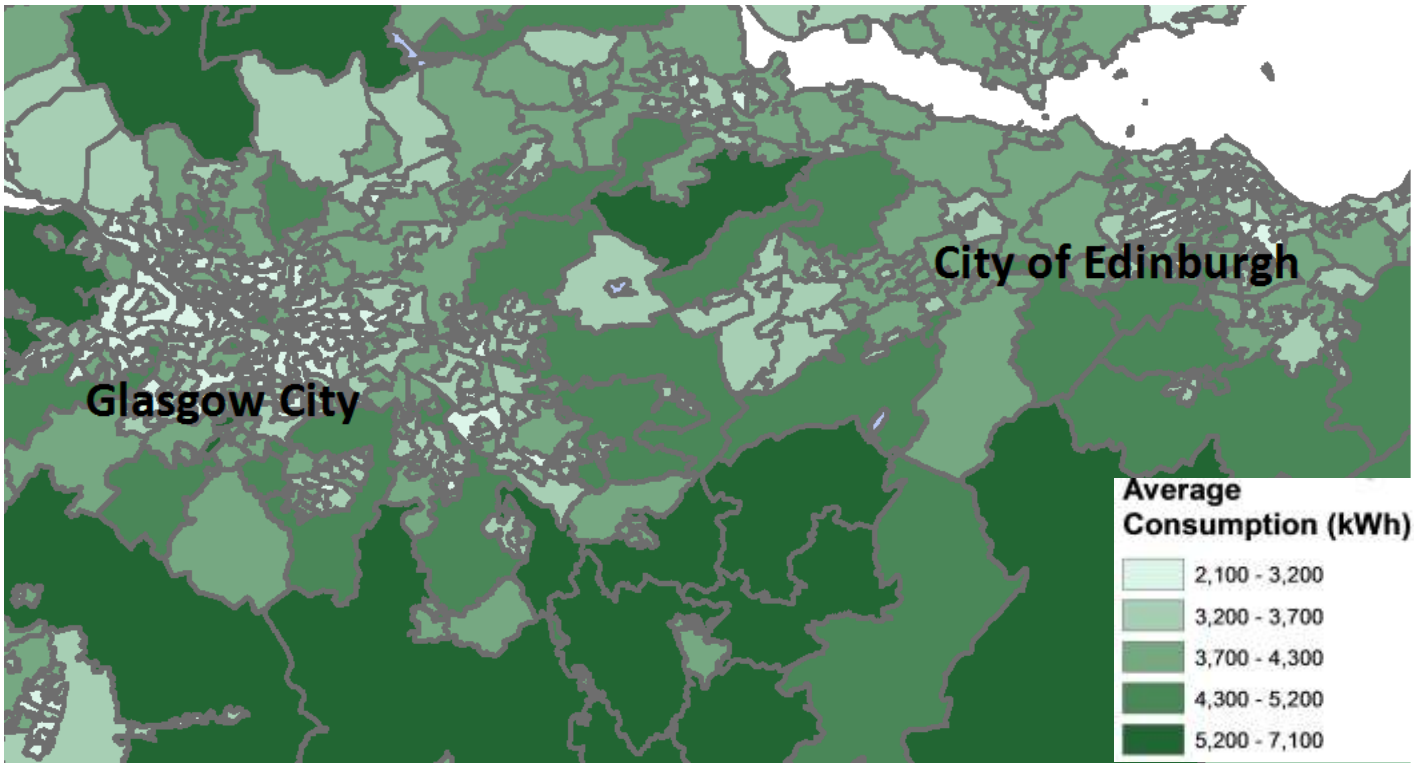


Figure 3.30: Domestic Electricity Consumption—Average Consumption (kWh per meter), Central Belt of Scotland by Intermediate Geographic Zone, 2015



HIGHEST 10 CONSUMING ZONES...

	Zone Name	Local Authority	Average Consumption (kWh)
1st	Kippen and Fintry	Stirling	6,968
2nd	Arbroath Landward	Angus	6,830
3rd	East Mainland	Orkney Islands	6,620
4th	Muthill, Greenloaning and Gleneagles	Perth & Kinross	6,496
5th	Whitecraigs and Broom	East Renfrewshire	6,485
6th	North Mainland	Shetland Islands	6,414
7th	Powmill, Cleish and Scotlandwell	Perth & Kinross	6,356
8th	Lerwick South	Shetland Islands	6,284
9th	Benderloch Trail	Argyll & Bute	6,253
10th	Shetland South	Shetland Islands	6,214

LOWEST 10 CONSUMING ZONES...

	Zone Name	Local Authority	Average Consumption (kWh)
1st	Wyndford	Glasgow City	2,263
2nd	Govanhill West	Glasgow City	2,346
3rd	Easter Road and Hawkhill Avenue	Edinburgh, City of	2,466
4th	Gorbals and Hutchesontown	Glasgow City	2,497
5th	Govan and Linthouse	Glasgow City	2,508
6th	Shettleston North	Glasgow City	2,509
7th	Hillhead	Glasgow City	2,515
8th	Seaton	Aberdeen City	2,545
9th	Alexandra Parade	Glasgow City	2,569
10th	Gorgie West	Edinburgh, City of	2,570

The tables above show both the ten highest and ten lowest domestic electricity consuming areas (average per meter) in Scotland. It is interesting to note that seven out of the ten lowest consuming areas were within the Glasgow City local authority.

Please see Annex D for more information regarding the source of this information and points to be aware of when using this analysis.

DATA NOTE - INTERMEDIATE GEOGRAPHY ZONES (IGZ) 2011

The data zone is the key small area statistical geography in Scotland. The intermediate geography will be used to disseminate statistics that are not suitable for release at the data zone level.

There are 1,279 intermediate zones in Scotland, containing on average 4,000 household residents.

For more information:

http://www.gov.scot/Topics/Statistics/sns/SNSRef

Figure 3.31: Non— Domestic Electricity Consumption - Average Consumption (kWh per meter), Scotland by Intermediate Geographic Zone, 2015

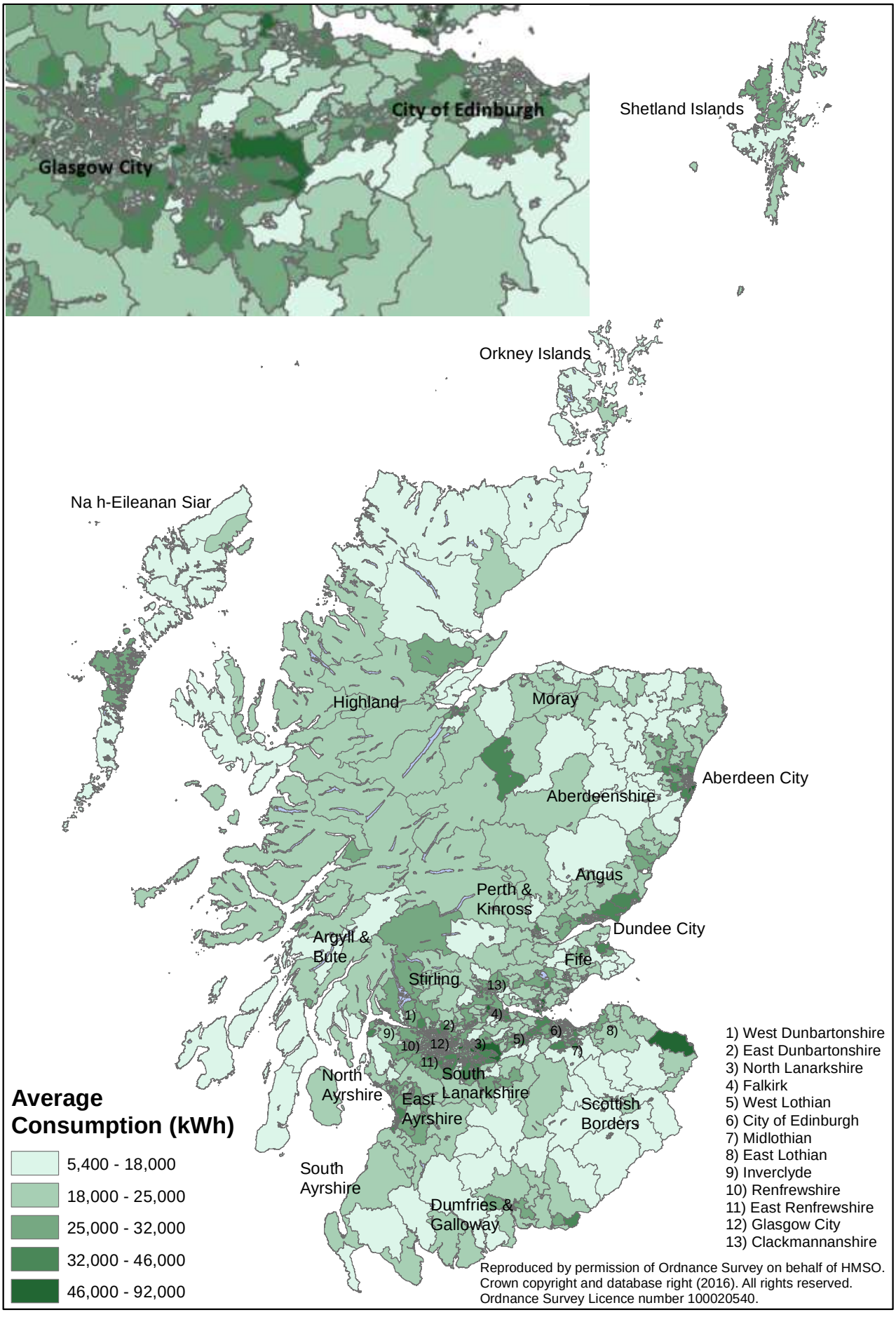
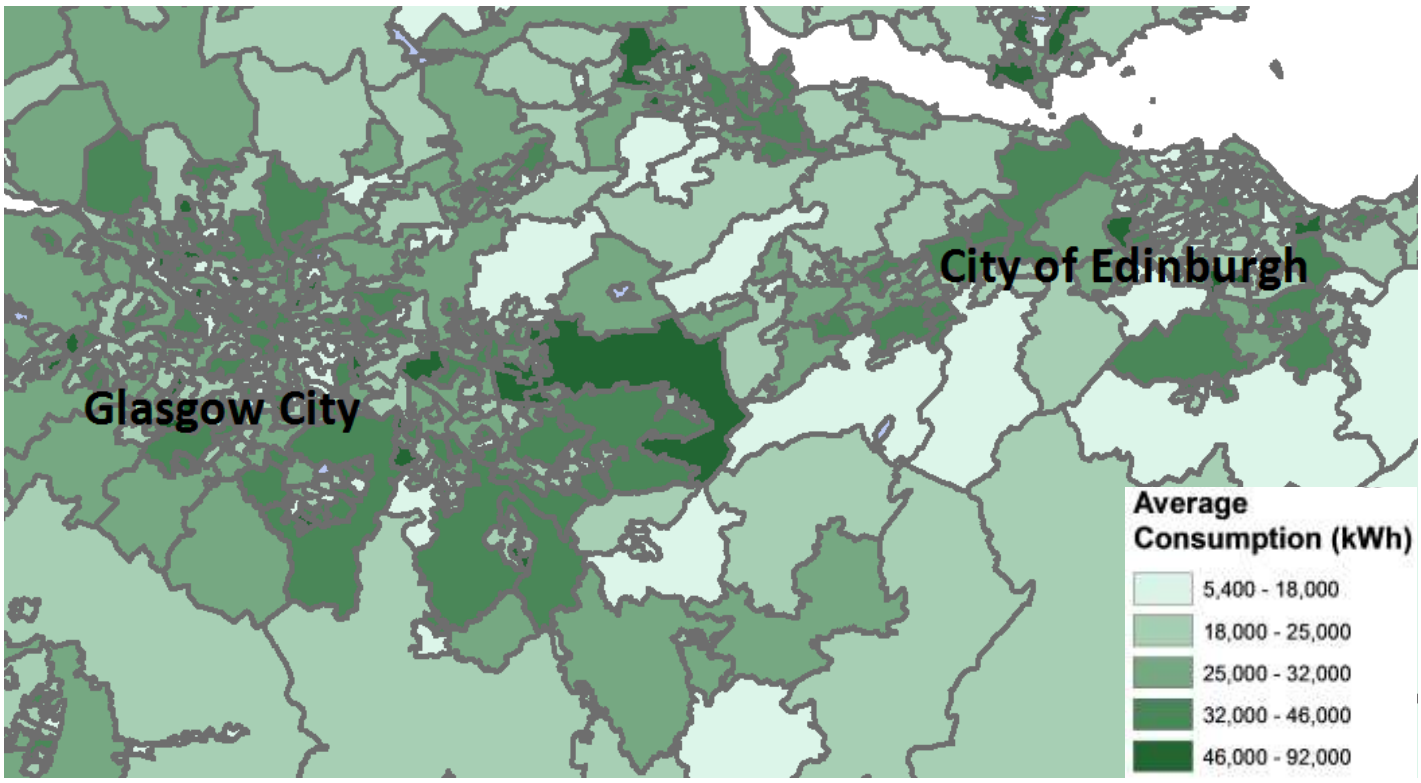


Figure 3.32: Non-Domestic Electricity Consumption—Average Consumption (kWh per meter), Central Belt of Scotland by Intermediate Geographic Zone, 2015



HIGHEST 10 CONSUMING ZONES...

	Zone Name	Local Authority	Average Consumption (kWh)
1st	Harestanes	East Dunbartonshire	244,616
2nd	Berwickshire East	Scottish Borders	153,779
3rd	Cumbernauld Central	North Lanarkshire	113,916
4th	Stenhouse and Saughton Mains	Edinburgh, City of	108,343
5th	Falkirk - Camelon West	Falkirk	71,633
6th	Calside	Dumfries & Galloway	65,353
7th	Glenrothes Balgeddie and Town Park	Fife	65,234
8th	Irvine Castlepark North	North Ayrshire	65,166
9th	Garlogie and Elrick	Aberdeenshire	63,033
10th	Jewel, Brunstane and Newcraighall	Edinburgh, City of	61,241

LOWEST 10 CONSUMING ZONES...

	Zone Name	Local Authority	Average Consumption (kWh)
1st	Gorgie East	Edinburgh, City of	4,589
2nd	Dunfermline Masterton	Fife	4,926
3rd	West Pilton	Edinburgh, City of	5,952
4th	Carrick Knowe	Edinburgh, City of	7,516
5th	Girvan Glendoune	South Ayrshire	7,686
6th	Polwarth	Edinburgh, City of	8,140
7th	Denholm and Hermitage	Scottish Borders	8,726
8th	Thornybank	Midlothian	8,892
9th	Leith (Hermitage and Prospect Bank)	Edinburgh, City of	9,080
10th	Glenrothes Balfarg Pitcairn and Coul	Fife	9,127

The tables above show both the ten highest and ten lowest industrial and commercial electricity consuming areas in Scotland (average per non-domestic electricity meter).

It is interesting to note that of the ten lowest consuming areas, five were within the City of Edinburgh local authority.

Please see Annex D for more information regarding the source of this information and points to be aware of when using this analysis.

DATA NOTE - LOCAL AREA CONSUMPTION

BEIS produce gas and electricity sub-national energy consumption analysis below local authority level. These data are used by a range of users for different purposes, including enabling local authorities to understand local energy use with the ability to monitor and target small areas for interventions as part of their local energy strategies. Data is available here:

https://www.gov.uk/government/collections/sub-national-gas-consumption-data#mlsoa-llsoa-data

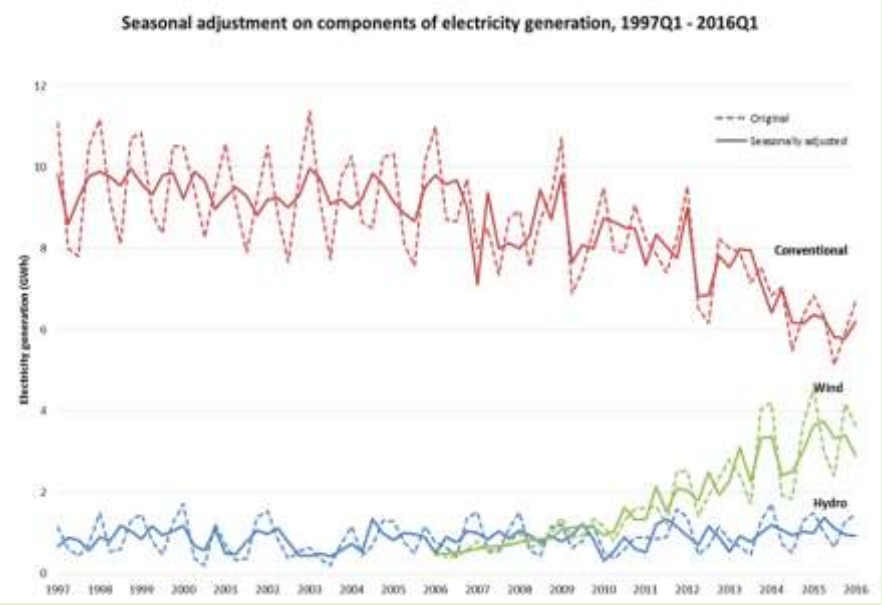
CONTRIBUTION OF ELECTRICITY GENERATION TO GROSS DOMESTIC PRODUCT (GDP)

The value added by electricity production accounts for 2% of Scotland's GDP - around as much as production of spirits and wines. This includes the transmission and distribution of electricity as well as generation.

Seasonal effects in electricity generation

Electricity generation within Scottish GDP is separated by source type to aid seasonal adjustment. Generation is highly seasonal, with different sources exhibiting different patterns. Seasonal adjustment lets us account for these patterns, allowing us to compare different time periods. In general, electricity generation is much higher in the autumn/winter than in the spring/ summer.

Figure 3.33: Seasonal adjustment of electricity generation by broad type (GWh), Scotland, 1997–Q1 2016

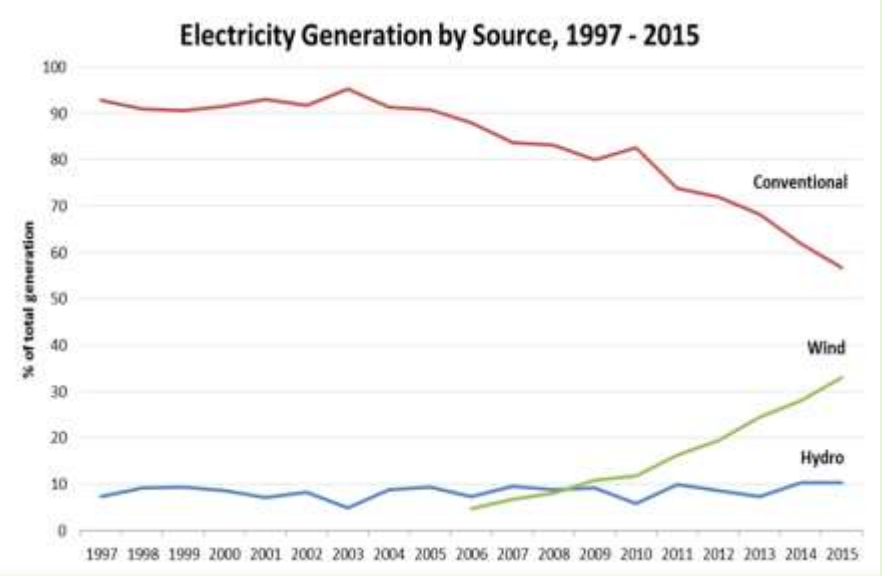


Sources: Scottish Government, BEIS

Figure 3.33 shows the seasonal patterns present in different components of electricity generation. Generation from conventional sources of electricity (nuclear and fossil-fuel) is fixed or scaled to meet demand and so show strong seasonality (for example, shorter days mean more lights left on). Generation from renewable sources are determined by weather conditions, and so while they do show seasonal behaviour (since generation relies on rain and wind) it is not as strong as with conventional sources. This also means renewable sources can be volatile, since weather conditions are harder to predict than electricity demand.

Figure 3.34: Proportions of total electricity generation by source, Scotland, 1997 - 2015

Distinguishing between generation sources also makes longer term trends more clear. Figure 3.34 shows that the share of electricity generation from conventional sources has been in decline since 2007; this is largely due to the move away from coal-fired stations. Within Scottish GDP, we account for the change in electricity generation mix by summing the seasonally adjusted component series - there is no weighting required since all use the same units.



Sources: Scottish Government, BEIS

STATISTICS NOTE - TIME SERIES DATA

Time series can be thought of as a combination of three distinct features:

- **SEASONAL EFFECTS**: Regular and predictable fluctuations which can be expected to recur with similar intensity in the same season every year, for instance the increase in energy consumption in the winter months;
- **IRREGULAR EFFECTS**: Comprise both random sampling or non-sampling variation and extreme values with identifiable causes such as uncharacteristic weather conditions and power stations outages. The latter, also referred to as outliers, are temporarily taken out in order to avoid distortions in the estimation of the seasonality, and are reinstated into the time series after seasonal adjustment is completed;
- **TREND:** Captures the long-term behaviour and direction of the time series and is affected by aspects such as installed generation capacity.

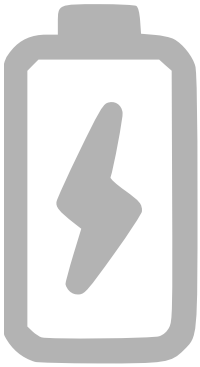
The process, which is aimed at removing seasonality from the time series, involves estimating these components and the relationship among them that provides the best fit to the data. As well as outliers, issues such as breaks in the seasonal pattern caused by structural changes in the electricity industry, also need to be accounted for.

ENERGY STORAGE

How does it work?

Energy is stored when production exceeds demand and is then released when demand exceeds production. Energy storage comes in many forms from large scale hydro pumped storage which supplies electricity to the grid to domestic batteries and electric vehicles which stores energy on a much smaller scale. There are a range of developing technologies for energy storage as well as existing storage in Scotland—Cruachan Power station (pumped storage hydro scheme) has been operational for around 50 years now. A number of storage technologies are discussed below.

Battery storage



Battery devices store electrical energy in the form of chemical energy and have the ability to convert that energy back into electrical energy. Batteries can be used for a wide variety of applications, such as balancing supply and demand from the grid and can operate across a range of scales, from large systems which connect to the grid to small-scale domestic batteries and electrical vehicles. The UK's first large-scale battery connected to the distribution network is based in Orkney, this consists of a 2 MW lithium-ion device which connects to the Island's Active Network Management System.

Flywheel Storage

Flywheels store kinetic energy in the form of a spinning rotator and when short-term power is needed

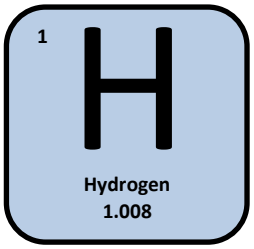
the energy in the spinning rotor is used to generate electricity. Flywheel storage is being installed on the Isle of Eigg and Fair Isle to help improve grid networks.

Pumped Hydro Storage

Pumped storage schemes work by using electricity to pump water from a lower to a higher reservoir where it can be stored and then released when required to generate electricity as a conventional hydroelectric power station would. Scotland is currently home to two pumped hydro storage systems—Cruachan power station which has a capacity of 440 MW and Foyers which has a capacity of 300 MW.

Hydrogen

Hydrogen can be produced in a number of ways, including electrolysis, and can be stored and re-converted to electricity using fuel cells or used as a fuel e.g for transport or in the gas distribution system. A number of major hydrogen demonstration projects are underway in Scotland, including those being supported by the Scottish Government's Local Energy Challenge Fund.



Supercapacitors

A supercapacitors store power using a static charge and are useful for producing short bursts of energy or storing power surges but are less useful for long-term demand management. As yet, supercapacitors have not been proven in Scotland although they have been deployed in Ireland in both a domestic and non-domestic setting.

Compressed Air Energy Storage

Compressed air energy storage converts electrical energy into high-pressure compressed air which can then be released at a later stage to drive a generator to produce electricity. The compressed air can be stored underground in existing infrastructure. Compressed air and storage methods have been tested in Scotland, in the waters off Orkney, where compressed air was stored underwater in large balloon-type bags.

Liquid Air Energy Storage

Liquid air energy storage is the storage of liquid air or liquid nitrogen in insulated low pressure tanks which have been cooled to very low temperatures. The liquid air can then be re-heated which turns it back into a gas to drive a generator and in turn produce electricity. A 350 kW system is operating at a biomass power station in Slough.

ClimateXChange (CxC) has published reports on both electrical and thermal energy storage in the context of Scotland's energy policy ambitions.

For more information on the basics of storage please see:

https://www.scottishrenewables.com/publications/energy-storage-basics/

CHAPTER 4

HEAT

'Heat demand in Scotland has fallen by a third in the last ten years'

HEAT– KEY FACTS

FOUR OUT OF FIVE SCOTTISH HOUSEHOLDS USE MAINS GAS AS THEIR PRIMARY HEATING FUEL

AVERAGE DOMESTIC GAS CONSUMPTION

13.7 MWh

32% LOWER THAN 2005 AVERAGE

3% HIGHER THAN GB AVERAGE

NON-DOMESTIC GAS CONSUMPTION IN SCOTLAND HAS FALLEN BY 29% IN THE LAST DECADE, TO 18,000 GWh

INDUSTRY AND COMMERCE ACCOUNTS FOR 40% OF SCOTTISH GAS CONSUMPTION

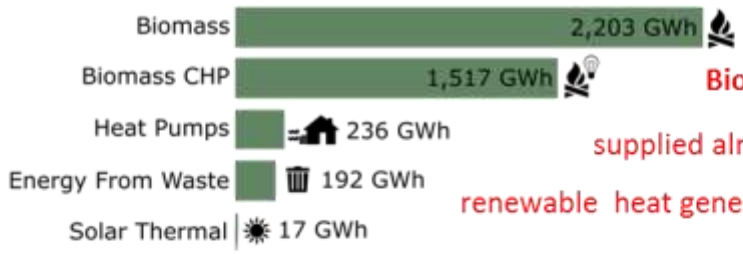
RENEWABLE HEAT GENERATION IN 2015:

4,165 GWh

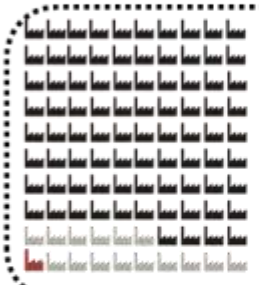
ENOUGH TO HEAT MORE THAN 10% OF SCOTTISH HOUSEHOLDS

(AROUND 300,000 HOUSEHOLDS)

RENEWABLE HEAT TECHNOLOGIES

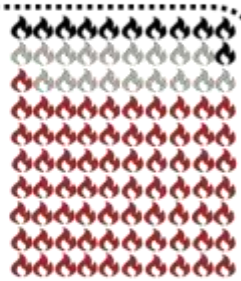


In 2015 Biomass combustion supplied almost 90% of the renewable heat generated in Scotland.



Large renewable heat installations account for less than 1% of all Scottish installations, but account for 71% of renewable heat output.

85% of installations are small, together producing only 11% of output.



In 2014 Scotland generated...

3.8%

...of heat demand from renewables sources

Using a range of scenarios to estimate heat demand, Scotland generated an estimated

5.3%-5.6%

of heat demand from renewable sources

in 2015

16% OF SCOTTISH HOUSEHOLDS ARE IN OFF GRID AREAS

COMPARED TO 9% IN GB AS A WHOLE

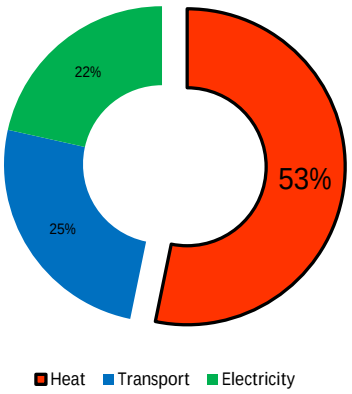
AS ARE 87% OF SCOTLAND'S DOMESTIC RHI ACCREDITATIONS

Around 20% of capacity generated from the renewable heat incentive is produced by installations in Scotland

Heat Demand in Scotland

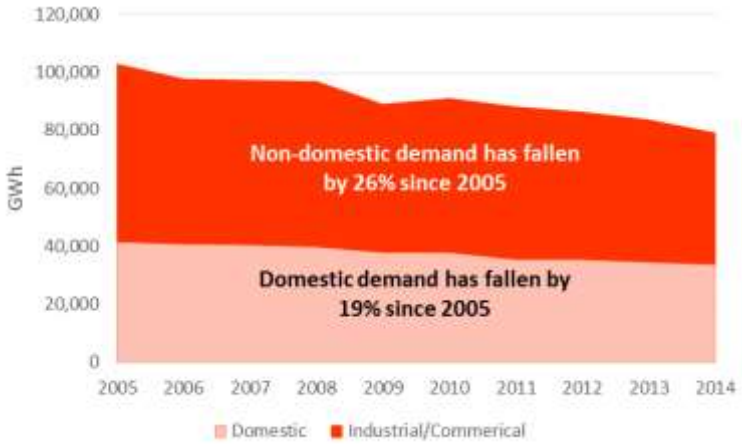
Heat is estimated to account for over half of Scotland's total energy use (see Figure 4.1). Reducing our need for heat, using it more efficiently and switching from fossil fuel to low carbon and renewable sources of heat has the potential to reduce greenhouse gas emissions and make a significant contribution to Scotland's overall renewable energy target.

Figure 4.1: Total final energy consumption by sector, Scotland, 2014



Source: BEIS, Scottish Government

Figure 4.2: Non-electrical heat demand by sector, Scotland, 2005 - 2014



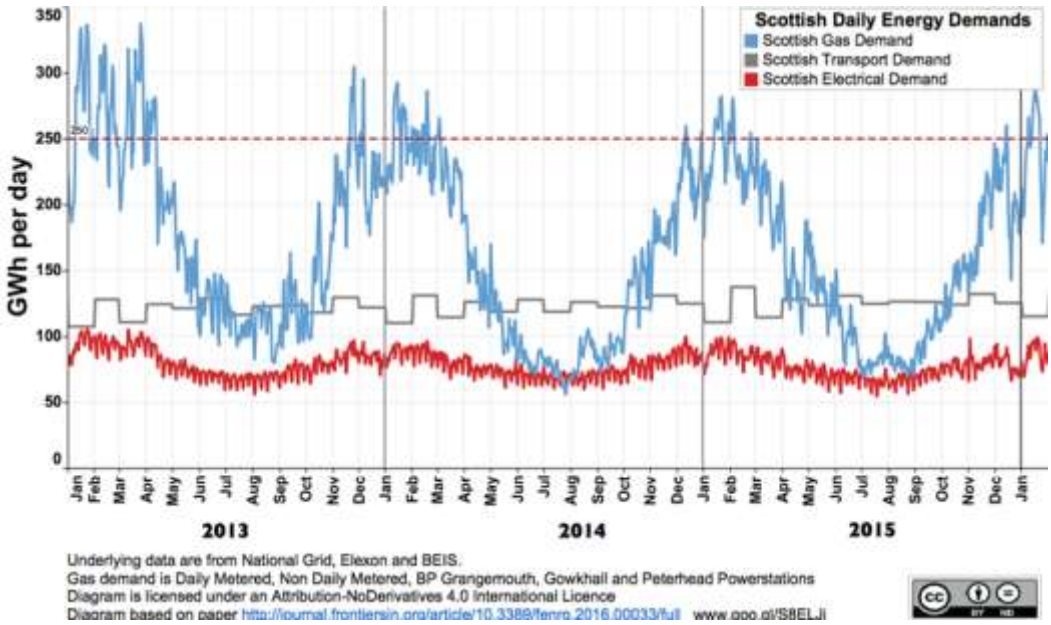
Source: BEIS, Scottish Government

In 2014, of the 53% of total energy consumption accounted for by non-electrical heat demand (see box on page 82 for more information on electrical heat use); approximately 43% was consumed domestically and 57% was consumed by the industrial and commercial sectors. Some of this industrial heat is required at very high temperatures, such as up to 1,450°C in a cement kiln. Figures published by BEIS on heat use in the UK suggest that industrial heat demand in the UK was 32% greater than the commercial heat demand in 2014.

Since 2005, there has been a significant reduction in the consumption of energy used for heating (and cooling) in Scotland—decreasing by 23% from 103,007 GWh to 79,207 GWh in 2014. This reduction is higher for the industrial & commercial sectors (-26%) than for the domestic sector (-19%) (see Figure 4.2).

Annual Patters in Heat Demand

Figure 4.3: Energy use in GB per day, 2011-2015



Heat demand varies over the day, at weekends and holidays and in the case of space non-electrical heating, heat demand is significantly higher in winter months. The pattern of heat use is highlighted in Figure 4.3. Using analysis showing annual gas and electricity consumption in the UK - demand for gas in the winter can be as much as three times the demand for electricity.

Renewable Heat Generation in Scotland

Low carbon and renewable heat technologies can support emissions reductions whilst also potentially offering economic opportunities to reduce industry and household costs. It can also enable new or emerging sectors to develop products and services for use around the world. Some of these technologies can also help to diversify Scotland's sources of heat, to build up security of supply for the future.

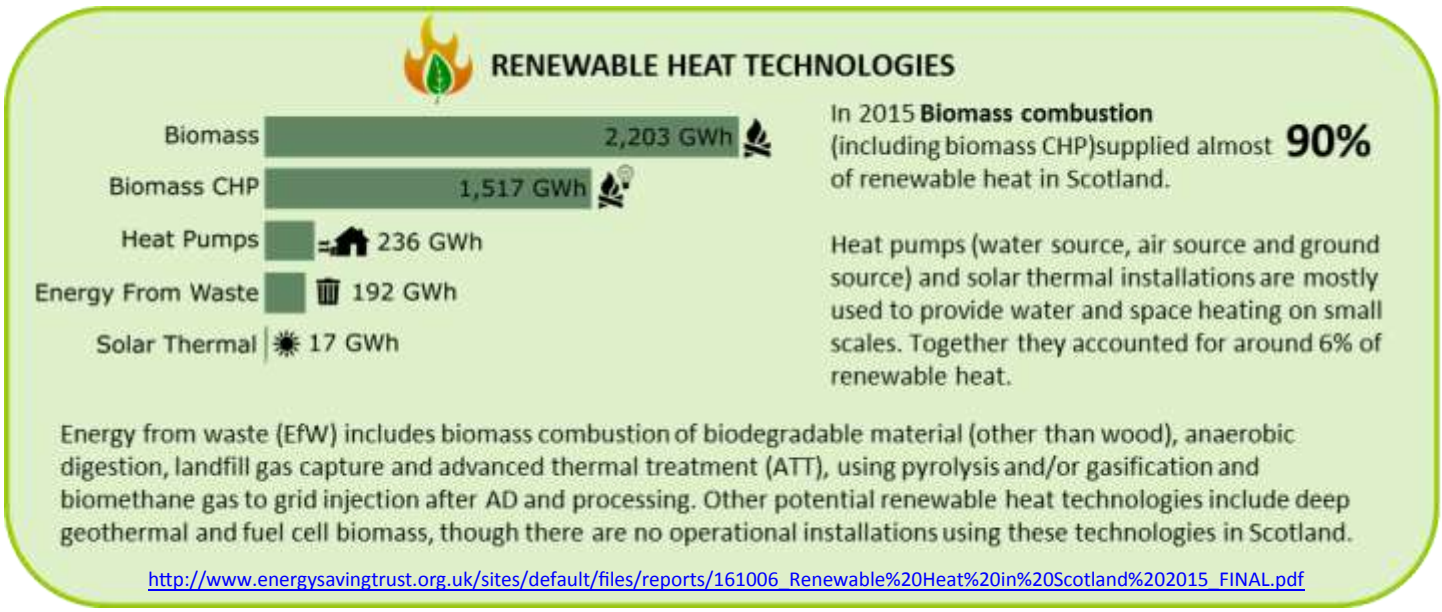
In 2015, just over 1.5 GW of renewable heat capacity was operational in Scotland, producing over 4,000 GWh of useful renewable heat. This represents a 47% increase in renewable heat capacity and a 37% increase in heat generated from renewable sources compared with 2014.

Figure 4.4: Renewable heat generation and non-electrical heat demand, Scotland, 2008/09 - 2015[10]

Figure 4.4 shows how renewable heat generation in Scotland has changed over the last few years. Generation in 2015 is more than four times greater than in 2008/09, when 845 GWh was produced. In 2015, the majority of the increase in generation came from large commercial sites and installations supported by the Renewable Heat Incentive (RHI).

Sources: EST, BEIS, Scottish Government

10. Please note there was no renewable heat estimate produced for 2009.



Renewable Heat Target

The 2009 Renewable Heat Action Plan set a target of delivering 11% of Scotland's projected 2020 heat demand from renewable sources. In 2014, renewable heat generation equated to 3.8% of Scotland's non-electrical heat demand, up from 2.7% in 2013.

Figure 4.5: Share of renewable heat in non-electrical heat demand, Scotland, 2008 - 2014

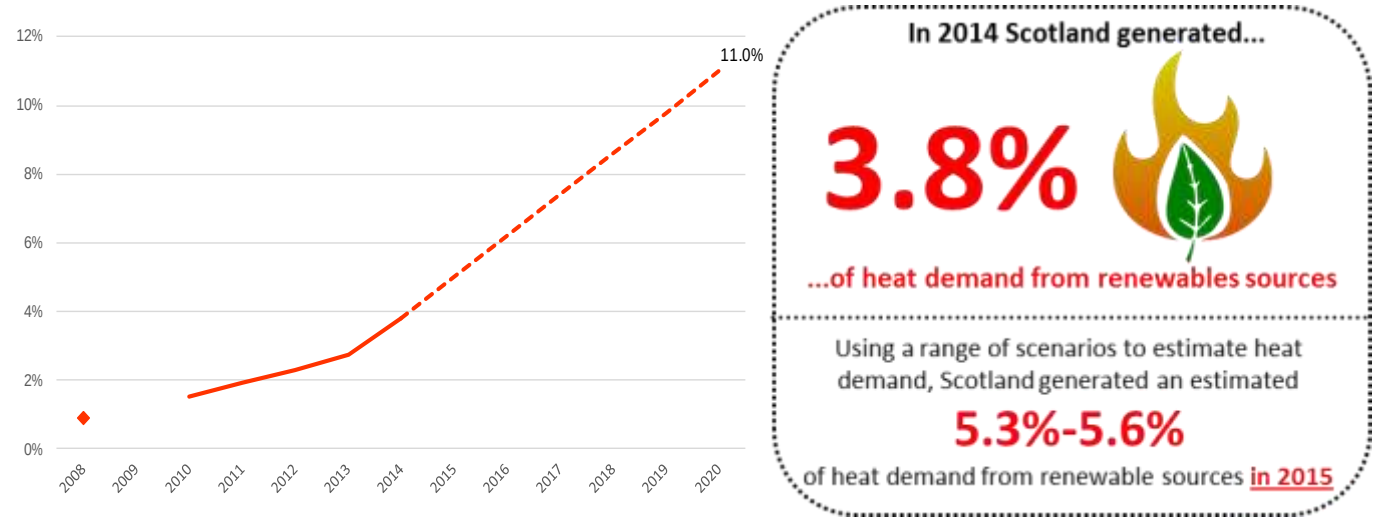


Table 4.1 below shows that over the year to 2014, renewable heat generation increased by 37%, while non-electrical heat demand decreased by 5%.

Table 4.1: Renewable heat target statistics, Scotland, 2008- 2015

	2008	2009	2010	2011	2012	2013	2014	2015
Renewable Heat (GWh)	845	-	1,345	1,660	2,003	2,223	3,031	4,165
Heat Demand (non-electrical, GWh)	97,053	89,155	91,156	88,269	86,447	83,805	79,207	-
% Renewable Heat	0.9%	-	1.5%	1.9%	2.3%	2.7%	3.8%	-

Heat demand in Scotland has been steadily falling over the last ten years, due to rising gas prices, improved energy efficiency and increases in average temperatures. This decreased demand means that renewable heat meets a greater proportion of total heat demand than would otherwise have been the case. Between 2008/9 and 2014, reductions in demand have contributed to around 89% of progress towards the renewable heat target, while the remaining progress has been due to increased renewable output.

Figure 4.6: Estimated increases in renewable output required to meet 2020 renewable heat target

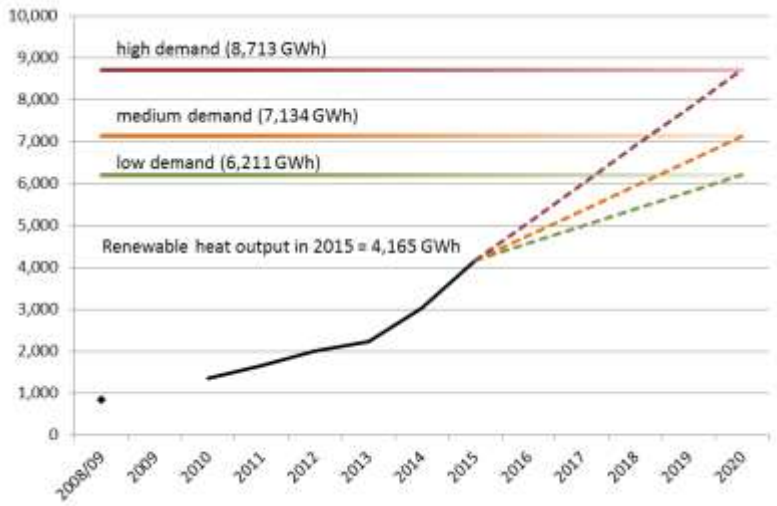
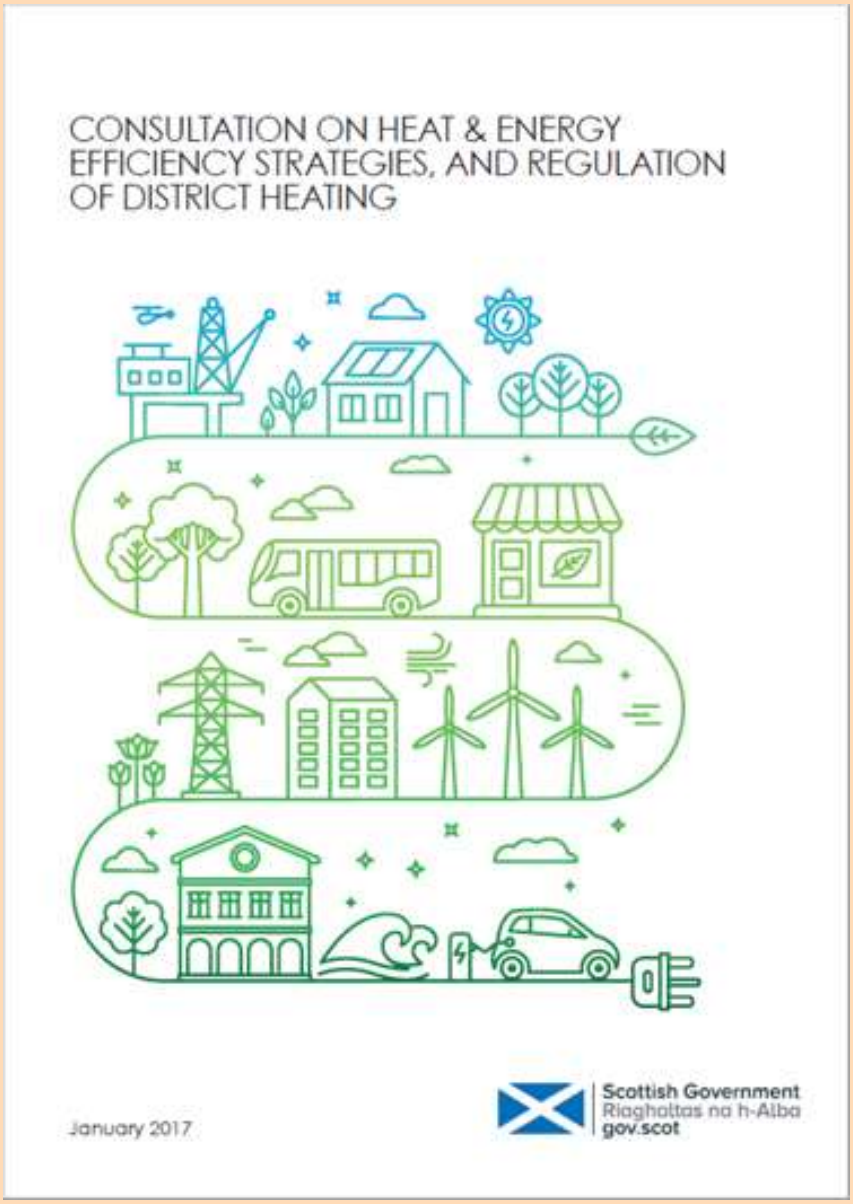


Figure 4.6 shows the difference between renewable heat output in 2015 and output required to meet the 2020 target under three scenarios. Based on these scenarios, renewable heat output would need to increase by between approximately 50% and 100% over five years in order to reach the Scottish Government's target by 2020. The majority of progress to date was due to reductions in heat demand rather than increases in renewable heat output.

HEAT POLICY STATEMENT

Published in June 2015, the Scottish Government's Heat Policy Statement (HPS) sets out the Scottish Government's future policy direction for addressing the three key aspects of the heat system: how it is used (heat demand and its reduction), how it is distributed and stored (heat networks and heat storage), and where the heat comes from (heat generation).



Each aspect of the heat system is addressed by three specific objectives as set out in the Heat Hierarchy: reducing the need for heat; supplying heat efficiently and at least cost to consumers; and using renewable and low carbon heat.

The Heat Policy Statement also set out the Scottish Government's intention to develop appropriate regulation, commensurate with the scale of the market. In December 2015, the Scottish Government designated energy efficiency as a national infrastructure priority. The cornerstone of this will be Scotland's Energy Efficiency Programme (SEEP), which will commence in 2018 with substantial annual public funding.

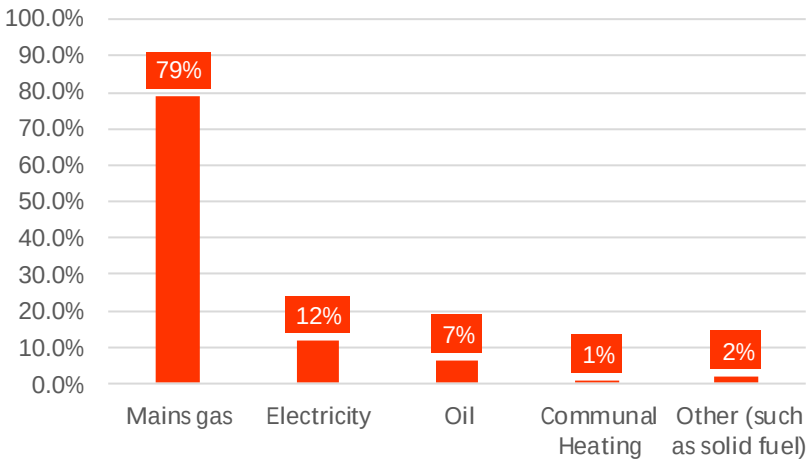
It will be a co-ordinated programme to reduce the energy demand and decarbonise the heat of Scotland's domestic and non-domestic buildings. From January 2017, the Scottish Government will be consulting on SEEP as part of the consultation on the draft Energy Strategy. Alongside this the Scottish Government are also consulting on options for Heat & Energy Efficiency Strategies and Regulation of District Heating. This is a high-level policy scoping consultation that seeks views and evidence to allow Scottish Government to finalise its policy direction.

Gas Consumption

The most common heating fuel in Scotland is gas. 60% of all gas consumed in Scotland is used domestically. 79% of Scottish households (around 1.9 million) use mains gas as their primary heating fuel. This is unchanged from 2014 and up from 72% in 2007.

In 2015, domestic gas consumption per consumer in Scotland stood at 13.7 MWh (or 13,700 KWh), a 2% reduction from 13.9 MWh in 2014, continuing the decline in consumption over the last decade; during which domestic gas consumption has fallen by a third. However, in part due to the colder climate compared to other regions, Scotland still has the highest average consumption of gas in GB (along with the South East of England), with consumption in Scotland 3% higher than the GB average.

Figure 4.7: Primary heating fuel for households, Scotland, 2015



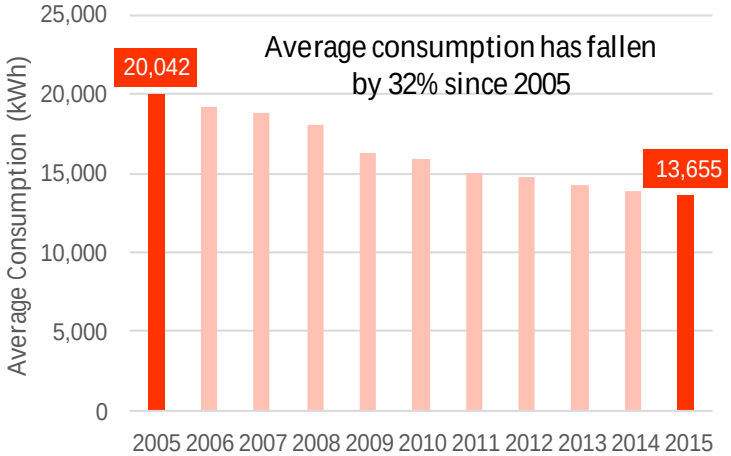
Source: Scottish Household Condition Survey

As shown in Figure 4.7, gas accounts for the majority (79%) of Scottish households' primary heating systems, electricity accounts for 12% and oil 7%. Communal heating and solid fuels cover most of the rest.

Estimates for the UK in 2015 show that gas accounts for a similar proportion of heating in the domestic sector at 77%. However, electricity only accounts for 9%, demonstrating Scotland's higher dependency on electricity for heating - likely due to a higher percentage of properties in off -gas grid areas (properties without a gas supply).

Figure 4.8: Average domestic gas consumption per consumer, Scotland, 2005 - 2015

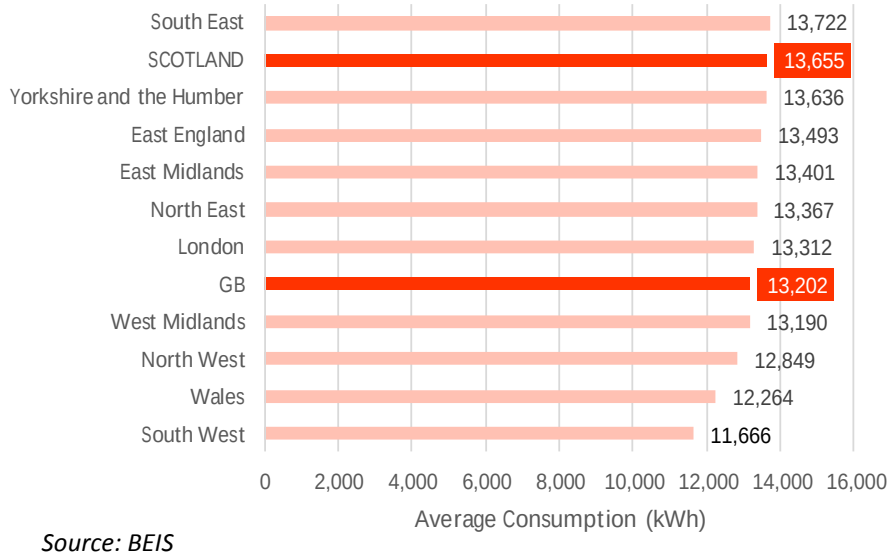
Figure 4.8 shows that domestic gas consumption per consumer has decreased steadily in Scotland between 2005 and 2015 (-32% overall). Rising gas prices and improved energy efficiency in homes and boilers were contributing factors to this trend. Please see sections on energy efficiency in Chapter 2 and energy prices in Chapter 7 for more information.



Source: BEIS

Figure 4.9 below compares the average gas consumption per consumer in Scotland, Wales and the English regions in 2014.

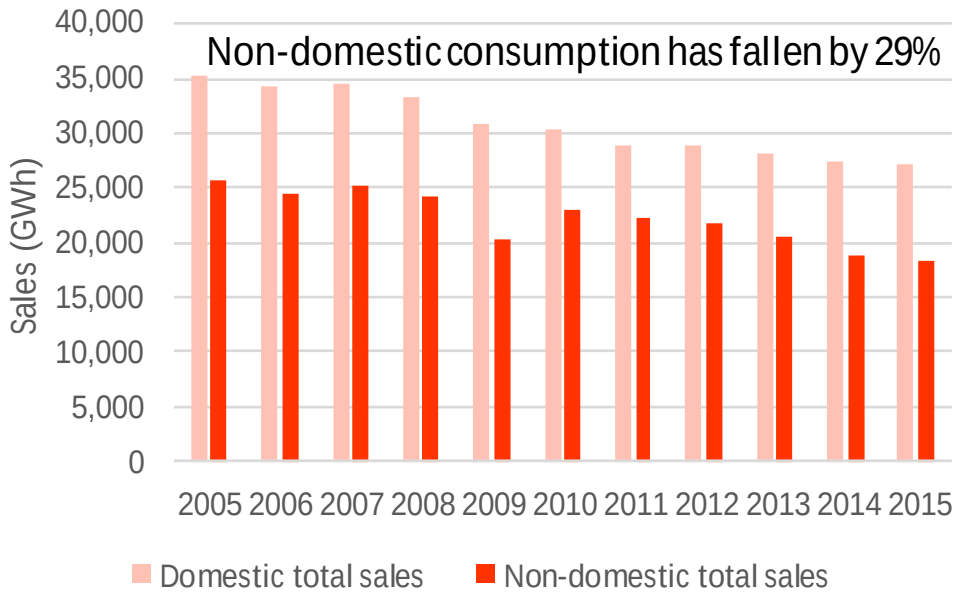
Figure 4.9: Average domestic gas consumption per consumer, regions and countries of GB, 2015



Source: BEIS

As expected, other northern parts of the UK, such as the North East and Yorkshire and the Humber, are among the higher domestic consuming areas, in part due to the impact of weather differences on demand for heating fuel, though in 2015 consumption in the South East has overtaken that in Scotland and Yorkshire and the Humber; as consumption in the South East has risen, compared to decreases in most other regions, including Scotland.

Figure 4.10: Total gas consumption by sector, Scotland, 2005 - 2015



Source: BEIS

Non-domestic gas consumption

Industrial and commercial gas consumption makes up 40% of all gas consumed in Scotland (see data note on page 84). Figure 4.10 compares how total non-domestic and domestic gas consumption has changed since 2005. Domestic consumption has decreased by 23% between 2005 and 2015.

Over the same period, non-domestic gas consumption has reduced by 29% - only a slightly greater reduction. Hence maintaining a similar share of all gas consumption compared with 2005.

DATA NOTE: ELECTRICITY USED FOR HEAT IN SCOTLAND

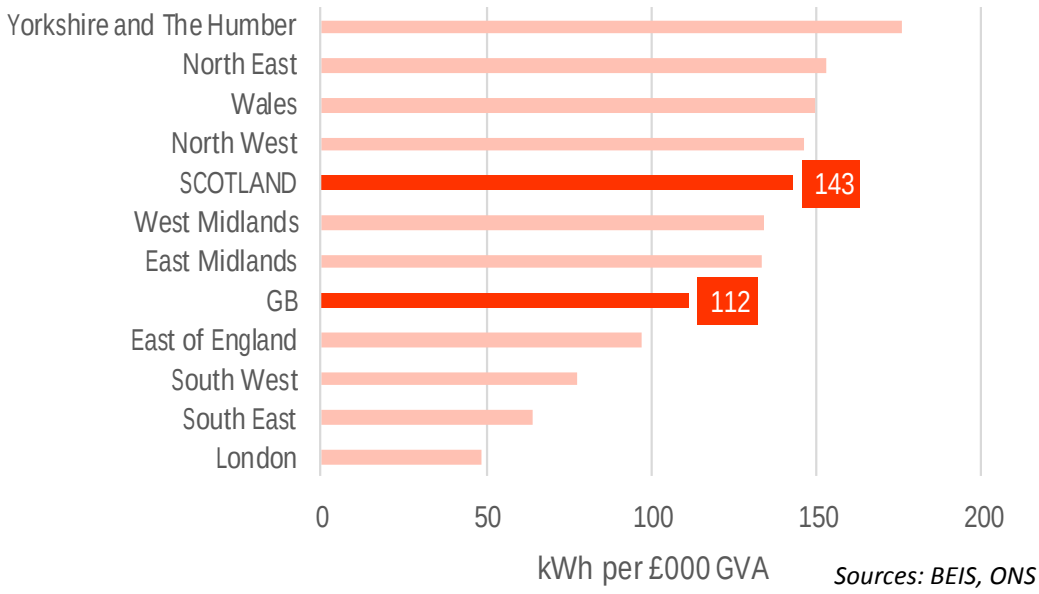
Estimates published by BEIS for the UK indicate that electricity used for heat accounts for an even larger proportion of all heat demand in the industrial and commercial sectors; at 28% of industrial heat and 19% of commercial heat, compared to 12% of domestic heat. For more information, please see the following UK article published by BEIS:

https://www.gov.uk/government/statistics/energy-consumption-in-the-uk (see table 1.04)

As an indication of energy productivity, an interesting way to compare non-domestic gas consumption across the countries and regions of Great Britain is to look at gas consumption relative to gross value added (GVA). Figure 4.11 shows that in 2015, of all GB countries and regions, Scotland had the **fifth highest** commercial and industrial gas consumption per thousand pounds of gross value added (GVA).

Yorkshire and the Humber, the North East, Wales, the North East and Scotland were among the highest average non-domestic consumers in 2015, reflecting the mix of industry in these regions, and the greater use of gas for industrial purposes.

Figure 4.11: Non-domestic gas consumption per £000 GVA, regions and countries of GB, 2015



Sources: BEIS, ONS

The South East and London are more service sector orientated and had the lowest mean non-domestic consumption in 2015. Between 2014 and 2015, all regions saw a reduction in average consumption per non -domestic gas meter – greatest in the South West, with a 14% reduction in average consumption. This compares to a 12% reduction in Scotland.

DATA NOTE: WEATHER CORRECTED GAS DATA

The gas data are weather corrected; that is, the consumption figure is revised downward in colder years and upwards in warmer years, to isolate changes in demand that are not due to year-on-year weather variation. Please see the following document (published by BEIS) for more information:

https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/369933/Overview_of_Weather_Correction_of_Gas_Industry_Data.pdf

DATA NOTE: OFF GAS GRID

Many areas in Scotland are off the gas grid[9] (off-grid properties are those without a record of a gas supply), including the majority of the islands and more remote parts of rural Scotland. Therefore the gas consumption statistics tend to be presented per customer rather than per household, as the 'per customer' figure gives a better indication of the amount used by a typical gas user.

Data published by BEIS estimates that 16% of households in Scotland are off the gas grid, this compares to 9% of GB as a whole. In Scotland 63% of rural households are not connected to the gas grid. Excluding Orkney, Shetland and Eilean Siar (Western Isles), the local authorities with the highest proportions are Highland (61%), Argyll & Bute (49%) and Aberdeenshire (40%).

For more information on BEIS's off gas grid estimates see here:

https://www.gov.uk/government/statistics/sub-national-estimates-of-households-not-connected-to-the-gas-network

BEIS and partners have also produced "The non-gas map". See link below:

https://www.nongasmap.org.uk/

It is a detailed map of Great Britain showing the distribution of properties without a gas grid connection across local authorities, LSOAs (lower-level super output areas) and, for registered users, postcodes. It also provides a wealth of other information about properties and residents, from the type of house or flat to the type of heating and tenure.

9. Scotland has five Statutory Independent Undertakings (SIUs) for gas supplies that are operating gas networks not connected by pipeline to the rest of the network. Four use Liquefied Natural Gas (LNG) [around 7,500 gas customers] and one uses Liquefied Petroleum Gas (LPG). Campbeltown, Oban, Wick and Thurso have SIUs supplied with LNG by road tanker. The fifth SIU, Stornoway, uses LPG.

DATA NOTE: NON-DOMESTIC GAS DATA

A limitation of the gas consumption data is that it is not possible to accurately determine all of the non-domestic consumers accurately. BEIS use the gas industry standard "Annual Quantity" cut-off point of 73,200 kWh and classifies all consumers using under such annual consumption as domestic consumers. Unfortunately, this classification incorrectly allocates many small businesses to the domestic sector and, conversely, a small number of larger domestic consumers to the non-domestic sector. This also implies that a small number of meters can change sector from year to year.

Additionally, gas used by power stations and some large industrial users, as well as a relatively small quantity of gas that is not supplied through the National Transmission System, are excluded from these statistics. Further information is available from the methodology document published by BEIS to accompany these statistics.

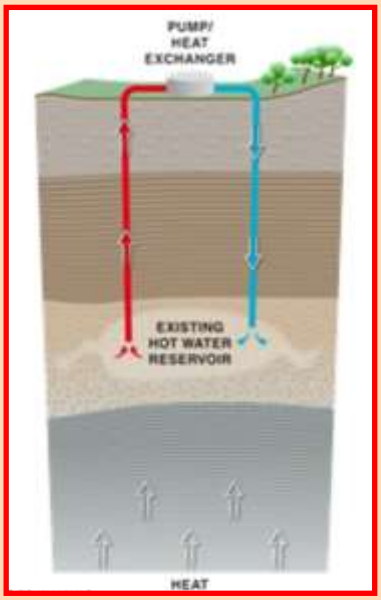
https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/579258/Sub-national_Methology_and_Guidance_Booklet_2016.pdf

GEOTHERMAL ENERGY

What is Geothermal energy?

Geothermal energy is the natural heat that exists within our planet. Building on the results of a study highlighting Scotland's potential deep geothermal resource which was published in October 2013, the Scottish Government is targeting the geothermal potential of 3 geological settings within Scotland:

- the water which has accumulated in abandoned mineworkings
- bodies of permeable rock that can conduct significant quantities of warm or hot groundwater (known as hot sedimentary aquifers—see diagram for illustration of the process)
- and crystalline rocks at several kilometres depth (known as hot dry or hot wet rocks).



Source: British Geological Survey

The heated water can be abstracted from the mineworkings, aquifers and rocks and used to provide space heating and hot water. In some cases, the thermal energy stored in the water in fractures of crystalline rocks can be so hot that it can be converted into electricity at the surface.

In each case, following the extraction of the heat, the water can be re-injected at the site, maintaining the level of the groundwater available for future abstraction.

Scottish Government action to progress use of Geothermal energy in Scotland

Under the Scottish Government's Geothermal Energy Challenge Fund, over £179,000 of Low Carbon Infrastructure Transition Programme (LCITP) funding supported exploration of the technical feasibility, economic viability and environmental sustainability of the geothermal resource in sites in Fife, North Lanarkshire, Aberdeen and Aberdeenshire. Following a technical appraisal of the reports, a further grant of £37,000 was awarded to the University of St Andrews for development work at the geothermal hot sedimentary aquifer project at Guardbridge in Fife. In addition, Clackmannanshire Council received funding of £19,000 through LCITP for a minewater geothermal feasibility study at Forrestmill.

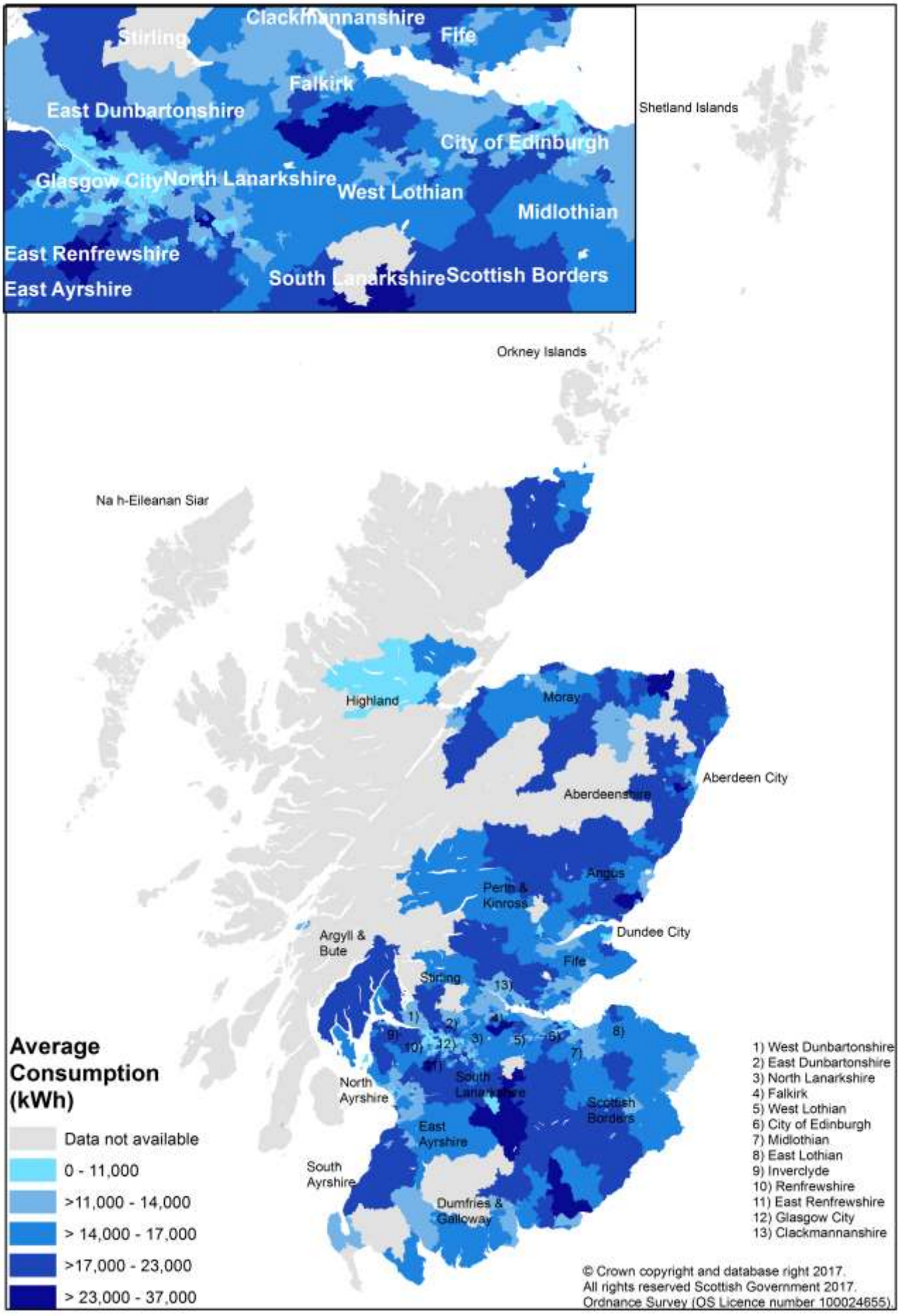
As the knowledge of Scotland's geothermal resource grows, a clear understanding of the regulatory framework governing geothermal projects is necessary. In order to provide a point of reference for those considering undertaking an onshore geothermal project in Scotland, the Scottish Government worked with relevant regulatory authorities to publish guidance highlighting the key primary and secondary legislation specific, or relevant, to projects involving the exploration and extraction of geothermal heat from the ground.

The Scottish Government can also learn from other countries with a history of geothermal projects. In 2016, the Scottish Government and Scottish Development International sponsored a learning journey for stakeholders in the public, private and academic sectors to the Heerlen minewater geothermal project in the Netherlands. Since the last report, we have gained a better understanding of the potential geothermal resource in 5 sites across Scotland and have learned important lessons about project development and stakeholder engagement from visiting a successful international large-scale minewater geothermal development and district heating scheme.

Underpinned by a robust regulatory framework, the Scottish Government can continue to explore how geothermal energy can contribute to Scotland meeting the target of delivering 11% of non-electrical heat demand from renewable sources by 2020.

FIGURE 4.12: DOMESTIC GAS CONSUMPTION - Average Consumption (kWh per meter)

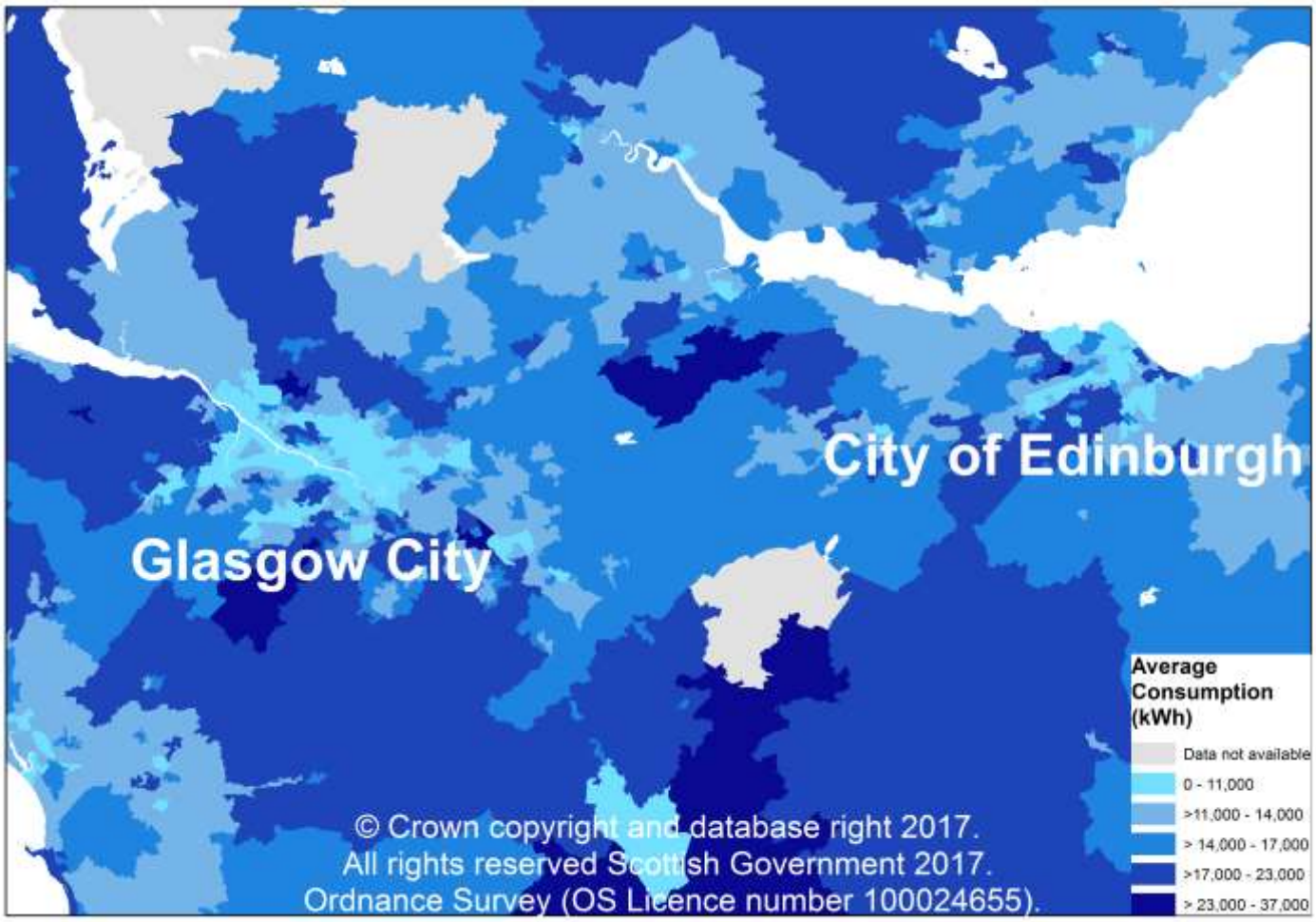
SCOTLAND BY INTERMEDIATE GEOGRAPHY ZONE, 2015



Source: BEIS

Figure 4.13: DOMESTIC GAS CONSUMPTION—Average Consumption (kWh per meter)

CENTRAL BELT OF SCOTLAND BY INTERMEDIATE GEOGRAPHY ZONE, 2015



Source: BEIS

HIGHEST 10 CONSUMING ZONES...

	Zone Name	Local Authority	Average Consumption (kWh)
1st	Annandale East	Dumfries & Galloway	36,785
2nd	Whitecraigs and Broom	East Renfrewshire	31,047
3rd	Lower Whitecraigs and South Giffnock	East Renfrewshire	29,257
4th	Carstairs, Carstairs Junction and	South Lanarkshire	28,208
5th	Clydesdale South	South Lanarkshire	28,007
6th	West End North	Aberdeen City	27,823
7th	Cults, Bieldside and Milltimber East	Aberdeen City	25,786
8th	Murrayfield and Ravelston	Edinburgh, City of	25,271
9th	Cults, Bieldside and Milltimber West	Aberdeen City	24,688
10th	Braes Villages	Falkirk	24,538

LOWEST 10 CONSUMING ZONES...

	Zone Name	Local Authority	Average Consumption (kWh)
1st	Gorgie East	Edinburgh, City of	6,302
2nd	Leith (Albert Street)	Edinburgh, City of	6,447
3rd	Gorgie West	Edinburgh, City of	6,671
4th	Dalry and Fountainbridge	Edinburgh, City of	6,975
5th	Easter Road and Hawkhill Avenue	Edinburgh, City of	6,998
6th	Abbeyhill	Edinburgh, City of	7,170
7th	Granton South and Wardieburn	Edinburgh, City of	7,467
8th	Carntyne West and Haghill	Glasgow City	7,560
9th	Granton South and Wardieburn	Edinburgh, City of	7,644
10th	Meadowbank and Abbeyhill North	Edinburgh, City of	7,679

The tables above show both the ten highest and ten lowest domestic gas consuming areas (average per household gas meter) in Scotland. It is interesting to note that all of the ten lowest consuming areas were within the City of Edinburgh and Glasgow City local authorities.

Please see Annex D for more information regarding the source of this information and points to be aware of when using this analysis.

DATA NOTE: INTERMEDIATE GEOGRAPHY ZONES (IGZ)

Data zones are the key small area statistical geography in Scotland. Intermediate geography is used to disseminate statistics that are not suitable for release at the data zone level.

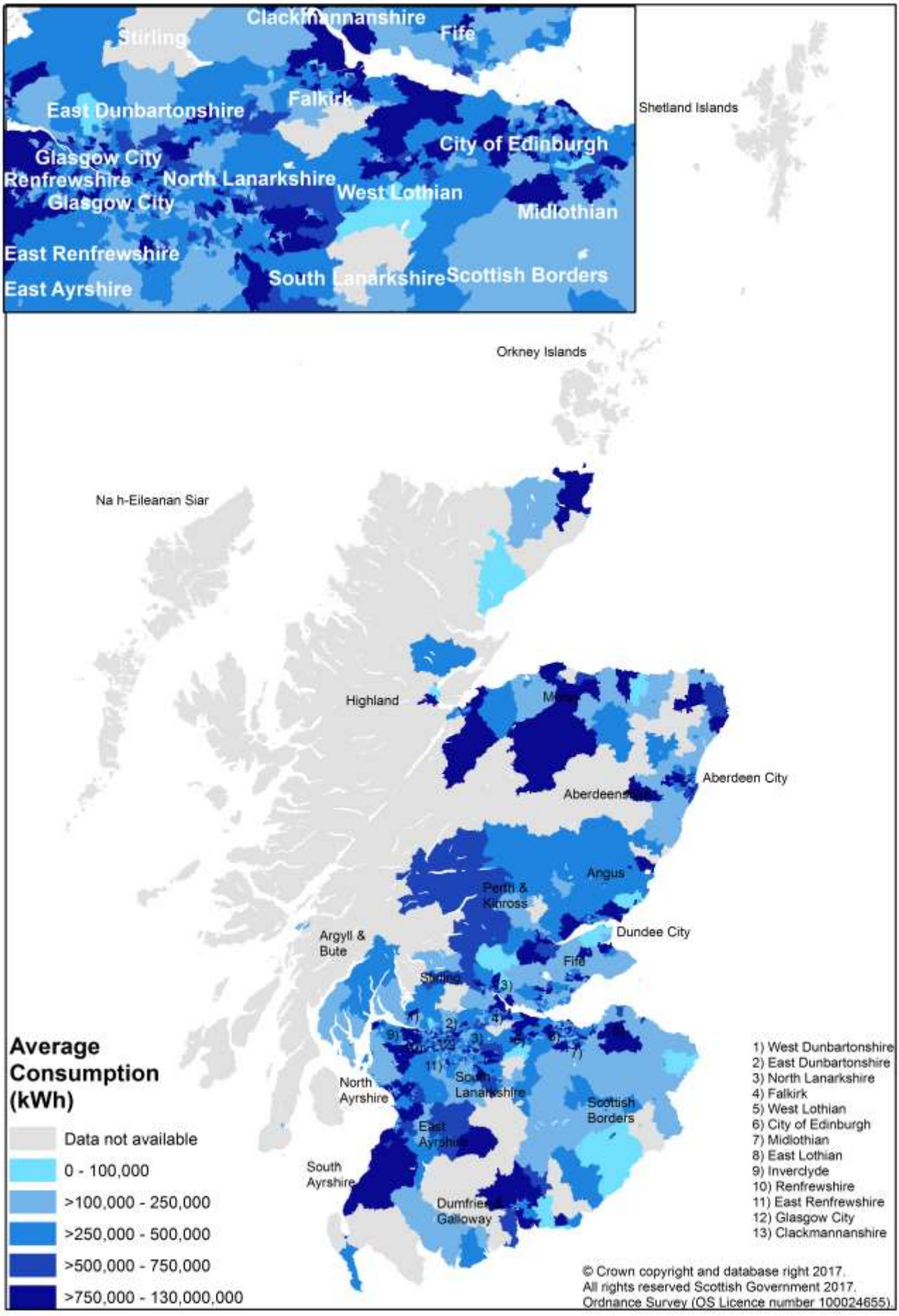
There are 1,279 intermediate zones in Scotland, containing on average 4,000 household residents.

For more information:

http://www.gov.scot/Topics/Statistics/sns/SNSRef

FIGURE 4.14: NON-DOMESTIC GAS CONSUMPTION - Average Consumption (kWh per meter)

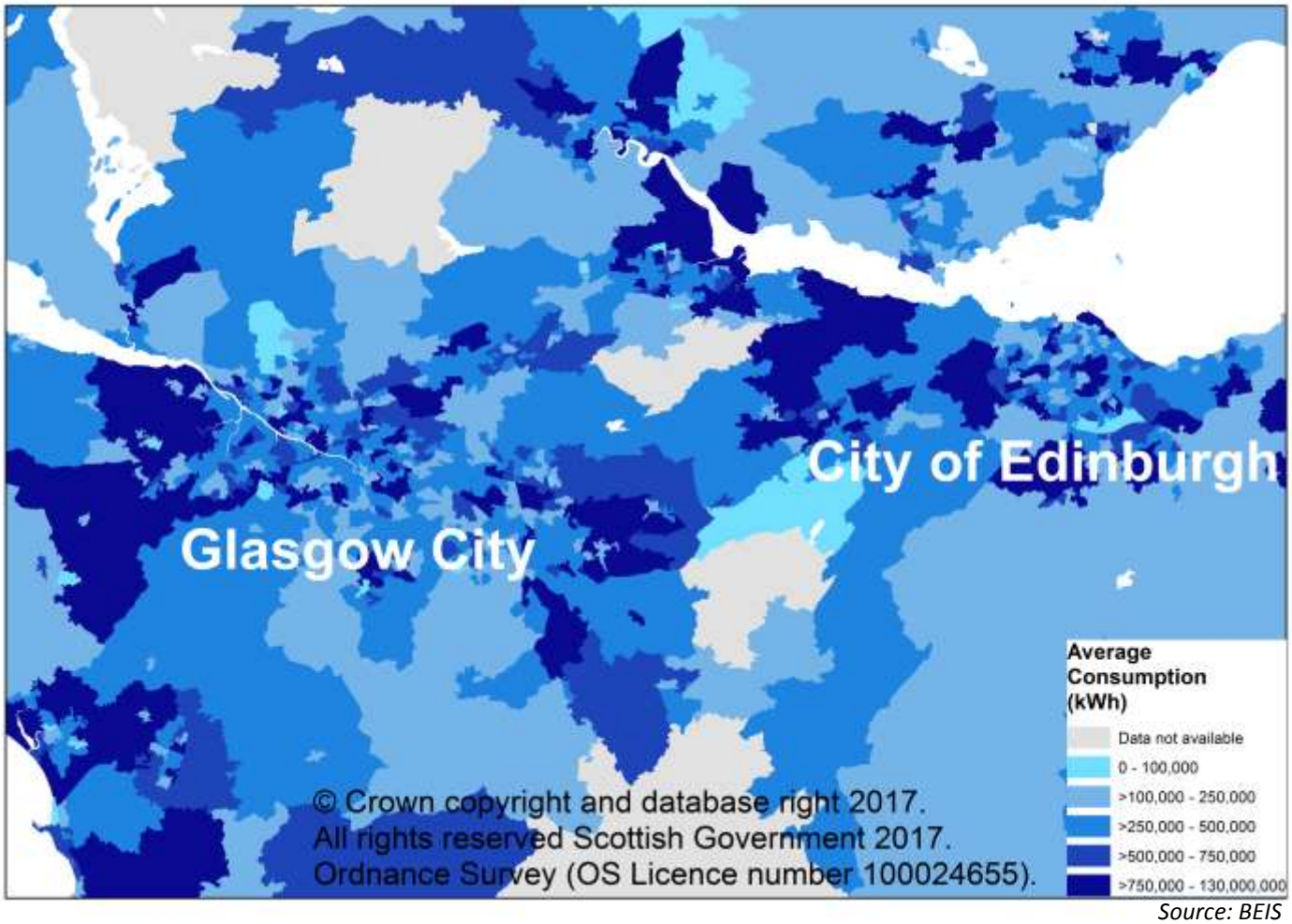
SCOTLAND BY INTERMEDIATE GEOGRAPHY ZONE, 2015



Source: BEIS

FIGURE 4.15: NON-DOMESTIC GAS CONSUMPTION - Average Consumption (kWh per meter)

CENTRAL BELT OF SCOTLAND BY INTERMEDIATE GEOGRAPHY ZONE, 2015



Source: BEIS

HIGHEST 10 CONSUMING ZONES...

	Zone Name	Local Authority	Average Consumption (kWh)
1st	Carrick South	South Ayrshire	126,883,521
2nd	Muir of Ord	Highland	49,873,312
3rd	Badenoch and Strathspey North	Highland	27,950,853
4th	Inverness East Rural	Highland	21,565,652
5th	Springside and Rural	North Ayrshire	18,472,746
6th	South Speyside and the Cabrach	Moray	17,320,286
7th	Allanton—Newmains Rural	North Lanarkshire	11,093,325
8th	North Speyside	Moray	10,854,443
9th	Alloa South and East	Clackmannanshire	10,218,338
10th	Heldon West, Fogwatt to Inchberry	Moray	9,105,898

LOWEST 10 CONSUMING ZONES...

	Zone Name	Local Authority	Average Consumption (kWh)
1st	Houston South	Renfrewshire	73,241
2nd	Stenhousemuir—Antonshill	Falkirk	74,923
3rd	Sutherland East	Highland	75,508
4th	Irvine Broomlands	North Ayrshire	75,740
5th	Kirkcaldy Newliston and Redcraigs	Fife	76,237
6th	Monifieth West	Angus	76,602
7th	Methill Methihill	Fife	77,160
8th	Muthill, Greenloaning and Gleneagles	Perth & Kinross	79,696
9th	Earnock	South Lanarkshire	80,160
10th	Glimerton South and the Murrays	Edinburgh, City of	81,176

DATA NOTE: LOCAL AREA CONSUMPTION

BEIS produce gas and electricity sub-national energy consumption analysis below local authority level. These data are utilised by a range of users for different purposes, including enabling local authorities to better understand local energy use with the ability to monitor and target small areas for interventions as part of their local energy strategies. Data is available here:

https://www.gov.uk/government/collections/sub-national-gas-consumption-data

The tables above show both the ten highest and ten lowest industrial and commercial gas consuming areas in Scotland (average per non-domestic gas meter) . Please note that this analysis excludes a considerable amount of consumption fed directly to power stations and some very large industrial consumers, as this would be disclosive. Please see Annex D for more information regarding the source of this information and notes on this analysis.

Combined Heat and Power (CHP)

Combined heat and power (CHP) schemes capture heat from the electricity generation process that would otherwise have been wasted and uses the heat for productive purposes such as space heating. Table 4.4 sets out the number of CHP schemes, their capacity and output, for Scotland and the UK in 2015.

Table 4.2: CHP statistics by installation size, Scotland, 2013-2015

		2013	2014	2015
Scotland	No. of schemes	130	135	137
	Electrical capacity (MWe)	512	546	525
	Electricity generated (GWh)	2,357	2,503	2,426
	Heat generated (GWh)	5,802	5,893	5,750
UK	No. of schemes	2,032	2,081	2,102
	Electrical capacity (MWe)	5,925	5,894	5,692
	Electricity generated (GWh)	19,593	19,698	19,900
	Heat generated (GWh)	44,353	41,962	40,325

Source: BEIS

There are 137 CHP schemes in Scotland, an increase of 1% since 2014. However the electrical capacity has decreased by 4% and now stands at 525 MW.

The heat generated from CHP has also decreased, by 2%, totalling 5,750 GWh in 2015. This is enough to heat the equivalent of 421,000 homes in Scotland (using the estimate for the average domestic gas consumption per household in Scotland).

The full article "Combined Heat and Power in Scotland, Wales, Northern Ireland and the regions of England" is published annually by BEIS and the latest report (for 2015) is available here:

https://www.gov.uk/government/statistics/energy-trends-september-2016-special-feature-article-combined-heat-and-power-in-scotland-wales-northern-ireland-and-the-regions-of-england-in-20

CALCULATING HEAT FROM CHP

For biomass combined heat and power (where other data are not available), the Energy Saving Trust (EST) use a calculation to work out the estimate of heat energy produced from oven-dried tonnes of wood, based on the values given for electrical power (MWe) and heat output (MWth).

Example calculation:

a 20 MWe and 80 MWth biomass CHP unit.

Total output (electricity + heat) = 20 + 80 = 100 MW

Total efficiency = 90% (as for large biomass combustion plant)

Total input = output / total efficiency = 100 / 0.9 = 111 MW

Electrical efficiency = electrical output / total input = 20 / 111 = 18%

Thermal efficiency = heat output / total input = 80 / 111 = 72%

For the full renewable heat report produced by the EST see here: http://www.energysavingtrust.org.uk/sites/default/files/reports/161006_Renewable%20Heat%20in%20Scotland%202015_FINAL.pdf

See page 100 for renewables CHP heat output estimates from the Energy Saving Trust.

UNUSED AND EXCESS HEAT

The National Comprehensive Assessment, required under the EU Energy Efficiency Directive, identified the potential for high-efficiency cogeneration and efficient district heating and cooling. Many industrial processes and commercial buildings generate heat as a by-product (as opposed to Combined Heat and Power plants which are designed to utilise the heat produced during electricity generation).

Heat resulting from industrial processes is a valuable resource and can be costly to treat before releasing into the environment. Depending on the temperature of the surplus heat and the wider circumstances, it may be usable for many onsite and offsite purposes. Recovering and reusing this surplus industrial heat has an economic value; reducing initial energy consumption and creating new revenue streams.

The Scottish Government is keen to ensure that potential surplus industrial heat resource is exploited as efficiently as possible, either recovered on-site or sold to third parties. This would help energy intensive industries to reduce costs, create new sources of income, improve competitiveness, and potentially contribute to the development of district heating networks. From January 2017, the Scottish Government is consulting on options for Local Heat & Energy Efficiency Strategies and Regulation of District Heating. This is a high-level policy scoping consultation that seeks views and evidence to allow Scottish Government to finalise its policy direction, and includes a scenario on how surplus industrial heat could contribute, including regulating for data collection.

In the meantime, as a preliminary investigation of the potential for reusing surplus industrial heat, the Scottish Government issued a voluntary data request via SEPA's annual Scottish Pollution Release Inventory data collection. In 2017, an additional questionnaire was included to investigate the challenges faced by industry in reducing and reusing surplus heat, the appetite to sell it and the support needed. Where respondents agree, the Scottish Government will investigate how the surplus industrial heat data could be represented on the Scotland Heat Map. The Scotland Heat Map visualises heat demand and supply, and could be used by industry to identify opportunities to sell their surplus industrial heat.

District Heating

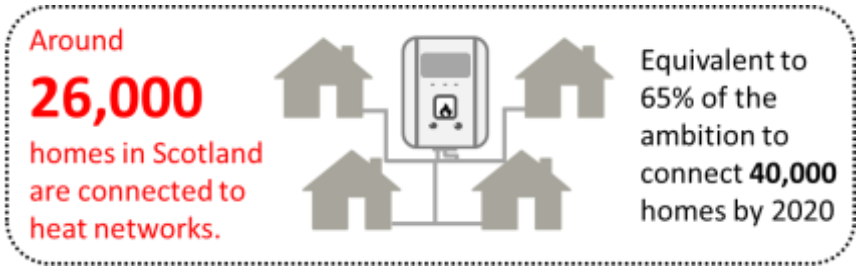
District heating networks are a means of distributing heat to homes, businesses and public buildings, to allow us to make efficient use of a range of heat sources. Heat exchangers in individual buildings allow consumers to tap into the heat network for affordable controllable heat to meet their heat demand. In Scotland, individual boilers heating individual buildings are the main source of heat, but many other European countries have heat networks that supply towns or whole cities. In heat dense areas, the result can be lower carbon emissions, affordable heating and long-term investment in infrastructure which can be adapted to meet changing energy markets.

The Heat Network (Metering and Billing) Regulations 2014 implement the requirements in the Energy Efficiency Directive (EED) with respect to the supply of distributed heat, cooling, and hot water. There are many thousands of district heat networks and communal heating systems in the UK, supplying hundreds of thousands of dwellings, commercial premises, and public buildings. This legislation is enforced in the UK by Regulatory Delivery (RD) – part of BEIS.

For the first time, BEIS published provisional data on district and communal heating in the UK as part of their monitoring of these regulations. This information will be used to create a national database identifying the level and scope of how much heating is supplied through shared networks in the UK. The information should facilitate a better understanding of the impact of heat networks and may be shared to help inform policy decisions in the future. In particular, the Scottish Government intends to use this information to help monitor progress towards the two district and communal heating ambitions set out in the 2015 Heat policy Statement:

1) to achieve 1.5 TWh of Scotland's heat demand to be delivered by district or communal heating, and

2) to have 40,000 homes connected by 2020.



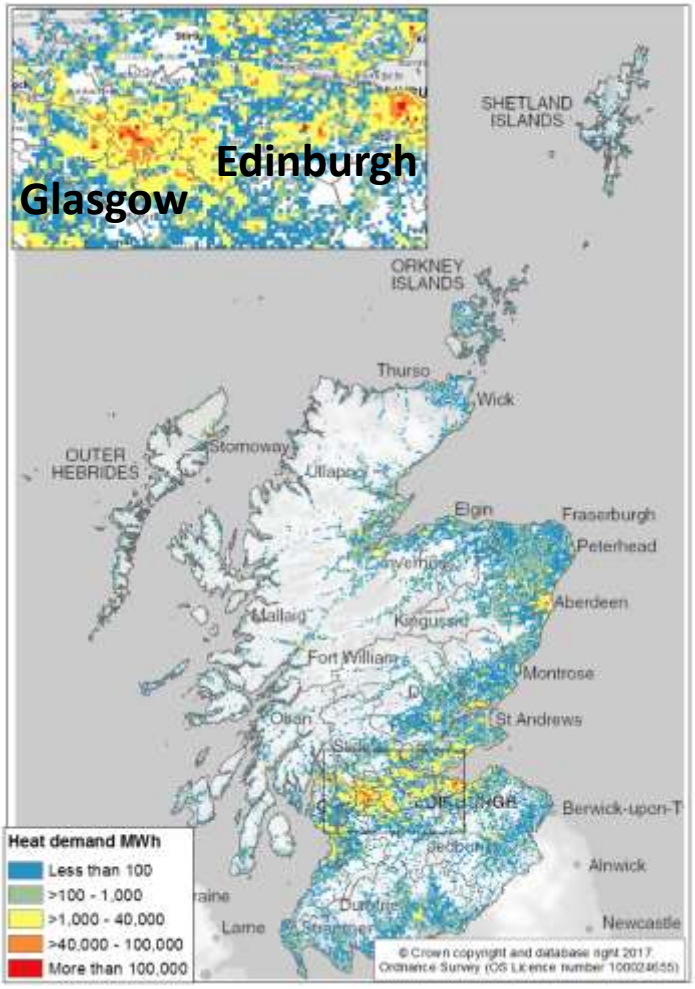
It should be noted that these are early provisional figures and at this time only 16% of networks in Scotland have been quality assured by BEIS in terms of generation, capacity and supply, with the majority of those being domestic connections. Once quality assurance has been completed, these figures will be used to help monitor progress towards the above heat demand ambition.

While new notifications continue to come in, these provisional estimates currently show that there are 25,858 homes connected to district or communal heating networks in Scotland; meaning that Scotland is just over two thirds (65%) of the way towards reaching 40,000 homes connected to heat networks. With an additional 14,142 domestic connections needed in the next 4 years in order to achieve this ambition by 2020. For more information please see: https://www.gov.uk/heat-networks

Heat Network (Metering & Billing) Regulations 2014

Scottish Ministers have authorised Regulatory Delivery (*RD*) (part of the Department for Business, Energy & Industrial Strategy—*BEIS*) to enforce these regulations in Scotland, and officials have worked closely with BEIS on their development and implementation. The Heat Network Regulations implement requirements in Energy Efficiency which essentially place certain responsibilities on anyone supplying and charging for heating, cooling or hot water through district or communal heating. These responsibilities include:

1. notifying BEIS RD of the existence of their network;
2. the fitting of heat meters where appropriate to accurately measure, memorise and display the consumption of final customers and of some buildings;
3. in buildings with more than one final customer, to fit Heat Cost Allocators (HCAs), hot water meters, and Thermostatic Radiator Valves (TRVs) to measure the consumption of final customers where installing heat meters is not feasible;
4. ensuring heat meters or HCAs are continuously operating, maintained and periodically checked for errors;
5. billing customers fairly, transparently and based on actual consumption where cost effective to do so.



The map above shows heat demand by 1km square areas. Blue is lower demand while red/yellow is higher. The inset map at the top left shows heat demand around Glasgow and Edinburgh.

What is a heat map?

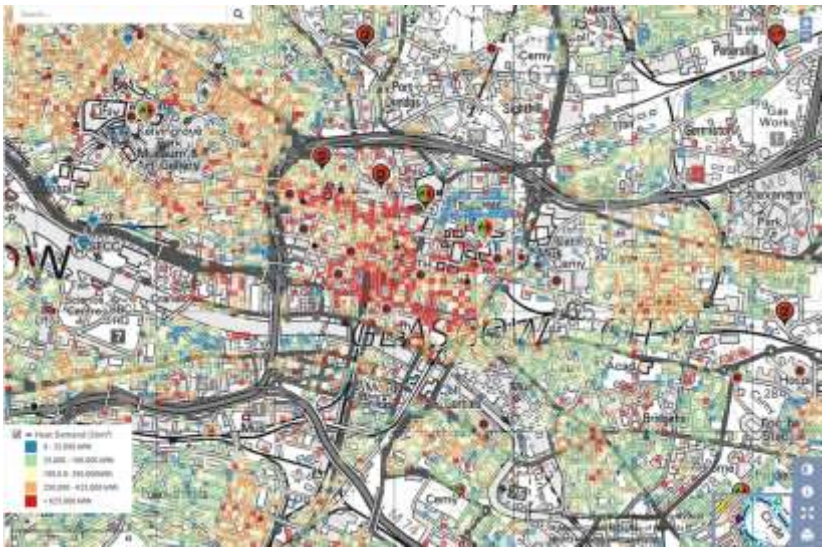
The Scotland Heat Map models heat demand on an individual building level. Every building in Scotland with a unique property reference number is assigned a heat demand value typical for a building of that type, age and use.

The Scotland Heat Map is a powerful tool to help Scotland meet its renewable heat, low carbon and fuel poverty targets.

All Scottish Local Authorities have access to the Heat Map dataset for their area. Certain public sector organisations such as Scottish Enterprise and NHS Boards also have access to the Scotland Heat Map data.

What are the benefits?

The Scotland Heat Map provides a starting point to look for new opportunities and answer questions such as – where can demand be matched with supply? Where would benefit most from affordable, low carbon heating? It is also a valuable pre-feasibility tool, helping to answer questions such as - which areas should be targeted for detailed feasibility studies? What are the most promising sites for a new District Heating Scheme? Where should we target retrofit heat solutions?



The map above shows energy supply points in the city centre of Glasgow alongside heat demand (50m square areas)

The Scotland Heat Map is a valuable resource for informing strategic energy masterplanning and policy development such as Local Development Plans.

It can also be used to inform and support local investment proposals and help manage pipeline energy infrastructure projects as it can be combined and presented with other geospatial data.

SCOTLAND HEAT MAP INTERACTIVE - REPORTING TOOL

Scotland Heat Map Interactive is the publically accessible online version of the Heat Map available at:

www.gov.scot/heatmap

It is designed for everyone to use, so businesses and communities can find out more about the heat demand and energy opportunities in their area. An **in-browser reporting tool** has been added to **Scotland Heat Map Interactive** to allow users to interrogate the data within an internet browser.

Scotland Heat Map—Custom reporting tool:

Users are able to draw areas on the map and request a report that provides summary analysis for those areas, including total heat demand and a number of energy sources. Users are also able to retrieve reports on pre-defined geographies such as Local Authorities or Data Zones.

What else is in the heat map?

The Heat Map contains many other useful datasets besides heat demand. It has data on Energy Supply points - both heat generation and electricity generation have been mapped on an individual site basis (where data are available). The Scotland Heat Map contains the most comprehensive data available on existing and planned district heating networks. Opportunities and constraints data (for example conservation areas) has also been included so heat can be considered in context.

The data used to create the heat map was provided by many different organisations from both the public and private sectors, including all local authorities. The full list of data layers is available in the heat map methodology documentation accessible at:

www.gov.scot/heatmap

How can I access the heat map data?

Public sector organisations

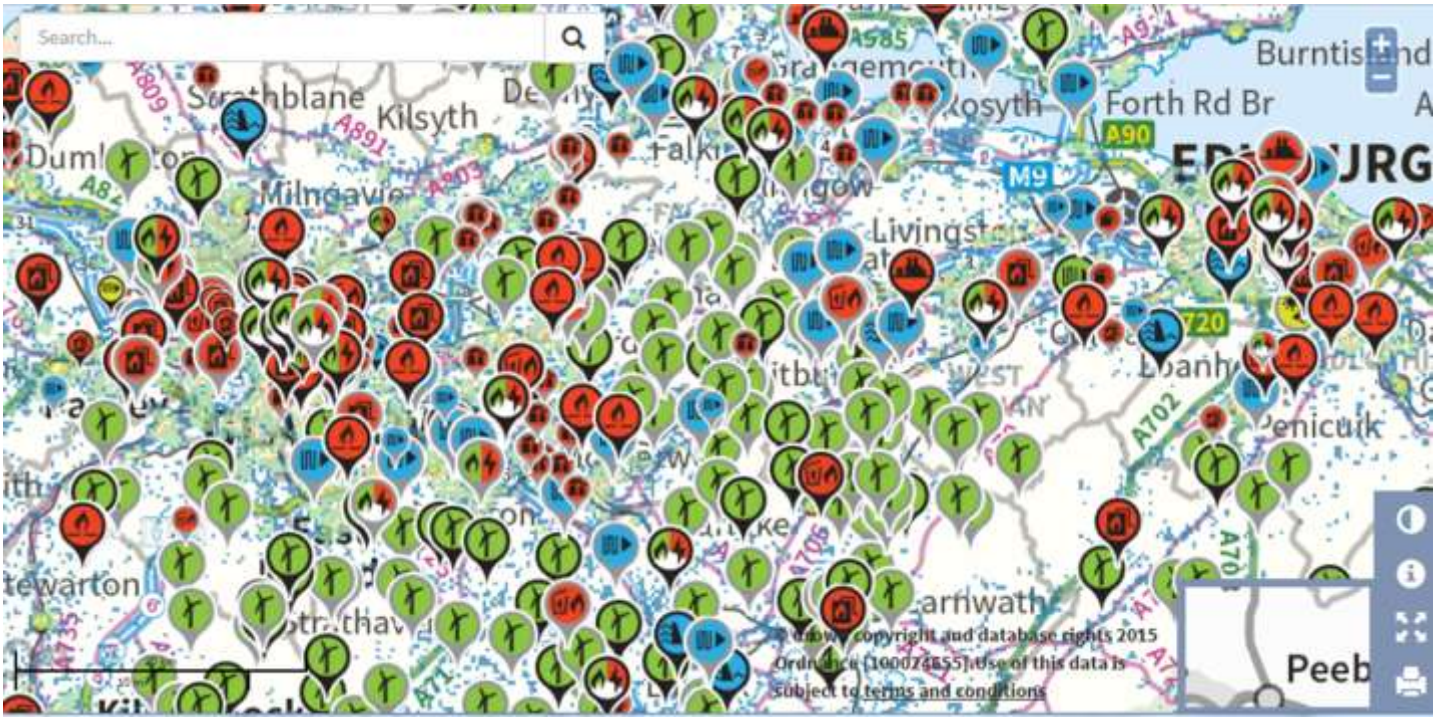
Please contact heatmap@gov.scot. Please note – due to restrictions on some data sources, only certain organisations can have access to the full heat map database.

Company/contractors or community organisations

Firstly, please see the information on the Heat Map Framework Agreement for more details regarding sharing data with third parties. If you believe you qualify for access, please contact your Local Authority. A table of heat map email contacts is available at www.gov.scot/heatmap on the 'Who Has the Map?" page.

Researchers or members of the public

Access the public version at www.gov.scot/heatmap. Certain layers are available to download as ESRI shapefiles from http://heatmap.scotland.gov.uk/inspire.



This map shows Energy Supply Points across the Central Belt of Scotland.

DATA DEVELOPMENT

Improved Heat Demand Methodology

The Scotland Heat Map methodology was updated in 2015 with the aim of incorporating official statistics on energy consumption to provide a more robust estimate of heat demand.

BEIS sub-national data on gas and electricity consumption was combined with census data on central heating type to create an alternative measure of heat demand for every Data Zone in Scotland.

The individual address level estimates were then scaled to match the alternative estimate. By combining benchmarking and official statistics, the updated methodology allows data users greater confidence when using the data at larger geographies.

District Heating Opportunities Analysis

The Heat Network Partnership has been working with local authorities to develop local district heating strategies or district heating elements of wider strategies. A district heating opportunities tool has been made available which works with the Scotland Heat Map data to evaluate user-defined areas suitability for district heating.

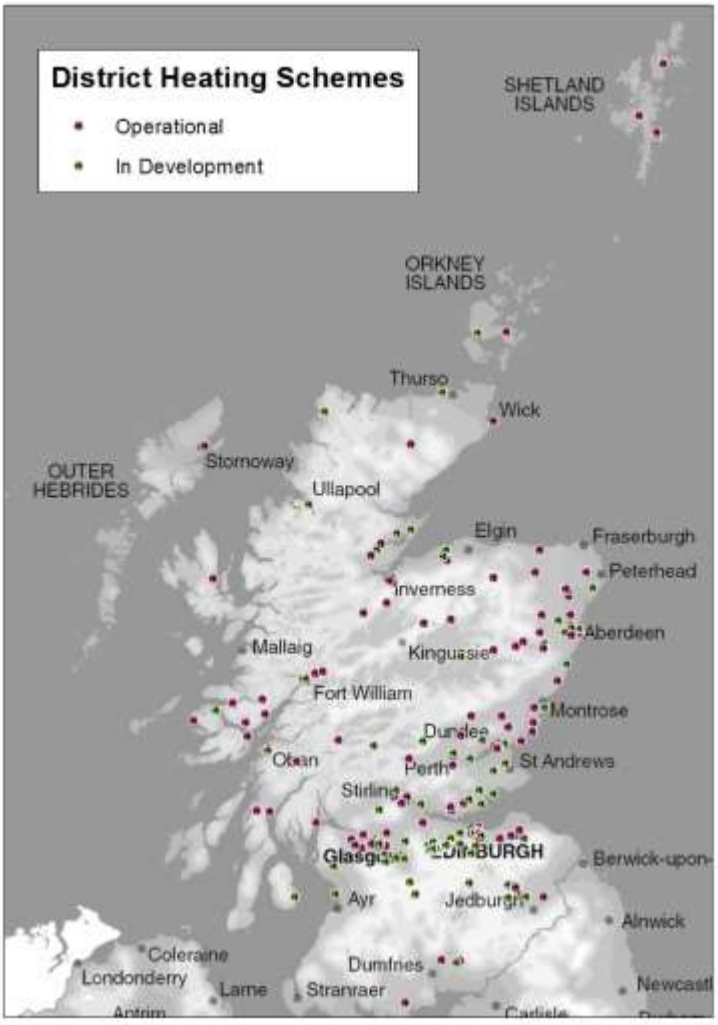
For more information visit www.districtheatingscotland.com

DATA DEVELOPMENT

Updated Energy Supply Points

Energy supply data has been updated in the heat map to include more data on historic hydropower sites, large power stations and also incorporated updated datasets from data providers such as Energy Saving Trust Renewable Heat Database.

The new data provides a more complete picture of energy generation sites in Scotland.



This map shows the location of planned and existing District Heating Schemes across Scotland.

Analysis of the Scotland Heat Map shows that an estimated 24% of domestic heat demand is within 1 kilometre of a major river.

Water Source Heat Pumps (WSHP) can extract latent heat in rivers and use it to heat nearby homes and businesses.

With almost a quarter of domestic demand situated near Scotland's major waterways, WSHP technology has the potential to make an important contribution to decarbonising Scotland's energy system.

The Scottish Government are aware of a number of projects looking at the feasibility of large-scale WSHP technology.

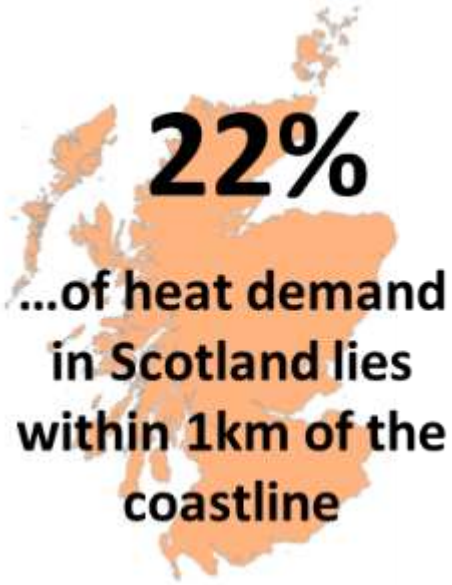
Feedback, Validation and General Enquiries

The Scotland Heat Map continues to be developed. User feedback is invaluable in helping us direct resources where they can produce the most benefit to heat map users.

In addition to feedback, we appreciate any responses regarding data quality. Drawing together multiple datasets with millions of records means local knowledge is invaluable in highlighting areas we may need to improve.

To provide any feedback, data corrections or general enquiries please contact:

heatmap@gov.scot



Analysis of the Scotland Heat Map indicates a substantial proportion of Scotland's building heat demand lies within 1 kilometre of the coast. With 22% of all demand near to the sea, there could be the opportunity to extract heat from the waters surrounding Scotland using heat pumps.

DATA DEVELOPMENT

The Scotland Heat Map is an interactive web map that allows users to identify where there are opportunities for decentralised energy projects across Scotland, for example for heat networks, to assess heat density and proximity to heat sources. The tool can help to visualise heat demand and sources, and how these can be connected in an efficient way to reduce the cost of heat supply and the carbon intensity of heat generation.

The map is a continually evolving resource. Over the coming year we will work with data providers and key users to refine and update the information it contains. This will include a focus on quality assurance of datasets and processes to improve and maintain the reliability of the map and encouraging the use of the unique property reference number (UPRN). UPRNs allow us to uniquely identify properties across different datasets and to map them accurately.

We will also investigate other datasets that could be included in the map to further enhance its value as a heat planning tool. For example, more comprehensive and up-to-date information on district heat networks and excess waste heat from industrial processes.

The longer term vision is to exploit the potential to develop the existing heat map into a broader energy map; something that our stakeholders have demonstrated a clear demand for. While maintaining a focus on supporting the development of low cost/low carbon decentralised heat solutions, we will begin exploring opportunities to incorporate high value energy datasets to supplement and strengthen the value of this resource.

Stratego
ENHANCED HEATING & COOLING PLANS

The Stratego Project

The Stratego project, co-funded by the Intelligent Energy Europe Programme of the European Union and the Scottish Government, ran for two years from 2014-2016. The project aimed to support **a strategic approach to heating and cooling planning**, whilst **building the capacities of local authorities** to bring about delivery of **district heating** projects.

The project worked with the Scottish Government and the seven local authorities in the Scottish Cities Alliance (Aberdeen City Council, Dundee City Council, City of Edinburgh Council, Glasgow City Council, The Highland Council, Perth and Kinross Council, Stirling Council).

International exchange of knowledge

The local authorities took part in international coaching with experts at the Aalborg municipally-owned district heating company (Denmark), Hamburg district heating company (Germany), and the Danish District Heating Association.

Participants visited municipal and community-owned district heating schemes using low carbon heating sources such as solar thermal generation with inter-seasonal storage, and waste heat from industry.

Developing local networks to support delivery of district heating

Establishing partnerships and buy-in from local stakeholders is a critical part of achieving successful district heating projects. During the project, a total of 294 people attended 7 local stakeholder events across Scotland. Michael Kellett, Sustainable Economy officer at City of Edinburgh Council said:

> *"On the back of the Stratego local event, further discussions have taken place with developers around the need for a strategic delivery partner for district heating. It provided the City of*
>
> *Edinburgh Council's recently launched ESCO 'Energy for Edinburgh' with a platform to start looking at partnership opportunities to support delivery of district heating schemes in Edinburgh"*

More information and outputs from the project, including best practice reports, can be found at the project website: http://stratego-project.eu/

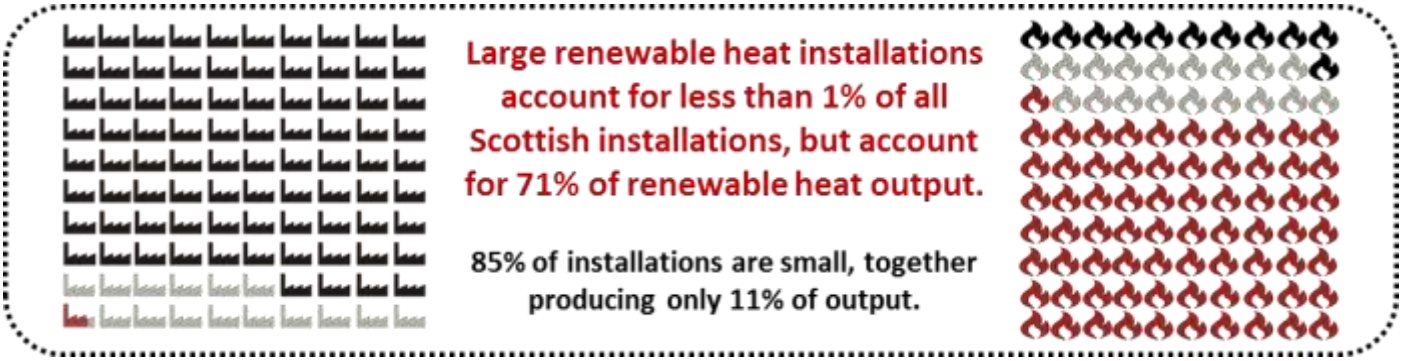
Renewable heat installation size

As Table 4.3 shows, the majority of renewable heat output in 2015 continues to come from large (1 MW+) installations. In total, large installations contributed 47% of the renewable heat capacity and 71% of the annual output. This large contribution from a small number of sites is inherent with the scale of these sites but also the fact that the large installation category includes installations which are primarily using renewable heat to provide process heat, as a product of combined heat and power, or combustion of waste, which are year-round activities. Small to medium and micro installations are more likely to be used to provide space heating and/or hot water for buildings, whose demands are more seasonal and so their contribution to total renewable heat output is proportionately less.

Table 4.3: Renewable heat statistics by installation size, Scotland, 2015

	RENEWABLE HEAT CAPACITY (GWth[11])	% RENEWABLE HEAT CAPACITY	ANNUAL OUTPUT (GWh)	% ANNUAL OUTPUT	NUMBER OF INSTALLATIONS	% OF INSTALLATIONS
LARGE (>1 MWth)	0.710	47%	2,958	71%	60	<1%
SMALL TO MEDIUM (>45kWth & <1MWth)	0.510	34%	722	17%	3,130	15.0%
MICRO (<45kWth)	0.283	19%	464	11%	17,670	85.0%
UNKNOWN	<0.001	<0.1%	<1	<0.1%	<10	<0.01%
TOTAL	1.504	100%	4,165	100%	20,870	100%

Source: EST



Renewable heat technologies

Table 4.4 shows that most of Scotland's renewable heat output comes from biomass combustion, which supplies almost 90% of renewable heat. Other sources such as heat pump and solar thermal installations, which are most suited to use in water and space heating on small scales account for around 7%, with the remainder generated from waste sources.

Table 4.4: Renewable heat statistics by technology type, Scotland, 2015

	RENEWABLE HEAT CAPACITY (GWth*)	% RENEWABLE HEAT CAPACITY	ANNUAL OUTPUT (GWh)	% ANNUAL OUTPUT
BIOMASS	0.901	60%	2,203	53%
BIOMASS CHP	0.391	26%	1,517	36%
ENERGY FROM WASTE	0.052	3%	192	5%
HEAT PUMPS	0.126	8%	236	6%
SOLAR THERMAL	0.033	2%	17	<1%
TOTAL	1.504	100%	4,165	100%

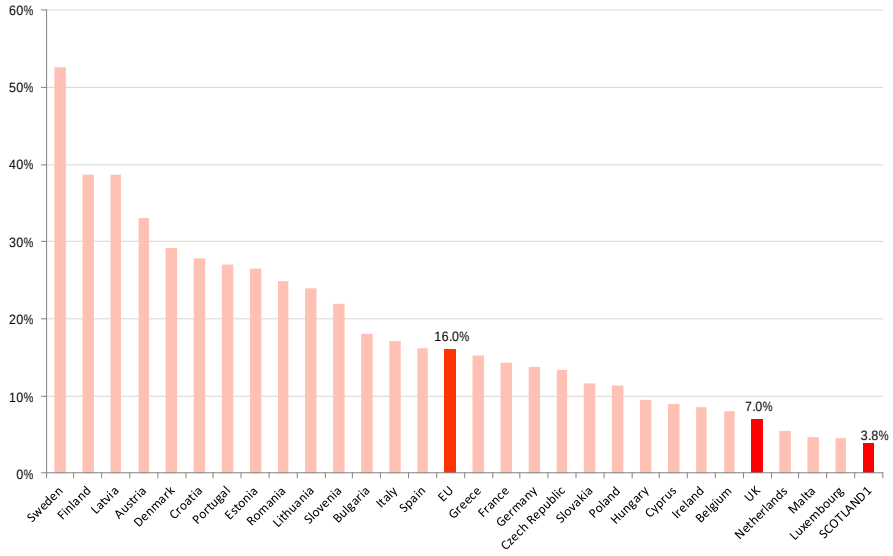
Source: EST

11. GWth refers to thermal capacity, whereas GWe would refer to electrical capacity. Please also see the calculation box on page 91.

International comparisons

In 2014, renewable energy accounted for 16% of total energy use for heating and cooling in the EU. This is a significant increase from 9.9 % in 2004. Increases in industrial sectors, services and residential use (building sector) contributed to this growth.

Figure 4.16[1]: Share of renewable heat of all heating and cooling demand, countries of the EU, 2014



Sources: Eurostat, Scottish Government

SCOTLAND.....3.8%

UK.....7.0%

EU average....16.0%

Although good progress has been made in Scotland since 2009, the share of renewable heat is the lowest of all EU countries (including the UK as a whole) and well below the EU average.

COOLING DEMAND

It is important to note that heat demand refers to demand for both heating ***and cooling***. Heat used for cooling counts towards the UK's renewables targets under the Renewable Energy Directive (RED) and many commercial and industrial users of energy consume comparable amounts of energy for heating and for cooling. For example, heat can be used to provide cooling through absorption chillers and this is quite common practice in commercial and industrial uses. Air conditioning is also an example of cooling demand , particularly in the commercial sector.

National Comprehensive Assessment

The National Comprehensive Assessment (NCA) report met the EU legal requirement for all member states to submit a report by 31 December 2015, and presented the results of extensive work carried out to assess the technical and socially cost-effective potential of individual high-efficiency heat technologies and efficient district heating solutions up to 2030.

The results suggested there is significant potential for future development of district heating and cooling and these results will be helpful in informing the further development of Heat policy in Scotland.

Renewable Heat Incentive (RHI)

The RHI is a UK Government scheme set up to encourage uptake of renewable heat technologies amongst householders, communities and businesses through financial incentives. It is the first of its kind in the world, and the Scottish Government expects the RHI to contribute towards its 2020 target of 11% of non-electrical heat demand from renewable sources. The RHI, along with Scottish Government programmes, will help to sustain and build the supply-chains needed to deliver the Scottish Government's aspirations for renewable heat in 2020 and beyond.

The RHI is designed to bridge the gap between the cost of fossil fuel heat sources and renewable heat alternatives. The scheme pays owners of participating installations based on the renewable heat supplied to their (or others') buildings. By increasing the generation of heat from renewable energy sources (instead of fossil fuels), the RHI helps the UK reduce greenhouse gas emissions and meet targets for reducing the effects of climate change. There are two parts to the RHI:

Domestic RHI – launched 9 April 2014 and open to homeowners, private landlords, social landlords and self-builders

Non-domestic RHI – launched in November 2011 to provide payments to industry, businesses and public sector organisations

BEIS publish statistics on a monthly basis providing an update on the uptake of both the non-domestic and domestic Renewable Heat Incentive (RHI) schemes. The latest data, available for this report, is for uptake as at December 2016. See here:

https://www.gov.uk/government/collections/renewable-heat-incentive-statistics

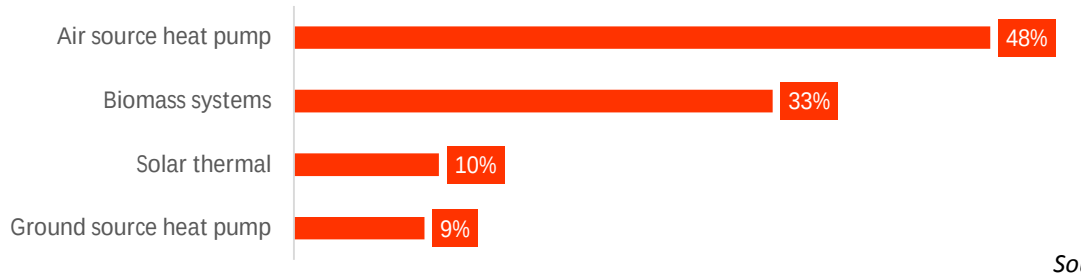
Domestic RHI

There is considerable difference in the uptake rates across Great Britain, with Scotland maintaining a greater uptake than its' population share.

- 20% of all GB applications (11,377 of 56,624)
- 20% of all GB accreditations (10,849 of 52,971)

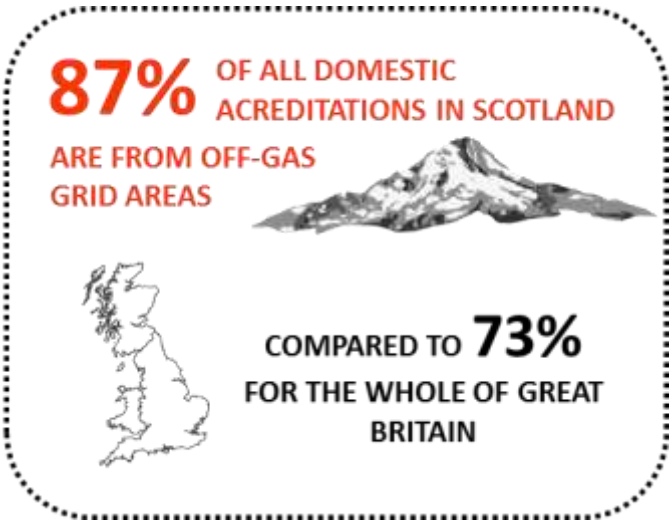
In terms of the renewable heat technologies being accredited, Figure 4.17 shows that Air Source Heat Pumps (ASHP) are the single most popular technology, accounting for 48% of all domestic RHI accreditations in Scotland to date. Biomass also accounts for a large proportion, with 33% of all domestic accreditations in Scotland.

Figure 4.17: Domestic RHI accreditations by technology, Scotland, as at December 2016



Source: BEIS

There is data available which shows the number of accreditations made from properties in Scotland and whether or not they are off-gas grid. In Scotland, 87% of accreditations are from properties off-gas grid (see page 85 for more information on off-gas grid), compared to 73% for GB as a whole. Disaggregating further, by technology type, shows the proportion of accreditations for each technology that are made from off gas grid properties:



- Air Source Heat Pumps (ASHP) **(90%)**
- Biomass **(89%)**
- Ground Source Heat Pumps (GSHP) **(89%)**
- Solar thermal **(62%)**

The local authority area with the largest proportion of accredited domestic RHI installations to date is Highland with 17%. South Lanarkshire is second with 15%, and Dumfries and Galloway in third place with 14%.

Non-Domestic RHI

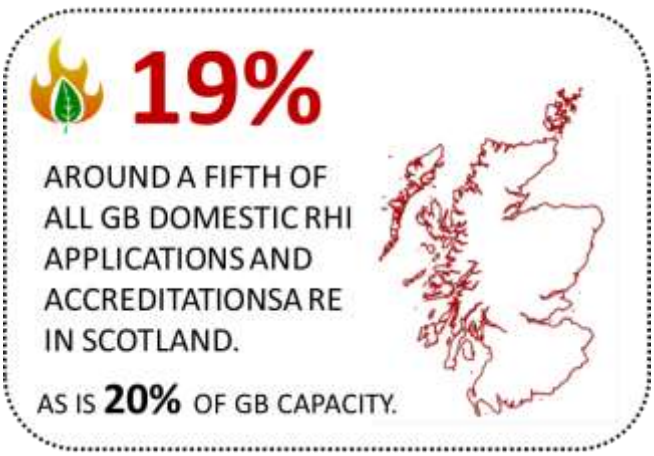
Similar to domestic RHI, Scotland maintains a higher than population share of its non-domestic counterpart. To date, Scotland accounts for:

- 19% of all GB applications (3,268 of 17,430) with 20% of the capacity (684 MW of 3,464 MW)
- 19% of all GB accredited installations (2,991 of 16,133) with 20% of the capacity (585 MW of 2,965 MW)

The local authority area with the largest proportion of accredited non-domestic installations to date is Dumfries and Galloway with 16%. Highland is second with 14%, and Aberdeenshire in third place with 12%. Although Dumfries & Galloway accounts for the largest proportion of installations, Highland accounts for the largest proportion of overall capacity in Scotland with 16%.

"Non-domestic RHI is designed to bridge the gap between the cost of fossil fuel heat installations and renewable heat alternatives"

Department for Business, Energy and Industrial Strategy



Domestic RHI

The data in this section is for uptake as of end September 2016, using data supplied by BEIS for RHI activity in Scotland.

As at end September 2016 there had been over 11,000 applications and over 10,500 accreditations in Scotland of which 53% and 54% respectively were from new installations.

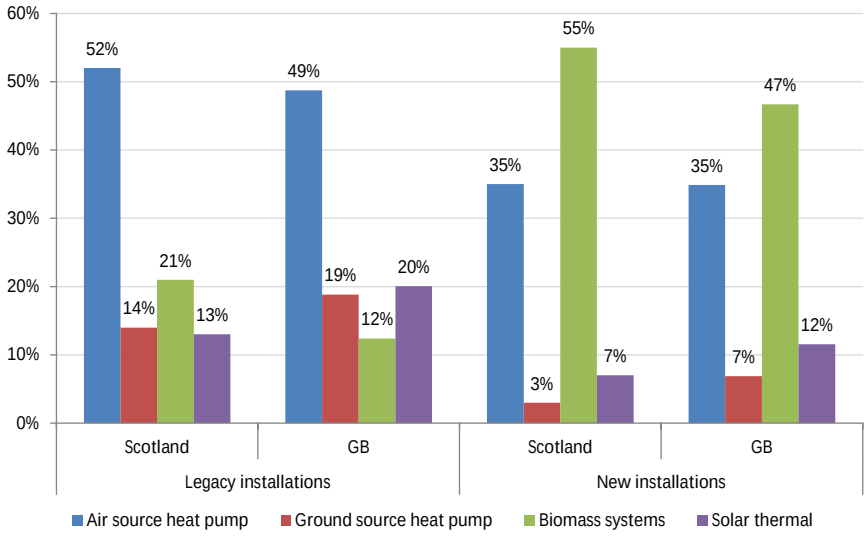
New installations *(installed after launch of the RHI scheme)*

As at end of September 2016, there had been 5,893 applications in Scotland for new installations to join the domestic RHI scheme and 5,675 of these (96%) had gone through full checks by Ofgem to ensure they comply with the relevant conditions, and had been accredited. Since scheme launch, most accreditations from new installations were for either air source heat pumps (44%) or for biomass systems (44%). Solar thermal accounted for 7% of accredited new installations and ground source heat pumps for 5%.

Legacy installations

As at end September 2016, of the 11,090 applications to join the domestic RHI scheme, 47% (5,197) were from legacy applicants. 4,913 (95%) of the legacy applications have been accredited, with 52% of accreditations for ASHP, 21% for biomass systems , 14% for GSHP and 13% for solar thermal.

Figure 4.18: Percentage of domestic RHI accreditations by technology type, Scotland and GB, Apr 2014 to Sep 2016



Source: BEIS

Figure 4.18 shows the shift in the proportion of accreditations by technology type between legacy and new installations.

Legacy accreditations are dominated by air source heat pumps, 52% for Scotland and 49% for GB. While ASHP systems do dominate among new installations, there are a higher proportion of biomass systems.

DATA NOTE: LEGACY INSTALLATIONS

Legacy Installations were those installed between 15 July 2009, when the scheme was first announced, and 9 April 2014 when the RHI scheme was first launched. The deadline for legacy applicants to apply was 8 April 2015, after which time only applicants with mitigating circumstances could apply.

New installations refer to systems installed on or after the launch of the domestic RHI scheme on 9 April 2014. Such applicants have not received Renewable Heat Premium Payment (RHPP) scheme funding or any other government support.

THE RENEWABLE HEAT INCENTIVE

A Reformed Scheme

In March 2016, the UK Government set out its initial proposals for reform of the RHI scheme in the consultation: The Renewable Heat Incentive - A reformed and refocused scheme.

The UK Government response to this consultation was published on 12 December 2016:

The Renewable Heat Incentive: A reformed scheme – Government response to consultation.

Main Features of Reforms

The reforms aim to ensure the Renewable Heat Incentive Scheme continues to:

- Offer value for money and protects consumers
- Contributes to the development of sustainable markets and supply chains
- Incorporates a robust scheme design
- Focuses on long term decarbonisation and renewable energy targets

To achieve these aims the following reforms will be incorporated into the scheme:

A Budget Cap Mechanism: As of April 2016, BEIS publish monthly estimates of spending in current and future financial years against the scheme's total budget to allow potential applicants to make an assessment of how likely the cap is to be triggered and the scheme closed, providing transparency to aid financial decision-making.

Heat Pumps: There will be an increase in tariff support for domestic ground source and air source heat pumps to support growing installation numbers. All new domestic heat pumps will be required to have electricity meters installed, to provide performance information to households and enable market-driven performance improvement. Heat demand limits for air source heat pumps will be introduced and ground source heat pumps limits increased for domestic installations.

Biogas and Biomethane: New plants will be required to produce at least half their biogas and biomethane from waste-based feed stocks to receive support for all their production. This will improve the carbon cost-effectiveness of further support to this technology.

Biomass: The introduction of one level of support for all new non-domestic biomass boiler deployment. Introduce a cap to the annual payments for new domestic biomass systems to ensure owners of larger properties are not overly compensated. An increase to the tariff for new domestic biomass systems to allow the technology to continue to deploy.

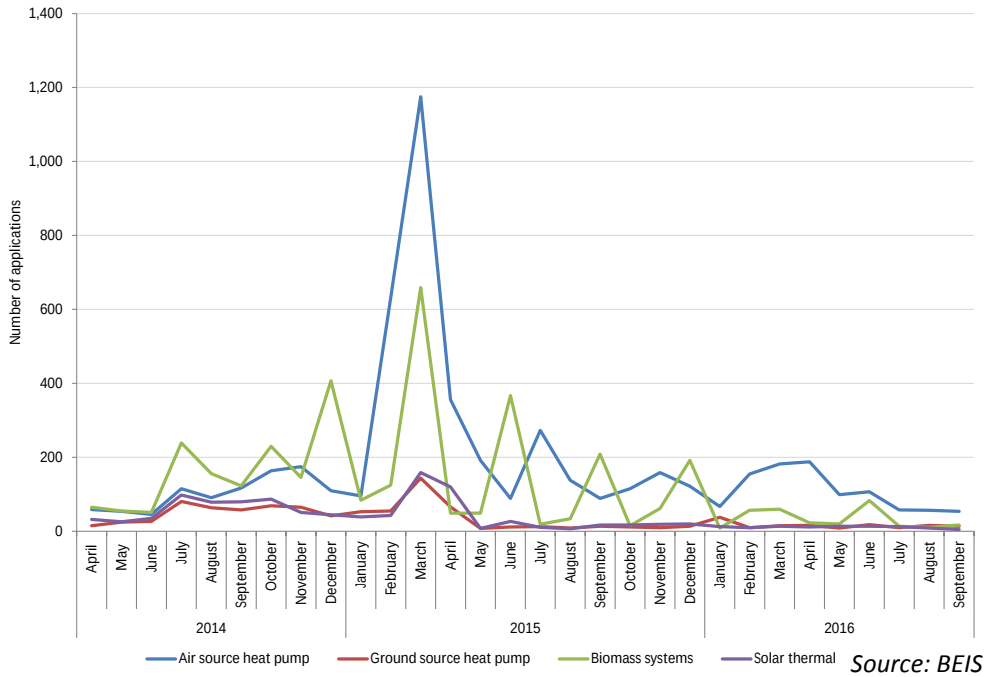
Certainty for Large Scale Projects: The introduction of "tariff guarantees" to help address the imbalance in the scale of projects, by providing certainty to investors regarding the tariff they will receive earlier in the project lifecycle and increase and encourage deployment and certainty for larger projects.

Third Party Financing Arrangements: The proposed reforms will not introduce changes to allow the development of third-party financing arrangements in the domestic RHI scheme as planned. Further consideration will be given to ensure that such changes do not lead to consumer protection issues before they are introduced.

Application and accreditation rates

Figure 4.19 below shows that since the domestic RHI scheme began, there has been a considerable variation in the number of applications received per month.

Figure 4.19: Number of Domestic RHI applications per month by technology, Scotland, April 2014 to September 2016



Source: BEIS

There were distinct increases in application rates during December 2014, March 2015 and June 2015, largely for biomass and air source heat pumps. With March 2015 seeing a particularly sharp rise in applications for air source heat pumps.

Smaller peaks in 2014 relate to expansions to eligibility criteria for the scheme.

The increased application rate in December 2014 was likely due to new biomass applicants submitting applications prior to the 10% biomass tariff reduction which came into effect from 1 January 2015. The very large spike in applications in March 2015 was predominantly due to legacy applicants joining the scheme before the deadline for participation arrived on 8 April 2015. There was also an increase in new biomass applicants due to a 20% reduction to the biomass tariff affecting applications after 1 April 2015.

July to September 2016 saw the lowest number of new domestic biomass applications since the domestic RHI scheme began. The most recent degression tariff change on the domestic scheme was a reduction in the biomass tariff; announced in May 2016 and effective from July 2016. From July 2016, there has been relatively equal deployment between months, rather than the pattern of quarterly peaks that can be seen in prior months. This may be because there were no tariff changes announced for October.

Please note that these are explanations of trends that are GB wide, but are likely to also explain the impact in Scotland. Please see RHI Quarterly Statistics - Sep 2016 for more GB wide information.

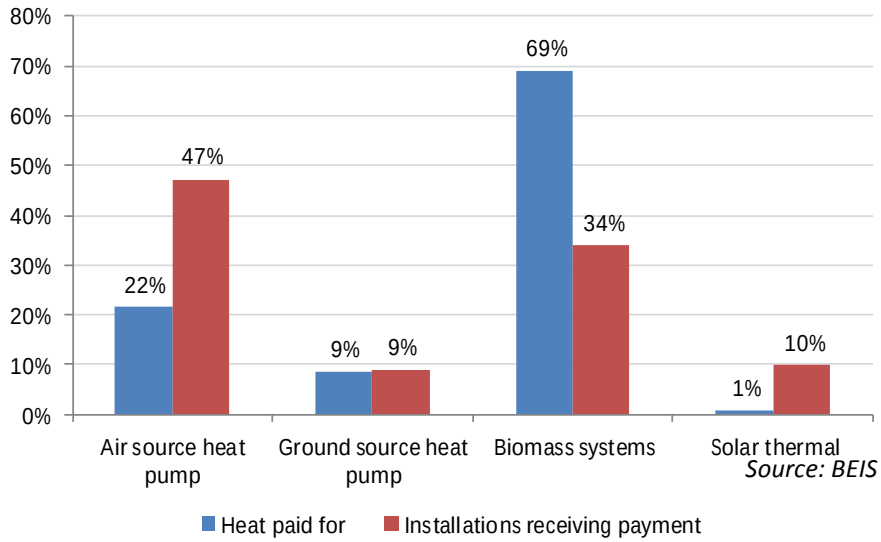
The third quarter of 2016 saw a decrease from the previous quarter, with application numbers less than half (54%) that of the previous quarter (603 in Q2) and accreditations down by more than a third (down 38% from 576 in Q2).

Heat Generated

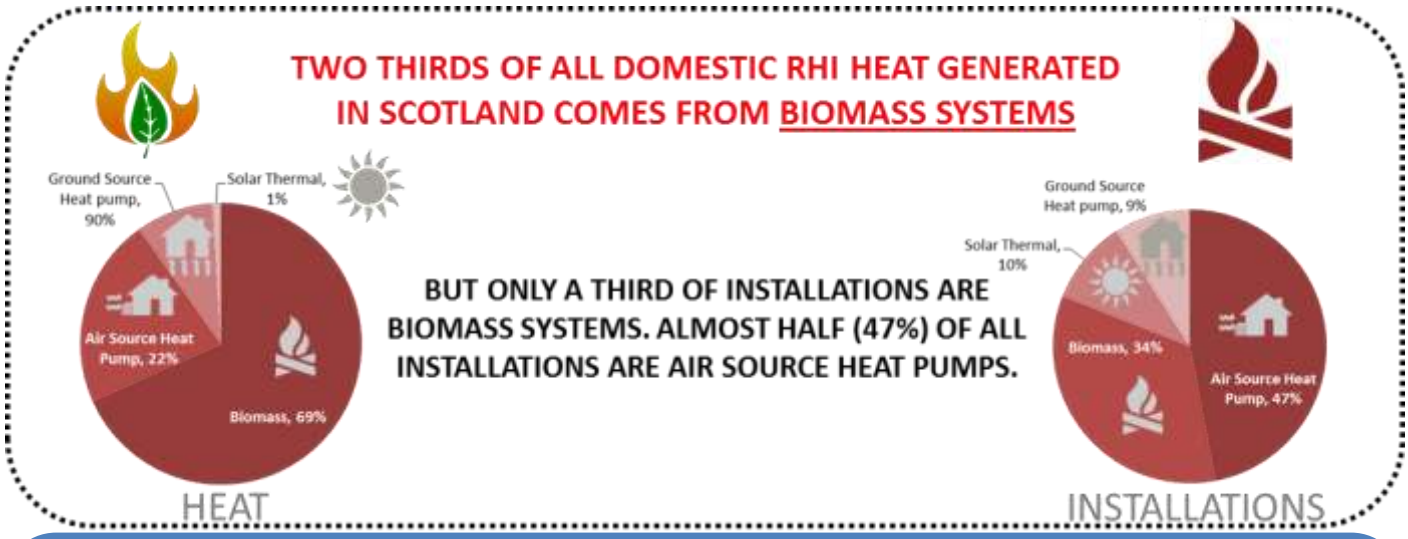
As at end September 2016, over 276 GWh of heat had been paid for under the domestic RHI scheme in Scotland:

- 190 GWh of heat was generated by biomass systems (69%)
- 59 GWh air source heat pumps (22%)
- 24 GWh by ground source heat pumps (9%)
- and 3 GWh by solar thermal (1%).

Figure 4.20: Percentage of Heat generated and number of installations receiving payment by technology, Scotland, April 2014 to September 2016



Whilst 69% of heat generated to date is from biomass systems, they account for only 34% of installations to have received one or more payments. This is partly due to biomass systems typically having greater capacity and more likely to be installed within larger households. Conversely, solar thermal accounts for 10% of the installations receiving payment, yet just 1% of the heat generated. This is because solar thermal is a complimentary heating technology not typically capable of producing heat in the volumes seen from the other technologies.

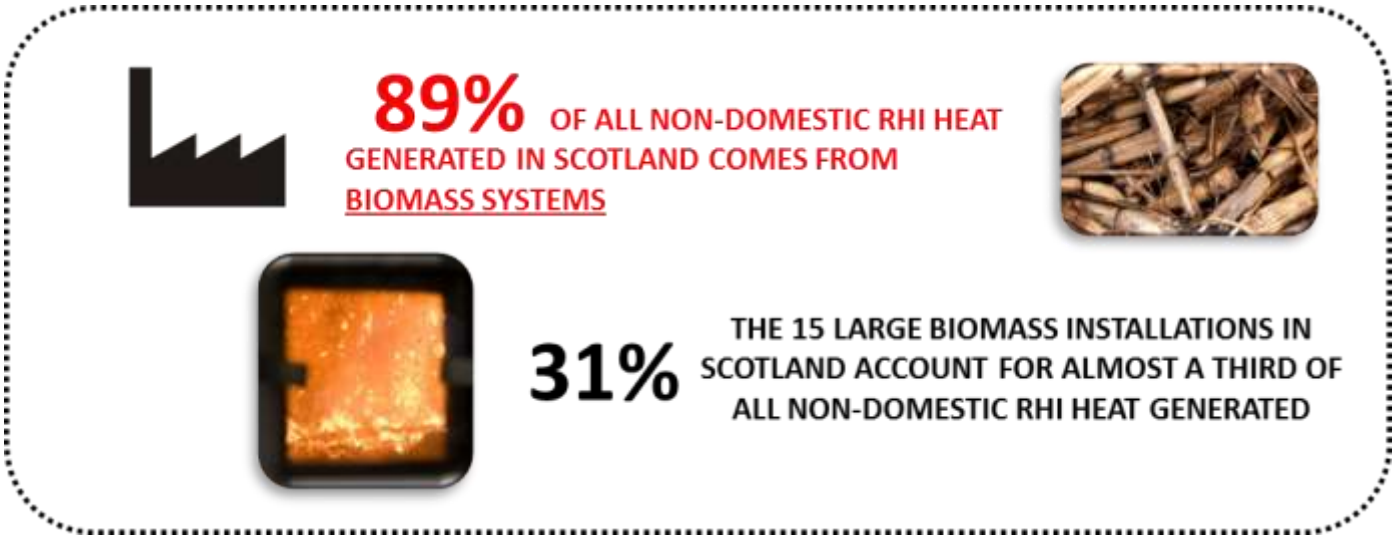


DATA NOTE: RHI PAYMENTS

Payments are calculated using either estimates of annual heat demand (determined via green deal assessment) or meter readings provided by the applicant. Accredited applicants will not receive their first payment until at least 3 months after they originally applied to the scheme. This is the reason for the discrepancy between the number of accredited applications and the number receiving payment.

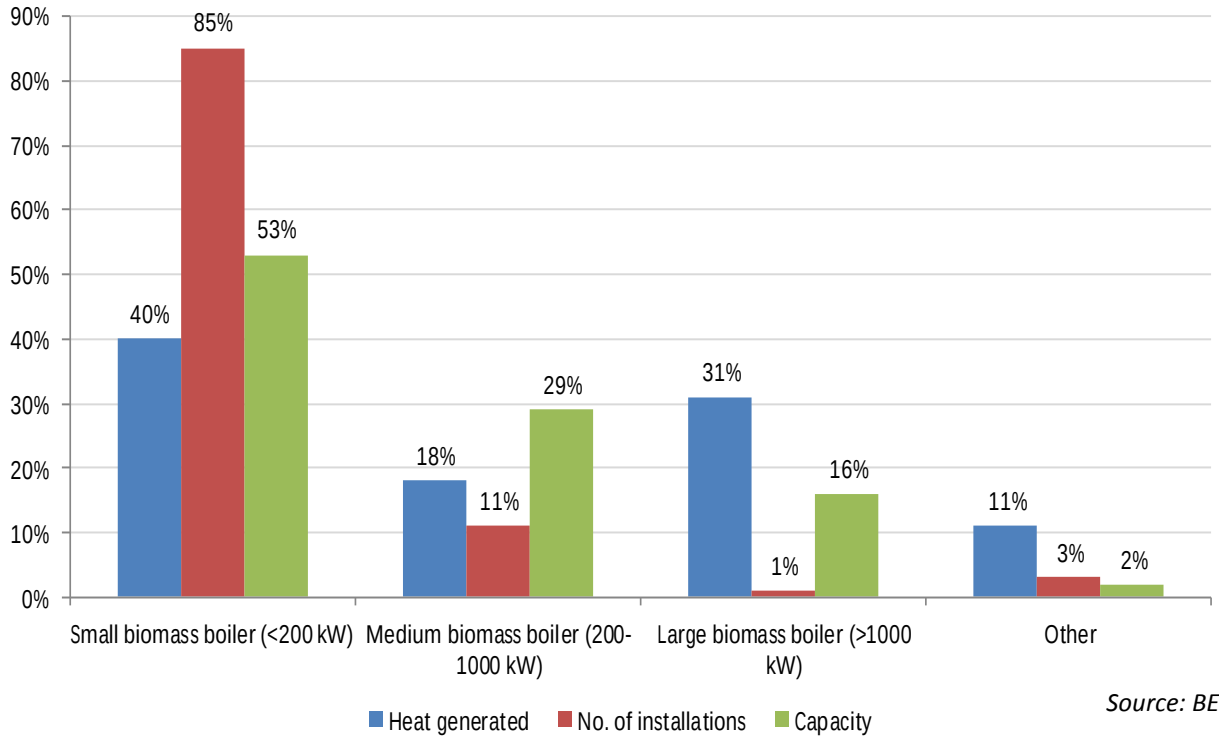
Non-domestic RHI

Heat generated is calculated by Ofgem from the meter readings of accredited scheme participants. Meter readings are collected and processed to ensure that the correct amount of support can be paid. Statistics on heat generation in this publication relate to the period when the payment was made for heat generated, not the period in which heat was actually generated.



As at end of September 2016, installations on the non-domestic RHI scheme had provisionally generated almost 1,890 GWh of eligible heat in Scotland, 16% of the UK total. Biomass boilers dominate heat generation with around 2,700 systems responsible for 89% of heat generated and paid for under the scheme. Figure 4.21 shows the breakdown by technology. Biomethane injected into the gas grid accounts for 10% (193 GWh) of the total heat generated under the non-domestic RHI scheme in Scotland since it was introduced in November 2011.

Figure 4.21: Heat generated, installed capacity and number of installations receiving payment by tariff, Scotland, November 2011 to September 2016

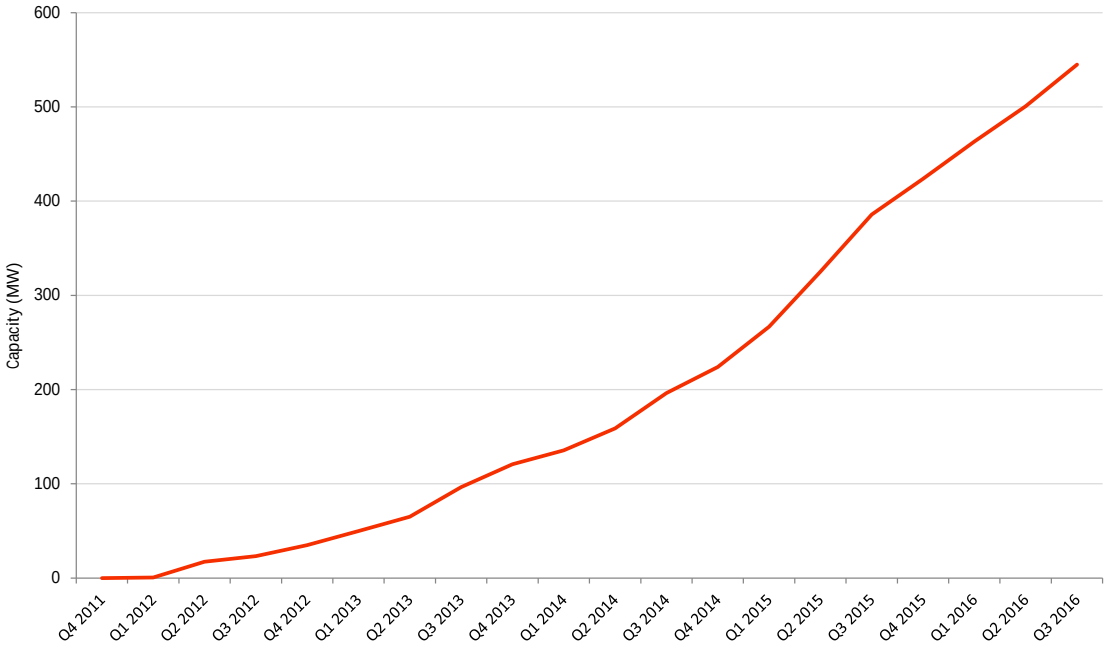


Source: BEIS

A distinction has been made between metered heat, generated on site and the equivalent energy of biomethane injected into the gas grid.

Figure 4.22 shows the cumulative installed heat capacity receiving payment under the non-domestic RHI scheme. The chart demonstrates that there has been a consistent increase in non-domestic RHI capacity installed since the scheme was established in 2011, though in the last year the rate of increase has reduced slightly. The capacity installed in the third quarter of 2016 (44.2 MW) was 27% lower than the same period in 2015 (60.6 MW).

Figure 4.22: Non-domestic RHI cumulative installed capacity per month, Scotland, November 2011 to September 2016



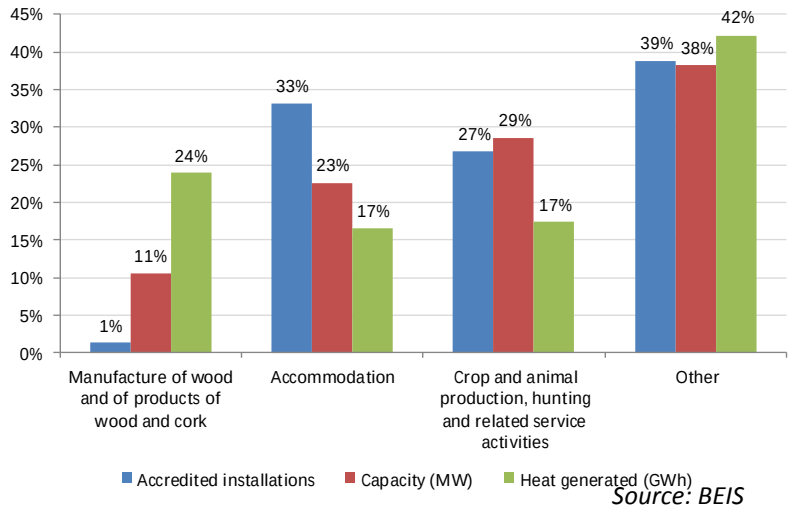
Source: BEIS

As at end September 2016, the heat generated from all accredited non-domestic RHI installations was 1,890 GWh. Three sectors dominate the heat generated from non-domestic RHI installations in Scotland, accounting for 58% of the total:

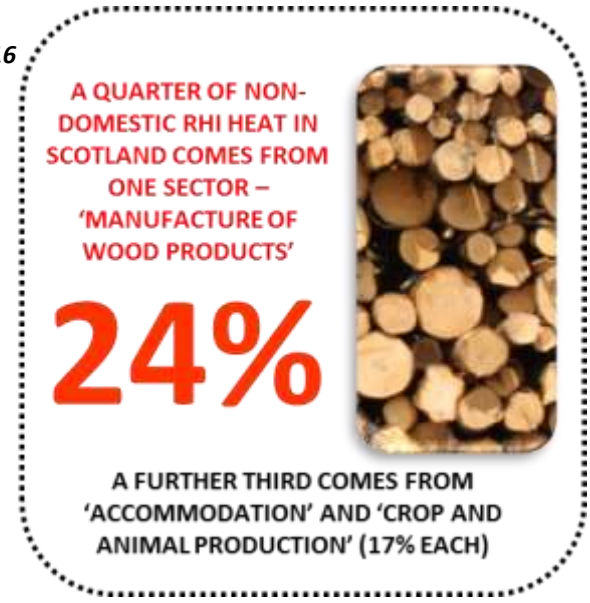
- 24% in the manufacture of wood products sector (452 GWh)
- 17% in the accommodation sector (311 GWh)
- 17% in the crop and animal production sector (329 GWh)

The 24% of heat generated by the 'manufacture of wood products' sector is generated by only 37 sites, whereas the 17% of heat generated in the accommodation sector comes from 954 sites.

Figure 4.23: Capacity of accredited installations by Standard Industrial Classification Code (SIC), Great Britain, November 2011 to September 2016



Source: BEIS



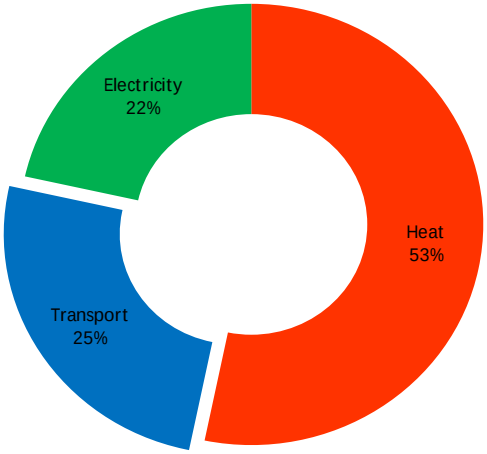
CHAPTER 5

TRANSPORT

'In 2015 biofuels had a 3.2% share of road fuels'

TRANSPORT

KEY FACTS



In 2015 biofuels had a ...

3.2%

...share of road fuels in the UK

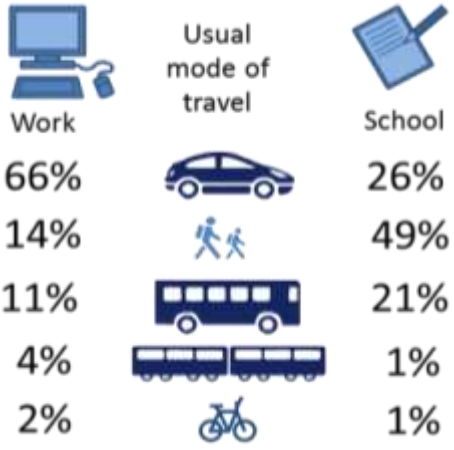
Transport is estimated to account for 25% of Scotland's total energy use. The split of energy used to transport people and goods on the roads is about 60:40 respectively.

In Scotland in 2015,

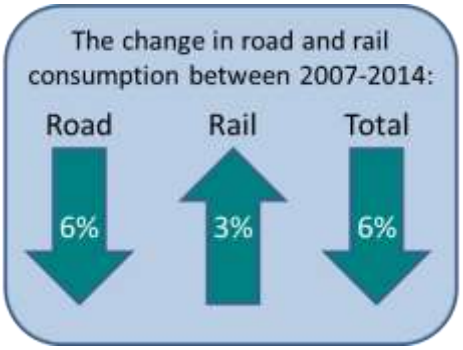
77%

reported travelling the previous day,
the same as in 2014.

In 2015, the distance driven by cars in Scotland on major roads was 22.6 billion km - the equivalent of driving the length of Britain around 16 million times.



25.5 million air terminal passengers at airports in Scotland in 2015, **up by 6%** since 2014



"Latest data for Q3 2016 shows that biofuels made up 3.4% of all road fuels in the UK"

Of the 537 million public transport journeys made in 2015 in Scotland:

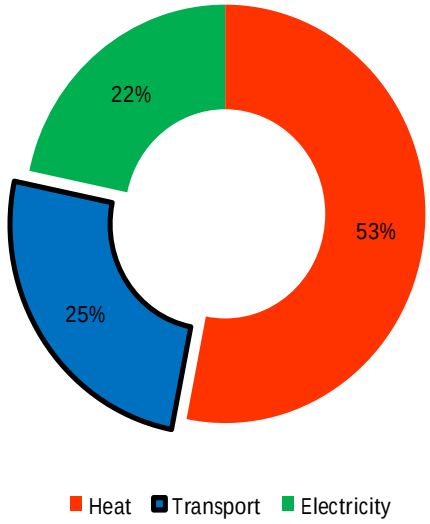
	Bus	Rail	Air	Ferry
2015:	78%	16%	4%	2%
1991:	89%	8%	1%	1%

Final Energy Consumption in the Transport Sector

Transport is estimated to account for around a quarter of Scotland's total energy use (see Figure 5.1). The split of energy used to transport people and goods on the roads is about 60:40 respectively.

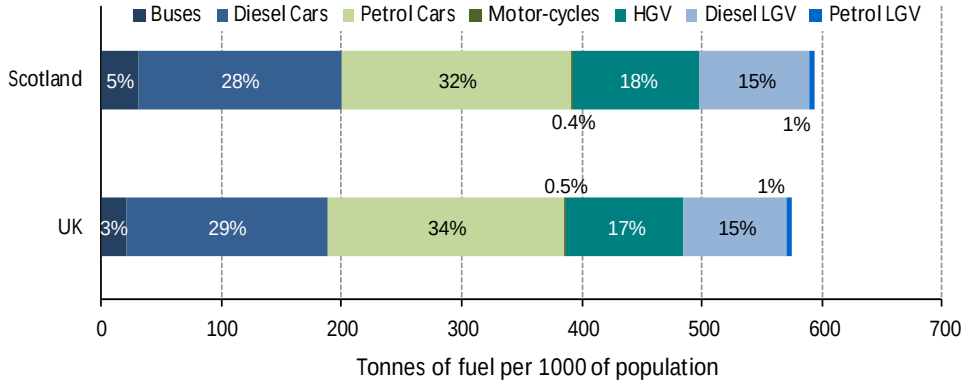
As Figure 5.2 shows, road transport fuel consumption per capita in Scotland in 2014 is similar to the overall UK level. With Petrol Cars accounting for 32% of fuel used per capita in Scotland and 34% in the UK, diesel cars accounting for 28% in Scotland and 29% in the UK, and heavy goods vehicles (HGV) accounting for 18% in Scotland and 17% in the UK.

Figure 5.1: Total final energy consumption by sector, Scotland, 2014



Sources: Department for Business, Energy and Industrial Strategy, Scottish Government

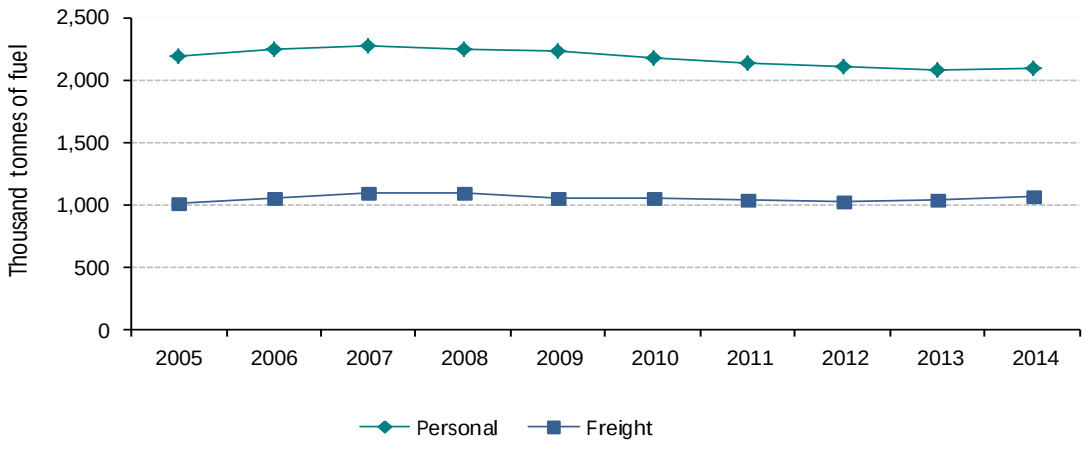
Figure 5.2: Road transport energy consumption per thousand of population, Scotland, 2014



Source: BEIS

Figure 5.3 shows that from 2005 to 2014, total personal transport fuel consumption fell by 4%, while over the same period freight consumption increased by 5%. Across the UK total fuel consumption for personal use reduced by 6%, while freight increased marginally by less than 1% over the same period.

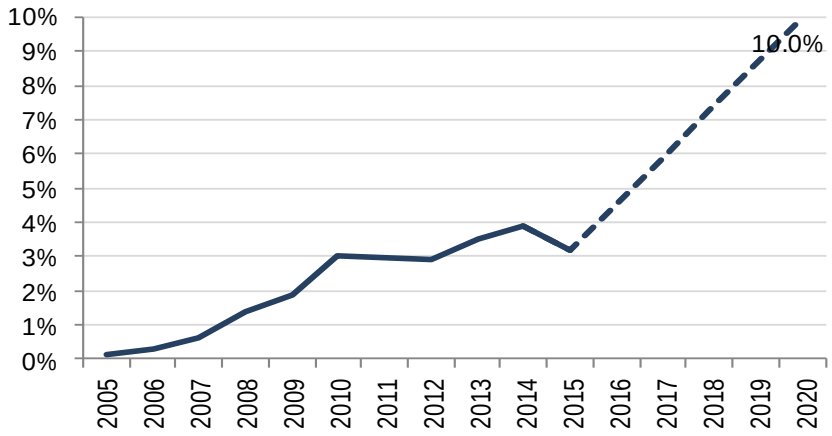
Figure 5.3: Road transport fuel use for personal and freight consumption, Scotland, 2005-2014



Source: BEIS

Renewable Transport Target

Figure 5.4: Share of biofuels in transport petrol and diesel consumption, Scotland, 2005 - 2015



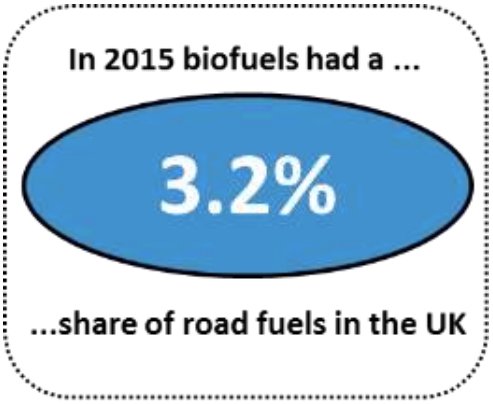
Source: BEIS

In 2015, 1,464 million litres of liquid biofuels were consumed in transport in the UK, a decrease of 17.1% from the 2014 total. This is over 12 times higher than that consumed in 2005.

Liquid Biofuels are broken down into two categories: Bioethanol (used with Petrol) and Biodiesel (used with Diesel).

Using the latest data for the third quarter of 2016, bioethanol accounted for 4.4% of motor spirit and Biodiesel 2.8% of diesel (DERV). The combined contribution was 3.4%, an increase of 0.1 percentage points compared to Q3 2015.

The Scottish Government has a 2020 target of 10% of transport fuels to be from renewables. Thus far, Biofuels had a 3.2% share of road fuels in the UK as a whole in 2015, down from 3.9% in 2014 (data is not available separately for Scotland, so the UK proportion is assumed).



"Latest data for Q3 2016 shows that biofuels made up 3.4% of all road fuels"

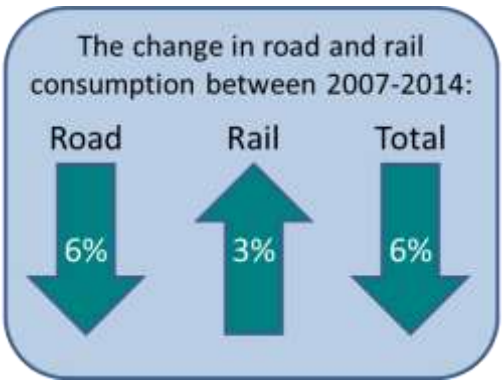
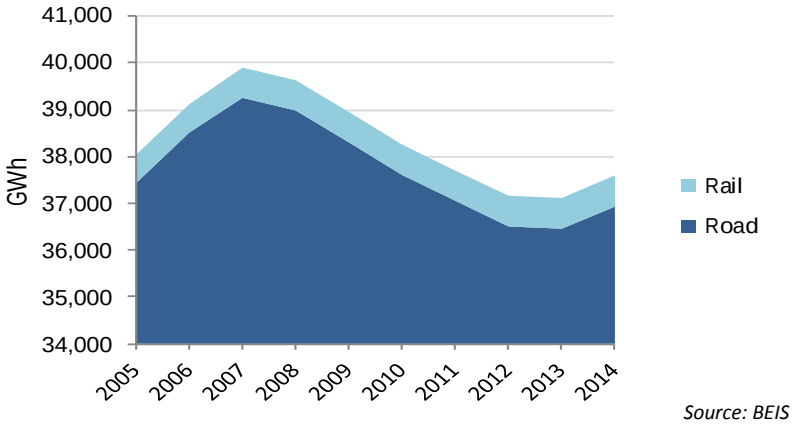


Figure 5.5: Total final energy consumption for road and rail transport, Scotland (GWh), 2005—2014



Source: BEIS

Overall energy consumed by road and rail transport combined, increased from 2005 and peaked in 2007. Consumption began to fall until 2014, in which consumption increased by 1% compared to 2013. This was mainly due to an increase in road consumption. The decrease in consumption of road and rail fuels between 2007 and 2014 was 6% for Scotland compared to 7% for the UK.

Energy consumed by rail transport increased by 3% in Scotland and 1% in the UK, between 2007 and 2014. Over the same period, energy consumed by road transport has decreased by 6% in Scotland and 7% in the UK.

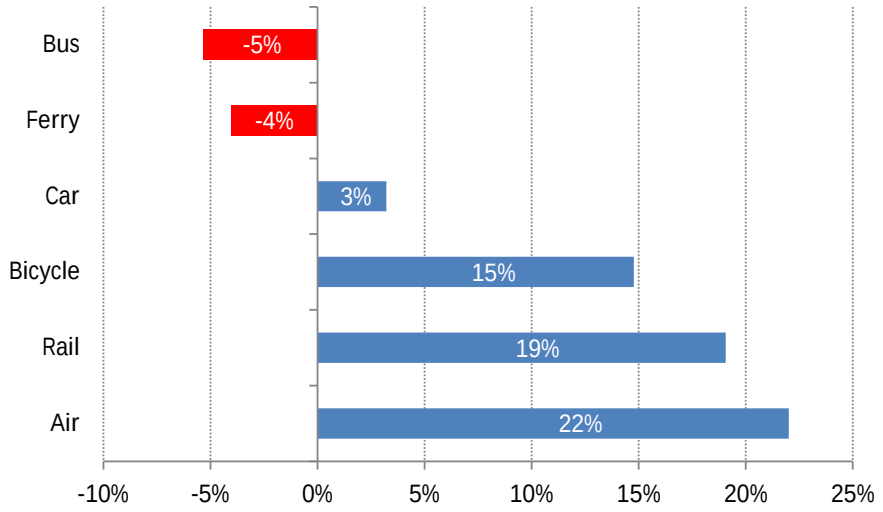
Transport Key Trends

Between 2010 and 2015, there have been changes in travel patterns in Scotland as reported by the Scottish Household Survey and administrative data.

Car traffic over this period increased by 3%, while the distance cycled is estimated to have increased by 15%.

There has been a fall in the number of bus and ferry passengers of 5% and 4% respectively, whereas air and rail passengers have increased over this period, by 22% and 19% respectively.

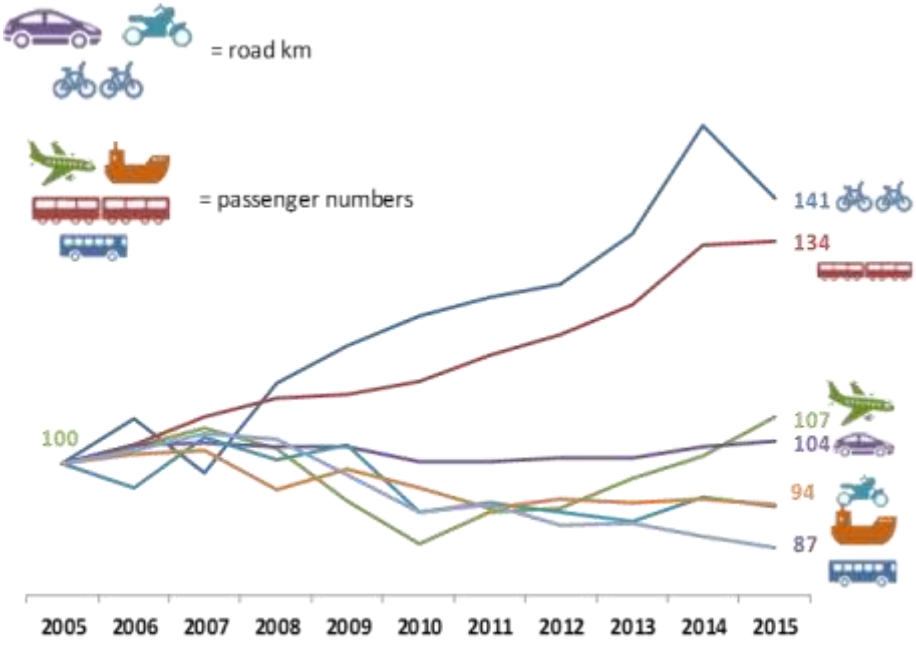
Figure 5.6: Changes in travel, Scotland, 2010 - 2015



Source: Transport Scotland

Figure 5.7: Long term changes in travel, Scotland, 2005—2015

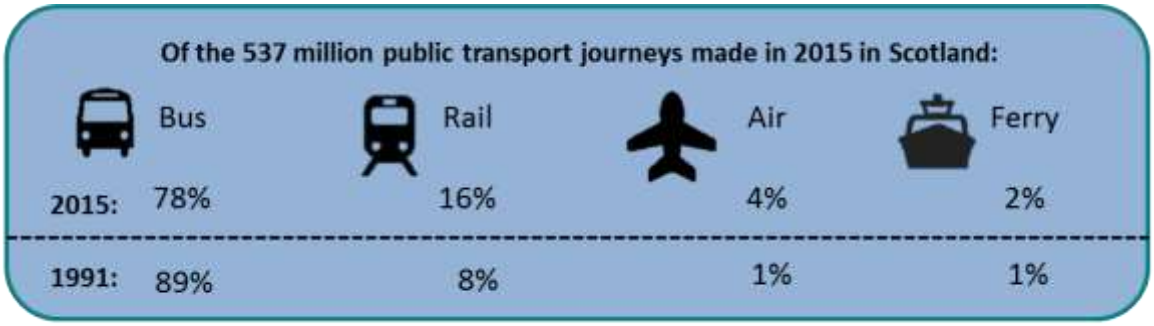
The indexed graph in Figure 5.7 shows the longer-term changes since 2005.



Source: Transport Scotland

In 2015, the distance driven by cars in Scotland on major roads was 22.6 billion km - the equivalent of driving the length of Britain around 16 million times.

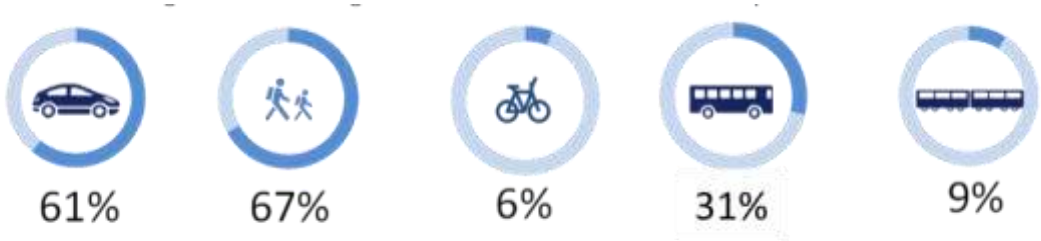
There were 537 million public transport journeys made on bus, rail, air and ferry in 2015 (the latest year for which ORR rail data is available for cross border journeys, and including trips abroad by ferry or air).



76% of all public transport journeys were made by bus and 17% by rail in 2015. Air travel accounted for 5% and ferries 2%. In the same year, 22.6 billion kilometres were traveled by car on major roads (M and A roads), the equivalent of driving the length of Britain around 16 million times.

Figure 5.8 shows how often people in Scotland used different modes of transport in 2015.

Figure 5.8: Percentage of adults using each mode of travel at least once per week, Scotland, 2015



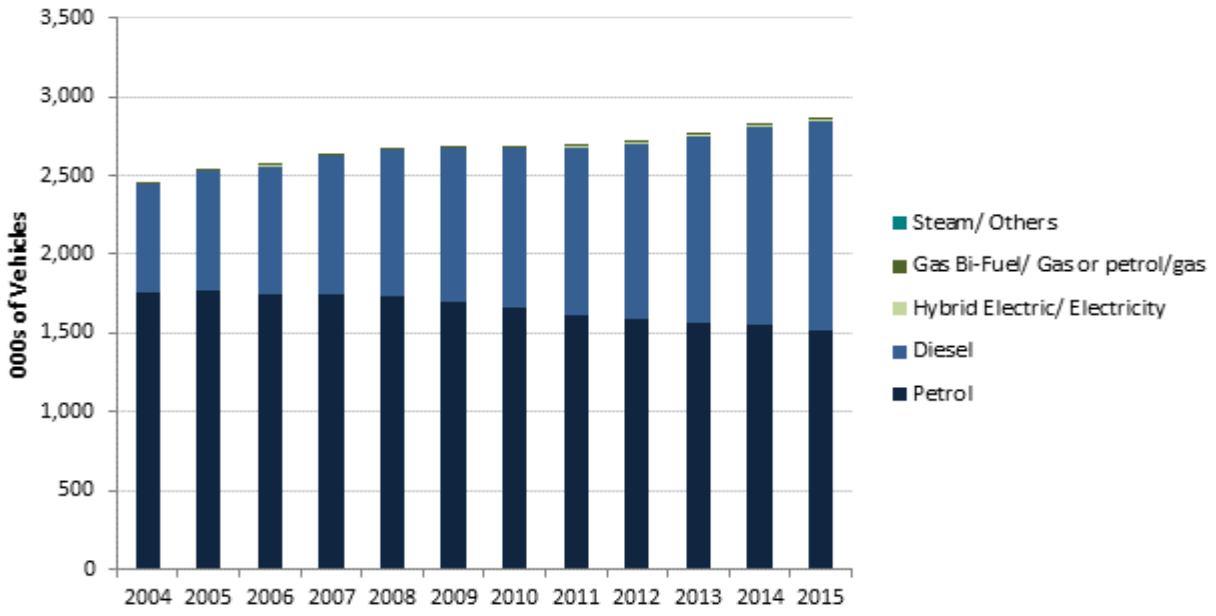
Source: Scottish Household Survey

Travelling by Road in Scotland

In 2015, there were 2.9 million vehicles licensed for use on the roads in Scotland of which 83% were cars. Over two thirds (68%) of the adult population (17+) held a full driving licence. 70% of households have access to one or more cars or vans for private use in 2015. 27% of households have access to two or more cars/ vans.

Figure 5.9 shows vehicles licensed as at December 31st from 2004 – 2015 by method of propulsion. The number of taxed vehicles in Scotland has increased by 17% between 2004 and 2015. The largest number of taxed vehicles have consistently been powered using petrol, however the number of petrol vehicles is on a downward trend, decreasing by 13% between 2004 and 2015. The number of diesel vehicles has increased by 92%. There were only 25 hybrid electric vehicles and 342 electric vehicles in Scotland in 2002. These have increased rapidly and in Scotland, there were 11,331 and 6,002 in 2015 respectively .

Figure 5.9: Vehicles licensed by method of propulsion, Scotland, 2004-2015



Source: Transport Scotland

ELECTRIC VEHICLE USAGE

The Department for Transport has forecast the proportion of cars, LGV, and other vehicles kilometres using petrol, diesel or electricity up to 2030 for the UK as a whole.

See more in Table A1.3.9 which can be found here:

https://www.gov.uk/government/publications/webtag-tag-data-book-july-2016

DATA NOTE–TRANSPORT STATISTICS SOURCES

Official Statistics covering transport topics in Scotland are published by Transport Scotland, an Agency of the Scottish Government. Further information about the work of transport Scotland can be found at: **http://www.transportscotland.gov.uk/statistics**

This report makes use of two main sources of transport data, the 'Scottish Transport Statistics' and 'Transport and Travel in Scotland' National Statistics publications.

Scottish Transport Statistics

This is an annual compendium National Statistics publication that brings together transport data for Scotland from a wide range of sources. The publication covers topics such as: road vehicles, traffic and the road network; bus and coach statistics; freight transport; water transportation; personal travel and international comparisons as well as others.

The latest edition (no. 34; 2015) was published in February 2016 and covers the latest data available at the time of release. The next edition will be published in February 2017.

In the most recent edition, following extensive user consultation and feedback, a set of **infographic summary sheets** and an improved summary chapter have been included. It is hoped that these will provide useful "at-a-glance" summaries of the key facts and content of the publication.

Transport and Travel in Scotland

This National Statistics Transport Scotland publication brings together information from the Scottish Household Survey relating to the transport behaviours of the Scottish population. The survey sample covers around 10,000 adults per year.

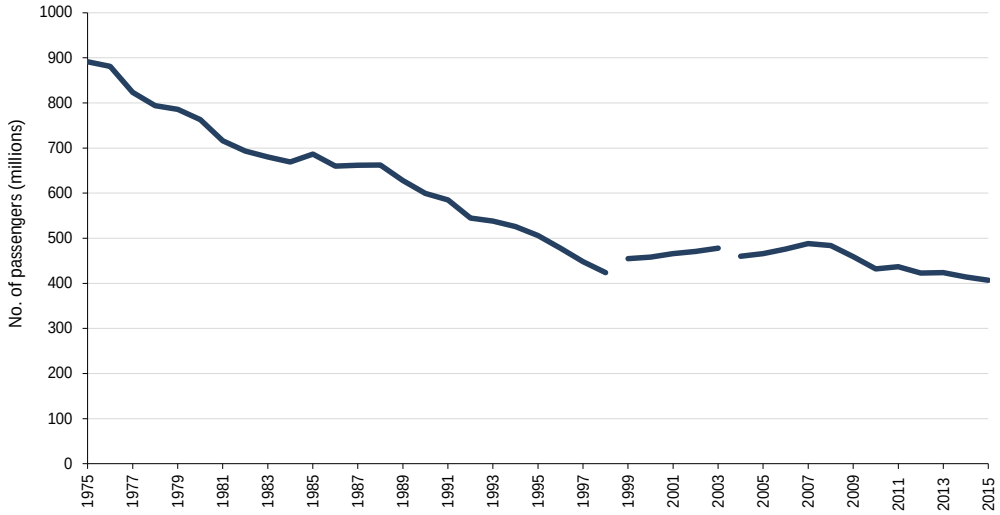
In the 2015 edition, published in September 2016, Transport Scotland also included analysis of the Scottish Household Surveys' travel diary.

The next edition of Transport and Travel in Scotland is likely to be published in late summer 2017.

Bus and Coach Travel

In the 2015-16 financial year, there were 409 million passenger journeys on local bus services in Scotland, a decrease over the previous year of 1.7%, as shown in Figure 5.10.

Figure 5.10: Passenger numbers: local bus, Scotland, 1975-2015



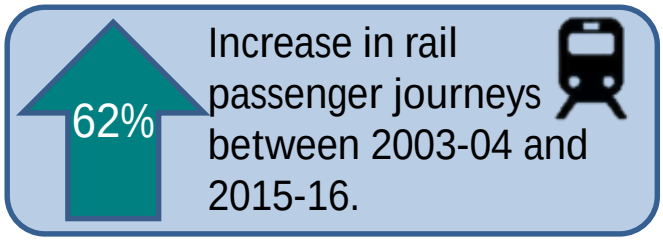
Source: Transport Scotland

Over the longer-term, there has also been a fall in bus passenger journeys. There were almost 1.7 billion passenger journeys on local bus services in 1960. This number had almost halved by 1975. Since then, it has more than halved again, from 891 million in 1975 to 409 million in 2015-16. There was a steady fall in numbers between 1960 and 1999.

Rail Services

There were 93.2 million ScotRail passenger journeys recorded in 2015-16, 0.5 million (0.5%) more than in the previous year and an increase of 34% since 2005/06.

Over the longer-term, the number of rail passenger journeys originating in Scotland (including cross-border journeys) fell from a peak of 73 million in 1964 to a low of 50 million in 1982.

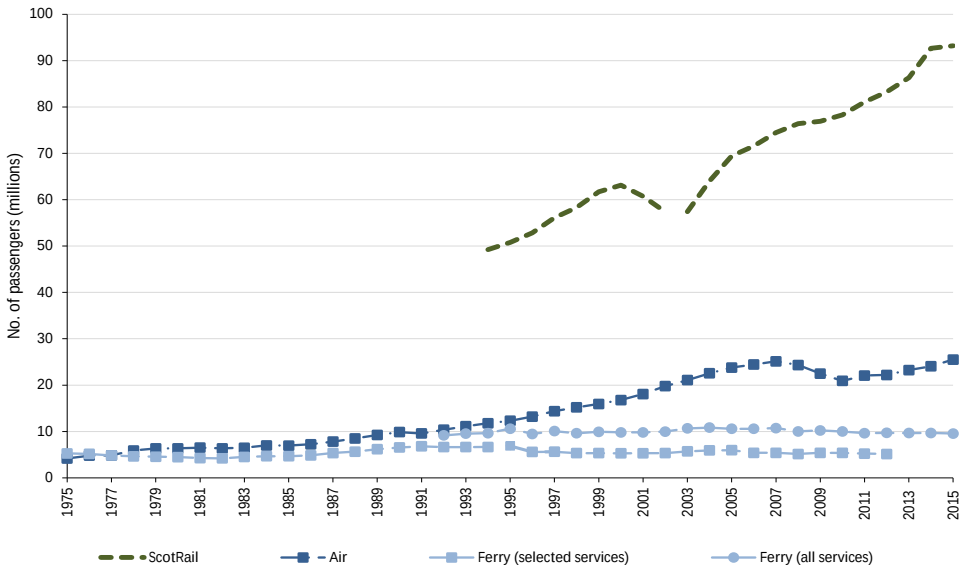


Air Passengers

There were around 25.5 million air terminal passengers at airports in Scotland in 2015, an increase of 1.4 million (5.9%) on 2014 and 1.5% above the 2007 peak.

Figure 5.11 shows the overall rise in air passengers since 1975. Over the longer-term, terminal passenger numbers grew from 1.2 million in 1960 to 25 million in 2007.

Figure 5.11: Passenger numbers: rail, air and ferry, Scotland, 1975-2015



Source: Transport Scotland

Ferry Services 

In 2015, 9.5 million passengers travelled by ferry, 1% less than the previous year. Of these, 7.8 million (82%) were carried on routes within Scotland, with the remainder carried on routes between Scotland and Northern Ireland and the EU.

DATA NOTE–INFORMATION ON FUTURE DEMAND FOR TRANSPORT ENERGY

The future demand for energy for transport involves predicting how much travel will take place along with the type of energy used for those journeys.

Forecasting the total demand for travel involves predicting both the demand for personal travel and the demand for goods. These can follow very different trends.

Forecasting Future Personal Travel Demand

The energy we use in making those trips depends on how far we travel in that time and what mode of travel we use.

Factors affecting how much energy each of us use to travel include our:

- Age
- Sex
- Household Income
- Employment Type (National Statistics Socio-economic Classification – NS-SEC)
- Car Ownership
- Licence holding
- Household structure – different household structures affect distance travelled
- Location – people living in rural areas travel further than those living in urban areas

More information on forecasting transport for the UK is available on the Department for Transport website which can be found here:

https://www.gov.uk/government/publications/understanding-the-drivers-of-road-travel-current-trends-in-and-factors-behind-roads-use

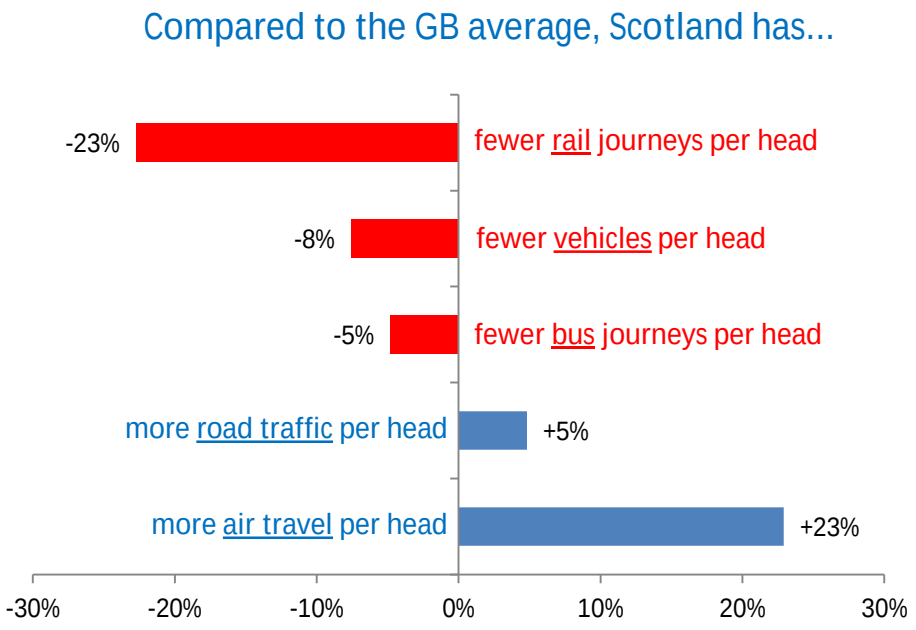
In 2015, vehicle-km per head per year were 8,445 in Scotland which is **5% more** than the GB average.

However, Scotland had 53 vehicles per 100 of the population whereas GB had 58 vehicles. Scotland had a higher number of air passenger journeys (per 100 of the population) per year at 4.7 journeys whereas the GB average was 3.9.

Figure 5.12: Travel and vehicle summary of Scotland and Great Britain (or UK), 2015

Scotland had 23% fewer rail journeys (per head) than the GB average in 2014 (latest statistics available).

Scotland also had, on average, 76 bus journeys per head compared to the GB average of 80 journeys per head.



Source: Transport Scotland

Travel to Work and School

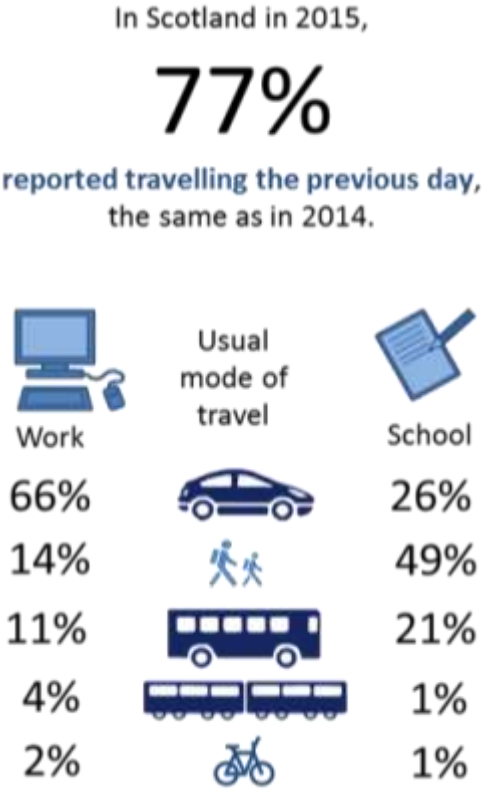
Results from the Scottish Household Survey show that in 2015:

- two-thirds of commuters travelled to work by car or van
- 14% walked
- 11% went by bus
- 4% took a train
- 2% cycled.

There has been little change in modal choice since 2002. The Scottish Household Survey also reported that 49% of pupils walked to school in 2015, 21% went by bus, 26% by car, 1% cycled, and 1% travelled by rail.

While there have been year-to-year fluctuations in the results, there has been little change in modal choice since 1999.

Figure 5.13: Mode of transport for travelling to work and school, Scotland, 2015



Source: Scottish Household Survey

CHAPTER 6

OIL AND GAS

'In 2015, oil and gas production is estimated to have been worth £9.8 billion to the Scottish economy'

OIL AND GAS

KEY FACTS

UP TO **20** BILLION

...BARRELS OF OIL AND GAS STILL TO BE RECOVERED FROM THE UK CONTINENTAL SHELF

OIL AND GAS PRODUCTION WORTH...

£9.8 BN

...TO THE SCOTTISH ECONOMY

6.2% OF TOTAL SCOTTISH GDP

IN 2014 INTERNATIONAL SALES FROM THE SCOTTISH OIL AND GAS SUPPLY CHAIN HAVE INCREASED BY...

9%

SCOTTISH SHARE OF UK OIL AND GAS PRODUCTION...

95%

58%

BETWEEN 2014 AND 2015 SCOTTISH...

SALES REVENUE

- 29%

OPERATING EXPENDITURE

- 15%

CAPITAL EXPENDITURE

- 16%

'In Q3 2016 the UKCS production of crude oil and NGLs was 8% higher than a year earlier'

SCOTLAND IS LARGEST OIL PRODUCER AND SECOND LARGEST GAS PRODUCER IN THE EU

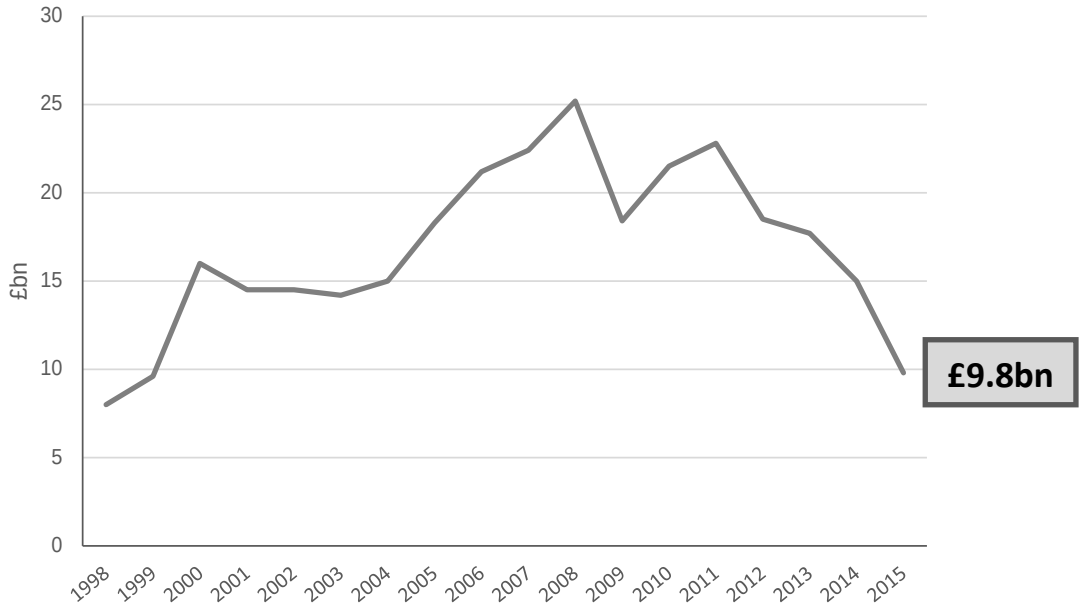
Oil and Gas in Scotland - Overview

This chapter presents a range of statistics relating to the oil and gas industry and the offshore economy in Scotland, with an additional section focussing on other fossil fuel extraction. The analysis in this chapter is based primarily on the activity of the oil and gas sector in Scotland and its adjacent waters, rather than the UK Continental Shelf (UKCS) as a whole. The method used to apportion activities on the UK Continental Shelf between Scotland and Rest of UK (RUK) for this purpose is explained on page 124.

The North Sea is a mature basin that has made a substantial contribution to the Scottish and UK economies over the last 40 years. As outlined in Chapter 7, the oil price fell sharply in the second half of 2014 following a period of stable prices above $100 per barrel. This lower oil price continued throughout 2015 and recovered only marginally in 2016. Sustained low oil prices have exacerbated many of the challenges that already existed within the North Sea oil and gas sector, with industry now adapting to ensure it is best placed to compete and succeed in a 'lower for longer' price market.

This publication presents the latest available historical data for the oil and gas sector.

Figure 6.1: GDP associated with Scottish Oil and Gas production (£ bns), 1998-2015



Source: QNAS, Scottish Government

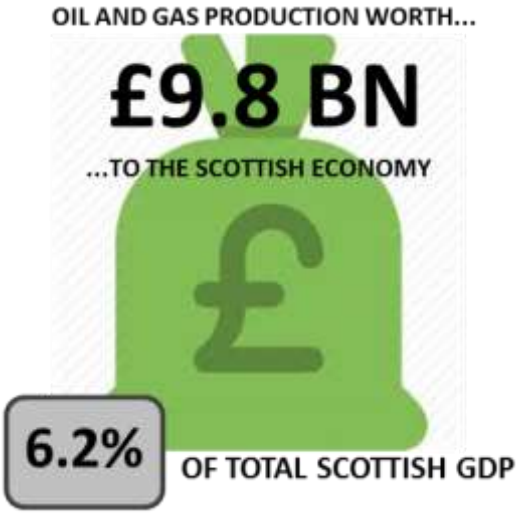


Figure 6.1 shows the gross value added (GVA) associated with the offshore oil and gas production which is estimated to occur in the Scottish portion of the UKCS. In 2015, the extraction of oil and gas is estimated to have been worth £9.8 billion to the Scottish economy, down from £15.0 billion in 2014.

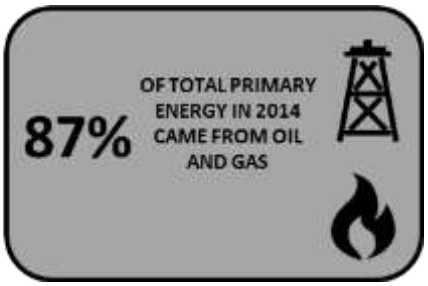
This is equivalent to 6.2% of total Scottish GDP (including a geographical share of UK Extra Regio activity) in that year.

Crude oil and NGL production in Scottish waters peaked in 1999 and then declined by roughly 8% year-on-year until 2014. Despite a substantial increase of 15% in 2015, the level of production in the latest year was around a third of the production peak recorded in 1999. Natural gas production in Scottish waters peaked in 2002 and experienced a similar decline in subsequent years, with production in 2015 again around a third of peak levels.

'In Q3 2016 the UKCS production of crude oil and NGLs was 8% higher than a year earlier'

Despite the decline in production for both fuels since the turn of the century, significant resources remain to be extracted. According to the latest estimates by the industry body, Oil & Gas UK, up to 20 billion barrels of oil and gas could still be recovered from the UKCS.

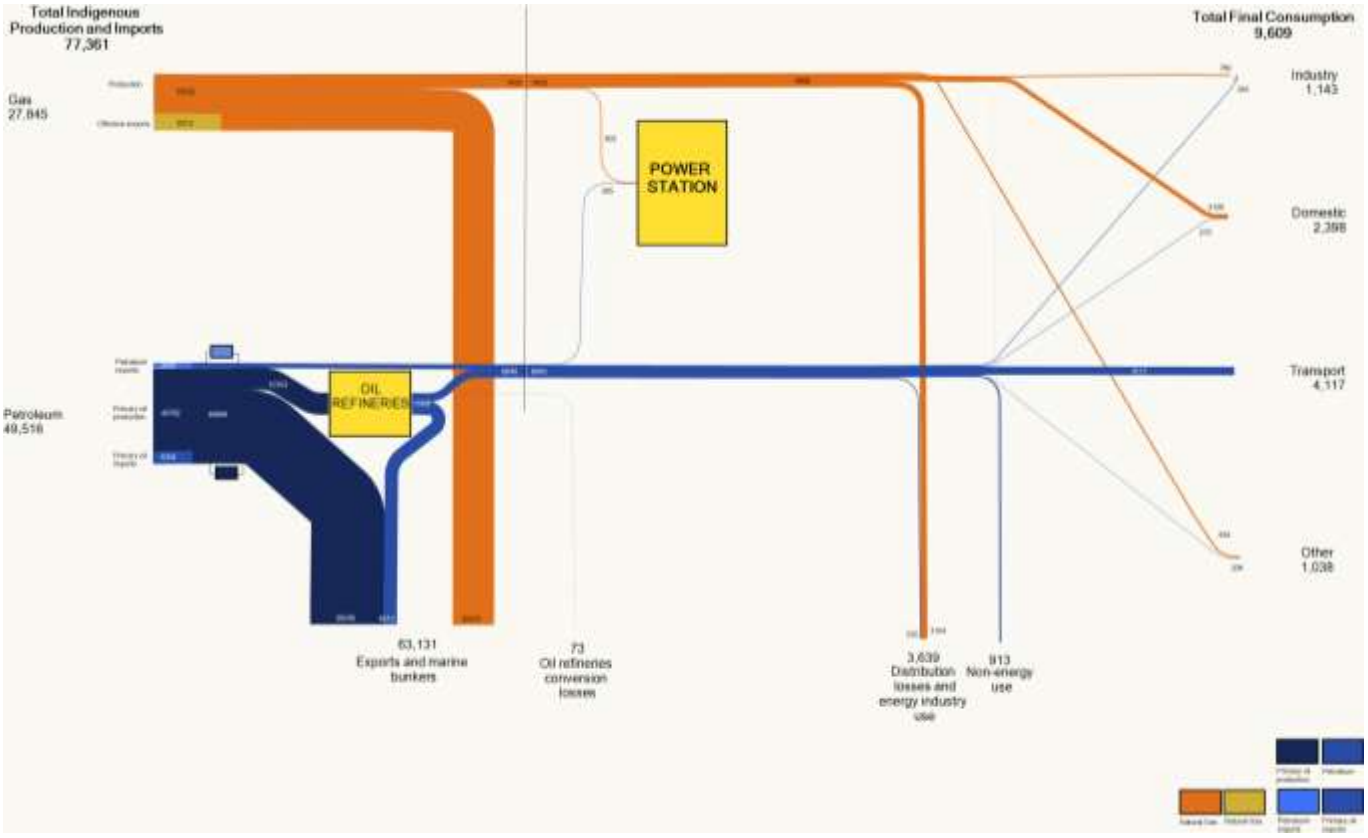
Oil & Gas Energy Balance for Scotland



Following on from full energy balance on page 24, Figure 6.2 below focuses in on the oil and gas flows in Scotland.

Oil and gas makes the largest contribution to overall primary energy in Scotland (indigenous production plus imports), with petroleum and natural gas combined accounting for 87% in 2014. Approximately 80% of all primary oil and gas energy in Scotland is exported.

Figure 6.2: Oil and gas flow chart, Scotland, 2014 (thousand tonnes of oil equivalent)



Source: Scottish Government

Apportionment of Offshore Oil and Gas Activity

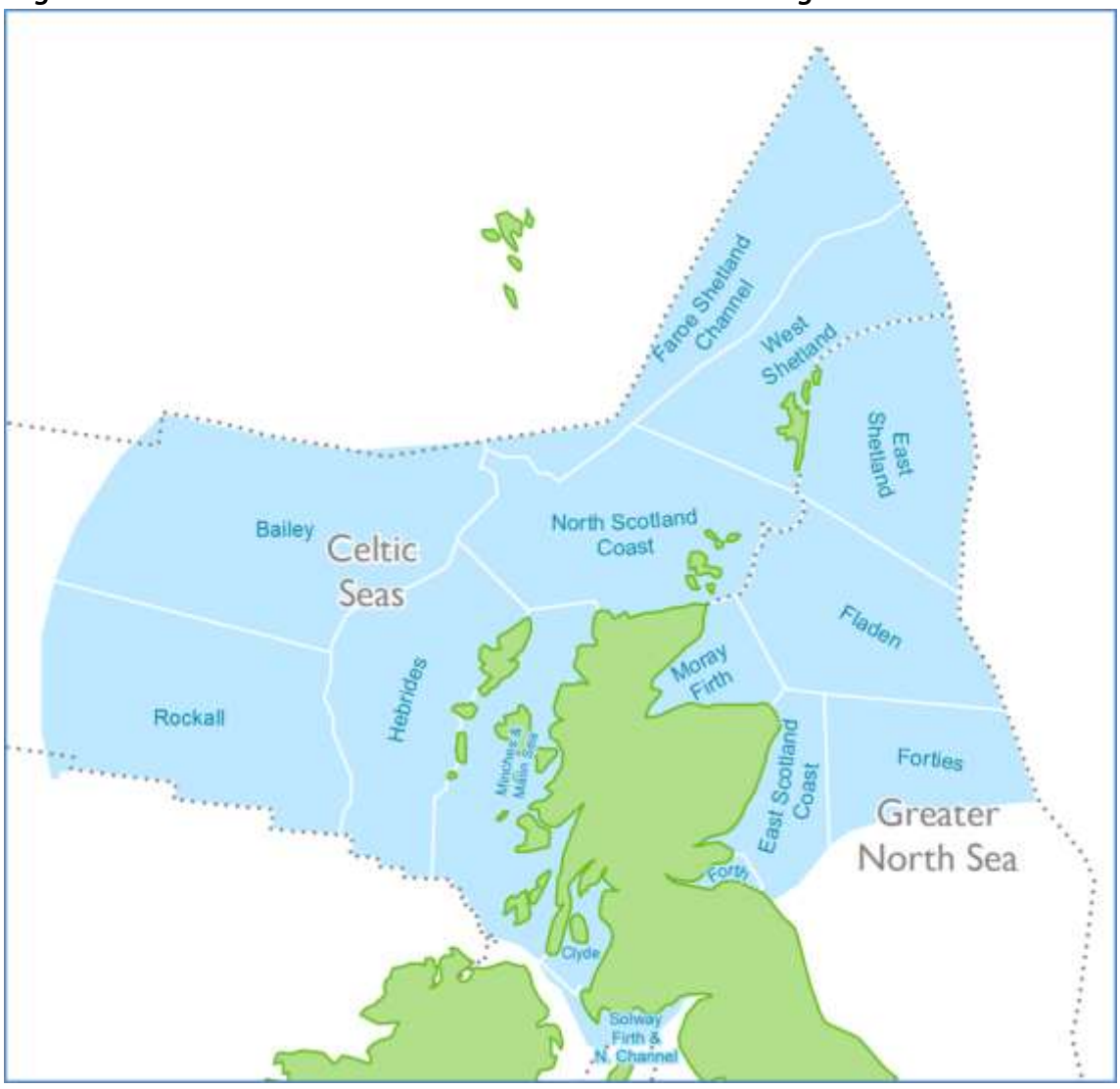
Estimates of Scottish oil and gas activity are derived from official statistics for total UK activity produced by the UK Department for Business, Energy & Industrial Strategy (BEIS). These activities are allocated between the Scottish and Rest of UK (RUK) portions of the UKCS using data related to individual oil and

gas fields. Identifying the location of each field ensures that the results accurately reflect the location of activities.

The Scottish portion of UK Continental Shelf is chosen to coincide with the Scottish adjacent waters boundary, which was defined during the devolution of marine policy responsibilities and is described in the Scottish Adjacent Waters Boundaries Order (1999). The Scottish Government uses this zone in all official statistics that contain estimates of Scottish offshore activity, including Quarterly National Accounts and Government Expenditure and Revenue Scotland (GERS). For economic statistics, this zone has become known as the 'illustrative geographical share' of UK offshore activities.

Alternative boundaries could be used to demarcate the limits of the Scottish zone of the UKCS, but would be unlikely to significantly affect the proportion of oil and gas production which is allocated to Scotland.

Figure 6.3: Marine Scotland Marine Atlas areas and MSFD regions



Source: Marine Scotland

Marine Scotland further separate Scottish waters into individual geographical sea areas. Scottish waters were divided into fifteen sea areas based on areas previously adopted for certain environmental monitoring programmes.

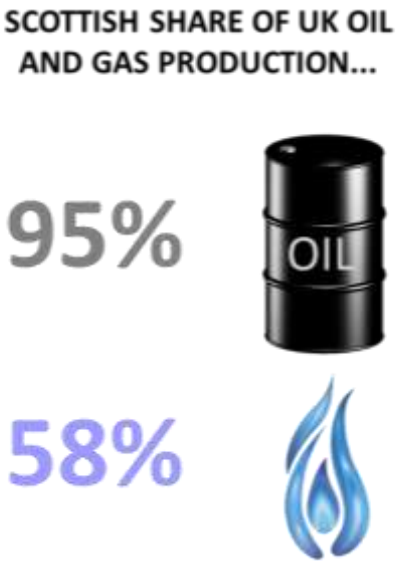
More recently, the data from these areas have been aggregated to develop information for the two main areas required for the Marine Strategy Framework Directive (MSFD) initial assessment: the Greater North Sea (Area II) and the Celtic Seas (Area III). These are existing sea areas used by OSPAR (the Oslo Paris Convention for the Protection of the North East Atlantic). The territory defined as Scottish waters, and the areas within it, are illustrated in Figure 6.3.

Oil and Gas Production

The Scottish Government publishes official statistics which include estimates of production volumes, approximate sales income, operating costs and capital expenditure relating to the oil and gas industry in Scotland (including Scottish adjacent waters) since 1999.

This provides a consistent time series of data covering the economic activity in the Scottish portion of the UKCS. Further information about the publication can be accessed at:

http://www.gov.scot/Topics/Statistics/Browse/Economy/oilgas

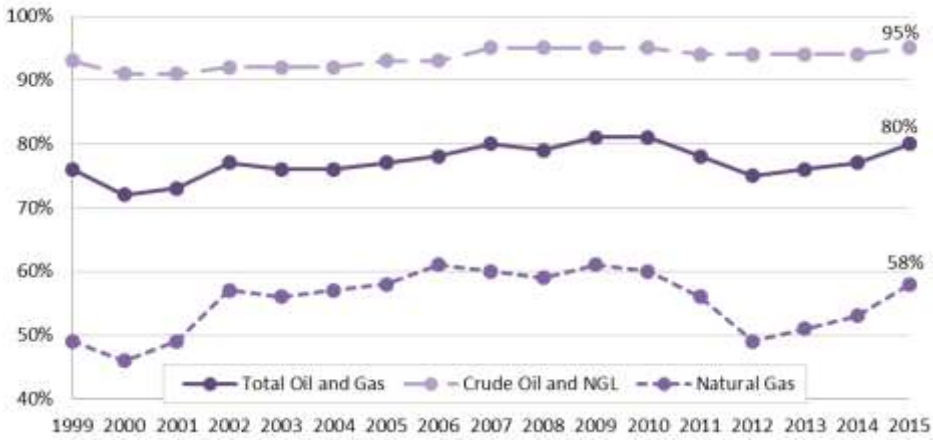


In 2015, Scotland is estimated to have produced 47 million tonnes of oil equivalent (mtoe) of crude oil and natural gas liquids (NGL). This figure accounted for 95% of total UK crude oil and NGL production and represents a significant increase on the 41 mtoe produced in Scotland in 2014. Emerging data for total UKCS production shows this trend has continued throughout 2016, with crude oil and NGL production in Q3 8% higher than at the same stage a year earlier. Figure 6.4 shows that historically over 90% of UK oil and NGL production has occurred in Scottish waters, with this share having increased slightly over time.

Scotland is estimated to have produced 20 mtoe of natural gas in 2015, accounting for 58% of total UK gas production. Figure 6.4 shows the split between the Scottish and RUK portions of total UK natural gas production has been more variable over time, with Scotland historically accounting for a smaller share of total gas production compared to oil.

Table 6.1 provides estimates for the volume of oil and gas production in Scotland over the past ten years.

Figure 6.4: Scottish share of UK oil and gas production, 1999-2015



Source: SNAP, Scottish Government

The statistics show that production has been on a downward trend over this period, but in 2015, production of crude oil and NGL was 15.2% higher than in 2014 – the single biggest increase in 15 years.

Table 6.2 and Table 6.3 break down Scottish production into individual areas of the Scottish seas, as identified by Marine Scotland in Figure 6.3, to give a further geographical breakdown of historical production.

Table 6.1: Scotland Oil and Gas Production (mtoe), 2006-2015

Million tonnes of oil equivalent	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
OIL/NGL PRODUCTION	78.5	79.8	74.9	71.1	65.8	53.7	45.7	41.6	41.0	47.2
SCOTLAND AS A % OF UK	*93%*	*95%*	*95%*	*95%*	*95%*	*94%*	*94%*	*94%*	*94%*	*95%*
GAS PRODUCTION	44.1	39.0	37.3	32.1	30.2	22.0	16.5	16.2	17.0	19.7
SCOTLAND AS A % OF UK	*61%*	*60%*	*59%*	*61%*	*60%*	*56%*	*49%*	*51%*	*53%*	*58%*

Source: SNAP, Scottish Government

Table 6.2: Marine Atlas areas crude oil and NGL production (mtoe), 2006–2015

Oil and NGL (toe)	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
EAST SHETLAND	18.2	15.3	12.5	10.9	10.6	8.4	7.4	7	7.4	7.4
FLADEN	23.4	32.6	34	32	30.7	23.7	23.3	23.1	20.1	24.9
FORTIES	22.2	19	16.9	17.1	14.2	12.1	6.5	5.8	7.6	9.5
MORAY FIRTH	0.1	0.1	0.1	0.4	0.5	0.2	0.1	0.1	0.1	0
NORTH SCOTLAND COAST	3.3	3.3	2.3	2.6	1.9	2.3	1.3	1.5	1	1.2
WEST SHETLAND	11.3	9.5	9.1	8.1	7.9	6.9	7.1	4	4.7	4.2

Source: SNAP, Scottish Government

Table 6.3: Marine Atlas areas Gas production (mtoe), 2006 - 2015

Gas (toe)	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
EAST SHETLAND	17.3	15.5	13.8	11.4	10.8	7.2	6.7	7.1	5.7	6.7
FLADEN	10.8	10.2	10	7.4	7.6	4.9	4.4	4.1	4	4.7
FORTIES	15.4	12.9	13	12.8	11.5	9.7	5.2	4.9	7.1	8.1
MORAY FIRTH	-	-	-	-	-	-	-	-	-	-
NORTH SCOTLAND COAST	-	-	-	-	-	-	-	-	-	-
WEST SHETLAND	0.6	0.5	0.5	0.5	0.4	0.2	0.2	0.1	0.2	0.1

Source: SNAP, Scottish Government

To put these in context, Scotland is estimated to be the largest oil producer and second largest gas producer in the EU.

In 2016, following years of significant capital investment, new fields have been brought on stream which have boosted production levels. For example, in January 2016, BP announced that the Kinnoull field had started production .

According to Wood Mackenzie, there were 8 new field start-ups in 2015 with 10 in 2016 including Total's 170 million barrels of oil equivalent Laggan Tormore gas field located west of Shetland, which commenced production in February 2016. In addition, a number of fields which have been operating below capacity due to shutdowns (e.g. Elgin-Franklin, Gryphon, the Penguins Cluster and Andrew) resumed production.

'UKCS Production of crude oil and NGLs over the first three quarters of 2016 was 8% higher than the same period in 2015'

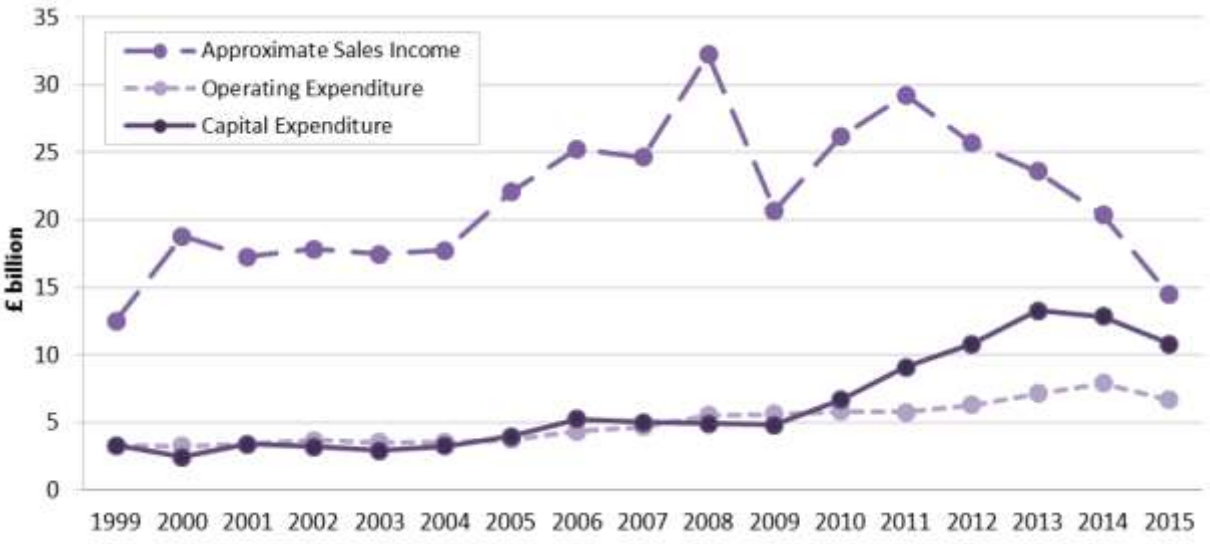
Due to these developments, UK production in 2015 and 2016 has seen large increases for both oil and gas fields. Total UK production of crude oil and NGL in Q3 2016 is 19 % higher than a year ago.

Production over the first three quarters of 2016 was also 8.3% higher than in 2015. This increase is due to new and old fields start-ups, as well as efforts by industry to increase production efficiency.

Approximate Sales Income and Costs

Sales of oil and gas produced in Scotland are estimated to have been worth £14.5 billion in 2015, 82% of the UK total. This is a decrease of £5.9 billion (or 29%) over the course of one year and is the fourth consecutive year in which approximate sales income has fallen. As illustrated in Figure 6.5, approximate sales income relating to activities in Scottish waters broadly followed an upward trend since 1999, but more recently has fallen back to near the 1999 level. This reflects the general increase, and subsequent decrease, in wholesale prices throughout this period.

Figure 6.5: Oil and Gas Approximate Sales Income, Operating Costs and Capital Costs, Scotland, 1999-2015



Source: SNAP, Scottish Government

According to Oil & Gas UK, in 2015 capital investment on the UK continental shelf fell 26% from £14.8 billion to £11.6 billion. As of September 2016, less than £100 million of fresh capital had been sanctioned in 2016 with around £9 billion expected for 2016.

Oil & Gas UK, a global energy consultancy, anticipate this trend to continue into 2017. Given the set of current challenges, the number of fields reaching Final Investment Decision is expected to be low.

Despite both falling in 2015, capital investment and operating expenditure have been generally increasing over the past decade. This has been driven by a range of factors including reduced efficiency, the increased level of complexity and maturity of UKCS fields, and a process of general cost inflation, with costs running ahead of the rest of the economy.

As can be seen in Figure 6.6, UK continental shelf unit operating costs have fallen by 17% over the course of 2015. This is due to a mixture of the recent increase in production of oil and gas and efficiency gains in the face of challenging conditions.

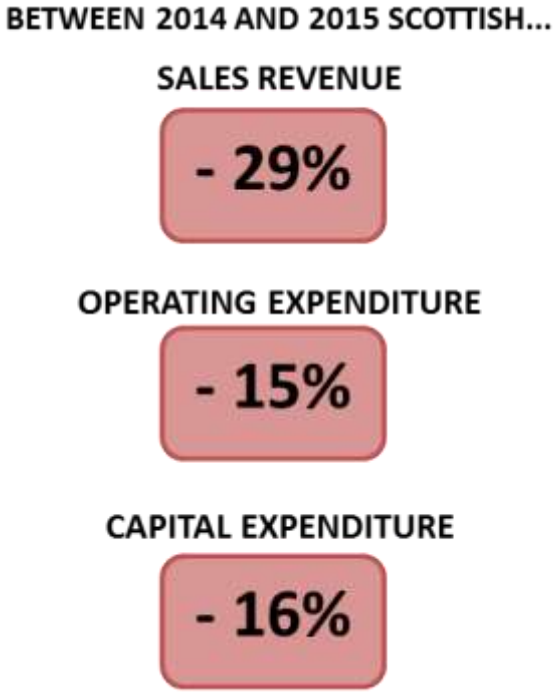
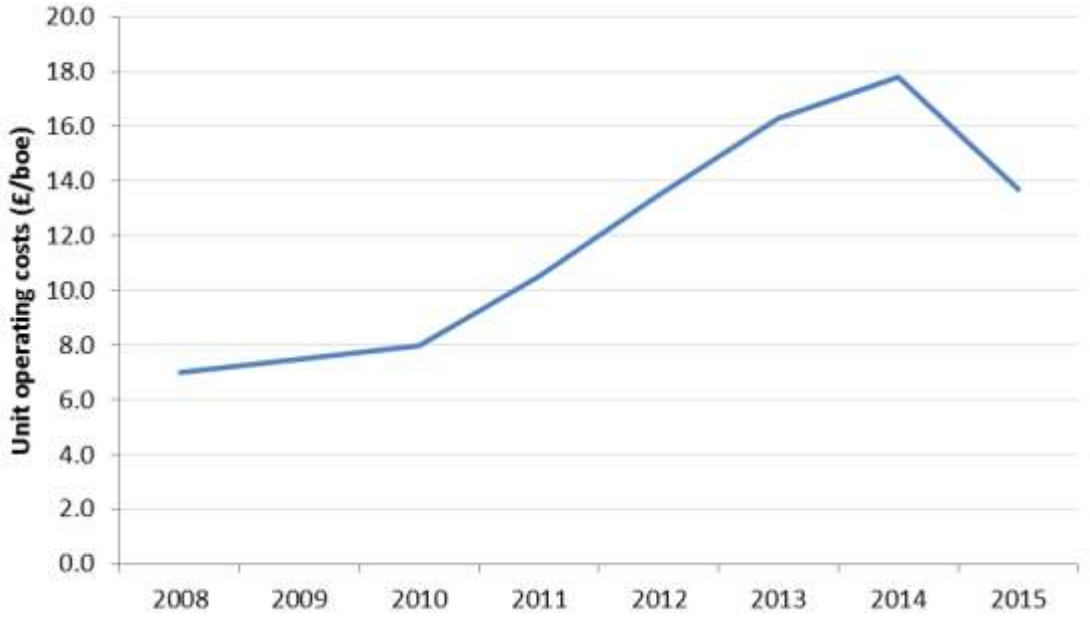


Figure 6.6: UK continental shelf unit operating costs, 2008-2015



Source: Oil and Gas UK

Operators engaging in a significant process of cost reduction and cost efficiency have put in place a range of strategies that they hope will lead to lower costs and increased international competitiveness of the UKCS – particularly in a low oil price environment. These include an effort to increase engagement with the supply chain and the standardisation of processes.

According to the latest Economic Report by Oil and Gas UK, unit operating costs in 2016 are expected to be around 45% lower than their peak in 2014. Efficiency improvements, the increase in production and the depreciation of the pound against the dollar, have driven this reduction.

Remaining Reserves

Oil & Gas UK estimates that between 10 and 20 billion recoverable barrels of oil equivalent (boe) of oil and gas remain on the UK Continental Shelf (UKCS). This encompasses proven, probable, and possible reserves. These figures also include potential additional resources, defined as discoveries without a current plan of development, as they are not currently technically viable. Finally, yet-to find volumes are also included, which are modelled based on geological success rates. This breakdown of potential reserves is provided in Figure 6.7.

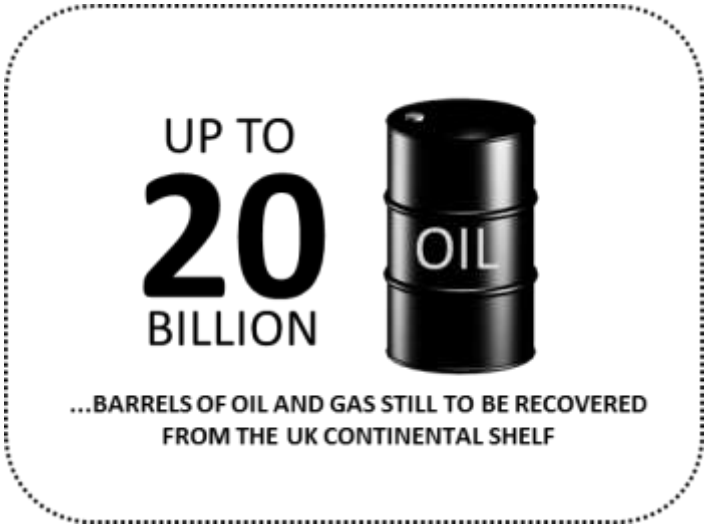
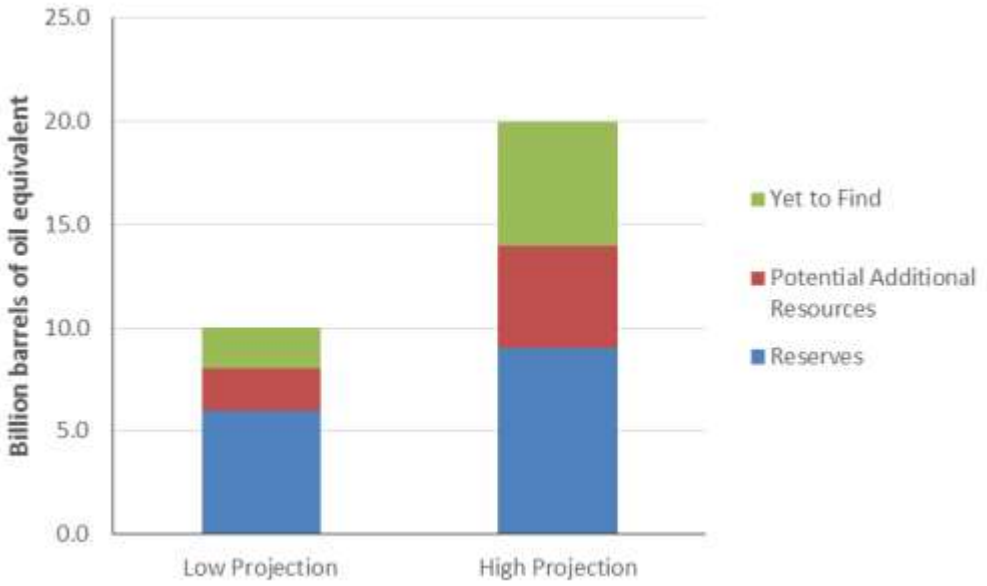


Figure 6.7: UK continental shelf projected reserves/resources (billion boe), 2016



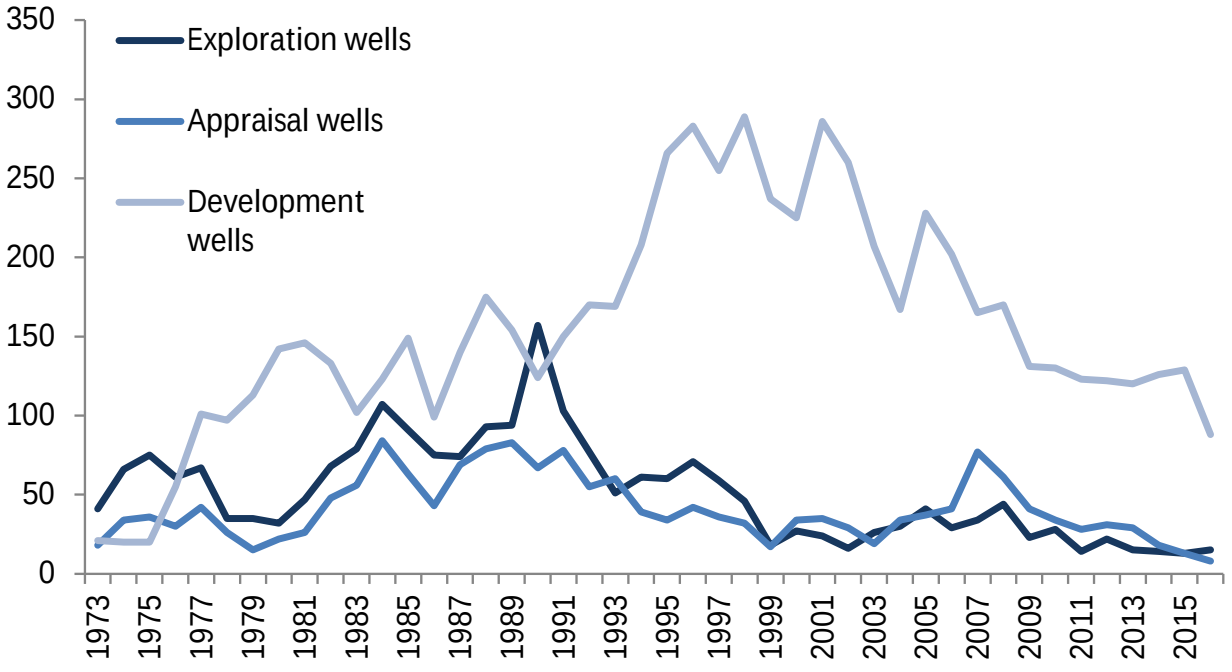
Source: Oil and Gas UK

Exploration

Exploration and appraisal (E&A) activity fell by nearly 12% in 2016 from levels a year earlier, as illustrated in Figure 6.8. This is the sixth largest year on year fall in the past 10 years, which have seen overall levels decline after peaking in 2007.

E&A activity is currently at its lowest since exploration began in the UKCS in the 1960s, as shown by the produced volumes to discovered volumes ratio which stands at 0.25 for 2015 (Oil and Gas UK, 2016). This represents a challenge that needs to be addressed if estimated undiscovered reserves are to be translated into future production.

Figure 6.8: Historic UK continental shelf exploration and appraisal activity, 1973-2016

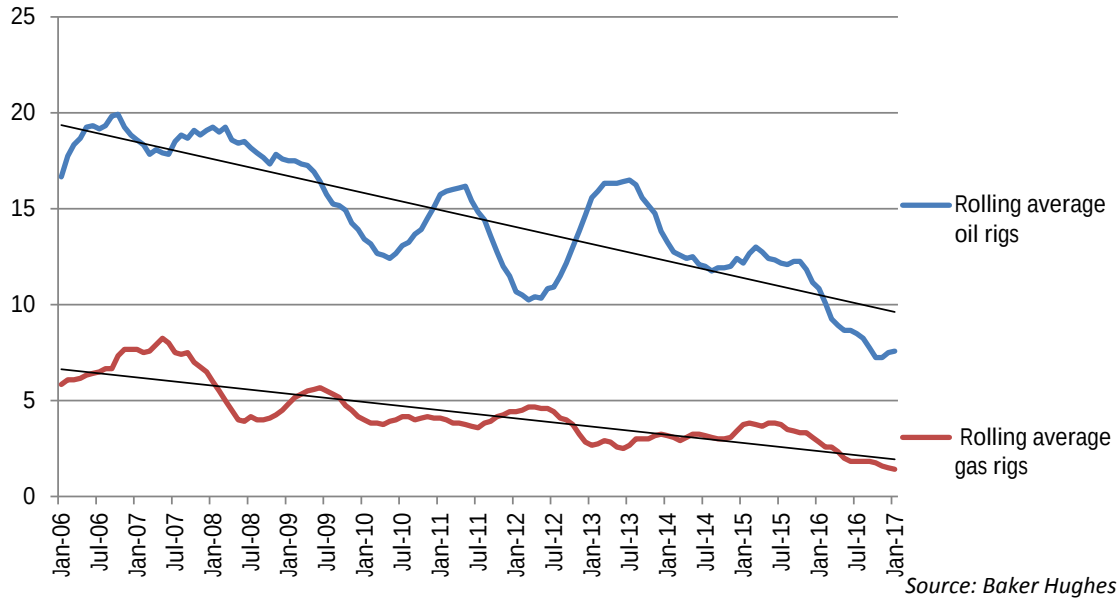


Source: BEIS

Although the number of both exploration and appraisal wells fell in 2016 compared to previous years, there was a modest resurgence in well success. Furthermore, the volumes discovered in 2016 (362 million boe) were the highest since 2008, including the sizeable discovery of Lincoln with 250 million boe. Looking forward, Wood Mackenzie expects the number of exploration wells to remain static in 2017, with frontier wells planned in the West of Shetland.

The 12-month average number of oil and gas rigs active in the UKCS has also been on a decreasing trend since 2007, as Figure 6.9 shows. It is worth highlighting that although the number of active gas rigs is lower than oil rigs, the number of the former has fluctuated substantially less over the past three years.

Figure 6.9: UK continental shelf 12-month rolling average oil and gas rigs, Jan 2006– Jan 2017

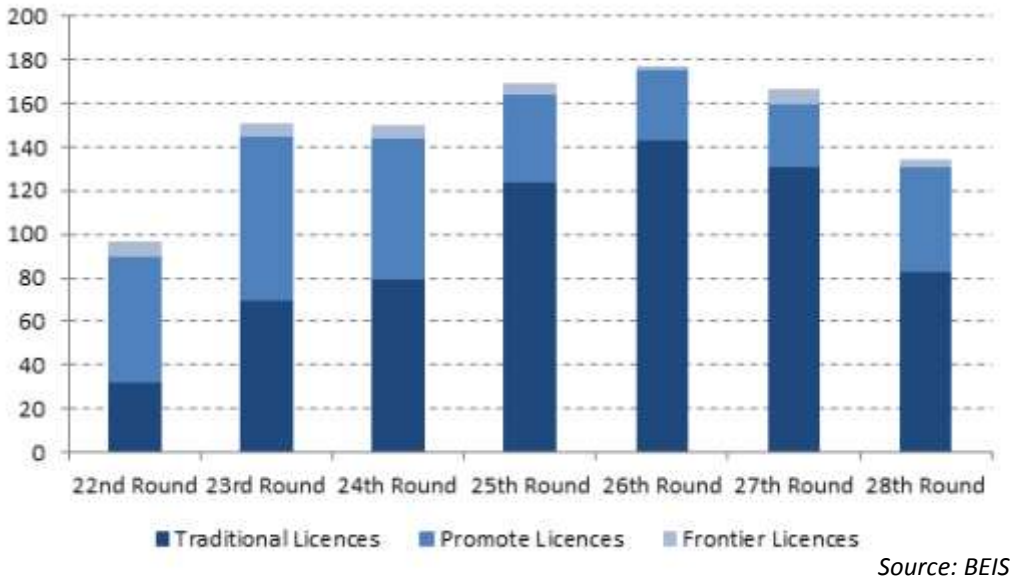


Source: Baker Hughes

The average number of oil rigs in the UKCS in 2016 Q4 is 20% less than 2015 Q4. The fall in activity is likely due to the combination of existing challenges in the UKCS, together with a lower oil price environment.

Nevertheless, although exploration activity has fallen, the last licensing round highlighted that there is still substantial interest in North Sea acreage. The number of licenses, though lower than in previous years, is still substantial —and the number of promote licenses has increased by 66% in comparison to the last round. The 29th licensing round took place in October 2016 with awards expected to be made in 2017.

Figure 6.10: North sea licensing rounds, 22nd—28th rounds



Source: BEIS

Supply Chain Exports and International Activity

The Scottish oil and gas supply chain continued to be a major exporter throughout 2014. According to the latest data published by Scottish Enterprise, total international sales increased by 9% on 2013 levels, reaching £12.2 billion pounds in 2014.

Overseas subsidiary sales represented 63% of these, with the remaining brought about by direct exports. Both components have had a similar growth rate from 2013, although overseas subsidiary sales have grown marginally more.

For the third year in a row, international sales accounted for over 50% of total sales, highlighting the deepening access of Scottish firms to global markets. Total sales in 2014 amounted to £22.9 billion, an increase of 3% over 2013 levels , with 53.4% accounting for international activity – making it a record year.

Table 6.4: International Supply Chain Sales (£m, current prices), 2011-2014

£million	2011	2012	2013	2014
DIRECT EXPORTS	2,409	3,700	4,200	4,500
OVERSEAS SUBSIDIARY SALES	5,787	6,300	7,000	7,700
TOTAL INTERNATIONAL SALES	8,195	10,000	11,200	12,200

Source: Scottish Enterprise

In total, respondents to the latest survey reported operating across 115 countries. During 2014, activity in North America and the Middle East appeared to fall, although these remained the major markets with the United States continuing to be the number one for international sales. The major change between 2013 and 2014 is the increase in percentage terms of sales in Africa.

Oil and Gas Exports

The commodity and energy balance (figure 6.2) shows that the majority of oil and gas produced in Scotland is exported. In 2015, the total value of crude oil, NGL and gas exports is estimated to be £14.8 billion, down from £19.9 billion in 2014. This includes some re-exports of imported oil and gas; for example, where production from Norway or the rest of the UK is transported to terminals in Scotland. Offshore trade statistics are being developed as part of the Scottish National Accounts Programme (SNAP). Further information on these developments can be accessed at: http://www.gov.scot/Topics/Statistics/Browse/Economy/oilgas.

Table 6.5: Scottish oil and gas exports (£ billion), 2015

£billion	REST OF UK	REST OF WORLD	TOTAL
CRUDE OIL/NGL	4.5	6.2	10.7
NATURAL GAS	3.4	0.8	4.1
TOTAL	**7.9**	**7.0**	**14.8**

Source: SNAP, Scottish Government

Employment

The oil and gas industry remains the major industrial employer in Scotland. Nevertheless, the fall in oil price has severely impacted employment levels.

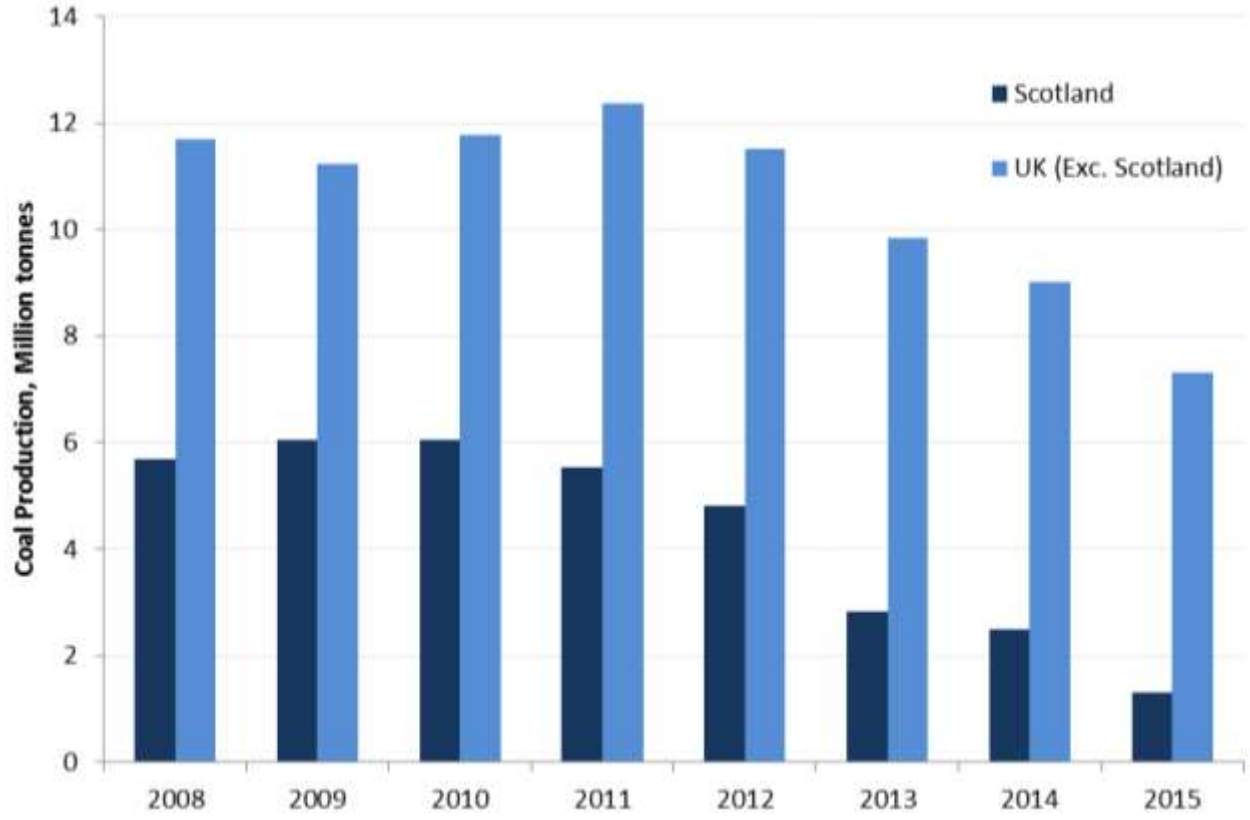
Oil and Gas UK have estimated that the industry across the UK supports 330,000 jobs either directly, indirectly or induced. This represents a 27% fall from levels of employment predating the lower oil price in 2014 at around 450,000. 124,500 of supported jobs are estimated to be based in Scotland, 38% of the total.

The Scottish Government recognised the potential impact that the low oil price could have on employment levels, and as a result the Energy Jobs Taskforce was put together in January 2015. The Taskforce has aimed to mitigate the impact of job losses, and tackle wider issues such as cost inefficiencies and the need for increased collaboration.

Coal Production

UK-wide coal production fell again for the fourth year running as did Scotland's share of total production. 1.3 million tonnes of coal was mined in Scotland in 2015 as shown in Figure 6.11. This represents a considerable drop of nearly 50% produced from 2014 and constitutes a fall from 22% to 15% in terms of Scotland's share of the UK.

Figure 6.11: UK Coal Production, Scotland and Rest of UK, 2008 – 2015



Source: The Coal Authority

CHAPTER 7

ENERGY PRICES

'Wholesale costs accounted for 43% of the average domestic dual fuel energy bill in 2015'

ENERGY PRICES

KEY FACTS

The proportion of a dual fuel bill attributed to wholesale costs fell by 2 percentage points between 2014 and 2015. Over the same period, supplier profit margins fell by less than 0.5 percentage points.

CHANGE IN AVERAGE DIRECT DEBIT BILLS IN SCOTLAND (2004 - 2016)

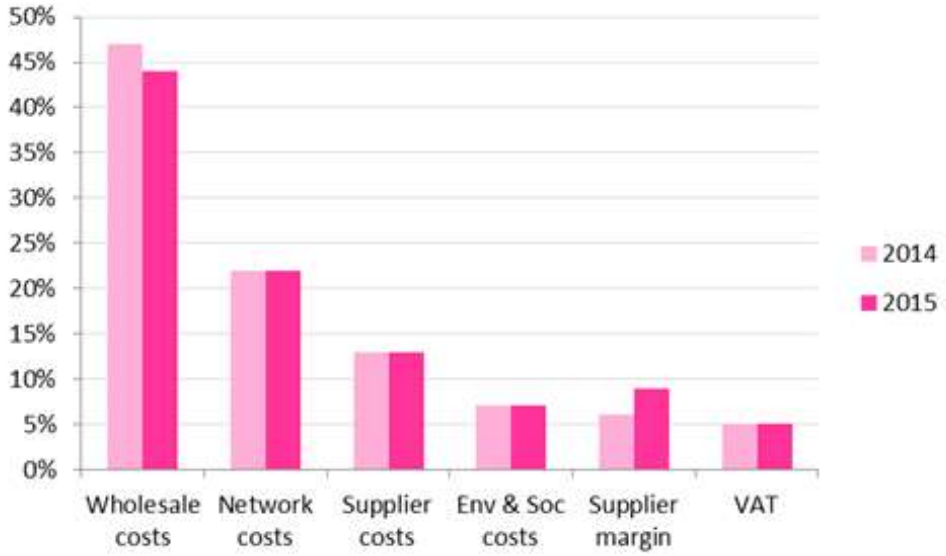
GAS

+88%

ELECTRICITY

+45%

WHAT MAKES UP A DOMESTIC GAS AND ELECTRICITY BILL?



FOR HOUSEHOLDS NEAR FUEL POVERTY THRESHOLD...

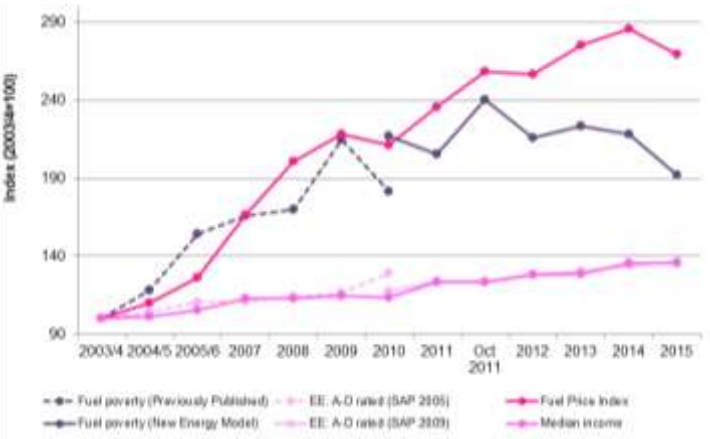
+ £100 IN FUEL COSTS

REQUIRES

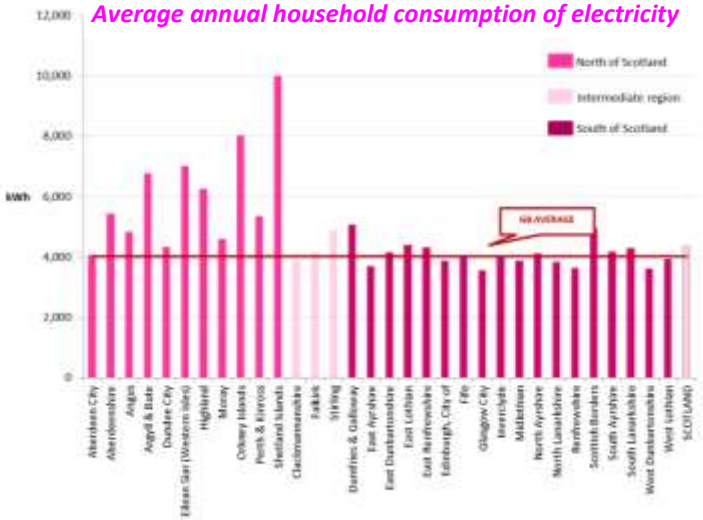
+ £1,000 IN INCOME

TO MITIGATE

Fuel Price, Energy Efficiency and Income Indices, 2003/04—2015



Average annual household consumption of electricity



31%

OF HOUSEHOLDS IN SCOTLAND WERE FUEL POOR IN 2015

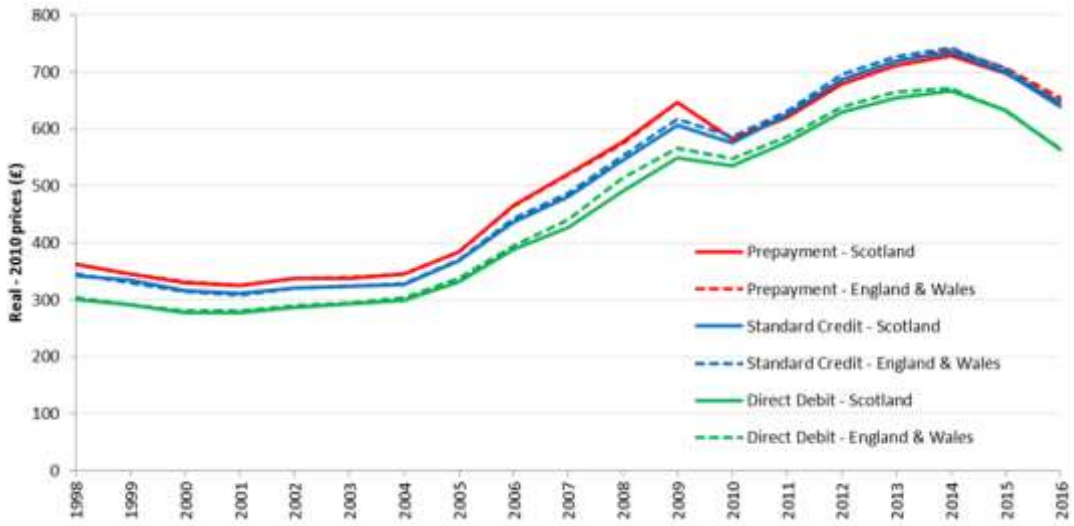
748,000 HOUSEHOLDS

Domestic Energy Bills

Domestic gas and electricity bills for all payment methods increased considerably between 2004 and 2009, in real terms, before falling slightly between 2009 and 2010. This was followed by a steady increase until 2014, and then a fall in 2015. In 2016, domestic gas bills for all payment methods and direct debit electricity bills continued to fall, whereas electricity bills for prepayment meters and standard credit payment rose slightly.

"In 2016, domestic gas bills for all payment methods and direct debit electricity bills continued to fall, whereas electricity bills for prepayment meters and standard credit payment rose slightly."

Figure 7.1: Average annual domestic gas bills for GB countries (2010 £), 1998-2016

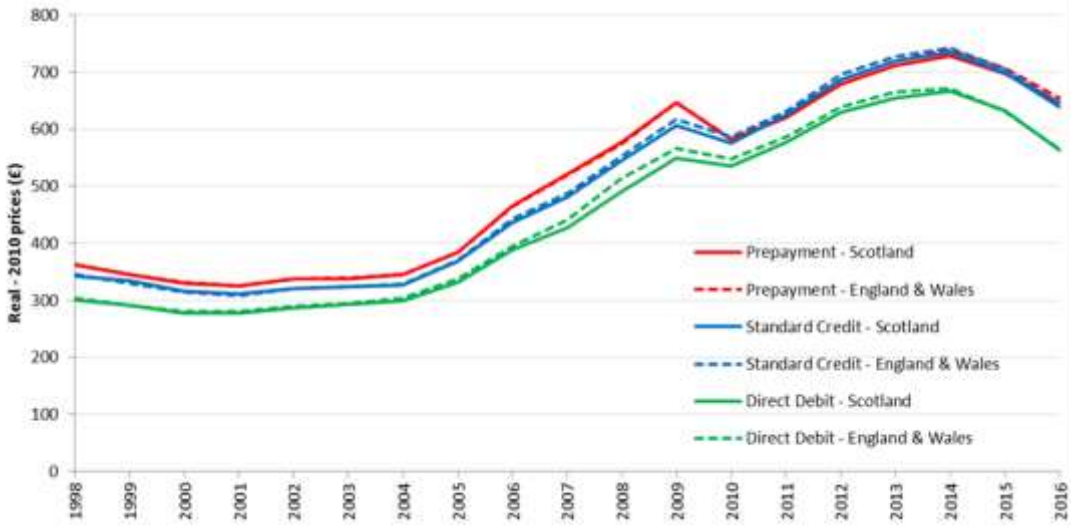


Source: BEIS

Gas: average annual domestic gas bills rose by approximately 25% for all payment methods between 2010 and 2014, before falling by 13% between 2014 and 2016. The average annual direct debit domestic gas bill in Scotland increased in real terms by approximately 88% between 2004 and 2016, as shown in Figure 7.1.

Electricity: average annual domestic electricity bills in Scotland increased by 11% for prepayment, 12% for standard credit and 13% for direct debit payment from 2010 to 2014. Between 2014 and 2016, average prepayment and standard credit bills remained stable while direct debit bills fell by 3%. The average annual direct debit domestic electricity bill in Scotland rose in real terms by approximately 45% between 2004 and 2016, as shown in Figure 7.2.

Figure 7.2: Average annual domestic standard electricity bills for GB countries (2010 £),1998-2016



Source: BEIS

Average domestic energy bills for 2016 are shown in Table 7.1. Note that, unlike in Figures 7.1 and 7.2, these costs are not adjusted for inflation. For the majority of payment methods, gas is less expensive in Scotland than England and Wales, whereas electricity is more expensive. The largest disparity is found for Economy 7 Electricity, with customers in Scotland paying 5 - 10% more than customers in England and Wales.

Table 7.1: Average annual domestic energy bills for GB countries for 2016 (£ cash terms)

Average annual domestic energy bills £	Standard Credit		Direct Debit		Prepayment	
	Eng & Wal	Scotland	Eng & Wal	Scotland	Eng & Wal	Scotland
Gas	**704**	**697**	**616**	**615**	**713**	**704**
Standard Electricity	**573**	578	512	516	576	575
Economy 7 Electricity	**769**	824	688	759	772	808

Source: BEIS

The average unit costs for domestic standard electricity in the North of Scotland for all three payment methods were substantially higher than in the South of Scotland and across the UK (see Table 7.2). In 2016, electricity consumers in the North of Scotland paid 8 - 9% more than the UK average per kilowatt hour under each payment method.

Between 2015 and 2016, the average unit cost for domestic standard electricity in the North of Scotland for standard credit and prepayment methods increased by 2%, whereas the average unit cost for direct debit payment methods in this region fell by 1%.

Table 7.2: Average unit cost for domestic standard electricity, Scotland & UK, 2016

Average unit cost (p/kWh)	Standard Credit	Direct Debit	Prepayment
North Scotland	**17.79**	**15.99**	**17.80**
South Scotland	**16.18**	14.40	16.08
GB	**16.42**	14.71	16.38

Source: BEIS

The average unit costs for prepayment and standard credit domestic gas consumption in the North of Scotland were slightly higher than in the South of Scotland (see Table 7.3) in 2016 and slightly lower than the GB average, whereas direct debit gas costs were identical across the three regions. Between 2015 and 2016, average unit costs of domestic gas consumption by standard credit, direct debit and prepayment fell around 7%, 10% and 6% respectively, across all three regions outlined in Table 7.3.

Table 7.3: Average unit cost for domestic standard gas, Scotland & GB, 2016

Average unit cost (p/kWh)	Standard Credit	Direct Debit	Prepayment
North Scotland	**4.67**	**4.10**	**4.71**
South Scotland	**4.64**	4.10	4.69
GB	**4.69**	4.10	4.75

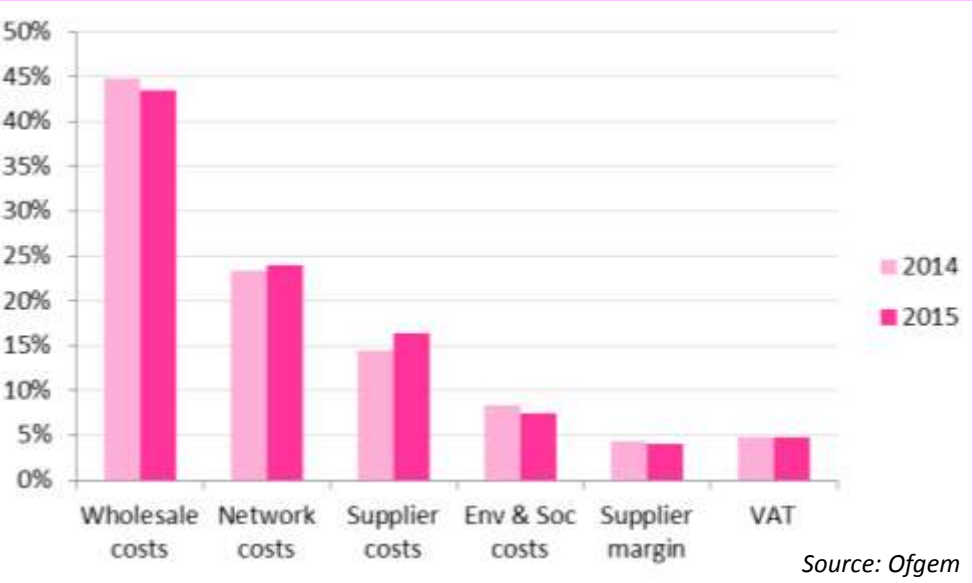
Source: BEIS

£ ***"In 2016, electricity consumers in the North of Scotland paid 8 - 9% more than the GB average."*** £

What makes up a domestic gas and electricity bill?

Ofgem analysis demonstrates that wholesale costs accounted for 43% of the average domestic dual fuel energy bill in 2015, network costs accounted for 24%, supplier costs for 16% and environmental and social costs accounted for 7%. VAT is set at 5%, while the estimated pre-tax margin to suppliers accounted for 4% of a bill.

Figure 7.3: Breakdown of a dual fuel bill, GB, 2014 - 2015



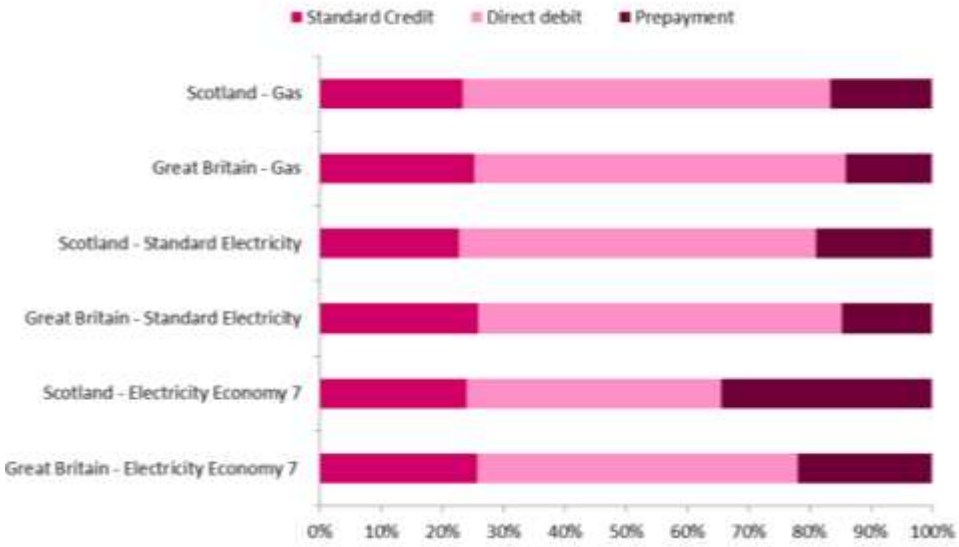
Source: Ofgem

The proportion of a dual fuel bill attributed to wholesale costs fell by 2 percentage points between 2014 and 2015, from 45% to 43%. The proportion of environmental and social obligation costs fell by 1 percentage point, while network costs and supplier costs increased by 1 and 2 percentage points respectively. Finally, supplier profit margins fell by less than 0.5 percentage points in the same period.

Payment Method for Household Energy Bills

In 2016, Scotland had a higher proportion of customers using prepayment meters, a lower proportion of customers paying by standard credit, and a lower proportion of customers paying by direct debit than Great Britain as a whole (as shown in Figure 7.4). The contrast is particularly stark regarding the Economy 7 tariff where 34 % of customers in Scotland use a prepayment meter, compared to just 22% in Great Britain. The costs that consumers face vary depending on their payment method. Direct debit is consistently the cheapest method, as shown in Figures 7.1 and 7.2.

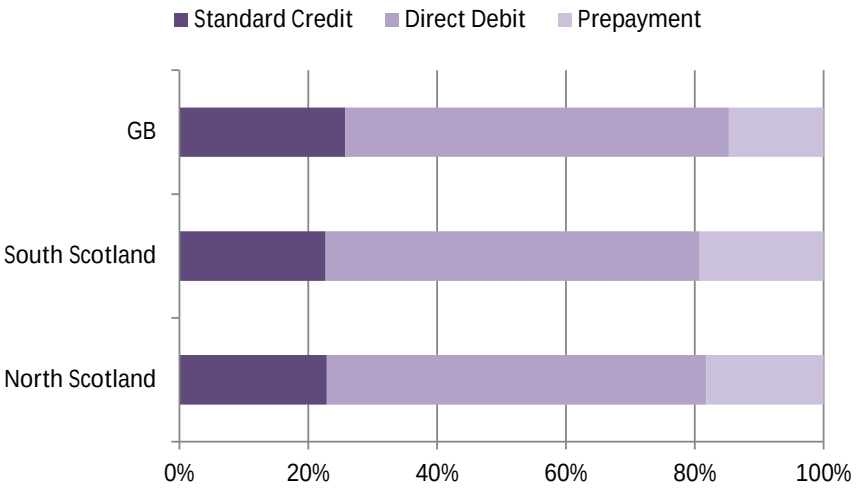
Figure 7.4: Percentage of customers by bill type (Scotland and GB), as at Sep 2016



Source: BEIS

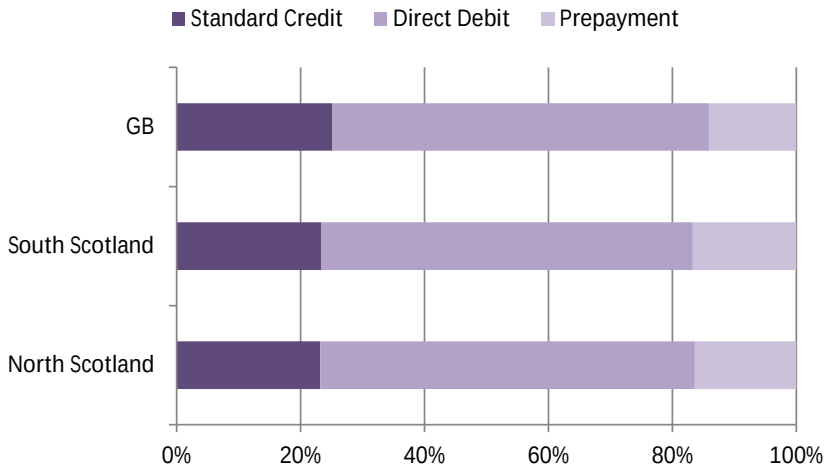
These variations are of particular interest within Scotland, as both the South of Scotland (19%) and the North of Scotland (18%) have a higher proportion of consumers prepaying for standard electricity than in Great Britain as a whole (15%). The South of Scotland (58%) and North of Scotland (59%) have a slightly lower proportion of consumers paying by direct debit than the GB average (60%). Both the North and South of Scotland have a lower proportion of consumers choosing the standard credit payment method than across Great Britain (see Figure 7.5).

Figure 7.5: Proportion of consumers by payment method for standard electricity, September 2016



Source: BEIS

Figure 7.6: Proportion of consumers by payment method for standard gas, September 2016



Source: BEIS

The payment method shares of domestic gas consumption in Scotland were similar to those in the electricity market (see Figure 7.6) in 2016, with a slightly lower proportion of consumers on prepayment meters. Since 2015, the proportion of consumers from all regions paying by direct debit increased by 2 percentage points, and the proportion on standard credit and prepayment meters decreased by 1 percentage point. The proportion of consumers prepaying in both the South of Scotland (17%) and the North of Scotland (16%) was higher than the GB level (14%) in 2016 .

Home Suppliers

Electricity consumers in Scotland are still more likely to choose their home supplier than the GB average (home suppliers are former incumbent suppliers). In particular, consumers in the North of Scotland are more likely to be with their home supplier irrespective of payment type. In the North of Scotland, 72% of standard credit customers used their home electricity supplier, compared to 42% across GB, in 2016. In addition, 69% of North of Scotland prepayment customers used their home supplier compared to only 37% across Great Britain (see Table 7.4).

Table 7.4: Proportion of home suppliers for standard electricity by payment type, September 2016

%	Standard Credit	Direct Debit	Prepayment	All Types
North Scotland	72	59	69	58
South Scotland	44	35	52	34
GB	42	32	37	30

Source: BEIS

The North of Scotland has the lowest proportion of customers using their home supplier for domestic gas, across all payment methods, in comparison to the South of Scotland and Great Britain as a whole (see Table 7.5). Across all payment types, a slightly higher proportion of customers in the South of Scotland than of all British customers use their home supplier.

Table 7.5: Proportion of home suppliers for domestic gas by payment type, September 2016

%	Standard Credit	Direct Debit	Prepayment	All Types
North Scotland	45	30	32	34
South Scotland	55	36	39	41
GB	6	32	44	40

Source: BEIS

How have domestic bills changed?

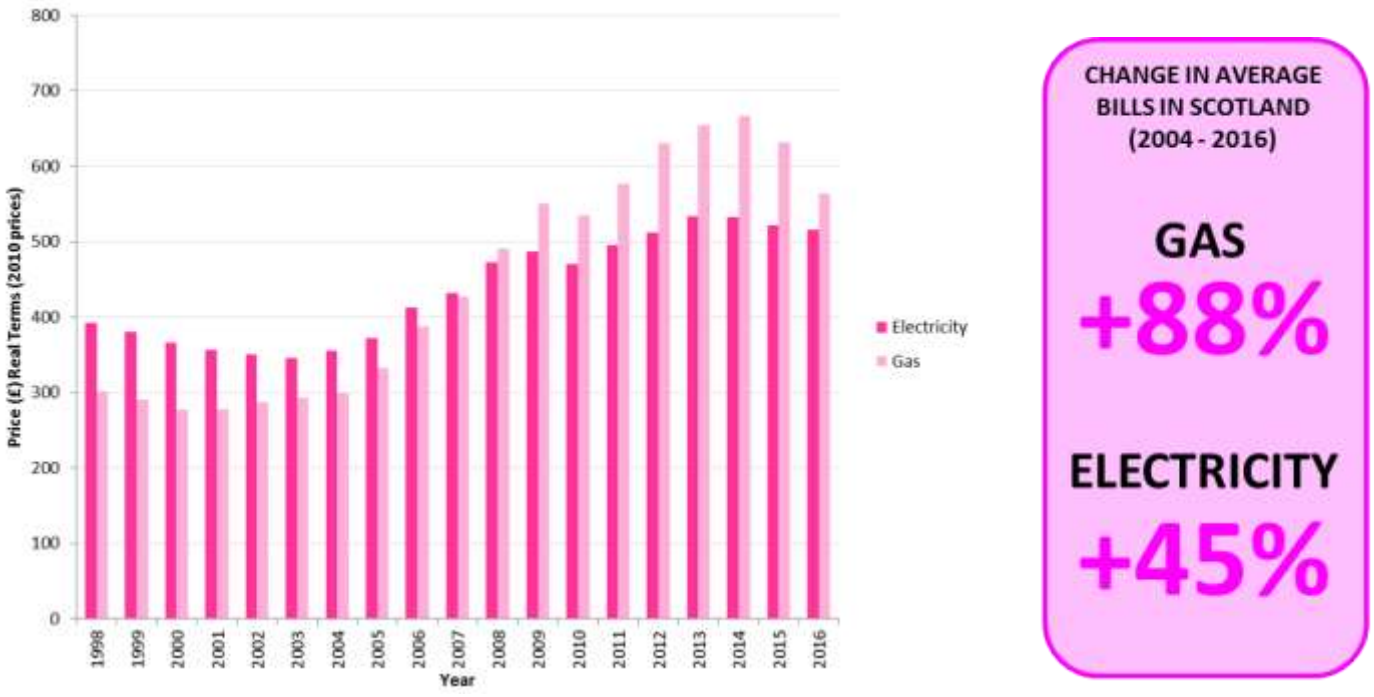
Between 2003 and 2016, after adjusting for inflation, the average annual domestic gas and electricity bill for direct debits—the most common payment method—in Scotland increased by 88% and 45% respectively.

Indeed, average annual domestic gas and electricity direct debit bills rose by 123% and 50% respectively between 2004 and 2014 before falling by 16% and 3% of their respective 2014 levels over the following two years.

Provisional 2016 figures for domestic gas bills in Scotland show that the average standard credit bill decreased by £60, the average direct debit bill decreased by £69 and the average prepayment bill decreased by £51, compared to 2015. Provisional domestic electricity bill figures for Scotland in 2016 show average standard credit and prepayment bills rose by £4 and £5 respectively while average direct debit bills fell by £6.

The costs that consumers face vary depending on their payment method. On average, across Scotland, consumers using standard credit pay 12% more for electricity and 13% more for gas than those using direct debit payments. Consumers using prepayment face 11% higher bills for electricity and 14% higher bills for gas than those using direct debit payments.

Figure 7.7: Average annual domestic gas and electricity bills (direct debit), Scotland, 1998 - 2016



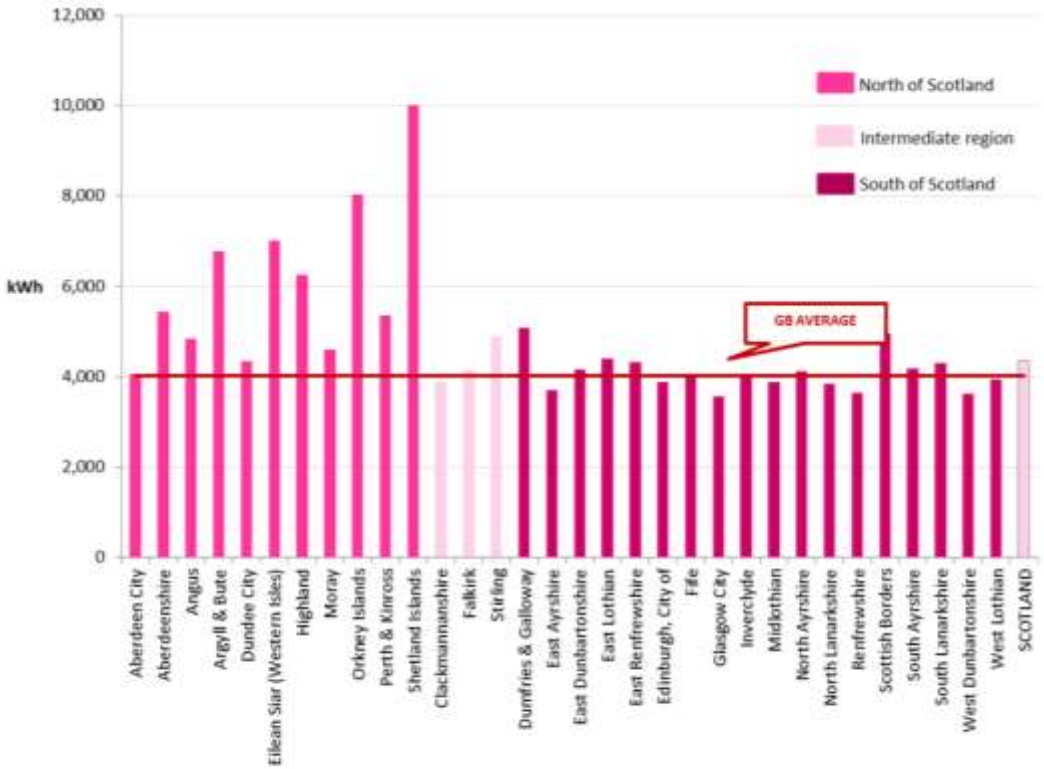
Source: BEIS

These figures rely on standardised consumption data to allow for comparison between regions, payment type and over time. There are differences in energy unit prices between Scotland and the rest of the UK, and within Scotland (see Tables 7.2 and 7.3).

In addition, the chart below (Figure 7.8) uses final energy consumption data for electricity to highlight the regional variations in consumption across Scotland. The North of Scotland region covers those local authorities wholly within the Scottish Hydro Electric Power Distribution area, while South of Scotland local authorities are solely served by Scottish Power Distribution. Three authorities are served by both distribution networks and excluded from either grouping .

A number of factors may influence this variation, including differences in temperature and the penetration of electrical heating as a primary heating fuel. While it is possible this data captures some proportion of consumption from small non-domestic enterprises, it nevertheless provides an indication of the geographical variation in consumption.

Figure 7.8: Average annual household consumption of electricity, Scotland, 2015



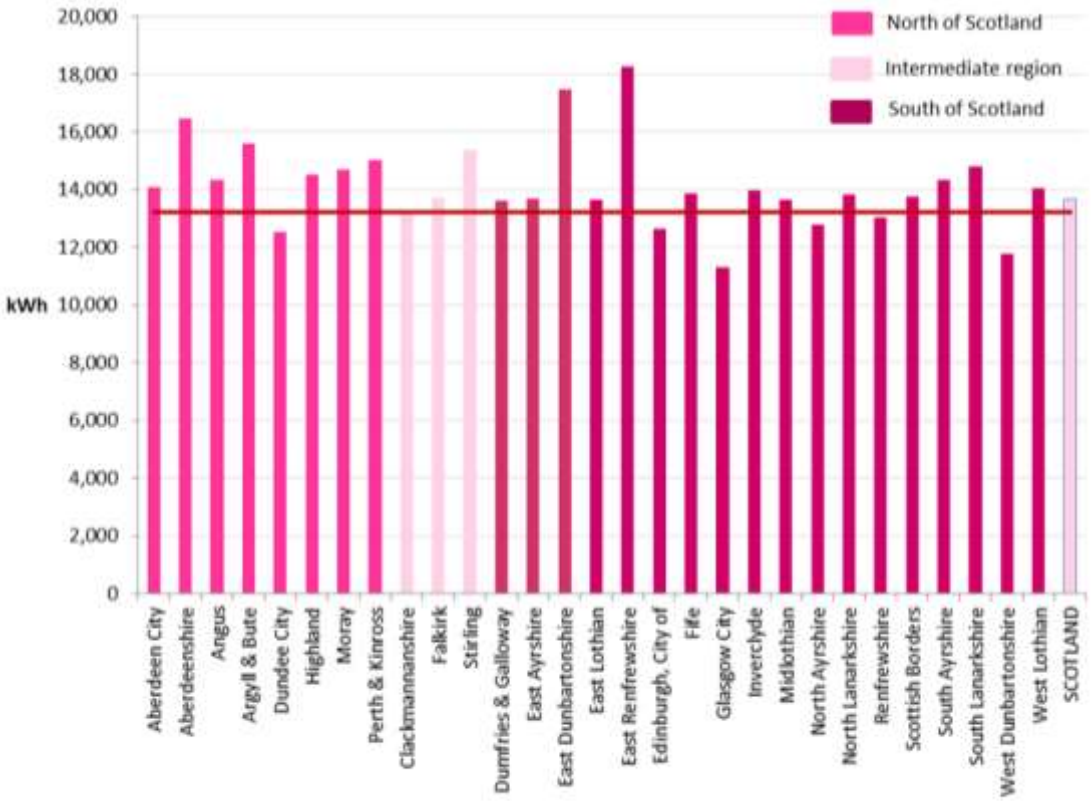
Source: BEIS

As Figure 7.8 shows, the average annual household consumption of electricity varies significantly across Scotland's local authorities, influenced by the factors outlined above. Households in Scotland display higher average electricity consumption than households in Great Britain as a whole, with 22 out of 32 local authority areas in Scotland consuming more electricity than the GB average.

Regional price differences for electricity and the variation in domestic electricity consumption have an impact on energy bills within Scotland. This is issue is particularly prevalent in the North of Scotland, where domestic electricity consumption is markedly higher than in the South of Scotland. In addition, customers in the North of Scotland pay higher average unit electricity prices across all payment methods. This combination of actual consumption data alongside regional unit cost information makes it clear that the average household electricity bill in the North of Scotland must be considerably higher than the GB average.

The majority of Scottish local authority areas (23 out of 29 – the three island local authority areas are excluded since they are not on the gas grid) consumed more domestic gas than the GB average, as illustrated in Figure 7.9. There are significant variations in domestic gas consumption across Scotland's local authority areas, but the North-South divide noted for electricity above is far less pronounced for gas. Indeed, East Renfrewshire had the highest average annual household gas consumption in 2015, 38% higher than the GB average.

Figure 7.9: Average annual household consumption of gas, Scotland, 2015



Source: BEIS

Oil Prices

Figure 7.10 plots monthly oil prices from December 2000 to December 2016. Oil prices increased significantly from 2004 to 2008, peaking at about $130 per barrel. During the financial crisis in 2008 oil prices declined to a low of $40 before rebounding in 2009. From 2011 to the first half of 2014, prices averaged around $110 dollars per barrel. Due to demand and supply imbalances in the market, prices then fell precipitously to $31 per barrel in January 2016, before rising to $53 per barrel in December 2016.

Figure 7.10: Crude Oil Price (not adjusted for inflation), Dec 2000 - Dec 2016

Source: US Energy Information

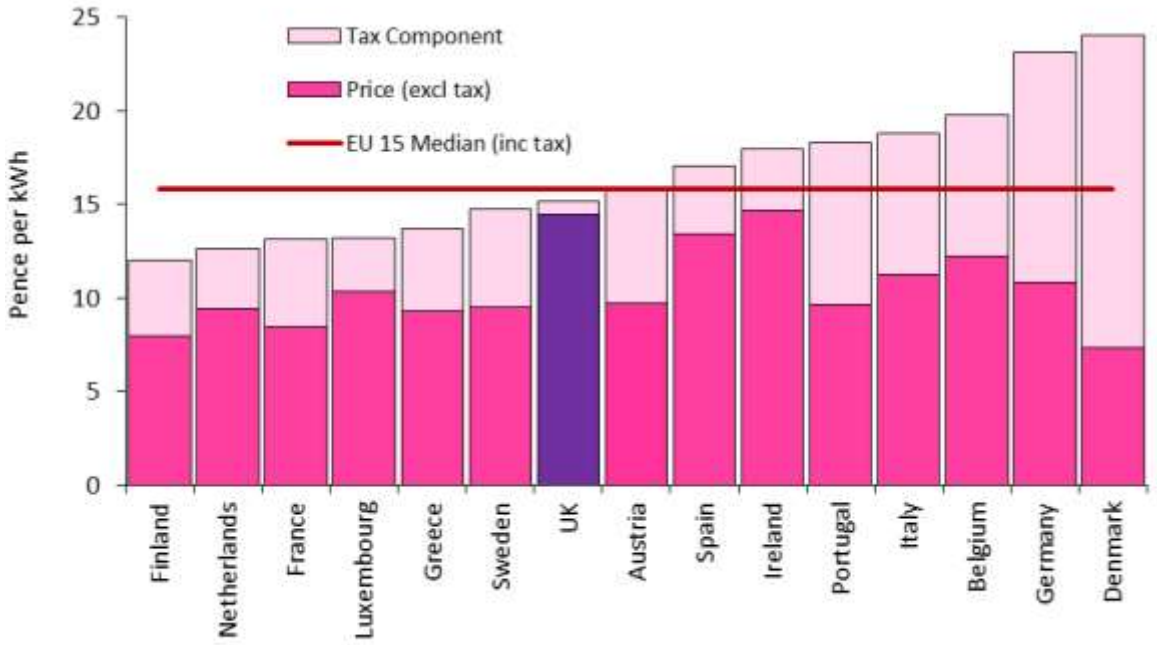
EU Domestic Energy Prices

Average domestic electricity prices

The average domestic electricity price including taxes in the UK for medium consumers (those consuming 2,500 – 4,999 kWh per year) for the period January to June 2016 was the ninth highest in the EU15 and was 4.1% below the EU15 median price. However, average domestic electricity prices excluding taxes in the UK were the second highest in the EU15, second only to Ireland (see Figure 7.11).

The average domestic electricity price including taxes for medium consumers in the UK fell by 2% between 2015 and 2016, whereas prices for the rest of the EU15 rose by an average of 6% over the same period. A fall in the average GBP-EUR exchange rate over the period of around 5% partially explains this variation.

Figure 7.11: Average domestic electricity prices for medium consumers in the EU15 - January to June 2016



Source: BEIS

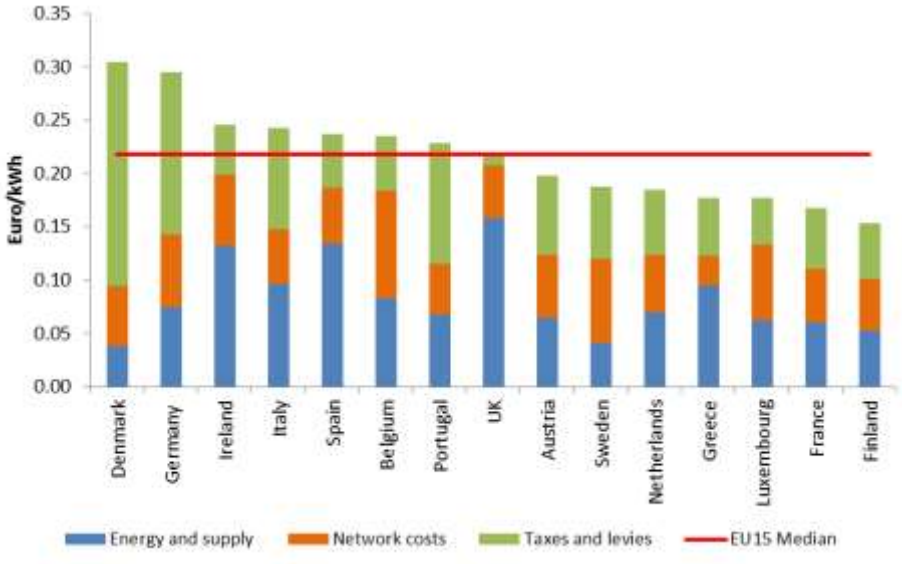
Electricity price components for medium consumers

Energy and supply costs (including supplier margin, and environmental and social costs) in the UK for medium consumers were the highest in the EU15 for the period July to December 2015 . These energy and supply costs in the UK were double the EU15 average during the period.

Network costs for UK medium consumers were the fourth lowest among the EU15, while taxes and levies continued to be the lowest. Overall, electricity prices for medium domestic consumers in the UK were equal to the EU15 median in 2015.

Average domestic electricity prices for medium consumers in the UK were below the EU15 average.

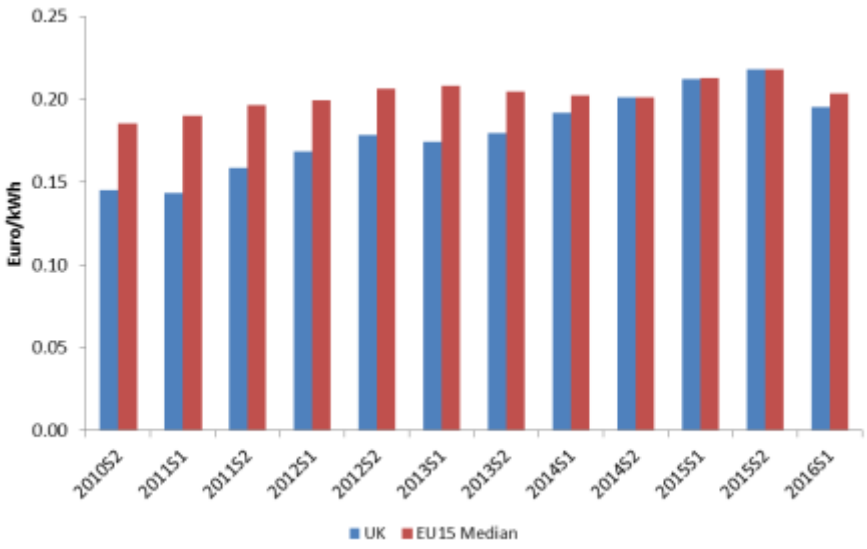
Figure 7.12: Electricity prices components for domestic medium consumers in the EU15, July to December 2015



Source: Eurostat

Domestic electricity prices, including taxes and levies, for UK medium customers increased by 35% between the second half of 2010 and the first half of 2016 (see Figure 7.13). The domestic electricity price for UK consumers was 22% less than the EU15 median in the second half of 2010. However, this price advantage experienced by UK customers has shrunk significantly. By the first half of 2016, UK medium consumers were paying an average of only 4% less than the EU median for electricity.

Figure 7.13: Domestic electricity prices for medium domestic consumers for the EU15 and the UK, 2010-2016, half-yearly prices



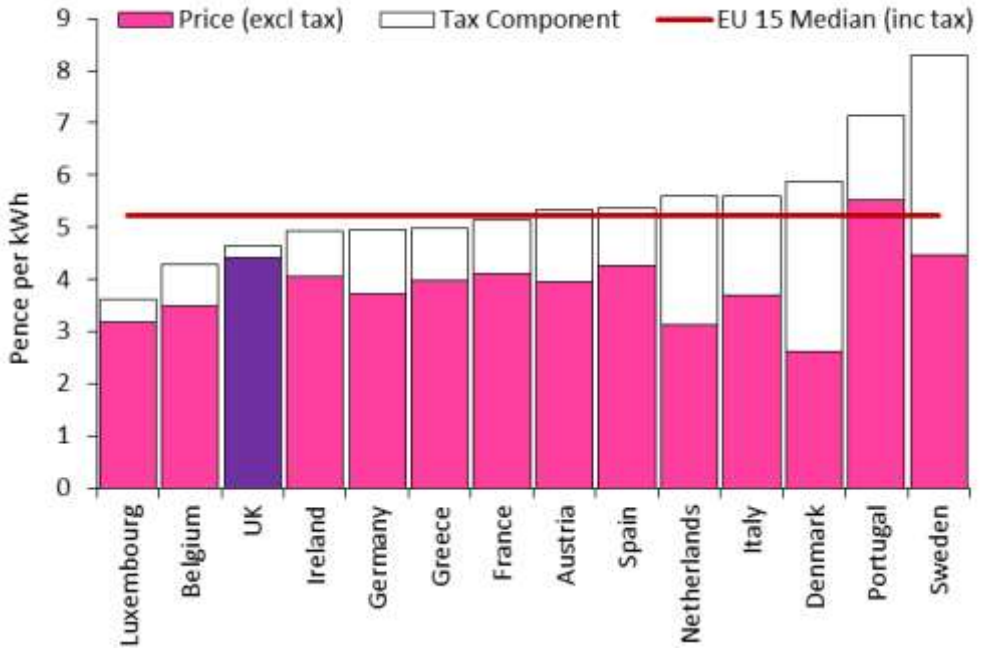
Source: Eurostat

Gas prices for medium domestic consumers

Average domestic gas prices, including taxes, in the UK for medium consumers (5,557 - 55,556 kWh per annum) for the period January to June 2016 were the third lowest in the EU15 and were 17% lower than the EU15 median, as shown in Figure 7.14.

The average domestic gas price including taxes in the UK for medium consumers was 7% lower than in the same period in 2015, whereas the EU15 median price fell by 0.5% . The UK price excluding taxes was the fifth highest among the EU15 and 5% higher than the EU 15 median.

Figure 7.14: Average domestic gas prices for medium consumers in the EU15, January to June 2016

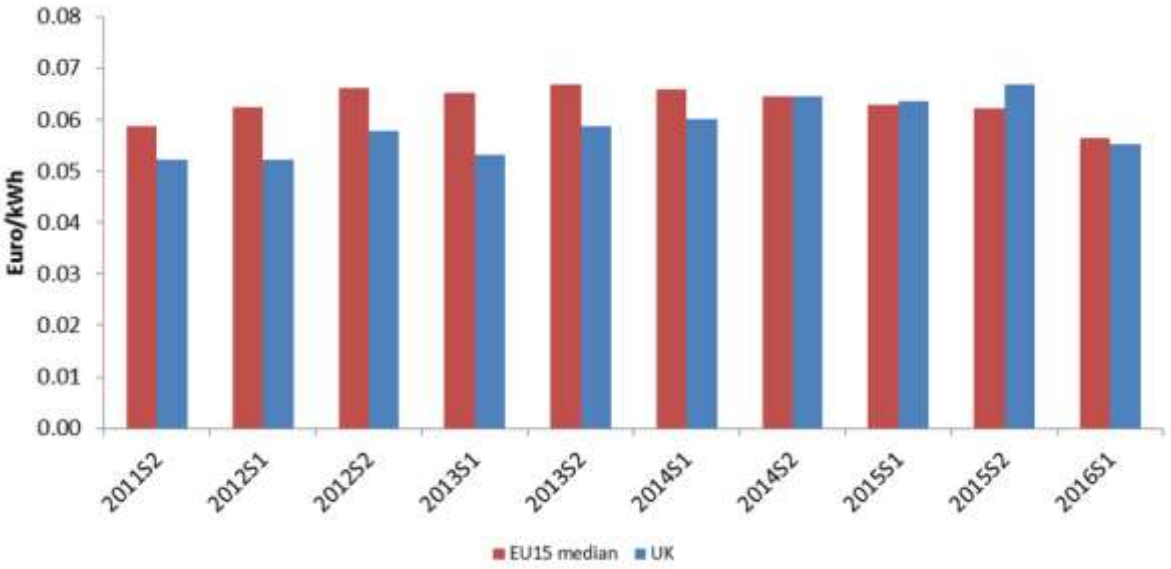


Source: BEIS

The EU15 median and UK domestic gas prices including taxes both fluctuated between 5 and 7 cents per kilowatt hour between 2011 and 2016. Domestic gas prices for UK medium consumers increased by 6% over the same time period, whereas the EU15 median gas price fell by 4%.

During this period prices were on average 7% lower in the UK than the EU 15 median, while in 2016 they were 2% lower. Figure 7.15 shows that the average UK medium customer consistently paid less for gas than the EU15 median, apart from between the second half of 2014 and the first half of 2015, when UK customers paid up to 8% more.

Figure 7.15: Domestic gas prices for medium consumers for the UK and the EU15 from 2011 to 2016, half-yearly price



Source: Eurostat

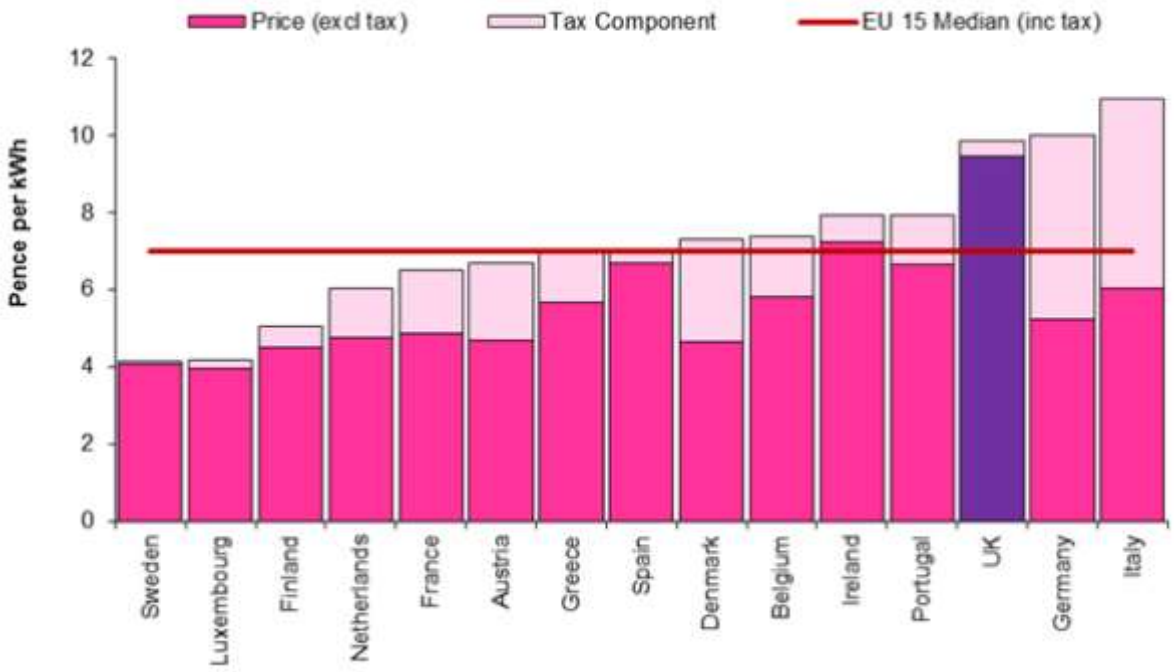
EU Industrial Energy Prices

Average industrial electricity prices

Average industrial electricity prices including taxes in the UK for medium consumers for the period January to June 2016 were the third highest in the EU15 and were 41% above the EU15 median (see Figure 7.16). The tax component was 0.41p per kWh in the UK during this period, the fourth lowest among the EU15.

The average industrial electricity price including taxes in the UK for medium consumers fell by 2% on the same period in 2015, whereas the EU15 median price was stable.

Figure 7.16: Average industrial electricity prices for medium consumers in the EU15, January to June 2016



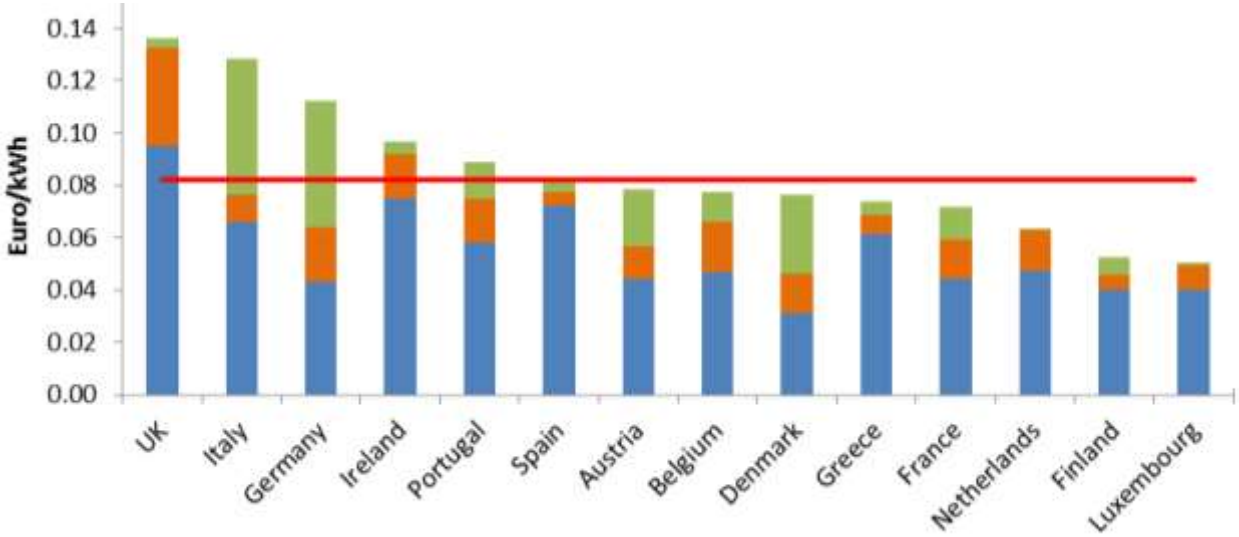
Source: BEIS

Electricity price components for large industrial consumers

Electricity costs for UK industry are consistently high relative to the EU15 median. Figure 7.17 shows that in the latter half of 2015, UK electricity prices including taxes for large industrial consumers of electricity (those consuming 20,000-70,000 MWh per year) were the highest in the EU15. UK network costs were also the highest in the EU15, but taxes and levies were among the lowest. Overall, electricity prices for large industrial consumers in the UK were around 65% higher than the EU15 median.

Average industrial electricity prices for very large users in the UK were the highest among the EU15 countries - and around 65% higher than the EU15 average.

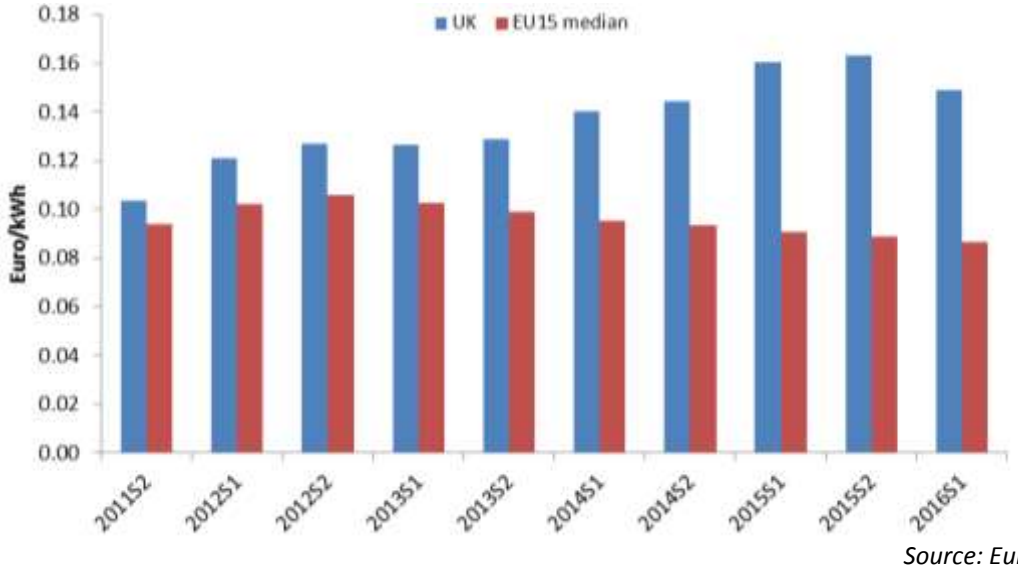
Figure 7.17: Electricity prices components for energy intensive industrial consumers in the EU15 in the period July to December 2015



Source: Eurostat

Electricity prices including taxes and levies for large UK industrial consumers increased by 44% between the second half of 2011 and the first half of 2016 (see Figure 7.18). Electricity prices for UK large industrial consumers were approximately 10% higher than the EU15 median in the second half of 2011. However, Figure 7.18 illustrates that the price differential between the UK and the EU15 median steadily increased to a peak of 84% of the EU15 median in 2015 before falling back to 72% of it in the first half of 2016.

Figure 7.18: Industrial electricity prices for large industrial users for the EU15 median and UK, 2011 – 2016 half -yearly prices



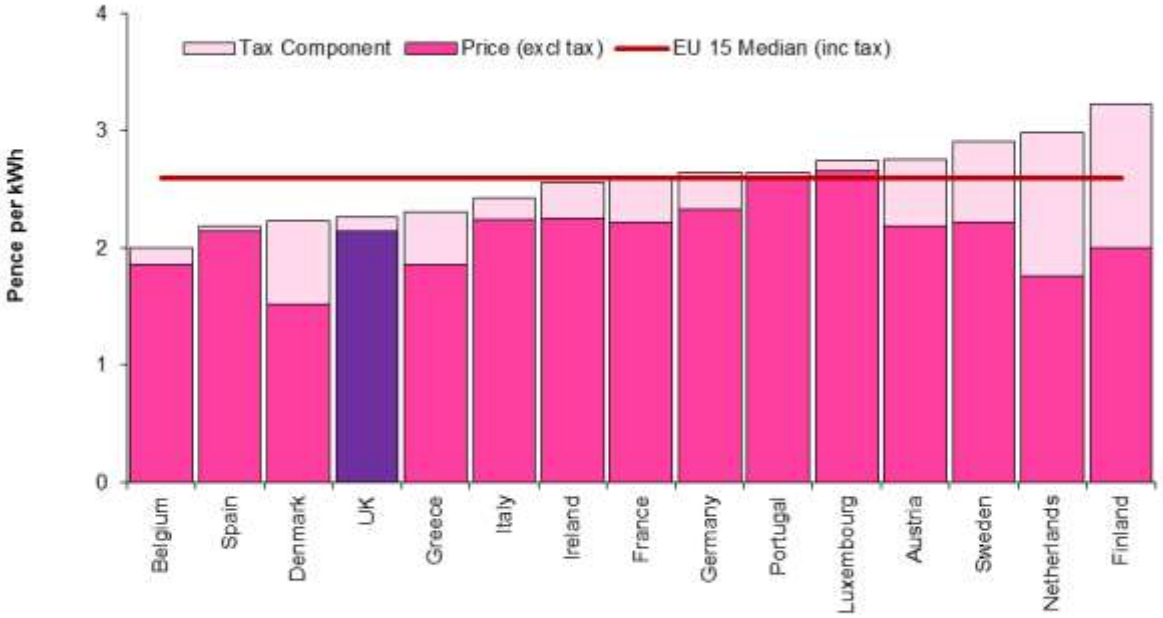
Source: Eurostat

Average industrial gas prices

Average industrial gas prices for the period January to June 2016, including taxes, in the UK for medium consumers were the fourth lowest in the EU15 and were 13% below the EU15 median price (see Figure 7.19).

The average industrial gas price including taxes in the UK for medium consumers fell by 13% on the same period in 2015 while the EU median fell by 10%.

Figure 7.19: Average industrial gas prices for medium consumers in the EU15, January to June 2016

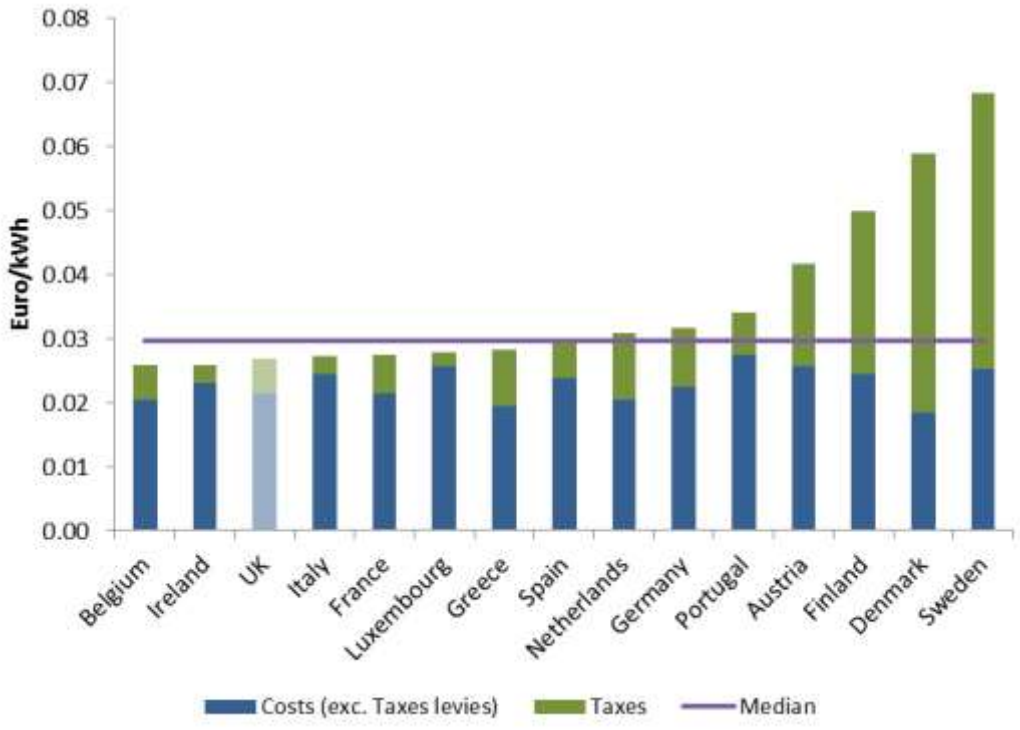


Source: BEIS

Gas Prices for Large Industrial Customers

UK industrial gas prices including taxes and levies for large industrial consumers (those consuming 100,000 – 1,000,000 GJ per annum) were 9% lower than the EU15 median gas price. Figure 7.20 shows that gas prices paid by UK large industrial consumers were the third lowest in the EU15 in the period from January to June 2016.

Figure 7.20: Industrial gas prices for large industrial consumers in the EU15, January to June 2016

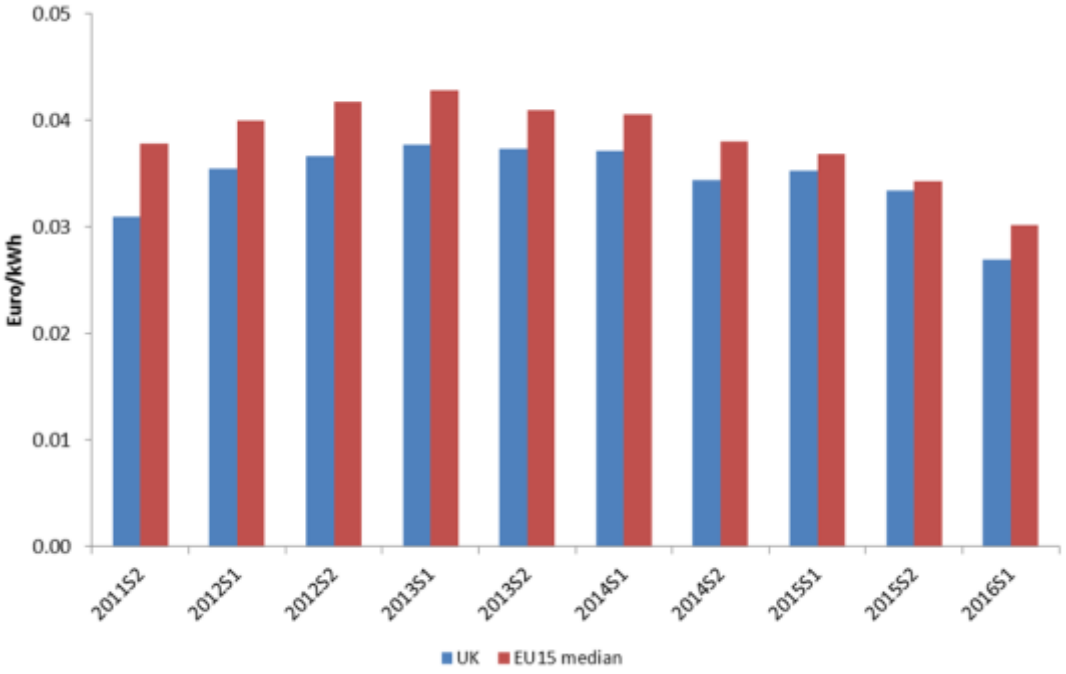


Source: Eurostat

The EU15 median large industrial consumer gas price including taxes increased gradually between the second half of 2011 and the first half of 2013, but subsequently gas prices have fallen (see Figure 7.21). The average UK large consumer price peaked in the first half of 2013 and then fell by 29% over the following three years.

The price advantage experienced by UK large industrial consumers relative to the EU15 median fell from 18% of the EU15 median in the second half of 2011 to 2% in the second half of 2015, but in the first half of 2016 it rose back to 11%.

Figure 7.21: Industrial gas prices for large industrial consumers for the EU15 median and the UK, 2010 to 2016, half-yearly price



Source: Eurostat

Fuel Poverty

Fuel poverty is the inability to heat a home to an acceptable standard at a reasonable cost. A household is in fuel poverty if, in order to maintain a satisfactory heating regime, it would be required to spend more than 10% of its income on all household fuel use[12].

Extreme fuel poverty indicates that a household would have to spend more than 20% of its income to maintain a satisfactory heating regime.

A satisfactory heating regime is defined as follows:

- For "vulnerable" households, 23°C in the living room (zone 1) and 18°C in other rooms (zone 2), for 16 hours in every 24.
- For other households, this is 21°C in the living room (zone 1) and 18°C in other rooms (zone 2) for 9 hours a day during the week and 16 during the weekend.

In 2015 fuel poverty declined by about 4 percentage points, equivalent to around 97,000 fewer fuel poor households compared to 2014. 30.7% (or around 748,000 households) were fuel poor and 8.3% (or around 203,000 households) were living in extreme fuel poverty in 2015.

The fuel poverty rate in 2015 is the lowest rate recorded by the survey since 2008.

Households using oil as primary heating fuel have benefitted most (now 26% fuel poor, down from 49% in 2014), presumably in large part due to the falling price of oil. Domestic liquid fuels were down by about 30% in the last year [13].

Rural households have also gained disproportionately in the last year (now 35% fuel poor, down from 50% in 2014), partly thanks to their higher usage of heating oil. Rural fuel poverty is now close to the level of fuel poverty in urban areas (30% in 2015).

DATA NOTE - FUEL POVERTY

Notes and Definitions

- Vulnerable households are those where an occupant is aged 60 or over or self-identifies as long-term sick or disabled.
- The cost of the satisfactory heating regime is determined using a BRE Domestic Energy Model (BREDEM) calculation which takes into account a range of energy uses in the home, average annual energy prices, and information from the Scottish Households Survey (SHS) and the Scottish House Condition Survey (SHCS) about the occupancy and location of the dwelling. No information on the actual energy use or energy bills of the household is taken into account when deriving the fuel poverty indicator.
- Over time there have been some changes in the energy modelling method which underpins the fuel poverty indicator. From 2010 onwards the modelling is based on BREDEM 2012, replacing the previous BREDEM –12 method. Sources and assumptions relating to fuel prices were updated for 2013 and subsequent years to better reflect the experience of Scottish households.

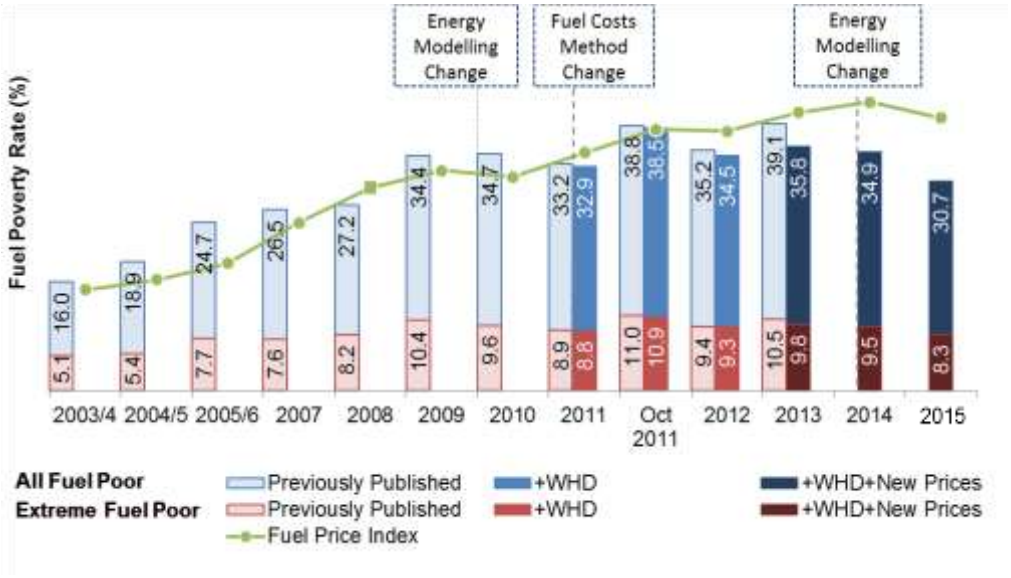
12. Scottish Fuel Poverty Statement 2002, http://www.scotland.gov.uk/Resource/Doc/46951/0031675.pdf

13. BEIS Quarterly Energy Prices, Table 2.1.3, https://www.gov.uk/government/collections/domestic-energy-prices

Figure 7.22 shows the latest estimates of fuel poverty with warm home discounting (WHD) and new prices in comparison to previously published figures.

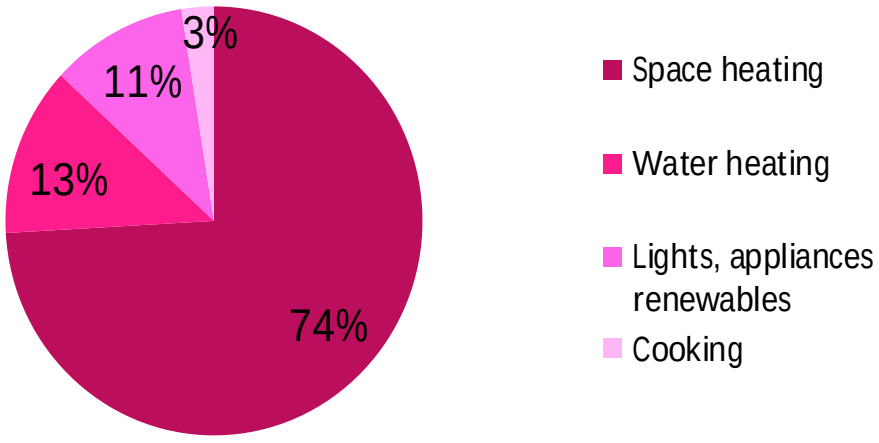
About half (2.3 percentage points) of the reduction in fuel poverty between 2014 and 2015 can be attributed to falling energy prices, around a third (1.3 points) to improved energy efficiency of the housing stock, and the rest (0.6 points) can be explained by higher household incomes.

Figure 7.22: Fuel poverty, extreme fuel poverty rates and indexed average fuel cost, 2003/4-2015



Source: SHCS

Figure 7.23: Average household energy consumption by end use, 2015



Source: SHCS

The measure of fuel poverty does not reflect the actual energy use of households, which may vary considerably from the standard set of behaviours. Although space heating is the largest component of the household energy use, accounting for 74% of the overall modelled energy demand, there are other types of energy use included, such as water heating (13%), lights and appliances usage (11%), and cooking (3%).

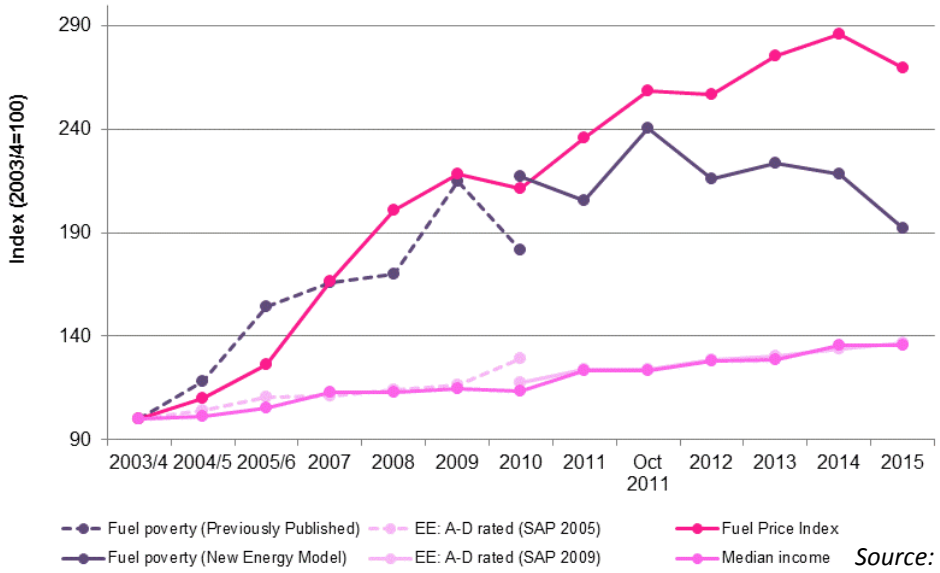
Levels of fuel poverty are broadly the outcome of three drivers:

- household income
- fuel prices
- the energy efficiency of the housing stock

However, the impact of these three drivers is not equal. For example, for households near the 10% threshold for fuel poverty, a £100 increase in fuel costs would require a £1000 increase in income to mitigate. Fuel poverty levels are sensitive to changes in consumer prices in spite of the improvements in energy efficiency.

As Figure 7.24 illustrates, fuel prices have risen much faster than income, so that by 2015 fuel prices were over two and a half times (170%) their level in 2003/04, while median household income has risen by less than a half (36%). In the same period, the proportion of dwellings rated A-D increased by 34%. Note that 2010 presents two fuel poverty points and two EE A-D rated points due to the introduction of a new energy model and SAP 2009. For more information please see the Scottish House Conditions Survey.

Figure 7.24: Fuel Price, Energy Efficiency and Income Indices, 2003/04—2015



Source: SHCS

While better energy efficiency offers some protection against fuel poverty, it does not fully offset the effect of rising fuel prices.

Table 7.6: Fuel poverty rates by EPC bands, 2014 and 2015

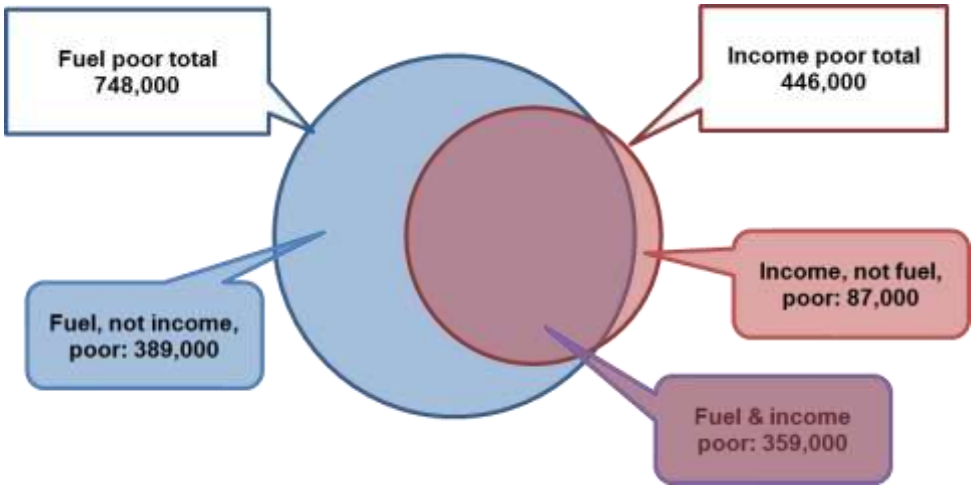
	2015			2014		
	000s	%	*Base Sample*	000s	%	*Base Sample*
EPC Band						
B - C	163	18%	*923*	158	18%	*833*
D	320	30%	*1,161*	359	34%	*1,171*
E	184	50%	*452*	222	59%	*458*
F - G	80	70%	*161*	106	75%	*172*
All Scotland	748	31%	*2,697*	845	35%	*2,634*

Source: SHCS

Table 7.6 shows that fuel poverty is higher for properties with a poor EPC band rating: in 2015, fuel poverty rates were 18% for dwellings rated A-C, 30% for D-rated dwellings, 50% for E-rated dwellings and 70% for those rated F or G.

Although fuel poverty is correlated with low income, it is not equivalent to income poverty. As Figure 7.25 shows, around half (52%) of fuel poor households (or 389,000 households) have incomes above the relative poverty threshold, defined as £291 per week before housing costs for a couple without children.

Figure 7.25: Fuel poor and income poor households, 2015



Source: SHCS

CHAPTER 8

CLIMATE CHANGE

'Greenhouse gas emissions in Scotland have fallen by 39.5% since 1990'

CLIMATE CHANGE

KEY FACTS

CLIMATE CHANGE TARGETS

FROM 1990 BASELINE...

⇩42% BY 2020

⇩80% BY 2050

94% ...OF ENERGY SUPPLY EMISSIONS FROM PARTICIPANTS OF EU ETS

IN 2014, GRID EMISSIONS IN SCOTLAND WERE...

196 gCO_2e/kWh

DOWN 9% SINCE 2013

EMISSIONS IN SCOTLAND 46.7 Mt CO_2e

CO_2e ⇩39.5% SINCE 1990

SCOTLAND EMITTED 46.7 Mt CO_2e IN 2014. THIS IS EQUIVALENT TO THE EMISSIONS FROM OVER...

18 MILLION GAS BOILERS

Based on Scotland's average domestic gas consumption per meter

CURRENT EU CARBON PRICE...

€5.35 PER TONNE CO_2e

Source: Cornwall, January 2017

CHANGE IN EMISSIONS SINCE 1990[1]...

13.4 MILLION TONNES OF CARBON DIOXIDE...

...WERE DISPLACED BY **SCOTLAND'S RENEWABLE** ELECTRICITY IN 2015

EMISSIONS PER CAPITA IN 2014[1]...

Greenhouse Gas Emissions in Scotland

There are **two measures of greenhouse gas emissions** which are presented in this chapter:

SOURCE EMISSIONS

A measure of the actual emissions or removals in Scotland. Includes international aviation and shipping Used for UK and international comparisons.

46.7 $MtCO_2e$ in 2014

39.5% from 1990

8.6% from 2013

ADJUSTED EMISSIONS: For Reporting Against Targets

Emissions adjusted to account for Scotland's participation in EU-wide emissions trading are used to measure progress against targets.

41.886 $MtCO_2e$ in 2014

45.8% from Baseline Period

12.5% from 2013

The Climate Change (Scotland) Act 2009 provides for a fixed annual target for 2014 of 46.958 $MtCO_2e$ which has been met. The Act also contains a 2050 target for at least an 80% reduction from baseline levels and an interim 2020 target for at least a 42% reduction. By 2014 a reduction of 45.8% has been achieved.

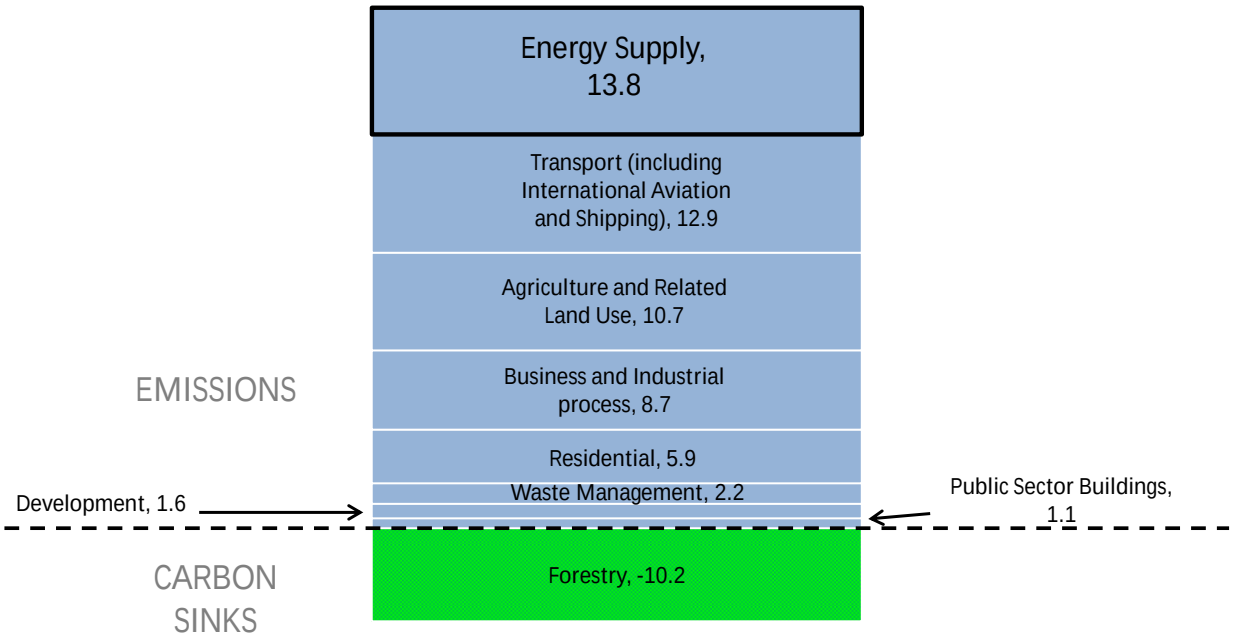
$MtCO_2e$ refers to million tonnes of carbon dioxide equivalent. This is a consistent measure of assessing the contribution of greenhouse gases[14] to global warming. The Baseline Period uses 1990 for carbon dioxide, methane and nitrous oxide and 1995 for hydrofluorocarbons, perfluorocarbons, sulphur hexafluoride and nitrogen trifluoride.

Source Emissions

Energy supply is a major source of greenhouse gas emissions. These are estimated in the Scottish Greenhouse Gas Inventory, which is the key tool for understanding the origins and magnitudes of the emissions and the assessment of policies designed to control or reduce emissions. The inventory is compiled in line with international guidance from the Intergovernmental Panel on Climate Change (IPCC). The inventory is also used to report data against targets as required under the Climate Change (Scotland) Act 2009.

Scottish Greenhouse Gas Emissions are allocated into sectors for the purposes of reporting and are classified according to the source where they have taken place. These source sectors include net sources of emissions, such as Energy Supply, Business and Industrial Processes and the Residential sectors, in addition to sequestration of emissions from sectors such as Forestry.

Figure 8.1: Sources of Scottish Greenhouse Gas Emissions, 2014. Values in $MtCO_2e$



Emissions from the Energy Supply sector are classified as those generated from fuel combustion for electricity and other energy production sources, and emissions from fuels (such as from mining or oil and gas exploration activities). Figure 8.1 shows that in 2014, the Energy Supply sector was the largest source of greenhouse gas emissions in Scotland, followed closely by Transport (including International Aviation and Shipping). Note that it is also possible to present energy emissions on an end-user basis. These emissions are allocated to the point of end usage of energy, such as from electricity usage in residential homes and in business. They also consider the emissions from the electricity which is exported from Scotland.

'The energy supply sector is the largest source of greenhouse gas emissions in Scotland... ...13.8 Mt CO_2e in 2014'

Table 8.1: Net Source Greenhouse Gas Emissions from the Energy Supply Sector in Scotland, 1990-2014

$MtCO_2e$	1990	2013	2014	% change 1990-2014	% change 2013-2014
TOTAL NET GREENHOUSE GAS EMISSIONS	77.2	51.1	46.7	-39.5%	-8.6%
ENERGY SUPPLY EMISSIONS	22.8	16.0	13.8	-39.2%	-13.4%
ELECTRICITY PRODUCTION	*14.8*	*11.4*	*9.8*	*-33.6%*	*-14.4%*
OTHER ENERGY SUPPLY	*8.0*	*4.5*	*4.1*	*-49.5%*	*-10.8%*

Source: Scottish Greenhouse Gas Inventory, 1990-2014

Table 8.1 provides the headline statistics on net source greenhouse gas emissions for Scotland and for the energy supply sector. In all years, energy supply is the main source of greenhouse gas emissions, although it has a seen a sharp fall in 2013 and 2014. This is partly linked to the closure of a power station and a mothballing of another power station.

It means that energy supply emissions in 2014 are now only 0.9 $MtCO_2e$ higher than the second largest source sector - transport emissions (including international aviation and shipping).

Scotland has reduced its greenhouse gas emissions (-39.5%) by a higher proportion than both the UK (-33.0%) and the EU overall (-23.9%), between 1990 and 2014.

In 2014, Scotland's greenhouse gas emissions per capita were slightly higher than for the UK and for the EU-28 as a whole. There were higher per capita emissions from agriculture and energy supply emissions (particularly from refineries) in Scotland in 2014, although these have been offset by a much larger amount of carbon sequestration, particularly from forestry but also from grasslands.

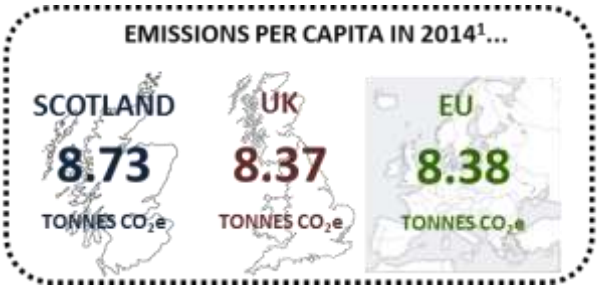
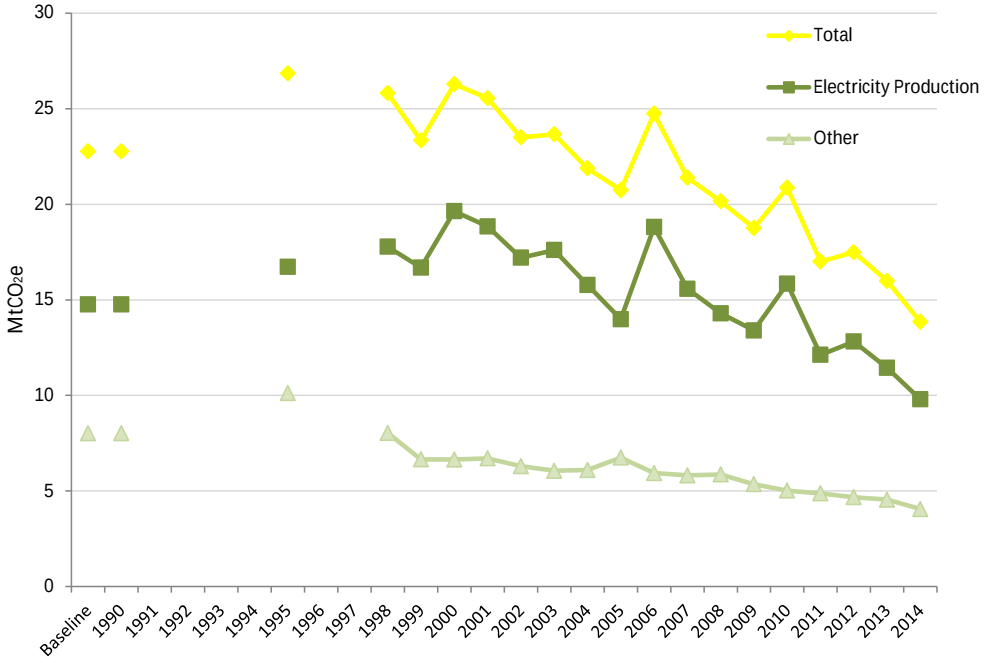


Figure 8.2: Emissions from the Energy Supply Sector in Scotland, 1990-2014



Source: Scottish Greenhouse Gas Inventory, 1990-2014

The Energy Supply sector saw the largest absolute decrease of any sector between 2013 and 2014 - a 2.1 $MtCO_2e$ (13.4 per cent) decrease. The largest contributor to the reduction in energy supply emissions between 2013 and 2014 has been power stations. In particular, a gas fired power station was mothballed in May 2014. A coal fired power station was also closed in March 2013 with some remaining emissions being reported for 2013, but not in 2014. There have also been falls in emissions from combustion in refineries and from gas production between 2013 and 2014.

The Energy Supply sector also saw the largest absolute decrease of any sector between 1990 and 2014 - an 8.9 $MtCO_2e$ (39.2 per cent) decrease. This series is very volatile and is driven by the fact that energy demand is linked to the ambient temperature, especially during the winter months, and fuel used for electricity production, which in turn is partly driven by the price of coal relative to "cleaner" fuels. Emissions from other energy supply sources have fallen since 1990 and these have been driven by falls in emissions from coal mining, upstream oil and gas production, coke manufacture and oil refining. For more detail on electricity generation in Scotland, please see Chapter 3.

The EU Emissions Trading System (EU ETS)

What is the EU Emissions Trading System (EU ETS)?

Launched in 2005, the EU ETS is an EU policy aimed at mitigating climate change by limiting greenhouse gas emissions from industry sectors and aviation. Participants include more than 11,000 heavy energy-using installations in power generation, the manufacturing industry and airlines across 31 countries in the European Economic Area (EEA).

How does it work?

The EU ETS is a 'cap and trade' system. A limit (cap) is placed on the overall volume of emissions from participants in the system. Within the cap, organisations receive or buy emissions allowances (EU Allowance Units [EAUs]) which they can trade (1 EAU equals 1 tCO_2e). Each year, an organisation must surrender enough allowances to cover its emissions. The cap is reduced each year so that by 2020, the volume of emissions permitted within the system will be 21% lower than in 2005. The reducing cap alongside the financial considerations of trading EAUs, incentivises organisations within the system to find the most cost effective way of reducing their emissions.

Scotland in the EU ETS

The EU ETS contributes to delivering Scotland's Climate Change Targets through incentivising the reduction in emissions from Scottish organisations participating in the system. In 2014, there were 77 fixed Scottish installations which are regulated by Scottish Environment Protection Agency (SEPA) that surrendered EAUs in the EU ETS.

What are 'traded emissions' and 'non-traded emissions'?

In the greenhouse gas inventory, source emissions can be categorised into traded and non-traded. Traded emissions capture those that come from installations covered by the EU ETS, whereas Non-traded emissions are those which do not fall within the scope of the EU ETS. The emissions from some sectors, such as the residential sector, are completely non-traded whereas emissions from other sectors, such as energy supply and business and industrial process, are a combination of traded and non-traded. For the years from 2012 to 2014, CO_2 emissions from domestic and international aviation are classified as being within the traded sector.

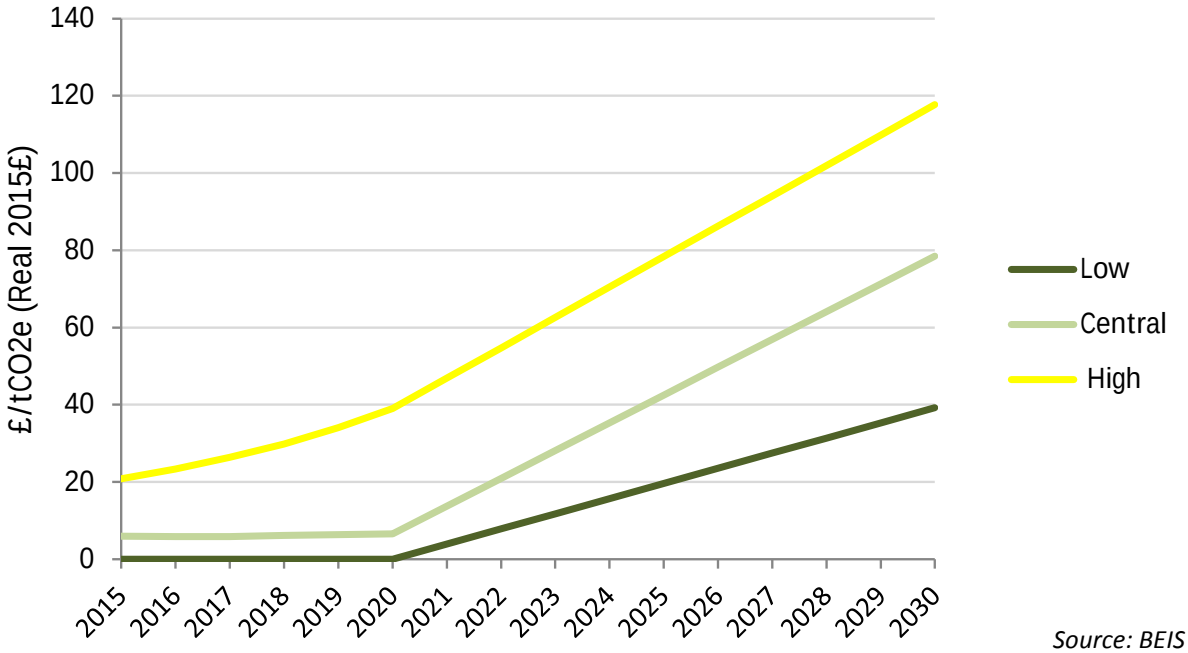
Carbon Price and the EU Emissions Trading System (EU ETS)

Since 2008, EU emissions have been lower than anticipated due in part to the economic downturn. This has resulted in a fall in demand for EAUs (EU Allowance Units), and a growing surplus of allowances in the system. Both elements have contributed to a reduction in the price of carbon in the EAU market.

The short-term traded carbon values have been updated for 2015 (see Figure 8.3) and the overall impact of the changes highlighted below is to slightly increase the values of the central scenario when compared to the 2014 short-term traded carbon values, and also increase the values in the high scenario. The differences between the 2015 values and 2014 values are most significant under the high scenario. The changes to the high series, as compared with 2014, is principally driven by the impact of decisions on the 2030 GHG target and MSR (Market Stability Reserve), which have been agreed since the 2014 values were published.

After 2030, it is assumed a global carbon market exists, applicable to both the traded and non-traded sectors. The long-term carbon values reflect the costs required to achieve the internationally agreed UNFCCC long-term goal of limiting global temperature increases to not greater than 2 degrees centigrade above pre-industrial levels.

Figure 8.3: Short-term Traded Carbon Valuation (Real 2015 £), 2015-2030



Source: BEIS

The Carbon Price Floor (CPF) came into effect on 1 April 2013.

It is made up of the price of CO_2 from the EU Emissions Trading System (EU ETS) and the Carbon Price Support rate per tCO_2 which is the UK-only additional tCO_2 emitted in the power sector.

The vast majority (94%) of emissions which were produced in the energy supply sector in 2014 occurred from installations which participate in the EU Emissions Trading System (EU ETS). Seven in ten (70%) of all of Scotland's EU ETS emissions in 2014 occurred within the energy supply sector.

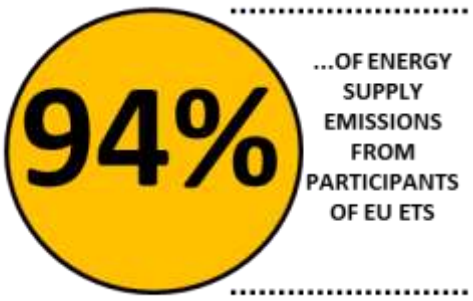
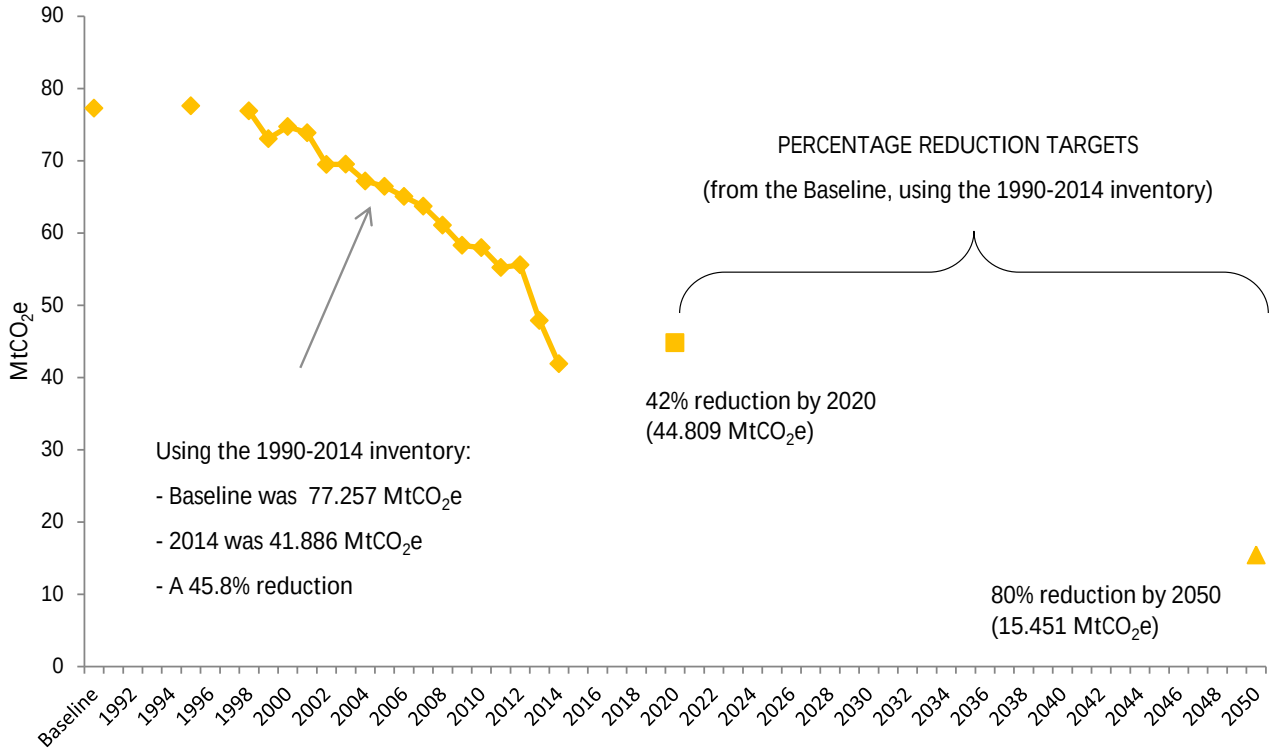


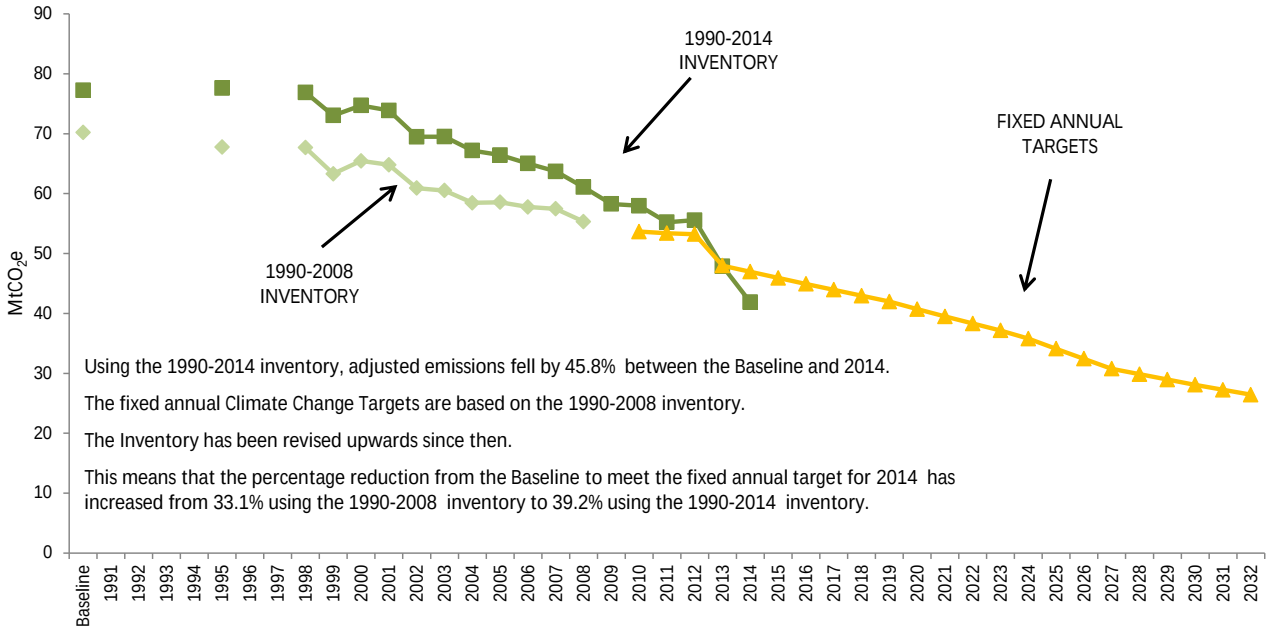
Figure 8.4 shows data from the latest (1990-2014) inventory, adjusted for trading in the EU Emissions Trading System, as well as data on progress against the 42 per cent and 80 per cent reduction from the Baseline Period in the latest inventory.



Source: Scottish Greenhouse Gas Inventory, 1990-2014

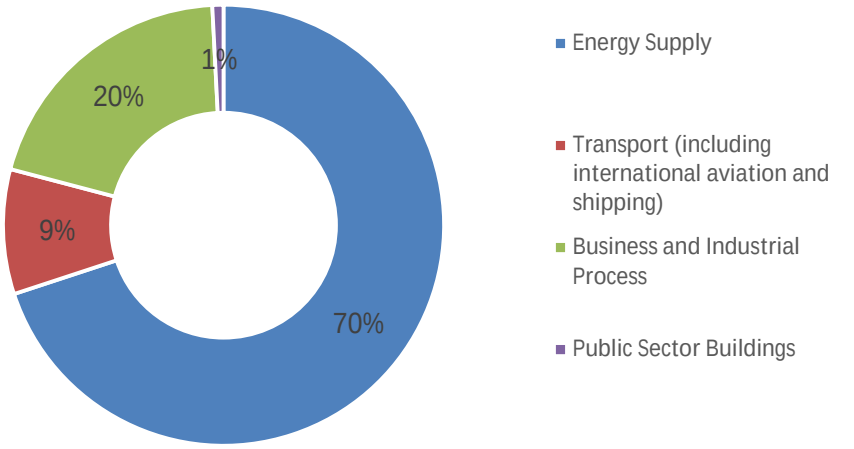
Figure 8.5 contains data from the latest (1990-2014) inventory, adjusted for trading in the EU Emissions Trading System. The fixed annual targets are also presented in this chart. These were set at the time of the 1990-2008 inventory. Emissions adjusted for trading in the EU ETS using the 1990-2008 inventory are shown for context.

Figure 8.5: Comparison of Adjusted Emissions and the Fixed Annual Targets which are based on the 1990-2008 Inventory, Scotland



Source: Scottish Greenhouse Gas Inventory, 1990-2014

Figure 8.6: Estimated traded greenhouse gas emissions, broken down by Scottish Government source sector, 2014



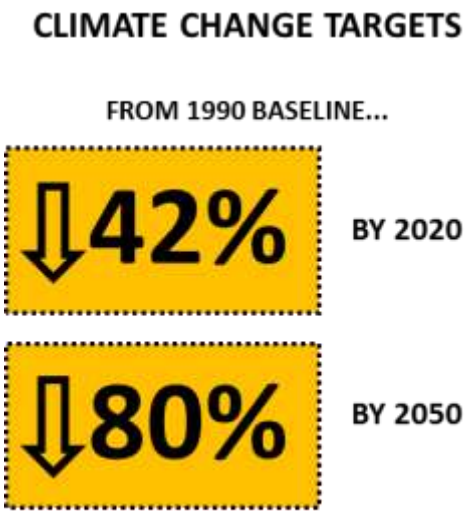
'In 2014, the EU ETS adjustment decreased reported emissions from 46.7 Mt CO2e to 41.9 Mt CO_2e'

Source: Scottish Greenhouse Gas Inventory, 1990-2014

What are the biggest sites in Scotland which release greenhouse gases?

In 2014, there were 17 fixed Scottish installations that surrendered over 100,000 tonnes of greenhouse gases in the EU ETS. In total, these point sources accounted for around 15.4 $MtCO_2$ - a third of Scotland's net source greenhouse gas emissions in 2014.

'The largest 17 point sources of greenhouse gas emissions in Scotland are estimated to contribute around 15.4 MtCO2e. That's a third of all of Scotland's greenhouse gas emissions'



Scotland's Climate Change Targets

Scotland has a number of targets for reducing greenhouse gas emissions contained in legislation, within the Climate Change (Scotland) Act 2009. These targets can be summarised as follows:

"The Act creates a statutory framework for greenhouse gas emissions reductions in Scotland by setting an interim target of at least a 42% reduction for 2020, and at least an 80% reduction target for 2050. These reductions are based on a 1990 baseline (1995 for the F-Gases). The Act also requires that Scottish Ministers set fixed annual targets for emissions at least 12 years in advance."

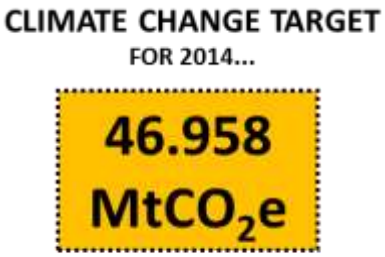
National Performance Framework - Sustainability Purpose Targets

In addition to the statutory Climate Change Targets, the greenhouse gas statistics are used to monitor progress against the Scottish Government's Sustainability Purpose Targets.

Information on progress towards these targets can be found on the Scottish Government Scotland Performs website:

http://www.scotland.gov.uk/About/Performance/scotPerforms/purpose/sustainability

In October 2010, the Scottish Parliament passed legislation setting the first batch of annual targets, for the years up to 2022. Targets for 2023-2027 were set in October 2011 and targets for 2028-2032 were set in October 2016. Current legislation requires these targets to be set at 5-year intervals.



The 2014 target of 46.958 $MtCO_2e$ was surpassed.

Scotland's Climate Change targets are presented in terms of emissions which are adjusted to take into account trading in the EU Emissions Trading System (EU ETS).

In four of the last 10 years, the adjustment has increased reported emissions, with 2011 and 2012 showing sizeable increases from the adjustment. In 2013 and 2014, the adjustment decreased reported emissions. In 2014, the adjustment represented a decrease of 4.818 $MtCO_2e$.

DATA NOTE

The Official Statistics publication **Scottish Greenhouse Gas Emissions 2014** contains further details on the process by which source emissions are adjusted to take into account of trading in the EU ETS:

www.gov.scot/Publications/2016/06/2307

More information on the Climate Change Targets can be found here:

www.gov.scot/Topics/Environment/climatechange/meetingemissionstargets

The Draft Climate Change Plan

The Climate Change (Scotland) Act 2009 set two statutory emissions reduction targets;

1. Reduce greenhouse gas emissions by 42% compared to 1990 by 2020.
2. Reduce greenhouse gas emissions by 80% compared to 1990 by 2050.

By 2014, a reduction of 45.8% has been achieved.

The "Draft Climate Change Plan: the draft third report on policies and proposals 2017-2032" was published in January 2017 and sets out a clear framework for hitting Scotland's annual emissions reduction targets from 2017 to 2032. It also sets the strategic direction towards further reductions in emissions of 80% by 2050.

The draft Plan sets out policies and proposals to reduce emissions in the electricity, residential, transport, services, industry, waste, land use and agriculture sectors.

Wider Impacts of Climate Change Mitigation Interventions

Policies designed to reduce greenhouse gas emissions can also have wider impacts on other policy objectives, such as improving air quality and improving health outcomes. The Scottish Government commissioned three evidence reviews of the potential wider impacts of climate change mitigation options, to inform the development of the draft Climate Change Plan. The reviews focused on the following policy sectors:

- Agriculture, Forestry, Land Use and Waste
- Built Environment
- Transport

The reviews highlighted a range of positive social, economic and environmental impacts which can potentially arise from policies in the draft Climate Change Plan. For example:

- Improving the energy efficiency of people's homes can result in reduced heat loss and warmer homes, and also reduce residents' anxiety about fuel bills, thereby improving their physical and mental health.
- Increasing the uptake of low emission vehicles (including electric cars) can improve air quality in towns and cities, thereby reducing health problems caused by air pollution.

For more information go to the Climate Change Plan (Annex E) and the individual Evidence Reviews

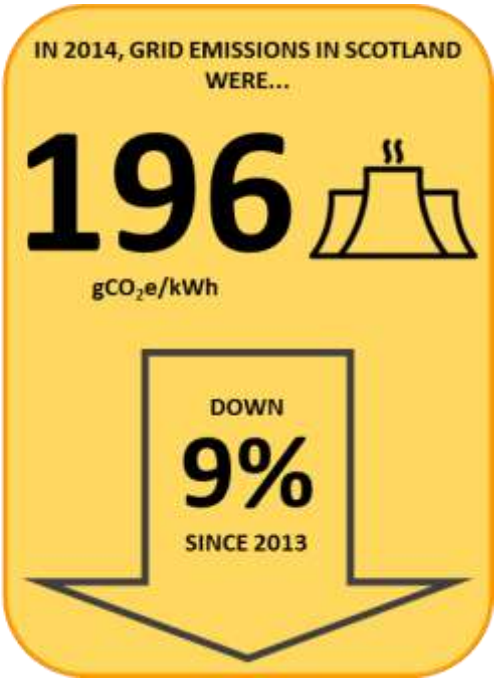
Grid Emissions

Under the terms of the Climate Change (Scotland) Act 2009 the amount of Scottish gross electricity consumption and the average greenhouse gas emissions per kilowatt hour of electricity generated in Scotland are required to be reported on an annual basis. The latest report was published in October 2016, covering emissions in 2014.

In 2014, total Scottish electricity generation was 49,929 GWh and gross electricity consumption was 38,115 GWh. The average greenhouse gas emissions per kilowatt hour of electricity generated in Scotland was estimated to be 196 gCO_2e/kWh in 2014.

This represents a decrease from 216 gCO_2e/kWh in 2013, and the carbon intensity of electricity generated in Scotland has reduced by approximately 9.2% since 2013.

Overall electricity generation in Scotland increased by 1,255 GWh to 51,000 GWh in 2015, and Scotland continued to be a net exporter of electricity, exporting 28.9% of total generation in 2015, up from 23.7% in 2014.



DATA NOTE

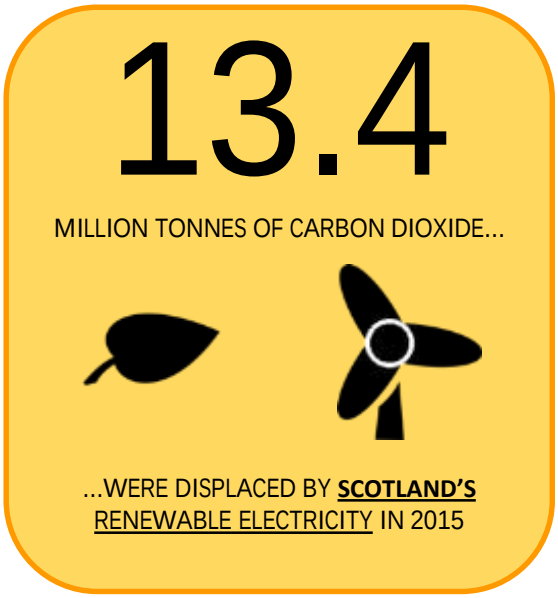
The methodology[15] used to calculate the figure for tonnes of CO_2 displaced by renewable electricity generation in Scotland is sourced from the following UK Parliamentary Question:

http://www.parliament.uk/business/publications/written-questions-answers-statements/written-question/Commons/2016-09-05/45055/

The data used in the calculation are sourced from the following BEIS publications:

https://www.gov.uk/government/statistics/regional-renewable-statistics

https://www.gov.uk/government/statistics/electricity-chapter-5-digest-of-united-kingdom-energy-statistics-dukes



Therefore, while grid intensity of Scottish generation represents a key measure of emissions in the sector, it is also important to consider emissions from electricity generation in the wider context of the GB grid.

It is not necessarily the case that Scottish renewables will displace the equivalent amount of thermal output in Scotland, rather renewable output in Scotland may displace emissions from elsewhere in the GB system.

Data published by BEIS shows that an estimated 13.4 million tonnes of CO2 were displaced by Scotland's renewable electricity generation in 2015, an increase of 8% on the 12.4 million tonnes of CO2 displaced by the sector in 2014.

Carbon emissions displaced by renewable electricity generation have been calculated as provisional renewable electricity generation figures multiplied by the average emissions factor for electricity supplied by fossil fuel power stations in 2015.

DATA DEVELOPMENT

TIMES Scotland - Modelling the energy system in Scotland

The development of the Scottish Government's **draft Climate Change Plan (CCP)** and Energy Strategy were informed by the use of a TIMES (The Integrated Markal EFOM System) for Scotland. The TIMES modelling approach was developed by the International Energy Agency – Energy Technology System Analysis Programme (IEA-ETSAP) and is a Whole System Energy Model (WSEM). Such models aim to capture the main characteristics of an energy system and the interlinkages within it. They are particularly useful for understanding the strategic choices that are required to decarbonise an economy. While this is the first time a model like this has been available for Scotland, they are widely used internationally for modelling climate and energy policy choices.

DATA DEVELOPMENT (cont.)

TIMES Scotland - Modelling the energy system in Scotland

What is TIMES?

The Scottish TIMES model is a high level strategic model, covering the entire Scottish energy system, and containing thousands of variables capturing existing and future technologies and processes.

The model combines two different, and complementary, approaches to modelling energy: a technical engineering approach and an economic approach. The model uses this information to identify the effectiveness of carbon reduction measures in order to provide a consistent comparison of the costs of action across all sectors of the economy.

The aim of the model is to capture the main characteristics which effect the deployment of technologies, their costs and associated greenhouse gas emissions for Scotland as a whole given a range of policy and other constraints. This allows consideration of the strategic choices which Scotland faces as it seeks to decarbonise its energy system.

For more information please see annex A of the Draft Climate Change Plan published in January 2017:

http://www.gov.scot/Publications/2017/01/2768/downloads

CHAPTER 9

LOW CARBON ECONOMY

'The low carbon economy supports 43,500 jobs in Scotland'

LOW CARBON ECONOMY

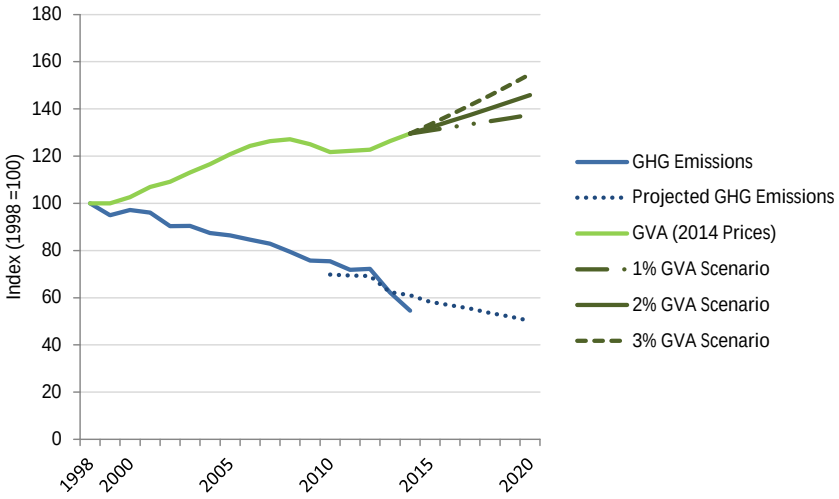
KEY FACTS

"A strong low carbon economy – sharing the benefits across our communities, reducing social inequalities, and creating a vibrant climate for innovation, investment and high value jobs."

Increase in carbon productivity in Scotland since 1998...

138%

Estimated GVA and Greenhouse Gas Emissions, Scotland, 1998-2020



43,500

JOBS WERE SUPPORTED BY THE LOW CARBON AND RENEWABLE ENERGY SECTOR IN SCOTLAND IN 2014, GENERATING A TURNOVER OF

£10.7 BILLION

CAPITAL INVESTMENT IN LOW CARBON AND RENEWABLE ENERGY ECONOMY IN SCOTLAND IN 2014...

£1.25 BILLION

Increase in energy productivity in Scotland since 2005...

28%

BETWEEN 1998 AND 2014:

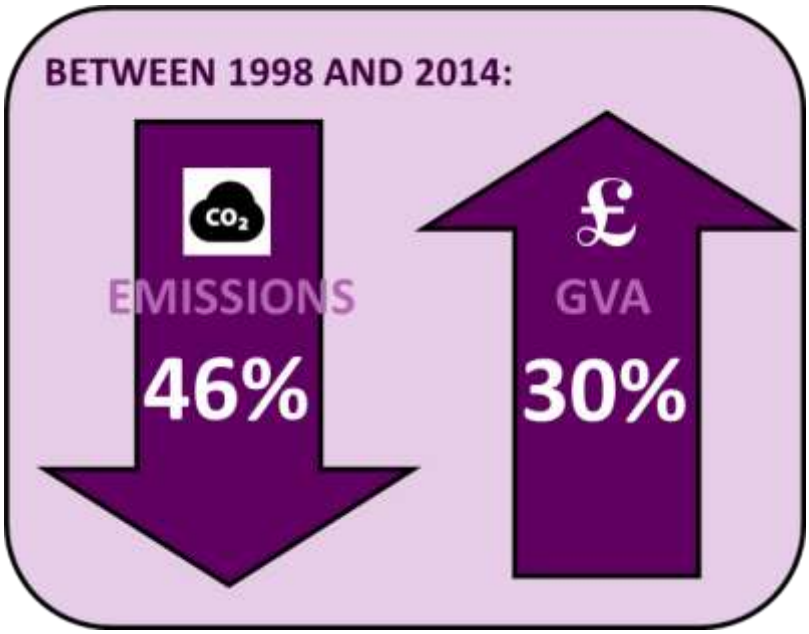
Low Carbon Economy in Scotland

All countries will have to adjust to a more resource efficient and sustainable economic model. The Scottish economy is particularly well placed to benefit from the development of the low carbon economy.

The Scottish Government is committed to driving the decarbonisation of our economy more quickly than our competitors, whilst developing low carbon products and services that will be needed across the globe. It will continue to invest in Scotland's low carbon infrastructure through the Low Carbon Infrastructure Transition Programme and Scotland's Energy Efficiency Programme.

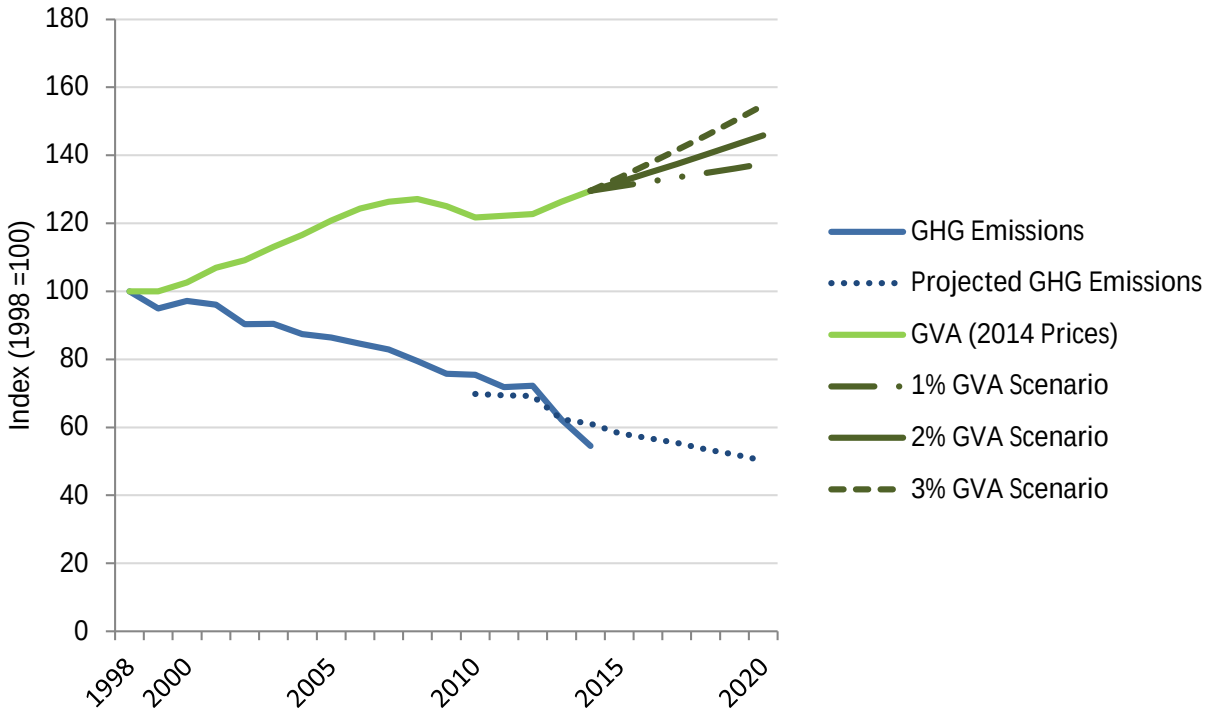
"A strong low carbon economy – sharing the benefits across our communities, reducing social inequalities, and creating a vibrant climate for innovation, investment and high value jobs."

Draft Scottish Energy Strategy, January 2017



In making the transition to a low carbon economy, Figure 9.1 shows how Gross Value Added (GVA) is changing in relation to the level of emissions in Scotland. While GVA in Scotland has increased by 30% - in real terms - between 1998 and 2014, emissions have reduced by 46%.

Figure 9.1: Estimated GVA and Greenhouse Gas Emissions, Scotland, 1998-2020



Sources: ONS, Scottish Government

Carbon Productivity

Carbon productivity is measured as the level of GVA per tonne of CO^2e, as shown in Figure 9.2.

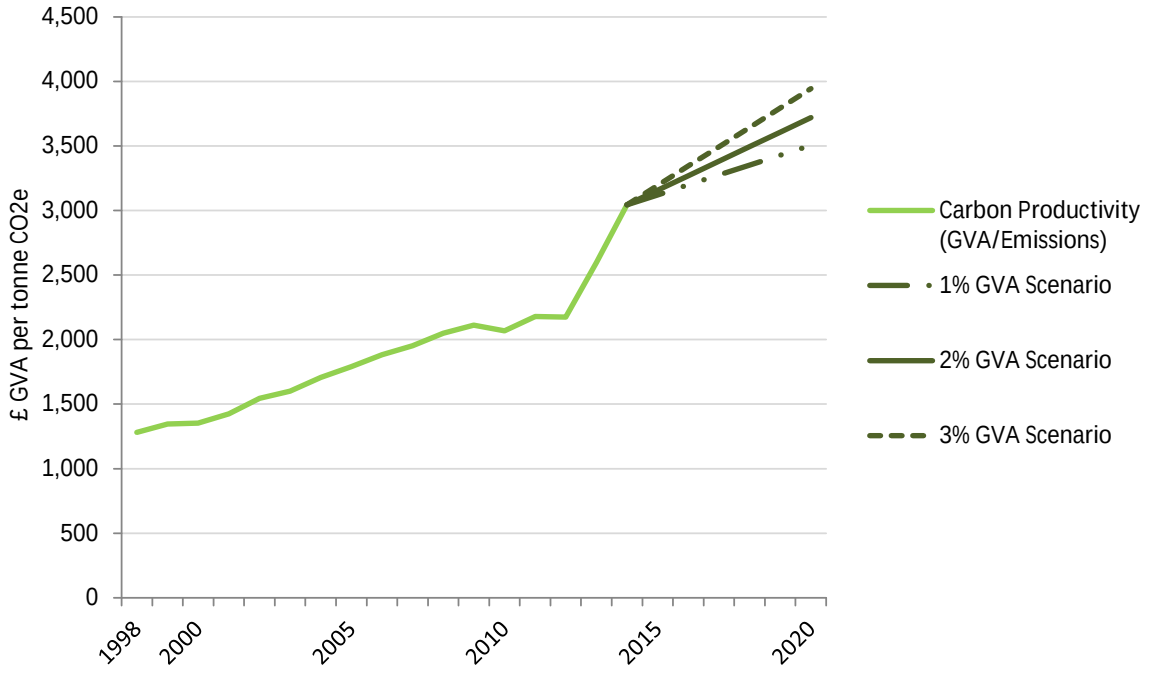
Between 1998 and 2014, carbon productivity has more than doubled (up 138%). Successful delivery of the emissions reductions target would see this figure improve further; to what extent will depend on the growth rate of the economy.

The scenarios used in Figure 9.2 show that carbon productivity in Scotland could have trebled by 2020, from a 1998 baseline.

Increase in carbon productivity in Scotland since 1998...

138%

Figure 9.2: Estimated Carbon Productivity, Scotland, 1998-2020



Sources: ONS, Scottish Government

A further indicator of success of the transition to a low carbon economy will be the numbers employed in low carbon sectors. Please see the data development box below for more information on the measurement issues regarding low carbon employment.

DATA DEVELOPMENT

Low Carbon and Renewable Energy Survey (ONS)

Scottish Government officials have been working closely with the Office for National Statistics (ONS), other UK departments (primarily BEIS) and devolved administrations to develop a more robust way of measuring the wider low carbon economy, to enable consistent and systematic monitoring on an annual basis.

DATA DEVELOPMENT (cont.)

This new survey was rolled out during 2015 and surveyed over 40,000 businesses UK-wide.

This is a very positive development in a key area for the Scottish Government, and allows the impact of the low carbon economy to be quantified and monitored using high quality national statistics.

The latest results from the survey (for 2015) were published in December 2016 and are available here:

Low Carbon and Renewable Energy Economy 2015

It includes UK and regional estimates of the low carbon and renewable energy sector for England, Scotland, Wales and Northern Ireland for turnover and employment. Estimates are also presented for low carbon groups (sub-sectors), both at the UK and regional level. It shows that, in 2015, **31,000** people were employed directly in the low carbon and renewable energy economy in Scotland.

For a more detailed summary of these latest figures for Scotland please see page 175.

Data on the number of businesses and more detailed analysis (including 2015 estimates of indirect activity) will be presented alongside revised figures for 2014 in the final 2015 estimates bulletin, to be published in March 2017.

Employment in Energy and Low Carbon sectors

As explained in previous Energy in Scotland publications, official statistics on the employment and Gross Value Added (GVA) of the energy sector are based on the **Standard Industrial Classification (SIC) system** which does not lend itself to measuring non-traditional or new sectors that straddle a number of different industries – like the low carbon economy and renewable energy sector.

The energy sector (including renewables), as defined using SIC codes for the **Scottish Government growth sector**, accounted for **73,000 jobs** in 2015. However, it is likely that a significant proportion of renewable jobs will fall under other SIC classifications such as construction or manufacturing. It is also particularly difficult to attribute renewable or low carbon employment where organisations cover a wider range of business activities (e.g. Scottish Power and Scottish and Southern Energy have employees dealing with onshore wind, hydro and marine renewables, as well as with coal and gas generation, grid, customer services etc.).

Other estimates of renewable and low carbon employment are published through commissioned research projects such as **The size and performance of the UK low-carbon economy**. However, these studies do not necessarily lend themselves to consistent comparisons over time or across technologies. For example, direct jobs in offshore wind may also be classed as indirect jobs of onshore wind or other marine technologies.

LOW CARBON INFRASTRUCTURE TRANSITION PROGRAMME (LCITP)

The Low Carbon Infrastructure Transition Programme (LCITP) was launched in March 2015 to support the development of substantive private/public/community low carbon projects across Scotland. It was designed through consultation and partnership between Scottish Government, Scottish Enterprise, Highlands and Islands Enterprise, Scottish Futures Trust and Resource Efficient Scotland, with the aim of simplifying the landscape for low carbon projects to seek support in Scotland whilst strengthening the financial and technical support available to them.

Interventions focus on supporting the acceleration of projects to develop investment grade business cases allowing them to secure existing streams of public and private capital finance.

The activities and goals of LCITP are aligned with, and contribute to, the Scottish Government's main policy initiatives, primarily climate change targets to reduce greenhouse gas emissions by 42% by 2020, coupled with the wider economic and social transformational aspirations of the transition to a low carbon economy.

Project Stages

There are three broad stages in the development of a low carbon project:

Progress to Date

Between March 2015 and December 2016, 49 low carbon projects have received financial support through LCITP. The Programme has held a number of specific capital calls focusing on specific energy technologies – geothermal energy, use of water source heat pumps, standalone low carbon demonstration, as well as support to local authorities to deliver new and innovative approaches to energy efficiency through Scotland's Energy Efficiency Programme (SEEP). Alongside these particular calls, funded projects include a wide range of technologies such as hydrogen storage from solar energy project and an urban deep single well geothermal heat project.

More information

Please visit the following link for more information on LCITP:

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

LCITP CASE STUDY - Prestwick District Energy Network

The Low Carbon Infrastructure Transition Programme (LCITP) is providing £120,000 support towards preparation of an Investment Grade Business Case to stimulate third party investment in a district energy network at Prestwick Aerospace Park.

It will be developed around the cluster of aerospace companies and the airport itself alongside other stakeholders with significant energy demands. This preparation work will determine whether a more resource efficient, lower cost and lower carbon solution can be found to provide energy savings to the participants.

The project is being developed by a partnership led by Scottish Enterprise and including South Ayrshire Council, Glasgow Prestwick Airport and local companies.

High energy costs have been identified as an important issue for companies located in the area and this project aims to attract investment in new low carbon infrastructure with associated cost and carbon savings for businesses and the wider economy.

Energy Productivity

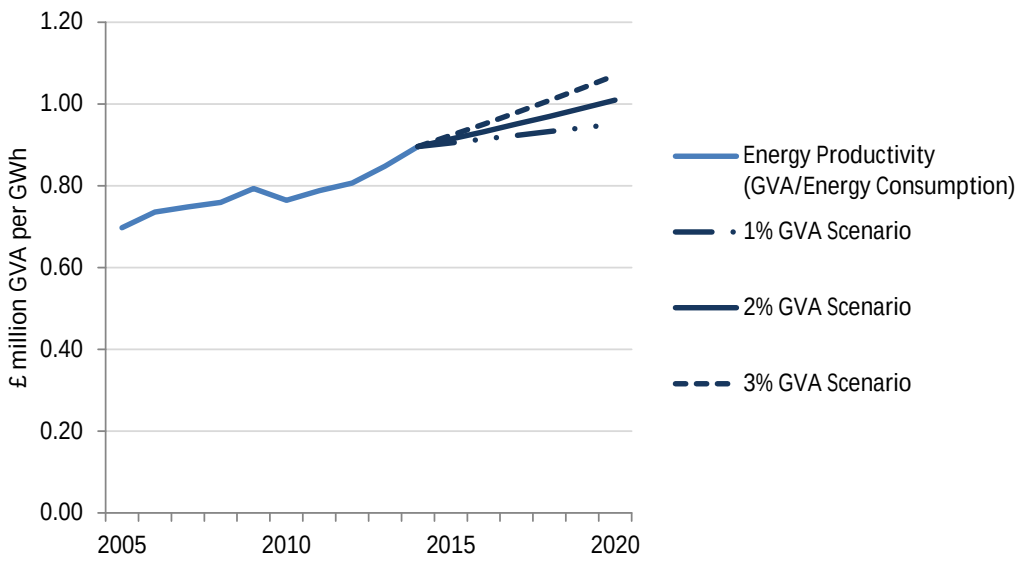
We can also measure how productively energy is being used in the economy.

Energy productivity expresses the gross value added (GVA) achieved in the economy from the input of one unit of energy. Increasing energy productivity means 'squeezing' more out of every unit of energy consumed. This is measured as the level of GVA per GWh of final energy consumed in Scotland (as shown in Figure 9.3).

Energy productivity in Scotland has increased by approximately 28% between 2005 and 2014.

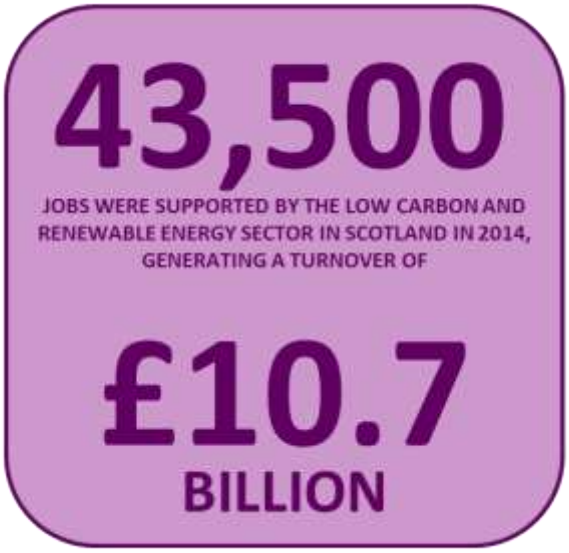
Increase in energy productivity in Scotland since 2005...

Figure 9.3: Estimated Energy Productivity, Scotland, 2005-2020



Sources: ONS, BEIS

Low Carbon and Renewable Energy Sector in Scotland



Last year, the Office for National Statistics (ONS) published new results from the UK Low Carbon and Renewable Energy Economy Survey for 2014. It includes UK and regional estimates of the low carbon and renewable energy sector for number of businesses, turnover and employment—both from direct and indirect activity (e.g. supply chain).

Estimates are also presented for low carbon groups (sub-sectors), both at the UK and regional level.

In 2014, the low carbon and renewable energy economy supported **43,500 jobs** in Scotland.

This accounted for 9.7% of the total UK employment in this sector (higher than population share). It also generated £10.7 billion in turnover, 12.7% of the total UK turnover in this sector (again higher than population share).

Table 9.1: Direct and Indirect Low Carbon and Renewable Energy Economy Activity, by country, 2014

	DIRECT ACTIVITY	INDIRECT ACTIVITY	TOTAL ACTIVITY	% OF UK TOTAL
EMPLOYEES (FTE)				
UK	238,500	209,000	447,500	-
SCOTLAND	**21,500**	**21,500**	**43,500**	**9.7%**
England	201,000	172,500	373,500	83.5%
Wales	9,500	8,000	17,500	3.9%
Northern Ireland	6,500	6,500	13,000	2.9%
TURNOVER (£000)				
UK	46,193,500	37,228,500	83,422,000	-
SCOTLAND	**5,613,500**	**5,116,500**	**10,730,000**	**12.9%**
England	37,558,500	29,780,500	67,339,500	80.7%
Wales	1,977,500	1,499,000	3,477,000	4.2%
Northern Ireland	1,044,000	832,000	1,876,000	2.2%

Indirect Activity

Indirect activity (i.e. supply chain) in Scotland in 2014 accounted for 47.7% of total turnover (£5.1 billion), whereas indirect activity in the

DATA NOTE:

LOW CARBON GROUP DEFINITIONS

Low Carbon Electricity

Offshore wind, Onshore wind, Solar Photovoltaic, Hydropower, Other renewable electricity, Nuclear power, Carbon capture and storage

Low Carbon Heat

Renewable heat, Renewable combined heat and power

Energy from Waste and Biomass

Bioenergy, Alternative fuels

Energy Efficient Products

Energy efficient products, Energy efficient lighting, Energy monitoring, saving or control systems

Low Carbon Services

Low carbon financial and advisory services

Low Emission Vehicles and Infrastructure

Low emission vehicles and infrastructure and fuel cells and energy storage systems

Indirect Activity (cont.)

rest of the UK was lower (between 43.1% and 44.3%). The higher proportion of turnover generated by indirect activity in Scotland may be a result of Scotland's LCRE economy being dominated by low carbon electricity generation.

Indirect activity in Scotland in 2014 accounted for 49.4% of total employees (21,500). A higher proportion than England (46.2%) and Wales (45.7%), and only marginally lower than Northern Ireland (50.0%).

DATA DEVELOPMENT

Measuring Indirect activity from the low carbon economy

Most economic transactions increase economic activity by a larger amount than their size – this is because any transaction results in an increase in another economic actor's income or demand for an input, which in turn results in an increase in their spending, or investment.

Multipliers are used to estimate the indirect effect an economic activity has on the wider economy, such as additional activity due to demand generated for the products of other firms by the wages paid to employees, or the increase in demand for the inputs used. A multiplier effect is the impact an economic transaction has on the wider economy; the multiplier measures the overall increase in economic activity resulting from the transaction, proportional to its size.

Multipliers for the low carbon economy

The total activity estimates in the ONS publication - Low Carbon and Renewable Energy (LCRE) Economy Survey 2014 - were calculated by constructing multipliers for each LCRE sector, based on the sector's composition in terms of Standard Industrial Classifications and the corresponding multipliers for turnover and employment published by ONS in February 2014. Turnover and employment for each region, group and sector were multiplied by the corresponding multiplier to yield an estimate of total activity generated, including both direct and indirect activity. The difference between the direct activity previously published and the calculated total estimate is the indirect activity.

These multipliers are published in a dataset at the following link:

https://www.ons.gov.uk/economy/environmentalaccounts/datasets/lowcarbonandrenewableenergyeconomymultipliersdataset

For any further information contact ONS at:

environment.accounts@ons.gsi.gov.uk

Low Carbon subsectors

Scotland has strong representation in the low carbon electricity (onshore wind in particular) and low carbon heat sub-sectors, in terms of share of overall UK employment and turnover.

For low carbon electricity generation (renewables plus nuclear and CCS) Scotland has 16% of all UK employment and 22% of all UK turnover in this sector.

For onshore wind alone, these proportions are considerably higher - Scotland has 38% of all UK employment and 56% of all UK turnover.

For low carbon heat, Scotland represents 14% of all UK employment and 15% of all UK turnover in this sector.

Capital Investment

In 2014, Scotland acquired £1.25bn of low carbon and renewable energy capital assets. This was 14% of the UK total.

Over 80% (more than £1bn) of these acquisitions in Scotland were in the low carbon electricity group (e.g. onshore wind).

Renewable Energy Sector

In 2014, the renewable energy economy (subset of all low carbon economy) supported 14,000 jobs in Scotland. This accounted for 17% of the total UK employment in this sector (higher than population share). It also generated £5.4 billion in turnover, 19% of the total UK turnover in this sector (again higher than population share).

DATA NOTE:

RENEWABLE SUB-SECTOR DEFINITION

- Offshore wind
- Onshore wind
- Solar Photovoltaic
- Hydropower
- Other renewable electricity
- Renewable heat
- Renewable combined heat and power

DATA NOTE

New Low Carbon and Renewable Energy Economy Data for 2015

The latest data from ONS, published in December 2016, estimates the direct LCRE activity attributed to Scotland in 2015. This is the second time the survey has been run and therefore the first time it has been possible to consider how the low carbon and renewable energy economy in Scotland is changing over time. However, given there are only 2 point estimates (for direct activity in 2014 and 2015), ONS do not consider it possible to directly assess whether or not the observed differences between the 2014 and 2015 estimates are likely to represent statistically significant change. For more information on this publication please visit the link below:

https://www.ons.gov.uk/economy/environmentalaccounts/bulletins/finalestimates/2015

Estimates of indirect activity for 2015 are due to be available with the full publication in March 2017. The data published for 2014 (at the end of November 2016) estimated both direct and indirect activity and therefore showed a higher employment estimate of 43,500 (i.e. jobs supported by the low carbon and renewable energy economy in Scotland).

Low Carbon and Renewable Energy Sector in Scotland

Interim 2015 Results

In 2015, 31,000 people were employed directly in the low carbon and renewable energy economy in Scotland. This accounted for 13% of the total UK employment in this sector (higher than population share). It also generated £5.3 billion in turnover, 13% of the total UK turnover in this sector (again higher than population share).

This can be compared to an estimated 21,500 FTE employees in 2014. However, this change should be interpreted with caution due to the large variance around the 2015 estimate, particularly for the estimate of FTE employees in the low carbon electricity group.

Also, the low carbon and renewable energy economy represented 1.6% of all direct (non-financial) employment in Scotland, higher than the UK as a whole (1.0%).

Scotland once again has strong representation in the low carbon electricity (renewables plus nuclear and CCS) sub-sector, in terms of share of overall UK employment and turnover, with 32% of all UK employment and 25% of all UK turnover in this sector. Low carbon electricity accounted for 57% of all LCRE turnover in Scotland, whereas energy efficient products accounted for the highest turnover in all other UK countries.

ANNEX A - Scotland Energy Balance, 2014

Aggregate energy balance 2014

Gross calorific values

Thousand tonnes of oil equivalent

	Coal	Primary oils	Petroleum products	Natural gas	Bioenergy & wastes	Primary electricity	Electricity	Manufactured fuels & Other (1)	Total
Supply									
Indigenous production	**1552**	**40782**	**-**	**19532**	**711**	**5096**	**-**	**-**	**67673**
Imports (2)	**4266**	**6304**	**2430**	**8313**	**273**	**-**	**17**	**-**	**21603**
Rest of World	-	6304	1766	8282	-	-	-	-	-
Rest of UK	-	-	665	31	-	-	17	-	-
Exports (2)	**-2370**	**-36246**	**-5560**	**-20372**	**-32**	**-**	**-1033**	**-**	**-65613**
Rest of World	-	-21904	-3934	-4214	-	-	-	-	-
Rest of UK	-	-14342	-1626	-16158	-	-	-1033	-	-
Marine bunkers	**-**	**-**	**-953**	**-**	**-**	**-**	**-**	**-**	**-953**
Stock change (3)	**-329**	**-86**	**43**	**-**	**-**	**-**	**-**	**-**	**-373**
Primary supply	**3119**	**10753**	**-4040**	**7472**	**952**	**5096**	**-1016**	**-**	**22337**
Statistical difference (4)	2	-	-5	-	-	-	-	-	-3
Primary demand	**3116**	**10753**	**-4035**	**7472**	**952**	**5096**	**-1016**	**-**	**22339**
Transfers (5)	**-**	**-1848**	**1848**	**-**	**-**	**-1482**	**1482**	**-**	**0**
Transformation	**-2970**	**-8905**	**8547**	**-583**	**-434**	**-3614**	**2811**	**334**	**-4814**
Electricity generation	-2433	-	-232	-503	-430	-3614	2811	-	-4400
Petroleum refineries	-	-8905	8832	-	-	-	-	-	-73
Manufactured fuel & other	-537	-	-54	-80	-4	-	-	334	-341
Energy industry use and distribution losses	**-**	**-**	**535**	**3104**	**-**	**-**	**493**	**66**	**4198**
Final Consumption	**147**	**-**	**5825**	**3785**	**518**	**-**	**2784**	**269**	**13327**
Non-Energy Use	-	-	851	62	-	-	-	41	955
Industry	100	-	383	760	93	-	771	172	2279
Domestic	45	-	270	2128	220	-	1167	55	3885
Transport	0	-	4117	-	149	-	37	-	4304
Other	2	-	204	834	56	-	808	-	1904

(1) Includes coke manufacture, blast furnaces, patent fuel manufacture and heat generation. Manufactured fuel consumption can be split with 60 ktoe used by industry and 17 ktoe used domestically.

(2) Estimates for a rest of World and rest of UK split for imports and exports are included where there is available data

(3) Stock fall (+), stock rise (-).

(4) Primary supply minus primary demand.

(5) Transfers between primary oil and petroleum products include NGL transfers and transfers of feedstock to refineries

The current flows are a best estimate in a simplified representation of what is a complex sector.

Please note that figures used in the energy balance may not be strictly comparable to figures quoted throughout the rest of the publication. The energy balance and accompanying Sankey diagram sit slightly separate to the rest of the publication as an experimental piece of work which relies on a number of different data sources. It is subject to change as we gain access to more comprehensive data sources and improve the methodology.

ANNEX B - Energy conversion units/factors

This annex explains the conversion units/factors used within this publication. More information and a conversion calculator is published here:

http://www.gov.scot/Topics/Statistics/Browse/Business/Energy/onlinetools/ConvCalc

Some of the more common terms and conversions are listed below for reference.

Unit terminology

Calorific values – The amount of heat produced by the complete combustion, under specified conditions, of a fuel or material.

Joules – A joule is a generic unit of energy, work or amount of heat from the conventional International System of Units. It is the equivalent to the energy dissipated by an electrical current of 1 ampere driven by 1 volt for 1 second ; it is also equal to twice the energy of motion in a mass of 1 kilogram moving at 1 metre per second.

Tonne of oil equivalent (toe) – A common unit of measurement which enables different fuels to be compared and aggregated.

Watt – The conventional unit to measure a rate of flow of energy. One watt amounts to 1 joule per second.

Prefixes

kilo (k)	= 1,000	or 10^3
mega (M)	= 1,000,000	or 10^6
giga (G)	= 1,000,000,000	or 10^9
tera (T)	= 1,000,000,000,000	or 10^{12}
peta (P)	= 1,000,000,000,000,000	or 10^{15}

Standard Energy Conversion Factors

1 tonne of oil equivalent (toe)	= 10^7 kilocalories
	= 396.83 therms
	= 41.868 GJ
	= 11,630 kWh
100,000 British thermal units (Btu)	= 1 therm

Crude Oil

1 tonne of crude oil = 45.7 GJ

1 tonne of crude oil = 1,192 litres

1 tonne of crude oil = 1.09 tonnes of oil equivalent (toe) of crude oil

1 tonne of crude oil = 7.5 barrels of crude oil

Natural Gas

1 tonne of natural gas = 41.0 GJ

1 million m3 of natural gas = 11 GWh

1 m3 of natural gas = 35.315 standard cubic feet (scf) of gas

1 m3 of natural gas = 0.0009 toe

1 million standard cubic feet (mmscf) of natural gas = 26.629 toe

ANNEX C - Terminology and definitions

Capacity Factor (or Load Factor) - Actual output as a proportion of the theoretical maximum output.

Capacity margin – The 'capacity margin' is the difference between the electricity generating capacity needed to meet peak demand and what is actually available. This capacity margin is needed to ensure that in extreme situations - i.e. power station failures, sustained periods of high demand – there is sufficient reserve capacity to meet demand.

Carbon Intensity of Electricity Generation (or Grid Intensity) – The Climate Change (Scotland) Act 2009 requires Scottish Ministers to estimate the carbon intensity of electricity generation. This calculation estimates the aggregate emissions from electricity generation, as defined under the EU Emissions Trading Scheme, divided by the aggregate electricity generation in a given year. There are numerous ways of estimating this figure with some options discussed in the official report to the Scottish Parliament. The approach adopted in the 2012 report uses the Scottish Pollutant Release Inventory which calculates emissions based on fuel inputs. As such, the figure reported to the Scottish Parliament are based on emissions from regular operations and abnormal events, including start-up and shut-down and emergency situations over the reporting period.

CO_2 –Carbon dioxide

Co-firing – Usually refers to the burning of biomass products in fossil fuel power stations.

Conventional thermal power stations – Power stations which burn fossil fuels to produce heat to convert water into steam, which then powers steam turbines, which in turn generates electricity.

BEIS – Department of Energy and Climate Change

DEFRA – Department for Environment, Food and Rural Affairs.

De-rated capacity margin – The de-rated capacity margin is an indicator of security of supply. It is defined as the expected excess of available generation capacity over demand. Available generation capacity is the part of the installed capacity that is expected to be accessible in reasonable operational timelines, i.e. it is not decommissioned or offline due to maintenance or forced outage. The available generation capacity will also take into account any expected intermittency of the generation fleet.

DUKES— Digest of United Kingdom Energy Statistics.

EU-ETS – European Union Emissions Trading Scheme. It was launched on 1st January 2005 to combat climate change and involves the trading of emissions allowances as a means of reducing emissions by a fixed amount.

Exports – Refers to goods exiting the UK or, in more specific cases, Scotland.

Feed-In Tariffs – The Feed-In Tariffs (FITs) scheme was introduced on 1st April 2010 to encourage deployment of small-scale, low-carbon electricity generation. This scheme replaced the UK government grants as the main financial incentive to encourage uptake of renewable electricity-generating technologies.

Final energy consumption –Total energy consumed by a final user. It is the energy which reaches the final consumer's door and excludes energy which is used by the energy sector itself, including for deliveries and transformation.

Fossil fuels –Contain a high percentage of carbon and are typically formed over millions of years. Coal, natural gas and fuels derived from crude oil are classed as fossil fuels.

Fuel poverty – The Scottish definition of fuel poverty as set out in the Scottish Fuel Poverty Statement (2002):

'A household is in fuel poverty if, in order to maintain a satisfactory heating regime, it would be required to spend more than 10% of its income (including Housing Benefit or Income Support for Mortgage Interest) on all household fuel use'

GDP – Gross Domestic Product

Generation output - This is the actual output of electricity delivered by a generating plant. It is normally expressed in megawatt hours (MWh) or gigawatt hours (GWh).

Green deal – A scheme by which energy-saving improvements can be made to a home or business without having to pay all the costs up front. These include: loft or cavity wall insulation, heating, draught-proofing, double glazing and renewable energy technologies.

Heat pumps – A device that takes heat from the ground or air and converts it into heating. Ground source heat pumps use pipes which are buried into the ground to extract heat. Air source heat pumps absorb heat from the air outside.

Imports – Refers to goods entering the UK or, in more specific cases, Scotland.

Indigenous production – The production of primary energy.

Installed Capacity - This is the maximum power output at which an electricity generating plant can operate. Manufacturers generally measure the maximum, or rated, capacity of generating plant to produce electric power in megawatts (MW).

Large Plant Combustion Directive (LPCD) -The LPCD is an EU directive which requires countries to limit emissions from existing combustion plants with a thermal capacity of 50 MW or more. From 2007, a plant could either opt to comply with the emissions limit or opt out and be limited to a maximum of 20,000 hours of further operation.

Levelised costs – Electricity generation costs are a fundamental consideration of energy market analysis but, different types of generation exhibit different cost profiles which can lead to difficulties in making direct comparisons. For example, renewable technologies are characterised by high capital costs and low running costs, whereas CCGT gas power plants are characterised by relatively low capital costs but high operating costs (e.g. fuel costs). Levelised costs estimate data broken down into component costs, from planning through construction to eventual decommissioning, which are combined to estimate the lifetime cost of generation of a plant. These are combined with estimates of energy output from the plant to derive an average cost per unit of energy generation. These average costs are described as levelised costs.

Median— middle value.

Mean— average.

Non-energy use – Non-energy uses include chemical feedstock, solvents, lubricants and road making material.

OFGEM – The regulatory office for gas and electricity markets.

ONS – Office for National Statistics.

Primary electricity – Electricity generated from sources other than fossil fuels, these include nuclear and non-thermal renewables. Imports of electricity are also included.

Primary fuels – Fuels which are directly obtained from a natural source, these include coal, oil and natural gas.

Renewable energy sources – Renewable energy sources includes wind, wave and tidal, solar power and hydroelectricity. Renewable energy includes solar power, wind, wave and tidal, and hydroelectricity. Solid renewable energy sources consist of wood, straw, short rotation coppice, other biomass and the biodegradable fraction of wastes. Gaseous renewables consist of landfill gas and sewage gas.

RESTATS – The Renewable Energy Statistics database for the UK.

RO – Renewables Obligation. An obligation on all electricity suppliers to supply a specific proportion of electricity to customers from renewable resources.

Secondary fuels – Fuels which are derived from primary sources of energy, which includes electricity generated from burning coal, gas or oil.

Thermal efficiency – The thermal efficiency of a power station is the ratio between the useful output of a device (electrical energy) and the input (heat energy contained in fuel).

ANNEX D - Notes and References

NOTES/REFERENCES

1. Please note that comparisons for some metrics with the relevant UK and EU figures may not be strictly comparable and should be used as a broad indication only. This is primarily due to lack of comparable sub-national data being available and different assumptions and methodologies have to be used to generate the relevant Scottish proxy comparators. For example, the BEIS produce different metrics to measure the share of renewable electricity generation - one of which is used to report to the EU for the Renewable Energy Directive. Please see page 69 of BEIS's latest energy trends publication for more information:

   https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/579542/ET_Dec_16.pdf

2. Totals may not equal sums due to rounding. These figures also do not include the capacity of installations recorded as being combined heat and power.

3. Within the definition of the energy growth sector, the estimate of the GVA for the extraction of crude petroleum and natural gas (SIC 06) relates to the GVA generated by companies registered at an address in Scotland. It does not reflect the full value of GVA generated from oil and gas production in the North Sea. For a further discussion of the GVA and GDP associated with offshore oil and gas production, please refer to Chapter 6.

4. Final energy consumption estimates for Northern Ireland are not comparable as gas and electricity consumption within NI is excluded due to differences in market structure.

5. Coal includes a small quantity of non-renewable wastes.

6. The difference in Scotland's proportion of wind output and wind capacity is explained by the fact that the UK has a higher proportion of wind capacity from offshore sites. As offshore sites tend to experience higher load factors, the overall average generation is higher.

7. There are a number of sites where generation is not available at LA level. Therefore the sum of total renewable electricity generated by LA will not be consistent with the total included in other BEIS publications.

8. The data for those projects 'in planning', 'consented – awaiting construction', and 'under construction' are sourced from the October 2016 extract of the Renewable Energy Planning Database (data as at end of September 2016). The 'operational' capacity figure is the provisional Q3 2016 figure sourced from BEIS's quarterly energy trends publication. The REPD 'operational' figure excludes: i) projects not going through the formal planning system ii) large scale hydro, and iii) projects that are generating but not fully completed. It therefore underestimates the total renewable capacity in operation.

   The REPD figures exclude the following categories: 'No application made', 'Connection Applied for', 'Application refused', and 'Application Withdrawn'.

   As explained above, the energy trends publication includes the capacity of projects that are generating but not fully completed yet, whereas the REPD only includes the operational capacity for those sites that are fully complete. Adjustments are made to the 'under construction' figures used in these tables to avoid double counting of capacity.

9. Scotland has five Statutory Independent Undertakings (SIUs) for gas supplies that are operating gas networks not connected by pipeline to the rest of the network. Four use Liquefied Natural Gas (LNG) [around 7,500 gas customers] and one uses Liquefied Petroleum Gas (LPG). Campbeltown, Oban, Wick and Thurso have SIUs supplied with LNG by road tanker from a depot at Avonmouth, near Bristol. The fifth SIU, Stornoway, uses LPG.

10. Please note there was no renewable heat estimate produced for 2009.

11. GWth refers to thermal capacity, whereas GWe would refer to electrical capacity. Please also see the calculation box on page 91.

12. Scottish Fuel Poverty Statement 2002, http://www.gov.scot/Resource/Doc/46951/0031675.pdf

13. BEIS Quarterly Energy Prices, Table 2.1.3, https://www.gov.uk/government/collections/domestic-energy-prices

14. This is an estimate of emissions of the basket of greenhouse gases: carbon dioxide, methane, nitrous oxide and the four F gases (hydrofluorocarbons- HFCs, perfluorocarbons - PFCs, sulphur hexafluoride- SF_6 and nitrogen trifluoride- NF_3), weighted by global warming potentials. The Global Warming Potentials (GWPs) are based on international reporting standards, as set by the Intergovernmental Panel on Climate Change (IPCC). For 1990-2014, the global warming potentials (GWPs) used for each gas have been updated to those published in the IPCC's 4th Assessment Report.

15. Final annual generation estimates for renewable electricity have been published since the date of the Parliamentary Question (which uses provisional renewable electricity generation estimates).