Energy in Scotland 2018 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:

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

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

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:

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CHAPTER 1

ENERGY IN SCOTLAND

OVERVIEW

‘Nearly 18% of Scotland’s total final energy consumption came from renewable sources in 2015’
**ENERGY IN SCOTLAND OVERVIEW — KEY FACTS**

**RENEWABLE SOURCES SUPPLIED**

17.8%  
...OF SCOTLAND’S TOTAL ENERGY CONSUMPTION IN 2015.  
THE TARGET IS 30% BY 2020

---

**ENERGY GROWTH SECTOR EXPORTS IN 2016**

£13.9 BILLION  
18% OF ALL SCOTTISH EXPORTS

---

**SCOTLAND ACCOUNTS FOR...**

10%  
...OF UK ENERGY CONSUMPTION

---

**79%**

OF ALL PRIMARY ENERGY IN SCOTLAND IS EXPORTED

---

**93%**

OF TOTAL PRIMARY ENERGY IN 2016 CAME FROM Oil & Gas

---

**COMMUNITY AND LOCALLY OWNED RENEWABLE ELECTRICITY CAPACITY IN 2020 target**

<table>
<thead>
<tr>
<th>Status</th>
<th>MW</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operating*</td>
<td>666</td>
</tr>
<tr>
<td>Under construction</td>
<td>50</td>
</tr>
<tr>
<td>Consented not built</td>
<td>283</td>
</tr>
<tr>
<td>In planning</td>
<td>101</td>
</tr>
<tr>
<td>In scoping</td>
<td>62</td>
</tr>
</tbody>
</table>

* 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.

---

“**Our vision - A flourishing competitive local and national energy sector delivering secure, affordable, clean energy for Scotland’s households, communities and businesses**”

---

**RENEWABLE ENERGY TARGETS - SUMMARY OF LATEST PROGRESS**

<table>
<thead>
<tr>
<th>Target Description</th>
<th>%</th>
<th>Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>Overall Renewable Energy Target</td>
<td>17.8%</td>
<td>2015</td>
</tr>
<tr>
<td>30% of total Scottish energy consumption from renewables by 2020</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Renewable Electricity Target</td>
<td>54.0%</td>
<td>2016</td>
</tr>
<tr>
<td>100% of gross electricity consumption from renewables by 2020</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Renewable Heat Target</td>
<td>4.8%</td>
<td>2016</td>
</tr>
<tr>
<td>11% of non-electrical heat demand from renewables by 2020</td>
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<tr>
<td>Renewable Transport Target</td>
<td>3.1%</td>
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</tr>
<tr>
<td>10% of transport petrol and diesel consumption from biofuels by 2020</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Energy Consumption Target</td>
<td>-15.4%</td>
<td>2015</td>
</tr>
<tr>
<td>12% in total final energy consumption by 2020</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

---

**COMMUNITY AND LOCALLY OWNED RENEWABLE ELECTRICITY CAPACITY IN 2020 target**

- Operating*: 666 MW
- Under construction: 50 MW
- Consented not built: 283 MW
- In planning: 101 MW
- In scoping: 62 MW

---

COMMUNITY AND LOCALLY OWNED RENEWABLE ELECTRICITY CAPACITY IN 2020 target
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 65% 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 nearly trebled since the end of 2006 and is now equivalent to over half of the electricity consumed in Scotland;
- 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 over 4 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 a fourth year in a row, international sales have been over half of the total Scottish oil and gas supply chain sales;
- The fuel poverty rate in 2016 is the lowest rate recorded since 2008;
- Source greenhouse gas emissions in Scotland have reduced by nearly 40% since 1990; and
- 49,000 jobs are supported by the low carbon and renewable energy sector in Scotland, generating a turnover of £11 billion.

The Scottish Energy Strategy, published on 20th December 2017, sets out the Scottish Government’s vision for the future energy system in Scotland for the period to 2050.

The final Strategy follows a period of public consultation in early 2017 on a draft Scottish Energy Strategy, which drew over 250 substantive responses. Those detailed responses, as well as feedback from the Scottish Energy Advisory Board and responses to further consultations on the onshore wind policy statement, local heat and energy efficiency strategies, regulation of district heating and Scotland’s Energy Efficiency Programme helped shape, inform and influence Scotland’s first Energy Strategy.

SCOTTISH GOVERNMENT ENERGY STRATEGY

This vision is guided by three core principles:

- **A whole-system view** – broadening the focus of the Scottish Government’s energy policy to include heat and transport, alongside electricity and energy efficiency - creating an integrated approach which recognises the effect that each element of the energy system has on the others.

- **An inclusive energy transition** – recognising that the transition to a low carbon economy over the coming decades must happen in a way that tackles inequality and poverty, and promotes a fair and inclusive jobs market.

- **A smarter local energy model** – enabling a smarter, more coordinated, approach to planning and meeting distinct local energy needs that will link with developments at the national scale.
Scotland’s energy priorities

Built around the following six energy priorities, the Strategy will guide the decisions that the Scottish Government, working with partner organisations, will make over the coming decades, supporting work already planned or underway to achieve our long term climate change targets, and to address the impact of poor energy provision.

Delivering the Scottish Energy Strategy

The Energy Strategy will guide our long term transition - a transition which is fully consistent with our climate ambitions and reflecting our objective to create a dynamic sustainable and inclusive economy.

The Scottish Government intends to continue the work that we’ve been doing to help businesses in Scotland use their experience, adaptability and willingness to diversify in order to become more
competitive and to deliver sustainable, inclusive economic growth for Scotland. This includes attracting and stimulating interest, capability and private sector investment in a wide range of low carbon energy projects and companies, including at local and community level.

The Strategy includes a range of actions to deliver the Scottish Government’s goals, including a £20 million Energy Investment Fund, which will build on the success of the Renewable Energy Investment Fund, and a £60 million Low Carbon Innovation Fund, to provide dedicated support for renewable and low carbon infrastructure over and above wider interventions to support innovation across the economy.

To see the full Scottish Energy Strategy please go to:
www.gov.scot/energystrategy

Scottish Energy Targets

Our new energy strategy sets out the Scottish Government’s long-term vision for the future energy system in Scotland. Underpinning this vision is our commitment to a range of near term actions and 2030 targets. We remain committed to the existing renewable energy target of 30% by 2020 and the associated individual targets for renewable electricity, heat and transport.

The Strategy also sets two targets for the Scottish energy system by 2030:

- The equivalent of 50% of the energy for Scotland’s heat, transport and electricity consumption to be supplied from renewable sources
- An increase by 30% in the productivity of energy use across the Scottish economy.

Renewable Energy

The proposed 2030 ‘all-energy’ target for the equivalent of 50% of the energy for Scotland’s heat, transport and electricity consumption to be supplied from renewable sources captures the ambition of the new strategy to adopt a system-wide approach.

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 in their report on renewable energy published in September 2013.

Figure 1.1 shows that in 2015, **17.8%** of total Scottish energy consumption came from renewable sources, up from 15.2% in 2014. Renewable electricity contributes the most to the overall renewable energy target followed by renewable heat and then renewables in transport. Each of these are explored in more detail later in this chapter.
Scottish Government analysis underpinning the 2030 renewable energy target shows that renewable electricity – which has already outperformed our interim 2015 target of generating the equivalent of 50% of Scottish electricity demand – could rise to around 140% by 2030.

The heat and transport shares do not include the impact of electrifying heat and transport demand to 2030. These impacts are captured within the electricity sector, as they will impact the overall consumption of electricity.

Achieving this penetration requires a considerably higher installed capacity of renewable generators than today – in the region of 17 GW installed capacity by 2030 (compared to 9.7 GW in September 2017).

Ensuring this is achievable and supports the whole energy system will be a significant challenge. Greater interconnection with parts of continental Europe can help by providing an expanded market for our electricity generators and consumers.

The target anticipates the switch from fossil fuels in transport to ultra-low emission vehicles, including plug-in hybrids, battery powered electric vehicles which can directly use electricity from renewable sources, and biofuels. We assume the non-electrical proportion of all transport demand met by renewables to be around 5%.

Renewable heat grows to around 20% of non-electrical heat demand, with heat pumps and district heating schemes increasingly important means to deliver heat.

Whilst increased renewable generation is important in meeting the 50% targets, the successful delivery of energy efficiency measures, through Scotland’s Energy Efficiency Programme will be important in limiting the total energy used in Scotland and can be seen as a no regrets option.
Energy Productivity

The Scottish Government’s energy consumption target is to reduce final demand for energy by 12% by 2020 (from a 2005-07 baseline) which was aimed at improving energy efficiency in Scotland. This target was surpassed 6 years early, and final demand in 2015 remains beyond the target at 15.4% lower than the baseline. However, reducing demand is only one part of the Scottish Government’s energy efficiency ambition.

The new 2030 energy productivity target is a measure of the combination of energy consumption and the output of the economy. Higher energy productivity means squeezing more out of every unit of energy consumed across the economy – more economic activity for each unit of energy being used. Energy productivity in Scotland increased by approximately 31% between 2005 and 2015.

This target is consistent with the overall EU ambition to implement an EU-wide energy efficiency improvement by 2030, and with our Climate Change Plan analysis. The change in productivity between 2005-07 and 2030 could be in excess of 60%.

The pace at which the energy system changes (and has changed over the past decade and a half) as a result of changing market, policy, technological and regulatory drivers means forecasting the precise breakdown of the 2030 energy system is not feasible and the actual distribution of renewable energy within and between sectors could be different to that shown above. However, setting the target based on all sources of energy, across heat, transport and electricity, will accommodate variations in the rate of development and take up of renewables in individual sectors; acting as a complement to our whole system approach to energy policy.

We will report progress against the 2030 target on an annual basis in future editions of Energy in Scotland and the annual Energy Statement.

Renewable Energy Targets - Summary of Latest Progress

<table>
<thead>
<tr>
<th>Target</th>
<th>2030 Target</th>
<th>2020 Target</th>
<th>Progress</th>
<th>Year</th>
</tr>
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<tbody>
<tr>
<td>Overall Renewable Energy Target</td>
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<td>12% in total final energy consumption by 2020</td>
<td>-15.4%</td>
<td>2015</td>
<td></td>
</tr>
</tbody>
</table>
The European Union (EU) seeks to obtain a 20% share of its gross final energy consumption from renewable sources by 2020; this target is distributed between 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 1.4 shows the latest data available for the share of renewable energy in gross final energy consumption across the EU. The EU average in 2015 was 16.7% - 1.2 percentage points lower than Scotland and 8.5 percentage points higher than the UK.

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 2015, Sweden had by far the highest share of energy from renewable sources in its gross final consumption of energy (53.9%), ahead of Finland (39.3%), Latvia (37.6%) and Austria (33.0%). In contrast, the lowest proportions of renewables were found in Luxembourg (5.0%), Malta (5.0%), the Netherlands (5.8%) and Belgium (7.9%). The UK is the fifth lowest at 8.2%.

**Figure 1.4: Share of renewable energy in gross final energy consumption across the EU, 2015**

Sources: Eurostat, Scottish Government, BEIS
Eleven out of the 28 EU Member States have already reached the level required to meet their national 2020 targets: Bulgaria, Croatia, Czech Republic, Denmark, Estonia, Finland, Hungary, Italy, Lithuania, Romania and Sweden. At the opposite end of the scale, the Netherlands (8.2 percentage points from reaching its national 2020 objective), France (7.8 pp), the United Kingdom (6.8 pp) and Ireland (6.8 pp) are the furthest away from their target.

Relative to 2009 baselines, Scotland has had the second largest increase in renewables share behind Denmark. Figure 1.5 shows the progress made by Scotland, the UK, and the EU as a whole since 2009, when the EU Renewables Directive was introduced.

Scotland’s renewable energy share is now greater than the EU average with Scotland making relatively better progress since 2009 - increasing the share by 10.3% points (7.5% - 17.8%).

The UK has increased its share by 4.9% points since 2009 (3.3% - 8.2%), with the EU average going up by 4.3% points (12.4% - 16.7%).
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.

In 2016, the equivalent of 54.0% of gross electricity consumption was from renewable sources, down from 59.5% in 2015. This is explored in more detail in Chapter 3. Figure 1.6 shows a general rising trend in renewable electricity generation in Scotland since 2005, with the exceptions of 2010 and 2016.

The lower level of renewable electricity generation experienced in 2010 and 2016 was a result of a fall in both hydro and wind generation due to lower rainfall and lower average wind speed. However, following 2010, Scotland went on to surpass the two interim renewable electricity generation targets of 31% by 2011 and 50% by 2015, and remains above this 50% interim target in 2016.

“How does Scotland compare with other countries?”

SCOTLAND........59.5%
UK...................22.4%
EU...................28.8%
In 2015, the equivalent of 5.4% of non-electrical heat demand was met from renewable sources. This is up from 3.9% in 2014. Over the year to 2015, renewable heat generation increased by 37%, while non-electrical heat demand decreased by 1.6%.

Renewable heat generation data for 2016 show an 11% decrease compared with 2015. In 2016, Scotland generated an estimated 4.8%-5.0% of its non-electrical heat demand from renewable sources.

Please see page 75 for more information regarding the measurement of heat demand in Scotland.

Figure 1.7 shows that steady progress has been made since 2008/09 with the proportion of renewable heat generation in Scotland, up to 2015. The drop in 2016 was primarily due to the closure of the Tullis Russell paper mill in Fife, a significant user of renewable heat. However, from a baseline 863 GWh in 2008/09, generation is over 4 times higher - 3,752 GWh in 2016.

84% of renewable heat output in 2016 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.

“Renewable heat output is over 4 times greater in 2016 compared with 2008/09 baseline”
Biofuels had a 3.1% share of road fuels in the UK as a whole in 2016, down from 3.2% in 2015.

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 1.8: Share of biofuels in transport petrol and diesel consumption, Scotland, 2005 - 2016**

**UK trends in liquid biofuel consumption for transport**

In 2016, 1,465 million litres of liquid biofuels were consumed in transport in the UK, a **fall of 0.1%** on the total for 2015. 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 4.8% to 758 million litres between 2015 and 2016 - accounting for 52% of all liquid biofuels.
- Biodiesel consumption increased by 5.5% to 707 million litres between 2015 and 2016 - accounting for 48% of all liquid biofuels.

Using the latest data, for the third quarter of 2017, bioethanol accounted for 4.3% of motor spirit, and biodiesel 2.3% of diesel (DERV). The combined contribution was 3.0%, a decrease of 0.2 percentage points compared to Q3 2016.

“Latest data for Q3 2017 shows that biofuels made up **3.0%** 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:

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 2015 was 0.3% lower than in 2014, and 15.4% lower than the 2005-2007 baseline against which the 12% Energy Efficiency Target is measured. More information on this is available in Chapter 2.

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 1.9 shows the progress since the baseline and the annual maximum consumption values associated with the 2020 target. The 15.4% 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 of 23%, with the domestic and transport sectors consuming 20% and 3% less respectively while energy productivity in Scotland has increased by approximately 31% between 2005 and 2015.

Initial data from BEIS shows that, between 2015 and 2016, gas consumption in Scotland declined by 0.2% and electricity consumption declined by 4.3%. However, data on the total impact across all fuels and sectors in Scotland is not available until September 2018.

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 21.
Community and locally owned renewables

Alongside the headline renewable energy ambition, our Energy Strategy, published in December 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 believes 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 2017 found that:

- As of June 2017 there was an estimated minimum 666 MW of community and locally owned renewable energy capacity operation in Scotland
- This is a 12% increase on the last report, when the operating capacity was estimated at 595 MW at June 2016.
- The operating capacity resulted from around 17,950 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 17.

Development pipeline

As Figure 1.10 shows, a further 496 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).

*Source: EST*
**Categories of ownership**

A breakdown of operational capacity by type of owner is shown in Figure 1.11. The largest proportion of operational capacity is on Scottish farms and estates (266 MW, or 40%). Community groups own 12% of total operational capacity (81 MW). The largest numbers of individual installations (15,830) are in local authority and housing association ownership, together accounting for 88% of individual installations.

![Figure 1.11: Estimated capacity of operational community and locally owned renewable installations by ownership category (MW), Scotland, June 2017](https://example.com/figure11)

**Installed technologies**

The majority of capacity in operation in June 2017 was from wind turbines (313 MW), and from biomass (178 MW). These two technologies account for about 74% of overall operational capacity in June 2017. A breakdown by technology type is shown in Figure 1.12.

![Figure 1.12: Capacity of operational community and locally owned renewable installations by technology (MW), Scotland, June 2017](https://example.com/figure12)
**Type of Output**

The 666 MW of total operational capacity is split between approximately 61% (403 MW) of electrical capacity (MWe) and 38% (254 MW) of thermal (heat) capacity (MWth). The other 1% 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 1,664 GWh of renewable energy.

*Figure 1.13: Capacity of operational community and locally owned renewable installations by output type (MW), Scotland, June 2017*

**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 2017.

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


**Maps**

The 2017 report also includes a series of maps illustrating the distribution of operational community and locally owned renewable energy capacity throughout Scotland at June 2017, by ownership category.

Each map shows the location of a renewable energy installations and the size of each circle indicates the capacity of the installation in MW, and its 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 165. 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 70,000 in 2016, representing a decrease from 2015 (down 3,000 jobs). In Scotland, the sector accounts for 2.7% of employment, whilst across Great Britain as a whole, the Scottish sector accounts for 22.4% of GB employment in Energy, and for 66.7% of all GB employment in Extraction of crude petroleum and natural gas.

Employment in the Energy growth sector is highly concentrated, with 52.9% of employment being located in Aberdeen City (40.0%) and Aberdeenshire (12.9%) 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 2017, increasing by 2.5% in year on year terms.

Across the economy as a whole, in the third quarter of 2017 output grew by 0.2% (0.6% in year on year terms).

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 165 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
Exports
Total exports* from the Energy growth sector stood at £13.9 billion in 2016, accounting for 18.4% of Scotland’s total exports. Exports from the sector were down 15.8% in real terms from their 2015 level.

Exports to the Rest of the UK stood at £9.0 billion in 2016 and accounted for 65% of total Energy exports. Exports to the Rest of the World stood at £4.9 billion and accounted for 35% of total Energy exports.

Turnover/Gross Value Added (GVA)³
In 2015, total turnover in the Energy growth sector was £45.7 billion, down 11.6% in nominal terms on 2014. A large share of this turnover was generated by extraction of crude petroleum and natural gas (26.3%). Gross Value Added for the Energy growth sector totalled £16.4 billion, down 12.9% in nominal terms on 2014. The drop in GVA between 2014 and 2015 was largely driven by the decline in the oil price over this period.

Enterprises
In March 2017, there were 3,920 registered enterprises operating in the Energy growth sector, representing 2.2% of all registered businesses operating in Scotland. The Scottish Energy growth sector is characterised by small businesses. In 2017, 96.3% of registered enterprises in the Scottish Energy growth sector were small (0-49 employees), although these accounted for only 12.3% of employment in the sector. In contrast, large enterprises (250+ employees) which accounted for just 1.9% of registered enterprises, accounted for 80.3% of employment in the sector.

The majority of enterprises in the sector are ultimately based in Scotland (94.4%), but these accounted for 41.8% of employment in 2017. Although only 4.3% of businesses in the sector were foreign-owned, they accounted for 42.4% of employment in 2017.

*Exports figures do not include SIC 06—Extraction of crude petroleum and natural gas.
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.

**MARCH**
- **Renewable Electricity Data**
  - Q4 (previous year) provisional
  - 1st annual generation estimate and progress toward 100% target (previous year)

**JUNE**
- **Renewable Electricity Data**
  - Q1 (current year) provisional
  - Q4 (previous year) final
  - 2nd annual generation estimate and progress toward 100% target (previous year)
- **National Indicator Update (Renewable Electricity)**
  - 1st estimate (previous year) using proxy consumption data

**SEPTEMBER**
- **Renewable Electricity Data**
  - Q2 (current year) provisional
  - Final annual generation estimate and 3rd estimate of progress toward 100% target (previous year)
- **Sub-national Final Energy Consumption Data**
  - Progress towards 12% energy consumption reduction target (2 years previous)
  - Progress towards 11% renewable heat target (2 years previous)

**DECEMBER**
- **Renewable Electricity Data**
  - Q3 (current year) provisional
  - Confirmation of progress toward 100% target (previous year)
- **National Indicator Update (Renewable Electricity)**
  - 2nd estimate (previous year) using actual consumption data
- **Electricity Generation and Consumption**
  - Estimate of electricity generation (all technologies, previous year) and electricity consumption
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:


**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 77 for more information on the heat target methodology.
**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:


Figure 1.14 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 1.14: Simplified Energy Flow Chart, Scotland, 2016*

### Indigenous Production and Imports – 102,478 ktoe

- Primary oils: 52%
- Natural gas: 38%
- Coal: 1%
- Bioenergy & wastes: 1%
- Manufactured fuels & Other: 5%
- Electricity: 1%

### Exports and Losses – 88,742 ktoe

- Exports: 91%
- Conversion Losses: 4%
- Energy Industry and Distribution Losses: 5%

### Final Consumption – 13,736 ktoe

- Petroleum products: 46%
- Electricity: 29%
- Manufactured fuels & Other: 19%
- Bioenergy & wastes: 4%
- Natural gas: 19%
- Coal: 1%

*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 25 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.scot

In 2016, indigenous production and imports totalled 102,478 thousand tonnes of oil equivalent (ktoe). Approximately 79% of this was exported or used in marine bunkers, a further 8% was ‘lost’ in transformation, distribution, energy industry use and conversion from primary energy to electricity and other energy products.

The remaining 13% was accounted for by final end use consumption. 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:

Of the 102,478 ktoe of primary energy in 2016 - indigenous production accounted for 81,577 ktoe (80%) and imports accounted for 20,901 ktoe (20%). Oil and gas makes the largest contribution, accounting for a combined value of 93% of total primary energy in 2016.

Final consumption, including non-energy use, was at 13,736 ktoe in 2016. The transport sector consumed the largest proportion of energy - around 32% of energy consumption, followed by domestic which consumed 30% and then industry which consumed 16%.

Figure 1.17 shows the end use split by fuel. Petroleum is the largest consumed fuel with around 46% of consumption, followed by natural gas at 29% and electricity at 19%.

DATA DEVELOPMENT

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

Figure 1.18: Scotland Energy Flow Chart, 2016 (thousand tonnes of oil equivalent)

Please see Annex A for full aggregate energy balance and supplementary notes
‘Scotland’s total energy consumption has decreased by 15.4% since 2005/07’
ENERGY CONSUMPTION—KEY FACTS

ENERGY CONSUMPTION IN SCOTLAND

-15.4%

SINCE BASELINE 2005-2007

THE TARGET IS -12% BY 2020

IN 2015 THE AMOUNT OF ENERGY CONSUMED IN SCOTLAND WAS...

142 TWh

Equivalent to the energy required for approximately...

23,000 flights around the world

HOW DOES SCOTLAND COMPARE1... energy consumption change between baseline (2005-2007) and 2015

SCOTLAND...-15.4%

UK.................-14.3%

EU.................-8.7%

ENERGY EFFICIENCY IMPROVEMENTS IN THE SCOTTISH HOUSING STOCK. IN 2016...

94%...HAVE AT LEAST 100mm OF LOFT INSULATION INSTALLED

INCREASE IN ENERGY PRODUCTIVITY SINCE 2005...

31%

EXCLUDING TRANSPORT...

42% OF ENERGY CONSUMED DOMESTICALLY

58% OF ENERGY CONSUMED BY INDUSTRY/COMMERCE

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

DOMESTIC -20%  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 2015, Scotland consumed approximately 142 TWh of energy.

Figure 2.1: Scotland Energy Comparisons

Scotland consumed 142 TWh of energy in 2015, equivalent to...

- The gas and electricity consumption of over... 3 times the number of homes in Scotland
- Approximately... 23,000...flights around the world
- Turning the Falkirk Wheel around... 95 BILLION...times

Figure 2.2 shows that the majority of final energy consumption in Scotland is used for heat (51%). Transport is the next largest consuming sector accounting for a quarter of total energy, with electricity consumption responsible for 24%.

Figure 2.2: Total final energy consumption by sector, Scotland, 2015

Figure 2.3 shows the proportion of overall final energy consumption due to various fuel types in Scotland in 2015. Petroleum Products and Gas dominate the final consumption, accounting for 76% of all final energy consumption. Electricity is the other fuel with an 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, 2015

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.
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 42% of total energy consumption (electricity and heat) is consumed domestically and 58% in the non-domestic sector.

Figure 2.4 shows that over the year to end of 2015, final energy consumption decreased by 0.3%. Also, final energy consumption was 15.4% 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, -20% and -23% respectively, with the transport sector lower at -3%.

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

In 2015, 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. On average, Scotland has the greatest final energy consumption at 17.1 MWh per household per year, 0.5 MWh greater than the GB average.

EXCLUDING TRANSPORT...

42% OF ENERGY CONSUMED DOMESTICALLY

58% OF ENERGY CONSUMED BY INDUSTRY/COMMERCIAL

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

DOMESTIC -20% NON-DOMESTIC -23% TRANSPORT -3%

Figure 2.4: Total final energy consumption by consuming sector, Scotland, 2005 - 2015

In terms of average final energy consumption per household (MWh), the comparison across the UK in 2015 is as follows:

- Scotland: 17.1 MWh
- England: 16.5 MWh
- Wales: 16.6 MWh
- Northern Ireland: N/A MWh
- Great Britain: 16.6 MWh

Source: BEIS

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.

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 (14.0 TWh) - 25% 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.

Table 2.1: Total final energy consumption, by local authority in Scotland, 2015

<table>
<thead>
<tr>
<th>Local Authority</th>
<th>Total Final Energy Consumption (GWh)</th>
<th>% of Scotland Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. FALKIRK</td>
<td>16,573</td>
<td>12%</td>
</tr>
<tr>
<td>2. FIFE</td>
<td>11,404</td>
<td>8%</td>
</tr>
<tr>
<td>3. GLASGOW CITY</td>
<td>10,892</td>
<td>8%</td>
</tr>
</tbody>
</table>

Source: BEIS
How Energy Consumption varies over the Year

Figure 2.9 below shows historical daily energy flows through Scotland’s electrical and gas transmission networks, as well as transport energy demand, from 2014 to 2016. 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, and the variation in gas demand across the seasons in contrast to the relative stability and predictability of electrical demand.

![Energy use in Scotland per day, 2014-2016](image)

The peaks and troughs in gas demand (both within a day and across the seasons) are far greater than the variations in electrical demand. The latter 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, with demand for gas in the winter 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 colder weather drives 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 in hot water tanks or batteries, biomass or hydrogen or as thermal energy in individual properties (such as a hot water tank or a battery) or on a larger scale within a heat network. The appropriate storage system will depend on factors including costs, geographic opportunities, how stored energy needs to be used, and the necessary level of flexibility.

The Scottish Government Heat Policy Statement published in 2015 sets out our future policy direction for addressing the three 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.
**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.

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**Energy Consumption Target (12% reduction by 2020)**

Energy consumption in 2015 was 15.4% lower than the 2005-2007 baseline against which the Scottish Government’s 12% Energy Efficiency Target is measured.

Over the year to 2015, final energy consumption decreased marginally by 0.3%.

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) - 2015*

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 31% between 2005 and 2015.

---

**INCREASE IN ENERGY PRODUCTIVITY SINCE 2005...**

31%
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 take 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 indicate 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 - 2015**

<table>
<thead>
<tr>
<th>Energy Consumption (TWh)</th>
<th>Industry/Commercial</th>
<th>Transport</th>
<th>Domestic</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total</td>
<td>3.7</td>
<td>3.2</td>
<td>3.7</td>
</tr>
<tr>
<td>Output</td>
<td>7.1</td>
<td>-3.4</td>
<td>-26.8</td>
</tr>
<tr>
<td>Intensity</td>
<td>-11.1</td>
<td>-19.7</td>
<td>-14.8</td>
</tr>
</tbody>
</table>

Between 2005 and 2015, total final energy consumption in Scotland fell by 31,076 GWh, a reduction of 19%.

It has been estimated that if efficiency had remained at 2005 levels, 13,950 GWh more energy would have been needed to produce the same amount of output.

Therefore, it is estimated that an increase in output of 8% has added to final energy consumption, with energy intensity improvements accounting for a 27% reduction to offset this.
Industrial and Commercial Energy Intensity

In 2015, 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 19,720 GWh (26%) between 2005 and 2015 to 56,797 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, 7,088 GWh more energy would have been needed to produce the same amount of output. Therefore, it is estimated that an increase in output of 9% has added to industrial/commercial energy consumption, with energy intensity improvements accounting for a 35% reduction to offset this.

Transport Energy Industry

In 2015, the transport sector accounted for 28% of total final energy consumption in Scotland (excluding bioenergy & waste).

Final consumption in this sector fell by 267 GWh (1%) between 2005 and 2015 to 37,772 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, 3,152 GWh more energy would have been needed to produce the same amount of output. Therefore, it is estimated that an increase in output of 8% has added to transport energy consumption, with energy intensity improvements accounting for a 9% reduction to offset this.

Domestic Energy Industry

In 2015, the domestic sector accounted for 31% of total final energy consumption in Scotland (excluding bioenergy & waste).

Final consumption in this sector fell by 11,089 GWh (20%) between 2005 and 2015 to 41,738 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, 3,709 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 domestic energy consumption, with energy intensity improvements accounting for a 28% 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 National 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.

The draft Climate Change Plan outlines our long-term 2050 ambition to see Scotland’s buildings transformed so that they are near zero carbon wherever feasible. Over its lifetime SEEP will improve the energy efficiency of both domestic and non-domestic buildings and solutions for switching heating supplies from high to lower carbon or renewable sources for properties off the mains gas grid, as well as encouraging district heating where it is most appropriate.

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 support growth and jobs in the Scottish economy.

Through two phases of pilots, SEEP is helping local authorities to test new and innovative approaches to energy efficiency with community groups and businesses, helping reduce costs and improving warmth in homes, schools, hospitals and businesses. In May 2018, we will launch a full routemap for SEEP and introduce the SEEP Transition Programme.

The 2016 Programme for Government committed to investing more than half a billion pounds to SEEP over four years setting out a clear commitment to develop this programme with substantial annual funding. By 2040, 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.

While SEEP is a cornerstone of the Scottish Government’s ‘whole-system’ approach to energy policy, a suite of new policies and programmes will be required in all areas of our energy system. 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.

Non-domestic energy efficiency baseline

Improving the energy efficiency of Scotland’s non-domestic building stock is a key component of Scotland’s Energy Efficiency Programme and in achieving the ultimate aim of decarbonising heat supply; making energy more affordable and reducing carbon emissions from the built environment.
Domestic Energy Consumption

The energy efficiency levels in the Scottish housing stock are monitored using the Scottish House Condition 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, lighting and, where relevant, energy generated by renewables 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 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, 2010-2016

Figure 2.13: Grouped Energy Efficiency Ratings, Scotland, 2010-2016

Figure 2.13 shows that, in 2016, 39% of Scottish homes were in EPC band C or better (SAP 2012); this is similar to 2015. Using SAP 2009 shows strong improvement in the energy efficiency profile of the Scottish housing stock in the last six years; there was a 79% increase in the share of the most energy efficient dwellings (rated C or above) between 2010 and 2016.
Social rented dwellings are among the most energy efficient in the Scottish stock; 45% of Local Authority housing and 63% of Housing Association housing are rated B or C under SAP 2012 compared to 35% 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 2016, at least 100 mm of loft insulation had been installed in 94% of lofts, an increase of 12 percentage points on 2010 levels, and 30% of lofts were insulated to 300 mm or more, an increase of 25 percentage points on 2010. In 2016, around 72% of cavity wall dwellings and 15% of solid wall dwellings were insulated, both similar to the previous year.

As a result of higher standards for replacement boilers, the efficiency of central heating systems is also improving; 61% used condensing gas or oil boilers for heating and/or hot water in 2016, 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 December 2017, there were approximately **1.9 million domestic** EPCs and **35,000 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](http://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](http://www.scottishepcregister.org.uk)

The Scottish Government is also in the process of collating EPC data to support wider research and statistical work. Publication of this 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. 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.

**BEIS Data for Scotland**

BEIS published results for Scotland in July 2017, as part of their annual NEED publication. Note that the data on property attributes for Scotland is modelled whereas England & Wales data uses assessors data. As a result, this increases uncertainty in the data for Scotland and therefore these figures should be treated as provisional.

**Domestic Consumption**

The average (median) gas consumption for properties in Scotland was 12,600 kWh with average (median) electricity consumption at 3,400 kWh. Typical consumption in Scotland is slightly higher than in England & Wales for both gas (+5%) and electricity (+3%).

**Figure 2.14: Annual Energy Consumption, kWh, Scotland, 2015**

![Gas and Electricity Consumption Bar Chart]

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

The NEED data allows for an indication of how energy is used by domestic consumers. Figure 2.15 shows the median gas consumption by household income in 2015 for both Scotland and the rest of GB.
It can be seen that Scotland has a higher gas consumption compared to England & Wales, for all household income bands except £20,000 to £29,999. Generally, overall consumption increases as household income rises, as does the difference in consumption between Scotland and England & Wales. The greatest difference in consumption is 22% for households with income £150,000 or greater, whereas for those households earning less that £15,000 the difference is 3%. On average, electricity consumption for each income band follows a very similar pattern to gas consumption. Figure 2.16 shows the 2015 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 gas consumption.

In England & Wales however, semi-detached properties have the second highest consumption. Gas consumption in Scotland is 16% greater in Bungalows than in the rest of GB. This is because Scotland has proportionally more larger sized bungalows compared to England & Wales. Flats have the lowest gas consumption for both Scotland and England & Wales, with Scottish flats consuming 24% more gas compared to flats in England & Wales.

* Terraced for England & Wales is estimated using median figures for end-terraced and mid-terraced houses.
Figure 2.18 shows Scottish domestic energy consumption in 2015, 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 18,800 kWh and a median electricity consumption of 4,200 kWh. The lowest consuming property type is the Flat, which has a median gas consumption of 8,300 kWh and median electricity consumption of 2,900 kWh. On average a detached property consumes 126% more gas and 45% more electricity compared to a flat. This is likely because detached properties stand alone and tend to be larger than flats.

Figure 2.17 shows Scottish domestic energy consumption in 2015, 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 18,800 kWh and a median electricity consumption of 4,200 kWh. The lowest consuming property type is the Flat, which has a median gas consumption of 8,300 kWh and median electricity consumption of 2,900 kWh. On average a detached property consumes 126% more gas and 45% more electricity compared to a flat. This is likely because detached properties stand alone and tend to be larger than flats.

Figure 2.18 shows Scottish domestic energy consumption in 2015, 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 14,600 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; properties built before 1920 and after 1980 are larger than those built between this period. This could explain the dip in energy consumption that can be seen in mid 20th century properties.
Results from the Scottish House Condition Survey 2016 state that 80% of properties that are owner-occupied are houses, whereas, only 37% of properties that are privately rented are houses. The larger floor area of houses in comparison to flats could explain why owner-occupied properties have a higher consumption than privately rented or council/association housing.

Figure 2.19 shows Scottish domestic energy consumption in 2015, 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 14,500 kWh and a median electricity consumption of 3,600 kWh. Private rented properties have the lowest gas consumption at 8,600 kWh with council/association housing in lying in between at 10,200 kWh. Privately rented and council properties have similar electricity consumption at 3,100 kWh and 3,000 kWh, respectively. On average an owner occupied property consumes 69% more gas and 16% more electricity compared to a privately rented property.

Results from the Scottish House Condition Survey 2016 state that 80% of properties that are owner-occupied are houses, whereas, only 37% of properties that are privately rented are houses. The larger floor area of houses in comparison to flats could explain why owner-occupied properties have a higher consumption than 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 these measures have achieved this outcome is key to the successful evolution of policy. There are multiple reasons why energy consumption in domestic properties could fall. Attributing such decrease in consumption to energy efficiency measures may be invalid. 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.
Impact of Energy Efficiency Measures in Homes

NEED 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 including 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.

The NEED also measures the impact of loft insulation, cavity wall insulation, solid wall insulation and boiler installation programs. Impacts of these energy efficiency measures can be estimated using gas and electricity consumption data and property characteristics data.

The NEED data shows that in 2014 the median energy consumption savings from installing cavity wall insulation and loft insulation were 9.1% and 3.5% respectively. This equates to an annual energy saving of 1,300 kWh for households that installed cavity wall insulation and 500 kWh for households that installed loft insulation. At 2017 gas prices (see Table 7.3* in the energy prices chapter) this would translate to a saving on gas bills of £53 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, showing an energy saving of 13.5% and 8.7% respectively. However, the sample rates for solid wall insulation and boiler installation measures are relatively small, so these estimates should be used with caution.

* Based on Direct Debit gas prices
**REBOUND EFFECT**

**What is the Rebound Effect?**

When an 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 consumer’s behavioural change to this increased efficiency. The consumer may reduce energy consumption less than expected, reacting to the lower cost of heating a property by heating it to a higher temperature.

**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 installed 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 3.5% 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 4%. 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%.

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**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 coverage. This represents 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 to evaluate the CRC energy efficiency scheme.

The latest progress made with ND-NEED was published in March 2015.
‘Renewable sources delivered 54.0% of gross electricity consumption in 2016’
IN 2016, RENEWABLES SHARE OF GROSS ELECTRICITY CONSUMPTION IS 37.2 pp. GREATER THAN IN 2006.

THE TARGET IS 100% BY 2020.

**RENEWABLE SOURCES GENERATED**

54.0% ...OF GROSS ELECTRICITY CONSUMPTION IN 2016.

**UK**

Share of generation since 2007:
- Renewables: Up 20 pp. to 24.6%
- Fossil Fuels: Down 24.8 pp. to 53.3%
- Nuclear: Up 5.3 pp. to 21.2%

**SCOTLAND**

Share of generation* since 2007:
- Renewables: Up 25.8 pp. to 42.9%
- Fossil Fuels: Down 41.5 pp. to 13.2%
- Nuclear: Up 17.1 pp. to 42.8%

**ELECTRICITY GENERATION & EXPORTS**

**SCOTLAND GENERATION MIX, 2016**

- 19,676 GWh (42.9%)
- 19,630 GWh (42.8%)
- 3,130 GWh (6.8%)
- 2,238 GWh (4.9%)
- 1,839 GWh (1.5%)

**EXPORTS, 2016**

- 20% OF TOTAL GENERATION IN 2016

**IN THE UK, SCOTLAND ACCOUNTS FOR**

- 92% HYDRO POWER
- 34% WIND OUTPUT

**OPERATIONAL AND PIPELINE RENEWABLE PROJECTS**

AMOUNT TO 21.3 GW IN CAPACITY

9.7 GW OF INSTALLED RENEWABLE ELECTRICITY CAPACITY IN 2017

**WIND ACCOUNTS FOR** 76% OF ALL OPERATIONAL RENEWABLE CAPACITY IN 2017 Q3
Latest Statistics on Electricity Generation
Renewables were again the single largest source of electricity generated in Scotland in 2016 at 42.9%, closely followed by nuclear generation at 42.8% with fossil fuel generation making up only 13.2%. Scotland continued to be a net exporter of electricity, exporting 20% of total generation in 2016, down from 29% in 2015. Overall electricity generation in Scotland decreased by 5,506 GWh to 45,845 GWh in 2016. Figures 3.1 and 3.2 show electricity generated in Scotland and UK, respectively, by fuel type (GWh) for 2000 to 2016. 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.

Renewables
Renewable electricity generation delivered 19,676 GWh in 2016, down 10% on 2015. This decrease is partly due to adverse weather conditions for renewable generation.

Nuclear
Nuclear power output in Scotland as a proportion of overall electricity generation increased from 34.6% in 2015 to 42.8% in 2016. Nuclear generation increased 10.5% on 2015 partially offsetting the reduction in generation from coal (see Figure 3.1). The UK as a whole saw a 2.0% rise in nuclear generation in 2016.

Coal
In 2016, the proportion of electricity generated from coal decreased to 4.9%, down from 16.6% in 2015. In the UK as a whole electricity generation from coal decreased from 23.6% in 2015 to 10.4%. 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.

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

Source: BEIS
The proportion of electricity generation from gas rose slightly from 3.7% in 2015 to 6.8% in 2016. The main gas-fired power station in Scotland is in Peterhead in Aberdeenshire. The proportion of electricity generated by gas in the UK as a whole increased from 29.5% in 2015 to 42.4%, offsetting the reduction in generation from coal.

Figure 3.3 shows the proportion of electricity generated by fuel in Scotland and the UK in 2016, where ‘Renewables’ represents generation from natural hydro flow, wind and other renewable generators.

**Fossil Fuels**

The share of fossil fuel generation as a whole, in Scotland, has decreased from 22.0% in 2015 to 13.2% in 2016, while generation from renewables has increased from 42.4% to 42.9%. This is in line with 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 50).

The UK generated 338,428 GWh of electricity in total in 2016. Between 2015 and 2016 Scotland’s share of total UK electricity generation decreased from 15.2% to 13.4%. For the UK as a whole, renewable generation made up 25% of total generation in 2016.

For renewable generation only, the proportion generated in Scotland accounted for 24% of total UK renewable generation – down from 26% in 2015.
Renewable Electricity

Installed renewable capacity has risen year on year since 2000 and, as shown in Figure 3.4, there has been an increase from around 1,400 MW in 2000 to around 9,000 MW in 2016. This overall increase can be largely attributed to the significant increase in operational wind sites. 2016 saw an increase in renewable installed capacity of 1,100 MW, up approximately 14% from 2015.

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 3.4. 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 2016 was 19,676 GWh – down 10% on 2015 with the equivalent of 54.0% of gross consumption in Scotland met using renewable sources (see Monitoring the 100% Electricity Target Box on page 52). The reduction in renewable electricity generation is partly due to adverse weather conditions for renewable electricity generation.

Provisional data from the BEIS regional quarterly generation statistics shows that renewable electricity generation in quarter three of 2017 is 15% greater than in quarter three of 2016.
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 3.5 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 2018. However, it will not be possible to officially report against the target until the Scottish electricity gross consumption data is published in December 2018.

**Figure 3.5: Electricity Generation (GWh) from Renewable Sources, Scotland 2000-2016**

**Scottish Electricity Generation (2016)**  
45,845 GWh

**Generation Mix**

<table>
<thead>
<tr>
<th>Output (GWh)</th>
<th>Proportion Generated (%)*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Renewables</td>
<td>19,676 42.9%</td>
</tr>
<tr>
<td>Wave / tidal</td>
<td>19,630 42.8%</td>
</tr>
<tr>
<td>Sewage Gas</td>
<td>3,130  6.8%</td>
</tr>
<tr>
<td>Landfill Gas</td>
<td>2,238  4.9%</td>
</tr>
<tr>
<td>Other biofuels</td>
<td>686  1.5%</td>
</tr>
<tr>
<td>Solar PV</td>
<td>486   1.1%</td>
</tr>
</tbody>
</table>

**Minus Net Exports**  
(9,387 GWh)  
20% of generation

**Transmission/distribution losses**  
(2,546 GWh)

**Generation own use**  
(3,004 GWh)

**Scottish Consumption**  
30,908 GWh

**Gross Consumption**  
36,458 GWh

**Renewables proportion of Gross Consumption**  
\[ \frac{19,676}{36,458} = 54.0\% \]

**Scottish Electricity**

**Generation Mix**

<table>
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**Generation own use**  
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**Scottish Consumption**  
30,908 GWh

**Gross Consumption**  
36,458 GWh

**Renewables proportion of Gross Consumption**  
\[ \frac{19,676}{36,458} = 54.0\% \]

**Reductions in Scottish consumption through energy efficiency measures will have a positive impact for the Scottish targets.**

* Figures do not sum to 100% due to rounding
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. Scotland has the second greatest electricity generation from renewables per unit of economic activity compared with UK regions as illustrated in Figure 3.7 (GVA is used as a proxy for economic activity).

Scotland’s ratio of renewable electricity generated per unit of economic activity is over 3 times larger than that of the UK as a whole.

Figure 3.6 shows renewable electricity generation broken down by country and by energy source. In 2016, Scotland is the primary location for hydro generation accounting for around 89% of installed capacity and 92% of UK hydro output. Scotland also accounts for 34% of UK wind output (40% of capacity). Overall, Scotland accounted for 24% of total UK renewable electricity output in 2016.

Source: BEIS

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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.
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.

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.

Figure 3.8: Renewable Electricity Generation by LA, Scotland, 2016

<table>
<thead>
<tr>
<th>TOP THREE LOCAL AUTHORITIES</th>
<th>LOCAL AUTHORITY</th>
<th>RENEWABLE ELECTRICITY GENERATION (GWh)</th>
<th>PROPORTION OF TOTAL RENEWABLE ELECTRICITY GENERATION (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1st</td>
<td>Highland</td>
<td>5,176</td>
<td>27%</td>
</tr>
<tr>
<td>2nd</td>
<td>Dumfries and Galloway</td>
<td>1,912</td>
<td>10%</td>
</tr>
<tr>
<td>3rd</td>
<td>South Lanarkshire</td>
<td>1,754</td>
<td>9%</td>
</tr>
</tbody>
</table>

Renewable Electricity Generation

Local Authority Area Proportion of Scotland Total

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

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 3.9 shows renewable electricity as a percentage of gross consumption for EU countries in 2015, the year for which comparable data is available. Austria ranks first with 70.3%. Scotland ranks third, with the equivalent of 59.4% of gross consumption generated from renewable sources, which was ahead of both the UK (ranked 16th with 22.4%) and the EU average of 28.8%.

Figure 3.9: Renewable Electricity as a Proportion of Gross Consumption for EU Countries, 2015

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 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 (in planning, consented, under construction, or operational) and local authority area in Scotland.

Since November 2014, REPD 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:


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.
As at September 2017, Scotland had 9.7 GW of installed renewable electricity generation capacity, with an additional 11.6 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 21.3 GW, - over double the level currently deployed.

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 target 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 2017). The ‘operational’ capacity figure is the provisional Q3 2017 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.

**Figures 3.11 and 3.12 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).**
Table 3.1: Installed Capacity and Number of Pipeline Renewable Projects in Scotland, September 2017

<table>
<thead>
<tr>
<th></th>
<th>NUMBER OF PROJECTS</th>
<th>INSTALLED CAPACITY</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Onshore Wind</td>
<td>Offshore Wind</td>
</tr>
<tr>
<td>PROJECTS IN PLANNING</td>
<td>65 (91%)</td>
<td>0 (0%)</td>
</tr>
<tr>
<td>AWAITING CONSTRUCTION</td>
<td>79 (51%)</td>
<td>11 (7%)</td>
</tr>
<tr>
<td>UNDER CONSTRUCTION</td>
<td>30 (59%)</td>
<td>1 (2%)</td>
</tr>
<tr>
<td>OVERALL</td>
<td>174 (63%)</td>
<td>12 (4%)</td>
</tr>
</tbody>
</table>

Table 3.1 shows the breakdown of renewable projects in the planning system by technology and planning stage. It can be seen that onshore wind projects dominate the projects in the planning system at 63%. Despite offshore wind accounting for only 4% of the projects currently in the planning system, due to the large scale sites, the installed capacity contribution makes up 36% of the total installed capacity in the planning system. Other projects (including solar photovoltaic, biomass, etc) account for 33% of projects in the planning system, but only 9% of the total installed capacity in the planning system.
Fossil Fuel Generation

In 2016, fossil fuels accounted for 13% of Scotland’s electricity generation, down from 22% in 2015. 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. 2016 saw the lowest contributions to the overall percentage of electricity generated from coal due to the closure of Longannet in March 2016. Between 2015 and 2016, the proportion of electricity generated from gas rose slightly from 4% to 7% partially offsetting the reduction in coal generation.

In 2016, coal generated 2,238 GWh of electricity (which accounted for 5% of total generation), down from 8,508 GWh in 2015. In 2016, gas generated 3,130 GWh of electricity, up from 1,919 GWh in 2015.

Cockenzie power station used up its remaining operating hours under the Large Plant Combustion Directive (LPCD) and closed in early 2013. Along with the aforementioned closure of Longannet in March 2016, this leaves 1.3 GW of installed capacity from fossil fuels with the gas fired power station at Peterhead accounting for the majority of this capacity.

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

Source: BEIS

---

**Figure 3.13: Electricity generated in Scotland from fossil fuels (GWh), 2000-2016**

- **Coal**: 34%
- **Gas**: 64%
- **Oil**: 74%

**DECREASE IN ELECTRICITY GENERATION FROM COAL, GAS AND OIL SOURCES 2000 TO 2016**

- **Coal**: 87%
- **Gas**: 64%
- **Oil**: 74%
Nuclear Output

Accounted for 42.8% of all electricity generation in Scotland, up from 34.6% in 2015.

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 now due to operate until 2030.

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 the end of May 2016, according to UK government data.

In 2016, 42.8% of electricity generated in Scotland came from the two Nuclear power stations, up from 34.6% in 2015. Figure 3.15 below shows the output from nuclear generation since 2000, ranging from a low of 12,344 GWh (following unplanned outages in 2006 and 2007) to a high of 19,630 GWh in 2016.

Figure 3.14: Gas and Coal prices (p/kWh) for large users in the UK, 2004-2016

Figure 3.14 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 oil prices between 2013-2016 brought down oil-indexed gas prices, dropping the price of gas around the world. Other potential reasons for lower gas prices include an increase in LNG supply and a slowdown in worldwide demand growth.

Figure 3.15: Nuclear electricity generation in Scotland (GWh), 2000-2016

Figure 3.15 shows the nuclear electricity generation in Scotland from 2000 to 2016. 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 now due to operate until 2030.

Source: BEIS

Source: BEIS
The diagram below shows the flow of energy from primary fuel inputs through to electricity consumed in Scotland in 2016. Simplifying the aggregate energy balance shown in Annex A by focussing on the electricity sector alone. Figure 3.16 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.

**Electricity Balance for Scotland**

The diagram below shows the flow of energy from primary fuel inputs through to electricity consumed in Scotland in 2016. Simplifying the aggregate energy balance shown in Annex A by focussing on the electricity sector alone. Figure 3.16 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 3.16: Electricity Flow Chart, Scotland, 2016 (thousand tonnes of oil equivalent)**

**Electricity Balance - Key Facts**

**Primary Energy**

- Imports accounted for a small proportion of primary energy - less than 2%, whereas exports accounted for the equivalent of 12% of total primary energy.
- Of the 7,409 ktoe total primary energy, 36% was used within Scotland, 12% was exported and the rest was lost in conversion, distribution or consumed within the energy industry.

**Transformation**

- Around 58% 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.

**End Use**

- 43% of end use electricity was consumed by the domestic sector, 29% was consumed by ‘other’ sectors, 27% was consumed by industry and 1% was consumed by transport.
Electricity Exports

Scotland typically generates 45,000 GWh - 50,000 GWh of electricity, as shown in Figure 3.17, while typically consuming between 35,000 GWh - 40,000 GWh. As a result, Scotland is a net exporter of electricity and has been for a number of years. In 2016, net exports to England and Northern Ireland accounted for 20% of total generation.

Figure 3.16 shows two measures of electricity consumption – both measures are illustrated in more detail in the box on page 52.

Total electricity consumption is calculated as total generation, minus generators’ own use, transmission and distribution losses, and exports. Total electricity consumption in Scotland was 30,908 GWh in 2016.

Figure 3.17: Electricity generated, consumed and exported, Scotland, 2000 - 2016

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 36,458 GWh in 2016. 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 3.18 shows, total annual exports decreased by 31% from 15,508 GWh in 2015 to 10,742 GWh in 2016, while total imports increased from 718 GWh to 1,355 GWh. Since 2000 there has been an overall increasing trend in Scotland’s annual electricity exports, varying between 6,830 GWh (2003) and 15,508 GWh (2015) over the period. The reduction in exports in 2016 is a result of reduced electricity generation in Scotland and in part is explained by the closure of Longannet in that year.

Figure 3.18: Quarterly Electricity imports and exports (GWh), Scotland, 2000 - Q3 2017

Source: BEIS
Total domestic consumption of electricity fell by 18% between 2005 and 2016, as shown in Figure 3.20. Over the same period, there was a 21% 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 2016, total domestic consumption, decreased by 5% from 2015 and non-domestic consumption decreased by 4% over the year.

Latest provisional figures show that for the first three quarters of 2017 Scotland imported 1,231 GWh of electricity, a 76% increase compared to the same period in 2016. Over the same period Scotland exported 9,074 GWh, an increase of 12% on first three quarters of 2016.

Figure 3.19 shows Scotland’s electricity imports and exports to GB and Irish markets in 2016.
Figure 3.21 shows that domestic electricity consumption per household in Scotland in 2016 was estimated to be the fourth highest in Great Britain at 4.1 MWh, 0.2 MWh greater than the GB average of 3.9 MWh, while South West England had the highest average consumption at 4.3 MWh.

**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.

Figure 3.22 shows that average domestic electricity consumption per household in Scotland decreased by 24% between 2005 and 2016, with a 6% fall between 2015 and 2016. Key drivers of this overall decrease include increased electricity prices and improved energy efficiency of appliances.
Figure 3.23: Domestic Electricity Consumption - Average Consumption (kWh per meter), Scotland by Intermediate Geographic Zone, 2016
Figure 3.24: Domestic Electricity Consumption—Average Consumption (kWh per meter), Central Belt of Scotland by Intermediate Geographic Zone, 2015

The tables above show both the seven highest and seven lowest domestic electricity consuming areas (average per meter) in Scotland.

It is interesting to note that four out of the seven 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 3.25: Non-Domestic Electricity Consumption - Average Consumption (kWh per meter), Scotland by Intermediate Geographic Zone, 2016
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:

Contribution of Electricity Generation to Gross Domestic Product (GDP)

The value added by the electricity industry (including generation, transmission and distribution) accounts for 2% of Scotland’s GDP - around as much as the production of wines and spirits.

The output of electricity generation within Scottish GDP is directly measured using generation figures by source type. This information is supplied by major power producers and BEIS. Information is collected for conventional sources (nuclear and fossil fuel), hydroelectricity, and onshore wind. We seasonally adjust these series to remove regular demand-driven and weather-related changes. These adjustments are more effective when electricity sources are treated separately. With the closure of Scotland’s last coal-fired electricity plant in 2016 Q1, seasonal adjustment is no longer required for conventional generation (this can be seen in Figure 3.27).

We estimate the contribution of electricity transmission and distribution using total annual electricity consumption for Scotland. This accounts for the effects of imports and exports of electricity on the total output of the industry (since electricity generated and supplied in Scotland adds more value than electricity generated in Scotland but exported elsewhere).

Figure 3.27: Seasonal adjustment of electricity generation by broad type (GWh), Scotland, Q1 2010-Q3 2017

Figure 3.28: Electricity contribution to GDP quarterly growth, Scotland, 2016-2017 Q3

For more information on Scottish GDP methodology, see this link.
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 station 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 store 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**

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 tested 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/](https://www.scottishrenewables.com/publications/energy-storage-basics/)
'Heat demand in Scotland has fallen by a fifth in the last decade'
HEAT – KEY FACTS

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

AVERAGE DOMESTIC GAS CONSUMPTION
13.4 MWh
30% LOWER THAN 2006 AVERAGE

3% HIGHER THAN GB AVERAGE

NON-DOMESTIC GAS CONSUMPTION IN SCOTLAND HAS FALLEN BY 21% IN THE LAST DECADE, TO 19,316 GWh
INDUSTRY AND COMMERCE ACCOUNTS FOR 41% OF SCOTTISH GAS CONSUMPTION

RENEWABLE HEAT GENERATION IN 2016...
3,752 GWh
ENOUGH TO HEAT MORE THAN 10% OF SCOTTISH HOUSEHOLDS (AROUND 275,000 HOUSEHOLDS)

RENEWABLE HEAT TECHNOLOGIES

<table>
<thead>
<tr>
<th>Technology</th>
<th>Output (GWh)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Biomass</td>
<td>2,504</td>
</tr>
<tr>
<td>Biomass CHP</td>
<td>555</td>
</tr>
<tr>
<td>Energy from Waste</td>
<td>342</td>
</tr>
<tr>
<td>Heat Pumps</td>
<td>287</td>
</tr>
<tr>
<td>Solar Thermal</td>
<td>19</td>
</tr>
</tbody>
</table>

In 2016
Biomass combustion (including biomass CHP) supplied more than 80% of renewable heat generated in Scotland.

Large renewable heat installations account for less than 1% of all Scottish installations, but account for 56% of renewable heat output.

85% of installations are micro, together producing only 15% of output.

20% OF SCOTTISH HOUSEHOLDS ARE IN OFF-GAS GRID AREAS

In 2015 Scotland generated...
5.4%
...of heat demand from renewables sources
Using a range of scenarios to estimate heat demand, Scotland generated an estimated 4.8%-5.0% of heat demand from renewable sources in 2016

Around 20% of heat generated in GB under the Renewable Heat Incentive schemes is produced by installations in Scotland

COMPARSED TO 14% IN GB AS A WHOLE
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.

In 2015, 51% of total energy consumption was accounted for by non-electrical heat demand (see box on page 83 for more information on electrical heat use). Approximately 43% of heat 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 commercial heat demand in 2015.

Since 2006, there has been a significant reduction in the consumption of energy used for non-electrical heating in Scotland—decreasing by 20% from 97,897 GWh to 77,976 GWh in 2015. This reduction is greater for the industrial & commercial sectors (-22%) than for the domestic sector (-18%) (see Figure 4.2).

Annual Patterns in Heat Demand

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. This analysis of gas and electricity consumption in Scotland shows that 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. They 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, increasing the security of future supply.

In 2016, just over 1.7 GW of renewable heat capacity was operational in Scotland, producing 3,752 GWh of useful renewable heat. This represents a 13% increase in capacity but an 11% reduction in heat generated from renewable sources compared with 2015. This reduction in renewable heat output was primarily due to changes at a small number of large non-domestic sites (sites with a capacity of 1 MW or more).

In 2016 Biomass combustion (including biomass CHP) supplied more than 80% of renewable heat in Scotland. Energy from waste (EfW) includes biomass combustion of biodegradable material (other than wood), anaerobic digestion (AD), landfill gas capture, advanced thermal treatment (ATT) using pyrolysis and/or gasification and biomethane gas to grid injection after AD and processing. EfW supplied 9% of renewable heat.

Heat pumps (water, air and ground source) and solar thermal installations are mostly used to provide water and space heating on small scales. Together they supplied around 8% of renewable heat. A breakdown by technology type was not available for just under 50 GWh of renewable heat output, for more details please see:

http://www.energysavingtrust.org.uk/sites/default/files/reports/renewable%20Heat%202016%20%20cot%202016%20report%20FINAL%203.03.17.pdf

Figure 4.4 shows how renewable heat generation in Scotland has changed over the last few years. Despite the reduction between 2015 and 2016, renewable heat generation is more than four times greater than in 2008/09, when 863 GWh was produced. Large sites accounted for the majority of this increase. Whilst renewable heat output from large sites fell between 2015 and 2016, output from both ‘micro’ (≤45 kW) and ‘small to medium’ (>45 kW—<1 MW) installations increased, although at a slower rate than in previous years.

Sources: EST, BEIS, Scottish Government

10. Please note there was no separate renewable heat estimate produced for calendar year 2009.
Renewable Heat Target

The 2009 Renewable Heat Action Plan set a target of delivering 11% of Scotland’s projected 2020 non-electrical heat demand from renewable sources. In 2015, renewable heat generation equated to 5.4% of Scotland’s non-electrical heat demand, up from 3.9% in 2014.

Figure 4.5: Estimated increases in renewable output required to meet 2020 renewable heat target

Figure 4.5 shows the difference between renewable heat output in 2016 and output required to meet the 2020 target under three scenarios. Based on these scenarios, renewable heat output would need to approximately double (increase by between 96% and 129%) over four years in order to reach the Scottish Government’s (SG’s) target by 2020. The majority of progress to date was due to reductions in heat demand rather than increases in renewable heat output.

Non-electrical 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—see figure 4.2. This decreased demand means that renewable heat meets a greater proportion of total non-electrical heat demand than would otherwise have been the case.

Between 2008 and 2015 non-electrical heat demand fell by 20%. If it had remained unchanged, only 4.3% of heat demand would be fulfilled by renewable heat in 2015.

Table 4.1 below shows that over the year to 2015, renewable heat generation increased by 37%, while non-electrical heat demand decreased by 1.6%.

Table 4.1: Renewable heat target statistics, Scotland, 2008-2016

<table>
<thead>
<tr>
<th></th>
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<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Renewable Heat (GWh)</td>
<td>863</td>
<td>-</td>
<td>1,363</td>
<td>1,690</td>
<td>2,045</td>
<td>2,266</td>
<td>3,071</td>
<td>4,205</td>
<td>3,752</td>
</tr>
<tr>
<td>Heat Demand (non-electrical, GWh)</td>
<td>97,053</td>
<td>89,155</td>
<td>91,156</td>
<td>88,269</td>
<td>86,447</td>
<td>83,805</td>
<td>79,207</td>
<td>77,976</td>
<td>-</td>
</tr>
<tr>
<td>% Renewable Heat</td>
<td>0.9%</td>
<td>-</td>
<td>1.5%</td>
<td>1.9%</td>
<td>2.4%</td>
<td>2.7%</td>
<td>3.9%</td>
<td>5.4%</td>
<td>-</td>
</tr>
</tbody>
</table>

Sources: EST, BEIS, Scottish Government

The SG’s ‘Energy Strategy’, published in December 2017, sets out its long-term vision for the future energy system. It includes a new target for the equivalent of 50% of the energy for Scotland’s heat, transport and electricity consumption to be supplied from renewable sources by 2030 (see ‘Chapter 1’).
International comparisons

In 2015, renewable energy accounted for 19% of total energy use for heating and cooling in the EU. This is a significant increase from 10% in 2004. Increases in industrial sectors, services and residential use (building sector) contributed to this growth.

Figure 4.6*: Share of renewable heat of all heating and cooling demand, countries of the EU, 2015

Although good progress has been made in Scotland since 2009, the share of renewable energy in energy use for heat is the lowest of all EU countries, including the UK as a whole, and well below the EU average. At 5.5% the share of renewable heat for the UK as a whole is 0.1 percentage point higher than Scotland’s.

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.

Renewable heat installations—size and technology type

As Table 4.2 on the next page shows, the majority of renewable heat output in 2016 continues to come from large (1 MW+) installations. In total, these contributed 42% of renewable heat capacity and 56% of annual output despite accounting for less than 1% of installations.

Large renewable heat installations account for less than 1% of all Scottish installations, but account for 56% of renewable heat output.

85% of installations are micro, together producing only 15% of output.
This large contribution from a small number of sites not only results from their scale but also from the fact that large installations include those which are primarily using renewable heat to provide process heat, as a product of combined heat and power, or combustion of waste, which are often 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 is proportionately less.

Table 4.2: Renewable heat statistics by installation size, Scotland, 2016

<table>
<thead>
<tr>
<th>Installation Size</th>
<th>Renewable Heat Capacity (GWh)</th>
<th>% Renewable Heat Capacity</th>
<th>Annual Output (GWh)</th>
<th>% Annual Output</th>
<th>Number of Installations</th>
<th>% of Installations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Large (&gt;1 MWth)</td>
<td>0.717</td>
<td>42%</td>
<td>2,070</td>
<td>56%</td>
<td>70</td>
<td>&lt;1%</td>
</tr>
<tr>
<td>Small to Medium (&gt;45kWth &amp;</td>
<td>0.663</td>
<td>39%</td>
<td>972</td>
<td>26%</td>
<td>3,610</td>
<td>15%</td>
</tr>
<tr>
<td>Micro (&lt;45kWth)</td>
<td>0.314</td>
<td>19%</td>
<td>562</td>
<td>15%</td>
<td>20,510</td>
<td>85%</td>
</tr>
<tr>
<td>Biomethane (no stated capacity)</td>
<td>N/A</td>
<td>N/A</td>
<td>100</td>
<td>3%</td>
<td>10</td>
<td>&lt;0.1%</td>
</tr>
<tr>
<td>Unknown</td>
<td>&lt;0.001</td>
<td>&lt;0.1%</td>
<td>&lt;1</td>
<td>&lt;0.1%</td>
<td>Missing data</td>
<td>Missing data</td>
</tr>
<tr>
<td>Total</td>
<td>1.695</td>
<td>100%</td>
<td>3,705</td>
<td>100%</td>
<td>24,200</td>
<td>100%</td>
</tr>
</tbody>
</table>

Source: EST

Table 4.3 shows the renewable heat technologies used in 2016. Most of Scotland’s renewable heat output comes from biomass combustion, which supplies more than 80% of renewable heat. Heat pump and solar thermal installations, which are most suited for space and water heating, account for around 8%, with the remaining 9% generated from waste sources.

Table 4.3: Renewable heat statistics by technology type, Scotland, 2016

<table>
<thead>
<tr>
<th>Technology Type</th>
<th>Renewable Heat Capacity (GWh)</th>
<th>% Renewable Heat Capacity</th>
<th>Annual Output (GWh)</th>
<th>% Annual Output</th>
</tr>
</thead>
<tbody>
<tr>
<td>Biomass</td>
<td>1.030</td>
<td>61%</td>
<td>2,504</td>
<td>68%</td>
</tr>
<tr>
<td>Biomass CHP</td>
<td>0.401</td>
<td>24%</td>
<td>555</td>
<td>15%</td>
</tr>
<tr>
<td>Energy From Waste</td>
<td>0.079</td>
<td>5%</td>
<td>342</td>
<td>9%</td>
</tr>
<tr>
<td>Heat Pumps</td>
<td>0.147</td>
<td>9%</td>
<td>287</td>
<td>8%</td>
</tr>
<tr>
<td>Solar Thermal</td>
<td>0.036</td>
<td>2%</td>
<td>19</td>
<td>&lt;1%</td>
</tr>
<tr>
<td>Total</td>
<td>1.695</td>
<td>100%</td>
<td>3,705</td>
<td>100%</td>
</tr>
</tbody>
</table>

Source: EST

11. GWth refers to thermal capacity, whereas GWe would refer to electrical capacity.

* The renewable heat capacity and annual output figures in this table exclude information provided through the Combined Heat and Power Quality Assurance (CHPQA) scheme on CHP installations. Therefore the total renewable heat capacity and total annual output figures are lower than their headline values of 1.710 GW and 3,752 GWh respectively for 2016 quoted elsewhere in this publication and in EST’s ‘Renewable Heat in Scotland 2016’ report.
HEAT POLICY IN THE ENERGY STRATEGY AND SCOTLAND’S ENERGY EFFICIENCY PROGRAMME

The Scottish Government’s Heat Policy Statement set 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). This has been further supplemented and considered within the wider energy system in the Energy Strategy, published 20 December 2017.

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.

SEEP will be a co-ordinated programme to reduce the energy demand and decarbonise the heat of Scotland’s domestic and non-domestic buildings. In January 2017, the Scottish Government consulted on SEEP as part of the consultation on the draft Energy Strategy. Alongside this, in January 2017, the Scottish Government also carried out a high-level policy scoping consultation, followed by a more detailed Second Consultation on Local Heat & Energy Efficiency Strategies and Regulation of District and Communal Heating published in November 2017. The November consultation was open until 20 February 2018 and the consultation document is available at: http://www.gov.scot/Publications/2017/11/6232.

Gas Consumption

The most common heating fuel in Scotland is gas. According to BEIS’s sub-national consumption statistics, 59% of all gas consumed in Scotland is used domestically. The Scottish House Condition Survey estimates that in 2016 79% of Scottish households (around 1.9 million) used mains gas as their primary heating fuel. This is unchanged from 2015.

As shown in Figure 4.7, gas accounts for the majority (79%) of Scottish households’ primary heating fuels, electricity accounts for 11% and oil 6%. Communal heating (which includes district heating networks) and solid fuels cover most of the rest.

Estimates produced from the English Housing Survey in 2015 show that 87% of English households use gas and 8% use electricity, demonstrating Scotland’s higher dependency on electricity for heating.

Estimates published by BEIS indicate that at 20%, Scotland has a higher percentage of households in off gas grid areas than Great Britain as a whole (see page 84 for more information on off gas grid areas).

In 2016, domestic gas consumption per consumer in Scotland stood at 13.4 MWh (or 13,400 KWh), a 2% reduction from 13.7 MWh in 2015, continuing the decline in consumption over the last decade; during which domestic gas consumption per consumer has fallen by almost 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 4.8 shows that domestic gas consumption per consumer has decreased steadily in Scotland between 2006 and 2016 (-30% overall). There are a number of factors that may have contributed to this trend including rises in gas prices and improved energy efficiency in homes and boilers. Please see sections on energy efficiency in Chapter 2 and energy prices in Chapter 7 for more information.
Figure 4.9 below compares the average gas consumption per consumer in Scotland, Wales and the English regions in 2016.

**Figure 4.9: Average domestic gas consumption per consumer, regions and countries of GB, 2016**

As expected, other northern parts of the UK, such as 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. However, in 2016 consumption was highest in the South East for the second year running. Consumption in the South East rose in 2015, compared to year on year decreases in most other regions, including Scotland. Despite falling 2016 consumption in the South East remains higher than in Scotland.

Non-domestic gas consumption

Industrial and commercial gas consumption makes up 41% 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 2006. Domestic consumption has decreased by 20% between 2006 and 2016.

Over the same period, non-domestic gas consumption has reduced by 21%. The split of gas consumption between the domestic and non-domestic sectors remains similar to that seen in 2006.

Source: BEIS
DATA NOTE: ELECTRICITY USED FOR HEAT IN SCOTLAND

Estimates published by BEIS for the UK indicate that electricity used for heat accounts for a larger proportion of all heat demand in the industrial and commercial sectors; at 23% of industrial heat and 15% of commercial heat, compared to 9% of domestic heat. For more information, please see table 1.04 in ‘Energy Consumption in the UK’ published by BEIS:

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

Energy productivity expresses the gross value added achieved in the economy through the input of one unit of energy. 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 the amount of GVA produced per gigawatt hour of gas consumed. Figure 4.11 shows that in 2016, of all GB countries and regions, Scotland had the fifth lowest value for GVA produced per GWh of non-domestic gas consumption.

Figure 4.11: £million GVA per GWh of non-domestic gas consumption, regions and countries of GB, 2016

Yorkshire and the Humber, Wales, the North West, Scotland and the North East were the highest average non-domestic consumers in 2016, reflecting the mix of industry in these regions, and the greater use of gas for industrial purposes.

London and the South East are more service sector orientated and had the lowest mean non-domestic consumption in 2016. Between 2015 and 2016, seven regions saw a reduction in average consumption per non-domestic gas meter – greatest in the East, with a 10% reduction. This compares to a 1.6% reduction in Scotland. In four regions there was an increase, with the largest rise in Yorkshire and the Humber, an increase of 14%.

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:

Many areas in Scotland are off the gas grid\(^9\) (i.e. they don’t have a mains 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 consumer rather than per household, as the ‘per consumer’ figure gives a better indication of the amount used by a typical gas user.

There isn’t a definitive source of information on households that are off the gas grid. BEIS produces estimates of the number of households without gas based on the difference between the number of gas meters in each area and the number of households in each area. Using this method they estimate that in 2016 20% of households in Scotland were off the gas grid, compared to 14% in GB as a whole. Excluding Orkney, Shetland and Comhairle nan Eilean Siar (Western Isles), the local authorities with the highest proportions of off-grid properties are Highland (63%), Argyll & Bute (58%) and Aberdeenshire (43%). The Scottish House Condition Survey estimates the proportion of households that are off the gas grid by looking at the distance between properties in the survey sample and the nearest gas distribution network pipe. Using this method, it is estimated that in 2016 65% of rural households in Scotland were not connected to the gas grid compared with just 7% of urban households (and 17% for Scotland as a whole).

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


Xoserve, the company responsible for the collation and aggregation of gas consumption, produces a list of postcodes where they don’t have a record of either a domestic or non-domestic gas connection. BEIS use this information to determine whether properties accredited under the domestic Renewable Heat Incentive are on or off the gas grid.

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. The percentage of non-gas properties at LSOA level has been estimated using Ordnance Survey data and the location details of properties on the gas grid during 2013.

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. Properties covered by the SIUs do feature in BEIS’s sub-national gas consumption statistics. Therefore these areas are not considered to be off the gas grid.

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 classify all consumers using under such annual consumption as domestic consumers. Unfortunately, this classification incorrectly allocates many small businesses to the domestic sector (BEIS estimate around 2 million in Great Britain) 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.

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

SCOTLAND BY INTERMEDIATE GEOGRAPHY ZONE, 2016

Source: BEIS

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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 eight of the ten lowest consuming areas were within the City of Edinburgh local authority area.

Please see Annex D for more information regarding the source of this information and points to be aware of when using this analysis.
FIGURE 4.14: NON-DOMESTIC GAS CONSUMPTION - Average Consumption (kWh per meter)

SCOTLAND BY INTERMEDIATE GEOGRAPHY ZONE, 2016

Source: BEIS

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Ordnance Survey (OS Licence number 100024655).

Source: BEIS
<table>
<thead>
<tr>
<th>Zone Name</th>
<th>Local Authority</th>
<th>Average Consumption (kWh)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chapelton, Glengavel and Sandford</td>
<td>South Lanarkshire</td>
<td>91,605</td>
</tr>
<tr>
<td>Wick South</td>
<td>Highland</td>
<td>106,661</td>
</tr>
<tr>
<td>Thurso West</td>
<td>Highland</td>
<td>107,053</td>
</tr>
<tr>
<td>Whitecraigs and Broom</td>
<td>East Renfrewshire</td>
<td>107,985</td>
</tr>
<tr>
<td>Leslie and Newcastle</td>
<td>Fife</td>
<td>110,589</td>
</tr>
<tr>
<td>Wick North</td>
<td>Highland</td>
<td>111,937</td>
</tr>
<tr>
<td>Bonaly and The Pentlands</td>
<td>Edinburgh, City of</td>
<td>113,110</td>
</tr>
<tr>
<td>Kirkcaldy Bennochy West</td>
<td>Fife</td>
<td>119,411</td>
</tr>
<tr>
<td>Lenzie South</td>
<td>East Dunbartonshire</td>
<td>119,462</td>
</tr>
</tbody>
</table>

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.
UNUSED AND EXCESS HEAT

Many industrial processes and some commercial buildings generate heat as a by-product. This heat can be 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 recoverable and usable for 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.

We continue to encourage industry with surplus heat to provide data about potential off-site heat provision on a voluntary basis. In order to facilitate this, we are calling for further evidence from stakeholders on how data on surplus industrial heat could be made available to develop Local Heat and Energy Efficiency Strategies or a detailed district heating project in the ‘Second Consultation on Local Heat & Energy Efficiency Strategies, and Regulation of District and Communal Heating’, which was open until 20 February 2018. The consultation document is available at: [http://www.gov.scot/Publications/2017/11/6232](http://www.gov.scot/Publications/2017/11/6232)

Industry receives support from a number of partners such as Scottish Enterprise and Scottish Environment Protection Agency (SEPA) as set out in the Scottish Manufacturing Action Plan. For example, Resource Efficient Scotland are trialling Energy Measurement and Quantification support to assess energy flows and waste heat streams at industrial sites in Scotland to identify opportunities for heat recovery and reuse, both on site and for export off site. As outlined in the Energy Strategy, the Scottish Government will collaborate with key industrial sector representatives to overcome barriers to investment. This will include work to realise the decarbonisation, and revenue, potential presented by harnessing excess heat or by making better use of other process-by-products.

Additionally the Low Carbon Infrastructure Transition Programme has received applications on the use of recoverable heat. For example, the Dundee and Angus Residual Waste Combined Heat and Power Project was awarded £1,687,000 of capital support in 2017 through the Transformation Low Carbon Demonstrator. The aim of this project is to establish supply of medium pressure steam to the Michelin Tyre Plc. tyre factory in Dundee from a new Energy from Waste (EfW) plant to be built by MES. The EfW plant being procured by Dundee City and Angus Councils will be built on land adjacent to the Michelin site and the residual waste heat project has been championed through the procurement approach. The supply of steam will be delivered from an off-take on the steam turbine through a pipeline to be used directly in the Michelin steam network (principally for the vulcanisation of tyres). The impact of a direct steam supply will be to reduce the consumption of natural gas in the Michelin boilers by 84% leading to an estimated reduction of 7,450 tons CO₂e annually.
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 use 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 2016.

In 2016, 15% of heat generated from CHP in the UK was from Scottish installations, up slightly from 14% in 2014. Scotland accounts for around 1 in 16 CHP installations in the UK. Whilst the number of installations and heat generated by them have risen since 2014 in Scotland (despite a fall in heat generated in 2015), the UK as a whole has seen a decline in heat generated even though the number of schemes has increased. The 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 2016) is available here: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/647371/CHP_in_the_Regions_2016.pdf

There are 140 CHP schemes in Scotland, an increase of 2% since 2015. Following a reduction in 2015, electrical capacity has increased by around 1% to 528 MWe. Electricity generated has fallen by 6%.

In contrast heat generated from CHP has increased by 6%, to 6,104 GWh in 2016 (following a reduction in 2015). This is enough to heat the equivalent of 454,000 homes in Scotland (using the estimate for the average domestic gas consumption per household in Scotland).

Table 4.4: CHP statistics by installation size, Scotland, 2014-2016

<table>
<thead>
<tr>
<th></th>
<th>2014</th>
<th>2015</th>
<th>2016</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Scotland</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No. of schemes</td>
<td>135</td>
<td>137</td>
<td>140</td>
</tr>
<tr>
<td>Electrical capacity (MWe)</td>
<td>546</td>
<td>525</td>
<td>528</td>
</tr>
<tr>
<td>Electricity generated (GWh)</td>
<td>2,503</td>
<td>2,435</td>
<td>2,298</td>
</tr>
<tr>
<td>Heat generated (GWh)</td>
<td>5,893</td>
<td>5,760</td>
<td>6,104</td>
</tr>
<tr>
<td><strong>UK</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No. of schemes</td>
<td>2,076</td>
<td>2,139</td>
<td>2,182</td>
</tr>
<tr>
<td>Electrical capacity (MWe)</td>
<td>5,892</td>
<td>5,730</td>
<td>5,571</td>
</tr>
<tr>
<td>Electricity generated (GWh)</td>
<td>19,695</td>
<td>19,558</td>
<td>20,070</td>
</tr>
<tr>
<td>Heat generated (GWh)</td>
<td>41,957</td>
<td>40,261</td>
<td>40,423</td>
</tr>
</tbody>
</table>

Source: BEIS

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 heat 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 this is the first collection of national level data on heat networks and at this time only 32% of networks in Scotland have passed quality assurance by BEIS in terms of heat supplied, with the majority of those being domestic connections. We will continue to develop measurement of this ambition as more reliable data becomes available.

While new notifications continue to come in, these initial estimates suggest that there were 26,144 homes connected to district or communal heating networks in Scotland at the end of 2017; meaning that Scotland is just over two thirds (65%) of the way towards reaching 40,000 homes connected to heat networks; with an additional 13,856 domestic connections needed in the next 3 years in order to achieve this ambition by 2020. Until then, only new networks will be required to notify and so growth in network coverage will not be captured. 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.
About the Scotland 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, accounting for building characteristics or energy use. It 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.

The 2016 version of the Scotland Heat Map was released in 2017. It incorporated updated heat demand estimates and updated data on energy supply.

The heat map contains data from over 100 sources which are grouped into four main themes to support local and strategic planning decisions.

Some of the data sources are indicated in the illustration below. There are almost 3 million properties in the heat map, along with data on around 4,000 energy supply points.

In the example above N/E—northings/eastings, UPRN—unique property reference number,
Uses

The Scotland Heat Map is a tool which allows users to assess who needs heat (demand) and where sources of heat might come from (supply).

It visualises how supply and demand can be connected in an efficient way to reduce the cost of heat supply and the carbon intensity of heat generation. The heat map allows users to identify where there are opportunities for decentralised energy projects across Scotland. It is a vital tool for developing district heating networks and is promoted by organisations such as District Heating Scotland.

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 planning and policy development. It will be key in the delivery of Scotland’s Energy Efficiency Programme (SEEP) through the Scottish Government’s proposed statutory duty for local authorities to develop Local Heat and Energy Efficiency Strategies (LHEES), please see page 95 for more information. It can also be used to inform and support local investment proposals and help manage pipeline energy infrastructure projects.

DATA DEVELOPMENT

The Scotland Heat Map is a continually evolving resource. Updating the underlying data is a rolling programme of work, therefore not all of it is refreshed each time a new version of the map is released.

Over the coming year we will work with data providers and key users to refine and update the information contained in the Scotland Heat Map. There will be a particular emphasis on data that is most crucial to the preparation of Local Heat and Energy Efficiency Strategies (LHEES). This will include investigating potential new or improved sources of information required for LHEES. The LHEES pilots being undertaken by 12 local authorities in the next year and a half will inform this work.

Other datasets that could be included in the map to further enhance its value as a heat planning tool include more comprehensive and up-to-date information on district heat networks and indicators of sites where there may be potential to utilise excess waste heat from industrial processes.

Other data 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 is available). It contains data on existing and planned district heating networks, including layouts for a selection of them. Opportunities and constraints data (for example conservation areas) has also been included so heat can be considered in context.
The Scotland Heat Map estimates the annual heat demand, in kWh, of 2.9 million properties, both domestic and non-domestic, in Scotland. A range of sources are used and estimation is done in stages.

Confidence level 1 uses Ordnance Survey data to estimate floor area and two heat demand benchmarks, one for all domestic and one for all non-domestic properties. These lowest confidence level estimates are successively replaced with higher confidence estimates, where data is available, each level of which incorporates more information on property characteristics or energy use for heat.

Confidence levels 2 and 3 use data from the Scottish Assessors Association which includes information on property type, age and floor area. This allows the application of more specific benchmarks that account for factors which directly affect heat demand.

Confidence level 4 uses Energy Performance Certificate data giving a property specific estimate of the energy required for space and water heating, therefore no longer requiring generalised benchmarks.

Confidence level 5, the highest level, uses public sector energy billing data, which is only available for some public sector properties.


District Heat Networks Opportunities Analysis

The Scotland Heat Map can be used as a tool to identify opportunities for district heating networks. Along with the design of local programmes for energy efficiency improvement, identifying low regret opportunities for heat supply decarbonisation such as district heating networks will form a key part of Local Heat and Energy Efficiency Strategies (LHEES). In developing Scotland’s Energy Efficiency Programme (SEEP), the Scottish Government has carried out a high level policy scoping consultation on LHEES, and set out in a second more detailed consultation that it considers it would be appropriate to introduce a statutory duty for local authorities to develop LHEES. These would set a framework and delivery programme for how each local authority would both reduce the energy demand and decarbonise the heat supply of buildings in its area to ensure progress against the national objectives of SEEP.
To pilot the development of LHEES, 12 local authorities have been funded through the SEEP pathfinder fund to procure consultancy support and/or appoint dedicated local authority officers. Support has also been provided through existing national support programmes such as the Heat Network Partnership and through a dedicated Scottish Government officer to ensure wider collaboration and knowledge sharing between local authorities. This support builds upon previous work undertaken to encourage the use of Scotland’s Heat Map for strategic energy planning and to identify opportunities for district heating using tools available from

[Link to Scotland Heat Map data showing an operating heat network in Glasgow—Wyndford Estate.]

### Analysis of the Heat Map

#### Heat demand near major rivers

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 from water bodies and use it to heat nearby homes and businesses. With almost a quarter of domestic demand situated near Scotland’s major waterways, heat pumps have the potential to make an important contribution to decarbonising Scotland’s energy system.

The Scottish Government’s Low Carbon Infrastructure Transition Programme (LCITP) is providing capital support to two projects using large scale water source heat pumps.

The Gorbals Heat Pump Project, led by Star Renewable Energy, will install high efficiency water source heat pumps to draw water from the River Clyde and supply heat to a number of public buildings and four tower blocks in the New Gorbals area of Glasgow.

The Queens Quay and Clydebank District Heating Network, led by West Dunbartonshire Council, will also use water source heat pump technology in the River Clyde basin for a number of public and community buildings.

Additionally, LCITP is supporting the Stirling Renewable Heat Project which uses innovative wastewater heat recovery technology for a district heating network in the Springkerse area of the city.

Further information on these projects can be found at:

[Link to further information on LCITP projects.]

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Heat demand in the area of abandoned mineworkings

The heat map contains data on geothermal potential including the depth of abandoned mineworkings. The water in abandoned mines traps the natural heat of the earth. Heat pumps can be used to extract this heat, offering a low carbon and renewable source of heat for district heating networks. See the article below for more information on geothermal potential.

Analysis of the heat map indicates that 41% of domestic heat demand in Scotland lies within the 4,300km² area covered by abandoned mineworkings, accounting for 13,000 GWh of heat demand per year.

GEOTHERMAL ENERGY

What is Geothermal energy?

Geothermal energy is the natural heat that exists within our planet. There is geothermal potential in three 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).

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

The Scottish Government is making more than £3.8 million available towards the cost of installing a geothermal district heating system to serve the mixed use development at Kilmarnock Halo. £1.8 million has been made available from the Low Carbon Infrastructure Transition Programme and £2 million from the District Heating Loan Fund. This will be the first large scale deep geothermal district heating system in Scotland.

The Scottish Government is also working with UK stakeholders with an interest in undertaking geothermal research in Scotland. The Scottish Government is a member of the stakeholder group convened by the Natural Environment Research Council and the British Geological Survey to assist with the development of plans for a Glasgow Geothermal Energy Research Field Site as part of their UK Geoenergy Observatories Programme.
SCOTLAND HEAT MAP INTERACTIVE - REPORTING TOOL

Scotland Heat Map Interactive is the publicly accessible online version of the Heat Map available at: [www.gov.scot/heatmap](http://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. It was updated with the 2016 version of the Scotland Heat Map in November 2017, incorporating updated heat demand estimates and energy supply data.

An in-browser reporting tool allows users to interrogate the data within an internet browser. 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.

Scotland Heat Map—custom reporting tool:

**Accessing 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**


**Researchers or members of the public**

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, including some tables showing data for Scotland. The latest data, available for this report, is for uptake as at December 2017. See here:


With the exception of heat generated and paid for, all of the RHI data presented in this chapter comes directly from the December 2017 monthly RHI statistics publication. As many of the published tables do not give separate figures for Scotland, BEIS have in the past provided Scotland specific versions of selected tables to allow more detail on the RHI in Scotland to be included here. This additional information relates to uptake as at the end of the previous September. Unfortunately this year BEIS have only been able to supply data on heat generated and paid for under the two RHI schemes. Therefore, the following sections do not include information on new and legacy installations, monthly/quarterly uptake and non-domestic RHI installations by industrial classification. We hope to be able to reinstate this data in future versions of ‘Energy in Scotland’.

**Domestic RHI**

There is considerable difference in the uptake rates across Great Britain, with Scotland maintaining a greater uptake than expected from a pro-rata share.

- 19% of all GB applications (12,662 of 64,938)
- 20% of all GB accreditations (11,945 of 60,093)
In terms of the renewable heat technologies being accredited, Figure 4.16 shows that Air Source Heat Pumps (ASHP) are the single most popular technology, accounting for 50% of all domestic RHI accreditations in Scotland to date. Biomass also accounts for a large proportion, with 31% of all domestic accreditations in Scotland.

**Figure 4.16: Domestic RHI accreditations by technology, Scotland, as at December 2017**

- Air source heat pump: 50%
- Biomass systems: 31%
- Ground source heat pump: 10%
- Solar thermal: 9%

Source: BEIS

BEIS use data on off-gas grid postcodes to estimate the numbers of accreditations made from properties that are on and off the gas grid. In Scotland, 86% of accreditations are from properties in off-gas grid areas (see page 84 for more information on off-gas grid), compared to 72% for GB as a whole. Separate figures published by BEIS estimate that 20% of households in Scotland are in off-gas grid areas, compared to 14% 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) (89%)
- Biomass (89%)
- Ground Source Heat Pumps (GSHP) (88%)
- Solar thermal (63%)

The number of domestic RHI accreditations varies across Scotland, from just under 20 in West Dunbartonshire to more than 2,000 in Highland. Together the three local authority areas with the highest numbers—Highland, South Lanarkshire and Dumfries and Galloway—account for more than two fifths of all Scottish accreditations.

**Heat Generated**

The following information on heat generated and paid for is for uptake as of end September 2017, and comes from data supplied by BEIS for RHI activity in Scotland. As of end September 2017 around 477 GWh of heat had been paid for under the domestic RHI scheme in Scotland (23% of the GB total):

- 323 GWh of heat was generated by biomass systems (68% of the Scotland total)
- 108 GWh by air source heat pumps (23%)
- 41 GWh by ground source heat pumps (9%)
- and 4 GWh by solar thermal (1%).

**Domestic RHI Accredited Installations**

Top 3 local authorities in Scotland...
1. Highland 17%
2. South Lanarkshire 15%
3. Dumfries and Galloway 12%
Figure 4.17 shows that whilst 68% of heat generated to date is from biomass systems, they account for only 32% of installations to have received one or more payments. This is partly due to biomass systems typically having greater capacity and generating more heat than air or ground source heat pumps. However, the relative popularity of biomass in the first two years of the scheme also means that a large volume of biomass installations have been in payment for several years. 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 complementary heating technology not typically capable of producing heat in the volumes seen from the other technologies.

Biomass systems also account for the majority of heat generated under the domestic RHI in GB as a whole. However at 54% their share is lower than the two thirds (68%) of heat generated by biomass systems in Scotland. Ground and air source heat pumps generated around a third (31%) of heat paid for in Scotland, compared to more than two fifths (45%) in GB as a whole.

TWO THIRDS OF ALL DOMESTIC RHI HEAT GENERATED IN SCOTLAND COMES FROM BIOMASS SYSTEMS

BUT ONLY A THIRD OF INSTALLATIONS ARE BIOMASS SYSTEMS. ALMOST HALF (49%) OF ALL INSTALLATIONS ARE AIR SOURCE HEAT PUMPS.

DATA NOTE: RHI PAYMENTS

Payments are calculated using either estimates of annual heat demand as listed on the property’s Energy Performance Certificate (or in the case of solar thermal, from the estimated annual generation on the microgeneration certification scheme (MCS) certificate) 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.
THE RENEWABLE HEAT INCENTIVE: A REFORMED SCHEME


These reforms were intended to come into force in the spring of 2017. **Due to local and general elections held in 2017 the majority of these reforms did not come into force as originally planned. The intention is for the remainder of the reforms to come into force by summer 2018 but this may change depending on the legislative timetable.**

Main Features of Reforms

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

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

To achieve these aims the following reforms will be or already have been 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.

**Eligible Heat Uses:** BEIS published a response to their consultation on The Non-Domestic Renewable Heat Incentive – Chapter 2 – Eligible Heat uses on 29th January 2018. This notes the intention to remove wood fuel drying as an eligible heat use under the RHI scheme, unless replacing a fossil fuel source. See link for details: https://www.gov.uk/government/consultations/the-non-domestic-renewable-heat-incentive-further-proposed-amendments

BEIS intend to bring this change into force by the summer of 2018 depending on legislative timescales.
Non-Domestic RHI

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

- 19% of all GB applications (3,717 of 19,240) with 21% of the capacity (971 MW of 4,597 MW)
- 19% of all GB accredited installations (3,421 of 17,955) with 21% of the capacity (814 MW of 3,864 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 is in third place with 12%. Although Dumfries & Galloway accounts for the largest proportion of installations, Aberdeenshire accounts for the largest proportion of overall capacity in Scotland with 15%, followed by Highland at 14%. Dumfries and Galloway accounts for 11%.

“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

Heat Generated

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. The information in this section is for uptake as of end September 2017, using data supplied by BEIS for RHI activity in Scotland.
As at end of September 2017, installations on the non-domestic RHI scheme had provisionally generated 3,336 GWh of eligible heat in Scotland since November 2011, 19% of the GB total. Biomass boilers dominate heat generation with around 3,000 systems responsible for 82% of heat generated and paid for under the scheme, they account for 95% of all installations receiving payments. In GB as a whole 90% of installations receiving payments were biomass boilers and together they generated 75% of heat paid for.

*Figure 4.18: Heat generated, installed capacity and number of installations receiving payment by tariff, Scotland, November 2011 to September 2017*

Figure 4.18 shows the breakdown of heat generated, installed capacity and number of installations by technology. The ‘Other’ category includes a range of technology types (e.g. solar thermal, ground and air source heat pumps, biogas). However it is dominated by biomethane injected into the gas grid. This technology accounts for 16% (546 GWh) of the total heat generated under the non-domestic RHI scheme in Scotland since it was introduced in November 2011. In GB as a whole, biomethane injected into the gas grid accounts for 21% of non-domestic RHI heat generated since November 2011.

Source: BEIS
‘In 2016 biofuels had a 3.1% share of road fuels’
TRANSPORT

TRANSPORT—KEY FACTS

IN 2016, BIOFUELS HAD A...

3.1%

...SHARE OF ROAD FUELS IN THE UK.

THE TARGET IS 10% BY 2020

Latest data for Q3 2017 shows that biofuels made up 3.0% of all 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 2016, 75% reported travelling the previous day, down from 77% in 2015.

26.9 million air terminal passengers at airports in Scotland in 2016, up by 6% since 2015.

IN 2016, THE DISTANCE DRIVEN BY CARS IN SCOTLAND ON MAJOR ROADS WAS 35.4 BILLION KM.

THE EQUIVALENT OF DRIVING THE LENGTH OF BRITAIN AROUND 25 MILLION TIMES

“Latest data for Q3 2017 shows that biofuels made up 3.0% of all road fuels in the UK”

Of the 522 million public transport journeys made in 2016 in Scotland:

<table>
<thead>
<tr>
<th></th>
<th>2016</th>
<th>1991</th>
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<tbody>
<tr>
<td>Bus</td>
<td>75%</td>
<td>89%</td>
</tr>
<tr>
<td>Rail</td>
<td>18%</td>
<td>8%</td>
</tr>
<tr>
<td>Air</td>
<td>5%</td>
<td>1%</td>
</tr>
<tr>
<td>Ferry</td>
<td>2%</td>
<td>1%</td>
</tr>
</tbody>
</table>

The change in road and rail consumption between 2007-2015:

- ROAD: 5%
- RAIL: 1%
- TOTAL: 5%
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 2015 is similar to the overall UK level. With Petrol Cars accounting for 32% of fuel used per capita in Scotland and 33% in the UK, diesel cars accounting for 29% in both Scotland and UK, and heavy goods vehicles (HGV) accounting for 17 in both also.

Figure 5.3 shows that from 2005 to 2015, total personal transport fuel consumption fell by 5%, while over the same period freight consumption increased by 8%. Across the UK total fuel consumption for personal use reduced by 6%, while freight increased by 5% over the same period.
The Scottish Government has a 2020 target of 10% of transport fuels to be from renewables. Thus far, biofuels had a 3.1% share of road fuels in the UK as a whole in 2016, down from 3.2% in 2015 (data is not available separately for Scotland, so the UK proportion is assumed to apply to Scotland).

In 2016, 1,465 million litres of liquid biofuels were consumed in transport in the UK, the same as the 2015 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 2017, bioethanol accounted for 4.4% of motor spirit and Biodiesel 2.3% of diesel (DERV). The combined contribution was 3.0%, an decrease of 0.2 percentage points compared to Q3 2016.

Energy consumed by road and rail transport combined increased from 2005 to a peak in 2007. Consumption began to fall until 2014 when it rose 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 2015 was 5% for Scotland compared to 6% for the UK.

Energy consumed by rail transport decreased by 1% in Scotland and 5% in the UK, between 2007 and 2015. Over the same period, energy consumed by road transport has decreased by 5% in Scotland and 6% in the UK.
Transport Key Trends

Between 2011 and 2016, 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 5%, while the distance cycled is estimated to have increased by 15%.

There has been a fall in the number of bus passengers of 10%, whereas ferry, air and rail passengers have increased over this period, by 7%, 22% and 16% respectively.

The indexed graph in Figure 5.7 shows the longer-term changes since 2006.

There were 524 million public transport journeys made on bus, rail, air and ferry in 2016. 75% of all public transport journeys were made by bus and 18% by rail in 2016. Air travel accounted for 5% and ferries 2%. In the same year, 35.4 billion kilometres were travelled by car on major roads (M and A roads), the equivalent of driving the length of Britain around 25 million times.
Travelling by Road in Scotland

In 2016, there were 2.9 million vehicles licensed for use on the roads in Scotland of which 83% were cars. Over two thirds (69%) of the adult population (17+) held a full driving licence. 71% of households have access to two or more such vehicles for private use in 2016. 29% of households have access to two or more cars/vans.

Figure 5.9 shows vehicles licensed as at December 31st from 2004 – 2016 by method of propulsion. The number of taxed vehicles in Scotland has increased by 19% between 2004 and 2016. 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 14% between 2004 and 2016. The number of diesel vehicles has doubled in this time. There were only 25 hybrid electric vehicles and 342 electric vehicles in Scotland in 2002. Uptake has increased rapidly and in 2016 there were 14,170 and 7,225 respectively.

Figure 5.8 shows how often people in Scotland used different modes of transport in 2016.

Figure 5.8: Percentage of adults using each mode of travel at least once per week, Scotland, 2016

- 63% by car
- 69% by foot
- 6% by bicycle
- 28% by bus
- 9% by train

Source: Scottish Household Survey

Source: Transport Scotland
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: https://www.transport.gov.scot/our-approach/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.

The latest edition (no. 35; 2016) was published in February 2017 and covers the latest data available at the time of release. The next edition will be published in February 2018.

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 2016 edition, published in September 2017, Transport Scotland also included analysis of the Scottish Household Survey travel diary.

The next edition of Transport and Travel in Scotland is likely to be published in late summer 2018.

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:

Bus and Coach Travel

In the 2016-17 financial year, there were 393 million passenger journeys on local bus services in Scotland, a decrease over the previous year of 3.4%, as shown in Figure 5.10.

Figure 5.10: Passenger numbers: local bus, Scotland, 1975-2016

There has also been a longer term 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 396 million in 2016-17. There was a steady fall in numbers between 1960 and 1999.

Rail Services

There were 94.2 million ScotRail passenger journeys recorded in 2016-17, 1 million (1%) more than in the previous year and an increase of 64% since 2003/04.

Air Passengers

There were around 26.9 million air terminal passengers at airports in Scotland in 2016, an increase of 1.4 million (5.6%) on 2015 and 7% 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.
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 trips depends on how far we travel 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:


In 2016, 10.3 million passengers travelled by ferry, 5% less than the previous year. Of these, 8.3 million (83%) were carried on routes within Scotland, with the remainder carried on routes between Scotland and Northern Ireland and the EU.
In 2016, vehicle-km per head per year were 8,592 in Scotland which is 5% more than the GB average. However, Scotland had 54 vehicles for each 100 people of the population whereas GB had 58 vehicles. Scotland had a higher number of air passenger journeys per year at 5.0 journeys whereas the GB average was 4.1.

Scotland had 25% fewer rail journeys (per head) than the GB average in 2015 (latest statistics available). Scotland also had, on average, 73 bus journeys per head compared to the GB average of 77 journeys per head.

Travel to Work and School

Results from the Scottish Household Survey show that in 2016:

- two-thirds of commuters travelled to work by car or van
- 12% walked
- 10% went by bus
- 5% took a train
- 3% cycled.

There has been little change in modal choice since 2002. The Scottish Household Survey also reported that 52% of pupils walked to school in 2016, 19% 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 5.12: Travel and vehicle summary of Scotland and Great Britain (or UK), 2016

Compared to the GB average, Scotland has...

- fewer rail journeys per head
- fewer vehicles per head
- fewer bus journeys per head
- more road traffic per head
- more air travel per head

Source: Transport Scotland

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

In Scotland in 2016, 75% reported travelling the previous day, Down from 77% in 2015.

Usual mode of travel

<table>
<thead>
<tr>
<th>Work</th>
<th>School</th>
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<tbody>
<tr>
<td>67%</td>
<td>26%</td>
</tr>
<tr>
<td>12%</td>
<td>52%</td>
</tr>
<tr>
<td>10%</td>
<td>19%</td>
</tr>
<tr>
<td>5%</td>
<td>1%</td>
</tr>
<tr>
<td>3%</td>
<td>1%</td>
</tr>
</tbody>
</table>

Source: Scottish Household Survey
'In 2016, oil and gas production is estimated to have been worth £9.2 billion to the Scottish economy'
UKCS production of crude oil and NGLs in 2016 was 21% higher than in 2014.

Oil and gas production worth £9.2 BN to the Scottish economy, representing 5.8% of total Scottish GDP.

Up to 20 billion barrels of oil and gas still to be recovered from the UK Continental Shelf.

Scottish share of UK oil and gas production in 2015 international sales from the Scottish oil and gas supply chain have decreased by 7%.

95% of total sales revenue, 65% of operating expenditure, and 27% of capital expenditure between 2014 and 2016 in Scottish oil and gas.

‘UKCS production of crude oil and NGLs in 2016 was 21% higher than in 2014.’

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 focusing 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 118.

The North Sea is a mature basin that has made a substantial contribution to the Scottish and UK economies over the last 40 years, providing the HM Treasury with around £330 billion in tax receipts. The oil price fell sharply in the second half of 2014 following a period of stable prices above $100 per barrel. The low price persisted throughout 2015 and 2016; slashing the profitability of the sector which ensured a near-halt in fresh investment and widespread job losses. In the second half of 2017, the oil price began to somewhat increase, albeit remaining significantly below the heights of $100 per barrel, bringing confidence back to the industry with many now believing the downturn has bottomed out.

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

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 2016, the extraction of oil and gas is estimated to have been worth £9.2 billion to the Scottish economy, down from £15.2 billion in 2014. This is equivalent to 5.8% of total Scottish GDP (including a geographical share of UK Extra Regio activity) in that year.
Crude oil and natural gas liquids (NGLs) production in Scottish waters peaked in 1999 and then declined by roughly 8% year-on-year until 2014. Despite a substantial increase of over 20% since the trough of 2014, the level of production in 2016 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 2016 45% that of peak levels.

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 Oil & Gas Authority (OGA), the industry regulator, up to 20 billion barrels of oil and gas could still be recovered from the UKCS, which could sustain production for at least another 20 years.

**Oil & Gas Energy Balance for Scotland**

Following on from full energy balance on page 25, 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 93% in 2016. Approximately 83% of all primary oil and gas energy in Scotland is exported.

**Figure 6.2: Oil and gas flow chart, Scotland, 2016 (thousand tonnes of oil equivalent)**

**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**

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 has 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:


In 2016, Scotland is estimated to have produced 45.2 million tonnes of oil equivalent (mtoe) of crude oil and natural gas liquids (NGLs). This figure accounted for 95% of total UK crude oil and NGLs production and represents a significant increase of more than 20% on 2014 levels. Figure 6.4 shows that historically over 90% of UK oil and NGLs production has occurred in Scottish waters, with this share having increased slightly over time.

Scotland is estimated to have produced 25.9 mtoe of natural gas in 2016, accounting for 65% of total UK gas production—the highest share it has been this century. This is largely due to large gas developments such as Laggan-Tormore in the West of Shetland region coming online, complemented by the slow decline of the Southern Gas Basin.

Figure 6.4 shows that in 2016 oil and gas production in Scottish adjacent waters accounted for 82% of total UK hydrocarbon production.

Figure 6.4: Scottish share of UK oil and gas production, 1999-2016

Table 6.1: Scotland Oil and Gas Production (mtoe), 2006-2016

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</tr>
</thead>
<tbody>
<tr>
<td>OIL/NGL PRODUCTION</td>
<td>71.6</td>
<td>72.8</td>
<td>68.3</td>
<td>65.0</td>
<td>60.1</td>
<td>49.0</td>
<td>41.8</td>
<td>38.1</td>
<td>37.5</td>
<td>43.1</td>
<td>45.2</td>
</tr>
<tr>
<td>SCOTLAND AS A % OF UK</td>
<td>93%</td>
<td>95%</td>
<td>95%</td>
<td>95%</td>
<td>95%</td>
<td>94%</td>
<td>94%</td>
<td>94%</td>
<td>94%</td>
<td>95%</td>
<td>95%</td>
</tr>
<tr>
<td>GAS PRODUCTION</td>
<td>48.7</td>
<td>43.1</td>
<td>41.3</td>
<td>35.7</td>
<td>33.3</td>
<td>24.5</td>
<td>18.2</td>
<td>18.1</td>
<td>19.0</td>
<td>22.3</td>
<td>25.9</td>
</tr>
<tr>
<td>SCOTLAND AS A % OF UK</td>
<td>61%</td>
<td>60%</td>
<td>59%</td>
<td>61%</td>
<td>60%</td>
<td>56%</td>
<td>49%</td>
<td>51%</td>
<td>53%</td>
<td>58%</td>
<td>65%</td>
</tr>
</tbody>
</table>

Source: SNAP, Scottish Government

Table 6.1 provides estimates for the volume of oil and gas production in Scotland over the past ten years.

The statistics show that production has been on a downward trend over this period, but in 2016, production of crude oil and NGLs was 21% higher than in 2014.
Scotland is estimated to be the largest oil producer and second largest gas producer in the EU.

In 2017, following years of significant capital investment, new fields brought on stream boosted production levels. In June 2017, EnQuest announced that the Kraken oil field had started production. In total, there were 11 new field start-ups in 2017 including Total’s Glenlivet and Edradour gas fields located west of Shetland, which commenced production in August 2017.

Furthermore, two projects, Lancaster and Captain Enhanced Oil Recovery, reached Final Investment Decision (FID) in 2017. Hurricane’s Lancaster is predicted to come on stream in 2019, bringing 600 million barrels of oil equivalent (boe) to the UK’s production profile. This will be the largest field to come onstream on the UKCS since Buzzard in 2007.

‘UKCS production of crude oil and NGLs in 2016 was 21% higher than in 2014’

Into 2018, Wood Mackenzie, a global energy consultancy, predict that production will be at the highest level since 2010, directly as a result of recent start-ups. The number of FIDs sanctioned will also see a sizeable increase, with as many as 14 expected.

Approximate Sales Income and Costs

Sales of oil and gas produced in Scotland are estimated to have been worth £15.4 billion in 2016, 87% of the UK total. This represents a year-on-year decrease of £600 million (or 4%). Emerging data from quarter one 2017 indicates that sales volumes are in fact up 15.2% compared to the same period in 2016. The increase in the wholesale price of oil across this period and small increases in production are the key drivers behind this rise. 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 begun to fall considerably since peaking in 2011. Again, this broadly reflects the general increase, and subsequent decrease, in wholesale prices over this period.

Figure 6.5: Oil and Gas Approximate Sales Income, Operating Costs and Capital Costs, Scotland, 1999-2016

Source: SNAP, Scottish Government
According to the industry body Oil and Gas UK (OGUK), in 2016 capital investment on the UK Continental Shelf fell 28% from £11.6 billion to £8.3 billion. Wood Mackenzie forecast that capital investment will continue to fall over the coming years. Furthermore, they predict that by 2021 decommissioning expenditure will surpass development expenditure across the UKCS marking a new phase in the basin’s lifecycle.

To remain competitive in a low price environment, the industry needed to reduce operating costs. In 2016, operating costs fell 27% to £5.7 billion from a high of £7.7 billion in 2014. Figure 6.6 highlights that unit operating costs halved since 2014, down to $15 per barrel of oil equivalent (boe) in 2016. Efficiency improvements, the increase in production and the depreciation of the pound against the dollar have driven this reduction. Going forward, Wood Mackenzie believe that 55% of unit operating cost reductions can be sustained by 2020.

**Figure 6.6: UK continental shelf unit operating costs, 2013-2017**

![Graph showing unit operating costs from 2013 to 2017.](source: Oil and Gas UK)

**Remaining Reserves**

To date, a total of 43.5 billion boe has been extracted from the UK and UKCS. The OGA estimates that between 10 and 20 billion recoverable boe of oil and gas remain on the UKCS. This encompasses proven, probable, undeveloped and undiscovered reserves. Replacement of proven and probable reserves remains a concern though. In 2016 approximately 600 million boe were produced but only 80 million boe of contingent resources were matured to reserves. This indicates a reserve replacement ratio of 13%, representing in an underlying decline of proved resources.
Exploration

Offshore exploration and appraisal (E&A) activity remains near all-time lows, with 23 E&A wells drilled in 2017, an increase of one from its record low in 2016. This represents a significant challenge as continued low exploration levels will lead to diminished future production profile.

Overall offshore drilling, which includes E&A and development wells, fell by 14% in 2017 from levels a year earlier, dropping below 100 for the first time since 1973 and compares to 275 wells drilled ten years ago.

While the well count remains low, the volumes discovered are estimated to have topped 300 million boe for the second consecutive year in 2017, however the discoveries represent challenging potential developments. Looking forward, Wood Mackenzie expects the number of exploration wells to remain similar across 2018, with the west of Shetland region expected to be busy.

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.

In fact, the average number of oil rigs in the UKCS in 2017 Q3 is 22% higher than over the same period in 2016. This uptick in activity may suggest that confidence is slowly returning to the sector.

“For the fourth year in a row, international sales accounted for over 50% of total Scottish supply chain sales”
Supply Chain Exports and International Activity

The Scottish oil and gas supply chain continued to be a major exporter throughout 2015 despite a tough economic climate. According to the latest data published by Scottish Enterprise, an economic and business development agency, total international sales decreased by 7% on 2014 levels, dropping to £11.4 billion pounds in 2015.

Overseas subsidiary sales represented 64% of these international sales, with direct exports making up the rest.

Total sales in 2015 amounted to £22.4 billion, a decrease of 2% compared to 2014 levels. For the fourth year in a row, international sales accounted for over 50% of total Scottish supply chain sales, highlighting the deepening access of Scottish firms to global markets. Going forward, supporting international market growth will become an integral component to realise the OGA’s Vision 2035 blueprint, which looks to unlock a further £290 billion of value for the UK economy by 2035.

Table 6.2: International sales from Scottish oil and gas supply chain (Em, current prices), 2011 - 2015

<table>
<thead>
<tr>
<th>Emillion</th>
<th>2011</th>
<th>2012</th>
<th>2013</th>
<th>2014</th>
<th>2015</th>
</tr>
</thead>
<tbody>
<tr>
<td>DIRECT EXPORTS</td>
<td>2,409</td>
<td>3,700</td>
<td>4,200</td>
<td>4,500</td>
<td>4,100</td>
</tr>
<tr>
<td>OVERSEAS SUBSIDIARY SALES</td>
<td>5,787</td>
<td>6,300</td>
<td>7,000</td>
<td>7,700</td>
<td>7,300</td>
</tr>
<tr>
<td>TOTAL INTERNATIONAL SALES</td>
<td>8,195</td>
<td>10,000</td>
<td>11,200</td>
<td>12,200</td>
<td>11,400</td>
</tr>
</tbody>
</table>

Source: Scottish Enterprise
In total, respondents to the latest survey reported operating across 130 countries – an increase of 15. North America was the top international destination in 2015, with the United States specifically being the largest market. Looking to the future, Norway was identified as being the top growth destination for the immediate future and at a regional level the Middle East was selected.

**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 2016, the total value of crude oil, NGL and gas exports is estimated to be £13.3 billion, including sales to the rest of UK (RUK) which are subsequently exported to the rest of the world (ROW). The value of exports has decreased in recent years due to the lower oil and gas prices experienced since 2014.

The Scottish Government has been developing new statistics for offshore trade and the supply chain links between the offshore and onshore economies. A paper setting out the methods used to produce these new experimental statistics and providing provisional results has been published as part of Scottish National Accounts Programme (SNAP). Further information on these statistics and their development can be found at [http://www.gov.scot/Topics/Statistics/Browse/Economy/oilgas](http://www.gov.scot/Topics/Statistics/Browse/Economy/oilgas)

<table>
<thead>
<tr>
<th>Year</th>
<th>Direct</th>
<th>Indirect</th>
<th>Induced</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>2013</td>
<td>36,600</td>
<td>198,100</td>
<td>206,200</td>
<td>440,900</td>
</tr>
<tr>
<td>2014</td>
<td>41,300</td>
<td>206,100</td>
<td>216,500</td>
<td>463,900</td>
</tr>
<tr>
<td>2015</td>
<td>37,300</td>
<td>163,100</td>
<td>173,400</td>
<td>373,800</td>
</tr>
<tr>
<td>2016</td>
<td>29,500</td>
<td>150,600</td>
<td>135,300</td>
<td>315,400</td>
</tr>
<tr>
<td>2017</td>
<td>28,300</td>
<td>141,900</td>
<td>132,000</td>
<td>302,200</td>
</tr>
</tbody>
</table>

Source: Oil Gas UK

**Employment**

The oil and gas industry remains the major industrial employer in Scotland. Nevertheless, the fall in oil price has severely impacted employment levels.

OGUK have estimated that the industry across the UK supports 302,000 jobs either directly, indirectly or induced. This represents a 35% fall from employment levels when oil prices were much higher in 2014. 115,000 of all supported jobs are estimated to be based in Scotland, 38% of the total. The deceleration of jobs losses in 2017, at 4.2% compared with 15.6% a year earlier, suggests that the largest reductions to the workforce may now be behind us.
While not specific to the oil and gas industry, Figure 6.9 below highlights the increase in the Claimant Count Rate in Aberdeen City and Aberdeenshire over the previous three years since the beginning of the downturn in the oil and gas industry. The claimant count has also increased in Moray, Orkney and Shetland.

**Figure 6.9 Claimant Count Rate (as proportion of residents aged 16-64) in Aberdeen City, Aberdeenshire and Scotland**

While employment indicators have historically been stronger in Aberdeen City and Aberdeenshire than for Scotland as whole, they have weakened significantly since the downturn, resulting in Aberdeen City now having a similar employment rate to the Scottish average. For instance, the number of job seeker claimants in Aberdeen City and Aberdeenshire over a 3 year period since August 2014 has increased by 83% and 100% respectively.

**Coal Production**

UK coal production dramatically fell by more than half in 2016. Largely due to the closure of Longannet, coal production in Scotland fell by 40% to 0.8 million tonnes in 2016. Since 2014 this represents a total decrease of 68%. Despite a large decrease in indigenous Scottish production, the rate of deceleration was more pronounced in England however, resulting in Scotland’s share of total UK production increasing from 15% to 19%.

**Figure 6.10 : UK coal production, Scotland and Rest of UK, 2008-2016**

Source: DUKES, BEIS
Decommissioning

Decommissioning of oil and gas infrastructure, such as offshore platforms and pipelines, represents the final stage of an asset’s lifecycle on the UKCS. As the basin now enters maturity, decommissioning will become increasingly widespread as the industry looks to bring infrastructure ashore in a cost-effective and environmentally sound manner. The prospect of decommissioning represents a significant growth opportunity for both offshore and onshore supply chains. OGUK estimate that 840,400 tonnes will be brought ashore from offshore installations between 2017 and 2025 representing £17 billion worth of expenditure across the UKCS. The central North Sea represents the biggest concentration of this spend at £7.9 billion (46%).

Shale Production

In September 2017, it was announced by the Minister for Business, Energy and Innovation Paul Wheelhouse that the Scottish Government will not support the development of Unconventional Oil and Gas in Scotland, meaning there is an effective ban on fracking across Scotland. This decision was taken after an extensive period of evidence gathering, public engagement and dialogue on the issue. This included a four-month public consultation which received over 60,000 responses, of which over 99% were opposed to fracking.
'Wholesale costs accounted for 38% of the average domestic dual fuel energy bill in 2016'
The proportion of a dual fuel bill attributed to wholesale costs fell by 5 percentage points between 2015 and 2016. Over the same period, supplier profit margins increased by just over 0.5 percentage points.

**WHAT MAKES UP A DOMESTIC GAS AND ELECTRICITY BILL?**

<table>
<thead>
<tr>
<th>Component</th>
<th>2014</th>
<th>2015</th>
<th>2016</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wholesale costs</td>
<td>25%</td>
<td>24%</td>
<td>23%</td>
</tr>
<tr>
<td>Network costs</td>
<td>35%</td>
<td>34%</td>
<td>33%</td>
</tr>
<tr>
<td>Supplier costs</td>
<td>15%</td>
<td>14%</td>
<td>13%</td>
</tr>
<tr>
<td>Env &amp; Soc costs</td>
<td>5%</td>
<td>5%</td>
<td>5%</td>
</tr>
<tr>
<td>Supplier margin</td>
<td>15%</td>
<td>16%</td>
<td>17%</td>
</tr>
<tr>
<td>VAT</td>
<td>5%</td>
<td>5%</td>
<td>5%</td>
</tr>
</tbody>
</table>

**CHANGE IN AVERAGE DIRECT DEBIT BILLS IN SCOTLAND (2004 - 2017)**

- Gas: +81%
- Electricity: +52%

**“In 2017, electricity consumers in the North of Scotland paid 7 - 9% more than the GB average.”**

649,000 households of households in Scotland were fuel poor in 2016.

For households near fuel poverty threshold...

- £100 in fuel costs requires
- £1,000 in income to mitigate
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 and 2016. In 2017, domestic gas bills for all payment methods and prepayment electricity bills continued to fall, whereas electricity bills for direct debit and standard credit payment rose slightly.

“In 2017, domestic gas bills for all payment methods and prepayment electricity bills continued to fall, whereas electricity bills for direct debit and standard credit payment rose slightly.”

**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 2017, average standard credit and direct debit bills increased by 4% and 2% respectively, while average prepayment bills decreased by almost 2%. The average annual direct debit domestic electricity bill in Scotland rose in real terms by 52% between 2004 and 2017, as shown in Figure 7.2.

**Gas:** average annual domestic gas bills rose by approximately 25% for all payment methods between 2010 and 2014, before falling by 16% for standard credit, 19% for direct debit and 22% for prepayment meters between 2014 and 2017. The average annual direct debit domestic gas bill in Scotland increased in real terms by approximately 81% between 2004 and 2017, as shown in Figure 7.1.

---

**Figure 7.1: Average annual domestic standard gas bills for GB countries (2010 £), 1998-2017**

**Figure 7.2: Average annual domestic standard electricity bills for GB countries (2010 £), 1998-2017**

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**Source: BEIS**
Average domestic energy bills for 2017 are shown in Table 7.1. Note that, unlike in Figures 7.1 and 7.2, these costs are not adjusted for inflation. For all 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 between 5 - 10% more than customers in England and Wales.

Table 7.1: Average annual domestic energy bills for GB countries for 2017 (£ cash terms)

<table>
<thead>
<tr>
<th></th>
<th>Standard Credit</th>
<th>Direct Debit</th>
<th>Prepayment</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Eng &amp; Wal</td>
<td>Scotland</td>
<td>Eng &amp; Wal</td>
</tr>
<tr>
<td>Gas</td>
<td>£694</td>
<td>£689</td>
<td>£609</td>
</tr>
<tr>
<td>Standard Electricity</td>
<td>£675</td>
<td>£677</td>
<td>£600</td>
</tr>
<tr>
<td>Economy 7 Electricity</td>
<td>£915</td>
<td>£968</td>
<td>£813</td>
</tr>
</tbody>
</table>

Table 7.2: Average unit cost for domestic standard electricity, Scotland & UK, 2017

<table>
<thead>
<tr>
<th>Average unit cost (p/kWh)</th>
<th>Standard Credit</th>
<th>Direct Debit</th>
<th>Prepayment</th>
</tr>
</thead>
<tbody>
<tr>
<td>North Scotland</td>
<td>19.00</td>
<td>17.13</td>
<td>17.72</td>
</tr>
<tr>
<td>South Scotland</td>
<td>17.40</td>
<td>15.50</td>
<td>16.13</td>
</tr>
<tr>
<td>UK</td>
<td>17.68</td>
<td>15.76</td>
<td>16.20</td>
</tr>
</tbody>
</table>

Table 7.3: Average unit cost for domestic standard gas, Scotland & GB, 2017

<table>
<thead>
<tr>
<th>Average unit cost (p/kWh)</th>
<th>Standard Credit</th>
<th>Direct Debit</th>
<th>Prepayment</th>
</tr>
</thead>
<tbody>
<tr>
<td>North Scotland</td>
<td>4.60</td>
<td>4.07</td>
<td>4.21</td>
</tr>
<tr>
<td>South Scotland</td>
<td>4.59</td>
<td>4.03</td>
<td>4.22</td>
</tr>
<tr>
<td>GB</td>
<td>4.63</td>
<td>4.06</td>
<td>4.23</td>
</tr>
</tbody>
</table>

“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 2017, electricity consumers in the North of Scotland paid 7% to 9% more than the UK average per kilowatt hour under each payment method.

Between 2016 and 2017, the average unit cost for domestic standard electricity in the North of Scotland for standard credit and direct debit increased by 7%, whereas the average unit cost for prepayment methods in this region fell by 1%.

“In 2017, electricity consumers in the North of Scotland paid 7 - 9% more than the GB average.”
What makes up a domestic gas and electricity bill?

Ofgem analysis demonstrates that wholesale costs accounted for 38% of the average domestic dual fuel energy bill in 2016, network costs accounted for 26%, supplier costs for 18% and environmental and social costs accounted for 8%. VAT is set at 5%, while the estimated pre-tax margin to suppliers accounted for 5% of a bill.

The proportion of a dual fuel bill attributed to wholesale costs fell by 5 percentage points between 2015 and 2016. The proportion of environmental and social obligation costs increased by one percentage point, while network costs and supplier costs increased by two percentage points each. Finally, supplier profit margins increased by just half of a percentage point in the same period.

Payment Method for Household Energy Bills

In 2017, 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 21% 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.
These variations are of particular interest within Scotland, as both the North and South of Scotland (both 17%) have a higher proportion of consumers prepaying for standard electricity than in Great Britain as a whole (14%). The North and South of Scotland (both 61%) also have a slightly lower proportion of consumers paying by direct debit than the GB average (62%). 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).

The payment method shares of domestic gas consumption in Scotland were similar to those in the electricity market (see Figure 7.6) in 2017, with a slightly lower proportion of consumers on prepayment meters. Since 2016, the proportion of consumers from all regions paying by direct debit increased by at least 2 percentage points, and the proportion on standard credit and prepayment meters decreased. The proportion of consumers prepaying in both the South of Scotland (16%) and the North of Scotland (16%) was higher than the GB level (13%) in 2017.

**Home Suppliers**

Electricity consumers in Scotland are still more likely to choose their home supplier than the GB average (home suppliers are the 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, 73% of standard credit customers used their home electricity supplier, compared to 43% across GB in 2017. In addition, 70% of North of Scotland prepayment customers used their home supplier compared to only 38% across Great Britain (see Table 7.4).

**Table 7.4: Proportion of home suppliers for standard electricity by payment type, June 2017**

<table>
<thead>
<tr>
<th></th>
<th>Standard Credit</th>
<th>Direct Debit</th>
<th>Prepayment</th>
<th>All Types</th>
</tr>
</thead>
<tbody>
<tr>
<td>North Scotland</td>
<td>73</td>
<td>59</td>
<td>70</td>
<td>58</td>
</tr>
<tr>
<td>South Scotland</td>
<td>45</td>
<td>32</td>
<td>52</td>
<td>33</td>
</tr>
<tr>
<td>GB</td>
<td>43</td>
<td>30</td>
<td>38</td>
<td>26</td>
</tr>
</tbody>
</table>

Source: BEIS
Domestic electricity prices, including taxes and levies, for UK medium customers increased by 22% between the second half of 2010 and the first half of 2017 (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 2017, UK medium consumers were paying an average of only 9% less than the EU 15 median for electricity.

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 2017 were the second lowest in the EU15 and were 28% 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 6% lower than in the same period in 2016, whereas the EU15 median price rose by 8%. The UK price excluding taxes was the fourth lowest among the EU15 and 8% lower than the EU 15 median.
The North of Scotland has a lower proportion of customers using their home supplier for domestic gas, across all payment methods than in the South of Scotland and Great Britain as a whole (see Table 7.5). A slightly higher proportion of all customers in the South of Scotland than of all British customers use their home supplier.

<table>
<thead>
<tr>
<th></th>
<th>Standard Credit</th>
<th>Direct Debit</th>
<th>Prepayment</th>
<th>All Types</th>
</tr>
</thead>
<tbody>
<tr>
<td>North Scotland</td>
<td>40</td>
<td>30</td>
<td>33</td>
<td>30</td>
</tr>
<tr>
<td>South Scotland</td>
<td>52</td>
<td>34</td>
<td>43</td>
<td>34</td>
</tr>
<tr>
<td>GB</td>
<td>51</td>
<td>35</td>
<td>48</td>
<td>33</td>
</tr>
</tbody>
</table>

How have domestic bills changed?

Between 2004 and 2017, after adjusting for inflation, the average annual domestic gas and electricity bill for direct debits—the most common payment method—in Scotland increased by 81% and 52% respectively.

Indeed, average annual domestic gas and electricity direct debit bills rose by 123% and 50% respectively between 2004 and 2014 before increasing by 2% and decreasing by 19% from their respective 2014 levels between 2014 and 2017.

2017 figures for domestic gas bills in Scotland show that the average standard credit bill decreased by £24, the average direct debit decreased by £22 and the average prepayment bill fell by £79, compared to 2016. Provisional domestic electricity bill figures for Scotland in 2017 show the average standard credit bill rose by £29, the average direct debit bill increased by £27 and the average prepayment bill fell by £10.

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 14% more for gas than those using direct debit payments. Consumers using prepayment face 4% higher bills for electricity and 5% higher bills for gas than those using direct debit payments.
These figures rely on standardised consumption data to allow for comparison between regions, between 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 are 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, 2016**

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 18 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. The North of Scotland typically has domestic electricity consumption markedly higher than in the South of Scotland, with 10 out of 11 areas in the North of Scotland having higher consumption than the GB average. In addition, customers in the North of Scotland pay higher average unit electricity prices across all payment methods. Given higher consumption and higher prices, it is 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. This is calculated by dividing the total domestic consumption by the number of household meters. 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 2016, 38% higher than the GB average.

**Figure 7.9: Average annual household consumption of gas, Scotland, 2016**

Oil Prices

Figure 7.10 plots monthly oil prices from December 2000 to December 2017. 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. During 2017 prices remained low, falling to $46 in July before increasing to $64 in December.

**Figure 7.10: Crude Oil Price (not adjusted for inflation), Dec 2000 - Dec 2017**

Source: BEIS

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 2017 was the fifth lowest in the EU15 and was 9.5% below the EU15 median price. However, average domestic electricity prices excluding taxes in the UK were the fifth highest in the EU15 (see Figure 7.11).

The average domestic electricity price including taxes for medium consumers in the UK remained constant between 2016 and 2017, whereas GBP prices for the rest of the EU15 rose by an average of 10% over the same period. A fall in the average GBP-EUR exchange rate over the period of around 5% partially explains this variation.

Electricity price components for medium consumers

The total of electricity price components (including network costs, supplier margin, and environmental and social costs) in the UK for medium consumers were the fifth lowest in the EU15 for the period July to December 2016.

The energy and supply costs alone in the UK were 25% higher than the EU15 average during the period. Network costs for UK medium consumers were the third lowest among the EU15, while taxes and levies were the lowest. Overall, electricity prices for medium domestic consumers in the UK were below the EU15 median in 2016.
The EU15 median and UK domestic gas prices including taxes both fluctuated between 5 and 7 cents per kilowatt hour between 2011 and 2017. Domestic gas prices for UK medium consumers decreased by 10% over the same time period, while the EU15 median gas price increased by 11%.

During this period, prices were on average 13% lower in the UK than the EU 15 median. 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 1% more.

**Figure 7.14:** Average domestic gas prices for medium consumers in the EU15, January to June 2017

**Source:** BEIS

**Figure 7.15:** Domestic gas prices for medium consumers for the UK and the EU15 from 2011 to 2017, half-yearly price

**Source:** Eurostat
Electricity prices including taxes and levies for large UK industrial consumers increased by 37% between the second half of 2011 and the first half of 2017 (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 62% of it in the first half of 2017.

Average industrial gas prices

Average industrial gas prices for the period January to June 2017, including taxes, in the UK for medium consumers were the second lowest in the EU15 and were 23% below the EU15 median price (see Figure 7.19).

The average industrial gas price including taxes in the UK for medium consumers fell by 6% on the same period in 2016 while the EU median rose by 7%.
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 23% lower than the EU15 median gas price. Figure 7.20 shows that gas prices paid by UK large industrial consumers were the lowest in the EU15 in the period from January to June 2017.
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 2017 were the third highest in the EU15 and were 37% above the EU15 median (see Figure 7.16). The tax component was 2.22p per kWh in the UK during this period, the fifth highest among the EU15.

The average industrial electricity price including taxes in the UK and the EU15 for medium consumers increased by 5% and 8% respectively from the same period in 2016.

Figure 7.16: Average industrial electricity prices for medium consumers in the EU15, January to June 2017

Electricity price components for large industrial consumers

Electricity costs for UK industry have been consistently high relative to the EU15 median. Figure 7.17 shows that in the latter half of 2016, UK electricity prices including taxes for large industrial consumers of electricity (those consuming 20,000-70,000 MWh per year) were the third highest in the EU15. Electricity prices for large industrial consumers in the UK were 57% higher than the EU15 median.
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 over the following three years before rising slightly in the first half of 2017.

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. However, in the first half of 2016 it rose back to 11% and has continued to increase to 27% in the first half of 2017.

*Figure 7.21: Industrial gas prices for large industrial consumers for the EU15 median and the UK, 2010 to 2017, half-yearly price*

*Source: Eurostat*
Fuel Poverty

Fuel poverty is the inability to heat a home to an acceptable standard at a reasonable cost. Under the current definition of fuel poverty 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 2016 fuel poverty declined by about 4 percentage points, equivalent to around 99,000 fewer fuel poor households compared to 2015. 26.5% (or around 649,000 households) were fuel poor and 7.5% (or around 183,000 households) were living in extreme fuel poverty in 2016.

The fuel poverty rate in 2016 is the lowest rate recorded by the survey since 2005/06.

Households using gas as their primary heating fuel have benefited most (now 23% fuel poor, down from 27% in 2015), at least in part due to the falling gas prices.

Urban households have also gained disproportionately in the last year (now 24% fuel poor, down from 30% in 2015). Rural fuel poverty rates have remained similar to 2015 levels at 37% in 2016.

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 methods which underpin 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. A further small improvement was introduced for 2016 through the collection of information in the 2016 survey about pre-payment meters.

Figure 7.22 shows headline fuel poverty rates for Scotland up to 2016. Almost two thirds (2.7 percentage points) of the reduction in fuel poverty between 2015 and 2016 can be attributed to falling energy prices, around a third (1.5 percentage points) to improved energy efficiency of the housing stock, and the rest (0.1 points) can be explained by higher household incomes.

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.

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 (11%), and cooking (3%).
As Figure 7.24 illustrates, fuel prices have risen much faster than income, so that by 2016 fuel prices were over two and a half times (155%) their level in 2003/04, while median household income has risen by less than a half (38%). In the same period the proportion of dwellings rated A-D increased by 38%. 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.

While improved energy efficiency offers some protection against fuel poverty, it does not fully offset the effect of rising fuel prices. Table 7.8 shows that fuel poverty is higher for properties with a poor EPC band rating: in 2016, fuel poverty rates were 14% for dwellings rated A-C, 29% for D-rated dwellings, 42% for E-rated dwellings and 66% 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 (47%) of fuel poor households (or 307,000 households) have incomes above the relative poverty threshold, defined as £291 per week before housing costs for a couple without children.

**Table 7.8: Fuel poverty rates by EPC bands, 2015 and 2016**

<table>
<thead>
<tr>
<th>EPC Band</th>
<th>2016</th>
<th></th>
<th>Base</th>
<th>2015</th>
<th></th>
<th>Base</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>000s</td>
<td>%</td>
<td></td>
<td>000s</td>
<td>%</td>
<td></td>
</tr>
<tr>
<td>B-C</td>
<td>137</td>
<td>14%</td>
<td>1,006</td>
<td>163</td>
<td>18%</td>
<td>923</td>
</tr>
<tr>
<td>D</td>
<td>313</td>
<td>29%</td>
<td>1,207</td>
<td>320</td>
<td>30%</td>
<td>1,161</td>
</tr>
<tr>
<td>E</td>
<td>133</td>
<td>42%</td>
<td>417</td>
<td>184</td>
<td>50%</td>
<td>452</td>
</tr>
<tr>
<td>F-G</td>
<td>66</td>
<td>66%</td>
<td>155</td>
<td>80</td>
<td>70%</td>
<td>161</td>
</tr>
<tr>
<td>All Scotland</td>
<td>649</td>
<td>26.5%</td>
<td>2,785</td>
<td>748</td>
<td>31%</td>
<td>2,697</td>
</tr>
</tbody>
</table>

Source: SHCS

**Figure 7.25: Fuel poor and income poor households, 2016**

Source: SHCS
‘Greenhouse gas emissions in Scotland have fallen by 37.6% since 1990’
GHG EMISSIONS IN SCOTLAND
-37.6%
SINCE 1990.
TARGETS:
-42% BY 2020
-80% BY 2050

CHANGE IN EMISSIONS SINCE 1990:
- SCOTLAND: 37.6%
- UK: 34.8%
- EU: 23.4%

IN 2015, GRID EMISSIONS IN SCOTLAND WERE...
150 gCO₂e/kWh
DOWN 23.4% SINCE 2014

EMISSIONS PER CAPITA IN 2015:
- SCOTLAND: 8.94 TONNES CO₂e
- UK: 8.28 TONNES CO₂e
- EU: 8.42 TONNES CO₂e

94% OF ENERGY SUPPLY EMISSIONS FROM PARTICIPANTS OF EU ETS

9.4 MILLION TONNES OF CARBON DIOXIDE...
...WERE DISPLACED BY SCOTLAND’S RENEWABLE ELECTRICITY IN 2016

SCOTLAND EMITTED 48.1 Mt CO₂e IN 2015. THIS IS EQUIVALENT TO THE EMISSIONS FROM OVER...

18 MILLION GAS BOILERS

Based on Scotland’s average domestic gas consumption per meter
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.

| 48.1 MtCO₂e in 2015 | 37.6% from 1990 | 3.0% from 2014 |

### 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.

| 45.504 MtCO₂e in 2015 | 41.0% from Baseline Period | 1.8% from 2014 |

The Climate Change (Scotland) Act 2009 provides for a fixed annual target for 2015 of 45.928 MtCO₂e 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 2015 a reduction of 41.0% has been achieved.

MtCO₂e refers to million tonnes of carbon dioxide equivalent. This is a consistent measure for assessing the contribution of greenhouse gases 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)](https://www.ipcc.ch). The inventory is also used to report data against targets as required under the [Climate Change (Scotland) Act 2009](https://www.legislation.gov.uk/ukpga/2009/41).
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, 2015. Values in MtCO₂e**

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 2015, the Energy Supply sector was the second largest source of greenhouse gas emissions in Scotland.

Note that it is also possible to present energy emissions on an end-user basis. Here emissions are allocated to the final point of energy consumption, such as emissions associated with electricity usage being allocated to residential homes and businesses. This approach also considers the emissions from exported electricity.


<table>
<thead>
<tr>
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<th></th>
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<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>TOTAL NET GREENHOUSE GAS EMISSIONS</td>
<td>77.0</td>
<td>49.5</td>
<td>48.1</td>
<td>-37.6%</td>
<td>-3.0%</td>
</tr>
<tr>
<td>ENERGY SUPPLY EMISSIONS</td>
<td>22.7</td>
<td>13.9</td>
<td>12.2</td>
<td>-46.4%</td>
<td>-12.0%</td>
</tr>
<tr>
<td>ELECTRICITY PRODUCTION</td>
<td>14.8</td>
<td>9.8</td>
<td>7.7</td>
<td>-47.7%</td>
<td>-21.4%</td>
</tr>
<tr>
<td>OTHER ENERGY SUPPLY</td>
<td>8.0</td>
<td>4.1</td>
<td>4.5</td>
<td>-43.8%</td>
<td>10.6%</td>
</tr>
</tbody>
</table>

Table 8.1 provides the headline statistics on net source greenhouse gas emissions for Scotland and for the energy supply sector. In all years, until 2015, energy supply was the main source of greenhouse gas emissions. Energy supply emissions have seen a fall recently. This is partly linked to the closure of a power station and a mothballing of another power station.
Scotland has reduced its greenhouse gas emissions (-37.6%) by a higher proportion than both the UK (-34.8%) and the EU 28 as a whole (-23.4%), between 1990 and 2015.

In 2015, Scotland’s greenhouse gas emissions per capita were slightly higher than for the UK and for the EU-28 as a whole. Scotland’s per capita emissions were lower than Wales (15.04 tonnes CO₂e) and Northern Ireland (11.45 tonnes CO₂e).

The Energy Supply sector saw the largest absolute decrease of any sector between 2014 and 2015 - a 1.7 MtCO₂e (12.0 per cent) decrease. The largest contributor to the reduction in energy supply emissions between 2014 and 2015 has been a decrease in the use of coal in the power generation sector. Overall reduction in the energy sector was offset somewhat by an increase in emissions from the combustion of fuel at refineries.
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 which they can trade (1 emissions allowance equals 1 tCO\textsubscript{2}e). 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 emissions allowances, 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 deliver Scotland’s Climate Change Targets by incentivising emissions reductions among participating Scottish organisations.

In 2015, there were 79 fixed Scottish installations which are regulated by Scottish Environment Protection Agency (SEPA) that surrendered emissions allowances 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. All emissions from some sectors, such as the residential sector, are non-traded whereas emissions from other sectors, such as energy supply and business and industrial process are a combination of traded and non-traded. From 2012 onwards, CO\textsubscript{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.

BEIS have updated their short-term traded carbon values for 2017 (see Figure 8.3) and the overall impact of the changes highlighted above is to decrease the values of the central scenario when compared to the 2016 short-term traded carbon values, but increase the values in the high scenario. The differences between the 2016 values and 2017 values are most significant under the high scenario. The changes to the high series as compared with 2016 are primarily driven by changes in the underling BAU (Business As Usual) emissions projections; and longer horizon and revised foresight window in the DCPM (DECC Carbon Price Model). 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 2 degrees centigrade above pre-industrial levels.

The Carbon Price Floor (CPF) came into effect on 1 April 2013.

It is made up of the price of CO₂ from the EU Emissions Trading System (EU ETS) and the Carbon Price Support rate per tCO₂ which is the UK-only additional tCO₂ emitted in the power sector.

The vast majority (94%) of emissions produced in the energy supply sector in 2015 occurred at installations which participate in the EU Emissions Trading System (EU ETS). 67.4% of all of Scotland’s EU ETS emissions in 2015 occurred within the energy supply sector.
Figure 8.4 shows data from the latest (1990-2015) 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.

**Figure 8.4: Percentage Reductions Targets - Based on Adjusted Emissions, Scotland, 1990 - 2050**

Using the 1990-2015 inventory:
- Baseline was 77.091 MtCO₂e
- 2015 was 44.504 MtCO₂e
- A 41% reduction

PERCENTAGE REDUCTION TARGETS
(from the Baseline, using the 1990-2015 inventory)

- 42% reduction by 2020
  (44.713 MtCO₂e)
- 80% reduction by 2050
  (15.418 MtCO₂e)

Source: Scottish Greenhouse Gas Inventory, 1990-2015

Figure 8.5 contains data from the latest (1990-2015) 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 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**

Using the 1990-2015 inventory, adjusted emissions fell by 41% between the Baseline and 2015.

The fixed annual Climate Change Targets are based on the 1990-2008 inventory.

The inventory has been revised upwards since then.

This means that the percentage reduction from the Baseline to meet the fixed annual target for 2015 has increased from 34.6% using the 1990-2008 Inventory to 40.4% using the 1990-2015 Inventory.

Source: Scottish Greenhouse Gas Inventory, 1990-2015
Scotland has a number of targets for reducing greenhouse gas emissions contained in legislation, within the **Climate Change (Scotland) Act 2009**. These targets are summarised:

"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."

**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 are summarised:

"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."

**What are the biggest sites in Scotland which release greenhouse gases?**

In 2015, there were 17 fixed Scottish installations that surrendered over 100,000 tonnes of greenhouse gases in the EU ETS. In total, these accounted for 13.8 MtCO₂e in 2015.
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

An updated Climate Change Plan is to be published at the end of February 2018.

In October 2010, the Scottish Parliament passed legislation setting the first batch of annual targets, running until 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 five year intervals.

The 2015 target of 45.928 MtCO2e has been met.

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 2014 and 2015, the adjustment resulted in decreases for the reported cap. In 2015, the adjustment represented a decrease of 2.547 MtCO2e.

DATA NOTE

The Official Statistics publication Scottish Greenhouse Gas Emissions 2015 contains further details on the process by which source emissions are adjusted to take into account trading in the EU ETS:

http://www.gov.scot/Publications/2017/06/9254

More information on the Climate Change Targets can be found here:


Scotland’s Carbon Footprint

The Scottish Government also established a National Indicator to reduce the overall carbon footprint. The carbon footprint measures all greenhouse gas emissions (expressed in 'carbon dioxide equivalents') generated at home and abroad in the production and transport of the goods and services that we consume.

Information on progress towards this target can be found on the Scottish Government Scotland Performs website:

http://www.gov.scot/About/Performance/scotPerforms/indicator/carbon

Further information on the Scottish Government’s Carbon Footprint publication can be found at:

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 2017, covering emissions in 2015.

In 2015, total Scottish electricity generation was 51,351 GWh and gross electricity consumption was 36,562 GWh. The average greenhouse gas emissions per kilowatt hour of electricity generated in Scotland was estimated to be 150 gCO2e/kWh in 2015. This represents a decrease from 196 gCO2e/kWh from 2014, and the carbon intensity of electricity generated in Scotland has reduced by approximately 23.4% since 2014.

Overall electricity generation in Scotland decreased by 5,506 GWh to 45,845 GWh in 2016, and Scotland continued to be a net exporter of electricity, exporting 20% of total generation in 2016, down from 29% in 2015.
The methodology used to calculate the figure for tonnes of CO₂ 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:


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 9.4 million tonnes of CO₂ were displaced by Scotland’s renewable electricity generation in 2016, a decrease of 31% on the 13.6 million tonnes of CO₂ displaced by the sector in 2015.

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 2016. Note that due to the closure of Longannet and Ferrybridge C in March 2016, the average emissions factor for electricity supplied by fossil fuels has reduced from 623 tCO₂e/GWh to 477 tCO₂e/GWh in 2016 explaining the reduction in emissions displacement from renewables.

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.
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
‘The low carbon economy supports 49,000 jobs in Scotland’
“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...

33% of all UK employment in Scotland

49,000 JOBS WERE SUPPORTED BY THE LOW CARBON AND RENEWABLE ENERGY SECTOR IN SCOTLAND IN 2016, GENERATING A TURNOVER OF £11 BILLION

62% of all Scottish LCRE turnover

Increase in energy productivity since 2005...

113%
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.

Carbon Productivity

Carbon productivity is measured as the level of GVA per tonne of CO$_2$e, as shown in Figure 9.1.

Between 1998 and 2015, carbon productivity has more than doubled (increasing by 113%). 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.

A further indicator of the successfulness of the transition to a low carbon economy will be the number employed in low carbon sectors. Please see the data development box below for more information on measurement issues regarding low carbon employment.

**Figure 9.1: Estimated Carbon Productivity, Scotland, 1998-2015**

Sources: Scottish Government

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 2016) were published in January 2018 and are available here:

**Low Carbon and Renewable Energy Economy 2016**

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 2016, **24,000** people were employed directly in the low carbon and renewable energy economy in Scotland.

**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.
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:

- **Catalyst**: Initial strategy development and feasibility work
- **Development**: Final business case, investment options and investment propositions
- **Demonstrator**: Where a technology is not proven in Scotland capital support may be available to demonstrate its commercial viability

Progress to Date

The LCITP programme has already offered over £40 million of funding to 16 low carbon demonstrator projects supporting low carbon energy generation and supported the co-development of over 30 proof of concept and development proposals.

The Programme has held a number of specific capital calls focusing on specific energy technologies – transformational low carbon projects, 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 powered ferries and integrated local energy systems.

Please visit the following link for more information on LCITP:

**LCITP CASE STUDY**

Michelin is Dundee’s largest industrial employer, with approximately 850 staff, located at the company’s factory in Baldovie. In March 2017, the Scottish Government’s Low Carbon Infrastructure Transition Programme (LCITP) provided capital support of £1.68 million to Michelin and MVV Environment Baldovie Ltd for a project to supply a direct steam from the new energy from waste plant being constructed by MVV on land adjacent to the Michelin site.

Michelin will use the direct steam, supplied by the waste plant, primarily for the vulcanisation of tyres. The project has the potential to reduce CO2 emissions from tyre production by around 84%.

Once complete, reductions in energy consumed will help lower operating costs and further embed a more sustainable industrial operation within the local community. Whilst the end user of the project, in the initial phase, will be the Michelin site, Dundee City Council is in the process of developing its Sustainable Energy and Climate Change Action Plan which includes plans for a wider heat network within the Whitfield/Baldovie area. The facility in Dundee will install electrically-heated tyre curing presses on an industrial scale which are replacing presses using a combination of steam and hot water. The innovative electrical process has significant energy reduction benefits over traditional presses and, by reducing energy consumption has enhanced efficiency at the Dundee site. This project, supported by Scottish Enterprise, was announced in June 2017.

**Energy Productivity**

We can 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 (as shown in Figure 9.2).

Energy productivity in Scotland has increased by approximately 31% between 2005 and 2015.

**Increase in energy productivity since 2005...**

![Graph showing increase in energy productivity from 2005 to 2015]

Sources: Scottish Government, 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 2016. 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 2016, the low carbon and renewable energy economy supported **49,000 jobs** in Scotland.

This accounted for 12.5% of the total UK employment in this sector (higher than population share). It also generated £11 billion in turnover, 14.2% 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, 2016**

<table>
<thead>
<tr>
<th></th>
<th>DIRECT ACTIVITY</th>
<th>INDIRECT ACTIVITY</th>
<th>TOTAL ACTIVITY</th>
<th>% UK TOTAL</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>EMPLOYEES (FTE)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>UK</td>
<td>208,000</td>
<td>183,500</td>
<td>391,500</td>
<td>-</td>
</tr>
<tr>
<td>SCOTLAND</td>
<td>24,000</td>
<td>25,000</td>
<td>49,000</td>
<td>12.5%</td>
</tr>
<tr>
<td>England</td>
<td>165,000</td>
<td>140,500</td>
<td>305,500</td>
<td>78.0%</td>
</tr>
<tr>
<td>Wales</td>
<td>13,000</td>
<td>11,500</td>
<td>25,000</td>
<td>6.4%</td>
</tr>
<tr>
<td>Northern Ireland</td>
<td>6,000</td>
<td>6,000</td>
<td>12,500</td>
<td>3.2%</td>
</tr>
<tr>
<td><strong>TURNOVER (£000)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>UK</td>
<td>42,559,000</td>
<td>34,830,500</td>
<td>77,390,000</td>
<td>-</td>
</tr>
<tr>
<td>SCOTLAND</td>
<td>5,761,000</td>
<td>5,239,000</td>
<td>11,000,500</td>
<td>14.2%</td>
</tr>
<tr>
<td>England</td>
<td>33,423,000</td>
<td>26,893,500</td>
<td>60,316,500</td>
<td>77.9%</td>
</tr>
<tr>
<td>Wales</td>
<td>2,433,500</td>
<td>1,959,500</td>
<td>4,393,000</td>
<td>5.7%</td>
</tr>
<tr>
<td>Northern Ireland</td>
<td>928,000</td>
<td>722,500</td>
<td>1,650,500</td>
<td>2.1%</td>
</tr>
</tbody>
</table>

**Direct Activity**

In 2016, an estimated 9,000 businesses were operating in the low carbon and renewable energy economy in Scotland, approximately 10.7% of all UK businesses active in the LCRE economy.
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 2016 - 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

Indirect Activity

Just under half of the turnover (£5.24 billion) from the low carbon and renewable energy economy came from indirect activity such as the supply chain.

Indirect low carbon and renewable energy economy activity in Scotland in 2016 supported 25,000 jobs. This compared to 11,500 indirect jobs in Wales, 6,000 indirect jobs in Northern Ireland and 140,500 indirect jobs in England.
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 29.2% of all UK employment and 28.9% of all UK turnover in this sector.

For onshore wind alone, these proportions are considerably higher - Scotland has 43.2% of all UK employment and 46.1% of all UK turnover.

For low carbon services, Scotland represents 33.3% of all UK employment and 28.1% of all UK turnover in this sector.

Renewable Energy Sector

In 2016, the renewable energy economy (a subset of the low carbon economy) supported 16,000 jobs in Scotland. This accounts for 22.2% of the total UK employment in this sector (higher than population share). It also generated £5.9 billion in turnover, 21.1% of the total UK turnover in this sector.

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


The latest data from ONS, published in January 2018, estimates the direct and indirect LCRE activity attributed to Scotland in 2016. This is the third time the survey has been run and therefore 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 3 point estimates (for direct activity in 2014, 2015 and 2016), ONS do not consider it possible to directly assess whether or not the observed differences between the 2015 and 2016 estimates are likely to represent statistically significant change. For more information on this publication please visit the link below:

### Aggregate energy balance 2016

#### Gross calorific values

<table>
<thead>
<tr>
<th>Supply</th>
<th>Coal</th>
<th>Primary oils</th>
<th>Petroleum products</th>
<th>Natural gas</th>
<th>Bioenergy &amp; wastes</th>
<th>Primary electricity</th>
<th>Electricity</th>
<th>Manufactured fuels &amp; Other (1)</th>
<th>Total</th>
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</thead>
<tbody>
<tr>
<td>Indigenous production</td>
<td>497</td>
<td>48818</td>
<td>-</td>
<td>25915</td>
<td>742</td>
<td>5604</td>
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<td>3173</td>
<td>13036</td>
<td>258</td>
<td>-</td>
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<td>-</td>
<td>20901</td>
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<td>Rest of World</td>
<td>-</td>
<td>4195</td>
<td>2469</td>
<td>13019</td>
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<td>-</td>
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<tr>
<td>Rest of UK</td>
<td>-</td>
<td>-</td>
<td>704</td>
<td>17</td>
<td>-</td>
<td>-</td>
<td>116</td>
<td>-</td>
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<tr>
<td>Exports (2)</td>
<td>-105</td>
<td>-41149</td>
<td>-6968</td>
<td>-30561</td>
<td>-23</td>
<td>-</td>
<td>-924</td>
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<td>Rest of World</td>
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<td>-2003</td>
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<tr>
<td>Rest of UK</td>
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<td>-28558</td>
<td>-</td>
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<td>-1015</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-1015</td>
<td>-</td>
<td>-</td>
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<td>Stock change (3)</td>
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<td>-3</td>
<td>14</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-10</td>
<td>-</td>
<td>210</td>
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<tr>
<td>Primary supply</td>
<td>731</td>
<td>11845</td>
<td>-4796</td>
<td>8390</td>
<td>978</td>
<td>5604</td>
<td>-807</td>
<td>-</td>
<td>21944</td>
</tr>
<tr>
<td>Statistical difference (4)</td>
<td>-3</td>
<td>-</td>
<td>-7</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-10</td>
<td>-</td>
<td>-10</td>
</tr>
<tr>
<td>Primary demand</td>
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<td>8390</td>
<td>978</td>
<td>5604</td>
<td>-807</td>
<td>-</td>
<td>21954</td>
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<tr>
<td>Transfers (5)</td>
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<td>-2432</td>
<td>2432</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>1529</td>
<td>1529</td>
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<tr>
<td>Transformation</td>
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<td>-9412</td>
<td>9120</td>
<td>-719</td>
<td>-476</td>
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<td>3592</td>
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<tr>
<td>Electricity generation</td>
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<td>-</td>
<td>-215</td>
<td>-559</td>
<td>-472</td>
<td>-4075</td>
<td>2413</td>
<td>-3351</td>
<td></td>
</tr>
<tr>
<td>Petroleum refineries</td>
<td>-</td>
<td>-9412</td>
<td>9392</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-21</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Manufactured fuel &amp; other</td>
<td>-160</td>
<td>-</td>
<td>-57</td>
<td>-160</td>
<td>-4</td>
<td>-</td>
<td>-160</td>
<td>-220</td>
<td></td>
</tr>
<tr>
<td>Energy industry use and distribution losses</td>
<td>-</td>
<td>-</td>
<td>456</td>
<td>3669</td>
<td>-</td>
<td>-</td>
<td>477</td>
<td>25</td>
<td>4627</td>
</tr>
<tr>
<td>Final Consumption</td>
<td>131</td>
<td>-</td>
<td>6308</td>
<td>4002</td>
<td>502</td>
<td>-</td>
<td>2658</td>
<td>136</td>
<td>13736</td>
</tr>
</tbody>
</table>

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 23 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.
This annex explains the conversion units/factors used within this publication. More information and a conversion calculator is published here:


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

<table>
<thead>
<tr>
<th>Prefix</th>
<th>Value</th>
<th>Exponent</th>
</tr>
</thead>
<tbody>
<tr>
<td>kilo (k)</td>
<td>1,000</td>
<td>$10^3$</td>
</tr>
<tr>
<td>mega (M)</td>
<td>1,000,000</td>
<td>$10^6$</td>
</tr>
<tr>
<td>giga (G)</td>
<td>1,000,000,000</td>
<td>$10^9$</td>
</tr>
<tr>
<td>tera (T)</td>
<td>1,000,000,000,000</td>
<td>$10^{12}$</td>
</tr>
<tr>
<td>peta (P)</td>
<td>1,000,000,000,000,000</td>
<td>$10^{15}$</td>
</tr>
</tbody>
</table>

### 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 = 40.1 GJ
1 million m3 of natural gas = 11.1 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.

**CO₂** – 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, 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 70 of BEIS's latest energy trends publication for more information:

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. The fifth SIU, Stornoway, uses LPG. Properties covered by the SIUs do feature in BEIS’s sub-national gas consumption statistics. Therefore these areas are not considered to be off the gas grid.

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

11. GWth refers to thermal capacity, whereas GWe would refer to electrical capacity.


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 - SF₆ and nitrogen trifluoride - NF₃), 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).