Department for
Business, Energy
& Industrial Strategy

The UK's Integrated National Energy and Climate Plan

Completed as per 31 January 2020

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Contents

On 31 January 2020, the UK left the European Union (EU) and the Withdrawal Agreement we concluded with the EU entered into force. The UK is seeking a relationship with the EU which is based on friendly cooperation between sovereign equals, centred on free trade. At the end of 2020, the process of transition to that relationship will be completed. The UK will no longer be a part of the EU Single Market or the EU Customs Union. As the UK is no longer a Member State, we will not contribute to EU targets in the areas of energy and climate change.

The UK is submitting this National Energy and Climate Plan in order to uphold our commitments under the Withdrawal Agreement. The content within is wholly accurate up to 31 January 2020, the date the UK left the EU.[1] Since then, analysis in the National Energy and Climate Plan has been updated to ensure it provides an accurate overall picture of the UK's plans. However, policy announcements and publications after 31 January 2020 have not been incorporated and the National Energy and Climate Plan does not supersede those announcements that we have made domestically. This means that impacts from COVID-19 are also not taken into account.

The UK's approach to tackling and responding to climate change is set in legislation through the Climate Change Act 2008. The Act also established the Committee on Climate Change, the independent statutory body that provides expert advice to the UK government on climate change mitigation and adaptation.

On 27 June 2019, the UK government set a legally binding target to achieve net zero greenhouse gas emissions from across the UK economy by 2050, which will bring to an end our contribution to climate change. In the lead-up to COP26 in Glasgow in 2021, we continue to drive climate ambition on the global stage. As COP26 President, the UK will work with all partners to deliver on the Paris Agreement. Further policies and strategies to meet our net zero target will be set out in domestic publications, such as our Energy White Paper.[2]

This Plan has been completed according to the EU's reporting framework for National Energy and Climate Plans (italicised in each section), as specified in Annex I to the EU Regulation 2018/1999 on the Governance of the Energy Union and Climate Action.[3]

[1] Analysis based on data up to 31 January 2020, does not account from impacts resulting from COVID-19.
[2] www.gov.uk/government/publications/energy-white-paper-powering-our-net-zero-future
[3] https://eur-lex.europa.eu/eli/reg/2018/1999/oj

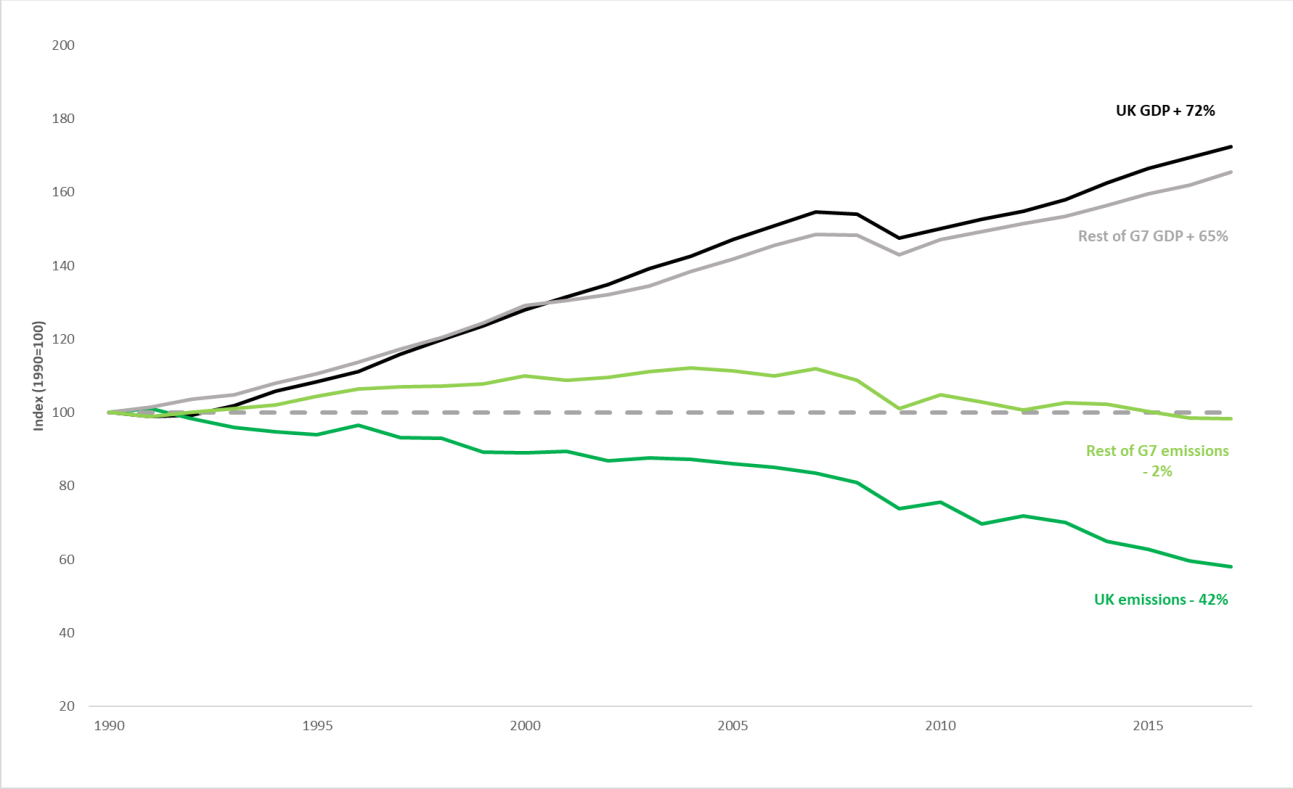
1. Overview and process for establishing the plan

1.1 Executive summary

i Political, economic, environmental, and social context of the plan

The UK was one of the first countries to recognise and act on the economic and security threats of climate change and has been among the most successful countries in the developed world at growing its economy while reducing emissions. Since 1990, the UK has cut emissions by over 40% whilst growing the economy by over two-thirds (see Figure 1).

Figure 1: GDP and emissions for the UK and G7[4]



Internationally, the UK together with the EU played a central role in securing the United Nations (UN) 2015 Paris Agreement. The UK is fully committed to working with other countries to achieve the Paris Agreement goals. The UK is one of the largest contributors of international climate finance, having committed to spending £5.8 billion on this between 2016 and 2021[5] and at least £11.6 billion between 2021/22 and 2025/26.[6] Additionally, the UK is promoting global alliances to encourage clean growth, such as the Powering Past Coal Alliance, to reduce emissions from the most polluting fuel.

[4] Data sourced from World Bank, UNFCCC National Inventory Submissions, ONS and BEIS Greenhouse Gas inventory.
[5] International Climate Finance, UK government, www.gov.uk/guidance/international-climate-finance
[6] UK aid to double efforts to tackle climate change, www.gov.uk/government/news/uk-aid-to-double-efforts-to-tackle-climate-change

The Climate Change Act

The Climate Change Act 2008 set in legislation the UK's approach to tackling and responding to climate change. It introduced the UK's long-term legally binding 2050 target to reduce greenhouse gas emissions by at least 80% relative to 1990 levels. It also introduced 'carbon budgets', which cap emissions over successive five-year periods and must be set 12 years in advance. The Act also established the Committee on Climate Change (CCC), the independent statutory body that provides expert advice to the UK government on climate change mitigation and adaptation.

Policies and proposals for mitigating climate change go through an established development process. As the development is completed, the impact of policies is quantified in updated Energy and Emissions Projections (EEP), which are published by the UK government annually. This is a continuous process and the latest EEP, published in April 2019, shows future emissions under the suite of policies that were fully developed as of 2018.

The Climate Change Act also requires the UK to produce a UK Climate Change Risk Assessment (CCRA) every 5 years. The CCRA assesses current and future risks to and opportunities for the UK from climate change. In addition, the Climate Change Act requires the UK government to produce a National Adaptation Programme to respond to the risk assessment. Finally, the Climate Change Act gives powers to the UK government to require certain organisations to report on how they are adapting to climate change through the Adaptation Reporting Power.

Net zero

The UK is committed to maintaining a robust climate framework that takes into account evolving scientific knowledge on climate change. Following the publication in October 2018 of the Intergovernmental Panel on Climate Change's (IPCC) special report on global warming of 1.5°C, the UK government, Welsh Government and Scottish Government asked our independent experts, the CCC, for their advice on the implications of the Paris Agreement for the UK's long-term emissions reduction targets, including on setting a net zero target.[7]

In May 2019, the CCC provided that advice, recommending that the UK legislate as soon as possible to reach net zero greenhouse gas emissions by 2050.

On 27 June 2019, the UK government set a legally binding target to achieve net zero greenhouse gas emissions from across the UK economy by 2050, via an amendment to the Climate Change Act. This world-leading target will bring to an end our contribution to climate change.

The Clean Growth Strategy and Clean Growth Grand Challenge

In October 2017, the UK government published its Clean Growth Strategy (CGS)[8] setting out ambitious policies and proposals, through to 2032 and beyond, to reduce emissions across the economy and promote clean growth.

[7] UK climate targets: request for advice from the Committee on Climate Change, October 2018, www.gov.uk/government/publications/uk-climate-targets-request-for-advice-from-the-committee-on-climate-change

[8] Clean Growth Strategy: www.gov.uk/government/publications/clean-growth-strategy

In November 2017 the UK government published its Industrial Strategy, which includes a Clean Growth Grand Challenge[9]. The Grand Challenge aims to put the UK at the forefront of industries of the future, by maximising the advantages for UK industry from the global shift to low-carbon.

25 Year Environment Plan

Building on the proposals set out in the CGS, the UK outlined its plans to improve the environment in the 25 Year Environment Plan. The 25 Year Environment Plan[10] was published in January 2018 and sets out the UK's approach to deliver on our ambition to leave our environment in a better state than we inherited, and to fully seize the opportunities of clean growth.

The second National Adaptation Programme (NAP) and the third strategy for Adaptation Reporting Power (ARP)

The Climate Change Act mandates that on a five-yearly cycle the UK government produce a Climate Change Risk Assessment (CCRA), followed by a National Adaptation Programme (NAP), setting out actions to address the risks identified in the CCRA.[11] The second CCRA (published January 2017) endorsed the six priority risk areas identified by the independent evidence report produced by the Adaptation Sub-Committee in July 2016. These are:

- Flooding and coastal change risks to communities, built environment and infrastructure
- Risks to health and wellbeing and productivity from high temperatures
- Risk of shortages in the public water supply and for agriculture, energy generation and industry with impacts on freshwater ecology
- Risks to natural capital including terrestrial, coastal, marine and freshwater ecosystems, soils and biodiversity
- Risks to domestic and international food production and trade
- New and emerging pests and diseases, and invasive non-native species affecting people, plants and animals

The second NAP was published in July 2018 and addresses the key risks highlighted in the second CCRA, showing the actions the UK government is, and will be, taking to address the risks and opportunities posed by a changing climate over the following five-year period. This was developed working with and drawing on the UK government's 25 Year Environment Plan. The NAP presents a set of actions in a broad range of areas: natural environment, infrastructure, people and the built environment, business and industry, and local government. This includes actions related to building resilience of energy infrastructure to flooding.

The NAP is primarily for England but also covers reserved and non-devolved matters. Devolved Administrations lead their own adaptation programmes. In October 2019, the government responded to the Adaptation Sub-Committee's biennial report on adaptation

[9] The UK's Industrial Strategy: www.gov.uk/government/topical-events/the-uks-industrial-strategy
[10] 25 Year Environment Plan: www.gov.uk/government/publications/25-year-environment-plan
[11] Climate change: a second national adaptation programme (2018 to 2023), July 2018, www.gov.uk/government/publications/climate-change-second-national-adaptation-programme-2018-to-2023

progress under the second NAP[12]. In 2019, Scotland, Wales and Northern Ireland all published their climate adaptation programmes, setting out planned adaptation action over the next five years.[13]

Adaptation Reporting Power (ARP)

The Adaptation Reporting Power (ARP)[14], a discretionary power under the Climate Change Act 2008, helps ensure that 'persons or bodies with a function of a public nature' and 'statutory undertakers' (reporting organisations) are taking actions to adapt to climate change by reporting on how they are addressing current and future climate impacts. The adaptation reporting process has been through two complete cycles so far. Reports submitted in the second round of adaptation reporting are available on GOV.UK.[15]

In the second cycle of adaptation reporting in 2013, the UK government chose a voluntary and flexible approach to reporting. Similarly, the third Adaptation Reporting strategy, published alongside the NAP in 2018, adopts a voluntary and sector-focused approach, with the reporting cycle running from the beginning of 2019 to the end of 2021. As of December 2018, over 90 organisations have committed to submit a report on their preparedness to climate change risks.[16] Gas and electricity companies, including transmission and distribution, are among those who will report on how they are strengthening resilience to the risks set out in the second CCRA, and what actions are being taken to reduce the vulnerability of core national infrastructure. In the third Strategy for Adaptation reporting, a number of key CCRA risks were identified for the energy sector to report on, including: cascade failures due to interdependencies; risks from flooding; risks to pipelines from high river flows and bank erosion; risks from high winds and lightning; risks to offshore infrastructure from storms and high waves. As part of the Resilient Electricity Networks for Great Britain (RESNET) consortium, researchers from the University of Manchester and Newcastle University have developed models that combine climate change projections with information about the National Grid to assess its long-term resilience. Electricity network companies spent £130 million on flood defence work from 2010-15, with a further £100 million due to be spent on flood defence by networks before 2021. Work is based around revised design guidelines (ETR138), which state that primary substations with over 10,000 connections should be defended against 1/1000-year flood events.[17]

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[12] Government response to the Committee on Climate Change, 2019, www.gov.uk/government/publications/committee-on-climate-changes-2019-progress-reports-government-responses

[13] Climate Ready Scotland: climate change adaptation programme 2019-2024, www.gov.scot/publications/climate-ready-scotland-second-scottish-climate-change-adaptation-programme-2019-2024/pages/10/
Prosperity for All: A Climate Conscious Wales, https://gov.wales/prosperity-all-climate-conscious-wales
Northern Ireland Climate Change Adaptation Programme 2019-2024, www.daera-ni.gov.uk/publications/northern-ireland-climate-change-adaptation-programme-2019-2024

[14] ARP, proposals for the third round of adaptation reporting: https://consult.defra.gov.uk/environmental-quality/adaptation-reporting/

[15] Adaptation Reporting, Second round reports, www.gov.uk/government/collections/climate-change-adaptation-reporting-second-round-reports

[16] List of organisations reporting under adaptation reporting power: third round, December 2018. www.gov.uk/government/publications/climate-change-adaptation-reporting-third-round/list-of-organisations-reporting-under-adaptation-reporting-power-third-round

[17] Government response to the Committee on Climate Change, 2019 Report to Parliament - Progress in preparing for climate change, www.gov.uk/government/collections/government-responses-to-the-committee-on-climate-change-ccc-annual-progress-reports

Strategies and legislation in Northern Ireland, Scotland and Wales

Energy policy is mainly devolved to Northern Ireland and partly devolved to Wales and Scotland. Climate change policy is devolved to Wales, Scotland and Northern Ireland, although the UK government retains control over many energy policy areas and also some other important policy areas which deliver emissions reductions.

Northern Ireland

In Northern Ireland energy policy and the independent regulation of energy companies are devolved matters. Northern Ireland's current energy strategy is set out in the Strategic Energy Framework (SEF) for the period 2010-2020. Northern Ireland's future energy strategy is likely to concentrate on a more consumer-led decentralised energy system and decarbonisation in areas such as electricity, heat and transport. The Department for the Economy NI is currently developing a new Energy Strategy for NI. A Call for Evidence will close in early 2020 and the department intends to publish an options paper for consultation by the end of March 2021, following the consultation, and subject to securing Ministerial and Executive approval, the aim is for the final strategy to be in place by November 2021.

The Single Electricity Market (known as the 'SEM') is a single, shared wholesale electricity market between Ireland and Northern Ireland. It was formed in November 2007 and underwent a reform programme in 2018 called the Integrated Single Electricity Market (or 'I-SEM'). These reforms to the market aim to integrate the all-island electricity market with European energy markets (as part of the internal energy market – or 'IEM'). They are designed to introduce efficiencies of interconnector flows, encourage new investment in the market, apply downward pressure on prices, create enhanced trading opportunities and options through the introduction of continuous trading in the intra-day, day-ahead, forwards, and balancing timeframes and facilitate the integration of renewables and continue to provide security of supply. The SEM one year ahead auction in December 2018 secured just under 2 gigawatts (GW) of capacity for Northern Ireland, which ensured that there would be sufficient capacity to meet demand in Northern Ireland during winter 2019-20.

The four year ahead capacity auction on 28 March 2019 secured 1.9GW of capacity for Northern Ireland with an auction clearing price of £43,030 per megawatts (MW) per year, which ensures sufficient capacity to meet expected demand for the year 2022-23.

Scotland

Scotland's climate change legislation requires Scottish Ministers to reduce emissions in Scotland to net-zero by 2045, with interim targets of 56% reduction (from a 1990 baseline) by 2020, 75% reduction by 2030, 90% reduction by 2045 and annual targets for each other year to net-zero.

The Climate Change Plan published in February 2018 sets out the Scottish Government's comprehensive package of policies and proposals for meeting emissions reduction targets under the Climate Change (Scotland) Act 2009 over the period to 2018 to 2032 – these targets have subsequently been increased (as above) through the Climate Change (Emissions Reduction Targets) (Scotland) Act 2019. The second annual report monitoring progress towards the Plan was published in December 2019.[18] The Scottish Government has committed to update the Plan in December 2020 to reflect the increased ambition of the 2019 Act targets. The Climate Change (Scotland) Act 2009 required Scottish Ministers to reduce emissions in

[18] Second annual report monitoring progress towards Scotland's 2018 Climate Change Plan, Dec 2019, www.gov.scot/publications/climate-change-plan-monitoring-report-2019/

Scotland by at least 80% by 2050, with an interim target of 42% by 2020 and annual targets for each year to 2050.

The Scottish Government also published an Energy Strategy[19] in December 2017, which sets out a vision for the future of energy in Scotland to 2050. The Energy Strategy was developed alongside, and is fully consistent with, the existing Climate Change Plan, taking a wider view of the long-term transformational change required in the energy sector. Together, the Energy Strategy and the Climate Change Plan provide the strategic framework for Scotland's transition to an inclusive, innovative, low-carbon economy; reducing greenhouse gas emissions whilst maximising the social and economic opportunities. The framework covers reserved areas as well as devolved, focusing action on those areas that the Scottish Government can directly affect.

Wales

The Environment (Wales) Act 2016[20] requires Welsh Ministers to reduce emissions in Wales by at least 80% by 2050. This Act also requires Welsh Ministers to set interim emissions reduction targets for the years 2020, 2030 and 2040, and establish a system of carbon budgeting that together create an emissions reduction pathway to the 2050 target.

Regulations passed by the National Assembly for Wales in December 2018 set the 2020 target at 27%, the 2030 target at 45% and the 2040 target at 67%. The first two carbon budgets (2016-20 and 2021-25) were also set in legislation. Since then, the Welsh Government has accepted the CCC's recommendation to increase Wales' 2050 target to 95% and has requested the CCC's advice on how this affects the interim targets and carbon budgets set in 2018. It has also asked the CCC to explore how Wales might go beyond 95%. The Welsh Government will ask the Senedd (Welsh Parliament) to amend the targets and budgets legislation early in 2021.

The Act requires Welsh Ministers to publish a plan for meeting each carbon budget. The plan for the first carbon budget, Prosperity for All: A Low Carbon Wales, was published in March 2019 and contains 100 policies and proposals from all emissions sectors and Ministerial portfolios.[21] The plan for the second carbon budget will be published in 2021.

The Welsh Government has set targets to drive deployment of renewables and to ensure Wales benefits from new energy developments. Wales has targets to produce 70% of the electricity used from renewable sources by 2030, and of 1GW of locally owned renewable energy capacity by 2030. There is also an expectation that new all renewable energy projects developed in Wales from 2020 have an element of local ownership. The National Development Framework will set out the Welsh Government's vision for how renewable energy should be delivered in Wales to help respond to the climate emergency.

ii Strategy relating to the five dimensions of the EU's Energy Union

Decarbonisation

Through the Climate Change Act, the UK has established in law the first five carbon budgets covering the period from 2008-32, with the sixth carbon budget due to be set in 2021. The UK

[19] Scottish Energy Strategy: The Future of Energy in Scotland, 2017, www.gov.scot/publications/scottish-energy-strategy-future-energy-scotland-9781788515276/
[20] Environment (Wales) Act 2016, https://gov.wales/topics/environmentcountryside/consmanagement/natural-resources-management/environment-act/?Lang=en&skip=1&lang=en
[21] Prosperity for all: A low carbon Wales, https://gov.wales/prosperity-all-low-carbon-wales

has met the first two carbon budgets (2008-12 and 2013-17) and latest emissions projections suggest we are on track to meet the third (2018-22). We recognise the need for further action to meet the fourth and fifth carbon budgets (2023-2032).

Scotland has statutory annual emissions reduction targets. The most recently reported target (for 2017) was missed, but the preceding three years (2014, 2015 and 2016) were all met. Actual emissions from Scotland have been reduced by almost half (47%) between the 1990 baseline and 2017.[22]

The most recent data for Wales estimates that emissions totalled 42.2 metric tonnes of carbon dioxide equivalent (MtCO2e) in 2017, a fall of 25% compared to base year emissions.[23] This represents a 13% decrease compared to 2016, reflecting the volatile nature of Welsh emissions. The CCC believes that "if Wales can maintain this progress it will be on track to meet its first carbon budget".[24]

Energy efficiency

To meet the UK's 2050 net zero climate change target, emissions from buildings will need to be near zero, coupled with action on industrial processes. This requires improving energy efficiency and energy management and decarbonising nearly all heating and cooling of buildings. Adapting to climate change risks, including overheating, can also reduce energy demand. New building developments can incorporate mechanical or passive ventilation systems to provide natural cooling limiting air conditioning use. The UK is taking a range of actions including addressing barriers to energy efficiency and low-carbon investment, such as supporting organisations to access finance.

The CGS provides a framework for driving UK policy on energy efficiency. Some policies and measures on energy efficiency that have already been implemented include commitments to fund energy efficiency improvements in the public sector, industry, business and homes. On 15 October 2019, the UK government published its response to the CCC's annual report, which included key proposals to improve the energy performance of non-domestic buildings. The UK government launched consultation on a future target of Energy Performance Certificate (EPC) Band B by 2030 for minimum energy efficiency standards in non-domestic rented buildings, and committed to consult in 2020 on introducing mandatory in-use energy performance ratings for non-domestic buildings in the private sector, which will be key to helping businesses to understand and improve the actual energy performance of their buildings.

Northern Ireland contributes to the UK's energy efficiency targets with the Northern Ireland Sustainable Energy Programme (NISEP) delivering up to 200GWh per year of energy savings as required by Article 7 of the Energy Efficiency Directive[25]. Northern Ireland is currently developing a new Energy Strategy, a key theme of which will be energy efficiency. Through the work to develop the Energy Strategy, the aim is to ensure co-ordinated and effective delivery of

[22] Scottish greenhouse gas emissions 2017, June 2019 www.gov.scot/publications/scottish-greenhouse-gas-emissions-2017/
[23] Devolved Administrations - Greenhouse Gas Reports, National Atmospheric Emissions Inventory (2019) http://naei.beis.gov.uk/reports/reports?section_id=4. The baseline year for each greenhouse gas is 1990 (carbon dioxide, methane, nitrous oxide) or 1995 (hydrofluorocarbons, perfluorocarbons, sulphur hexafluoride, nitrogen trifluoride)
[24] The Committee on Climate Change (2019), Reducing UK emissions – 2019 Progress report to Parliament, www.theccc.org.uk/publication/reducing-uk-emissions-2019-progress-report-to-parliament/
[25] UK National Energy Efficiency Action Plan 2014, www.gov.uk/government/publications/the-uks-national-energy-efficiency-action-plan-and-building-renovation-strategy.

energy efficiency policies and programmes across Northern Ireland and to examine the merits of establishing a new energy efficiency target for Northern Ireland if appropriate.

In Scotland, Energy Efficient Scotland was launched in May 2018.[26] This ambitious 20-year programme contains a set of actions to make Scotland's buildings near zero carbon wherever feasible by 2050 and to do so in a way that is socially and economically sustainable.

Energy Efficient Scotland will help to remove poor energy efficiency as a driver for fuel poverty and will reduce greenhouse gas emissions through more energy efficient buildings and decarbonising Scotland's heat supply. Over the lifetime of Energy Efficient Scotland, an estimated £10 to £12bn from public and private sources will be invested in improving the energy efficiency of Scotland's buildings generating economic opportunity across the whole of Scotland.

In Wales, the Welsh Government has invested more £265m in the Warm Homes Programme demand led Nest Scheme and Arbed area-based scheme since 2009, which has improved the energy efficiency of over 50,000 homes. By the current funding period in March 2021, Welsh Government investment will have reached £344m in the Warm Homes Programme and benefitted more than 75,000 homes. Nearly 130,000 people have received energy efficiency advice through the Warm Homes Programme since 2011.

Energy security

The UK is committed to ensuring there are secure supplies for consumers, regardless of the energy mix, and the CGS sets out actions to enhance energy security by delivering a more diverse and reliable energy mix. The UK is supporting smarter, flexible networks thereby enabling the integration of clean generation. Further detail on strengthening the resilience of the energy sector to climate change risks can be found in the section above (see - the third strategy for Adaptation Reporting Power (ARP)).

The UK government recognises a range of benefits that interconnection can provide and strongly supports greater electricity trading with our European partners. The electricity system in Great Britain is currently connected to north-west Europe via 4GW of interconnector capacity. 1GW of interconnection also links Great Britain with the Single Electricity Market on the island of Ireland. In addition to the 5GW already operational, 4.8GW of capacity is already in construction, and a further 8.1GW is progressing through regulatory process. This is expected to increase our level of interconnection by 2030.

We continue to support developing liberalised markets and successfully using competition to drive down energy prices. We are embracing the opportunity to increase renewable generation, decarbonise the economy and maintain affordability. We are implementing rules for a well-functioning UK market and our Electricity Market Reform introduced measures on, for example, Contracts for Difference and wholesale market liquidity. The CGS outlines the UK's commitment to move towards a more dynamic market, empowering the consumer and realising the potential of renewables, small scale generation, greater flexibility, smart metering and the digital revolution.

[26] Energy Efficient Scotland Route Map, May 2018, www.gov.scot/publications/energy-efficient-scotland-route-map/pages/1/

Research, innovation and competitiveness

The UK's early action on clean growth means that it has nurtured a broad range of low-carbon industries, including some sectors in which we have world leading positions. This success is built upon wider strengths – the UK's scientific research base, expertise in high-value service and financial industries, and a regulatory framework that provides long-term direction and support for innovation and excellence in the design and manufacturing of leading-edge technology.

This progress has been aided by the falling costs of many low-carbon technologies: renewable power sources like solar and wind are comparable in cost to coal and gas in many countries; energy efficient light bulbs are over 80% cheaper today than in 2010; and the price of lithium-ion batteries has fallen by 85% since 2010[27] and is expected to more than halve again by 2030 according to industry.[28] As a result of this technological innovation, new high value jobs, industries and companies have been created. This is driving a new, technologically innovative, high growth and high value 'low-carbon' sector of the UK economy.

Due to the UK's world leading expertise in technologies such as offshore wind, power electronics for low-carbon vehicles and electric motors, and global leadership in green finance, we are successfully exporting goods and services around the world. For example, in 2018, 1 in every 5 battery electric cars sold in Europe was built in the UK.[29] This progress means there are nearly 400,000 jobs in low-carbon businesses and their supply chains, employing people in locations across the country.[30]

Capturing part of the global opportunity while continuing to drive down carbon emissions from our own activities provides a huge economic opportunity for the UK. By one estimate, the UK low-carbon economy could grow by an estimated 11% per year between 2015 and 2030 – 4 times faster than the rest of the economy – and could deliver between £60 billion and £170 billion of export sales of goods and services by 2030.[31] This means that clean growth can play a central part in our Industrial Strategy – building on our strengths to drive economic growth and boost earning power across the country.

The Department for Business, Energy and Industrial Strategy (BEIS) holds the responsibility for strategic oversight of climate and energy science and innovation across UK government, promoting and protecting the UK government's policy interests. Its Science and Innovation for Climate and Energy Directorate (SICE) provides the science and engineering evidence and data to support, constructively challenge and enable development and delivery of national energy policy.

Wider prioritisation of activity, research and innovation spending on energy is co-ordinated through the UK government's Energy Innovation Board (EIB), with SICE providing the

[27] Battery Reality, Bloomberg, www.bloomberg.com/news/articles/2019-04-03/battery-reality-there-s-nothing-better-than-lithium-ion-coming-soon
[28] Electricity Storage and Renewables, IRENA, http://irena.org/-/media/Files/IRENA/Agency/Publication/2017/Oct/IRENA_Electricity_Storage_Costs_2017.pdf
[29] UK Office for Low Emission Vehicles, www.gov.uk/government/news/funding-for-thousands-of-electric-car-charge-points-unused-by-councils
[30] ONS (2019). Low Carbon and Renewable Energy Economy Survey: 2017 Final Estimates www.ons.gov.uk/economy/environmentalaccounts/bulletins/finalestimates/2017
[31] Ricardo Energy and Environment for the Committee on Climate Change (2017) UK business opportunities of moving to a low-carbon economy (supporting data tables) www.theccc.org.uk/publication/uk-energy-prices-and-bills-2017-report-supporting-research/

secretariat for this. There is currently no separate energy research and innovation strategy. Prioritisation decisions are informed by the Industrial Strategy and the CGS.

iii Overview table with key objectives, policies and measures of the plan

As of 31 January 2020, the UK has left the EU and is no longer part of the Energy Union. However, UK policies and measures relating to the five dimensions of the EU's Energy Union are detailed in section 3.1.1.

The Climate Change Plan sets out the Scottish Government's policies and proposals to reduce emissions over the period to 2032 in line with the reduction target in the 2009 Act.

The plan for the first Welsh carbon budget, Prosperity for All: A Low-Carbon Wales, was published in March 2019 and contains 100 policies and proposals from all emissions sectors and Ministerial portfolios.[32] The Welsh Government's plan for meeting Wales' second carbon budget will be published in 2021.

1.2 Overview of current policy situation

i National energy system and policy context of the national plan

The strategy of the EU's Energy Union consists of five dimensions which inform the structure and content of this plan. As of 31 January 2020, the UK has left the EU and is no longer part of the Energy Union. The UK government's CGS sets out the UK's proposals to deliver increased economic growth and decreased emissions:

- Accelerating clean growth
- Improving business and industry efficiency
- Improving UK homes
- Accelerating the shift to low-carbon transport
- Delivering clean, smart, flexible power
- Enhancing the benefits and value of our natural resources
- Leading in the public sector

ii Current energy and climate policies and measures relating to the five dimensions of the EU Energy Union

As stated above, UK policies and measures relating to the five dimensions of the EU's Energy Union are detailed in section 3.1.1.

The Climate Change Plan sets out the Scottish Government's policies and proposals to reduce emissions over the period to 2032 in line with the reduction target in the 2009 Act.

The Welsh Government's plan for meeting Wales' second carbon budget will be published in 2021.

[32] Prosperity for All: A Low Carbon Wales, Welsh Government, 2019: https://gov.wales/prosperity-all-low-carbon-wales

iii Key issues of cross-border relevance

Northern Ireland and Ireland have a shared wholesale single electricity market (SEM). It was formed in November 2007 and underwent a reform programme in 2018 called the Integrated Single Electricity Market (or 'I-SEM'). The reforms introduced new and more efficient wholesale trading arrangements, closer integration with other electricity markets and a more competitive capacity mechanism. While Northern Ireland is wholly dependent on Great Britain for its natural gas supply, it has gas interconnection with Ireland and gas security of supply is considered on a national and regional basis.

The UK is part of the wider North Seas region, which has a large renewable energy potential. More information on this cooperation is set out in section 1.4(ii).

Another forum for regional cooperation is the Energy Work Sector under the British Irish Council (BIC). This provides opportunities for the governments of the UK, Ireland, Scotland, Wales, Isle of Man, Jersey and Guernsey to share information and work together on energy issues of common interest.

iv Administrative structure of implementing national energy and climate policies

The UK government has a legally binding climate change framework under the Climate Change Act 2008. To ensure the UK is on an appropriate emissions reduction pathway, the UK government is obliged to set legally binding five-year caps on emissions twelve years in advance (carbon budgets), informed by advice from our independent statutory adviser, the CCC. Additionally, the UK is required to publish a report setting out the policies and proposals to meet budgets after setting each carbon budget. See Table 1 for the UK's actual and projected performance against the carbon budgets.

Table 1: Performance against carbon budgets[33]

Carbon budget:	1 (2008-12)	2 (2013-17)	3 (2018-22) No carry forward/ (with carry forward)	4 (2023-27)	5 (2028-32)
	Actual	Actual	Projection	Projection	Projection
Carbon budget level: cumulative emissions	3,018	2,782	2,544 (2,632)	1,950	1,725
Average required reduction vs 1990 emissions[34], %	-24%	-30%	-36%	-51%	-57%
Projected emissions, Mt	2,982 (actual)	2,398 (actual)	2,456	2,059	1,890
Result vs budget level, Mt	-36 Mt	-384 Mt	-88Mt (-176 Mt)	+109 Mt	+165 Mt
Result vs budget, %	-1%	-14%	-3% (-7%)	+6%	+10%

The Climate Change Act established the Committee on Climate Change (CCC) to advise the UK government and the Devolved Administrations on setting and meeting carbon budgets and other related matters.

The Scottish Parliament passed the Climate Change (Scotland) Act in 2009, establishing Scotland's 2050 target and the supporting framework of interim and annual targets. The Scottish Government is required to publish reports every five years setting out the policies and proposals to meet annual targets over periods of around the next fifteen years. The Climate Change (Scotland) Act also establishes Scotland specific roles for the CCC as an independent advisory body. On 25 September 2019, the Scottish Parliament approved the Climate Change (Emissions Reductions Targets) (Scotland) Act. Following advice received from the CCC, the Act sets a net zero emissions target for 2045. It also includes interim targets of a 75% reduction by 2030 and a 90% reduction by 2040 and makes provision for the establishment of a Citizens Assembly on Climate Change.

[33] Actual emissions (carbon budgets 1 and 2) - Source: BEIS, Final UK GHG emissions statistics 1990-2017 (table 9) www.gov.uk/government/statistics/final-uk-greenhouse-gas-emissions-national-statistics-1990-2017

Projected emissions (carbon budgets 3, 4 and 5) - Source: BEIS, Energy and Emissions Projections 2018 (web table 2.3), www.gov.uk/government/publications/updated-energy-and-emissions-projections-2018

[34] Base year emissions are revised each year, so the percentage reductions against carbon budgets are subject to change.

The National Assembly for Wales passed the Environment (Wales) Act in 2016[35], which includes Wales's 2050 target and allows for the establishment of an advisory body. The CCC currently exercises these functions. The National Assembly passed secondary legislation in 2018 to set decadal interim targets and the first two carbon budgets. Since then, the Welsh Government has accepted the CCC's recommendation to increase Wales's 2050 target to 95% and has requested the CCC's advice on how this affects the interim targets and carbon budgets set in 2018. The Welsh Government will ask the Welsh Parliament to amend the targets and budgets legislation in 2020.

1.3 Consultations and involvement of national and EU entities and their outcome

i Involvement of the national parliament

In accordance with the Climate Change Act, a carbon budget must be made by order, subject to affirmative resolution procedure.[36] Before laying a draft statutory instrument containing an order setting a carbon budget, the UK government must take into account the advice of the CCC as well as any representations made by the Devolved Administrations.

A carbon budget must be set with a view to meeting the 2050 target and complying with international obligations of the UK. The Climate Change Act sets out a number of matters that must also be taken into account when deciding the level of a carbon budget.[37]

In Scotland, the Climate Change (Scotland) Act 2009, requires that Scottish Ministers set annual targets, in secondary legislation, for each year from 2010 to 2050. Scottish Ministers also take advice from the CCC on the targets before these are set.

In Wales, the Welsh Ministers must lay interim targets and carbon budgets in the Welsh Parliament. Before doing so, they must obtain and have regard to advice from the CCC. The Environment (Wales) Act 2016 sets out the matters Welsh Ministers must take into account when setting a carbon budget and those the CCC must consider in its advice.[38]

Reporting to Parliament

The UK government must lay before Parliament an Annual Statement of Emissions by 31 March in the second year following that to which it relates. It must also prepare and lay a Final Statement for each budgetary period by 31 May in the second year following the end of the period to which it relates, setting out, among other things, the final amount for the period of UK emissions, removals and net emissions of each greenhouse gas.

In June each year (and in July in the second year after the end of a budgetary period), the CCC must lay before Parliament a report setting out its views on progress against the carbon budgets and 2050 target, to which the UK government is required to respond by October. In

[35] Environment (Wales) Act 2016, www.legislation.gov.uk/anaw/2016/3/part/2/enacted
[36] More information on the affirmative resolution procedure can be found at: www.parliament.uk/site-information/glossary/affirmative-procedure/
[37] See s10(2) of the CCA: www.legislation.gov.uk/ukpga/2008/27/section/10
[38] Environment (Wales) Act 2016, www.legislation.gov.uk/anaw/2016/3/part/2/enacted

the second year after the end of a budgetary period the report will also set out the CCC's views on how the UK performed on meeting the last carbon budget.

In Scotland, Scottish Ministers must lay before the Scottish Parliament an annual report that states whether the annual target has been met. The CCC must lay before the Scottish Parliament an annual report setting out Scotland's progress against achieving its targets and the Scottish Government provide a response to this report.

In Wales, the Welsh Ministers must lay a statement in the Senedd no later than two years after the end of each budget outlining the final amount of net Welsh emissions and the number of offsets used. If the carbon budget has not been met, Welsh Ministers must within three months lay before the Senedd a report setting out proposals and policies to compensate for the excess emissions in later budgetary periods. Welsh Ministers must also lay a statement in the Senedd, within two years of each interim target year outlining the final amount of net Welsh emissions for the target year, the number of offsets used for the year and why the target has been met or missed.

Welsh Ministers must also lay CCC progress reports on carbon budgets and interim targets before the Senedd, and Ministers' respond to the points raised by the CCC within six months.

ii Involvement of local and regional authorities

The BEIS Local Energy Programme has now supported Local Energy Strategies for each of the 38 Local Enterprise Partnerships in England. These documents are feeding into Local Economic planning at local and regional levels. These strategies form the basis of new Local Energy Hubs, which are resourced to support the development of commercially viable low-carbon energy projects. This includes raising awareness, building partnerships with green finance as well as developing the pipeline of projects. To support the hubs, we are also building a number of tools including the SCATTER tool which will support Local Authorities to report on action and also to help prioritise actions.

Alongside the Local Energy Programme, we have launched a UK wide innovation programme, Prospering from the Energy Revolution, which is working with Local Authorities across the UK to demonstrate and design future local energy systems.

The Scottish Government has an ambition to achieve 1GW of community and locally owned renewables by 2020, and 2GW by 2030, as well as an ambition to spread the economic benefits of commercial renewables schemes through shared ownership with communities.[39] As of June 2017, there was an estimated minimum of 666 MW of community and locally owned renewable energy capacity operating in Scotland. Local government in Scotland is already playing a key role in delivering energy efficiency programmes, primarily for the domestic sector. The Scottish Government sees a stronger role for local government in the future. In 2017, there was a consultation on the possible introduction of a statutory duty on local authorities to develop Local Heat and Energy Efficiency Strategies (LHEES), to be delivered in consultation with local stakeholders and in collaboration with community planning partners. This would provide the link between the delivery of long-term targets and national policies, and the delivery of energy efficiency and heat decarbonisation on the ground. A position paper on Local Energy Systems in Scotland has been developed, further to a commitment made in the Energy Strategy, and is due to be published in Autumn 2020.

[39] Source: Renewable and low carbon energy, Scottish Government website, www.gov.scot/policies/renewable-and-low-carbon-energy/local-and-small-scale-renewables/

The Welsh Government is supporting local authorities in the development of energy plans. There are transformative opportunities in developing local or regional energy plans, driven by network and/or national regional energy data, which will help decision-making and enable us to meet decarbonisation objectives in Wales. The Welsh Government has committed to providing support to enable regional strategic energy plans to be developed, as part of the Cardiff City Region and the Mid Wales and North Wales Growth Deals work. This will build on earlier work undertaken in the Swansea Bay City Region by the Institute of Welsh Affairs and Regen.[40] Using the learning from this work, the Welsh Government will explore the potential for developing more locally owned energy plans, which could lead to pipelines of energy projects and provide more clarity on the energy infrastructure required for a low-carbon energy system in Wales.

The Welsh Government has set a target to produce 70% of the electricity Wales uses from renewable sources by 2030, and for 1GW of locally owned renewable energy capacity by 2030. In 2018 Wales generated enough renewable electricity to meet 50% of its power use. At the end of 2018 there was 783MW of renewable energy in local ownership in Wales. 540MW of this capacity is renewable electricity and 243MW is renewable heat. In total there are over 64,600 locally owned renewable energy projects in Wales.[41]

iii Consultations of stakeholders, including the social partners, and engagement of civil society and the general public

The UK is committed to proper public participation and consultation and is committed to meeting its obligations under Article 7 of the Aarhus Convention, which are set out in the UK's published Consultation Principles.[42]

Ahead of the UK government setting a carbon budget, it is required to consider the advice of the CCC on the appropriate budget level, as well as any representations made by the Devolved Administrations. For the fifth carbon budget, the CCC published its advice in November 2015 and the budget was set in June 2016, in line with the requirements of the Climate Change Act. In preparing its advice on the level of the fifth carbon budget, the CCC ran a public call for evidence in mid-2015, to which 51 organisations responded. These organisations included representatives from the power, transport, buildings, industrial and agricultural sectors, as well as Non-Governmental Organisations (NGOs) and others. In addition, the CCC ran more than ten roundtable and workshop discussions with business stakeholders, including trade associations, and more than 200 meetings with individual stakeholders across all sectors including areas such as fuel poverty, competition and technological progress.

In the Clean Growth Strategy, the UK government stated that it welcomed views and comments on our approach to decarbonising the economy. An opportunity to provide feedback on the Strategy was provided between 12 October and 31 December 2017, and we received 132 responses from a wide range of stakeholders, including individuals, companies from different sectors, academia, trade associations, NGOs and local government.

As the policies and proposals in the Clean Growth Strategy are developed and implemented over time, they are subject to public consultation as part of the normal regulatory process.

[40] Swansea Bay City Region: A Renewable Energy Future, April 2018, www.iwa.wales/wp-content/uploads/2018/04/Regen-SBCR-A-Renewable-Future-FINAL.pdf
[41] Energy generation in Wales, Welsh Government website, https://gov.wales/energy-generation.
[42] UK Consultation Principles, July 2012, www.gov.uk/government/publications/consultation-principles-guidance

The UK government has conducted a number of public consultations on issues relating to the five dimensions of the EU's Energy Union, including on the UK Industrial Strategy Green paper.[43] A list of stakeholder and public consultations is set out below.

In summer 2018, the Welsh Government consulted on early ideas for meeting the Wales 2030 target across all emissions sectors.[44] Further policy-specific engagement and consultation will follow as appropriate.

The Scottish Energy Strategy committed the Scottish Government to publishing an Annual Energy Statement to monitor the strategy's delivery. The first of these was published on 15 May 2019 alongside a new Annual Compendium of Scottish Energy Statistics (ACSES).

The statement highlights the key developments in the sector which will have an impact upon Scotland's ability to deliver the strategy, progress made to date, and key plans for the coming year and beyond.

The Scottish Government has also consulted with the Scottish Energy Advisory Board (SEAB) on progress of the Energy Strategy and is working towards agreeing a new structure of expert advisory groups – one that is consistent with, and ensures effective coverage of, the strategic priorities set out in the strategy.

The Scottish Government's Climate Change Programme is supported by a range of engagement activities. The Big Climate Conversation included strands for the public sector, private sector and members of the public. This is an important part of shaping Scotland's response to the global climate emergency and all government portfolios are encouraged to engage with the events.

The public engagement element consisted of a series of 10 large scale, open public workshops designed to ascertain the public's awareness of the issue as a national endeavour and the appetite for particular societal changes and actions required to meet Scotland's goals. The workshops were supplemented by a programme of digital engagement through Twitter and Facebook and a free toolkit and funding were provided to enable groups to conduct their own sessions and contribute to the conversation. Over 2,500 people across Scotland participated in the Big Climate Conversation. The findings were summarised in the Big Climate Conversation Report that was published on 30 January 2020.[45]

With regards to public sector engagement a written consultation on the role of the public sector in tackling climate change, ran from September to December 2019. There is also a series of face-to-face engagements using existing networks such as the Scottish Leaders Forum, Convention of Highlands and Islands, and the Sustainable Scotland Network. Business engagement is happening with both multi-stakeholder and sector specific events. The Cabinet Secretaries for Finance, Economy and Fair Work will host a Business Summit in October; the Cabinet Secretary for Environment, Climate Change and Land Reform will host a climate change workshop at the Business in Parliament event in November; and other workshop events are being planned for small businesses (with FSB) and larger businesses (with CBI). In parallel, additional sector specific, portfolio-led business engagement events are being

[43] Industrial Strategy consultation, 2017, www.gov.uk/government/consultations/building-our-industrial-strategy
[44] A low carbon pathway for Wales (consultation), October 2018, https://gov.wales/low-carbon-pathway-wales
[45] Big Climate Conversation Report, published January 2020: www.gov.scot/publications/report-findings-big-climate-conversation/

planned, including the Energy Intensive Industry roundtable and an event focusing on decarbonising transport fleets.

The Department for the Economy in Northern Ireland has been considering how to advance proposals for an energy strategy that will enable new and challenging decarbonisation targets. Following a Call for Evidence in December 2019 the department will consider the responses and plans to establish five working groups on consumers, energy efficiency, heat, power and transport. A summary report of responses will be published in June 2020. The department intends to develop an Energy Transition Model for the entire energy system which will test different scenarios and pathways to estimate the impact on energy demand. An options paper will be published by end of March 2021 with the aim of a final strategy in place by November 2021.

Table 2: UK Consultations

EU Dimension	Consultation	More Information
Decarbonisation	An emissions reduction target for the wider public and higher education sectors: A summary of responses to the call for evidence	www.gov.uk/government/consultations/leading-by-example-cutting-energy-bills-and-carbon-emissions-in-the-public-and-higher-education-sectors
	E10 petrol, consumer protection and fuel pump labelling	www.gov.uk/government/consultations/e10-petrol-consumer-protection-and-fuel-pump-labelling
	Proposals for a new Climate Change (Scotland) Bill (2017)	https://consult.gov.scot/energy-and-climate-change-directorate/climate-change-bill/
	The Renewable Transport Fuel Obligations Order: Proposed changes for 2017	www.gov.uk/government/consultations/renewable-transport-fuel-obligation-proposed-changes-for-2017
	Renewables Obligation closure consultation	www.gov.uk/government/consultations/transition-from-the-renewables-obligation-to-contracts-for-difference
	Feed-in-Tariffs closure consultation	www.gov.uk/government/consultations/feed-in-tariffs-scheme
	Contracts for Difference publications	www.gov.uk/government/publications/contracts-for-difference/contract-for-difference
	The Renewable Heat Incentive: A reformed and refocussed scheme	www.gov.uk/government/consultations/transition-from-the-renewables-obligation-to-contracts-for-difference www.gov.uk/government/consultations/renewables-obligation-ro-grace-periods
	The future of low-carbon heat for off gas buildings: a call for evidence	https://consult.gov.scot/better-homes-division/the-future-of-low-carbon-heat/

EU Dimension	Consultation	More Information
	Smart Export Guarantee (SEG)	www.gov.uk/government/consultations/the-future-for-small-scale-low-carbon-generation
	Wales: Achieving our low-carbon pathway to 2030	https://gov.wales/low-carbon-pathway-wales
	Wales: Locally-owned renewable energy – Call for evidence	https://gov.wales/locally-owned-renewable-energy-call-evidence
	Carbon Capture, Usage and Storage: Re use of oil and gas infrastructure for CCUS projects	www.gov.uk/government/consultations/carbon-capture-usage-and-storage-ccus-projects-re-use-of-oil-and-gas-assets
	Carbon Capture, Usage and Storage: Business Models	www.gov.uk/government/consultations/carbon-capture-usage-and-storage-ccus-business-models
	Regulated Asset Base (RAB) model for nuclear	www.gov.uk/government/consultations/regulated-asset-base-rab-model-for-nuclear
	New NI Energy Strategy Call for Evidence	www.economy-ni.gov.uk/energy-strategy-call-for-evidence
	The Future of UK Carbon Pricing	www.gov.uk/government/consultations/the-future-of-uk-carbon-pricing
Energy efficiency	Building a market for energy efficiency: Call for evidence and summary of responses	www.gov.uk/government/consultations/building-a-market-for-energy-efficiency-call-for-evidence
	Energy Performance Certificates in buildings: Call for evidence	www.gov.uk/government/consultations/energy-performance-certificates-in-buildings-call-for-evidence
	Call for evidence and summary of responses on the Green Deal Framework	www.gov.uk/government/consultations/call-for-evidence-on-the-reform-of-the-green-deal-framework
	Widening eligibility for energy intensive industries for renewable cost exemption schemes	www.gov.uk/government/consultations/widening-eligibility-for-renewable-electricity-cost-relief-schemes
	Energy Company Obligation: ECO3, 2018 to 2022 ECO3: Improving Consumer Protection	www.gov.uk/government/consultations/energy-company-obligation-eco3-2018-to-2022 https://www.gov.uk/government/consultations/energy-company-obligation-eco3-improving-consumer-protection

EU Dimension	Consultation	More Information
	Removal of 'no cost to the land' principle in domestic private rented sector energy efficiency regulations (England and Wales)	www.gov.uk/government/consultations/domestic-private-rented-sector-minimum-level-of-energy-efficiency
	Energy efficiency scheme for small and medium sized businesses: call for evidence	www.gov.uk/government/consultations/energy-efficiency-scheme-for-small-and-medium-sized-businesses-call-for-evidence
	Non-domestic Private Rented Sector minimum energy efficiency standards: future trajectory to 2030	www.gov.uk/government/consultations/non-domestic-private-rented-sector-minimum-energy-efficiency-standards-future-trajectory-to-2030
	Heat Networks Investment Project	www.gov.uk/government/consultations/consultation-on-the-heat-networks-investment-project-hnip
	Warm Home Discount	www.gov.uk/government/consultations/warm-home-discount-scheme-2018-to-2019
	Energy Efficient Scotland	https://consult.gov.scot/better-homes-division/energy-efficient/
	Future Homes Standard: 2019 Consultation on changes to Part L (conservation of fuel and power) and Part F (ventilation) of the Building Regulations for new dwellings	www.gov.uk/government/consultations/the-future-homes-standard-changes-to-part-l-and-part-f-of-the-building-regulations-for-new-dwellings
Energy security	Capacity Market-related publications and consultations	www.gov.uk/government/collections/electricity-market-reform-capacity-market www.ofgem.gov.uk/publications-and-updates/report-our-five-year-review-capacity-market-rules-and-forward-work-plan www.gov.uk/government/consultations/capacity-market-carbon-dioxide-emissions-limits www.gov.uk/government/publications/capacity-market-5-year-review-2014-to-2019
	Petroleum extraction (Welsh Government)	Petroleum extraction policy in Wales: https://gov.wales/petroleum-extraction-policy-wales

EU Dimension	Consultation	More Information
Energy security	Ofgem (Office of Gas and Electricity Markets) Developing a Framework for Assessing Whether the Conditions for Effective Competition are in Place	www.ofgem.gov.uk/publications-and-updates/developing-framework-assessing-whether-conditions-are-place-effective-competition-domestic-supply-contracts
	RIIO 2 framework Consultation	www.ofgem.gov.uk/publications-and-updates/riio-2-framework-consultation
	Smart systems and flexibility plan	www.ofgem.gov.uk/publications-and-updates/upgrading-our-energy-system-smart-systems-and-flexibility-plan
	Smart systems and flexibility plan: progress update	www.gov.uk/government/publications/upgrading-our-energy-system-smart-systems-and-flexibility-plan
	Ofgem RIIO-ED2	www.ofgem.gov.uk/publications-and-updates/open-letter-consultation-riio-ed2-price-control
	Government response on proposals regarding the planning system for electricity storage	www.gov.uk/government/consultations/the-planning-system-for-electricity-storage-follow-up-consultation
	Electric vehicle smart charging	www.gov.uk/government/consultations/electric-vehicle-smart-charging
	Smart appliance proposals	www.gov.uk/government/consultations/proposals-regarding-setting-standards-for-smart-appliances
	The most recent consultation by Ofgem on the needs case for the connection to Hinkley Point C	www.ofgem.gov.uk/publications-and-updates/hinkley-seabank-consultation-final-needs-case-and-potential-delivery-models
	Smart meter interoperability	www.gov.uk/government/consultations/maximising-interoperability-for-first-generation-smets1-smart-meters
	Smart meter interoperability	www.gov.uk/government/consultations/enrolment-of-smets1-meter-cohorts-with-the-data-communications-company
	Smart meter interoperability	www.gov.uk/government/consultations/enrolment-of-secure-smets1-meters-in-the-data-communications-company-dcc
	Smart metering policy framework post-2020	www.gov.uk/government/consultations/smart-meter-policy-framework-post-2020

The UK held a 'Green Great Britain & Northern Ireland Week' in October 2018, to showcase the opportunities clean growth offers the UK and raise understanding of how business and the public can contribute to tackling climate change. Next year, the UK will host the UN climate change conference COP26, in Glasgow with our partners, Italy. The UK is committed to working with all countries and joining forces with civil society, companies and people on the frontline of climate change to inspire action ahead of COP26.

iv Consultations of EU Member States

As of 31 January, the UK has left the EU and is no longer a Member State. While a Member State the UK worked closely with Member States party to the North Seas Energy Cooperation (NSEC). The UK also worked with Member States on various technical and policy aspects of the draft NECP during workshop sessions at the NECP Technical Working Groups meetings. UK government officials attended workshops in France, Germany and the Netherlands to share ideas and comment on their respective NECPs. UK government officials also engaged in discussions with officials from Member States on preparation of their respective NECPs during meetings of the Concerted Action on the Energy Efficiency Directive (CA-EED).

v Iterative process with the Commission

A representative from BEIS attended NECP Technical Working Group meetings in 2018 and 2019 during the development of Member States' National Energy and Climate Plan (NECPs), taking onboard Commission advice in the development of the draft and final NECP.

Following the submission of the UK's draft NECP in December 2018, the Commission published a suite of documents under the Governance Regulation assessment and recommendations process. This included 11 formal recommendations for the UK to consider in its final NECP and an assessment of the draft NECP, which underpinned the Recommendations document. The UK government has considered all of the Commission's recommendations carefully in view of the UK's departure from the EU as of 31 January 200, and has provided a response to each at Annex A to this NECP document.

1.4 Regional cooperation in preparing the plan

i Elements subject to joint or coordinated planning

ii Explanation of how regional cooperation is considered in the plan

North Seas Energy Cooperation

The UK is part of the wider North Seas region, which has a large renewable energy potential.

Offshore wind generation and grid infrastructure projects may have cross-border effects on energy prices, security of supply and the environment, including availability of marine space as well as the pace of innovation. The North Seas countries therefore have benefits to gain from cooperation.

The NSEC a voluntary, market-oriented, regional cooperation initiative established in 2016.[46] The NSEC is a voluntary, market-oriented, regional cooperation initiative established in 2016.[47] It aims to coordinate and facilitate further cost-effective deployment of offshore renewable energy, in particular wind, ensuring a sustainable, secure and affordable energy supply in the North Seas countries.

Regional cooperation

The UK made use of the NSEC in preparing this plan, by experts in the support groups sharing information, best practice and experiences on specific issues, for example on barriers to offshore wind and grid development and on aggregating national renewable energy trajectories for offshore wind by 2030.

The UK furthermore consulted on its NECP in the area of planned offshore wind deployment until 2030 and related grid planning aspects with the other North Seas countries, while a member.

[46] The North Seas Energy Cooperation, https://ec.europa.eu/energy/topics/infrastructure/high-level-groups/north-seas-energy-cooperation_en
[47] The North Seas Energy Cooperation, https://ec.europa.eu/energy/topics/infrastructure/high-level-groups/north-seas-energy-cooperation_en

2. National objectives and targets

2.1. Decarbonisation

2.1.1 Greenhouse Gas (GHG) emissions and removals

i The elements set out in Article 4(a)(1) of Regulation (EU) 2018/1999

ii Where applicable, other national objectives and targets consistent with the Paris Agreement and the existing long-term strategies. Where applicable, other objectives and targets, including sector targets and adaptation goals, if available

The Paris Agreement on climate change entered into force on 4 November 2016. It was ratified by the UK on 18 November 2016. Parties to the Paris Agreement are required to prepare, communicate and maintain successive Nationally Determined Contributions (NDCs). The UK will come forward with an enhanced NDC well ahead of the 26th UN Climate Change Conference of the Parties (COP26).

The first joint EU/Member State NDC for the period of 2021-2030 was published in 2015. This commits the EU to at least 40% reduction in greenhouse gas emissions by 2030 compared to 1990 levels. The EU has adopted a legally binding domestic framework to meet its NDC commitments in both the traded sector (covered by Directive 2003/87/EC) and the non-traded sector. The EU's non-traded sector is covered by the following legislation.

Effort Sharing Regulation

EU Member States have binding annual greenhouse gas emission targets for 2021-2030 for those sectors of the economy that fall outside the scope of the EU Emissions Trading System (EU ETS), such as transport, buildings, waste and agriculture. As a whole, the EU has committed to reduce emissions in these sectors by 30% by 2030 compared to 2005.

As of 31 January 2020, the UK has left the EU, and therefore will not contribute to EU targets or be bound by the Effort Share Regulation after the Transition Period ends. The estimated emission trajectory and the resulting annual emission limits are set out in the table below.

Table 3: Calculated annual indicative GHG emission allocations for the UK from 2021 to 2030.

These are calculated on the basis Global Warming Potentials from the IPCC's 4th Assessment Report.

Year	2005 (base year)[48]	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Annual Emission Allocation (MtCO2e)[49]	416	321	315	308	301	295	288	282	275	268	262

Land use, land use change and forestry (LULUCF)[50]

Under further EU legislation adopted in May 2018, EU Member States agreed to ensure that greenhouse gas (GHG) accounted emissions from land use, land use change and forestry (LULUCF) are offset by at least an equivalent accounted sink for the periods from 2021-25 and from 2026-30 individually, as specified in Article 4 of the Regulation (EU) 2018/841. There are several flexible mechanisms to help Member States comply. As of 31 January 2020, the UK has left the EU, and will therefore not contribute to EU targets after the Transition Period ends.

The UK Climate Change Act 2008, including carbon budgets

This is explained in 1.1(ii) and 1.3(i).

Devolved Climate Change Legislation

Climate change policy is devolved to Wales, Scotland and Northern Ireland, although the UK government retains control over many policy areas that have great potential for emissions reduction.

The Environment (Wales) Act 2016[51] requires Welsh Ministers to reduce emissions in Wales by at least 80% in 2050. This Act also requires Welsh Ministers to set interim emissions reduction targets for the years 2020, 2030 and 2040, and establish a system of carbon budgeting that together create an emissions reduction pathway to the 2050 target. Regulations passed by the National Assembly for Wales in December 2018 set the 2020 target at 27%, the 2030 target at 45% and the 2040 target at 67%. The first two carbon budgets (2016-20 and 2021-25) were also set in legislation. Since then, the Welsh Government has accepted the CCC's recommendation to increase Wales's 2050 target to 95% and has requested the CCC's advice on how this affects the interim targets and carbon budgets set in 2018. It has also asked the CCC to explore how Wales might go beyond 95%. The Welsh Government will ask the Senedd to amend the targets and budgets legislation in early 2021.

Scotland's climate change legislation requires Scottish Ministers to reduce emissions in Scotland to net-zero by 2045, with interim targets of 56% reduction (from a 1990 baseline) by

[48] 2005 data from ESD dataset 2018 (data used was originally taken from ESD dataset 2019 which has since been revised) : www.eea.europa.eu/data-and-maps/data/esd-2
[49] Starting point for Annual Emission Allocations calculated by taking average of 2016, 2017 and 2018 UK ESD emissions from ESD dataset 2019: www.eea.europa.eu/data-and-maps/data/esd-2
[50] This analysis is based on reported emissions, not on accounted emissions following the regulation 2018/841.
[51] Environment (Wales) Act 2016, www.legislation.gov.uk/anaw/2016/3/contents/enacted

2020, 75% reduction by 2030, 90% reduction by 2045 and annual targets for each other year to net-zero.

The Climate Change Plan published in February 2018 sets out the Scottish Government's comprehensive package of policies and proposals for meeting emissions reduction targets under the Climate Change (Scotland) Act 2009 over the period to 2018 to 2032 – these targets have subsequently been increased (as above) through the Climate Change (Emissions Reduction Targets) (Scotland) Act 2019. The second annual report monitoring progress towards the Plan was published in December 2019.[52] The Scottish Government has committed to update the Plan in December 2020 to reflect the increased ambition of the 2019 Act targets. The Climate Change (Scotland) Act 2009 required Scottish Ministers to reduce emissions in Scotland by at least 80% by 2050, with an interim target of 42% by 2020 and annual targets for each year to 2050.

2.1.2 Renewable energy

i The elements set out in point (a)(2) of Article 4 of Regulation (EU) 2018/1999

The UK is producing record levels of renewable energy. We have performed particularly strongly with regards to renewable electricity – by the end of 2018 we had already achieved our original ambition of 31% for that sector in 2020, as set out in our 2010 National Renewable Energy Action Plan.[53] We continued our progress in the power sector with a record 38.9% of total electricity generation coming from renewables in the third quarter of 2019.[54] Offshore wind is a particular British success story, with new projects awarded contracts at record low prices creating opportunities for jobs and economic growth. Building on our achievements to date, the UK supports continued deployment of cost-effective renewable energy through the 2020s in line with our ambitious domestic decarbonisation objectives.

The EU has a target under the Renewable Energy Directive of 32% of energy coming from renewable sources in 2030, with Member States required to set their own non-binding contributions to collectively achieve the EU target. As of 31 January 2020, the UK has left the EU and will therefore not contribute to EU targets or be bound by the Renewable Energy Directive after the Transition Period ends.

However, to comply with our commitments under the Withdrawal Agreement with respect to the NECP, the UK has set out a proportion of renewables in final energy consumption in 2030 of between 22%-29%,[55] based on estimates of the level of renewables deployment which may be required to meet our carbon budgets and net zero target.[56] Future policies and strategies for encouraging deployment of renewable energy will be set out in forthcoming publications such as our Energy White Paper and Heat and Buildings Strategy.

[52] Second annual report monitoring progress towards Scotland's 2018 Climate Change Plan, Dec 2019, www.gov.scot/publications/climate-change-plan-monitoring-report-2019/
[53] UK National Renewable Energy Action Plan (NREAP) 2010, available at: www.gov.uk/government/publications/national-renewable-energy-action-plan
[54] Energy Trends: December 2019, section 6.3: www.gov.uk/government/statistics/energy-trends-section-6-renewables
[55] The UK will not contribute to the EU's renewable energy target. Should a point number be required for the purposes of Article 4(a)(2) of the Governance Regulation, this should be taken from the minimum bound of this range (i.e. 22%).
[56] Analysis does not account for impacts resulting from COVID-19.

The data in Table 4 show a trajectory to reach a 22%-29% proportion of renewable energy in 2030.

Table 4: Illustrative trajectory for proportion of renewable energy in final energy consumption.

Year	2020 Target	2022	2025	2027	2030
Proportion of renewables in final energy consumption	15%	16% - 18%	18% - 21%	20% - 24%	22% - 29%

ii Estimated trajectories for the sectoral share of renewable energy in final energy consumption from 2021 to 2030 in the electricity, heating & cooling, and transport sector

The UK supports cost-effective deployment of renewable and low-carbon energy to meet our domestic emissions reduction goals. It is likely that the balances between different sectors could change as we develop further policies and take additional action to decarbonise the UK energy system during the 2020s. The estimated trajectories in the electricity, heating & cooling and transport sectors shown in Table 5 and 6 below are therefore potential pathways for the purpose of complying with our commitments under the Withdrawal Agreement. They should not be taken as fixed targets for – or limits to – the UK's ambition for renewables deployment to 2030.

Table 5: Pathway 1, estimated trajectories for the sectoral proportion of renewable energy in final energy consumption

Sector	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Electricity	38%	39%	45%	46%	48%	50%	49%	48%	49%	50%
Heating & Cooling	10%	10%	10%	10%	11%	11%	12%	12%	13%	13%
Transport (including multipliers)[57]	11%	12%	13%	13%	14%	14%	15%	15%	16%	16%

[57] Transport data include the double weighting of some biofuels, as permitted under the Renewable Energy Directive.

Table 6: Pathway 2, estimated trajectories for the sectoral share of renewable energy in final energy consumption

Sector	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Electricity	38%	39%	45%	48%	52%	58%	62%	65%	70%	75%
Heating & Cooling	10%	11%	11%	12%	13%	13%	14%	15%	16%	17%
Transport (including multipliers)[58]	11%	12%	13%	13%	14%	14%	15%	15%	16%	16%

Note: Individual sectoral shares may not necessarily sum to the overall renewable share

iii Estimated trajectories by renewable energy technology to achieve the overall and sectoral trajectories for renewable energy from 2021 to 2030 including expected total gross final energy consumption per technology and sector in Mtoe and total planned installed capacity (divided by new capacity and repowering) per technology and sector in MW

Electricity

The UK is looking at several options and technology pathways in 2020 for expanding our deployment of renewables in the electricity sector in order to help reach net zero in 2050. This will include publication of an Energy White Paper and a range of other documents to support our climate ambitions. In light of where we are in terms of domestic policy development, we are unable to provide a breakdown for the renewable electricity technology mix at this point.

Heat

The CGS identifies heat as the most difficult decarbonisation challenge facing the country: meeting our net zero target will require virtually all heat in buildings to be decarbonised, and heat in industry to be reduced to close to zero carbon emissions. This will involve large-scale transformation of energy systems and markets, changing the way we supply heating and cooling to over 28 million buildings – the vast majority of which (85% of households, and 70% of all heat use) currently use natural gas in our extensive gas network.

Due to the UK's natural resources and historical investment and infrastructure decisions, the UK has one of the highest dependencies globally on natural gas for heating.[59]

In 2018, the UK government published a review of the options for the UK to meet our legally binding emissions reduction in heat target by 2050.[60] This report outlined the different options for decarbonising heat – including heat networks, heat pumps, low-carbon hydrogen, and biogas – and concluded that there is no clear consensus on the best approach to decarbonising heat at scale in the UK. This makes it extremely difficult to estimate with any certainty the technology mix for renewable heat over the next ten years.

[58] Transport data include the double weighting of some biofuels, as permitted under the Renewable Energy Directive.
[59] International Comparisons of heating, cooling and heat decarbonisation policies, www.gov.uk/government/publications/international-comparisons-of-heating-cooling-and-heat-decarbonisation-policies
[60] UK Government evidence review, 'Clean Heat: Transforming Heating' - www.gov.uk/government/publications/heat-decarbonisation-overview-of-current-evidence-base

Following the publication of our report, we are committed to publishing a Heat and Buildings Strategy, which will set out the immediate actions we will take for reducing emissions from buildings. These actions include the deployment of additional energy efficiency measures and low-carbon heating, as part of an ambitious programme of work required to enable key strategic decisions on how we achieve the mass transition to low-carbon heat and set us on a path to decarbonising all homes and buildings. In light of where we are in terms of domestic policy development, we are unable to provide a breakdown for the renewable heat technology mix at this point.

Transport

The UK's domestic policy for renewable transport fuels, the Renewable Transport Fuel Obligation, has set in law a biofuels volume target of 12% to 2032.[61] Transport has a huge role to play in the UK economy reaching net zero. The UK is developing an ambitious plan to accelerate the decarbonisation of transport. As with the heat and electricity sectors, in light of where we are in terms of domestic policy development, we are unable to provide a breakdown for the renewable transport technology mix at this point.

iv Estimated trajectories on bioenergy demand, disaggregated between heat, electricity and transport, and on biomass supply by feedstocks and origin (distinguishing between domestic production and imports). For forest biomass, an assessment of its source and impact on the LULUCF sink

Bioenergy demand

Current biomass policy has been informed by the CCC's 2011 Bioenergy Review and the UK government's 2012 Bioenergy Strategy. The strategy recommended support for sustainably produced biomass that delivers real greenhouse gas savings, is cost effective, taking into account wider impacts across the economy and that possible key risks from biomass (such as to food security and air quality) continue to be monitored and managed. The CCC published its 2018 Bioenergy Review (Biomass in a low-carbon economy)[62] in November 2018.

Biomass is an important technology, helping the UK on its path to a low-carbon economy. The CGS sets out the need to lay the groundwork for setting up decisions that will be made in the first half of the next decade about the long-term future of heat; the role that bioenergy can play in this is currently being explored. The Renewable Heat Incentive, which supports solid biomass and biogas technologies for heat, and biomethane injection to the gas grid, has budget confirmed to 2021. The UK government, however, recognises that there are scenarios where bioenergy could further support the decarbonisation of heat, for example in buildings that are currently dependent on coal and oil, and for which electrification is not the most suitable option, or where high temperature dispatchable heat is required for industry.

Bioenergy for transport is expected to be used in all forms of transport including for aviation fuels. It is incentivised via the RTFO and is expected to deliver around 27 Terawatt hours (TWh) of biomass derived energy in transport in 2032.[63]

[61] Guidance: Renewable Transport Fuel Obligation: www.gov.uk/guidance/renewable-transport-fuels-obligation
[62] Biomass in a low carbon economy (2018): www.theccc.org.uk/publication/biomass-in-a-low-carbon-economy
[63] Renewable Transport Fuel Obligations Order: government response (2017), www.gov.uk/government/publications/renewable-transport-fuel-obligations-order-government-response

Biomass supply

In the UK the main biomass feedstocks are:

a. **Biomass wastes** – sourced from food, sewage, or the biomass portion of mixed black bag waste – if not used for biomass these wastes may go to landfill and produce methane.[64] Use in the energy sector avoids these additional emissions and provide generators a fee for accepting the waste.[65]

b. **Woody/dry biomass residues** – sourced from sustainably managed forestry residues or by-products from agriculture (such as straw) or timber production. The effects of this harvesting are reported in the UK emission inventory.[66] The UK also imports woody biomass from North America and Europe which is reported in accordance with the source country's inventory.

c. **Energy crops** – domestically produced, these include fast-growing trees or grasses grown on low grade farmland that is not suitable for food production.

d. **Other crops** – domestically and internationally produced, these include food crops such as oil seed rape and sugar beet.

The Renewable Heat Incentive scheme[67] has imposed restrictions on the use of energy crops, to encourage the use of at least 50% agriculture and food waste feedstocks rather than energy crops. This change came into effect on 22 May 2018.

In transport, the RTFO includes a cap on the amount of incentive available for fuels made from 'other crops'. This is set at 4% in 2018/19 and reduces to 2% in 2032.[68] Detailed data is available on the origin and type of biomass feedstocks used to supply biofuels in the UK market. Nearly one third of biomass is sourced domestically and the remainder is imported. In 2018, nearly 70% of renewable transport fuels supplied were made from wastes.[69] Information on the volumes and types of biomass expected to be used to meet the RTFO targets in the period to 2032 is available in the cost benefit analysis that accompanied the legislation.[70]

For electricity, biomass electricity plants supported under our incentive schemes are required to provide information on biomass use to Ofgem. The latest information can be found via Ofgem's website.[71]

[64] For example, the Renewable energy directives provides a credit for the avoided emissions from methane when using wet wastes such as manure in anaerobic digestion (http://publications.jrc.ec.europa.eu/repository/bitstream/JRC104759/ld1a27215enn.pdf).
[65] Anaerobic digestion plants are paid between £0-65 per tonne to take source separated food waste. Energy from waste incinerators are paid between £26 and £144 per tonne to process 'refuse derived fuel'. (source: www.wrap.org.uk/sites/files/wrap/Gate%20Fees%20report%202017_FINAL_clean.pdf).
[66] UK Emissions Inventory: www.gov.uk/government/collections/uk-greenhouse-gas-emissions-statistics
[67] The Renewable Heat Incentive: A reformed Scheme (Consultation response), 2016: www.gov.uk/government/consultations/the-renewable-heat-incentive-a-reformed-and-refocused-scheme
[68] Renewable transport fuel obligations order: government response (2017), www.gov.uk/government/publications/renewable-transport-fuel-obligations-order-government-response
[69] Biofuels statistics, published 2019, www.gov.uk/government/collections/biofuels-statistics
[70] Cost Benefit Analysis: Amendments to the RTFO, 2017, www.legislation.gov.uk/uksi/2018/374/pdfs/uksiod_20180374_en.pdf
[71] Biomass Sustainability Dataset, Ofgem, available at: www.ofgem.gov.uk/publications-and-updates/biomass-sustainability-dataset-2017-18

v Where applicable, other national trajectories and objectives, including those that are long term or sectoral (e.g. share of renewable energy in district heating, renewable energy use in buildings, renewable energy produced by cities, energy communities and self-consumers, energy recovered from the sludge acquired through the treatment of wastewater)

Not applicable.

2.2 Energy efficiency

i The elements set out in point (b) of Article 4 of Regulation 2018/1999, where the elements in point (b) are:

(a) An indicative contribution to the Union's energy efficiency targets of at least 32.5% in 2030 (either Primary Energy Consumption (PEC) or Final Energy Consumption (FEC))

The EU has a headline target under the Energy Efficiency Directive to reduce energy consumption by 32.5% in 2030, with Member States required to set their own indicative contributions to the EU target. As of 31 January 2020, the UK has left the EU and will therefore not contribute to EU targets or be bound by the Energy Efficiency Directive after the Transition Period ends.

However, to comply with our commitments under the Withdrawal Agreement with respect to the NECP, the UK has set out at Table 7 a trajectory that leads to a primary energy consumption in 2030 of 151 Mtoe (Net Calorific Value (NCV)).[72] This is consistent with the pathway for energy efficiency policy presented in the UK's 2017 CGS.

Energy efficiency has an important role to play in helping the UK to decarbonise, and future policies and strategies to better incentivise the deployment of energy efficiency measures in line with our net zero target will be set out in domestic publications, such as our forthcoming Heat and Buildings Strategy.

Although we are ambitious in our domestic plans for energy efficiency, it is important that we maintain flexibility in the policy mix throughout the 2020s as we develop further measures and take additional action to ensure we are decarbonising in the most cost-effective way. It should also be noted that energy consumption is impacted to a large extent by external factors which are difficult to predict, such as weather conditions, oil prices and economic performance.

[72] Analysis based on data up to 31 January 2020, does not account for impacts resulting from COVID-19.

Table 7: Estimated trajectory for Primary Energy Consumption and Final Energy Consumption 2021-2030 by Net Calorific Value (NCV)

	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Primary Energy Consumption (NCV)	168	165	164	162	157	156	157	155	153	154	151
Final Energy Consumption (NCV)	131	131	130	129	129	125	125	123	122	123	121

(b) The cumulative end-use energy savings achieved 2021-30 due to EE obligation schemes

EU Member States are required under Article 7 of the Energy Efficiency Directive to achieve energy savings of 0.8% as an annual average between 2021-2030 through supplier obligations and/or alternative measures. As of 31 January 2020, the UK has left the EU and will therefore not contribute to EU targets or be bound by the Energy Efficiency Directive after the Transition Period ends. However, to comply with our commitments under the Withdrawal Agreement, the UK has calculated the cumulative end-use energy savings for 2021-2030 as 719 TWh.

The UK has already introduced a wide range of policies to help households, businesses and the public sector reduce their energy use and save money, including supplier obligations, building regulations and taxation measures. Please see Annex B for the UK's Article 7 methodology and a list of these measures.

(c) the Long-Term Renovation Strategy (LTRS) elements listed in ii) below

See section 2.2(ii).

(d) the total floor area to be renovated or equivalent annual energy savings to be achieved from 2021-30 under Article 5 of Directive 2012/27/EU on the exemplary role of public bodies' buildings

Article 5 of the Energy Efficiency Directive requires EU Member States either to renovate, each year from 2021 to 2030, 3% of the floor space of their central government building stock that does not meet minimum energy performance standards in eligible buildings, or to take alternative measures to achieve equivalent energy savings by end 2030 in eligible buildings owned and occupied by central government.

As of 31 January 2020, the UK has left the EU and will not be required to achieve the energy savings envisaged under Article 5 after the Transition Period ends. However, to comply with our commitments under the Withdrawal Agreement, we have calculated the equivalent annual energy savings for 2021-2030 as 716.8 GWh.

During the period 2014-2020 the UK has been able to achieve energy savings in eligible buildings considerably in excess of the EU requirement. Moving into the 2020s and beyond, our central government buildings are expected to continue to play an exemplary role in respect of energy efficiency. Future energy savings and greenhouse gas reductions in government buildings will be in line with the wider public sector ambitions set out in the Clean Growth

Strategy. Further information will be provided in our next set of Greening Government Commitments (GGCs),[73] along with commitments on waste, water, transport and other sustainability priorities.

> *ii The indicative milestones for 2030, 2040 and 2050, the domestically established measurable progress indicators, an evidence-based estimate of expected energy savings and wider benefits, and their contributions to the Union's energy efficiency targets as included in the roadmaps set out in the long-term renovation strategies for the national stock of residential and non-residential buildings, both public and private, in accordance with Article 2a of Directive 2010/31/EU*

The UK government's full Long-Term Renovation Strategy (LTRS) for the UK building stock is currently in development and is expected to be published separately in 2020, as permitted under the derogation found in Article 53 of Regulation 2018/1999. As of 31 January 2020, the UK has left the EU, and will therefore not contribute to EU targets after the Transition Period ends.

The following pages contain the advance elements of the LTRS required for the NECP in accordance with Articles 3 and 4 of Regulation (EU) 2018/1999:

- The indicative milestones for 2030, 2040 and 2050.
- The roadmap with domestically established measurable progress indicators.
- An evidence-based estimate of expected energy savings and wider benefits, and the contributions to the Union's energy efficiency targets.

This content is indicative and subject to revision upon publication of the UK's full LTRS.

The content of this advance LTRS focuses on policies and initiatives owned primarily by the UK government. A wide range of additional initiatives are being undertaken by the Devolved Administrations. These will be set out in more detail in the UK's full LTRS, following consultation with the governments of Northern Ireland, Scotland and Wales.

Overview and indicative milestones of the UK's Long-Term Renovation Strategy

Overview

Our homes as well as industrial and commercial buildings have become more efficient in the way they use energy, which is helping to reduce emissions and cut energy bills. Greenhouse gas emissions from the UK's housing sector (excluding electricity supply) fell by nearly 16% between 1990 and 2018[74], despite an increase in the total number of homes in the UK. We have also improved the energy efficiency of non-domestic buildings since 1990, with emissions 18% lower in 2015.[75] However, the UK building stock continues to account for a significant proportion of the UK's greenhouse gas emissions and energy use, and further progress will be required in order to underpin the UK's legally binding 2050 net-zero target.

There are a number of possible technological pathways leading to the decarbonisation of the building stock. One illustrative pathway to meet the UK's carbon budget 5 (which covers emissions over 2028-2032) could involve emissions from business and industry falling by 30%

[73] Greening Government Commitments: www.gov.uk/government/collections/greening-government-commitments
[74] Provisional UK greenhouse gas emissions national statistics, 2018: www.gov.uk/government/statistics/provisional-uk-greenhouse-gas-emissions-national-statistics-2018
[75] Clean Growth Strategy, 2017: www.gov.uk/government/publications/clean-growth-strategy

and from homes by 19% between 2017 and 2032 from 2017 levels. This could be delivered in a number of ways including significant improvements in energy efficiency, phasing out high carbon fossil fuels in off-gas grid properties, rolling out heat networks where appropriate, reducing energy use per unit of output and drastically reducing emissions from electricity generation through increased use of renewables and a smarter power grid.

Indicative milestones

We cannot at this stage predict the exact technological changes or policy solutions that will help us deliver on our ambitions, particularly as we approach 2050. Some technologies, processes and business models will develop faster than expected, making it easier to reduce emissions. Others may develop less quickly than we hope. It is also challenging to predict exactly what the UK economy will look like in 2030, 2040 or 2050.

Given these elements of uncertainty, the UK's indicative milestones focus on our core objective of reducing greenhouse gas emissions, in line with our carbon budgets and 2050 net zero target. While the 2017 CGS forms the basis for these calculations, the UK government is expecting further advice in 2020 from its independent advisors, the CCC, on pathways to net zero in 2050. This will include advice on what level to set the sixth carbon budget (2033-2037). The below indicative milestones are provided without prejudice to that advice, which will further inform the UK government as we establish a pathway to net zero by 2050.

Table 8: The UK's indicative milestones for 2030, 2040 and 2050[76]

Milestone	2030	2040	2050
1. Residential greenhouse gas emissions	Around 60 (MtCO2e)[77]	Proportionate progress on pathway to 2050 milestone	Eliminate emissions from residential buildings by 2050.
2. Non-residential: private/business greenhouse gas emissions[78]	Around 9 (MtCO2e)[79]	Proportionate progress on pathway to 2050 milestone	Eliminate emissions from non-domestic buildings by 2050.
3. Non-residential: public greenhouse gas emissions	Around 5 (MtCO2e)[80]	Proportionate progress on pathway to 2050 milestone	Eliminate emissions from non-residential public sector buildings by 2050.
4. Total buildings emissions	Around 155(MtCO2e)	Proportionate progress on pathway to 2050 milestone	Eliminate emissions from the UK building stock by 2050.

[76] Based primarily on the 2032 and 2050 pathways set out in the Clean Growth Strategy.
[77] In line with the 2032 pathway set out in the Clean Growth Strategy.
[78] his segment includes greenhouse gas emissions created as a result of industrial processes, which are challenging to fully disaggregate from greenhouse gas emissions created purely from building energy use. However, building energy use does constitute the majority of this combined figure.
[79] In line with the 2032 pathway set out in the Clean Growth Strategy.
[80] In line with the 2032 pathway set out in the Clean Growth Strategy.

Outline roadmap of policies and measures including domestically established measurable progress indicators

Outline roadmap of policies and measures

The CGS sets out the UK's strategy for achieving its legally binding emissions reductions targets, known as carbon budgets, through to 2032, and includes indicative decarbonisation pathways out to 2050, as referred to in the previous section.

The pathways set out in the CGS provide an overview of how the impacts of its policies and proposals may map out over time. They include future policy development such as publications, key decisions, reviews and consultations, which aim to unlock future carbon savings.[81]

Achieving net zero will mean going further, virtually eliminating emissions from the UK's building stock. Decarbonising heat is our most difficult policy and technology challenge in meeting our carbon targets. The UK government is currently developing its low-carbon heat policy for the 2020s and beyond. We are working on a Heat and Buildings Strategy, which will set out the immediate actions we will take for reducing emissions from buildings. These actions include the deployment of energy efficiency measures and low-carbon heating as part of an ambitious programme of work required to enable key strategic decisions on how we achieve the mass transition to low-carbon heat and set us on a path to decarbonising all homes and buildings. (see section 2.1.2 above).

This LTRS sets out the UK's outline roadmap in accordance with the CGS and subsequent UK government documents – content is subject to revision in final version of the LTRS, expected to be published separately later in 2020.

Residential and non-residential buildings, both public and private, are dealt with in turn.

Residential buildings

2020-2032

Homes in the UK account for 15% of greenhouse gas emissions, or 22% including electricity use.[82] The UK has already made considerable progress in this sector with residential emissions having reduced by about 16% since 1990[83] despite there being over 20% more homes.[84]

We want to further reduce emissions while ensuring everyone has a home that is comfortable, heathy and affordable to run. Our objective is to ensure our policies will encourage people to improve their homes where it is cost effective and affordable for them to do so. Our aspiration, as set out in the CGS, is that fuel poor homes should be upgraded to an Energy Performance Certificate (EPC) rating of at least Band C by 2030, and more broadly that as many existing

[81] Clean Growth Strategy, 2017, www.gov.uk/government/publications/clean-growth-strategy
[82] Final UK greenhouse gas emissions national statistics: 1990-2017: www.gov.uk/government/statistics/final-uk-greenhouse-gas-emissions-national-statistics-1990-2017
[83] BEIS(2019), BEIS, Final UK greenhouse gas emissions statistics 1990-2017: www.gov.uk/government/statistics/final-uk-greenhouse-gas-emissions-national-statistics-1990-2017
[84] Live tables on house building: new build dwellings, 2019: www.gov.uk/government/statistical-data-sets/live-tables-on-house-building

homes as possible are improved to at least EPC Band C by 2035, where practical, cost-effective and affordable.[85] At present, 70% of homes fall below this standard in England.

The CGS, and subsequent UK government documents, set out policies and proposals to decarbonise this sector over the coming years, including:

Complete

- Strengthening domestic Private Rented Sector regulations to require landlords to contribute up to £3,500 towards improving their property to EPC Band E;
- Supporting around £3.6 billion of investment to upgrade around one million homes through the Energy Company Obligation (ECO), and confirming extended support for home energy efficiency improvements until 2028 at the current level of ECO (£640m per year);
- Sponsoring new standards (PAS 2035:2019 & PAS 2030:2019[86]) covering the end-to-end delivery of energy efficiency measures;
- Supporting a new TrustMark government-endorsed quality scheme for energy efficiency improvements to ensure consumers get what they are expecting and have suitable financial protections in place;
- Incorporating TrustMark and the new PAS standards into the Energy Company Obligation;
- Launching Simple Energy Advice, a new digitally led advice service that provides tailored advice to homeowners, landlords, and tenants on how they can improve their home's energy efficiency.

In progress

- Committing to introducing a Future Homes Standard which will see new build homes future-proofed with low-carbon heating and world-leading standards of energy efficiency by 2025. We expect new homes built to the new standard to produce 75-80 per cent lower CO2 emissions compared to current levels. These homes will be 'zero carbon ready', with the ability to become fully zero carbon homes over time as the electricity grid decarbonises, without the need for further costly retrofitting work.
- As a stepping-stone to the Future Homes Standard, we have consulted on a meaningful and achievable interim increase to the energy efficiency standards for new homes. The preferred option set out in consultation is a standard that should result in a 31% further reduction in emissions, compared to current standards.
- We will respond to the Future Homes Standard consultation in full in the autumn (2020). As part of this, we intend to review the roadmap to the Future Homes Standard to ensure that implementation takes place to the shortest possible timeline. To work towards ensuring that all new homes are fit for a zero-carbon future we will also explore options for the future of energy efficiency standards beyond the Future Homes Standard.

[85] Clean Growth Strategy, 2017, www.gov.uk/government/publications/clean-growth-strategy
[86] PAS 2035/2030:2019 is a key document in a framework of new and existing standards on how to conduct effective energy retrofits of existing buildings, developed by the British Institute of Standards (BSI): https://shop.bsigroup.com/ProductDetail/?pid=000000000030400875&creative=366703430328&keyword=%2Bpas%20%2B2030&matchtype=b&network=g&device=c&gclid=EAIaIQobChMIxuu1gZaO7AIVR-btCh31pAyfEAAYASAAEgIa7_D_BwE

- A further consultation will follow in due course, proposing changes to the energy efficiency standards for new non-domestic buildings; for building work to existing homes and non-domestic buildings; and on mitigating overheating in new dwellings.
- Consulting on strengthening domestic Private Rented Sector regulations, with a longer-term aim of upgrading as many private rented homes as possible to EPC Band C by 2030, where practical, cost-effective and affordable[87].
- Consulting on standards for social housing. The social housing Green Paper published in August 2018[88] asked, among other things, whether the energy performance of social homes should be upgraded. Government is currently considering the responses to the consultation and will publish a Social Housing White Paper for implementing social housing reform soon.
- Consulting on setting requirements for lenders to improve the energy efficiency of the homes they lend to and launching a £5m Green Home Finance Innovation Fund which will support the development and piloting of innovative green mortgages and other green home finance products.
- Launching a £10m Whole House Retrofit Innovation Competition to explore 'at scale' delivery of whole house energy efficiency retrofit, aiming to demonstrate the cost reduction potential of large-scale roll-out, and initiating a longer-term cost reduction trajectory.
- Testing six different approaches to delivering whole house retrofit in local areas across England that could be replicated at a broader scale, by providing support for local supply chain integration, skills training and project coordination.
- Providing funding to a number of local authorities to produce a series of feasibility studies to test means of encouraging homeowners to improve the energy efficiency of their properties through retrofit measures.
- Publishing an Action Plan to improve the EPC framework, following our public Call for Evidence. More robust EPCs will play a key role in underpinning various energy efficiency-related policies over the coming years.
- Updating the Fuel Poverty Strategy[89] (for England), including the mix of subsidy, regulations and incentives required to meet the fuel poverty target.
- Manifesto commitments of a £3.8bn Social Housing Decarbonation Fund to deliver transformational change in the social housing sector, and a £2.5bn Homes Upgrade Grant sector targeting fuel poor households in private housing.

Beyond 2032

Reducing demand for energy will not be enough on its own to meet our ambitions for homes. By 2050, we will likely need to fully decarbonise how we heat our homes. There are several low-carbon heating technologies with the potential to support the scale of change needed, including heat pumps, low-carbon gases such as hydrogen (using the existing gas grid) and

[87] Setting long-term energy performance standards for the private rented sector in England and Wales, 2019: https://beisgovuk.citizenspace.com/home-local-energy/prs-minimum-energy-efficiency-standards/supporting_documents/PRS_workshop_slides.pdf
[88] Social housing green paper: a 'new deal' for social housing, 2018: www.gov.uk/government/news/social-housing-green-paper-a-new-deal-for-social-housing
[89] Fuel poverty strategy for England (consultation), 2019: www.gov.uk/government/consultations/fuel-poverty-strategy-for-england

district heat networks. However, at present, it is not certain which approaches will work best at scale and offer the most cost-effective long-term answer.

Non-residential buildings - private non-domestic

2020-2032

Business and industry in the UK are responsible for around 20% of greenhouse gas emissions, or 30% including energy use.[90] In the CGS, the UK government set an ambition to support businesses to improve their energy efficiency by at least 20% by 2030. This could deliver up to £6 billion in cost savings by 2030 and contribute up to 22 MtCO2e of non-traded carbon savings towards the fifth carbon budget.[91]

The CGS committed the UK government to consult on a package of measures to support businesses to improve how productively they use energy, including actions that could be taken to improve the take up of energy efficiency measures across buildings. This would build on the significant existing measures to promote energy efficiency in business and industry such as the Climate Change Agreement (CCA) Scheme and the Energy Savings Opportunity Scheme (ESOS).

The CGS, and subsequent UK government documents, set out policies and proposals to decarbonise this sector over the coming years, including:

Complete

- Utilising environmental taxes to encourage businesses to operate in more environmentally friendly ways. There are taxes and schemes for different types and size of business.
- Requiring that from 1 April 2018, landlords of privately rented property in England or Wales ensure that their properties reach at least an Energy Performance Certificate (EPC) rating of E before granting a tenancy to new or existing tenants.
- Completing the compliance period for Phase 2 of the Energy Savings Opportunity Scheme (ESOS), which required large businesses, by 5 December 2019, to carry out audits of their energy use in buildings, processes and transport and receive recommendations on energy efficiency improvement actions they can take.
- Requiring large or quoted UK businesses to disclose their annual energy and carbon emissions in annual reports under the Streamlined Energy and Carbon Reporting (SECR) framework, which came into force in April 2019, following an earlier consultation.[92] This aims to simplify reporting requirements while increasing corporate transparency, further incentivising energy efficiency and reducing emissions.
- Completing the Electricity Demand Reduction Pilot which offered organisations £6m of funding for projects which could improve energy efficiency and security of supply through delivery of electricity savings at peak times. This pilot has finished, and we published the evaluation in July 2019[93], alongside a call for evidence which ran to

[90] Final UK greenhouse gas emissions national statistics: 1990-2017, 2019: www.gov.uk/government/statistics/final-uk-greenhouse-gas-emissions-national-statistics-1990-2017
[91] Helping businesses improve the way they use energy: call for evidence, 2018: www.gov.uk/government/consultations/helping-businesses-to-improve-the-way-they-use-energy-call-for-evidence
[92] Streamlined energy and carbon reporting (consultation outcome), 2018: www.gov.uk/government/consultations/streamlined-energy-and-carbon-reporting
[93] Electricity Demand Reduction pilot, 2019: www.gov.uk/guidance/electricity-demand-reduction-pilot

September 2019.[94] These initiatives will help us better understand how we can facilitate energy efficiency in the electricity system.

- Published a call for evidence on a new Small Business Energy Efficiency Scheme.[95]

In progress

- Published a consultation on a preferred future requirement of EPC Band B by 2030 for minimum energy efficiency standards in privately rented non-domestic buildings.
- Committing to consult in 2020 on introducing mandatory in-use energy performance ratings for business buildings.
- We are initiating the demonstration phase of the 'Boosting Access for SMEs (small and medium-sized enterprises) to Energy Efficiency' (BASEE) innovation competition in March 2019. This offers up to £6m to fund the development of new, innovative scalable business models or solutions that reduce costs, simplify processes and encourage the take up of energy efficiency by SMEs at scale. We have awarded eight contracts to pilot their solutions which will complete in March 2021.
- Publishing the evaluation and post implementation review of ESOS in 2020 and expect to publish a consultation in 2021 which sets out proposals for strengthening future phases of the scheme.
- Commencing work with the British Standards Institute (BSI) to develop Publicly Available Specification (PAS) standards for the installation of energy efficiency measures in the non-domestic sector to ensure consistency in the market and provide confidence to consumers.

Beyond 2032

To meet the UK's 2050 net zero target, the deep decarbonisation of industry and private sector non-domestic buildings will need to take place alongside wider measures, such as Carbon Capture, Usage and Storage (detailed in section 2.5(ii)) and the widespread decarbonisation of electricity and heat provision (as outlined in the residential roadmap and detailed in section 2.1.2 of this NECP).

Non-residential buildings - public non-domestic

2020-2032

The public sector in the UK is responsible for around 2% of direct greenhouse gas emissions, or 3% including indirect emissions from electricity use.[96] The government is taking a leading role in reducing greenhouse gas emissions through the Greening Government Commitments to reduce central government emissions by 43% by the end of 2019/20 compared to 2009/10 – having met the previous target of a 32% reduction three years early.[97] Good progress is being

[94] Facilitating energy efficiency in the electricity system (closed consultation), 2019: www.gov.uk/government/consultations/facilitating-energy-efficiency-in-the-electricity-system
[95] Boosting access for SMEs to energy efficiency (BASEE): competition, 2019: www.gov.uk/government/publications/boosting-access-for-smes-to-energy-efficiency-basee-competition
[96] Final UK greenhouse gas emissions national statistics: 1990-2017, 2019: www.gov.uk/government/statistics/final-uk-greenhouse-gas-emissions-national-statistics-1990-2017
[97] Greening Government Commitments, 2019: www.gov.uk/government/collections/greening-government-commitments

made towards our 43% reduction target, with the latest Greening Government Commitment Annual Report showing that we have delivered a 39% reduction in emissions by 2017/18[98].

Our illustrative pathway to 2032 sees emissions from the public sector falling by around 50% compared to a 2017 baseline.[99]

The CGS, and subsequent UK government documents, set out policies and proposals to decarbonise this sector over the coming years, including:

Complete

- Continuing to enable greenhouse gas emission reductions through the Public Sector Energy Efficiency Loan Scheme. The capital pot for England stands at £312m as of the end of 2019/20 and is planned to increase to a total of £385m by 2020/21. This funding, managed by Salix Finance, has delivered over 17,000 projects, significantly improving energy performance in the public sector, with estimated emissions reductions of over 800,000 tonnes per year.
- Modern Energy Partners, an innovation programme working to develop a toolkit to reduce greenhouse gas emissions from campus-scale public sector sites. The pilot phase concluded in March 2019 and the second phase of the project commenced in April 2019.

In progress

- Committed to publish a roadmap on the next steps for reducing public sector emissions in 2020.
- A manifesto commitment of £2.9bn for a Public Sector Decarbonisation Programme.

Beyond 2032

The CGS sets out the challenge facing the public sector in meeting the UK's 2050 target, and the leadership role the public sector can play in reducing carbon emissions. Central government has already shown what is possible through its Greening Government Commitments which include a greenhouse gas reduction target.[100] However, to meet the UK's 2050 target, emissions from the buildings and activities of the public sector will need to be near zero. This will mean improving energy efficiency and energy management and decarbonising the heating and cooling of buildings.[101]

Indicative progress indicators

Given the uncertainties surrounding the exact technological changes and policy solutions that will help us deliver on our ambitious milestones, particularly as we approach 2050, it is challenging to predict exactly which progress indicators will prove the most relevant over the long term, or whether new indicators will emerge.

The proposed progress indicators may be used by government in relation to the UK's indicative milestones for 2030, 2040 and 2050, and some are published publicly on a regular basis. Though it is not possible to set how any single indicator should change over the next 30 years,

[98] Greening Government Commitments, 2019: www.gov.uk/government/collections/greening-government-commitments
[99] Clean Growth Strategy, 2017, www.gov.uk/government/publications/clean-growth-strategy
[100] Greening Government Commitments, 2019: www.gov.uk/government/collections/greening-government-commitments
[101] Clean Growth Strategy, 2017, www.gov.uk/government/publications/clean-growth-strategy

it is clear that the landscape of metrics set out in the following table will need to, as a whole, display proportionate change in line with our milestones and clear, legally binding 2050 net zero target.

Table 9: Indicative progress indicators of the LTRS

Progress indicator (metric)	Building stock sector(s)	Link to milestones
Dwellings' EPC ratings (proportion at each EPC band)	Domestic	Buildings with better fabric and/or own renewable energy generation are likely to be responsible for fewer greenhouse gas emissions.
Energy intensity (MWh/household)	Domestic	Lower energy use (notwithstanding any rise in total no. of households) likely to lead to lower carbon emissions from sector.
Carbon intensity (tCO2e /household)	Domestic	Lower carbon energy sources and lower energy use (notwithstanding any rise in total no. of households) likely to lead to lower carbon emissions from sector.
ECO measures installed (no. installed by measure type and obligation)	Domestic	Buildings with better fabric / heating systems are likely to be responsible for fewer greenhouse gas emissions.
Greenhouse gas emissions from building stock (MtCO2e, by sector)	Domestic, non-domestic, public	Lower emissions from any one sector will contribute to the overall milestones.
Energy use per £ million output (MWh/£ million)	Non-domestic	Lower energy use (notwithstanding any rise in total output) likely to lead to lower carbon emissions from sector.
Emissions intensity energy use (tCO2e/kWh)	Non-domestic	Lower emissions intensity (notwithstanding any rise in total generation) likely to lead to lower total carbon emissions from sector.

Expected Energy Savings and contributions to the Union's energy efficiency targets pursuant to Directive 2012/27/EU

As set out in section 2.2(i), the UK has left the EU and will therefore not contribute to EU targets after the Transition Period ends.

Evidence-based estimates of expected energy savings and wider benefits resulting from the Long-term renovation strategy

In reaching our indicative milestones and net zero, we want to decarbonise our economy at lowest cost. Energy efficiency can play an important role in supporting this, reducing the quantity of heat required and the costs of future heat decarbonisation. It will also deliver a

range of wider economic benefits (explored in the next section) including lower energy bills, increased energy security, better air quality, and improved health. However, the optimal level of energy efficiency is subject to wider drivers, for example, our strategic choices around heat decarbonisation, future cost reductions, and technology innovation.

The above roadmap sets out numerous measures which will improve the energy efficiency of the building stock, and the CGS sets out how building energy efficiency improvements could contribute to the UK's 2032 pathway to meeting carbon budget 5:

Table 10: Possible building energy efficiency improvements under the 2032 pathway

	2015	2032
Home energy use per household (MWh/household)	17	15
Non-industrial business and public energy use per £ million output (MWh/£ million)	164	79

Wider benefits resulting from measures in the Long-Term Renovation Strategy

The reduction in greenhouse gas emissions and improvements in energy efficiency resulting from the measures and targets outlined in this LTRS will have numerous wider benefits applying at individual, macroeconomic and societal dimensions.

The UK government explicitly recognises these benefits. HM Treasury's Green Book[102] is the central government document setting out a framework for the appraisal and evaluation of policies, programmes and projects. It applies to all proposals that concern public spending, taxation, changes to regulations, and changes to the use of existing public assets and resources.

The updated 2018 edition of the Green Book sees a much-increased focus on environmental factors, improving the ability of UK policymakers to factor these into decision-making. It directs government to identify the social costs from policies' carbon emissions and to evaluate wider impacts on natural capital. It provides guidance on assigning value to greenhouse gas emissions and energy efficiency in recognition of their wider societal costs. The Green Book makes clear that energy efficiency has a social value in addition to the value of a reduction in greenhouse gas emissions, given its direct impact on society.

More broadly, the measures and milestones outlined in the LTRS have the potential to, for example:

Improve health: There is a clear link between cold homes and ill-health. The Building Research Establishment (BRE) has estimated that the cost of cold and damp homes to the NHS is approximately £760m per year.[103] The Health Impact of Domestic Energy Efficiency Measures

[102] The Green Book: appraisal and evaluation in central government, 2019: www.gov.uk/government/publications/the-green-book-appraisal-and-evaluation-in-central-governent
[103] Building Research Establishment (2011) The cost of poor housing to the NHS (Building Research Establishment), 2015: www.bre.co.uk/healthbriefings

(HIDEEM) model[104] was developed for government to quantify indoor environmental conditions and monetise the health impacts associated with energy efficiency changes.

Generate economic benefits: The UK low-carbon economy could grow by an estimated 11% annually between 2015 and 2030 (four times faster than the wider the economy)[105] and could deliver between £60bn and £170bn of export sales of goods and services by 2030[106]. There is significant potential for the retrofit supply chain to generate employment, driving UK manufacturing and expertise. In 2016 the domestic and non-domestic energy efficiency sectors employed 140,000 people, with turnover of £20bn.[107]

Reduce costs for consumers: Actions taken to tackle emissions and reduce energy use have already helped to reduce average energy bills - average household energy bills have fallen by 16.7% in real terms between 2013 and 2018.[108] The recently released Future Homes Standard consultation[109] outlines possible average annual bill savings of between £59 and £257 resulting from improving standards for future new build homes.

Reduce costs for businesses and government: Emissions from central government fell by 39% between 2009/10 and 2017/18, delivering savings to the taxpayer of an estimated £112 million in 2017/18 through reduced energy consumption.[110] The CGS set out our ambition to improve business and industry energy efficiency by at least 20% by 2030 compared to 2015 levels, which will reduce energy bills by up to £6 billion by 2030.[111]

Reduce fuel poverty: By reducing the heating costs of homes, energy efficiency reduces the breadth and depth of fuel poverty. The latest iteration of the Energy Company Obligation (ECO3) is a fuel poverty focused scheme which incentivises the treatment of properties which are expensive to heat.

Increase energy security: Delivering the 2032 pathway would result in changes in fuel consumption across the whole economy, with coal and gas use falling by an additional 38% and 23% respective over and above current plans. Reductions in fossil fuel consumption will reduce imports and in turn boost the UK's energy security.

> *iii Where applicable, other national objectives, including long term targets or strategies and sectoral targets, and national objectives in areas such as energy efficiency in the transport sector and with regard to heating and cooling.*

[104] The Health Impact of Domestic Energy Efficiency Measures (HIDEEM) model: www.ucl.ac.uk/energy-models/models/hideem
[105] Ricardo Energy and Environment for the Committee on Climate Change - UK business opportunities of moving to a low carbon economy, 2017: www.theccc.org.uk/publication/uk-energy-prices-and-bills-2017-report-supporting-research/
[106] Ricardo Energy and Environment for the Committee on Climate Change - UK business opportunities of moving to a low carbon economy, 2017 (supporting data tables): www.theccc.org.uk/publication/uk-energy-prices-and-bills-2017-report-supporting-research/
[107] Low carbon and renewable energy economy, UK: 2017: www.ons.gov.uk/economy/environmentalaccounts/bulletins/finalestimates/2017
[108] Annual domestic energy bills (BEIS dataset), 2019: www.gov.uk/government/statistical-data-sets/annual-domestic-energy-price-statistics
[109] The Future Homes Standard: changes to Part L and Part F of the Building Regulations for new dwellings (consultation), 2019: www.gov.uk/government/consultations/the-future-homes-standard-changes-to-part-l-and-part-f-of-the-building-regulations-for-new-dwellings
[110] Greening government commitments 2017 to 2018 annual report, 2019: www.gov.uk/government/publications/greening-government-commitments-2017-to-2018-annual-report
[111] Clean Growth Strategy, 2017, www.gov.uk/government/publications/clean-growth-strategy

The UK government's ambition for decarbonising road transport and developing zero and low emission vehicles is clearly set out in recent strategies, including the Road to Zero, CGS and Industrial Strategy.

By 2040, the UK government expects the majority of new cars and vans sold to be 100% zero emission and all new cars and vans to have significant zero emission capability[112]. By 2030, the UK government wants to see at least 50% and as many as 70% of new car sales to be ultra-low emission, and up to 40% of new van sales.

The road freight sector has agreed a voluntary industry-wide commitment to reduce HGV CO2 emissions by 15% by 2025. This was announced in the Road to Zero Strategy[113] in July 2018 and was welcomed by road freight trade bodies. We will work with industry to help operators contribute to this commitment by reducing their CO2 emissions.

2.3 Energy security

i The elements set out in point (c) of Article 4

The UK government's ambition for interconnector capacity is set out in the CGS, which states that project assessments to date indicate at least a further 8.1GW of interconnection by the early to mid-2020s will be in consumers' interests, in addition to the 5GW currently operational and 4.8GW that is currently under construction.

The UK government also has an objective to establish a best-in-class regulatory framework to harness the full potential of smart and flexible energy solutions such as storage and demand side response. We are working closely with Ofgem and industry to support the transition to a smarter, more flexible energy system and to deliver the actions set out in the 2017 Smart System and Flexibility Plan[114] and 2018 Progress Update[115] by 2022. This Plan is discussed in more detail in section 2.3(iv).

More information on resilience of our energy systems is set out in the Security of Supply report[116] Also see 2.3(ii) and (iv).

ii National objectives with regard to increasing the diversification of energy sources and supply from third countries for the purpose of increasing the resilience of regional and national energy systems

BEIS works with industry, regulators, sector bodies and other stakeholders to improve and maintain the resilience of the energy infrastructure, networks and assets, to reduce vulnerabilities, and ensure an effective response to actual or potentially disruptive incidents. The UK government recognises a range of benefits that interconnection can provide. By giving access to generation beyond national borders it can improve security of supply when market prices reflect scarcity and flows across interconnectors follow prices. Interconnection can also

[113] The Road to Zero Strategy, 2018: www.gov.uk/government/publications/reducing-emissions-from-road-transport-road-to-zero-strategy
[114] Upgrading our Energy System: Smart Systems and Flexibility Plan, July 2017, www.gov.uk/government/publications/upgrading-our-energy-system-smart-systems-and-flexibility-plan
[115] Upgrading Our Energy System: Progress Update, October 2018, www.gov.uk/government/publications/upgrading-our-energy-system-smart-systems-and-flexibility-plan
[116] Security of Supply Report, www.gov.uk/government/collections/statutory-security-of-supply-report

help with the integration of intermittent sources of energy and the associated system balancing. In terms of interconnection with third countries, the NorthConnect project between Great Britain and Norway has been granted a Cap and Floor regime in principle and the UK government continues to explore the potential of further projects with Norway and Iceland.

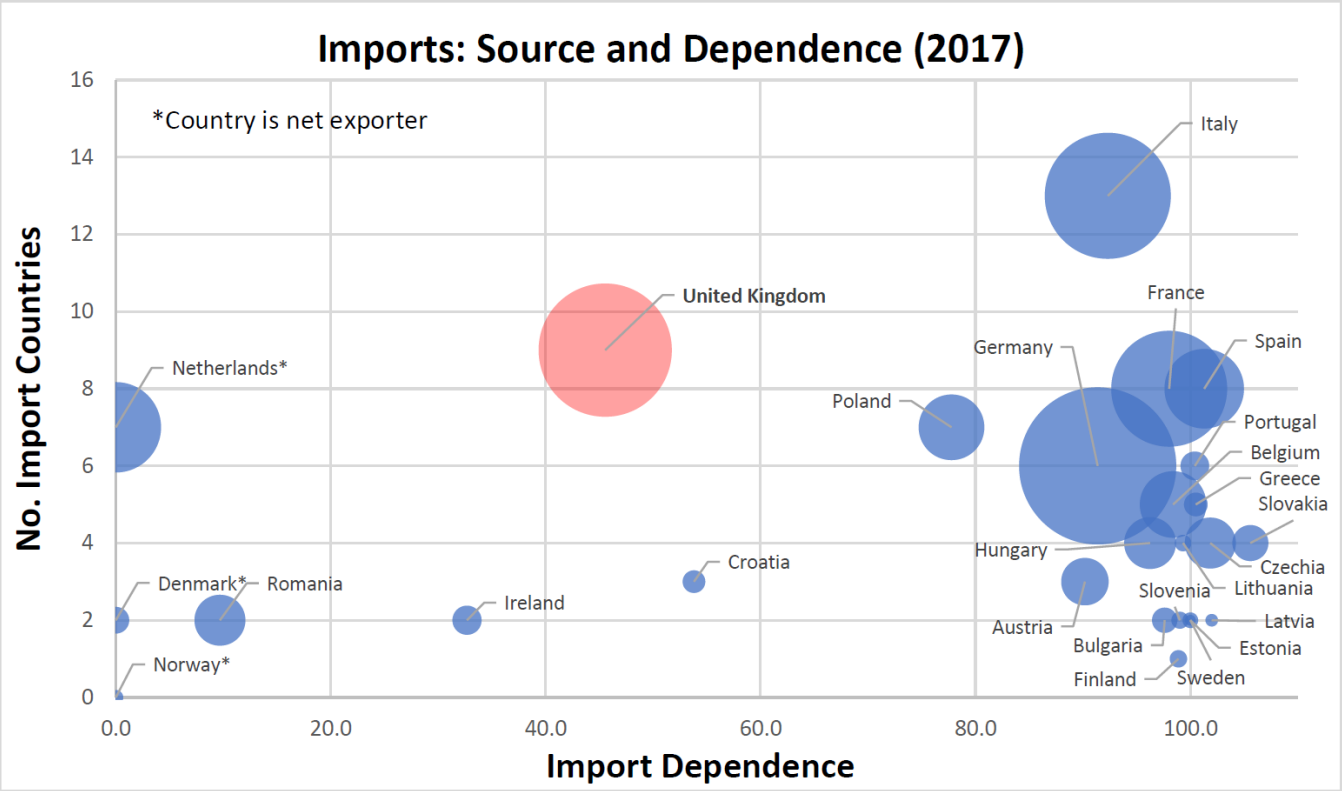
The UK's import dependency in 2018 was just under 50% and the UK benefits from a diverse range of supply sources of both piped gas and liquified natural gas (LNG). Gas interconnectors between the UK and Ireland, Belgium and the Netherlands means that this supply diversity and resilience is of benefit regionally as well as nationally. The UK currently has an import deliverability of ~56 billion cubic metres per year (bcm/y) from Norway, ~43bcm/y from continental Europe and ~49bcm/y from LNG import terminals.[117] This supply diversity and resilience is of benefit regionally as well as nationally.

The UK is connected to global gas markets through three LNG import terminals. The UK currently has the infrastructure capacity to import around 49bcm/y of LNG through the two terminals at Milford Haven (South Hook and Dragon, 21bcm/y and 8bcm/y respectively) and through the Isle of Grain terminal in Kent (20bcm/y).[118] This means the UK has the second largest LNG infrastructure in Europe in terms of capacity, after Spain.[119]

These terminals connect the UK to any LNG producing country, and the UK's LNG supply is becoming more diversified as a wider range of new LNG supply sources come online. In 2018 the UK received LNG from 10 different countries including Qatar, the USA, and Trinidad and Tobago, among others. Though the majority of UK LNG receipts are still from Qatar, imports from Qatar decreased from around 12.1% of total UK gas supply in 2016, to 3.6% in 2018.[120]

[117] Gas Ten Year Statement, National Grid 2018, www.nationalgridgas.com/insight-and-innovation/gas-ten-year-statement-gtys
[118] National Statistics Digest of UK Energy Statistics (DUKES) 2019, Table 4.4, www.gov.uk/government/statistics/digest-of-uk-energy-statistics-dukes-2019
[119] Gas Infrastructure Europe (GIE) LNG Map, December 2016, www.gie.eu/index.php/gie-publications/databases/lng-database
[120] National Statistics Digest of UK Energy Statistics (DUKES) 2019; Chapter 4 Natural gas (Commodity Balances - DUKES 4.1 and 4.5): https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/820686/DUKES_4.1.xls

Figure 2: Gas import source and dependence, UK and EU member states[121]



iii Where applicable, national objectives with regard to reducing energy import dependency from third countries, for the purpose of increasing the resilience of regional and national energy systems

The UK set out a strategy to maximise economic recovery of petroleum from the United Kingdom Continental Shelf (UKCS), based on the UKCS Maximising Recovery Review (2014 Wood Review).[122] Based on the recommendations of the review, the UK government established an independent regulator, the Oil and Gas Authority (OGA, a Government Company) with new competences under the Energy Act 2016 to enable maximising economic recovery of UKCS hydrocarbons. The OGA issued the Maximising Economic Recovery UK Strategy in March 2016. Its Central Obligation states that "relevant persons must take the steps necessary to secure that the maximum value of economically recoverable petroleum is recovered from the strata beneath UK waters.". The Strategy is due to be reviewed in 2020 including with a view to integrating expressly into the Strategy relevant aspects where industry can assist the Secretary of State in meeting the net zero target. Assisting in achieving net zero forms a part of a proper consideration of the Maximising Economic Recovery Strategy.

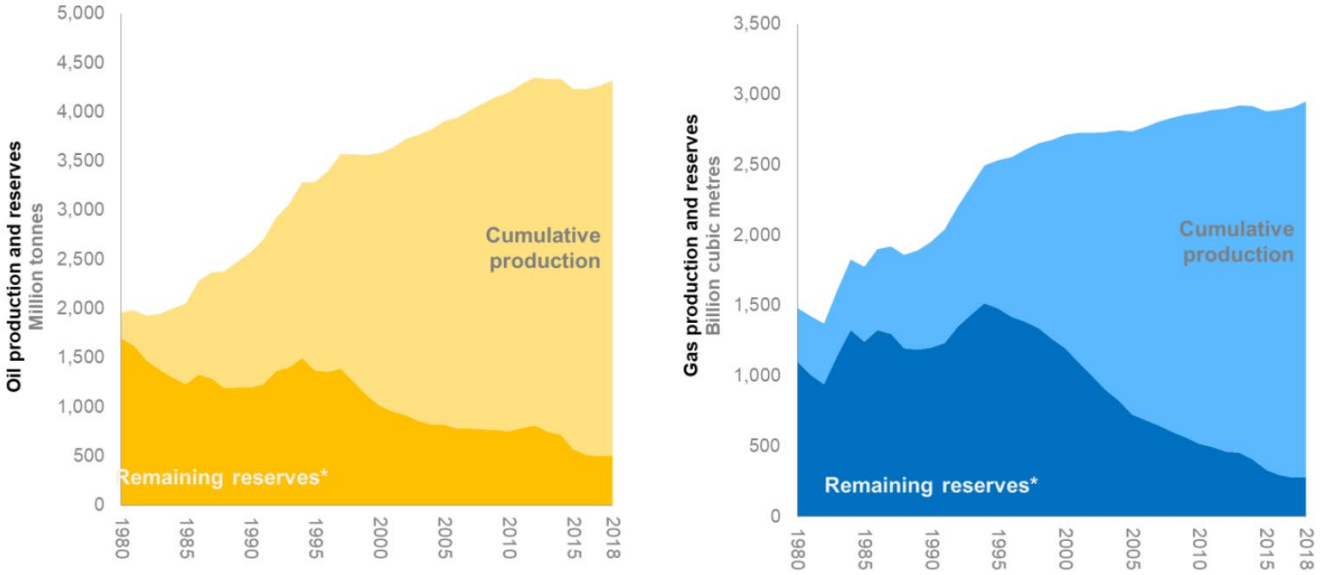
The UK government introduced changes to the fiscal regime over 2 budgets including measures abolishing the Petroleum Revenue Tax and cutting the supplementary charge from 32% to 10% and has supported seismic surveys in under-explored areas of the UKCS. Operators in the UKCS will be able to transfer part of their tax history when assets change

[121] BEIS chart, data taken from: ACER 'Market Monitoring Report 2017' https://acer.europa.eu/en/Electricity/Market%20monitoring/Pages/Current-edition.aspx; Eurostat 'Energy Dependence by Product' https://ec.europa.eu/eurostat/tgm/refreshTableAction.do?tab=table&plugin=1&pcode=sdg_07_50&language=en; Eurostat 'Final Energy Consumption by Product' https://ec.europa.eu/eurostat/tgm/refreshTableAction.do?tab=table&plugin=1&pcode=ten00095&language=en

[122] www.gov.uk/government/uploads/system/uploads/attachment_data/file/471452/UKCS_Maximising_Recovery_Review_FINAL_72pp_locked.pdf

hands in order to facilitate the transfer of late-life oil and gas assets. This will allow new investors to benefit from tax relief when assets are eventually decommissioned and help extend field life.

Figure 3: UK Oil and gas production and reserves, 1980-2018*[123]



*From 2015, contingent resources have been re-categorised and removed from the probable and proven reserves category.

Exploration and appraisal drilling have been declining in the UKCS since the mid-2000s. The OGA is continuing to support exploration and appraisal drilling through licensing rounds, including making significant quantities of high quality seismic and other exploration data openly available in support of these rounds.

Unconventional gas resources

The UK government is committed to a low-carbon and affordable future for our energy. Gas still meets over a third of our primary energy demand and we will need it for many years to come. However, it is the UK government's view that hydraulic fracturing should only take place if it is safe and environmentally appropriate to do so.

A range of measures specific to hydraulic fracturing and the nascent industry have been put in place to ensure that shale gas exploration is safe and environmentally sound. The Infrastructure Act 2015 introduced thirteen technical and legislative conditions that need to be met before a hydraulic fracturing consent will be issued; this includes an equivalent assessment of the financial resilience of the company proposing to carry out hydraulic fracturing, including its ability to fund decommissioning costs.

Following analysis of hydraulic fracturing operations in 2018, the OGA has found that it is not currently possible to accurately predict the probability or magnitude of earthquakes linked to hydraulic fracturing operations. On this basis and following the significant disturbance that has been caused to local people following seismic events in August 2019, due to further operations at Preston New Road, Lancashire, on 2 November 2019 the BEIS Secretary of State

[123] UK energy in brief 2019, www.gov.uk/government/statistics/uk-energy-in-brief-2019

announced a moratorium with immediate effect. On 4 November 2019, the UK government issued a Written Ministerial Statement[124] that sets out its position – namely that the UK government will no longer be supporting further hydraulic fracturing activities in England at this time. The statement sets out that there will be a presumption against Ministers issuing further Hydraulic Fracturing Consents, which would only be altered if compelling new evidence comes to light.

In 2018, onshore oil and gas licensing powers in Scotland and Wales were devolved to both Scottish and Welsh Ministers respectively and Wales and Scotland have adopted their own policy positions with respect to unconventional oil and gas exploration (UOG).[125]

Following consultation in 2018, Wales will not undertake any new petroleum licensing or support applications for hydraulic fracturing petroleum licence consents.[126] Fossil fuel extraction is not compatible with Wales's decarbonisation and renewable energy generation targets and is placed at the bottom of the hierarchy in Planning Policy Wales.[127] On 3 October 2019, the Scottish Government confirmed its finalised policy position of no support for unconventional oil and gas development in Scotland. This means development connected to the onshore exploration, appraisal or production of coal bed methane or shale oil or shale gas using unconventional oil and gas extraction techniques, including hydraulic fracturing and dewatering for coalbed methane.

Government incentives to promote exploration and production, changes in upstream regulatory regime

The UK government announcements have included:

- The establishment of the Oil and Gas Authority to be a strong and independent regulator and supporter of the oil and gas industry;
- In its 2015 and 2016 budgets, the UK government provided a £2.3bn fiscal package to support the offshore industry. This included zero rating the Petroleum Revenue Tax and cutting the supplementary charge from 32% to 10%;
- Providing £40m (in two tranches) for seismic surveys in under-developed areas of the UK Continental Shelf and £5m to support exploration;
- A £250m Aberdeen City Region Deal in collaboration with Scottish Government, which included £180m for the new Oil and Gas Technology Centre (£90m from each government); and
- In the Autumn budget 2017, the UK government announced that operators in the UKCS will be able to transfer part of their tax history when assets change hands in order to facilitate the transfer of late-life oil and gas assets. This will allow new investors to benefit from tax relief when assets are eventually decommissioned and help extend field life.

[124] Written Ministerial Statement on shale gas, November 2019, www.parliament.uk/business/publications/written-questions-answers-statements/written-statement/Commons/2019-11-04/HCWS68/
[125] Scottish Government position statement, December 2017, www.gov.scot/publications/unconventional-oil-and-gas-position-statement/
[126] https://gov.wales/written-statement-petroleum-extraction-policy-statement
[127] Planning Policy Wales, Edition 10, December 2018, https://gov.wales/planning-policy-wales

iv National objectives with regard to increasing the flexibility of the national energy system, in particular by means of deploying domestic energy sources, demand response and energy storage

National objectives about increasing flexibility of the national energy system are set out in the 'Smart Systems and Flexibility' section in 2.4.3(i).

v) addressing constrained or interrupted supply of an energy source, for the purpose of improving the resilience of regional and national energy systems, including a timeframe for when the objectives should be met

The UK government continually monitors and assesses the UK's gas security of supply, including the potential for disruption caused by constrained or interrupted gas supplies. UK government analysis over the past 10 years has shown that Great Britain's gas system is resilient and well-placed to respond effectively to unexpected changes in supply and demand including supply constraints. The resilience of Great Britain's gas system is based on:

- A mature and liquid gas market;
- An effective regulatory regime and dynamic pricing signals; and,
- A diversity of flexible import infrastructure and spare import capacity.

The UK government's monitoring and analysis forms part of a five-year cycle of reviews announced by the Secretary of State for Energy and Climate Change in October 2015, the most recent of which was published in October 2017.[128]

2.4 Internal energy market

As of 31 January 2020, the UK has left the EU and will not be part of the internal energy market after the Transition Period ends. The UK is open to an agreement on energy with the EU that would provide efficient cross-border electricity and gas trade, with technical cooperation between network operators and organisations in the planning and use of energy infrastructure.

2.4.1 Electricity interconnectivity

i The level of electricity interconnectivity aimed for in 2030

The UK government recognises the potential for further interconnection to contribute to energy security, affordability and decarbonisation objectives and supports projects which support these outcomes. The Great Britain electricity system is currently connected with north-west Europe via 4GW interconnector capacity – 2GW with France, 1 GW with Belgium and 1GW with the Netherlands. 1GW of interconnection also links Great Britain and the Single Electricity Market (SEM) on the island of Ireland.[129]

The UK provides a supportive policy environment for further interconnection projects, including through the regulatory route of the Cap and Floor regime and an exempted route for merchant

[128] Gas Security of Supply: a strategic assessment, Department for Business Energy and Industrial Strategy, www.gov.uk/government/publications/gas-security-of-supply-strategic-assessment-and-review
[129] Electricity Interconnectors, Ofgem, www.ofgem.gov.uk/electricity/transmission-networks/electricity-interconnectors

projects. In addition to the 5GW already operational, 4.8GW of capacity is already in construction, linking GB with Norway, France, and Denmark. A further 8.1GW is progressing through regulatory process. This is expected to increase our level of interconnection by 2030.

The UK has been involved in the North Seas Energy Cooperation (NSEC) work on concrete concepts for joint offshore projects or cluster projects. The NSEC identified a list of potential areas and projects in the region, where joint projects could be most beneficial. This showed that there is considerable potential for such projects in UK waters.

2.4.2 Energy transmission infrastructure

i Key electricity and gas transmission infrastructure projects, and, where relevant, modernisation projects

There are a number of key electricity transmission projects in the UK, such as the recently completed Western high-voltage direct current (HVDC) link which is helping to transport renewable energy from Scotland to England and Wales.[130]

Also, the fourth list of Projects of Common Interest published by the European Commission on 31 October 2019 included a number of UK-impacted Projects of Common Interest, which are set out in Table 11.

Table 11: UK-impacted Projects of Common Interest[131]

PCI No.	Name	Description	Size (GW)
1.14	Viking Link	Interconnection between Revsing (DK) and Bicker Fen (UK)	1.4
1.15	Nautilus	Interconnection between the Antwerp area (BE) and the vicinity of Kemsley (UK)	1.4
1.16	New GB - NL	Interconnection between Netherlands and United Kingdom	1-2
1.2	NeuConnect	Interconnection between Germany and United Kingdom	1.40
12.2	CO2-Sapling	Transportation infrastructure component of the Acorn full chain CCS project (UK, in further phases Netherlands, Norway)	N/A
1.10.1	North Sea Link	Interconnection between Blythe (UK) and Kvilldal (NO)	1.40
1.10.2	NorthConnect	Interconnection between Peterhead (UK) and Simadalen (NO)	1.40
1.12.3	CARES	3 Compressed air energy storage in Middlewich	0.50
1.12.4	Cruachan II	Hydro-pumped electricity storage at Cruachan II	0.60

[130] Electricity transmission networks: major projects update, 2018, www.gov.uk/government/publications/electricity-transmission-networks-major-projects-update
[131] 4th list of Projects of Common Interest, European Commission 2019, https://ec.europa.eu/info/news/commission-publishes-4th-list-projects-common-interest-making-energy-infrastructure-fit-energy-union-2019-oct-31_en

PCI No.	Name	Description	Size (GW)
1.7.1	FAB	Interconnection between Cotentin (FR) and the vicinity of Exeter (UK)	1.40
1.7.3	ElecLink	Interconnection between Coquelles (FR) and Folkestone (UK)	1.00
1.7.5	Gridlink	Interconnection between the vicinity of Dunkerque(FR) and the vicinity of Kingsnorth (UK)	1.40
1.9.1	Greenlink	Interconnection between Wexford (IE) and Pembroke, Wales (UK)	0.50
2.13.1	North-South	Connection between Woodland (IE) and Turleenan (UK)	1.50
2.13.2	RIDP1	Interconnection between Srananagh (IE) and Turleenan (UK)	1.50

In the gas sector, the iron mains risk reduction programme which seeks to replace fractured iron mains pipe with plastic is also improving the efficiency of the gas network by reducing leaks of uncombusted gas. Ofgem intend to consult on the RIIO2 price control mechanism for the period from 2021.[132] This will help direct investment in the gas network, including expenditure on resilience and decarbonisation.

There is also investment in new natural gas infrastructure in Northern Ireland through two significant gas extension projects, which will build on existing gas networks which only commenced development since 1996.

ii Where applicable, main infrastructure projects envisaged other than Projects of Common Interest (PCIs)

In addition to the list for PCI interconnector projects, the NeuConnect interconnector project has been granted regulatory approval in principle through Ofgem's Cap and Floor regime.[133] Further projects, which have not yet applied for regulatory approval, are listed on the Ten Year Network Development Plan.[134]

The UK government requires the electricity transmission operator to submit updates on the progress of infrastructure projects on a quarterly basis. This information is published online.[135]

[132] www.ofgem.gov.uk/regulating-energy-networks/2021-price-control-review-riio-gd2
[133] Decision on the Initial Project Assessment of the GridLink, NeuConnect and NorthConnect interconnectors, January 2018, www.ofgem.gov.uk/publications-and-updates/decision-initial-project-assessment-gridlink-neuconnect-and-northconnect-interconnectors
[134] www.entsog.eu/tyndp
[135] Electricity transmission networks: major projects update, 2018, www.gov.uk/government/publications/electricity-transmission-networks-major-projects-update

2.4.3 Market integration

i National objectives related to other aspects such as increasing system flexibility, in particular related to the promotion of competitively determined electricity prices in line with relevant sectoral law, market integration and coupling, aimed at increasing the tradeable capacity of existing interconnectors, smart grids, aggregation, demand response, storage, distributed generation, mechanisms for dispatching, re-dispatching and curtailment, and real-time price signals, including a timeframe for when the objectives shall be met.

Smart Systems and Flexibility

We are working closely with the energy regulator (Ofgem) and industry to support the transition to a smarter, more flexible energy system. Our aim is to establish a best-in-class regulatory framework to harness the full potential of smart and flexible energy solutions such as storage, demand side response and interconnection.

In July 2017, BEIS and Ofgem published the Smart Systems and Flexibility Plan.[136] The plan outlines the underlying principles of our approach to enable the transition to a smart and flexible system and sets out 29 actions for the UK government, Ofgem and industry to implement.

The actions are split across three core themes:

- removing barriers to smart technologies, such as electricity storage – for example, ending double payment of network and policy costs by storage providers;
- enabling the use of smart solutions, including demand side response, in homes and businesses – for example, rolling out smart meters, implementing market-wide half hourly settlement and regulating smart appliances; and
- ensuring markets fairly reward flexibility and smart solutions – for example, enabling access of aggregators to the balancing mechanism and encouraging development of new local flexibility markets.

In October 2018, BEIS and Ofgem published a Progress Update[137] to the Plan which announced that we have now implemented over half of the original actions in the plan. This update also identified nine new actions which continue to support the transition to a smart and more flexible energy system.

ii Where applicable, national objectives related to the non-discriminatory participation of renewable energy, demand response and storage, including via aggregation, in all energy markets including a timeframe for when the objectives are to be met.

National objectives are outlined in the ‘Smart Systems and Flexibility’ section in 2.4.3(i).

iii Where applicable, national objectives with regard to ensuring that consumers participate in the energy system and benefit from self-generation and new technologies, including smart meters.

[136] Upgrading our Energy System: Smart Systems and Flexibility Plan, July 2017, www.gov.uk/government/publications/upgrading-our-energy-system-smart-systems-and-flexibility-plan
[137] Upgrading Our Energy System: Progress Update, October 2018, www.gov.uk/government/publications/upgrading-our-energy-system-smart-systems-and-flexibility-plan

Self-Generation

The Feed-in Tariffs scheme supports a range of small-scale, low-carbon electricity generation projects (with capacity up to 5MW for solar PV, wind, hydropower and anaerobic digestion, and up to 2kW for combined heat and power), and was designed to be accessible to organisations, businesses, communities and individuals that have not traditionally engaged in the electricity market. Generators receive three benefits:

- Generation tariff - a payment for every kWh generated (the rate being dependent on the technology, the capacity of the installation, and the date installed);
- Export tariff - an additional payment for every kWh that is exported to the electricity network, and
- Bill savings - additional benefit from usage of electricity 'onsite' as opposed to paying the retail price for importing that energy from the grid.

Following a consultation process, the scheme closed to new applications in March 2019 – however projects that have previously qualified will continue to be supported by the scheme.

In December 2018, the UK government proposed to introduce a new market-led Smart Export Guarantee (SEG), which aims to ensure that eligible small-scale low-carbon generators who export electricity to the network can receive payment for it. This received Parliamentary approval in June 2019 and came into force on 1 January 2020. More information on the SEG is included in 3.1.2(iii).

Smart meters

Smart meters are replacing traditional gas and electricity meters across Great Britain as part of an important national upgrade that will build a smart grid, digitise our energy system and drive innovation. In September 2019, the UK government published a consultation on a post-2020 policy framework to further drive investment and maintain momentum towards a market-wide roll out that will deliver consumer and system benefits as soon as practicable.[138]

Smart meters offer a range of intelligent functions and provide consumers with more accurate information on their energy usage and cost. Every domestic consumer is also offered an In-Home Display, which gives consumers easy access to their energy consumption data in pounds and pence to help them manage and reduce their energy consumption, save money and reduce emissions.

The UK government's latest Cost Benefit Analysis estimates the roll-out of smart meters in Great Britain will deliver total net benefits of around £bn, the majority of which come from consumer energy savings and industry operational cost savings.[139] Without the flexibility enabled by smart metering, modelling for the CCC estimates the costs of delivering net zero emissions by 2050 could be up to £16bnhigher each year.[140]

[138] Smart meter policy framework post 2020, September 2019, www.gov.uk/government/consultations/smart-meter-policy-framework-post-2020
[139] Smart meter roll-out: cost-benefit analysis 2019, www.gov.uk/government/publications/smart-meter-roll-out-cost-benefit-analysis-2019
[140] Analysis of Alternative UK Heat Decarbonisation Pathways, for the Committee on Climate Change, August 2018, www.theccc.org.uk/wp-content/uploads/2018/06/Imperial-College-2018-Analysis-of-Alternative-UK-Heat-Decarbonisation-Pathways.pdf

As at 30 September 2019 there were 15.6 million smart and advanced meters operating in homes and businesses across Great Britain[141], allowing consumers to take control of their energy consumption, making it easier for them to switch energy supplier, paving the way towards a smart energy system,[142] and playing a key role on the road to decarbonisation and net zero.

The UK government has developed a comprehensive consumer engagement strategy to help consumers benefit from smart metering. Energy suppliers hold the primary consumer engagement role as the main point of contact for customers before, during and after the smart meter installation. A mandatory installation code of practice requires energy suppliers to take consumers' specific needs into account. This ensures that all consumers, particularly vulnerable consumers, can access the benefits of smart metering. In addition, Smart Energy GB, an independent body funded by energy suppliers, is delivering a national engagement programme to raise awareness and drive behaviour change. As part of this work Smart Energy GB is partnering with grassroots organisations around Great Britain to reach all types of consumers including the most vulnerable.

Millions of energy consumers are already benefitting from smart meters and the overwhelming majority are having a good experience, which is testament to the hard work, skill and dedication of all the organisations involved in delivering the rollout:

- 9 in 10 people with smart meters say they were satisfied with the installation process.[143]
- 8 in 10 people with smart meters say they have a better idea of their energy costs.[144]
- 9 in 10 smart pre-payment customers say that topping up has become easier since getting a smart meter.[145]

The Scottish Government is working to deliver a Smart Meter Advice Project (SMAP) delivered through Home Energy Scotland to enable customers to make the most of the energy use data provided by their smart meters. Home Energy Scotland now has a network of advisors trained to provide general smart meter information and recruit customers for SMAP. Each centre has a smart meter specialist fully trained to use the SMAP tool. Home Energy Scotland will routinely ask customers about their meter and, if they have a smart meter, ask their permission to use their data to improve the service provided.

iv National objectives with regard to ensuring electricity system adequacy, as well as for the flexibility of the energy system with regard to renewable energy production, including a timeframe for when the objectives are to be met

Capacity Market

The UK government has established in law a reliability standard for system adequacy in Great Britain. This is set at 3 hours Loss of Load Expectation (LOLE), i.e. the expectation that there will be three hours per year on average where generation in the market may not meet demand,

[141] Statistical release and data: Smart Meters, Great Britain, quarter 3 2019, published November 2019, www.gov.uk/government/statistics/statistical-release-and-data-smart-meters-great-britain-quarter-3-2019
[142] Smart meters: unlocking the future, published December 2018, www.gov.uk/government/publications/smart-meters-unlocking-the-future
[143] BEIS, Smart Meter Customer Experience Study: Post-installation survey, August 2017, www.gov.uk/government/publications/smart-meter-customer-experience-study-2016-18
[144] Smart Energy GB, Smart Energy Outlook March 2019, www.smartenergygb.org/en/-/media/SmartEnergy/essential-documents/press-resources/Documents/Smart-energy-outlook-March-2019.ashx
[145] BEIS, Smart Meter Customer Experience Study: Post-installation survey, August 2017, www.gov.uk/government/publications/smart-meter-customer-experience-study-2016-18

and other measures may be needed. Capacity Market (CM) auctions are held one (T-1) and four (T-4) years ahead of the delivery year with targets set at the level needed to meet this reliability standard. Existing generators compete against a range of other technologies to obtain agreements under which they commit to making their capacity available when needed, in return for guaranteed payments.

Section 3.3(i) contains information on flexibility.

v Where applicable, national objectives to protect energy consumers and improve the competitiveness of the retail energy sector

The UK's plans for the next 10 years include:

Default Tariff Cap:

- On 1 January 2019, the Default Tariff Cap came into force in Great Britain.[146] This will remain in place until the end of 2020 but can be extended each year until 2023. Analysis from Ofgem (the independent GB energy market regulator) suggests that the cap will save around 11 million default tariff customers c.£75-100/year compared to if the cap was not introduced.[147] As of October 2019, the default tariff cap was set at £1,179/year for a typical domestic customer.[148]
- Ofgem implemented the measure following the passing of the Domestic Gas & Electricity (Tariff Cap) Act 2018 in July 2018.[149] The legislation was put in place following the Competition & Markets Authority's (CMA) Energy Market Investigation conducted in 2016, which found that in total domestic customers of the six largest energy companies were paying an average of £1.4bn a year more than they would in a truly competitive market. The Default Tariff Cap is designed as an interim measure to protect consumers on standard variable and default tariffs from overpaying for their energy.

Engaging consumers:

- Ofgem are introducing a principles-based approach which allows bills to be simplified with information presented in a way that works for consumers. This approach balances the protection of consumers, with greater room for flexibility and innovation in the future.
- Ofgem are also conducting trials to discover what works to appropriately engage consumers. These trials may be scaled up and rolled out nationally if successful.

Future Retail:

- The joint BEIS-Ofgem Future Retail Markets Review launched in November 2018 is looking at how the regulatory framework might need to evolve to ensure the energy market is fit for the future, so that consumers can take advantage of the increased flexibility and lower costs of a smart, low-carbon energy system. The review will seek to

[146] Default Tariff Cap: www.ofgem.gov.uk/gas/retail-market/market-review-and-reform/default-tariff-cap
[147] Figure based on typical domestic consumption values of 3100kwh electricity, 12000kwh gas. Source: Ofgem, Higher wholesale costs push up default and pre-payment price caps from April, www.ofgem.gov.uk/publications-and-updates/higher-wholesale-costs-push-default-and-pre-payment-price-caps-april
[148] Figure based on typical domestic consumption values of 3100kwh electricity, 12000kwh gas. Source: Ofgem, default tariff cap level – Letter (1 April 2019 to 30 September 2019), www.ofgem.gov.uk/publications-and-updates/default-tariff-cap-level-1-april-2019-30-september-2019
[149] Domestic Gas and Electricity (Tariff Cap) Act 2018, www.legislation.gov.uk/ukpga/2018/21/contents/enacted/data.htm

ensure that consumers are appropriately protected no matter what energy related products and services they sign up to.

- In July 2019 the joint team published the consultation 'Flexible and Responsive Energy Retail Markets', setting out a vision for the future of the energy retail markets, including key opportunities and challenges.[150] The consultation closed on 16 September 2019. The team are currently analysing the responses from the wide range of stakeholders. We plan to use the responses and continue to work with stakeholders to help us shape the development of more detailed reforms over the coming months.

Use of data:

- The UK government and Ofgem are revising the Midata programme so that domestic consumers can quickly, securely and easily share their energy data with trusted third parties. This will enable services including, but not limited to, faster and more accurate tariff comparisons.
- Price comparison websites are to be granted access to the Electricity Central Online Enquiry Service and gas and electricity customers' data to reduce errors in switching process. There will be an annual report on the development of this work.
- Smart meters are replacing traditional gas and electricity meters across Great Britain as part of an important national upgrade that will build a smart grid, digitise our energy system and drive innovation. The UK government has published a consultation on a post-2020 policy framework to further drive investment so that momentum continues that will deliver a market-wide roll out and all consumer and system benefits as soon as practicable.[151]
- Building on the functionality provided by smart metering, Ofgem is considering the move to market-wide half-hourly electricity settlement; and intend to reach a decision on the approach and timeframe for implementing it in Q1 2021.[152]

Faster switching:

- Ofgem and the UK government are moving to faster and more reliable switching for customers.

The Scottish Government published the Energy Consumer Action Plan in May 2019.[153] The Action Plan establishes a framework to guide devolved energy policy and influence change in areas reserved to UK government. Building on two Scottish Energy Summits held in 2016 and 2018 and delivering on a commitment in the Scottish Energy Strategy, the Energy Consumer Action Plan sets out a collaborative approach to ensuring consumers are informed, engaged and empowered as the energy system evolves.

The Scottish Government also announced in October 2017, an ambition to establish a public energy company with the aim of supporting efforts to tackle fuel poverty and helping to achieve

[150] Flexible and Responsive Energy Retail Markets, www.gov.uk/government/consultations/flexible-and-responsive-energy-retail-markets
[151] Smart meter policy framework post 2020, published September 2019, www.gov.uk/government/consultations/smart-meter-policy-framework-post-2020
[152] Electricity Settlement Reform, Ofgem, www.ofgem.gov.uk/electricity/retail-market/market-review-and-reform/smarter-markets-programme/electricity-settlement-reform
[153] Energy Consumer Action Plan, www.gov.scot/publications/energy-consumer-action-plan-putting-consumers-heart-scotlands-energy-transition/pages/3/

climate change targets.[154] It will be publicly owned and run on a not-for-profit basis. The company will offer energy at a fair price and ultimately will contribute to economic development through supporting renewable energy ambitions. An outline business case is currently being finalised and will be published once considered by Ministers and potential local authority partners.

2.4.4 Energy poverty

i Where applicable, national objectives with regard to energy poverty including a timeframe for when the objectives are to be met.

Energy poverty, known as fuel poverty in the UK, is a devolved issue, with separate objectives to address fuel poverty in each administration which are set out below. Each administration is also able to set out specific policies to support their objective. Some of the policies implemented by the UK government extend to more than one administration, where this is the case the geographical extent is specified.

England

The Fuel Poverty (England) Regulations 2014[155] created an objective for improving the energy performance of as many fuel poor homes in England as is reasonably practicable to a minimum energy efficiency rating of Band C by 31 December 2030. The fuel poverty strategy for England includes interim milestones for as many fuel poor homes as is reasonably practicable to achieve a minimum energy efficiency rating of Band E by 2020 and Band D by 2025.

An annual assessment of the number of households living in fuel poverty is undertaken in England. Currently fuel poverty is measured using the Low Income High Cost indicator. In 2019 Government consulted on a proposal to update this to a new measure of fuel poverty 'Low Income Low Energy Efficiency', further details on this proposal is set out in the Consultation on the Fuel Poverty Strategy for England.[156] Data is collected through the English Housing Survey to produce annual fuel poverty statistics. The 2019 Report[157] provides the latest statistics on the number of households living in fuel poverty in England, analysis of the composition of the fuel poor group in 2017 and projections of the number of households in fuel poverty in 2018 and 2019. The proportion of households in England in fuel poverty was estimated to be 10.9% in 2017, approximately 2.53 million households.

In 2017, further progress was made towards the fuel poverty interim milestones and fuel poverty target. Table 12 highlights the percentage of fuel poor households that have an energy efficiency rating corresponding to the milestones and target and highlights the percentage change since 2010:

[154] Public Energy Company, Scottish Government website, www2.gov.scot/Topics/Business-Industry/Energy/POEC
[155] The Fuel Poverty (England) Regulations 2014, www.legislation.gov.uk/uksi/2014/3220/contents/made
[156] Consultation on the Fuel Poverty Strategy for England, www.gov.uk/government/consultations/fuel-poverty-strategy-for-england
[157] The 2019 Annual Fuel Poverty Statistics, www.gov.uk/government/statistics/annual-fuel-poverty-statistics-report-2019

Table 12: Progress towards fuel poverty interim milestones and fuel poverty target in England[158]

Target year	Target	2010 (%)	2017 (%)	Percentage point change
2020	E or above	81.1	92.2	+11.1
2025	D or above	32.7	65.9	+33.2
2030	C or above	1.5	10.0	+8.5

Northern Ireland

In Northern Ireland a household is considered to be living in fuel poverty if it needs to spend more than 10% of its income on fuel to obtain a satisfactory level of heating - that is, 21ºC in the living room and 18ºC in other occupied rooms. Essentially fuel poverty means not being able to keep your home adequately warm at a reasonable cost. It is generally caused by a combination of three factors:

- poor household energy efficiency (this is the factor addressed by the Affordable Warmth Scheme)
- low income
- high fuel costs

The 2016 House Condition Survey estimated that approximately 22% (160,000) of households in Northern Ireland were in fuel poverty.

The Northern Ireland Executive's fuel poverty strategy is delivered mainly through the Affordable Warmth Scheme.[159] The 2019/20 Fuel Poverty target for the Affordable Warmth Scheme and Boiler Replacement Scheme is to deliver 3,900 energy efficiency measures to 2,600 homes through the Affordable Warmth Scheme and to deliver a further 1,300 replacement boilers to 1,300 homes through the Boiler Replacement Scheme.

Scotland

The Fuel Poverty (Targets, Definition and Strategy) (Scotland) Act ('the 2019 Act')[160] was passed by Parliament with unanimous support in June 2019 and received Royal Assent on 18 July 2019. It sets statutory targets for reducing fuel poverty, introduces a new definition which aligns fuel poverty more closely with relative income poverty and requires Scottish Ministers to produce a comprehensive strategy to show how they intend to meet the targets. This Strategy is due to be published in 2021.

[158] Annual fuel poverty statistics report: 2019, June 2019, www.gov.uk/government/statistics/annual-fuel-poverty-statistics-report-2019
[159] Northern Ireland Affordable Warmth Scheme, www.nihe.gov.uk/index/benefits/affordable_warmth_scheme.htm; current AWS Fuel Poverty Strategy, www.communities-ni.gov.uk/publications/fuel-poverty-strategy
[160] The Fuel Poverty (Targets, Definition and Strategy) (Scotland) Act 2019, www.legislation.gov.uk/asp/2019/10/enacted

Targets

The statutory targets set by the 2019 Act are that in 2040:

- no more than 5% of households should be in fuel poverty
- no more than 1% of households should be in extreme fuel poverty
- the median fuel poverty gap of households in fuel poverty is no more than £250 in 2015 prices before adding inflation

Each of these 2040 targets must be achieved not only in Scotland as a whole, but also within each of the 32 local authority areas. This is to ensure that no part of the country is left behind. There are also interim targets set for the same metrics at 2030 and 2035. However, the interim targets only need to be met at a national level.

New definition and provisions for remote and island communities

The 2019 Act establishes a new two-part definition whereby a household is considered fuel poor if:

- more than 10% (20% for extreme fuel poverty) of their after-housing costs adjusted net income is required to pay for their reasonable fuel needs; and
- after further adjustments for childcare costs and receipt of specified benefits, their remaining adjusted net income is insufficient to maintain an acceptable standard of living, defined as being at least 90% of the UK Minimum Income Standard.

To take account of the generally higher costs of living in Scotland's remote and island communities, the legislation provides for uplifts to be applied to the Minimum Income Standard for households in these areas.

Fuel Poverty Statistics for 2018

The latest statistics on fuel poverty were published on 21 January as part of the Scottish House Condition Survey and relate to 2018. The figures presented in the 2018 survey are a best estimate of fuel poverty under the new definition. The headline figures are:

- The level of fuel poverty was 25.0% (around 619,000 households). This is similar to the rate in 2016 and 2017 but lower than the peak of 31.7% (761,000 households) in 2013.
- The level of extreme fuel poverty was 11.3%, equivalent to around 279,000 households. Levels of extreme fuel poverty have been decreasing since the peak in 2013 of 16.0% (384,000 households).
- While fuel poverty rates for households in urban and rural areas were similar in 2018, extreme fuel poverty rates were higher in rural areas compared to urban areas; 17% compared to 10%, respectively.
- Overall rates of extreme fuel poverty were similar between the social (13%) and private sector (10%) in 2018, although levels of extreme fuel poverty in housing association households have decreased from 18% in 2017 to 11% in 2018.
- 69% of fuel poor households are also income poor, similar to 2017.
- 28% of households report owning an energy monitoring device – a nine percentage point increase on the previous year.

- Fuel poor and extreme fuel poor households are more likely to monitor energy use (62% and 65% respectively compared to 57% for non-fuel poor households) but less likely to have monitoring devices at home (23% for both compared to 29% for non-fuel poor households).

By the end of 2021, the Scottish Government will have allocated over £1bn since 2009 to tackling fuel poverty and improving energy efficiency and is on track to deliver its 2016 Programme for Scottish Government commitment to make half a billion pounds available over four years to address these issues, making people's homes warmer and cheaper to heat.

The Scottish House Condition Survey[161] shows that just over two-fifths (44%) of homes in 2018 were rated EPC band C or above, an increase from 35% in 2014, based on the SAP 2012 (RdSAP v9.92) methodology. In the delivery of Scotland's Energy Efficient Scotland Programme, priority will be given to improving the homes of fuel poor households. The programme sets a target for all Scottish homes to achieve an EPC band C by 2040 (where technically feasible and cost effective). To support the ambition of eradicating fuel poverty by removing poor energy efficiency as a driver the Scottish Government have consulted on setting a more ambitious target for those households in fuel poverty - for all homes with households in fuel poverty to reach EPC Band C by 2030 and EPC Band B by 2040 (where technically feasible and cost effective).

Wales

The Warm Homes and Energy Conservation Act 2000 as amended by the Energy Act 2013, imposes a requirement on the Welsh Ministers in relation to Wales to publish and implement a strategy for reducing fuel poverty; to require the setting of targets for the implementation of that strategy, and for connected purposes.

Targets for eradicating fuel poverty in Wales were initially published in 2003, in the Welsh Assembly Government's A Fuel Poverty Commitment for Wales. The 2010 Strategy replaced the commitment, although the targets remained in place. As far as reasonably practicable, the objective is the eradication of fuel poverty:

- Amongst vulnerable households by 2010;
- In social housing by 2012; and
- By 2018, there would be no-one in Wales living in fuel poverty.

Under the Strategy, fuel poverty in Wales is measured by the number of people having to spend more than 10% of income on all household fuel used to maintain a satisfactory heating regime. Where expenditure on all household fuel exceeds 20% of income, households are defined as being in severe fuel poverty.

On 22 May 2019, new headline estimates for Fuel Poverty in Wales were published and detailed analysis was published in August.[162] In 2018, it is estimated:

- 155,000 households in Wales were living in fuel poverty, equivalent to 12% of households.

[161] Scottish House Condition Survey, 2017, Table 18, www.gov.scot/publications/scottish-house-condition-survey-2017-key-findings/pages/5/
[162] Fuel poverty estimates for Wales, 2019, https://gov.wales/fuel-poverty-estimates-wales

- Of these households, 32,000 households were living in severe fuel poverty[163], equivalent to 2% of households.
- 130,000 vulnerable[164] households in Wales were living in fuel poverty, equivalent to 11% of vulnerable households.
- 19,000 vulnerable households were living in severe fuel poverty, equivalent to 2% of vulnerable households.

From October to December 2020, the Welsh Government is consulting on a new draft plan for tackling fuel poverty. The aim of the new plan is to set out the actions to be taken by the Welsh Government to support efforts to reduce the number of homes in Wales living on a lower income in 'Fuel Poverty'. It will set out a range of new targets, policy goals, objectives and activities designed to collaborate with partners towards the objective of eradicating fuel poverty for people living on a lower income where it is practicable to do so, whilst contributing to the Welsh Government's commitments to tackle climate change by reducing carbon emissions.

2.5 Research, innovation and competitiveness

i National objectives and funding targets for public and, where available, private research and innovation including, where appropriate, a timeframe for when the objectives are to be met.

Through our Industrial Strategy, the UK government has set a Clean Growth Grand Challenge to put the UK at the forefront of the industries of the future. The UK government will maximise the advantages for UK industry from the global shift to clean growth – through leading the world in the development, manufacture and use of low-carbon technologies, systems and services that cost less than high carbon alternatives. As part of this Grand Challenge, the UK will:

1. Develop smart systems for cheap and clean energy across power, heating and transport.
2. Transform construction techniques to dramatically improve efficiency (with up to £170m available through wave 2 of the Industrial Strategy Challenge Fund up to 2021).
3. Work with industry to make the UK's energy intensive industries competitive in the clean economy.
4. Put the UK at the forefront of the global move to high-efficiency agriculture.
5. Make the UK the global standard-setter for finance that supports clean growth.

The UK government has significantly increased its investment in low-carbon innovation. From 2015 to 2021 we expect to invest more than £2.5bn in research, development and the demonstration of low-carbon energy, transport, agriculture and waste.[165] This includes:

- Up to £505m from BEIS's Energy Innovation Programme, which aims to accelerate the commercialisation of innovative clean energy technologies and processes.

[163] The sample sizes for severe Fuel Poverty are small and these estimates are not considered as robust as those for Fuel Poverty.
[164] A vulnerable household is defined as those with a person aged 60 years or over, a child or young person under the age of 16 years and/or a person who is disabled or has a long-term limiting condition.
[165] Energy Innovation, www.gov.uk/guidance/energy-innovation

- Up to £1.2bn of funding from the combination of UK Research Councils and Innovate UK – now being brought into one organisation with the creation of UK Research and Innovation. These investments include funding for the Energy Systems Catapult and the Offshore Renewable Energy Catapult.
- Up to £246m for the Faraday Challenge, which will ensure the UK builds on its strengths and leads the world in the design, development and manufacture of electric batteries.
- Up to £620m from a range of UK government departments, including BEIS, Department for Transport (DfT), Department for International Development (DfID) and Department for Environment, Food and Rural Affairs (Defra) and additional Industrial Strategy Challenge Fund support.
- In addition to this UK government funding, in the current price control Ofgem is making £720m of regulated expenditure available to gas and electric companies in Great Britain, to support smarter, more flexible, efficient, and resilient networks.
- The UK government is also stimulating industry-academia collaboration for example through the Agri-tech catalyst, which will help improve agricultural productivity and contribute to more environmentally sustainable agricultural systems.

The UK's Office of National Statistics (ONS) publishes estimates of total private sector research and development, but this is not broken down by Energy Technology Research, Development and Innovation (ETRDI). We are not aware of any formal reporting of data broken down in this way as there is no formal record of different private sector ETRDI projects.

The UK government actively encourages private sector participation in public ETRDI Programmes, recognizing the clear economic benefits such as supporting jobs and increasing export potential.

Co-ordination of UK energy research and innovation activity

The Energy Innovation Board was formed in November 2016 and replaces and builds on the work of the former Low Carbon Innovation Coordination Group (LCICG), as the strategic body aligning low-carbon innovation investments across the UK government and regulated bodies (Ofgem). It plays a strategic role in aligning domestic and international clean tech investments across the UK government.

The Board is currently chaired by the UK Government Chief Scientific Advisor and is attended by senior civil servants across BEIS, Innovate UK, Research Councils, Ministry of Housing, Communities and Local Government, Department for International Development, Department for Transport, Ofgem, and with the Treasury as observers. The Board is internal to the UK government but is seeking external members with industry insights to provide external challenge. The Board meets on a regular basis to discuss a range of clean technology innovation topics.

Prioritisation of UK energy research and innovation activity

The Energy Innovation Needs Assessment (EINA) project is a two-phased effort to develop a set of reports to provide evidence for the innovation needs of a range of clean energy technologies, and the systems and processes in which they are utilised. These reports build on the evidence developed as part of the Technology Innovation Needs Assessment (TINA) project, conducted during the 2010-2015 Parliament. The objectives of the EINAs are:

- To create a methodology for conducting assessments of future innovation needs in a way that will produce comparable outputs across different technologies.
- To facilitate efforts across government to identify strategic energy innovation areas for investment.
- To analyse the role of technologies in the energy system.
- To quantify the scale of the opportunity to UK and regions of:
  - reducing technology costs
  - expanding economic growth
- To help understand the uncertainty associated with the above estimates.

The EINAs assess themes such as power generation including bioenergy, carbon capture and storage, hydrogen, demand and supply of heating and transport.

The methodology has been tested through a small-scale pilot of heating technologies to test the effectiveness of the methodology. The EINAs were published in November 2019 and will be used as a key information resource for planning spending towards delivering the UK's international and net zero commitments.

In Scotland, the Energy Strategy emphasised the importance of attracting, retaining and developing low-carbon innovators who will shape the future. Alongside the publication of the Scottish Energy Strategy in December 2017, the Scottish Government announced the creation of a £20m Energy Investment Fund, building on the success of the Renewable Energy Investment Fund, and a £60m Low Carbon Innovation Fund, to provide support for renewable and low-carbon infrastructure over and above wider interventions to support innovation.[166] The programme aims to stimulate commercial interest and investment, maximising Scotland's vast potential in the low-carbon sector, building on the success of the Low Carbon Infrastructure Transition Programme (LCITP) which has allocated around £40m to 16 low-carbon capital projects since 2015. The invitation for the LCITP Low Carbon Innovation Fund launched in January 2018, seeking applications in three priority areas: Low Carbon Heat, Integrated Energy Systems and Ultra Low Emission Vehicle Infrastructure: 14 projects have received offers of development support.

The energy sector in Wales has benefited considerably from European structural funds. The funding awarded includes building research capacity at Welsh universities, enabling collaborative research, development and demonstrators, and investment in renewables and marine energy development. During the period 2014-2018 over £60m has been invested. In addition, the Smart Living Programme works with local authorities and other key stakeholders

[166] Low Carbon Infrastructure Transition Programme, www.gov.scot/policies/renewable-and-low-carbon-energy/low-carbon-infrastructure-transition-programme/

to develop innovative demonstrators in Smart Living.[167] Examples of projects which have received EU funding include:

- **FLEXIS**[168]: World-leading energy research scheme, involving collaborations with industry and research organisations in Wales, Europe and around the world. FLEXIS investigates how multiple energy sources can be supplied to consumers through more flexible and efficient systems that integrate traditional and renewable energy sources.
- **Active Building Centre**[169]: Developing and delivering the first examples of buildings as power stations which are able to generate, store and release their own energy both thermal and electrical.
- **Caerau Local Heat Scheme**: Using underground mine-water to warm 150 homes in Caerau Bridgend. Water in the underground mine workings of the former Caerau colliery has been naturally heated by the earth and will be harnessed using heat pump technology and a network of pipes as a geothermal source of energy.
- **WaveSub**: Enabling the design, manufacture and testing of a prototype Wave Energy Converter within the Haven Waterway Enterprise Zone.

ii Where available, national 2050 objectives related to the promotion of clean energy technologies and, where appropriate, national objectives including long term targets (2050) for deployment of low-carbon technologies, including for decarbonising energy- and carbon-intensive industrial sectors and, where applicable, for related carbon transport and storage infrastructure

Our future research and innovation activities will be designed to achieve our legally binding domestic carbon budgets and our new commitment to achieve net zero greenhouse gas emissions from the UK by 2050. Our research and innovation priorities and related spending to deliver these targets are in the process of being considered and agreed, but in the meantime, our intention is to remain closely engaged in international research and innovation activities to meet these world leading commitments. We have an overall target of spending an amount equal to 2.4% of GDP on UK research and innovation more generally, with energy research and innovation a part of this.

In the meantime, the CGS, published in 2017, included three illustrative pathways to meeting what was then our long-term target of reducing emissions by at least 80% relative to 1990 levels by 2050. These did not represent the most likely or preferred pathways to meeting the previous 2050 target, but showed that the 2032 pathway would leave open a wide range of options for 2050 - different pathways within this range, and beyond this range, were also possible. The pathways explored were:

- An Electricity pathway - where all cars and vans are electric, four in five buildings use electric heating, electricity is the main low-carbon energy source for the industry sector and around one in five buildings uses a largely low-carbon district heat network.
- A Hydrogen pathway- where all cars and vans are fuelled by hydrogen, the majority of buildings use hydrogen for heat, with CCUS capturing and storing the emissions during Hydrogen production.

[167] Smart Living, Welsh Government website, July 2018, https://gov.wales/low-carbon-living-smart-living-annual-review-2018-2019
[168] Meeting the energy demands of the future, www.flexis.wales/
[169] Active Buildings website, http://specific.eu.com/

- A Negative Emissions pathway- where negative emissions in the electricity sector create 'headroom' for other sectors such as transport, buildings and agriculture to decarbonise more slowly.

Scotland

The Scottish Energy Strategy sets two ambitious targets for 2030:

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

The Scottish Government has also set interim targets for 100% of Scotland's electricity and for 11% of Scotland's non-electrical heat demand to come from renewable sources by 2020. As well as a 12% reduction in energy consumption by 2020.

Like the CGS, the Scottish Energy Strategy is not prescriptive in setting out the pathway by which decarbonisation will ultimately be delivered – instead it offers two illustrative examples, a Hydrogen Future and an Electric Future, both of which are consistent with Scotland's Climate Change targets. These are designed to aid the consideration of developments in the near-term, and the influence they may have on the eventual shape of the system.

In terms of low-carbon and renewable transport, the Scottish Government have committed to phasing out the need for new petrol and diesel cars and vans by 2032, through expanding the electric charging infrastructure in Scotland, accelerating the procurement of ultra-low emission vehicles (ULEV) in the public and private sectors, and introducing large scale pilots to remove barriers to and encourage private motorists to use ULEVs.

iii Where applicable, national objectives with regard to competitiveness

Public investment in economic infrastructure will have doubled over the decade leading up to 2022-2023. This investment will be delivered through a strengthened institutional framework, with longer-term budgets, the advice of the National Infrastructure Commission, an increased focus on the effective delivery of projects in departments, and five-year capital investment programmes for road, rail, water and flooding.

The UK government will take a more strategic approach to our investment in the design of relevant markets, focusing on three principles. We will:

- Invest in ways that support all the objectives of the Industrial Strategy: increasing innovation, developing skills, growing business, and driving productivity and earning power in urban and rural locations across the UK.
- Take greater account of disparities in productivity and economic opportunity between different parts of the UK, ensuring our investments drive growth across all regions of the UK.
- Invest to increase UK competitiveness in relation to long-term global economic changes, such as the shift to clean growth. These will be positive choices that enable the UK economy to flourish in the context of these transformational changes.

Innovation in clean growth will be important for low-cost, low-carbon infrastructure systems, as well as for realising industrial opportunities. We will increase support for clean growth innovation by making this a strategic priority for the Industrial Strategy Challenge Fund.

This will build on the UK government investment in low-carbon innovation set out in the CGS, which has grown to more than £3bn between 2015 and 2021.[170] In addition to the Faraday Challenge for battery technology, the UK government has announced three new Industrial Strategy programmes in Clean Growth across energy, construction and agriculture. We will continue to build our international partnerships in clean growth research and innovation: the UK is a proud member of Mission Innovation – a global initiative that aims to reinvigorate and accelerate the global clean energy revolution. We will strengthen support to commercialise new clean technologies through our investments in patent capital, beginning with a new equity fund for which we will provide up to £2m.

We will use all the UK government tools available to support innovation in a low-carbon economy including market design, taxation and regulation. We will also aim to accelerate private investment and promote market growth.

We will promote overseas investment in the UK's clean economy and strengthen our support for UK exporters through better identification of overseas opportunities, industry briefings, overseas missions, pavilions at key international events and campaigns for sectors and industries that are delivering clean growth. We will also promote the UK's exceptional expertise through the Green is GREAT campaign to amplify the UK's global reputation for excellence in this area.[171]

In Scotland, the Energy Strategy highlights the huge economic opportunity that the transition to a low-carbon economy presents. Scotland has a well-established oil and gas sector, a proud engineering heritage and enviable natural resources, which has provided the platform for the recent growth in renewable energy deployment. Building on these strengths will help the UK as a whole to create a modern, integrated, low-carbon energy system, and support the delivery of the ambitions and priorities set out in Scotland's Economic Strategy. Scotland's rich energy history and expertise will support greater internationalisation by strengthening renewable supply chains and research dissemination. The Scottish Government is committed to building on Scotland's international reputation for excellence in energy, and to forging partnerships between the UK and other countries.

[170] Clean Growth Strategy, 2017, www.gov.uk/government/publications/clean-growth-strategy
[171] Industrial Strategy, 2017, www.gov.uk/government/publications/industrial-strategy-building-a-britain-fit-for-the-future

3. Policies and measures

3.1 Decarbonisation

3.1.1 GHG emissions and removals

i Policies and measures as referred in section 2.1.1 and covering all key emitting sectors and sectors for the enhancement of removals, with an outlook to the long-term vision and goal to become a low emission economy and achieving a balance between emissions and removals in accordance with the Paris Agreement

The UK has a significant package of policies and measures to meet its targets. Many of the policies described cross different sectors and involve a number of delivery mechanisms.

Table 13 below was published in the UK's 7th National Communication in December 2017[172] and summarises these policies, some of which have been updated. Not all of these policies apply across all of the Devolved Administrations.

In Scotland, the policies and proposals for meeting statutory emissions reduction targets are set out in the Scottish Government's Climate Change Plan[173] published in February 2018, and the Energy Strategy[174] published December 2017. The specific policies and proposals that apply to Scotland are therefore not listed below but can be accessed through these documents.

Prosperity for All: A Low Carbon Wales was published in March 2019 and sets out the policies and proposals for meeting the first Welsh carbon budget (2016-2020).[175] The plan for the second carbon budget will be published in 2021.

[172] Seventh National Communication – Annex I, https://unfccc.int/node/28527
[173] Climate Change Plan: third report on proposals and policies 2018-2032 (RPP3): www.gov.scot/publications/scottish-governments-climate-change-plan-third-report-proposals-policies-2018/
[174] Scottish Energy Strategy: The Future of Energy in Scotland, 2017, www.gov.scot/publications/scottish-energy-strategy-future-energy-scotland-9781788515276/
[175] https://gov.wales/prosperity-all-low-carbon-wales

Table 13: Summary of the UK's policies updated from the UK's 7th National Communication

Energy supply

Policy name	Status	Type of measure	Impacting traded or non-traded sectors
Climate Change Levy (CCL)	2001 (Implemented)	Economic, Regulatory, Fiscal	System of carbon pricing, ESR
The Climate Change Levy (CCL) was introduced in 2001. It is levied on the supply of energy to business and public sector consumers. Each of the four main groups of taxable commodities (electricity, gas, solid fuels, and liquefied petroleum gas [LPG]) has its own main rate per unit of energy. The main rates of the CCL are intended to incentivise businesses to reduce their energy consumption. Eligible energy-intensive industries may pay reduced main rates of CCL through CCAs, or be exempt from the CCL for mineralogical/metallurgical processes.			
Renewables Obligation (RO)	2002-2019 (Implemented)	Regulatory, Economic	System of carbon pricing, ESR
Sets an annual obligation on electricity suppliers to source a proportion of their generation from renewable sources. The RO was introduced in 2002 in Great Britain, and in 2005 in Northern Ireland. It closed to most new applicants on 31 March 2017. Limited grace periods extended the deadline for certain projects up to 31 January 2019 in Great Britain, and to 31 March 2019 in Northern Ireland. Stations receive support for up to 20 or 25 years until final closure of the scheme on 31 March 2037.			
Carbon Pricing	2005 (Implemented)	Economic	System of carbon pricing, ESR
Until the end of 2020 the UK will continue to participate in the EU ETS, which sets a limit (cap) on industrial and power sector emissions, which reduces year-on-year, on the total number of greenhouse gas emissions that can be emitted by scheme participants. Emitters must acquire and surrender enough allowances to cover their emissions each year. In May 2019 the UK consulted on The Future of Carbon Pricing outlining proposals for future carbon pricing policy in the UK.			
Large Combustion Plant Directive	2007 (Expired)	Regulatory	System of carbon pricing, ESR
The Large Combustion Plant Directive (LCPD, 2001/80/EC) sets limits on emissions of sulphur dioxide, nitrogen oxides, and dust from combustion plants with a thermal capacity of 50 MW or greater. Has now been replaced by the Industrial Emissions Directive.			

Policy name	Status	Type of measure	Impacting traded or non-traded sectors
Additional renewables in generation (Renewable Energy Strategy)	2009 (Implemented)	Regulatory, Economic	System of carbon pricing, ESR
Increases Renewable Obligation (RO) targets in electricity supply so as meet the UK's overall renewables target for 2020 as set out in the Renewables Directive (RED, 2009/28/EC).			
Feed in Tariffs (FIT) (GB only)	2010-2019 (Implemented)	Regulatory, Economic	System of carbon pricing, ESR
Feed-in Tariffs (FIT) support organisations, businesses, communities and individuals to generate low-carbon electricity using small-scale (5 MW or less total installed capacity) systems. Electricity suppliers are obliged to pay the regulated tariffs to eligible generators. The FIT scheme closed to new applications on March 31st, 2019.			
Carbon Price Support	2013 (Implemented)	Economic	System of carbon pricing, ESR
The Carbon Price Floor (CPF) is designed to further reduce the use of emission-intensive fossil fuels and increase the proportion of electricity generation and supply from low-carbon sources.			
Contract for Difference (CfD) (2014-2020) (GB only)	2014-2020 (Implemented)	Economic	System of carbon pricing, ESR
Offers Contracts for Difference (CfDs) in the electricity generation market for low-carbon and renewable sources. CfDs replaced the Renewables Obligation which closed to most new applications in 2017 (with extensions to 2019 for certain projects). Current policy offers CfDs for new capacity through competitive auctions.			
Industrial Emissions Directive (as it applies to Large Combustion Plant)	2016 (Implemented)	Regulatory	System of carbon pricing, ESR
As transposed into UK law, the IED replaced the LCPD from 1 January 2016 with similar although more stringent provisions set out in chapter III of the Industrial Emissions Directive (2010/75/EU) (IED). Those provisions already apply in respect to any plant newly permitted since 7 January 2013. Three compliance routes were available to generating plants; to abate emissions and comply with more stringent limits by 2020; to comply with less stringent limits but face a 1,500 hour per year load factor constrain; or to close by 2023.			

Policy name	Status	Type of measure	Impacting traded or non-traded sectors
Capacity Mechanism	2014 (Implemented)	Economic	System of carbon pricing, ESR
Part of the UK Government's Electricity Market Reform package, the Capacity Market ensures that sufficient capacity is available to meet peak demand, encouraging construction and use of a wide variety of new low-carbon generation capacity.			
CCL Budget 2016 Changes	2019 (Adopted)	Economic, Regulatory	System of carbon pricing, ESR
Budget 2016 announced that CCL rates will increase from April 2019, moving to an electricity-to-gas ratio of 2.5:1 compared to the previous 2.9:1 ratio. In the longer term, the UK Government intends to rebalance the rates further, reaching a ratio of 1:1 by 2025. The changes in CCL between 2019 and 2021 were announced in the Budget 2018, but the rates from 2021 onwards, have not yet been announced.			
Contract for Difference (CfD) (2021-2035)	2021-2035 (Planned)	Economic	System of carbon pricing, ESR
Planned continuation of Contracts for Difference (CfDs) for new low-carbon capacity after 2020.			
Smart Export Guarantee (from 2020)	From 2020	Economic	System of carbon pricing, ESR
In July 2019 legislation was passed requiring most (larger) suppliers to offer at least one tariff for exported electricity, to eligible small-scale low-carbon electricity generation projects, that meets Smart Export Guarantee requirements. This came into force on 1 January 2020.			

Energy consumption across homes, business & public sector

Policy name	Status	Type of measure	Impacting traded or non-traded sectors
Carbon Trust measures	2002-2012 (Expired)	Information, Education	System of carbon pricing, ESR
The Carbon Trust provides a range of measures from general advice to in-depth consultancy and accreditation, to reduce emissions and save energy and money to businesses and public sector organisations of all sizes.			
England & Wales - Building Regulations Part L (2002+2005/6)	2002 (Implemented)	Regulatory	System of carbon pricing, ESR
Scotland - Building Regulations 2007 (section 6)	2002 & 2007 (Implemented)	Regulatory	System of carbon pricing, ESR
Building Regulations set minimum energy performance standards for new buildings and when people carry out controlled ‘building work’ to existing properties including extensions, conversions and certain categories of renovation and replacement windows and boilers.			
Small and Medium Enterprises (SME) Loans	2004-2012 (Expired)	Economic	System of carbon pricing, ESR
The Carbon Trust provided interest free loans of £3,000 - £400,000 for small and medium sized businesses to invest in energy efficiency equipment and renewable technologies. These loans were designed so that in most cases the forecast reduction in energy costs would be similar to the total repayment amount.			
Energy Performance of Buildings Directive (EPBD) 2002/91/EC	2007 (Implemented)	Regulatory, Information	System of carbon pricing, ESR
The Directive sought to improve the energy performance of domestic and non-domestic buildings which required energy certificates and the inspection of air conditioning systems. Energy Performance Certificates (EPCs) give information on a building's energy efficiency expressed on a scale of A+ to G (or A to G in the case a building that is a dwelling) with G representing the least energy efficient rating.			

Policy name	Status	Type of measure	Impacting traded or non-traded sectors
CRC Energy Efficiency Scheme	2010 (Implemented)	Economic, Information	System of carbon pricing, ESR
The CRC Energy Efficiency Scheme is a mandatory UK-wide emissions trading scheme (launched in 2010). It encourages the uptake of energy efficiency measures in large non-energy intensive private and public sector organisations that use energy not covered by the EU ETS or Climate Change Agreements. It covers around 5000 medium and large users of energy across the business and public sector. The scheme is split into phases. Phase 1 ran from 1 April 2010 until 31 March 2014. Phase 2 covers emissions from 1 April 2014 until 31 March 2019. In the 2016 Spring Budget, the Chancellor announced there would be no further sales of CRC allowances after Phase 2 (i.e. following the 2018/19 compliance year) and legislation was laid in July 2018 to close the scheme after Phase 2. From April 2019, the CCL was increased to recover the revenue forgone from CRC allowances and a new streamlined energy and carbon reporting framework for quoted companies of all sizes and large unquoted companies and large Limited Liability Partnerships will come into force UJ-wide.			
Building Regulations 2010 Part L	2010 (Implemented)	Regulatory	System of carbon pricing, ESR
Building Regulations set minimum energy performance standards for new buildings and when people carry out controlled ‘building work’ to existing properties including extensions, conversions and certain categories of renovation and replacement windows and boilers.			
Renewable Heat Incentive	2011 non-domestic GB, 2014 domestic GB (Implemented)	Economic	System of carbon pricing, ESR
The Non-Domestic Renewable Heat Incentive (RHI) is a Great Britain (GB) wide scheme which provides financial incentives to increase the uptake of renewable heat by businesses, the public sector and non-profit organisations. Eligible installations receive quarterly payments for 20 years based on the amount of heat generated. The Domestic RHI is a GB wide scheme which provides financial incentives to promote the use of renewable heat in domestic properties. Eligible installations receive quarterly payments for seven years based on either the estimated amount of renewable heat generated, or their metered heat use. In Northern Ireland, separate Renewable Heat Incentive schemes operated before being suspended on 29 February 2016.			

Policy name	Status	Type of measure	Impacting traded or non-traded sectors
Smart Metering	2012-2020 (Implemented)	Information/regulatory	System of carbon pricing, ESR
The Smart Metering Implementation Programme aims to replace up to 53 million meters with smart electricity and gas meters in all domestic properties, and smart or advanced meters in smaller non domestic sites in Great Britain. Smart meters will provide consumers with near-real time information on their energy consumption to help them control energy use, and avoid wasting energy and money. They will provide energy networks with better information upon which to manage and plan current activities. Smart meters will also assist the move towards smart grids which support sustainable energy supply and will help reduce the total energy needed in the system. As at 30 September 2019 there were 15.6 million smart and advanced meters operating across Great Britain, and the UK Government published a consultation in September 2019 on a post-2020 policy framework to maintain roll out momentum.			
Climate change agreements (CCA)	2013-2023 (Implemented)	Economic, Voluntary Agreement/negotiated agreement	System of carbon pricing, ESR
Climate Change Agreements offer participating energy-intensive industries a discount from the Climate Change Levy (CCL) in return for meeting targets for energy reductions. From 2013 these are a 90% discount for electricity and a 65% discount for other fuels. From April 2019 this will increase to a 93% discount for electricity and 78% discount for other fuels to reflect changes to the CCL from this date. The UK Government due to evaluate the effectiveness of the current CCA Scheme in April 2020, which provides CCL discounts to March 2023.			
England - Building Regulations 2013 Part L	2013 (Implemented)	Regulatory	System of carbon pricing, ESR
Building Regulations set minimum energy performance standards for new buildings and when people carry out controlled ‘building work’ to existing properties including extensions, conversions and certain categories of renovation and replacement windows and boilers.			
Scotland - Building Regulations 2015 (section 6)	2015 (Implemented)	Regulatory	System of carbon pricing, ESR
Building Regulations set minimum energy performance standards for new buildings and when people carry out controlled ‘building work’ to existing properties including extensions, conversions and certain categories of renovation and replacement windows and boilers.			

Policy name	Status	Type of measure	Impacting traded or non-traded sectors
Energy Savings Opportunity Scheme (ESOS)	2014 (Implemented)	Regulatory/ Information	System of carbon pricing, ESR
A mandatory energy assessment scheme for all large undertakings (non-SMEs) in response to requirements contained Article 8 of the EU Energy Efficiency Directive (2012/27/EU). Organisations in scope must measure their total energy consumption and carry out audits of the energy used by their buildings, industrial processes and transport to identify cost-effective energy saving measures or comply with the alternative routes to compliance, by 5 December 2015 and every four years thereafter. It is estimated that around 10,000 organisations are participating in the scheme.			
Private Rented Sector (PRS) Energy Efficiency Regulations	2016, 2018 (Implemented)	Regulatory, Information	System of carbon pricing, ESR
‘There are two distinct parts to the Private Rented Sector Energy Efficiency Regulations. The first part represents the ‘Tenants’ energy efficiency improvements’ provisions, which came into force in 2016. The second part represents the ‘Minimum level of energy efficiency’ provisions which were implemented in 2018. This implies a requirement for any properties rented out in the private rented sector to have a minimum energy performance rating of E on an Energy Performance Certificate (EPC), unless the property meets the conditions for an exemption, and that exemption has been registered on the PRS Exemptions Register. The regulations came into force for new lets and renewals of tenancies in England and Wales with effect from 1 April 2018 and for all longer-term tenancies on 1 April 2020 (1 April 2023 for non-domestic properties). In April 2019 these regulations were further strengthened with respect to the domestic sector only, to require a contribution of up to £3,500 from landlords towards the cost of improving their property towards EPC Band E (previously landlords of domestic properties were only required to take action where third party funding was available to meet the improvement costs). It will be unlawful to rent a property which breaches the requirement for a minimum E rating, unless one of the limited number of exemptions applies. There is no minimum requirement for private rented sector properties in Northern Ireland currently.			
Energy Performance of Buildings Directive (EPBD) 2017 Cost Optimal Review and Nearly Zero Energy Buildings (NZEB) (2018 and 2020)	2018 (Delivered)	Regulatory, Information	System of carbon pricing, ESR
In July 2018 the UK Government submitted the second cost optimal assessment of energy performance requirements for the United Kingdom (UK) as required by the Energy Performance of Buildings Directive. Gibraltar submitted its own standalone report later in 2018. Cost-optimal energy performance means that the lifetime cost-benefit analysis is positive. Minimum energy performance requirements must be compared against calculated cost-optimal levels using the Comparative Methodology Framework.			

Policy name	Status	Type of measure	Impacting traded or non-traded sectors
Products Policy	2008 and 2017 (Adopted)	Regulatory	System of carbon pricing, ESR
The EU Ecodesign Directive and the Energy Labelling Framework Regulation operate by setting minimum energy performance and information requirements for energy-related products placed to take the least efficient products off the market and to give consumers clear information to make informed purchasing decisions. This is implemented domestically through product specific EU regulations.			
Amendments to Heat Networks Metering & Billing Regulations (2014)	2017 (Planned)	Regulatory	System of carbon pricing, ESR
UK legislation requiring heat network operators to submit data on networks and to install heat meters/heat cost allocators in buildings on networks unless it is not cost-effective to do so. The amendments will revise the cost-effectiveness methodology and address ambiguities in the existing legislation.			
Public Sector Energy Efficiency Loans Scheme	2004-2021 (Implemented)	Economic	System of carbon pricing, ESR
The Public Sector Energy Efficiency Loans Scheme, managed by Salix Finance Ltd, provides interest-free loans in England, Scotland and Wales to public sector organisations for energy efficiency schemes. These loans are intended to provide the capital cost of energy efficiency retrofit work and other measures to be installed. These loans have a payback period of five years (eight for schools) during which the repayments are met with the energy bill savings from the energy efficiency measures. Thus, once the loan has been paid off, the organisations continue to benefit from energy savings for the lifetime of these measures. This funding is then recycled once it has been returned to the Scheme and once again loaned out. BEIS provides the most amount of funding to the Scheme but there is also some funding from the Scottish Government, the Welsh Government and the Department for Education. Wales will have invested approximately £80 million in public sector energy efficiency and renewable energy projects by 2020. The loans are further supported by the provision of expert technical, commercial and financial expertise through the Welsh Government Energy Service. The service has enabled £55 million of zero-interest loans across the public sector in Wales between 2016 and 2018 and also supported the delivery of a further £27.5 million of energy and energy efficiency projects, where finance was secured from alternative routes. The projects supported will realise savings of £183 million for the public sector over the life of the installed technologies and also reduce carbon emissions by 820,000 tonnes[176].			

[176] Written Statement - Increasing the Scale and Rate of Residential Energy Efficiency Retrofit in Wales, November 2017, https://gov.wales/about/cabinet/cabinetstatements/2017/energyretrofits/?lang=en.

Policy name	Status	Type of measure	Impacting traded or non-traded sectors
Energy Performance of Buildings Directive (EPBD) Recast 2010	2013 (Transposed)	Regulatory, Information	System of carbon pricing, ESR
Recast of the EPBD 92010/31/EU) in July 2013, the principal regulations extended DECs to public buildings over 500 square metres. This size threshold was on 9 July 2015 to include buildings over 250 square metres.			
Warm Front	2000-2013 (Expired)	Economic	System of carbon pricing, ESR
Warm Front installed heating and insulation measures to make homes warmer and more energy efficient for private sector households in England vulnerable to fuel poverty. The scheme offered a package of heating and insulation measures of up to £3,500 (or £6,000 where oil central heating or other alternative technologies are recommended).			
EEC1, EEC2 (2002-2008) & Baseline Carbon Emissions Reductions Target (CERT) (2008-2010)	2002-2009 (Expired)	Regulatory	System of carbon pricing, ESR
Energy Efficiency Commitment I (EEC I): GB wide regulation that required all electricity and gas suppliers with 15,000 or more domestic customers to achieve a combined energy saving of 62 TWh by 2005 by incentivising their customers to install energy-efficiency measures in homes. EEC II - energy suppliers with more than 50,000 domestic customers required to deliver a total of 130 TWh lifetime energy use reductions in GB households, primarily through the promotion of energy efficiency measures. Carbon Emission Reduction Target (CERT) – GB regulation that required all domestic energy suppliers with a customer base in excess of 50,000 domestic customers to make savings in the amount of CO2 emitted by householders.			
Community Energy Saving Programme (CESP)	2009-2012 (Expired)	Regulatory	System of carbon pricing, ESR
Community Energy Saving Programme (CESP) - area based regulation that targeted households across Great Britain, in areas of low income, to improve energy efficiency standards, and reduce fuel bills. CESP was funded by an obligation on larger energy suppliers and also the larger, electricity generators.			

Policy name	Status	Type of measure	Impacting traded or non-traded sectors
Carbon Emissions Reduction Target (CERT) Uplift and Extension (2010-2012)	2010-2012 (Expired)	Regulatory	System of carbon pricing, ESR
CERT extension - increased the targets originally set under CERT by 20% and required domestic energy suppliers with a customer base in excess of 50,000 (later increased to 250,000) to make savings in the amount of CO2 emitted by householders. The extension also refocused subsidy towards insulation measures and away from electricity saving measures such as low energy lighting - and introduced a super priority group (households in receipt of certain means-tested benefits) to make energy reductions in low income and vulnerable households.			
Energy Company Obligation 1 and 2	2013-2017 (Expired)	Economic, Regulatory	System of carbon pricing, ESR
The Energy Company Obligation (ECO) is a statutory obligation on energy suppliers with over 250,000 domestic customers and delivering over a certain amount of electricity or gas to make reductions in carbon emissions or achieve heating cost savings in domestic households. ECO focuses on insulation measures, and also heating improvements to low income and vulnerable households. It ran until March 2017. ECO initially ran to March 2015 (also known as 'ECO1') and was extended in April 2014 to March 2017 ('ECO2').			
Heat Networks Investment Project	2017-2021 (Implemented)	Economic	System of carbon pricing, ESR
The Heat Networks Investment Project (HNIP) is a capital funding scheme across England and Wales to encourage the development of heat networks. The HNIP is expected to support up to 200 projects by 2022 through grants and loans and other mechanisms and to lever in up to wider investment, reducing bills, cutting carbon and forming a key part of wider urban regeneration in many locations. The scheme will be open for applications from heat networks for up to three years and allocate commercialisation and construction funding through a competitive process. The key objective of the project is to build a sustainable market for heat networks to support the decarbonisation of heat in buildings, helping the UK reach the carbon budget targets.			
Energy Company Obligation 2 Extension	2017-2018 (Expired)	Economic, Regulatory	System of carbon pricing, ESR
The 2015 Spending Review announced that ECO will be replaced with a new, lower cost scheme that will run for 5 years (April 2017 to March 2022) and will tackle the root causes of fuel poverty. The 5-year extension will take place in two phases, with the ECO 2 Extension (April 2017 - September 2018) acting as a bridge between the expired ECO scheme and the new fuel poverty focused scheme, ECO 3, which will run from autumn 2018 to March 2022. The Local Authority Flexible Eligible mechanism was introduced under ECO2 Extension, enabling LAs to determine eligibility and refer households to obligated suppliers. Up to 10% of Affordable Warmth could be delivered through this route.			

Policy name	Status	Type of measure	Impacting traded or non-traded sectors
Energy Company Obligation 3	2018 -2022 (Implemented)	Regulatory	ESR
The reformed scheme (ECO 3) will run from autumn 2018 to March 2022. The scheme focusses completely on low income and vulnerable households. Supplier thresholds were lowered to 200,000 domestic customers from 2019, and 150,000 domestic customers from 2020. A new 'Innovation' element was introduced to incentivise new better performing measures and cost-effective delivery techniques (up to 10% of scheme), and up to a further 10% of scheme for a monitoring regime to better understand measure performance. The LA Flexible Eligibility mechanism was increased to up to 25% of the scheme.			
Building Regulations 2020 Part L	2020 (Planned)	Regulatory	System of carbon pricing, ESR
Building Regulations set minimum energy performance standards for new buildings and when people carry out controlled 'building work' to existing properties including extensions, conversions and certain categories of renovation and replacement windows and boilers.			
Boiler Plus (standards for domestic boiler installations)	2018 (Implemented)	Regulatory	System of carbon pricing, ESR
The policy objectives of Boiler Plus are to deliver additional energy and carbon savings from the domestic heating sector in England by lowering overall gas demand from domestic properties. It aims to do this by increasing the deployment of devices which increase the efficiency of domestic heating systems, through controls and measures to make gas boilers heat homes more efficiently. The policy instrument is a technical standard set through statutory guidance under the Building Regulations framework. This requires existing households in England to install an additional energy saving measure from a choice list at the point of installing a new or replacement combi gas boiler in an existing dwelling.			
Streamlined energy and carbon reporting framework for business (SECR)	2019 (Implemented)	Information, Regulatory	System of carbon pricing, ESR
SECR is a reporting framework which obligates all large (as defined by the Companies Act 2006) UK registered companies to report their energy use and associated emissions relating to electricity, gas and transport in their annual reports. Companies will also be required to provide an intensity metric and disclose any energy efficiency actions undertaken during the reporting period. Quoted companies will in addition be required to report their global energy use and GHG emissions.			

Transport

Policy name	Status	Type of measure	Impacting traded or non-traded sectors
PSV Fuel Efficiency Policies	2006/07-2019 (Implemented)	Regulatory, Information, Voluntary Agreement	ESR
The Green Bus Fund (GBF) allowed bus companies and local authorities in England to compete for funds to help them buy new low-carbon emission buses. The four rounds of the fund, which ran from 2009- 2014, added around 1250 Low Carbon Emission Buses onto England's roads. The GBF was replaced in 2015 by the Low Emission Bus Fund (LEBS) which offered £30m for bus operators and local authorities across England and Wales to bid for low emission buses and supporting infrastructure. This scheme funding was open from 2016-2019 and the successful bidders were announced in July 2016, adding more than 300 extra low emission buses to fleets. In Autumn 2016, a further £100m was announced to increase the amount of low emission buses on the road. £11.1m was used to fund those who narrowly missed out on LEBS funding, and £48m formed the Ultra- Low Emission Bus Scheme which was launched in March 2018. Winners of this scheme were announced in February 2019. The remaining funding formed the Clean Bus Technology Fund, which was used to fund retrofitting solutions for existing bus fleets to a minimum Euro VI standard, and the winners of this fund was announced in February 2018. This was in addition to the previous £27m of Clean Bus Technology Fund rounds in 2013 and 2015. There was also a £5m Clean Vehicle Technology Fund in 2014. These funding schemes have contributed to an extra 5000 low emission buses on the road.[177]			
Renewable Transport Fuel Obligation, (RTFO)	2007 - 2032 (Implemented)	Regulatory	ESR
The RTFO sets phased targets for renewable fuel use by diesel and petrol suppliers to be achieved by 2020 and on to 2032. Targets are by volume rather than by energy. This implements the EU Renewable Energy Directive (2009/28/EC) and ILUC Directive (EU) 2015/1513.			
Advanced Biofuel Demonstration Competition	2014-2018 (Expired)	Economic	ESR
The Advanced Biofuel Demonstration Competition made available £25 million to enable the construction of two demonstration-scale advanced biofuel plants.			

[177] Renewable transport fuel obligations order: government response (2017), www.gov.uk/government/publications/renewable-transport-fuel-obligations-order-government-response

Policy name	Status	Type of measure	Impacting traded or non-traded sectors
Local Sustainable Transport Fund	2011-2016 (Expired)	Regulatory	ESR
£600m of capital and revenue funding between 2011 and 2015 to support sustainable travel investments by local government. The projects include promoting public transport, encouraging uptake of cycling and walking, and raising awareness of the alternative transport modes available to commuters and residents awards were made through competitive bidding processes. Since then central government has made an additional Local Sustainable Transport Fund revenue funding of £65m (2015/16) and Access Fund £20m (p.a. 2016/17 to 2019/20) available for similar schemes.[178]			
Car Fuel Efficiency Policies	2012 (Implemented) 2019 (Adopted)	Regulatory, Information, Voluntary Agreement	System of carbon pricing, ESR
EC Regulation 443/2009 sets fuel efficiency targets for new cars to be achieved by 2015 and 2020. The regulation translates a fleet average CO2 tailpipe emissions target for new vehicles sold into the EU market into specific targets for individual manufacturers according to the mass of their fleet. Heavy fines are imposed for non-compliance. The 2021 target is for a fleet average of 95g CO2/km across the single market, with a Transition Period where 95% of a manufacturer's fleet must meet the 95g target by 2020. New stretching CO2 reduction targets (EU Regulation 2019/631) have been introduced for 2025 and 2030 based on the 2021 Worldwide Harmonised Light Vehicle Test Procedure (WLTP) measurements. As a result, the new passenger cars and light duty vehicles CO2 regulation came into force in January 2020. The Road Vehicle Emission Performance Standards (Cars and Vans) (EU Exit) (Amendment) Regulations 2019 in March 2019 ensure the UK's existing ambition and targets out to 2024 still apply after the end of the Transition Period. Complementary measures are a collection of technologies that could improve 'real world' fuel efficiency of cars which would not be fully captured in new car CO2 target and could improve fuel efficiency within the existing fleet. These include gear shift indicators, tyre pressure monitoring systems, more efficient mobile air-conditioning and low rolling resistance tyres. EC Regulation 661/2009 sets minimum requirements and introduces labelling for the rolling resistance, wet grip and external rolling noise of tyres. Measures to support the uptake of ultra-low emission vehicles include the Plug-in Grant funding for ultra-low emission vehicle (ULEV) cars, vans, motorcycles and taxis as well as various tax incentives including lower rates for Vehicle Excise Duty and Company Car Tax. Electric vehicle (EV) infrastructure is directly supported through the Workplace Charging Scheme grants for EV charge points for employees and fleets, the Electric Vehicle Homecharge Scheme grants towards home EV charge points, the On-street Residential Chargepoint Scheme and the public-private £400 million Charging Infrastructure Investment Fund, launched in September 2019. Highways England have committed £15 million to ensure that 95% of the Strategic Road Network will be within 20 miles (32.2km) of a charging point.			

[178] Government response to call for evidence: Cycling and walking Investment Strategy (Safety Review), www.gov.uk/government/consultations/cycling-and-walking-investment-strategy-cwis-safety-review

Policy name	Status	Type of measure	Impacting traded or non-traded sectors
Van Fuel Efficiency Policies	2012 (Implemented) 2019 (Adopted)	Regulatory, Information, Voluntary Agreement	ESR
EC Regulation 510/2011 sets fuel efficiency targets for new Light Commercial Vehicles (LCV) to be achieved by 2017 and 2020. EC Regulation 661/2009 sets minimum requirements and introduces labelling for the rolling resistance, wet grip and external rolling noise of tyres. The regulation translates a fleet average CO2 tailpipe emissions target for new vehicles sold into the EU market into specific targets for individual manufacturers according to the mass of their fleet. Heavy fines are imposed for non-compliance. The 2020 target is for a fleet average of 147g CO2 /km and represents a reduction of 19% from the 2012 average. New stretching CO2 reduction targets (EU Regulation 2019/631) have been introduced for 2025 and 2030 based on the 2021 Worldwide Harmonised Light Vehicle Test Procedure (WLTP) measurements. As a result, the new passenger cars and light duty vehicles CO2 regulation came into force in January 2020. The Road Vehicle Emission Performance Standards (Cars and Vans) (EU Exit) (Amendment) Regulations 2019 in March 2019 ensure the UK's existing ambition and targets out to 2024 still apply after the end of the Transition Period. To help address payload penalty issues and encourage uptake of cleaner vans, a derogation from the European Union third Driving Licence Directive (2006/126/EC) has been introduced to allow Category B (car) licence holders to operate alternatively fuelled vehicles up to a maximum authorised mass of 4.25 (rather than 3.5) tonnes. Complementary measures to support the uptake of ultra-low emission vans include the Plug-in Van Grant and various tax incentives; for instance zero emission vans only pay a small proportion of the van benefit charge and are not subject to the van fuel benefit charge. Electric vehicle (EV) infrastructure is directly supported through the Workplace Charging Scheme grants for EV charge points for employees and fleets, the Electric Vehicle Homecharge Scheme grants towards home EV charge points, the On-street Residential Chargepoint Scheme and the public-private £400 million Charging Infrastructure Investment Fund, launched in September 2019. Highways England have committed £15 million to ensure that 95% of the Strategic Road Network will be within 20 miles (32.2km) of a charging point.			
HGV Fuel Efficiency Policies	2012 (Implemented)	Regulatory, Information, Voluntary Agreement	ESR
EC Regulation 661/2009 sets minimum requirements and introduces labelling for the rolling resistance, wet grip and external rolling noise of tyres. Industry and government are taking a range of actions to reduce freight emissions, including the Freight Transport Association's Logistics Carbon Reduction Scheme, which encourages members to record, report and reduce emissions from freight. The Mode Shift Revenue Support scheme encourages modal shift from road to rail or inland waterway where the costs are higher than road, and where there are environmental benefits to be gained. It currently helps to remove around 800,000 lorry journeys a year from Britain's roads. A similar scheme, Waterborne Freight Grant, can provide assistance with the operating costs associated with coastal or short sea shipping. A voluntary, industry-supported commitment to reduce HGV greenhouse gas emissions by 15% by 2025, from 2015 levels, was introduced in 2018.			

Policy name	Status	Type of measure	Impacting traded or non-traded sectors
HGV natural gas policy	2012 (Implemented)	Economic, Research	ESR
The UK government has implemented measures to encourage alternatively fuelled HGVs including through reduced fuel duty rates for road fuel gases and increasing rewards for renewable gaseous fuels under the Renewable Transport Fuel Obligation. The UK government has helped operators establish and run fleets of alternatively fuelled HGVs through the Low Carbon Truck Trial. £11.3 million funding has been provided, via competition, to part fund and test around 370 commercial vehicles, with most using a gas or dual fuel system (diesel and gas), and to develop refuelling infrastructure. Savings for this policy are captured within HGV fuel efficiency policies.			
Rail Electrification	2013-2019 (Implemented)	Economic	System of carbon pricing, ESR
Programme of rail electrification underway to replace older diesel trains with modern, low-emission electric or bi-mode trains.[179] Network Rail is leading a strategy that will inform the scale and pace of rail decarbonisation. This means that operators are contractually obliged to meet emissions levels based on running modern electric rather than diesel traction. Trans Pennine Express (TPE) and Northern are examples where 11% and 17% reductions in CO2e emissions per vehicle km respectively where contracted based on electrification schemes. Reducing costs: electric trains tend to be cheaper to buy, operate and maintain than diesels. They are also lighter so do less damage to the track. So whilst there is clearly a large capital cost associated with installing new electrification infrastructure, this can be compensated over time by the lower operational costs of electric trains. Increasing capacity and reliability and reducing journey times: electric trains tend to outperform equivalent diesels in terms of reliability, acceleration and carrying capacity. Reducing environmental impacts: electric trains are quieter and more carbon efficient than diesels and zero emission at point of use which helps with local air quality.			
Future Fuels for Flight and Freight Competition	2018-2021 (Adopted)	Economic	ESR
The Future Fuels for Flight and Freight Competition makes £22 million of funding available to projects that will produce low-carbon waste-based fuels to be used in aviation and freight. In December 2019, KEW Projects and Rika Biogas were awarded a share of £6.5 million to build plants which aim to provide fuel for heavy goods vehicles.[180]			

[179] DfT Rolling Stock Perspective, Third Edition (2017). Section 6.5 Sustainable Development Principles.
[180] www.gov.uk/government/news/orange-peel-rubbish-and-fatbergs-the-fuels-behind-the-future-of-green-transport

Industrial processes

Policy name	Status	Type of measure	Impacting traded or non-traded sectors
Ozone Depleting Substances Regulation	2001 and 2009 (Implemented)	Regulatory	ESR
This regulation implements obligations under the Montreal Protocol and EU Regulations (2037/2000/EC and 1005/2009/EC) on ozone depleting substances. With the exemption of some critical use exemptions, CFCs and halon use is banned and HCFC use was banned from 2015. Most ozone depleting substances are potent greenhouse gases, so reductions in their use both protects the ozone layer and provides some GHG emissions mitigation.			
Fluorinated GHG Regulation	2007 (Implemented)	Regulatory	System of carbon pricing, ESR
Control (containment, prevention and reduction) of F-gas emissions through recovery, leak reduction and repair and some very limited use bans. Mandatory certification requirements to work with F gases.			
F-gas regulation 2014	2015 (Implemented)	Regulatory	ESR
Introduced a 79% phase down in the quantities of hydrofluorocarbons (HFCs), the main group of F gases, that can be placed on the EU market delivered via a gradually reducing quota system; a number of bans on the use of certain F gases in some new equipment; a ban on the use of very high GWP HFCs for the servicing of certain types of refrigeration equipment; some strengthening of obligations in 2006 Regulation related to leak checking, repairs, F gas recovery and technician training. In November 2017 the UK ratified the Kigali Amendment to the Montreal Protocol, committing to an 85% reduction in the UKs consumption of HFCs, from a 2011-2013 baseline level, by 2036. A UK led review of the F-gas Regulation, to be completed by the end of 2022 at latest, will be used to assess what further reductions can be made.			
Industrial Heat Recovery Support (IHRS) Programme	2018 (Implemented)	Information, Economic	System of carbon pricing, ESR
The policy aims to increase industry confidence to invest in the technology potential to recover heat from industrial processes and increase the deployment of such technologies across manufacturing and data centres in England and Wales. It establishes a fund for feasibility studies that examine the potential for industrial businesses to adopt heat recovery technologies and a fund to subsidise the deployment of heat recovery technologies.			

Waste, Agriculture, Land Use and Forestry

Policy name	Status	Type of measure	Impacting traded or non-traded sectors
Waste measures	Various (earliest 1996) (Implemented)	Fiscal, regulatory	ESR
There are a number of waste measures with the aim of increasing recycling/reuse and reduce harmful disposal. The Waste Framework Directive (2008/98/EC) is the general framework of waste management requirements and sets rules governing the separate collection of waste. The Landfill Directive (1999/31/EC) sets rules governing the disposal of waste to landfill. The UK Landfill Tax escalates tax on waste sent to landfill, including biodegradable waste. There are other waste measures targeting other waste streams, such as the Industrial Emissions Directive (2010/75/EU). The overall effect is reducing environmental impacts of waste, such as landfilling biodegradable waste and its associated CH4 emissions.			
Environmental Stewardship (Entry Level Schemes and Higher Level Stewardship)	2005 (Implemented)	Economic	ESR
Provides income foregone support under Pillar 2 of the Common Agricultural Policy (CAP) for farmers to undertake management options that benefit biodiversity, resource protection and water quality.			
Catchment Sensitive Farming	2006 (Implemented)	Economic, information	ESR
Delivers practical solutions and targeted support to enable farmers and land managers to take voluntary action to reduce diffuse water pollution from agriculture to protect water bodies and the environment.			
Soils For Profit	2009-2013 (Expired)	Education	ESR
Provides on farm reviews and training on soils manures and nutrients. The programme closed in 2013.			
Agricultural Action Plan	2010-2022 (Implemented)	Voluntary Agreement, Information, Education	ESR
The Agricultural Action Plan covers a range of resource-efficiency and land management measures to reduce emissions to meet UK carbon budgets.			

Policy name	Status	Type of measure	Impacting traded or non-traded sectors
Nitrates Action Plan	2013 (Implemented)	Regulatory, Information	ESR
This ensures improved compliance with the Nitrate Directive (91/676/EEC). Designated revised 'Nitrate Vulnerable Zones' (NVC) established a range of mandatory measures to reduce nitrate pollution to water in each NVC. It includes also code of good practice for areas outside NVZs.			
Agri- Tech Strategy	2014 (Implemented)	Economic	ESR
Co-funded by industry and addressing industry priorities. Funding is split been projects – 'the Agri-Tech Catalyst' – and new Centres of Agricultural Innovation. These technologies can contribute to agricultural efficiency and reduce GHG emissions.			
CAP Cross Compliance	2015 (Implemented)	Regulatory	LULUCF
• Good Agricultural and Environmental Conditions in place to ensure minimum soil cover, to maintain soil organic matter and to minimise erosion. • Implementation of the Nitrates Directive. • Retention of permanent pasture (up to 2014 – now under Greening measures).			
Common Agricultural Policy (CAP) Greening	2015 (Implemented)	Regulatory	LULUCF
• Obtain consent before improving grassland that has not been cultivated for 15 years or more (Environmental Impact Assessment/EIA). • Select a range of Ecological Focus Area (EFA) measures to meet new standards: relevant actions include enhanced buffer strips, cover crops and growing N-fixing crops. • In Wales consent must be obtained to improve grassland that has less than 25% rye grass. • In Northern Ireland, under CAP Greening, farmers can select a number of relevant EFA measures including, landscape features, fallow land, agro-forestry, short rotational coppice and nitrogen fixing crops.			
Forestry Act, Felling Licence Regulations and Environmental Impact (Forestry) regulations	1999 (Implemented)	Regulatory	LULUCF
Strong regulatory framework that controls felling, only allows deforestation for purposes of nature conservation and prevents afforestation of deep peat. Legislation updated 1999.			

Policy name	Status	Type of measure	Impacting traded or non-traded sectors
Rural Development Programme	2007-2020 (Implemented)	Economic	LULUCF
Woodland creation grants provided through EU co-financed Rural Development Programmes in all four countries of the UK.			
Woodland Carbon Code	2011 (Implemented)	Voluntary Agreement, Information	LULUCF
Voluntary Code and associated carbon registry (2013) for UK domestic woodland carbon schemes to encourage private sector funding for woodland creation projects. Recognised as component of net GHG emissions reporting for businesses in Government's Environmental Reporting Guidelines.			
Wood fuel Implementation Plan	2011-2014 (Expired)	Information, Education, Economic	LULUCF
Initiative to develop supply chains, including through support for harvesting/processing and woodland access, to increase wood fuel supply from existing woodland.			
Grown in Britain	2013 (Implemented)	Voluntary Agreement, Information, Education	LULUCF
Industry-led action plan announced in the UK government's Forestry and Woodlands Policy Statement (2013) which aspires to encourage businesses to invest in woodland creation and sustainable forest management practice.			
Woodland Creation Planning Grant	2015 (Implemented)	Information, Education, Economic	LULUCF
Grant to support the planning of large-scale productive woodlands, compliant with the UK Forestry Standard.			
Woodland Carbon Fund	2016 (Implemented)	Voluntary Agreement, Information	LULUCF
The Woodland Carbon Fund is an exchequer-funded grant to support the creation of large-scale productive woodlands which also enhance natural capital.			
Revised UK Forestry Standard	2017 (Implemented)	Regulatory, Information	LULUCF
Revised (2017) national standard for sustainable forest management including a new guideline on climate change (2011), covering both adaptation and mitigation.			

Policy name	Status	Type of measure	Impacting traded or non-traded sectors
Forestry Investment Zone	2018 (Implemented)	Voluntary Agreement, Information	LULUCF
A pilot Forestry Investment Zone has been opened in Cumbria, North West England. A FIZ will establish the conditions necessary to create a more favourable investment environment for forestry, conducive to large scale tree planting, and create a supportive framework with local stakeholders to promote this.			
Northern Forest	2018 (Implemented)	Voluntary Agreement	LULUCF
'Kickstart' funding for a new forest covering a 150-mile-wide stretch of northern England.			
Natural England's Strategic Approach to the Restoration of Blanket Bog	2015 (Implemented)	Information	LULUCF
Natural England published the Strategy for the Restoration of Blanket Bog in England in 2015. The approach sets out the extent, nature and importance of the blanket bog resource across England and what is currently being done to conserve it, as well as setting out the required management and timeframe for delivery to achieve an improvement in site condition across the resource at a strategic level.			
Natural Environment White Paper (NEWP) targets on horticultural peat	2011 (Implemented)	Information, Other	LULUCF
The Sustainable Growing Media Taskforce was set up to look at ways in which the barriers to the use of peat alternatives could be overcome. The UK government published its response to the Task Force's report and draft roadmap in 2013 which set out where our resources will be focused. A policy review was published in 2017 assessing the delivery of the roadmap and identifying further actions necessary to achieve a transition to sustainable growing media and reduced peat use.			
Peat Restoration Northern Ireland	2018 (Implemented)	Voluntary	LULUCF
Northern Ireland (NI) will include peatland restoration measures within the new agri-environment scheme, the Environmental Farming Scheme (EFS), as part of its Northern Ireland Rural Development Programme 2014-2020.			
Peatland Area Designations	2004 (Implemented)	Regulatory	LULUCF
3 out of 12 Nature Improvement Areas (NIA, 2012) are focused on peatland restoration. 47% England's wetlands are protected by Sites of Special Scientific Interest (SSSIs).			

Policy name	Status	Type of measure	Impacting traded or non-traded sectors
Peatland Code	2011 (Implemented)	Economic, Information, Voluntary	LULUCF
A UK Voluntary Code to encourage and support private sector funding for peatland restoration projects. Provides standards and robust science to give business supporters confidence that their financial contribution is making a measurable and verifiable difference.			

ii Where relevant, regional cooperation in this area

The Powering Past Coal Alliance (PPCA) was launched by the United Kingdom (UK) and Canada at COP23 in 2017 and has since grown to 91 members. The aim of the PPCA is to accelerate the global transition from unabated coal fired power generation by international leadership through sustaining and growing an Alliance of progressive members. The UK works closely with European members to achieve this aim.

The UK is a founding member of the Green Growth Group (GGG), a group of ambitious European countries established in 2013 whose membership currently comprises 17 EU Member States and Norway. The GGG provides a forum for progressive ministers and officials to meet to discuss contemporary issues concerning climate ambition and identify opportunities for driving forward greater climate action.

iii Without prejudice to the applicability of state aid rules, financing measures, including Union support and the use of Union funds, in this area at national level, where applicable

Not applicable.

3.1.2 Renewable energy

i Policies and measures for renewable energy and trajectories as referred to in point (a)(2) Article 4, and, where applicable or available, the elements referred to in section 2.1.2, including sector- and technology-specific measures

Electricity

The UK already has a world-leading offshore wind sector and is well placed to benefit from further investment in renewables innovation to accelerate cost reduction. The Offshore Wind Sector Deal, published on 7 March 2019, builds on this global leadership, setting out a pathway for up to 30 GW[181] of generating capacity by 2030 whilst creating thousands of high-quality jobs, a strong supply chain and a fivefold increase in exports. This will help the UK to maintain itself as the anchor market in Europe and support economic growth across the UK, particularly in coastal communities.

The UK government expects to invest around £900 million of public funds between 2015 and 2021 in research and innovation in the power sector, including around £177 million in partnership with the Research Councils and Innovate UK to further reduce the cost of

[181] The recent manifesto commitment seeks to increase this ambition to 40 GW of offshore wind capacity by 2030.

renewables. Innovation opportunities are likely to arise in a number of areas, including floating offshore wind platforms and advanced solar PV technologies.[182]

The UK government is working to improve the route to market for renewable technologies. The 2019 Contracts for Difference allocation round saw 5.8GW of projects offered contracts, including offshore wind, Remote Island wind and Advanced Conversion Technologies, with offshore wind clearing prices 30% lower than the 2017 allocation round.[183] The UK government intends to run subsequent auctions around every 2 years.[184]

The UK government is also working to support small scale electricity generation as the cost of these technologies approach market competitiveness, by introducing the Smart Export Guarantee. This ensures that the owners of various low-carbon technology projects can access the electricity market and receive payment for any electricity they export. This is a market-led approach with no set prices and is designed to be compatible with smart meters that are being rolled-out across Great Britain (see section 2.4.3) and the growth of small-scale electricity storage.

Heat

In 2018, 7.3% of UK energy for heating and cooling came from renewable sources.[185] Through the Renewable Heat Incentive (RHI), the UK government has committed to spend £4.5 billion between 2016 and 2021 to support innovative low-carbon heat technologies in homes and businesses, such as heat pumps, biomass boilers and solar water heaters.[186] The government has also announced its intention to extend the Domestic RHI for 12 months to provide further support for the deployment of building level technologies, so it will remain open to new applicants until 31 March 2022, with funding committed until March 2024. Following the RHI, in April 2022, we propose to launch a new £100 million Clean Heat Grant scheme, providing targeted support to consumers and small businesses for heat pumps and some limited biomass. This scheme will be open for two years.

Beyond the RHI and Clean Heat Grant, our ambition is to phase out the installation of high carbon fossil fuel heating in new and existing off gas grid buildings during the 2020s, starting with new homes as these lend themselves more readily to other forms of low-carbon heating.[187]

In May 2018, the UK government launched the Buildings Mission[188], the first mission under the Clean Growth Grand Challenge, which aims to at least halve the energy use of new buildings by 2030, reduce the cost of retrofitting efficiency measures in existing buildings, and ensure homes and businesses are heated by clean energy sources. The Mission was backed by £170 million of public money through the Transforming Construction Industrial Strategy Challenge

[182] Clean Growth Strategy, 2017: www.gov.uk/government/publications/clean-growth-strategy
[183] Press release September 2019, UK Government website, www.gov.uk/government/news/clean-energy-to-power-over-seven-million-homes-by-2025-at-record-low-prices
[184] Press release July 2018, UK Government website, www.gov.uk/government/news/a-boost-for-north-east-innovation-to-promote-high-quality-jobs-and-growth
[185] Digest of UK Energy Statistics (DUKES) 2019, Table 6.7, www.gov.uk/government/statistics/renewable-sources-of-energy-chapter-6-digest-of-united-kingdom-energy-statistics-dukes
[186] Domestic RHI, www.gov.uk/government/publications/domestic-rhi-mechanism-for-budget-management-estimated-commitments; Non-Domestic RHI, www.gov.uk/government/publications/rhi-mechanism-for-budget-management-estimated-commitments
[187] Clean Growth Strategy, www.gov.uk/government/publications/clean-growth-strategy
[188] The Grand Challenge Missions, www.gov.uk/government/publications/industrial-strategy-the-grand-challenges/missions

Fund.[189] We expect this will be matched by £250 million of private sector investment, meaning over £400 million will be invested in new construction products, technologies and techniques.

In Spring 2019, the UK Chancellor announced that we will introduce a Future Home Standard by 2025 to ensure that all new build homes are future-proofed with low-carbon heating and world-leading levels of energy efficiency. We are consulting on amendments to Part L of the Building Regulations for England to deliver this policy.[190] The Future Homes Standard could pull through a significant amount of low-carbon heating, particularly heat pumps and heat networks, delivering up to nearly 9MtCO2e of emissions savings by the end of the fifth carbon budget.

The RHI also currently supports the injection of biomethane into the gas grid. The RHI has supported the injection of an estimated 9.3 TWh of biomethane (as of October 2019), of which 3 TWh was produced in the last 12 months. In 2019, we announced that we would seek to accelerate the decarbonisation of our gas supplies by increasing the amount of 'green gas' in the grid, and to consult on an appropriate mechanism to achieve this.

Heat networks form an important part of our plan to reduce carbon and cut heating bills for customers (domestic and commercial). The Heat Networks Investment Project is delivering £320 million[191] of capital investment support to increase the volume of heat networks built, deliver carbon savings for carbon budgets, and help create the conditions for a sustainable market that can operate without direct government subsidy.[192] Delivering continued market growth beyond the lifetime of HNIP will require the establishment of a long-term policy framework. In December 2018, the UK government published 'Heat Networks: ensuring sustained investment and protecting consumers' which sets out the priorities for the market framework, and we have consulted on that framework. We will use the consultation responses we have received to help us refine our policy proposals, and we will continue to discuss emerging issues with stakeholders. We will consult further in 2020 or 2021 on any significant changes to our proposals or new issues if required and we will publish a government response to our first consultation in late 2020.

The Northern Ireland RHI Scheme commenced in 2012, based on the RHI Scheme introduced in the rest of the UK but with differences in tariffs and tariff structures.[193] The Northern Ireland RHI schemes were suspended for new applicants on 29 February 2016.

In Scotland, the Scottish Government has established the District Heating Loan Fund (DHLF) which offers low rate, unsecured capital loans to overcome a range of technical and financial barriers. Since 2011, the DHLF has offered over £15m to 50 different projects across Scotland. Additionally, the Low Carbon Infrastructure Transition Programme (LCITP) can offer support for the development of investment grade business cases to help projects secure public and private capital finance and can provide financial support for capital.

[189] UKRI, Transforming Construction, www.ukri.org/innovation/industrial-strategy-challenge-fund/transforming-construction/
[190] The Future Homes Standard: changes to Part L and Part F of the Building Regulations for new dwellings, www.gov.uk/government/consultations/the-future-homes-standard-changes-to-part-l-and-part-f-of-the-building-regulations-for-new-dwellings
[191] Press release April 2018, Heat Networks Investment Project, www.gov.uk/government/news/governments-ground-breaking-heat-networks-investment-project-to-launch-in-the-autumn
[192] Heat Networks Guidance, GOV.UK, www.gov.uk/guidance/heat-networks-overview; Heat Networks Investment Project (HNIP), www.gov.uk/government/publications/heat-networks-investment-project-hnip
[193] Northern Ireland RHI, www.economy-ni.gov.uk/articles/renewable-heat-incentive-rhi

Transport

See section 3.1.3(iii).

ii Where relevant, specific measures for regional cooperation

Not relevant.

iii Specific measures on financial support for the promotion of the production and use of energy from renewable sources in electricity, heating and cooling, and transport

Renewables Obligation

The Renewables Obligation (RO) (enacted through the ROS and NIRO in Scotland and Northern Ireland respectively) was introduced to England, Wales and Scotland in 2002, and to Northern Ireland in 2005. The scheme was previously the main financial mechanism to incentivise the deployment of renewable electricity generation in the UK.[194] It closed to new applications on 31 March 2017, but limited grace periods extended the deadline for certain projects up to 31 March 2019. Early projects receive support for 25 years. Since 2008, new projects are supported for 20 years or until final closure of the scheme on 31 March 2037, whichever is earlier.

The scheme operates by putting an obligation on UK electricity suppliers to present a certain number of Renewables Obligation Certificates (ROCs) to Ofgem in respect of each MWh of electricity supplied during an obligation year. Suppliers buy these ROCs from renewable generators (or traders). Generators obtain them free of charge from Ofgem in relation to the renewable electricity they generate. The scheme is paid for by consumers through their energy bills and the UK government is committed to keeping these bills as low as possible. By the end of March 2018, 26,422 stations had been accredited, with a renewable energy capacity of 32.7GW. In 2017/18, 75.2TWh of renewable electricity was generated at a scheme cost of £5.3 billion.[195] The RO has now been replaced by the Contracts for Difference scheme in GB.

The Feed-in-Tariffs Scheme

The Feed-in Tariffs (FIT) scheme was introduced to England, Wales and Scotland on 1 April 2010, under powers in the Energy Act 2008. The intention was to encourage deployment of micro-scale and small-scale low-carbon electricity generation (up to 5MW), particularly by organisations, businesses, communities and individuals that have not traditionally engaged in the electricity market.[196]

The technologies supported under the scheme are solar PV, onshore wind, hydropower, anaerobic digestion (AD), and micro (<2kW) combined heat and power (micro-CHP).

Under the scheme, generators receive three sources of income/savings:

- Generation tariff - a payment for every kWh generated, dependent on the technology and capacity of the installation, and date installed
- Export tariff - an additional payment for every kWh exported to the local electricity network

[194] About the RO, OFGEM, www.ofgem.gov.uk/environmental-programmes/ro/about-ro
[195] Renewables Obligation (RO) Annual Report 2017-18, www.ofgem.gov.uk/publications-and-updates/renewables-obligation-ro-annual-report-2017-18
[196] About the FIT Scheme, OFGEM, www.ofgem.gov.uk/environmental-programmes/fit/about-fit-scheme

- Bill savings - additional benefit from usage of electricity 'on-site' as opposed to paying the retail price for importing that energy from the grid

Tariffs are calculated to give rates of return that encourage investment but prevent overcompensation. Payments to generators are made quarterly by electricity suppliers and then passed on to consumers through electricity bills.

Since its introduction, the FIT scheme has supported over 850,000 installations, or 6GW of capacity. 99% of installations are solar, which consist of 80% of overall capacity[197].

A periodic review of the scheme was conducted in the second half of 2015, as required by the EU State Aid approval. The purpose of the review was to ensure tariff levels provided sufficient incentive to potential generators whilst not over-compensating them. Following the review, the UK government also introduced a capping mechanism to bring costs under control to protect households and businesses. Our measures sought to put the scheme on a more sustainable footing which would maintain a viable small-scale renewables industry which could continue to reduce its costs and move towards subsidy free deployment. The closure of the generation tariff after March 2019 was also announced.

Growth in the small-scale low-carbon generation sector must be sustainable; driven by competition and innovation, not direct subsidies. The UK government therefore published a consultation on 19 July 2018 proposing to close the current FIT flat rate export tariff alongside the generation tariff from 31 March 2019, which reflects our desire to move towards fairer, cost reflective pricing and the continued drive to minimise support costs on consumers as set out in the Control for Low Carbon Levies.

On the same day, a call for evidence was also published to further understand the challenges and opportunities for small-scale low-carbon generation, including rooftop solar.

The call for evidence sought to identify:

- The challenges to, and opportunities for, small-scale low-carbon electricity generation in contributing to the UK government's objectives for clean, affordable, secure and flexible power; and
- The role for the UK government and the private sector in overcoming these challenges and realising these opportunities.

Legislation was introduced to close the FIT scheme in full to all new applications after 31 March 2019 subject to a number of time-limited extensions and a grace period. Existing generators will continue to receive generation and export tariff payments for the duration of their support under the scheme.

The importance of maintaining a route to market for small-scale low-carbon renewable generation after 31 March 2019 was stressed by many stakeholders and the UK government subsequently published a consultation on specific proposals for a Smart Export Guarantee in January 2019.

[197] Monthly feed-in tariff commissioned installations, 2014, www.gov.uk/government/statistics/monthly-small-scale-renewable-deployment

The Smart Export Guarantee (SEG)

In June 2019, following two public consultations, the UK government introduced legislation to implement the 'Smart Export Guarantee', which came into force on 1 January 2020. This enables anaerobic digestion, hydro, onshore wind, and solar photovoltaic generators with up to 5MW capacity, as well as micro-combined heat and power with up to 50kW capacity, to receive payment for electricity they export to the grid. It was introduced in the context of falling costs for low-carbon technologies, and a concern that due to their small size some of these small generators may otherwise find it difficult to access a competitive market for the electricity they produce.

Licensed electricity suppliers with 150,000 and over domestic customers will be required to provide at least one tariff offer for exported power (and they are free to offer more than one tariff); other suppliers may participate on a voluntary basis.

The SEG is very much a market-led policy. To provide space for the small-scale export market to develop, there will not be any specified minimum tariff rate, other than that suppliers must provide payment greater than zero at all times of export. To provide space for innovative approaches suppliers will be free to choose the form of the tariff they offer – provided they meet the requirements of the SEG. This will allow for relatively simple tariff offers to be implemented quickly, with an expectation that with time increasingly smart approaches will be implemented.

Exported power must be metered, with a meter capable of measuring export at half-hourly intervals, and meters must also be registered for settlement (though the SEG design is flexible and does not necessarily require half-hourly readings).

Recognising that smart systems may take various forms, the SEG therefore provides suppliers with the flexibility to purchase power from more complex systems including small-scale storage, and other forms of generation, if they choose to do so (provided they are co-located with a SEG installation). To benefit from the SEG, installations should be certified to suitable standards, and installations using anaerobic digestion meet sustainability criteria and feedstock requirements.

Contracts for Difference (CfD) Scheme

The Contracts for Difference (CfD) scheme was introduced in GB in 2014 and is the UK government's main mechanism for supporting new low-carbon electricity generation projects.[198] The scheme has been a success, delivering substantial new investment and helping deliver significant reductions in the costs of some renewable technologies.

A CfD is a 15-year private law contract between a low-carbon electricity generator and the Low Carbon Contracts Company (LCCC), a UK government-owned company. On top of market revenues generators are paid the difference between the strike price and the reference price for the electricity they generate. The cost of any top up is met by consumers via a levy on electricity suppliers. When the reference price is above the strike price then generator must 'pay back' the difference.

Contracts are awarded in a series of competitive 'pay as clear' auctions, with the lowest price bids being successful, which drives efficiency and cost reduction. The clearing price for new

[198] Electricity Market Reform: Contracts for Difference, www.gov.uk/government/collections/electricity-market-reform-contracts-for-difference

offshore wind projects, for example, fell from £114.39 per MWh[199] (2012 prices) in the first auction in 2015 to £39.65 per MWh[200] (2012 prices) in the third auction in 2019.

The CfD scheme[201] has awarded contracts to 58 renewable electricity projects[202] across a range of technologies, totalling around 16GW of renewable electricity capacity. The combined estimated budget spend for all three allocation rounds at the time of contract award is £491 million (2012 prices).[203]

Below is the capacity per technology offered contracts:

- Advanced Conversion Technologies – 159.91MW;
- Biomass Conversion – 1,065MW;
- Dedicated Biomass with Combined Heat and Power – 384.64MW;
- Energy from Waste with Combined Heat and Power - 94.75MW;
- Offshore Wind – 13,008MW;
- Onshore Wind - 748.55MW;
- Remote Island Wind – 275.22MW;
- Solar PV - 71.55MW.

The CGS announced up to £557 million of annual support for further CfDs, providing developers with the confidence they need to invest in bringing forward new projects.[204]

The third CfD allocation round saw 5.8GW of projects offered contracts, including offshore wind, Remote Island Wind and Advanced Conversion Technologies, with offshore wind clearing prices 30% lower than the 2017 allocation round.[205] The UK government plans to hold another allocation round in 2021 and further auctions around every two years after that.

iv Where applicable, the assessment of the support for electricity from renewable sources pursuant to Article 6(4) of Directive (EU) 2018/...

Not applicable.

[199] CfD First Round allocation results, www.gov.uk/government/uploads/system/uploads/attachment_data/file/407059/Contracts_for_Difference_-_Auction_Results_-_Official_Statistics.pdf
[200] CfD Third Round allocation results, www.gov.uk/government/publications/contracts-for-difference-cfd-allocation-round-3-results/contracts-for-difference-cfd-allocation-round-3-results
[201] In addition to the three auctions held between 2015 and 2019, early contracts were also awarded through the Final Investment Decision Enabling for Renewables (FIDER) scheme, which was put in place to help developers of low carbon electricity projects make final investment decisions ahead of the Contract for Difference scheme being introduced as part of Electricity Market Reform.
[202] Including projects that did not sign or failed their milestone requirements.
[203] The estimated budget impact did not increase after the AR3 results because due to all strike prices being below the reference prices forecast at the time of the auction, the estimated budget impact in the valuation years considered was zero.
[204] Clean Growth Strategy, 2017, www.gov.uk/government/publications/clean-growth-strategy
[205] Press release July 2018, UK Government website, www.gov.uk/government/news/a-boost-for-north-east-innovation-to-promote-high-quality-jobs-and-growth

v Specific measures to introduce one or more contact points, streamline administrative *procedures, provide information and training, and facilitate the uptake of power purchase agreements*

Summary of the policies and measures to promote and facilitate the development of renewable self-consumption and renewable energy communities

The UK has a relatively healthy short-term PPA market for renewables which a number of our policies have facilitated, however there has been limited growth in the long-term PPA market. The design of the Renewables Obligation encouraged suppliers to sign PPAs as a way of securing the corresponding certificates (ROCs). Similarly, the Contracts for Difference scheme, being based on wholesale market price, prompts PPAs to be signed which will provide revenues corresponding to market reference price for the CfD. Additionally, the SEG will allow small scale generators to secure some of the route-to-market benefits of a PPA-type agreement. We now see an established and liquid market for short-term PPAs, predominantly signed between generators and utilities. Single sites or portfolio projects regularly retender in a competitive field of over 40 offtakers. Value retention is therefore relatively high for generators.

The UK has recently seen a rise in the number of corporate offtakers signing PPAs with low-carbon generators. This is providing a route to market for some renewables projects. However, volumes remain small at present as there is a relatively limited amount of corporates that are able to enter into long-term agreements with generators.

A summary of the policies and measures to promote and facilitate the development of renewable self-consumption and renewable energy communities are outlined in 2.4.3(iii).

vi Assessment of the necessity to build new infrastructure for district heating and cooling produced from renewable sources

In 2014 the UK carried out the first comprehensive assessment of the investment picture and pipeline in the UK energy sector.[206] The assessment identified an enormous investment opportunity for new and renewable forms of heating, including heat networks. In the right circumstances, particularly where there is high heat demand, a high proportion of non-domestic consumers, new buildings and/or proximity to low-cost large-scale heat sources, heat networks are a highly cost effective and non-disruptive way to reduce carbon emissions.

The UK government is committed to significantly expanding the district heating sector. The CGS makes clear that heat networks have the potential to play a significant role in the decarbonisation of heat. In each of the Strategy's three illustrative pathways to 2050, heat networks are projected to meet 17% of heat demand in homes and up to 24% of heat demand in the non-industrial business and public sector buildings. There are currently over 14,000 heat networks in the UK. Of these, approximately 12,000 are communal heat networks (serving only one building) and 2,000 are district heat networks (serving multiple buildings). District heat networks currently supply around 10TWh of annual heat demand.[207]

[206] Delivering UK Energy Investment, July 2014, www.gov.uk/government/publications/delivering-uk-energy-investment-2014
[207] Energy Trends: March 2018, Experimental statistics on heat networks: www.gov.uk/government/publications/energy-trends-march-2018-special-feature-article-experimental-statistics-on-heat-networks

A study[208] commissioned by the CCC in 2015 developed three core scenarios for deployment of district heating to 2050. Under the central scenario analysis, this study estimates that 18% of buildings' heat will need to be supplied by heat networks by 2050 if the UK is to meet its carbon budgets cost effectively. While the majority of schemes in the UK are currently based on Gas CHP, this study expects gas CHP to play a limited role in the longer term and forecasts the use of a wide range of heat supply technologies by 2050 (primarily heat pumps, biomass and waste heat) reflecting the variety in locally-available secondary heat sources. In 2015 the UK also published its national comprehensive assessment of the potential for district heating and cooling in the UK.[209]

The UK government plans to publish further details on the approach to delivering a future market framework that will enable sustained investment in heat networks, strengthen consumer protections and move towards low-carbon heat sources.

The regulation of heat is devolved to Scotland. The Scottish Government has also set out its ambitions for a growth in heat networks[210] and in March 2018 there were over 800 district and communal heating networks in Scotland supplying over 25,000 final customers.[211]

The Scottish Government is currently preparing legislation that would introduce a regulatory framework and licensing system which aims to provide certainty to the sector and investors, reduce the risk premium on the cost of capital faced by projects by setting clear standards and providing the kind of rights that other utility companies receive, as well as raising consumer acceptance and awareness. In 2015 the Scottish Government published a Heat Policy Statement setting out how low-carbon heat can reach more householders, businesses and communities and a clear framework for investment in the future of heat in Scotland. The ambition is to achieve 1.5TWh of Scotland's heat demand to be delivered by district or communal heating and to have 40,000 homes connected by 2020.[212] The Scottish Government is in the process of developing a Heat Decarbonisation Policy Statement and Action Plan, to be published later in 2020. The Scottish Government's Climate Change Plan, published in 2018, sets out a pathway for low-carbon heat that will see around 45% of buildings' heat met by low-carbon sources by 2032. To support this, the Scottish Government is developing the Energy Efficient Scotland programme, and as part of this, in 2017 and 2018 consulted on the development of a policy and regulatory system to develop heat networks in a strategic manner, and provide appropriate conditions on the ground to accelerate the delivery of heat networks and to grow this market.

Northern Ireland is currently developing a long-term energy strategy, looking to 2030 and beyond, which will include considerations around heat policy. The future Energy Strategy will set out a pathway and timeline for decarbonising heat, and the most effective way to measure

[208] Research on district heating and local approaches to heat decarbonisation: A study for the CCC, 2015, https://www.theccc.org.uk/wp-content/uploads/2015/11/Element-Energy-for-CCC-Research-on-district-heating-and-local-approaches-to-heat-decarbonisation.pdf

[209] National Comprehensive Assessment of the Potential for Combined Heat and power and District Heating and Cooling in the UK, 2015, www.gov.uk/government/publications/the-national-comprehensive-assessment-of-the-potential-for-combined-heat-and-power-and-district-heating-and-cooling-in-the-uk

[210] Heat Policy Statement Towards Decarbonising Heat: Maximising the Opportunities for Scotland, the Scottish Government, 2015, www.gov.scot/publications/heat-policy-statement-towards-decarbonising-heat-maximising-opportunities-scotland/

[211] Energy Trends: March 2018, Experimental statistics on heat networks, www.gov.uk/government/publications/energy-trends-march-2018-special-feature-article-experimental-statistics-on-heat-networks

[212] Heat Policy Statement, Scottish Government 2015, https://beta.gov.scot/publications/heat-policy-statement-towards-decarbonising-heat-maximising-opportunities-scotland/

progress between now and 2030, and subsequently to 2050. The future policy options for decarbonising heat are being considered by taking a holistic view of energy in terms of energy efficiency, power, heat and transport, whilst also considering the impact on society as a whole, and consumers individually.

Policy initiatives to support district heating

In 2013, the UK government set up the Heat Network Delivery Unit (HNDU) to support local authorities in England and Wales through the early stages of heat network project development. Through HNDU support the UK government has invested over £17 million in grant funding to more than 200 projects across 140 local authorities.[213]

The UK government is investing £320 million in efficient heat network projects through the Heat Networks Investment Project (HNIP). The funding will be allocated from April 2019 for up to three years, with £18.5 million of funding already allocated to eight pilot projects.[214]

The GB Renewable Heat Incentive scheme (RHI) supports the deployment of heat networks by incentivising the take up of those technologies that will play a strategic role in the long-term decarbonisation of the UK; for example, large biomass and heat pumps. Heat network projects can become accredited to the non-domestic RHI to secure a tariff guarantee, so long as their heat generation plant meets the scheme criteria. The Northern Ireland RHI schemes were suspended for new applicants on 29 February 2016.

In Scotland, the Heat Network Partnership was set up in 2015 to support the development of heat networks and low-carbon heat projects.[215] Support includes provision of the Scotland Heat Map[216], and the District Heating Loan Fund, which offers loans to support the development of district heating networks. Since 2011, more than £15 million has been lent to 50 different projects across Scotland.[217] Additionally, since its launch in 2015, the Low Carbon Infrastructure Transition Programme (LCITP) has awarded over £50 million of funding to low-carbon demonstration projects that encourage replication and wider uptake of innovative renewable technology across Scotland, which includes committing over £25 million of grant funding to low-carbon heat network projects across Scotland that encourage the replication and wider uptake of innovative renewable technology. LCITP is a collaborative partnership led by the Scottish Government, working with Scottish Enterprise, Highlands and Islands Enterprise, Scottish Futures Trust and Resource Efficient Scotland.

Heat policy is not devolved to Wales, though Welsh Government received some powers under the Wales Act 2017. The UK government supports development of heat networks in Wales with revenue grants through the Heat Network Development Unit and capital through the Heat Network Investment Programme.

The Welsh Government Energy Service (WGES) is carrying out regional energy planning for power, heat and transport, which will feed into growth deals in Wales and help regions in developing the energy system of the future. Mapping has also been used to shape of the Welsh Government's spatial policy, with Priority Areas for District Heat Networks being identified in the draft National Development Framework. The heat map data has also been

[213] Heat Networks Delivery Unit, www.gov.uk/guidance/heat-networks-delivery-unit
[214] Heat Networks Investment Project (HNIP), www.gov.uk/government/publications/heat-networks-investment-project-hnip-scheme-overview
[215] Heat Network Partnership, www.districtheatingscotland.com/
[216] Scotland Heat Map, http://heatmap.scotland.gov.uk/
[217] District Heating Loan, Energy Savings Trust, www.energysavingtrust.org.uk/scotland/grants-loans/district-heating-loan

incorporated into Lle, the Welsh Government digital resource. This will make it available to support regional and local energy planning activity, which we are supporting through the WGES.

vii Where applicable, specific measures on the promotion of the use of energy from biomass, especially for new biomass mobilisation taking into account:

- biomass availability, including sustainable biomass: both domestic potential and imports from third countries

- other biomass uses by other sectors (agriculture and forest-based sectors); as well as measures for the sustainability of biomass production and use

Promotion of the use of energy from biomass

In 2018, biomass made up 21.4% of renewable electricity generation.[218] The UK has mandatory sustainability criteria for heat and power generation, which include criteria focusing on the land from which the biomass is sourced and greenhouse gas criteria which account for the life cycle emissions of the biomass.

Biomass is incentivised for electricity through the schemes outlined in section 3.1.2(iii) and generators only receive subsidies for the electricity output which complies with our sustainability criteria.

The Scottish Government is currently developing a Bioenergy Policy Update, which will set out its direction of travel to gather further evidence on how bioenergy can support meeting its net zero targets. This will help to develop a Bioenergy Action Plan going forward. Research was commissioned to assess the potential contribution that bioenergy can make towards meeting Scottish energy demand, considering scale, local restrictions and bioenergy resources. It concluded that there is potential for bioenergy to deliver another source of renewable energy; one that is low in cost and will help to tackle fuel poverty in Scotland.[219]

Renewable Heat Incentive (RHI)

The non-domestic RHI was introduced in 2011, with the domestic RHI following in 2014. The schemes are designed to help bridge the gap between the costs of fossil fuel heating technologies and low-carbon alternatives. Participants receive a tariff, set in pence per kilowatt hour of heat used, for either seven (domestic RHI) or 20 years (non-domestic RHI), which is set at a level to cover the additional costs of the low-carbon heating installation. Both RHI schemes cover a range of technologies, including solid biomass heating, and for the non-domestic scheme, biogas heating and biomethane injection to the gas grid.

The UK government has confirmed funding for new applications for the non-domestic RHI scheme until the end of March 2021, and the end of March 2022 for the domestic scheme. In December 2016, a series of wide-ranging reforms to the domestic and non-domestic RHI schemes were announced. The first tranche of reforms was implemented in September 2017, and the second tranche was implemented in 2018.

[218] Digest of UK Energy Statistics (DUKES) 2019, Table 6.4, available at: www.gov.uk/government/statistics/renewable-sources-of-energy-chapter-6-digest-of-united-kingdom-energy-statistics-dukes

[219] The potential contribution of bioenergy to Scotland's energy system, published May 2019: www.climatexchange.org.uk/research/projects/the-potential-contribution-of-bioenergy-to-scotland-s-energy-system/

These reforms were designed to refocus the RHI to ensure that it:

- Focusses on long-term decarbonisation
- Offers better value for money and protects consumers
- Supports supply chain growth and challenges the market to deliver

First introduced in May 2018, Tariff Guarantees offer investment certainty to large scale renewable heat generation projects which contribute towards the UK government's commitment to meeting our legally binding carbon targets. Under the initial round of Tariff Guarantees, applicants were required to commission projects in line with industry standards by 31 January 2020. On 31 May 2019, the Department for Business, Energy and Industrial Strategy announced its intention to extend the allocation of Tariff Guarantee applications on the Renewable Heat Incentive to 31 January 2021. The legislation extending the period for Tariff Guarantee applications came into force on 17 July 2019.

This change further supports the transition to low-carbon heating in Great Britain, helping generate renewable heat for homes and businesses across the country. Since the scheme's implementation, as of October 2019, the UK government has granted 47 tariff guarantees for large scale projects, the majority of which produce biomethane for injection to the gas grid.

Renewable Transport Fuel Obligation (RTFO)

Introduced in 2008 under the Energy Act, the RTFO scheme is the main mechanism to ensure the deployment of sustainable renewable fuels in transport.

The RTFO requires fuel suppliers to ensure that a specified proportion of their overall fuel supply into the UK market is from a renewable source. Suppliers can choose to meet their obligation by:

- Supplying fuel that meets the relevant sustainability criteria
- Buying RTF certificates from others who have supplied fuel that meets the criteria
- Paying a 'buy-out' in respect of each litre of shortfall in meeting their obligation.

The RTFO has developed over time, introducing mandatory sustainability criteria to implement the Renewable Energy Directive and more recently to introduce restrictions on the use of food crops to address concerns around indirect land use change. The latest changes were introduced in April 2018. These include:

- Setting a target trajectory for low-carbon fuels to 2032 (rising from ~3% of transport energy today to ~7% by 2032)
- Establishing a sub target for advanced fuels from wastes
- Extending eligibility to low-carbon aviation fuels
- Limiting the contribution of crops from a maximum of 4% in 2020, declining to a maximum of 2% in 2032

3.1.3 Other elements of decarbonisation

i Where applicable, national policies and measures affecting the EU ETS sector and assessment of the complementarity and impacts on the EU ETS

Until the end of 2020 the UK will continue to participate in the EU ETS. UK government and Devolved Administrations are firmly committed to carbon pricing as an effective tool for achieving carbon emissions reductions and a consultation on The Future of UK Carbon Pricing was carried out from May to July in 2019, to seek stakeholder views on policy proposals after the UK's exit from the EU. Emissions from installations in the EU ETS are falling as intended (decreasing by 4% between 2017 and 2018).[220] The 2020 target is a 21% ETS reduction below 2005 levels.[221]

In Scotland, the EU ETS has helped to drive reductions in actual Scottish emissions. Emissions from energy supply are down 70% from the baseline and those from business and industrial processes are down 32% and 72% respectively.[222] In Wales, the majority of emissions come from heavy industry and electricity generation, referred to as the 'traded sector' under the EU ETS.[223]

The Carbon Price Support

In Great Britain, the Total Carbon Price (TCP) for energy generation is made up of the EU Emissions Trading System price and the Carbon Price Support (CPS) rate. CPS is an HMT-led policy that was introduced to strengthen the then weak price signal provided by EU ETS prior to EU ETS reforms. The EU ETS price and the 'top-up' CPS tax sum to a total carbon price. The CPS has played a key role in incentivising the rapid reduction in UK coal fired power generation, supporting our commitment to phase out unabated coal generation by 2025. The CPS rate does not apply to energy generators in Northern Ireland.

HM Treasury confirms CPS rates in advance of delivery at Budget, and all revenue from the CPS is retained by the Treasury.

Past rates

The CPS rate was introduced in April 2013. At Budget 2014[224], the UK government announced that the CPS rate would be capped at £18/tCO2 from 2016-17 to 2019-20 to limit the competitive disadvantage faced by business and reduce energy bills for consumers. At Budget 2016, the cap was maintained at £18/tCO2 from 2016-17 to 2019-20.[225] At Budget 2019, the UK government announced that CPS rates will be frozen at £18/CO2 in 2021-22 following the rise in the EU ETS price.

[220] EU Emissions Trading (EU ETS): https://ec.europa.eu/clima/policies/ets_en
[221] Trends and projections in the EU ETS 2017, www.eea.europa.eu/publications/trends-and-projections-EU-ETS-2017/at_download/file
[222] Scottish greenhouse gas emissions 2018, www.gov.scot/publications/scottish-greenhouse-gas-emissions-2018/
[223] National Atmospheric Emissions Inventory: http://naei.beis.gov.uk/reports/reports?report_id=958
[224] 2014 UK Budget, www.gov.uk/government/publications/budget-2014-documents
[225] 2016 UK Budget, www.gov.uk/government/publications/budget-2016-documents

Small Emitters and Hospital Opt-Out Scheme

The UK's Small Emitter and Hospital Opt-Out Scheme (Article 27 of the EU Emissions Trading Scheme Directive[226]) provisions recognise the fact that lower emitters on average face a much higher cost of compliance per tonnes of CO2 equivalent (tCO2eq) than larger emitters. This means that administration costs are significantly higher for smaller emitters, with larger emitters taking advantage of economies of scale to keep costs down.

An assessment of the administrative costs faced by UK operators during Phases I (2005-2007) and II (2008-2012) of the ETS found that smaller emitters accounting for 2% of emissions, incurred approximately 20% of the total administrative burden (across the 60% of all installations covered by the assessment). The largest 8% of emitters were responsible for 60% of emissions and incurred 45% of the administrative burden.

The UK government continues to pursue it's 'better regulation' agenda[227], which aims to reduce regulatory burdens on business, thereby helping to boost economic growth. In climate change policy terms, this translates into a commitment to ensuring that regulatory effort is focused on those areas of greatest risk to achieving our climate emission reduction goals and that the administrative costs of delivering these goals are minimised. Therefore, all effort should be made to reduce the compliance burden on small emitters.

The UK's Small Emitter and Hospital Opt-Out Scheme (Article 27) allowed eligible installations to face a reduced administrative burden during Phase 3 (2013 to 2020) of the EU ETS. The scheme was approved by the European Commission.

The current UK opt-out scheme was designed in consultation with industry and aims to offer a simple, deregulatory alternative to the EU ETS whilst maintaining the incentives for emission reductions. The opt-out scheme offers deregulatory savings through:

- an option for risk-based auditing of emissions instead of third-party verification
- no requirement to hold an active registry operator holding account
- the replacement of the requirement to surrender allowances with an installation emission reduction target
- a less burdensome procedure for adjusting targets to take into account changes in capacity

As part of the consultation on the Future of UK Carbon Pricing, the UK government and Devolved Administrations have consulted on proposals for continuing to offer a Small Emitter and Hospital Opt-Out. In addition the Consultation sought views on proposals to also offer an Ultra-Small Emitter exemption, which is a feature of Phase IV of the EU ETS and would allow for installations with emissions less than 2,500 tonnes of carbon dioxide equivalent, excluding emissions from biomass, to be exempted from the UK ETS.

For more details please visit the Future of UK Carbon Pricing consultation[228], which outlines the proposals in more detail.

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[226] EU Emissions Trading Scheme Directive: https://eur-lex.europa.eu/legal-content/EN/TXT/?qid=1576083587727&uri=CELEX:02003L0087-20180408

[227] EU Emissions Trading System: Assessing the cost of compliance, 2010, available at: www.gov.uk/government/publications/eu-emissions-trading-system-assessing-the-cost-of-compliance

[228] The Future of Carbon Pricing consultation, published 2019: www.gov.uk/government/consultations/the-future-of-uk-carbon-pricing

Indirect compensation payments

Article 10a (6) of the revised EU Emissions Trading Scheme Directive, which took effect on 8 April 2018, requires Member States to publish annually, from 2018, the amount of compensation paid to sectors exposed to "genuine risk of carbon leakage due to significant indirect costs that are actually incurred from greenhouse gas emission costs passed on in electricity prices". While a Member State in 2018, the UK published a report detailing the amount of EU ETS Indirect Cost Compensation awarded in 2017:

Table 14: 2017 indirect cost compensation report[229]

Sector	No. of Businesses	EU ETS compensation (£)
Iron & Steel	10	19.2 million
Chemicals	12	17.3 million
Paper	30	12.8 million
Non-ferrous metals	6	1.00 million
Other	3	0.6

The UK government's current commitment is to provide compensation until 2020.

ii Policies and measures to achieve other national targets, where applicable

Not applicable.

iii Policies and measures to achieve low emission mobility (including electrification of transport)

Transport

The UK government recognises that transport is one of the key areas where we must step up the pace of progress in reducing emissions. Our main focus is road transport, which accounts for over 80% of transport greenhouse gas emissions and a significant proportion of air pollutant emissions.[230] The UK government is also taking action to support modal shift, enabling people to choose the most sustainable mode of travel for their journey. We are investing in public transport and walking and cycling, as well as driving down emissions from aviation and shipping.[231]

Cars, vans, motorcycles and taxis

In the Road to Zero strategy, published in 2018, the UK government reaffirmed that it will end the sale of new conventional petrol and diesel cars and vans by 2040. The 2040 target was conceived as ambitious but achievable. The government's aim is to put the UK at the forefront of the design and manufacturing of zero emission vehicles, and for all new cars and vans to be

[229] The Future of Carbon Pricing consultation, published 2019: www.gov.uk/government/consultations/the-future-of-uk-carbon-pricing
[230] Department for Transport (2019), Statistical data set, Energy and environment: data tables (ENV) www.gov.uk/government/statistical-data-sets/tsgb03
[231] BEIS (2018) Final UK greenhouse gas emissions national statistics: 1990 – 2016 (online): www.gov.uk/government/statistics/final-uk-greenhouse-gas-emissionsnational-statistics-1990-2016

effectively zero emission by 2040. Going beyond this, we will now consult on the earliest date we can phase out the sale of new conventional petrol and diesel cars and vans, while minimising the impact on drivers and businesses. By 2050 we want almost every car and van in the UK to be zero emission.

The public sector is leading the switch to ultra low emission vehicles by example, by ensuring 25% of the central government car fleet is ultra low emission by 2022, and that all new car purchases are ultra low emission by default, ensuring 100% of the central government car fleet to be ultra low emission by 2030.

The UK government offers a range of incentives to help consumers make the shift to cleaner vehicles, including through the tax system, direct grants for vehicles and charging infrastructure and other financial support. To achieve our ambitions, we are investing nearly £1.5 billion between April 2015 and March 2021.

As part of this, the UK government will continue to offer grants for plug-in cars, vans, taxis and motorcycles until at least 2020, with consumer incentives in some form continuing beyond that date. To accelerate the shift to zero emission vehicles, all zero emission models will pay no company car tax in 2020-21, 1% in 2021-22 before returning to the planned 2% rate in 2022-23 – a significant tax saving for employees and employers.

Thanks to UK government leadership, a growing private sector and continuous local authority engagement, the UK now has over 17,000 devices providing over 24,000 public chargepoints. At least 2,400 are rapid devices; one of the largest networks in Europe. Since 2013, the UK government has supported the installation of over 120,000 domestic chargepoints and 5,000 workplace sockets through grant support schemes. 54 local authorities have successfully been awarded funding through the On-street Residential Chargepoint Scheme since 2017, which has allocated £8.5 million in grant funding towards the cost of installing on-street chargepoints through to 2020. The UK has also invested over £20 million across 27 local authorities to deliver over 900 chargepoints dedicated to taxis and private hire vehicles. The eight cities funded through the £40m Go Ultra Low Cities Scheme continue to deliver a range of pioneering local initiatives and charging infrastructure projects – including the UK's first 350kW enabled electric vehicle charging station, in Sunderland. These grant schemes and the £400-million public-private Charging Infrastructure Investment Fund will see thousands more electric vehicle chargepoints installed across the UK.

The UK government has also taken new powers through the Automated and Electric Vehicles Act 2018 to ensure that chargepoints can be easily accessed and used across the UK, and that they are smart ready. Consultations on electric vehicle smart charging and proposals for chargepoints to be installed with all newly built homes in England, where appropriate, closed in October 2019.[232]

HGVs and road freight

The UK government's long-term goal for HGVs is the development and deployment of zero emission technologies. As solutions emerge, it remains essential to scale up and expand efficiency measures that can reduce emissions now. The UK government is supporting this by:

- Working with industry to develop an Ultra-Low Emission Truck standard to provide clarity on its emission reduction expectations.

[232] The Road to Zero, 2018: www.gov.uk/government/publications/reducing-emissions-from-road-transport-road-to-zero-strate

- Working at a European level to implement the new ambitious CO2 performance standards for new trucks.
- A new industry-wide voluntary target for reducing HGV greenhouse gas emissions by 15% by 2025, from 2015 levels.
- Maintaining the small and medium-sized enterprise HGV fleet review scheme, which advises companies on ways to reduce carbon dioxide emissions.
- Extending the Longer Semi-Trailer trial to further demonstrate the efficiencies gained through more effective use of the road network.
- Extending the plug-in van grant to cover all HGVs weighing more than 3.5 tonnes – the Plug in Van Grant provides 20% of the price of a qualifying vehicle to a maximum grant amount of £8,000, or £20,000 for the first 200 large vans (3.5 tonnes plus) or trucks.
- OLEV and Innovate UK awarding £20 million of grant funding to 20 projects under the Low Emissions Freight and Logistics Trial[233] and £18 million R&D funding focused solely on innovative low emission HGV technologies.
- Progressing planning for trials of HGV platoons, which could bring significant fuel and emissions savings, with real-world trials in 2020.

Rail freight

Rail freight offers benefits to the environment, helps reduce road congestion and is important to UK businesses. Rail is one of the most carbon efficient ways of moving goods over long distances. Carbon emissions per freight tonne fell by 4.1% in 2018/2019 (ORR: Rail Emissions 2018-19). Rail freight is estimated to remove 7.2 million HGV journeys and 1.5 billion HGV kilometres from the roads annually (ORR: 2018-19 Q4).

The main way to achieve rail freight decarbonisation is to stop using diesel traction, through direct government intervention to roll out further electrification. Network Rail is leading the Traction Decarbonisation Network Strategy (TDNS), which will inform decisions about the scale and pace of decarbonisation between now and 2050. The challenge for rail freight is that current alternatives to overhead electrification, such as hydrogen and battery, do not have sufficient power to pull heavy freight trains. There is potential for bi-modes to reduce emissions. We have recently funded, through Innovate UK and RSSB, competitions that provided over £4 million for projects to drive decarbonisation across passenger and freight.

Government recognises the economic and environmental benefits of rail freight; the sector plays an essential part of the UK economy. Government has invested £235m in the Strategic Freight Network over CP5 (2014-2019) to improve the capacity and capability of the rail network for freight. Government is also providing freight grant schemes to support the carriage of freight by rail and water on routes where road haulage has a financial advantage. The scheme is providing up to £15.6 million in 2019/20 and helps to remove around 900,000 lorry journeys a year from Britain's roads.

Rail

Rail is currently a relatively green mode of transport – making up 10% of GB kilometres travelled but only 2% of UK transport GHG emissions (about 0.5% of economy-wide emissions). Rail's carbon emissions are also going down: CO2 emissions per passenger km in 2018-19 were 10.3% lower than in 2017-18, a continuation of a general trend of falling

[233] TRL, Low Emissions Freight and Logistics Trial, https://left.trl.co.uk/

emissions per passenger km. In recent years this trend has mostly been due to grid decarbonisation, but still illustrates that rail remains a low-carbon travel option.

Nevertheless, if the UK is to meet its net zero target across the economy by 2050, the Government believes that the rail sector must play its part in decarbonising transport. To reduce carbon emissions from trains we will need to both reduce use of diesel trains and take advantage of grid decarbonisation. As the organisation responsible for railway infrastructure, Network Rail (NR) are developing a Traction Decarbonisation Network Study (TDNS), which will inform the scale and pace of rail decarbonisation. The strategy outcomes will identify the areas of the network likely to need electrification, and which would be better suited to novel technologies such as hydrogen and battery in order to decarbonise the railway. The Government has recently invested over £4.5 million innovation projects through RSSB and Innovate UK, which will help novel low-carbon technologies such as hydrogen-powered trains reach maturity.

Buses

As for other road vehicles, the UK government ultimately wants to see all buses become zero emission. The UK government has built on previous investments with the Ultra-Low Emission Bus Scheme, providing £48 million to accelerate the uptake of these buses and related infrastructure in England and Wales.[234] The UK government has also announced £220 million funding in September 2019 to transform bus services and promote the development of an all-electric bus town or city.[235]

The UK government also works to increase bus usage. The £220 million Clean Air Fund is available for investment in a range of measures, including bus priority measures, which improve reliability and reduce journey times.[236] The £2.45 billion Transforming Cities Fund is also providing support for public transport in some of England's largest cities.[237]

The Bus Services Act 2017 gives local authorities new powers to work with operators to improve passengers' experience of bus travel. It introduces new bus franchising powers for local authorities, and powers to allow local authorities and bus operators to work in partnership, among other tools. Regulations made under the new open data provisions and new ticketing powers will make it easier for passengers in England (outside London) to use buses, move between different modes of transport and, from 2020, to access timetables, routes, fares, tickets, real time information and the actual location of bus services. To facilitate the improvement of information available to bus passengers, and ease their travel decisions based on complete, accurate and timely data, the UK government is developing a new digital platform to support the development of bus travel apps.

More generally, the UK government already provides around £2 billion to bus operators and local authorities to support bus services, and £250 million is provided via the Bus Service Operators Grant, with £43 million of this directly devolved to local authorities to support bus services that are not commercially viable.[238] The UK government also supports free off-peak

[234] Ultra-low emission bus scheme, March 2015: www.gov.uk/government/publications/low-emission-bus-sche
[235] Press release, September 2019: www.gov.uk/government/publications/a-better-deal-for-bus-users/a-better-deal-for-bus-users
[236] Press release, March 2018: www.gov.uk/government/news/260-million-of-clean-air-funding-launched-by-government
[237] UK Government website, news article published March 2018: www.gov.uk/government/news/transport-secretary-welcomes-next-step-in-17-billion-fund-to-transform-local-journeys
[238] Bus service: Grants and funding, published May 2015: www.gov.uk/government/collections/bus-services-grants-and-funding

travel for older and disabled persons through the English National Concessionary Travel Pass.[239]

Low carbon fuels

The UK government introduced legislation in April 2018 to almost double the use of low-carbon fuels in transport, increasing the obligation level under the Renewable Transport Fuels Obligation to 9.75% by volume in 2020, and rising to 12.4% by volume in 2032.[240] The UK government has also launched the £22 million Future Fuels for Flight and Freight Competition to develop proposals for advanced fuels production plants. In December 2019, two projects were awarded a share of £6.5 million to build plants, which aim to provide fuel for heavy goods vehicles.[241]

Walking and cycling

The UK government is now implementing the Cycling and Walking Investment Strategy (CWIS), which was published in April 2017[242], supported nearly £1.2 billion to promote cycling and walking out to 2020/2021. The ambition for England by 2040 is to make cycling and walking the natural choices for shorter journeys, or as part of a longer journey. The CWIS also sets out some nearer term aims and targets for 2025, including an aim to double cycling to 1.6 billion stages by 2025. Since the strategy's publication, local councils and metro mayors have been greatly attracted by the benefits of cycling and walking, and they have allocated an additional £700 million to safe infrastructure and other Active Travel projects. The result is that almost £2 billion is being invested in this area over this Parliament. This represents an expected uplift of nearly 60% on the investment levels projected in 2017, reflecting the growing importance of this agenda.

Further investment in cycling and walking is being provided as part of the £2.45 billion Transforming Cities Fund, the £5.5 billion Housing Infrastructure Fund, the £1 billion Sport England Strategy, the £220 million Clear Air Fund and through the HS2 road safety fund. The £675 million High Streets fund and expanded £3.6 billion Stronger Towns fund is also expected to provide further funding opportunities. Our response to the CWIS Safety Review, published in November 2018, contained 50 commitments to make roads safer for those who cycle and walk.

Aviation and shipping

The UK government is continuing to decarbonise its aviation and shipping sectors, both through international action, such as standards and offsetting schemes, and domestically; for example, by working with industry to develop sustainable alternative fuels, improved design efficiency and new propulsion technologies. We have published our Maritime 2050 strategy, our Clean Maritime Plan and our Green Paper 'Aviation 2050 - The future of UK aviation'. The CCC provided the UK government with specific advice on international aviation and shipping emissions on 24 September 2019. It is critical that aviation plays its part in delivering the UK's

[239] Free bus passes for older and disabled people protected for the future, published April 2018: www.gov.uk/government/news/free-bus-passes-for-older-and-disabled-people-protected-for-the-future
[240] Renewable Transport Fuel Obligation Order, Government Response to the consultation on amendments, 2017: www.gov.uk/government/publications/renewable-transport-fuel-obligations-order-government-response
[241] Press notice, December 2019: www.gov.uk/government/news/orange-peel-rubbish-and-fatbergs-the-fuels-behind-the-future-of-green-transport
[242] Department for Transport, Cycling and Walking Investment Strategy (2017): www.gov.uk/guidance/renewable-transport-fuels-obligation

net zero ambitions and the Government is still planning to consult on our position on aviation and climate change later this year followed by our ambitious Aviation Strategy.

In developing these and future strategies, we have considered, and we will continue to consider the implications of our net zero target for 2050 while developing a robust and comprehensive approach to tackling aviation and shipping greenhouse gas emissions.

The Aviation Strategy will put in place a framework for tackling carbon emissions from UK aviation out to 2050. The UK government will consider all cost-effective measures to ensure that the sector contributes to the UK's emissions reduction obligations. Industry and the UK government have made a joint £3.9 billion commitment between 2013 and 2026 to the development of new aircraft technology with the Aerospace Technology Institute. The Renewable Transport Fuel Obligation has also been extended to include incentives to use renewable fuels in aviation. The UK government played an instrumental role in the International Civil Aviation Organisation (ICAO) agreeing the first worldwide scheme to tackle CO2 emissions in any single sector - the Carbon Offsetting and Reduction Scheme for International Aviation (CORSIA) - in October 2016. The UK is now negotiating for ICAO to agree a long-term emissions reduction goal for international aviation by its 41st Assembly in 2022.

In 2019 the UK government and the Devolved Administrations consulted on options to replace the EU Emissions Trading System (EU ETS) when it leaves the EU ETS at the end of the Transition Period, which included proposals for the aviation sector.

On domestic shipping, the Clean Maritime Plan identifies ways to tackle air pollutants and GHG emissions while securing clean growth opportunities for the UK. It delivers on the Industrial Strategy by placing the UK at the forefront of the global transition to clean maritime technologies.

Implementation of the Clean Maritime Plan is an essential component of the Government efforts to meet the legislative target of net zero emissions by 2050 across the UK economy.

By 2025 we expect that:

- All new vessels ordered for UK waters are being designed with zero emission propulsion capability, that all vessels operating in UK waters are maximising the use of energy efficiency options, and that zero emission commercial vessels are in operation in UK waters.
- The UK is building clean maritime clusters focused on innovation and infrastructure associated with zero emission propulsion technologies, including bunkering of low or zero emission fuel.

By 2035 we expect that:

- The UK is home to a world-leading zero emissions maritime sector, with a strong UK export industry, cutting-edge R&D activities, and the global centre for maritime services related to clean maritime growth.
- The UK has built a number of clean maritime clusters, which combine infrastructure and innovation for the use of zero emission technologies. Low or zero emission bunkering options are readily available across the UK.

Good progress was made in 2019 on delivering the commitments in the Clean Maritime Plan, including by launching a 'Greening Finance/Financing Green' for Maritime initiative at London International Shipping Week. We provided seed funding to contribute to the establishment of MarRI-UK, ensuring strong collaboration between Government, industry and academia in the field of clean maritime innovation, funding two competitions for innovation grant funding in clean maritime. The first was through the Department for Transport's Transport Technology Research and Innovation Grants (T-TRIG). The second is the Clean Maritime Call, in which MarRI-UK is administering a £1.5m provided by Government. Both initiatives will provide funding to early stage innovation projects in the field of maritime emissions reduction.

On international shipping, the UK was instrumental in reaching a global deal at the International Maritime Organization (IMO) in April 2018 that will see these greenhouse gas emissions reduced by at least 50% by 2050, against a 2008 baseline, while pursuing efforts to phase out these emissions entirely as soon as possible. Domestically, the UK government is working with ship owners and ports to identify the barriers faced in supplying and using sustainable alternative fuels and cleaner emissions technologies, to explore possible solutions. In addition, operational improvements are expected to play a role, including better use of ship capacity. In July 2019, the UK government published a Clean Maritime Plan, the environmental route map of the Maritime 2050 strategy, which addresses the challenge of tackling the maritime sector's emissions of greenhouse gases and air pollutants and sets out our ambition for all new ships for UK waters ordered from 2025 to be designed with zero-emission capable technologies. The plan also includes a £1 million competition to find innovative ways to reduce maritime emissions and is published alongside a call for evidence to reduce emissions on UK waterways and domestic vessels, which closed in January 2020.[243]

iv Where applicable, national policies, timelines and measures planned to phase out energy subsidies, in particular for fossil fuels

The UK has support schemes for renewables, which are described in 2.3(iii) and 3.1.2 and listed in Table 15 below:

Table 15: List of UK energy subsidies

Energy Subsidy	Details
Renewables Obligation (RO)	Replaced by the competitive Contracts for Difference support scheme
Contracts for Difference (CfD)	The Contracts for Difference (CfD) scheme was introduced in GB in 2014 and is the UK government's main mechanism for supporting new low-carbon electricity generation projects.[244] A CfD is a 15-year private law contract between a low-carbon electricity generator and the Low Carbon Contracts Company (LCCC), a UK government-owned company. Planned continuation of CfDs for new low-carbon capacity after 2020 until 2035. A generator is paid for the electricity they generate, the difference between the strike price and the reference price. The cost is met by consumers via a levy on electricity suppliers.

[243] Domestic shipping air pollution: call for evidence: www.gov.uk/government/consultations/domestic-shipping-air-pollution-call-for-evidence
[244] Electricity Market Reform: Contracts for Difference: www.gov.uk/government/collections/electricity-market-reform-contracts-for-difference

Energy Subsidy	Details
Feed in Tariffs Scheme (FIT)	The Feed-in Tariffs (FIT) scheme was introduced to England, Wales and Scotland on 1 April 2010, under powers in the Energy Act 2008. The intention was to encourage deployment of micro-scale and small-scale low-carbon electricity generation (up to 5MW), particularly by organisations, businesses, communities and individuals that have not traditionally engaged in the electricity market.[245] Closed to new applications from 31 March 2019.
Great Britain Renewable Heat Incentive (RHI)	The non-domestic RHI was introduced in 2011, with the domestic RHI following in 2014. The RHI scheme has confirmed funding for new applications until 1 April 2021 in the non-domestic scheme and 1 April 2022 in the domestic scheme. The UK government is currently developing its low-carbon heat policy for the 2020s and beyond. We are working on a Heat Policy Roadmap which will set out key steps required to make key strategic decisions in the first half of the 2020s on how we achieve mass transition to low-carbon heating. We aim to publish this roadmap in mid-2020.
Renewable Transport Fuel Obligation (RFTO)	The RTFO scheme was introduced in 2008 and is the main mechanism to ensure the deployment of sustainable renewable fuels in transport. The RTFO requires fuel suppliers to ensure that a specified proportion of their overall fuel supply into the UK market is from a renewable source.

The Feed-Tariff scheme was closed to new installations on the 31st March 2019. The Renewables Obligation has closed to new applicants (but will continue to provide support to accredited generators for a fixed period). Its successor, the CfD, largely allocates support through a competitive auction. The competitive nature of these auctions drives cost reductions and value for money for consumers. In future we expect generators for some technologies to bid close to the market price for power, and it is possible that some of these contracts may end up paying back to the consumer over the length of the scheme.

The UK uses the definition of fossil fuel subsidies developed with other G20 Member States to respond to the G20 commitment to phase out such subsidies. The definition, based on the approach of the International Energy Agency, is –

> *A fossil-fuel subsidy is any government measure or program with the objective or direct consequence of reducing below world-market prices, including all costs of transport, refining and distribution, the effective cost for fossil fuels paid by final consumers, or of reducing the costs or increasing the revenues of fossil-fuel producing companies.*

Using this definition, the UK has no fossil fuel subsidies.

[245] About the FIT Scheme, Ofgem, www.ofgem.gov.uk/environmental-programmes/fit/about-fit-scheme

3.2 Energy efficiency

Planned policies, measures and programmes to achieve the indicative national energy efficiency contributions for 2030 as well as other objectives referred to in section 2.2, including planned measures and instruments (also of a financial nature) to promote the energy performance of buildings, in particular with regard to the following:

i Energy efficiency obligation schemes and alternative policy measures under Articles 7a and 7b and Article 20(6) of Directive 2012/27/EU and to be prepared in accordance with Annex III to this Regulation

See Annex B.

The Energy Company Obligation (ECO) is a statutory scheme that places an obligation on energy suppliers to deliver energy efficiency (for example; solid wall insulation, loft insulation) and heating measures to domestic households in Great Britain.

ECO has been in place since April 2013. As of July 2019, it had delivered 2.5 million measures to approximately 2 million homes. The 2015 Spending Review committed £640 million per annum from April 2017 to March 2022. The CGS announced that domestic energy efficiency would be funded to at least this level until 2028.

The new ECO scheme came into force on 3 December 2018 and will run until March 2022. The new scheme focusses support to low income, vulnerable and fuel poor households.[246]

ii Long-term renovation strategy to support the renovation of the national stock of residential and non-residential buildings, both public and private[247], including policies, measures and actions to stimulate cost-effective deep renovation and policies and actions to target the worst performing segments of the national building stock, in accordance with Article 2a of Directive 2010/31/EU

The UK government's full Long-Term Renovation Strategy (LTRS) for the UK building stock is currently in development and is expected to be published separately in 2020. The requirement to submit the LTRS will be fulfilled through the publication of a Heat and Buildings Strategy. This will build on existing analysis from the Clean Growth Strategy in order to set out the UK government's long-term vision of how it will improve the energy performance of both residential and non-residential properties in support of the delivery of its legally-binding emissions and fuel poverty targets.

The required advance elements of the LTRS have been included in section 2.2. This content is indicative and subject to revision upon publication of the UK's full Strategy.

iii Description of policy and measures to promote energy services in the public sector and measures to remove regulatory and non-regulatory barriers that impede the uptake of energy performance contracting and other energy efficiency service models[248]

[246] ECO Scheme, www.ofgem.gov.uk/environmental-programmes/eco
[247] In accordance with Article 2a of Directive 2010/31/EU.
[248] In accordance with Article 18 of Directive 2012/27/EU.

The UK government has made available a model Energy Performance Contract,[249] which includes guidance notes and a guide to best practices for the public sector, and a list of registered energy service providers.[250]

In the business sector, BEIS has previously published research that it had commissioned to understand the potential size of the energy services market and the drivers and barriers to further growth.[251] The UK government also published a call for evidence to seek views on how the UK government could help businesses improve the way they use energy, including whether the UK government could stimulate the energy services market for businesses.

iv Other planned policies, measures and programmes to achieve the objectives referred to in section 2.2 (for example measures to promote the exemplary role of public buildings and energy-efficient public procurement, measures to promote energy audits and energy management systems[252], consumer information and training measures[253], and other measures to promote energy efficiency[254])

Further information on these are set out in 3.2(viii) and 5.1(iii).

v Where applicable, a description of policies and measures to promote the role of local energy communities in contributing to the implementation of policies and measures in sections i, ii, iii and iv

The UK government recognises that local delivery is critical to achieve objectives set out in the national Industrial Strategy and CGS. In 2017 BEIS launched a Local Energy Programme[255] which has committed almost £20 million funding to local areas to date. This has funded all Local Enterprise Partnerships (LEPs) in England to develop their own local energy strategy; five Local Energy Hubs across England to increase the capacity of LEPs and local authorities to identify and deliver local energy projects and undertake the initial stages of project development to help attract investment; and a range of good practice guidance and toolkits.

As part of the Local Energy Programme, the Rural Community Energy Fund (RCEF) re-opened in May 2019 offering £10 million to support rural communities in England to develop renewable energy projects. RCEF offers grants for feasibility studies and pre-development of the project up to the point where there is an investable business case, and it is being delivered by the five Local Energy Hubs.

As highlighted in the CGS, the UK government is also committed to supporting local leadership and has already given additional powers and responsibilities through the Cities and Local Government Devolution Act 2016. A number of Local Devolution deals have been agreed between the UK government and local areas including Greater Manchester, West Midlands, West of England, Cornwall, Greater Peterborough and Greater Cambridgeshire, Sheffield, Liverpool City Region, Tees Valley, North of Tyne. Many of these deals incorporate energy

[249] Model Energy Performance Contract, 2015, www.gov.uk/government/publications/energy-performance-contract-epc
[250] Registered energy service providers, published 2014: www.gov.uk/government/publications/registered-energy-service-providers
[251] The Non Domestic Energy Efficiency Services Market, May 2018: www.gov.uk/government/publications/non-domestic-energy-efficiency-services-market
[252] In accordance with Article 8 of Directive 2012/27/EU.
[253] In accordance with Articles 12 and 17 of Directive 2012/27/EU.
[254] In accordance with Article 19 of Directive 2012/27/EU.
[255] Clean Growth Strategy, 2017, October 2017, www.gov.uk/government/publications/clean-growth-strategy

commitments, including support for home energy efficiency, deep geothermal, tidal power and community energy initiatives.

Scotland

Scotland has a legacy of strong community engagement in local renewable generation, often led by remote rural and island communities. The Scottish Government is defining a distinctive approach to Scotland's future energy provision, including:

- Putting communities at the heart of decisions about their local energy system
- Empowering them to take an economic stake in new developments

The Scottish Government is committed to continuing to empower Scottish communities, supporting the development of innovative and integrated local energy systems and networks. There is already a flagship scheme in place to support the growth of community and local energy throughout Scotland; the Community and Renewable Energy Scheme (CARES). This scheme, which is delivered locally by Development Officers based throughout Scotland, is a one stop shop offering free independent advice and funding options to support communities in taking forward projects or taking a stake in commercial schemes.

Up to £4.5 million is available to applicants through CARES in 2020/21. This support includes:

- Enablement grants of up to £25,000
- Development loans and grants of up to £150,000
- Capital grants of up to £150,000

Since its inception CARES has supported approximately 600 renewable energy projects across Scotland.

Furthermore, in the 2017 Scottish Energy Strategy, Innovative Local Energy was highlighted as one of our strategic priorities and, as such, the Scottish Government has set the following targets:

- 1 GW of community and locally-owned renewable energy capacity by 2020
- 2 GW of community and locally-owned renewable energy capacity by 2030
- Half of newly consented renewable energy projects to have an element of shared ownership by 2020

Scotland has made considerable progress in achieving these ambitious targets: As of March 2019, almost 0.7 GW of capacity was operational – with a further 0.6 GW in the pipeline.

Welsh Government has set targets around local ownership to ensure the benefits are captured for Wales from new energy developments. There is an expectation for all new energy projects in Wales to include at least an element of local ownership, in order to retain wealth within Wales and provide real benefit to communities.

The Welsh Government Energy Service provides support to public sector organisations and communities to help them develop energy efficiency and renewable energy schemes which generate benefit for Wales from the transition to a low-carbon energy economy. Building on

experience and learning over recent years, the service offers a wide range of technical, commercial, strategic and project management skills.

Local Authorities are supported through the Welsh Government Energy Service with 0% loans to support the delivery of new projects which support decarbonisation. The Welsh Government Local Energy Loan Fund supports community-led renewable energy projects and enable groups to buy into projects. The Welsh Government Energy Service is also supporting regional energy mapping, which will feed into growth deals and help regions in developing the energy system of the future, identifying greater regional benefits than the current system delivers for Wales. This will include power, heat and transport.

vi Description of measures to develop measures to utilise energy efficiency potentials of gas and electricity infrastructure[256]

The Ofgem assessment of the energy efficiency potential of Great Britain's gas and electricity infrastructure was published in 2015, in line with the Energy Efficiency Directive. The report assessed the energy efficiency potential of gas and electricity infrastructure and described measures in place and their expected benefits alongside potential measures that could improve energy efficiency in future.[257] These measures continue to be progressed under the mechanisms described in 3.4 below.

vii Regional cooperation in this area, where applicable

BEIS participates in a number of international fora aimed at promoting product energy efficiency policies globally. The Super-efficient Equipment and Appliances Deployment Initiative is made up of 18 member governments including Chile, the European Commission, Canada, India, South Africa and Germany, and its primary aim is to support energy efficiency policies in developing economies. The Energy Efficient End-use Equipment (4E) initiative is a Technology Collaboration Programme under the aegis of the IEA and CEM with 15 member governments including the Netherlands, Sweden, France, US, Japan, Australia and New Zealand, it aims to promote the sharing of policy best practice and conduct research studies on energy efficiency.

viii Financing measures in the area at national level

The CGS set out an aspiration for as many homes as possible to be EPC B and C by 2035, where practical, cost-effective and affordable. To achieve this aspiration, the UK government will:

1. Support around £3.6 billion of investment to upgrade around a million homes through the Energy Company Obligation (ECO), and extending support for home energy efficiency improvements until 2028 at the current level of ECO funding (i.e. £640 million per annum).
2. Build a market for energy efficiency by making it as easy as possible for people to pay for and make home energy efficiency improvements. Alongside the CGS, the UK government published a Call for Evidence on Building a Market for Energy efficiency that sought views on additional measures to encourage home energy performance

[256] In accordance with Article 15(2) of Directive 2012/27/EU.
[257] Energy Efficiency Directive: An assessment of the energy efficiency potential of Great Britain's gas and electricity infrastructure, 2015: www.ofgem.gov.uk/publications-and-updates/energy-efficiency-directive-assessment-energy-efficiency-potential-great-britain-s-gas-and-electricity-infrastructure

improvements.[258] Following an analysis of the responses, the UK government outlined several of its resulting actions in the July 2019 Green Finance Strategy and published the summary of responses, to the call for evidence, alongside the strategy.

3. Review the Green Deal Framework to improve and simplify this. Launched in 2013, the Green Deal enables consumers to take out loans to pay for energy efficiency improvements in their properties, with repayments made through their energy bill. The UK government intends to improve the Framework, so that it can best support future use of 'pay as you save', as well as simplify and reduce costs, whilst providing adequate protection for consumers. A Call for Evidence was published late in 2017 and the summary of responses to the Call for Evidence was published in July 2018. A consultation will follow on any proposed changes.

4. Consult on a long-term trajectory for energy performance standards in the Private Rented Sector (PRS) in England and Wales, with the aim of as many private rented homes as possible being upgraded to EPC Band C by 2030, where practical, cost-effective and affordable. We have been working with stakeholders to develop policy design options for the trajectory during the summer of 2019 and we plan to consult on this in the Autumn.

The UK government has made strong progress since the publication of the CGS. As part of its long-term PRS trajectory, for example, on 1st April 2018 it introduced the PRS Minimum standard regulations, which require landlords to bring their properties to EPC Band E or above or register an exemption if one applies. These regulations were further strengthened in April 2019 to require a contribution of up to £3,500 from landlords towards the cost of improvements. The UK government is also taking action in the social rented sector. The Social Housing Green Paper published in August 2018[259] asked, among other things, whether the energy performance of social housing should be upgraded. Government is currently considering the responses and will publish a Social Housing White Paper for implementing social housing reform in due course.

Measures have also been introduced to improve the supply of energy efficiency measures and stimulate demand. For example, the UK government currently makes available a reduced rate of VAT of 5% for the installation of certain energy saving materials in residential properties, including insulation, draught stripping for windows and doors and heating controls. As set out in section 2.2, the UK government has also made the following finance available for demonstration projects:

- £2.5 million to improve retrofit supply chain integration and coordination across England;
- £5 million to support the development of innovative green finance products through the Green Finance Home Innovation Fund;
- And £10 million to fund projects demonstrating a cost reduction trajectory for whole house retrofit.

There is also potential for the energy services market to deliver more investment in energy efficiency to businesses. The CGS sets out the UK government's ambition to reduce business energy use by 20% by 2030. Achieving this ambition will require action across all businesses. The UK government's modelling suggests that the majority of improvements could come from

[258] Building a market for energy efficiency: call for evidence, 2017: www.gov.uk/government/consultations/building-a-market-for-energy-efficiency-call-for-evidence
[259] www.gov.uk/government/news/social-housing-green-paper-a-new-deal-for-social-housing

improving the efficiency of how energy is used in commercial and industrial buildings, in both the private rented sector and owner-occupied sectors.

The Scottish Government is committed to improving energy and resource efficiency while reducing carbon output across business and public sector and to continuing sustainable economic growth for Scotland. The Resource Efficient Scotland (RES) programme funded by the Scottish Government offers free independent, specialist advice and support to businesses, third sector and public sector organisations to implement energy, material resource and water efficiency measures that will translate into cost savings, increased economic competitiveness and reduced emissions. RES provides a degree of assistance to businesses of all sizes, but SMEs have a particular focus.

The Resource Efficient Scotland SME Loan scheme provides interest free loans up to £100,000 to small and medium sized Scotland based businesses for the installation of resource efficiency measures and renewable energy technologies. The scheme is currently offering, subject to availability, cashback funding of 15% of the total loan value (up to a maximum of £10,000) and is payable after the measures have been installed by the business. Available cashback has resulted in a higher uptake of the loan scheme over the past year (2018 – 2019).

The UK government is working with business and finance stakeholders to improve the market for energy services, building confidence across commercial and industrial customers. Delivering our ambition will present opportunities for green finance.

The CGS also set out the challenge facing the public sector in meeting the UK's 2050 target. The pathway set out to 2032 sees emissions from the public sector falling by around 50% compared to 2017. This will require UK government to go further with longer term emissions reduction targets across the public sector, addressing the barriers to energy efficiency and low-carbon investment, and making the case for action internally.

The UK government has already shown what is possible through the Greening Government Commitments which include a greenhouse gas emissions reduction target and has recently set a new, higher target of a 43% reduction by 2020 from a 2009-10 baseline across the central government estate. The UK government has also introduced a voluntary target - the Emissions Reduction Pledge - for the wider public sector and higher education sector, of a 30% reduction in greenhouse gas emissions by 2020 from a 2009-10 baseline, and will explore the possibility of moving to a more ambitious target during the 2020s.

A call for evidence was launched in October 2017: Leading by example: cutting energy bills and carbon emissions in the public and higher education sectors. A summary of responses was published in July 2018 and further analysis will feed into a review of carbon reduction policies across the public sector. The UK government has committed to publishing a roadmap on the next steps to take us towards delivering the ambition set out in the Clean Growth Strategy for the public sector to reduce greenhouse gas emissions.

We continue to enable greenhouse gas emission reductions through the Public Sector Energy Efficiency Loan Scheme. The capital pot for England stands at £312m as of the end of 2019/20 and is planned to increase each year to a total of £385 million by 2020/21. This funding, managed by Salix Finance, has delivered over 17,000 projects, significantly improving energy performance in the public sector. This revolving loan scheme will continue to be recycled to at least 2025. The UK government is also supporting development of the energy services market, helping public bodies access energy services procurement frameworks.

3.3 Energy security

i Policies and measures related to the elements set out in section 2.3

A greater number of electricity generation technologies provide increased diversity and enhanced energy security. In addition, we believe that low-carbon 'firm' (i.e. always available) power will be required in order to ensure a low-cost, stable, reliable, low-carbon system in 2050. Nuclear is one of the technologies currently available to provide this large-scale firm, low-carbon power and we should continue to support the development of new nuclear plant in this regard.

The UK has successfully maintained for many years, and intends to continue to maintain, a secure long-term supply of nuclear fuel through the use and implementation of risk-assessed security of supply policies for each utility. These policies apply both separately and holistically across each and all of the individual components of the fuel cycle (uranium supply, conversion, enrichment, fabrication, and finished fuel stocks). The policies are enabled and supported by the maintenance of market expertise and engagement such that genuine intelligent customer status is, and will be, retained in the utilities to assess and monitor security of supply risks (near and long term). Through the creation of alternatives and flexibilities in supply arrangements and the avoidance of exclusivity, there is recognition of, and proactive action and mitigation in response to, market evolution and shocks.

The approach includes consideration, as a minimum, of the following aspects:

- That there are multiple facilities and contracting entities to diversify risk against technical failure, accident, environmental events, commercial issues, geopolitical intervention/constraint (such as sanctions or counter sanctions), and regulatory impact
- That a number of those facilities are located in politically stable countries with which the UK has good relations and appropriate legislative arrangements, such as nuclear co-operation agreements, to allow the supply of material subject to nuclear proliferation safeguards
- That no market cartelisation through excessive concentration of facility ownership – whether horizontally or vertically integrated – has a dominant influence on security of supply
- That the potential for disruption of transport – whether environmental, regulatory, commercial or physical – is minimised and mitigated
- That physical stock holdings are matched to risks, predicted dispute/recovery times, processing durations and operating patterns
- That due consideration is given to the nuclear liability regimes in place in supplying countries, together with the implications for the financial and legal risk to the utility, so that a secure fuel supply does not introduce significant other risk
- That consideration is also given to the credit risk of counterparties and their risk of default (elective or non-elective) should market conditions change
- The ultimate source of material/service supplied and the ability of any intermediary (e.g. broker or trader) to guarantee future deliveries especially at times of market stress
- The sustainability credentials (environmental, economic, and social) of any entity or material introduced into the supply chain

- The quality implications of the choice of source, service provider, storage duration and conditions and/or material state on any physical stock holdings
- The development and maintenance of supply routes and the readiness to use (on a temporary or long-term basis and in both a regulatory and commercial context) alternatives to conventional mined natural uranium based supplies through the likes of 'underfed' enrichment output/tails re-enrichment, reprocessed uranium, down-blended highly enriched uranium, and mixed oxide fuels

Policies and measures related to system flexibility are outlined in 3.4.3 (ii).

ii Regional cooperation in this area

Gas security of supply

The United Kingdom is a member of both the United Kingdom and Norway Risk Groups for the purposes of implementing the EU Regulation on Gas Security of Supply (2017/1938). Common Risk Assessments, submitted to the European Commission in 2018, by both risk groups detail the regional cooperation measures undertaken by the United Kingdom and the other risk group member states for the purposes of gas security of supply.

In addition, there are a number of existing and planned agreements and protocols which govern gas security of supply arrangements between the United Kingdom and Ireland, including:

- Intergovernmental agreements, including solidarity arrangements that are currently in development
- Transportation arrangements between UK and Irish TSOs
- Load shedding protocols
- The undertaking of a joint risk assessment for the purposes of Ireland meeting the N-1 infrastructure standard – see the UK Risk Group Common Risk Assessment
- Regional communication fora

Intergovernmental Agreements

1993 and 2004 Intergovernmental Agreements

In 1993, the Irish and UK government signed an Intergovernmental Agreement regarding the transmission of natural gas by pipeline between the UK and Ireland. Specifically, the purpose of the Intergovernmental Agreement was to facilitate the construction and operation of a pipeline between Moffat in Scotland and Loughshinny in Ireland for the transmission of natural gas. Additionally, in 2004, the Irish and UK government signed a second Intergovernmental Agreement to facilitate the construction and operation of a second interconnector.

The Intergovernmental Agreements contain provisions regarding pipeline consents, ownership, operation, safety, security arrangements and co-operation in the event of disruption of supply. With reference to providing gas supply to Northern Ireland and the Isle of Man, the Intergovernmental Agreements state that a portion of gas capacities shall be allocated to Northern Ireland and the Isle of Man.

Solidarity Arrangements

Pursuant to Article 13 of Regulation 2017/1938, the United Kingdom and Ireland are currently in the process of developing arrangements for Solidarity measures. These measures are designed to facilitate the sharing of gas in the event of an emergency situation where the UK or Ireland request solidarity.

Transportation Arrangements

Connected Systems Agreement (GB-Ireland Interconnectors)

The Connected Systems Agreement (CSA) between NGG and BGE (UK) for GB-Ireland gas interconnectors came into effect on the 1st of October 1998. Under the CSA, it was agreed that BGE shall be entitled to have the BGE gas system connected to National Grid's gas system at the Connected System Points (CSPs). It was agreed and that the CSA shall not be amended, except by agreement between NGG and BGE. The provisions within the CSA address issues such as compatibility of connection facilities, operating procedures, provision of information, site maintenance and emergency co-operation.

Transportation Agreement between BGE (UK) and PTL

The Transportation Agreement was signed on the 21st August 1996. The Transportation Agreement involves Premier Transmission Ltd (PTL) and BGE (UK), and relates to provision of capacity from Moffat to Twynholm. The provisions within the Transportation Agreement address issues such as pipeline capacity, obligations of delivery and transportation, operation and maintenance, third party carriage, information and access, pipeline and facilities costs, pressure, pressure facilities and emergency arrangements. The Agreement ends in 2020 and discussions are ongoing between PTL and GNI (UK) on a replacement agreement.

Load Shedding Protocols

The NGG and GNI (UK) Joint Protocol for Load Shedding outlines the load shedding arrangements in place between NGG and GNI (UK) in the event of a Gas Deficit Emergency affecting either operator's gas transportation network. Specifically, these protocols address the scenarios of a:

- Network gas supply emergency in Great Britain
- Gas emergencies downstream of Moffat (e.g emergency on SWSOS, ICs, SNIP and SNP), which can affect gas supplies to Ireland, Northern Ireland and the Isle of Man

In the context of a gas supply emergency in GB that could affect the availability of gas to the Moffat network exit point, the overriding principle that is applied is one of proportionality. In a Network Gas Supply Emergency, any reduction of flows through the Moffat interconnector will be proportionate with actions being enacted on the GB network, unless specific geographical circumstances occur which require proportionally higher or lower load reduction in the north of GB.

In this way, domestic consumers in Ireland, Northern Ireland and the Isle of Man would be given the same priority as domestic consumers in GB unless there were geographical circumstances that required proportionally higher or lower load reduction in the north of the UK.

Regional Communication Fora

Co-operation between the UK and Ireland on issues pertaining to gas security of supply are facilitated through the UK and Ireland Emergency Planning Group, and previously the All-Island Emergency Planning Group.

The UK and Ireland Emergency Planning Group comprises the three government departments (BEIS, DCCAE and DfE), the three regulators (Ofgem, CRU and UREGNI), and the gas and electricity TSOs. Meetings take place every six months. As part of its work, the group is working towards applying a regional approach to risk analysis, preventative measures and emergency response. This includes the establishment of protocols between the gas TSOs to link emergency plans of each jurisdiction. Emergency exercises are also carried out by the TSOs in GB, Northern Ireland and Ireland on an annual basis and plans are refined based on the learning from the exercises. Additionally, the forum is used to discuss the implementation of the Regulation and the plans and assessments carried out by each jurisdiction in compliance with the Regulation.

Capacity Market

The Capacity Market (CM) is at the heart of the UK government's plans for a secure and reliable electricity system. It ensures sufficient investment in the overall level of reliable capacity (both supply and demand sides) needed to provide secure electricity supplies. The CM's design is consistent with the EU principle of technology neutrality, which requires State aid approved electricity resource adequacy schemes (like the CM) to enable participation by all technologies capable of the required technical performance. The CM is a technology neutral mechanism to achieve security of supply, however, to implement requirements of the EU Electricity Regulation, amendments were made to the Capacity Market Rules in July 2019 to introduce CO2 emissions limits requirements applying to all auctions held in 2020 onwards. New build plants that exceed the limit have been excluded from competing in auctions from 2020 and existing plants that exceed the limit will be excluded from being awarded agreements or receiving payments from 1 July 2025 at the latest.

A Call for Evidence as part of the Five-year Review of the CM[260] found that the CM has been important in ensuring security of supply. Capacity agreements have been awarded to a diverse mix of energy technologies, including significant amounts of flexible and smart technologies, such as Demand Side Response, batteries and reciprocating engines. This has been positive in facilitating the transition to a smarter, more flexible electricity system. Three capacity auctions scheduled to take place in early 2020 will secure the majority of Great Britain's capacity needs out to 2023/24.

Electricity security of supply

The UK is in the process of taking the action needed in order to comply with Regulation (EU) 2019/941 on risk preparedness in the electricity sector. This includes the identification of regional electricity crisis scenarios for our region which will form the basis of our risk-preparedness plans covering national, regional and, possibly, bilateral measures. We will work together with Ireland in the preparation of these plans and the underlying regional crisis scenarios. We will cooperate with Ireland in a spirit of solidarity in order to prevent and manage electricity crises and offer assistance where possible.

[260] Capacity Market: Five-year Review (2014 to 2019), www.gov.uk/government/publications/capacity-market-5-year-review-2014-to-2019

Oil stocks

Ireland is bound by the same IEA and EU rules. The obligations enable member countries to co-operate on and respond collectively to major disruptions to the global oil market.

iii Where applicable, financing measures in this area at national level

Not applicable.

3.4 Internal energy market

3.4.1 Electricity infrastructure

i Policies and measures to achieve the targeted level of interconnectivity as set out in point (d) of Article 4

These are outlined in section 2.4.

ii Regional cooperation in this area[261]

This is outlined in section 1.4.

iii Where applicable, financing measures in this area at national level

Several interconnectors between the UK and EU have received European Investment Bank financing. This includes €150 million for the BritNed electricity interconnector (2009) connecting it with the Netherlands[262] and €425 million for the UK-Belgium gas interconnector (1996),[263] and €300 million for the Eirgrid East-West electricity interconnector between Ireland and Wales (2009).[264]

A number of UK projects have received grant funding from the Connecting Europe Facility. As of 31 January 2020, this provided grant funding of over €70 million for electricity transmission projects in the UK and over €30 million for gas transmission projects in the UK bringing a cross border benefit.[265]

3.4.2 Energy transmission infrastructure

i Policies and measures related to the elements set out in section 2.4.2, including, where applicable, specific measures to enable the delivery of Projects of Common Interest (PCIs) and other key infrastructure projects

Energy network companies in England, Scotland and Wales are regulated by Ofgem, the independent energy regulator, via a price control process called RIIO. This process ensures that energy network companies maintain a safe and secure network and invest in new infrastructure where needed whilst ensuring value for money for consumers.

[261] Other than the PCI Regional Groups established under Regulation (EU) No 347/2013.
[262] www.eib.org/en/projects/loan/loan/20070229
[263] www.eib.org/en/projects/loan/loan/19941152
[264] www.eib.org/en/projects/loan/loan/20080326
[265] https://ec.europa.eu/inea/en/connecting-europe-facility/cef-energy/cef-energy-projects-and-actions

Ofgem introduced a 'Cap and Floor' regulatory regime for interconnection in 2014.[266] The 'Cap and Floor' regime has reduced risks and unlocked substantial investment in interconnection, reflected in the number of new interconnectors under construction from Great Britain and those that have received regulatory approval for projects.

Electricity interconnectors developed under this regime can earn revenue from the allocation of capacity to users who want to flow electricity between GB and its neighbours. The floor is the minimum amount of revenue that an interconnector can earn, which means that if an interconnector does not receive enough revenue from its operations, its revenue will be 'topped up' to the floor level. These funds are transferred from National Grid, which will in turn recover the sum from transmission charges applied to all users of the national electricity transmission system. The cap is the maximum amount of revenue an interconnector can earn; if an interconnector's revenue exceeds the cap, it will transfer the excess revenue to National Grid, which will in turn reduce transmission charges. For consumers, the cap on revenues provides benefits in return for their exposure in underwriting the floor.

As an alternative to the cap and floor, interconnector developers can seek an exemption from the regulatory regime. Exempt interconnectors would usually apply for exemptions from European legislation to facilitate this route. Under this exemption, an interconnector developer would face greater upside and downside risks on their investment.

ii Regional cooperation in this area[267]

This is outlined in section 1.4.

iii Where applicable, financing measures in this area at national level

Energy network companies are regulated by Ofgem in Great Britain, the independent energy regulator through a price control process called RIIO.[268] GB energy network investment is funded by bill payers through network charges and the companies are financed via a combination of debt and equity investment. All equity investment is made by private sector investors, mostly through private ownership but in some cases via the purchase of shares on the stock exchange (i.e. for publicly listed companies). Most debt finance is raised in the capital markets via the issuing of bonds, or otherwise via commercial banks loans. Some network companies in the GB have also received lending from the European Investment Bank (EIB). EIB loans typically have lower interest rates than commercial bank debt, all else being equal.

3.4.3 Market integration

i Policies and measures related to the elements set out in section 2.4.3

Policies and measures related to system flexibility are set out in section 3.4.3 ii.

ii Measures to increase the flexibility of the energy system with regard to renewable energy production such as smart grids, aggregation, demand response, storage, distributed generation, mechanisms for dispatching, re-dispatching and curtailment, real-time price signals, including the roll-out of intraday market coupling and cross-border balancing markets

[266] Electricity interconnectors: www.ofgem.gov.uk/electricity/transmission-networks/electricity-interconnectors
[267] Other than the PCI Regional Groups established under Regulation (EU) No 347/2013.
[268] Network regulation – the 'RIIO' Model: www.ofgem.gov.uk/network-regulation-riio-model

Smart Systems and Flexibility

In July 2017, the UK government and Ofgem jointly published the Smart Systems and Flexibility Plan.[269] The Plan outlines 29 actions for UK government, Ofgem and industry to implement by 2022 in order to realise the transition to a more flexible system and remove barriers to smart technologies, such as storage and DSR, so that they can compete fairly alongside other new or established energy solutions. In October 2018, BEIS and Ofgem published a Progress Update[270] to the Plan, which identified 9 new actions beyond those set out in the original Plan. We have now implemented over half of the actions in the plan and progress update. Analysis undertaken on behalf of the UK government estimates that a smart and more flexible energy system can save £17-40 billion by 2050.[271]

Actions in the Smart Systems and Flexibility Plan and Progress Update are split across three core themes:

1) Removing barriers to smart technologies, such as electricity storage

The Smart Systems and Flexibility Plan and Progress Update set out key measures that the UK government, Ofgem and/or industry will take to remove policy and regulatory barriers to storage, with the aim of creating a best in class regulatory framework. For example, clarifying the regulatory status of storage within the electricity system including a modified generation licence for storage and reviewing its treatment within the planning system.

Important actions focused on storage also include reforming network charges and policy costs faced by storage to ensure they are proportionate and ensuring the network connections process for storage is appropriate and does not present any undue burdens.

2) Enabling the use of smart solutions in homes and businesses

The Smart Systems and Flexibility Plan and Progress Update include a number of actions for UK government, Ofgem and industry to enable and develop DSR, including:

- Rolling out smart meters to households and small businesses across Great Britain as part of a national infrastructure upgrade that will help make our energy system cheaper, cleaner and more efficient.
- Moving to half-hourly electricity settlement on a market-wide basis to enable smart tariffs and other innovative products and services. Ofgem plan to make a decision and publish a full business case in Q1 2021.
- Setting standards for smart appliances, in order to stimulate the market and increase consumer demand. The UK government has now consulted on smart appliances and committed to taking powers to set regulatory requirements for a certain cohort of these appliances. In tandem, we are working with industry to develop standards.

[269] Upgrading our Energy System: Smart systems and Flexibility Plan, July 2017, www.gov.uk/government/publications/upgrading-our-energy-system-smart-systems-and-flexibility-plan
[270] Upgrading Our Energy System: Progress Update, October 2018, www.gov.uk/government/publications/upgrading-our-energy-system-smart-systems-and-flexibility-plan
[271] See: www.carbontrust.com/news/2016/12/capturing-the-benefit-of-a-smart-flexible-energy-system/

3) Ensuring markets provide the right incentives for flexibility and smart solutions

The Smart Systems and Flexibility Plan sets out the need for markets which reflect the true value of flexibility to the system and allow flexibility providers to stack revenues across multiple markets. Actions include:

- National Grid ESO opening up access to existing balancing services markets to a wider range of flexible technologies. Ongoing reforms will rationalise these services into a smaller number of more competitive, technology neutral products whilst increasing transparency and accessibility.
- Simplification of metering requirements for those offering DSR and enabling DSR component reallocation[272] in the Capacity Market; and allowing the stacking of revenues between the Capacity Market and ancillary services.[273]
- Distribution Network Operators (DNOs) opening up network requirements to competition with flexibility services[274,275], creating new markets for flexibility at the distribution level and improving co-ordination across transmission and distribution to deliver whole system approaches. Industry is leading on the delivery of these changes through the Energy Networks Association's Open Networks Project. In July 2019, UK government and Ofgem jointly published a letter setting out their views on the progress of the ENA's work, and their expectations for this work going forwards.[276]

Launching an Energy Data Taskforce to deliver recommendations to reduce costs and facilitate competition and innovation in the energy sector, through improving data availability and transparency. The Taskforce published their report in June 2019, which includes specific recommendations for the UK government, Ofgem and industry as part of a strategy for a modern and digitalised energy system. The UK government and Ofgem are now considering how we can realise the vision set out in this report.

iii Where applicable, measures to ensure the non-discriminatory participation of renewable energy, demand response and storage, including via aggregation, in all energy markets

See section 3.4.3 (ii).

iv Policies and measures to protect consumers, especially vulnerable and, where applicable, energy poor consumers, and to improve the competitiveness and contestability of the retail energy market

There are around 60 energy suppliers in the domestic retail energy market[277]. Evidence shows competition continues to benefit household consumers who are able and willing to shop

[272] Ofgem, Decision on the statutory consultation on amendments to the Capacity Market Rules, July 2019, www.ofgem.gov.uk/publications-and-updates/decision-statutory-consultation-amendments-capacity-market-rules-2
[273] Ofgem, Publication of the consolidated Capacity Market Rules, July 2017, www.ofgem.gov.uk/publications-and-updates/publication-consolidated-capacity-market-rules
[274] Energy Networks Association. (2018). Energy Networks Association's Flexibility Commitment. Available at: www.energynetworks.org/assets/files/ENA%20Flex%20Committment.pdf
[275] Energy Networks Association. (2019). Our six steps for delivering flexibility services. Available at: www.energynetworks.org/assets/files/ENA%20Flexibility%20Commitment%20Our%20Six%20Steps%20for%20Delivering%20Flexibility%20Services.pdf
[276] UK Government & Ofgem. (2019). Letter from BEIS/Ofgem to Energy Networks Association, July 2019. Available at: www.gov.uk/government/publications/open-networks-project-letter-from-beis-and-ofgem-to-the-energy-networks-association-ena
[277] Ofgem, Data Portal - Retail Energy Indicators www.ofgem.gov.uk/data-portal/retail-market-indicators

around, meaning they can usually get a good deal. However, competition is not working well for consumers who are less active. 53% of non-prepayment consumers are on a default tariff, such as a Standard Variable Tariff, which are around £260 more expensive each year than the cheapest fixed-term deals for a typical consumer.[278]

To achieve an innovative and competitive market, the UK government and Ofgem have introduced measures including:

- rolling out smart meters to households and small businesses across Great Britain
- moving to faster and more reliable switching for customers
- Ofgem trials including writing letters to disengaged customers offering cheaper market deals

To protect disengaged consumers who are on poor value tariffs, the UK government has introduced the temporary Tariff Cap, which will be in place until 2020, when Ofgem must report on the conditions for effective competition in the market and recommend to the UK government whether it should be extended. The cap can be extended annually for a year at a time up to the end of 2023 at the very latest.

See section 2.4.4(i).

v Description of measures to enable and develop demand response including those addressing tariffs to support dynamic pricing[279]

See section 3.4.3(ii).

3.4.4 Energy poverty

i Where applicable, policies and measures to achieve the objectives set out in section 2.4.4

There are specific initiatives introduced by the UK government that seek to address fuel poverty, which are summarised below.

The Energy Company Obligation (ECO) is a requirement on larger energy suppliers to deliver energy efficiency measures to domestic premises in **England, Scotland** and **Wales**. The scheme has delivered over 2.6 million measures since it was introduced in 2013. In 2018, the UK government reformed the scheme so that support is entirely focused on low income and vulnerable households. The scheme provides support worth up to £640m per year and will run to 2022. The 2017 Clean Growth Strategy committed to funding for home energy efficiency to continue to 2028 at least at the current level of ECO and that the scheme would be reviewed beyond 2022.

The Minimum Energy Efficiency Standards for landlords (found in The Energy Efficiency (Private Rented Property) (England and Wales) Regulations 2015) focus on the least energy-efficient private rental properties in **England** and **Wales** – those rated EPC Band F or G. Around 40% of households in such properties live in fuel poverty. The Minimum Energy Efficiency Standards require private landlords to improve their properties to at least EPC Band E, and, if they cannot source sufficient external funding, are required to make a financial

[278] Ofgem, State of the energy market 2019, www.ofgem.gov.uk/publications-and-updates/state-energy-market-2018
[279] In accordance with Article 15(8) of Directive 2012/27/EU.

contribution of up to £3,500 including VAT. This establishes the principle that landlords are expected to play an important role in funding improvements to the properties they own.

In addition to support to improve home energy efficiency, over 2 million low income and vulnerable households in **England**, **Scotland** and **Wales** receive a £140 rebate off their winter energy bill through the Warm Home Discount scheme and 11 million households are protected from poor value standard variable and default tariffs through the energy price cap. The Warm Home Discount scheme has been extended until at least 2021. The price cap will be in place until the end of 2020 and may be extended by a year at a time until the end of 2023 at the latest. The decision to lift the price cap will be informed by a review into whether the conditions for effective competition are in place.[280] In addition, the Winter Fuel Payment provides support worth up to £300 to help ensure pension aged households can afford to heat their homes over the winter and additional payments are made to low income and vulnerable households during periods of cold weather through the Cold Weather Payments.

England

The Warm Homes and Energy Conservation Act 2000 as amended by the Energy Act 2013 requires the Secretary of State to publish and implement a strategy in relation to England that sets out a comprehensive package of measures for achieving the 2030 fuel poverty target. The current fuel poverty strategy for England was published in 2015[281] and in July 2019 the UK government published a consultation on proposals to update the fuel poverty strategy for England.[282] One proposal in the consultation is to introduce a sustainability principle to align Government strategy on fuel poverty, decarbonisation and air quality to ensure that the fuel poor are not left behind in the energy transition and that action to meet the fuel poverty targets is consistent with wider objectives.

Northern Ireland

The Northern Ireland Executive's fuel poverty strategy is delivered mainly through the Affordable Warmth Scheme.[283] The Scheme identifies and assists those low-income households most at risk of fuel poverty. Since its inception in September 2014 the Affordable Warmth Scheme has invested more than £66 million improving the energy efficiency of more than 16,000 low income households.

Scotland

By the end of 2021, the Scottish Government will have invested over £1 billion in energy efficiency programmes that help make homes warmer and cheaper to heat. National and local action ensures that delivery meets the needs of a wide range of communities, as well as supporting individual households.

The Home Energy Scotland service provides free and impartial expert advice to people on how to make homes cheaper and easier to heat, support on switching energy supplier and a referral service for benefit maximisation.

[280] Ofgem (2019) www.ofgem.gov.uk/publications-and-updates/developing-framework-assessing-whether-conditions-are-place-effective-competition-domestic-supply-contracts
[281] www.gov.uk/government/publications/cutting-the-cost-of-keeping-warm
[282] www.gov.uk/government/consultations/fuel-poverty-strategy-for-england
[283] Northern Ireland Affordable Warmth Scheme, www.nihe.gov.uk/index/benefits/affordable_warmth_scheme.htm; current AWS Fuel Poverty Strategy, www.communities-ni.gov.uk/publications/fuel-poverty-strategy

The Scottish Government's national fuel poverty scheme Warmer Homes Scotland is delivered on a regional basis, including a separate islands region, to ensure those households who are living in or at risk of living in fuel poverty in the more remote parts of the country get the same level of service as those living in urban areas.

Warmer Homes Scotland has a strong focus on heating and insulation measures, to improve the energy efficiency, warmth and comfort of fuel poor households. Q-Bot robotic underfloor insulation and new renewable measures have been added to the suite of measures already available for eligible households, including ground source heat pumps, micro-hydro, micro wind and micro-CHP.

These measures provide opportunities for greener, more innovative solutions, that may be of particular benefits to those households in remote and rural areas that are not served by the gas grid. It also provides the Scottish Government with the building blocks for using innovative technologies and tackling fuel poverty in the future through providing opportunities to build up the skills and accreditations of contractors to undertake new types of work in the renewables sector.

In addition, new enabling measures such as asbestos removal and the replacement of existing unsafe oil storage tanks have been added to the Scheme This will help those households who are most in need of help to gain access to the scheme where financial constraints would previously have prevented them from doing so, allowing more fuel poor homes to benefit from Warmer Homes Scotland.

Since 2013, the Scottish Government has invested over £373 million through its Area Based Schemes supporting over 85,000 households and helping hundreds of local communities to tackle fuel poverty. Every council in Scotland has been enabled to design and deliver energy efficiency programmes targeting fuel poor areas. The design and delivery of these projects draws upon local knowledge and housing strategies, as well as reflecting the additional costs of delivery in remote rural and island communities.

Home Energy Scotland loans of up to £38,500 per home are also available to owner occupiers and eligible registered private sector landlords in Scotland. This covers a range of energy efficiency improvements, including up to £17,500 for home renewables systems or connections to an approved district heating scheme powered by a renewable energy source. The HEEPS Equity loan pilot scheme was extended in June 2018 from Glasgow, Perth & Kinross and Argyll and Bute areas to cover additional areas Inverclyde, Renfrewshire, Stirling, Dundee and Western Isles.

Wales

In Wales, investment through the Welsh Government's Warm Homes Programme, including European, UK and Welsh Government funding has reached more than £327m delivering the demand-led Nest Scheme and Arbed area based on Scheme since 2009, which has improved the energy efficiency of more than 55,000 homes in Wales. By the current funding period in March 2021, Welsh Government investment will have reached more than £344m in the Warm Homes Programme. Funding that will have benefitted more than 75,000 homes. More than 129,506 people have received energy efficiency advice through the Warm Homes Programme since 2011.

In Prosperity for All: A Low Carbon Wales, the Welsh Government recognised the need for greater understanding of the economic, environmental social and cultural impacts associated

with decarbonisation. It has committed to creating a Climate Just Advisory Group to advise Welsh Ministers on the transition from a fossil fuel economy.

3.5 Research, innovation and competitiveness

i Policies and measures related to the elements set out in section 2.5

Our future research and innovation activities will be designed to achieve our legally binding domestic carbon budgets and our new commitment to achieve net zero greenhouse gas emissions from the UK by 2050. Our research and innovation priorities and related spending to deliver these targets are in the process of being considered and agreed, but in the meantime, our intention is to remain closely engaged with EU and international research and innovation activities to meet these world leading commitments. We have an overall target of spending an amount equal to 2.4% of GDP on UK R&I more generally, with energy R&I a part of this.

The UK government has set out a Clean Growth Grand Challenge to put the UK at the forefront of the industries of the future. This is set out in section 2.5(i). Some specific examples of activity included in what now amounts to more than £3 billion of UK spending are included below for illustrative purposes.[284]

BEIS Energy Innovation Programme

BEIS has a £505 million Energy Innovation Programme which aims to accelerate the commercialisation of innovative clean energy technologies and processes into the 2020s and 2030s.[285] As set out in the CGS, the BEIS Energy Innovation Programme[286] will invest around:

- £70 million in smart systems
- £90 million in the built environment (energy efficiency and heating)
- £100 million in industrial decarbonisation and carbon capture, use and storage (CCUS)
- £180 million in nuclear innovation (fission)
- £15 million in renewables innovation
- £50 million in support for energy entrepreneurs and green financing

From the BEIS Energy Innovation Programme, the UK is progressing well in terms of contractually committing funding to projects and will be adding to this list over the duration of the programme. These include:

Renewable Innovation

- The UK is working with other countries to develop shared solutions to reduce the cost of renewable energy technologies. This includes UK investments through the European Research Area Network (ERANet) of around £700,000 in bioenergy demonstration projects and up to £8 million in the ‘DemoWind’ programme to reduce the cost of offshore wind technologies.

[284] Energy Innovation, www.gov.uk/guidance/energy-innovation
[285] Energy Innovation, www.gov.uk/guidance/energy-innovation
[286] Clean Growth Strategy, 2017: www.gov.uk/government/publications/clean-growth-strategy

- Up to £1.3 million in an Offshore Renewable Innovation Hub, which is led by the Offshore Renewable Energy Catapult and Knowledge Transfer Network to bring the offshore wind industry together to solve common innovation challenges.

Smart Systems Innovation

- Up to £9 million to reduce the cost of energy storage technologies (including electricity storage, thermal storage, and power-to-gas technologies).
- Up to £600,000 on feasibility studies for a potential first of a kind large-scale future energy storage demonstrator. Up to £20 million to fund innovative large-scale, long-duration storage projects that can provide an alternative to conventional commercial storage technologies.
- Up to £7.6 million for innovative demonstrations of energy DSR technologies in UK businesses or public sector organisations to reduce their energy use in peak times and provide flexibility to the energy system.
- Up to £30 million (£18 million from the BEIS Energy Innovation Programme, £12 million from the Office for Low Emission Vehicles) for an electric vehicle-to-grid programme to invest in demonstrators and feasibility studies.
- Up to £600,000 to fund flexible market feasibility studies, as part of the Upgrading our Energy System: Smart Systems and Flexibility Plan.
- Up to £4 million to fund the development of Flexibility Exchanges. Flexibility Exchanges are online market platforms for flexibility providers to view and bid for flexibility requirements across multiple markets. This funding followed on from the earlier work on flexibility market feasibility studies.
- Up to £9.78 million from 2018-2021 to support innovative domestic applications of DSR technologies and business models.
- Up to £8.8 million to develop innovative approaches to energy management using smart meter data, tailored to the needs of smaller non-domestic sites in three priority sectors (retail, hospitality and schools).

Nuclear Innovation

- Up to £20 million over 2016-2018 to support innovation in the civil nuclear sector.
- Up to £7 million to ensure UK regulators are able to build the capability and capacity required to support the development of advanced technologies.

Industrial Innovation

- Up to £9.2 million over the next 4 years on an industrial energy efficiency accelerator to seek industry-specific solutions which are close to commercialisation, by leveraging private sector investment and strengthening UK supply chains to reduce energy costs for UK industry.
- Up to £20 million to design and construct carbon capture and utilisation (CCU) demonstration projects.
- Up to £20 million to stimulate early investment in fuel switching processes and technologies, so that a range of technologies are available by 2030 and beyond.

Energy Entrepreneurs and Green Financing

- Up to £13 million for phase 5 and up to £11 million for phase 6 of the BEIS Energy Entrepreneurs Fund, which seeks the best ideas from the public and private sector, particularly aimed at small and medium-sized enterprises, and supports the demonstration of state-of-the-art energy technologies.
- Up to £20 million of new investment to support clean technology early stage funding.

Built Environment Innovation

- Up to £9.8 million for the second phase of work led by the Energy Systems Catapult on the 'Smart Systems and Heat' programme. The programme will help develop local energy plans alongside Local Authorities and support the development of low-carbon heating projects across the UK.
- Up to £25 million to investigate the potential uses of hydrogen gas for heating and testing the possibility of domestic gas pipes and appliances.
- Up to £10 million to develop technologies that reduce the carbon emissions associated with providing heat and hot water to UK buildings.
- Up to £10 million to develop technologies and approaches to improving the energy efficiency of existing UK buildings.
- We are partnering internationally, to accelerate the development of innovative, clean energy technologies, driving forward our own transition to a low-carbon economy and positioning the UK as a world leader in these areas.

Carbon capture, usage and storage

Carbon capture, usage and storage (CCUS) is likely to play a vital role in meeting our target to reach net zero greenhouse gas emissions by 2050 and supporting our Industrial Strategy. CCUS can add value to the economy and help tackle hard to decarbonise sectors of the economy, creating new high value jobs and export opportunities whilst reducing emissions.

Since 2011, the UK government has invested significantly to develop CCUS in the UK. The UK government is continuing this support by committing to spend up to £100 million from BEIS's Energy Innovation Programme to support industry and CCUS innovation and deployment in the UK with over £50 million of innovation funding announced in 2018, to drive down the cost of CCUS and support the development of the technology. This funding includes:

- A £20 million CCU Demonstration Programme to fund design and construction of CCU demonstration plants in the UK, including £4.2 million to support a CCU plant at Tata Chemicals in North West England.
- A £15 million CCUS Call for Innovation, supporting a new CCUS international testing centre near Rotherham and supporting engineering studies and planning for projects in Scotland, Yorkshire, Merseyside and Teesside.
- £6.5 million of UK funding to the second international call of the Accelerating Carbon Technologies research programme, a €30 million fund supporting CCUS research across 11 countries that can lead to safe and cost-effective development of CCUS technology.

The UK government is also committed to maintaining a leading position in global collaboration and capacity building on CCUS and to work internationally to drive down the cost and

accelerate deployment of CCUS. In May 2018, the UK took on leadership (with Saudi Arabia and Mexico) of the Carbon Capture Challenge under Mission Innovation.

The UK continues to support developing countries and emerging economies to develop their technical and institutional knowledge of CCUS through our £70m international CCUS programme, which uses Official Development Assistance (ODA)

Furthermore, to help industry decarbonise, we have launched an Industrial Energy Transformation Fund, worth up to £315m. This will provide funding for transformative decarbonisation investments, potentially including fuel switching and carbon capture.

Hydrogen

Hydrogen is an energy carrier with potential to support the UK's efforts to transform and decarbonise the energy system in line with our 2050 net zero target. We are committed to exploring the option of hydrogen as a strategic decarbonised energy carrier, alongside electricity and other decarbonised gases.

The UK government is currently investing up to £121m in a range of innovation programmes to explore and develop the potential of low-carbon hydrogen across the value chain from production through to end use:

- Up to £121m in a range of innovation programmes to explore and develop the potential of hydrogen.
- £33m in a Hydrogen Supply programme to reduce the costs of bulk low-carbon hydrogen production.
- £20m in a Fuel Switching Competition to support the switch to lower carbon fuels in industry, including hydrogen.
- £20m in a Storage at scale competition to demonstrate large scale energy storage, including power-to-gas.
- £23m in a Hydrogen for Transport programme to support deployment of hydrogen vehicles and growth of refuelling infrastructure.
- £25m in the Hy4Heat programme to ensure the safe use of 100% hydrogen in buildings.

We are also exploring the development of sustainable policy and market frameworks for hydrogen. In July 2019, we published a hydrogen chapter of the CCUS business models consultation, which explored the main challenges a hydrogen business model needs to address.

Scotland

Scotland's energy sector has benefited from EU funding for energy infrastructure projects and research and development, particularly in the pursuit of new, low-carbon technologies and enabling infrastructure, such as offshore wind, marine renewables and integrated hydrogen solutions. For example:

- Orkney is home to what was the UK's first smart grid, connecting renewable generation to Orkney's distribution network at a considerably lower cost than conventional network connection. The 'Surf 'n' Turf' project demonstrates a fully integrated energy model, with hydrogen produced using electricity from tidal and onshore wind turbines. This is stored in a fuel cell, and used to provide low-carbon heat, power and transport. A European-

funded project called 'BIG HIT' will build on the Surf 'n' Turf project in Orkney by producing hydrogen from renewable sources for transport and heating.[287]

- The Scottish Government launched the Low Carbon Infrastructure Transition Programme (LCITP) in March 2015, in partnership with Scottish Enterprise, Highlands and Islands Enterprise, Scottish Futures Trust and sector specialists. It is a Strategic Intervention supported by the European Structural and Investment Funds, and European match funding for the LCITP is guaranteed up until Autumn 2021.[288]

Wales

Through its Smart Living Initiative[289], the Welsh Government has been encouraging a portfolio of innovative pilots/demonstrators to help learning and shaping of future energy solutions. As a catalyst the initiative is facilitating the development of place-based and themed based concepts and feasible solutions from zero carbon areas, smart intelligent towns to hydrogen themed initiatives.

ii Where applicable, cooperation with EU Member States in this area, including, where appropriate, information on how the SET Plan objectives and policies are being translated to a national context

Whilst a Member State, the UK was a very active contributor to the ongoing work of the EU's Strategic Energy Technology (SET) Plan, providing the Chair for two of its governance bodies (SET Plan Bureau and Joint Actions Working Group). The UK participated in ten (out of fifteen) temporary working groups for the implementation of the integrated SET Plan, co-leading the one on nuclear safety. In addition, the UK has participated in 6 ERA-NETs launched under H2020 (CCS, Bioenergy, Wind, Smart grids, Ocean energy and Solar Energy). Regarding Horizon 2020, the UK has historically been involved in almost half of all successful H2020 Energy project proposals enabling UK organisations to benefit from the results.

For Horizon 2020, the UK was involved in almost half of all successful H2020 Energy project proposals, providing evidence of the significant strengths and engagement from the UK's energy research and innovation community towards delivering SET Plan objectives. SET Plan delivery continues to form a major driver of the priorities and spending under H2020's energy theme.

SET Plan objectives and policies in the energy technology areas relevant to the UK, already align well with our existing activities and we are actively looking for opportunities to increase bilateral and multilateral collaboration in these areas through the SET Plan's governance structures.

UK International Energy Innovation activity can be split into 4 main areas:

- UK government funding for R&D collaboration with developed countries
- UK government funding for R&D collaboration with, in or targeting developing countries (usually classified as Overseas Development Assistance or ODA)
- European funding for UK organisations

[287] Building Innovative Green Hydrogen Systems in Isolated Territories: www.bighit.eu/
[288] Renewable and low carbon energy, Scottish Government website: www.gov.scot/policies/renewable-and-low-carbon-energy/low-carbon-infrastructure-transition-programme/
[289] Smart Living review: https://gov.wales/low-carbon-living-smart-living-annual-review-2018-2019

- UK membership of multilateral organisations and fora

The UK government funding in this area is delivered by different organisations, pursuing slightly different objectives. For example, UKRI typically focusses on excellent science and academic collaboration, whereas BEIS Energy Innovation focuses on industrial collaborations.

The UK's Energy Innovation Board has an International Working Group (sub-Group to the EIB) tasked with developing cross-government co-operation opportunities and knowledge sharing related to international research and innovation collaboration. As part of its work, it has been developing an International Strategic Framework. Pooling a wide range of inputs from government funding organisations and stakeholders, the Framework identifies international objectives, key technology development needs, which countries have strengths in these areas and existing co-operation initiatives. The objective is to arrive at a menu of opportunities for international collaboration that can then be prioritised and pursued.

Examples of existing cross-Government activity

1. **Energy Catalyst**: Since 2013, BEIS, UKRI and DfID (since 2016) have provided funding enabling the Energy Catalyst programme to invest almost £100 million in grant funding across more than 750 organisations and 250 projects, via six rounds of open competition. Since DFID joined in round four, the programme has included international Overseas Development Assistance (ODA) alongside the original UK focus.
2. **International Climate Fund / Energy Innovation**: The BEIS portion of the International Climate Fund, jointly administered with DFID and DEFRA, includes a commitment to invest £40 million on Energy Innovation projects. Officials are currently designing this in close consultation with other departments.

Steel

A vibrant steel sector is of vital importance to the UK economy. Steel is a fundamental material input to a variety of industries and the sector makes a significant contribution to local economic growth and prosperity. However, the UK steel sector is also a significant source of emissions and faces a significant decarbonisation challenge, with specific barriers, including varying technology readiness, long lead in and pay back periods and the need to align with long term equipment replacement cycles. Consequently, we believe the time is right to provide dedicated support to our steel industry, to help put it on a pathway to decarbonisation in line with our net zero commitments. As a signal of that support, on 29th August, the UK government announced a £250 million Clean Steel Fund:

- To help set the UK steel sector on a pathway to decarbonisation that is consistent with the UK's net zero target under the Climate Change Act
- To maximise longevity and resilience in the UK steel sector by building on longstanding expertise and skills and harnessing clean growth opportunities

Recognising that availability of low-carbon hydrogen at scale is a constraint to large industrial users considering fuel switching, the UK government also announced a new £100 million Low Carbon Hydrogen Production Fund alongside the Clean Steel Fund. The Low Carbon Hydrogen Production Fund aims to:

- Deploy low-carbon hydrogen production capacity to enable greater use of hydrogen as a decarbonisation option across the energy system

- Encourage future private sector investment in low-carbon hydrogen to support scale up and market development that aligns with the UK's clean growth objectives

UK government funding for R&D collaboration with developed countries

Across the UK government, we expect to launch R&D collaborations with developed countries including the US, Canada and South Korea. UKRI (both Research Councils and Innovate UK) have run several competitions with these countries in the current spending review period. As part of future collaborations, BEIS and UKRI will discuss the possibility of co-funding calls.

The draft International Research and Innovation Strategy has recognised the issue of a relative lack of funding for collaboration with developed countries within the broader international research context and is proposing a new non-ODA fund to support such collaboration.

UK government funding for R&D collaboration with, in or targeting developing countries (usually classified as ODA)

As part of the UK's Overseas Development Aid (ODA) funding, the UK government has a substantial activity of R&D collaboration in developing countries, part of a wider set of ODA activities which span the full spectrum from R&D to technical assistance, and supporting innovation in market design and regulatory frameworks.

UK ODA funding for international energy innovation is delivered through many programmes and organisations, namely: BEIS (Newton Fund, Global Challenge Research Fund, and International Climate Fund); UKRI (Newton Fund, Global Challenge Research Fund); and DfID.

European funding for UK organisations

EU funding for energy innovation is largely delivered through two programmes: Horizon 2020 (the EU's main R&D programme) & Euratom, and the European Regional Development Fund (ERDF).

For further information, see section 3.4(ii).

The UK is a member of several multilateral organisations which aim to share information on energy innovation activity including:

- Mission Innovation
- Clean Energy Ministerial
- International Energy Agency (the UK is active in IEA Governance structures including providing a Vice-Chair to the CERT. The UK is also active in the Energy Technology Network's Technology Collaboration Programmes - UK organisations participate in c22 of these)
- International Renewable Energy Agency
- World Bank Group, particularly the Energy Sector Management Assistance Programme (ESMAP)

Areas of potential interest identified for UK international energy activity

1. Efficient, resilient, smart networks (including: off-grid access, mini-grids and embedded mini-grids; storage and system balancing, and vehicle charging
2. Electricity Supply – low-cost renewables (also nuclear, CCS)
3. Heating and Cooling in Buildings
4. Industrial Energy Efficiency
5. Energy for Mobility
6. Land use and land waste (Including land-use for bioenergy)
7. Hydrogen
8. Supporting potentially disruptive technologies, systems and materials
9. Skills and capacity to support the energy transition
10. Increased Global Access to Affordable, Reliable Energy
11. Common Financial and Non-Financial Barriers
12. Supporting new supply chains, business models and customer value propositions

Mission Innovation

There is strong momentum behind Mission Innovation.[290] Since Mission Innovation (MI) launched in 2015, MI estimates that members have committed in excess of US$31 billion to accelerate innovation in clean energy, three new members have joined Mission Innovation, it has brought together over 3,000 technical experts and innovators and more than 20 new international partnerships in clean energy between MI members have been announced.

The UK has a considerable leadership role in the initiative and as part of our involvement has pledged to double central government funding for energy innovation, to in excess of £400 million in 2020/21. The UK took over as Head of the Secretariat from the US on 1 October 2017. We are Vice-Chair of the Steering Committee and a member of all Innovation Challenges. The UK led the development of seven Innovation Challenges to deepen collaboration and information sharing between members. We are a member of all seven and co-lead the Affordable Heating and Cooling in Buildings Innovation Challenge with the UAE and EC.

The key Mission Innovation and UK priorities through to 2021 are:

- Deliver a substantial boost in public-sector investment in clean energy R&D
- Increase private sector engagement and investment in energy innovation
- Build new or strengthened international networks and partnerships in energy innovation
- Increase awareness of the transformational potential of energy innovation, the progress being made, and the remaining gaps and opportunities

[290] Mission Innovation, http://mission-innovation.net/

As part of Mission Innovation, the UK is working with both the Breakthrough Energy Coalition (BEC) and the World Economic forum (WEF). At the One Planet Summit in Paris (December 2017), Breakthrough Energy founder Bill Gates announced public-private collaborations with five Mission Innovation members: Canada, European Commission, France, Mexico, and the United Kingdom. By combining government expertise and the Coalition's convening power the partnership aims to focus on ensuring that the UK is one of the most attractive places in the world to invest in clean energy innovation and more rapidly bring breakthroughs from the lab to market.

We are building on the WEF's System Initiative on Shaping the Future of Energy to explore whether the outcomes of that project are relevant to the UK context.

iii Where applicable, financing measures in this area at national level

Our vision for a knowledge-led economy is underpinned by world-leading research, world-class facilities and international collaborations that push scientific frontiers and attract the brightest talents, from Nobel Prize winners to ambitious graduate students. 'Innovation clusters' will form and grow around our universities and research organisations, bringing together world-class research, business expertise and entrepreneurial drive. These clusters can create thousands of skilled jobs in R&D, innovation and wider sectors, driven by the growth in science, technology, engineering and maths (STEM) skills led by new teachers and more doctorates.

We will work with industry in the coming months to develop a roadmap for meeting this target. This will provide a framework to drive business investment in R&D and focus on key sectors, technologies and clusters, including by optimising government investment to drive private investment in R&D and considering further opportunities to improve the business environment, including access to finance, regulatory frameworks, and intellectual property. This will maximise the impact of public investment in science and innovation to support businesses to invest more and drive outputs to realise our commitment to invest 2.4% of GDP in R&D.

Increasing investment in R&D to 2.4% of GDP in a decade is ambitious and will require concerted effort by the UK government and business. As a first step we will invest an additional £2.3 billion over what was previously planned in 2021/22, raising total public investment in R&D to approximately £12.5 billion in that year alone. This investment will see public R&D spending increase as a share of GDP every year. It means that we will have raised public investment in R&D from around £9.5 billion in2016/17 to around £12.5 billion in 2021/22.

This is an extra £7 billion over five years – the biggest ever increase in public funding of R&D. The UK government will invest strategically in technologies and ideas closer to market to drive UK competitiveness, while also continuing to fund the curiosity-driven research that is fundamental to the quality of our work and ensures our place as a world-leading knowledge economy.

Section B: Analytical basis

4. Current situation and projections with existing policies and measures[291]

In this section we provide historical context for energy use and emissions and then show how we expect these to change in the future. We cover macroeconomic and price forecasts in the later section on projections.

4.1 Projected changes in the main outside factors that influence the UK's energy system and its GHG emissions

4.1.i Macroeconomic forecasts (GDP and population growth)

Table 16 presents the short to medium-term GDP growth projections that are provided in the OBR's Economic and Fiscal outlook report, published in March 2019. This report is usually published twice a year alongside the Budget and Spring Statement.

Table 16: OBR's Short to Medium-term GDP Growth Projections - Per cent[292]

Projections, released March 2019.

	2019	2020	2021	2022	2023
GDP Growth – Per cent	1.2	1.4	1.6	1.6	1.6

Table 17 provides the OBR's long-term GDP growth projections, which were released in their Fiscal Sustainability report in July 2018. This report is released every other year, presenting long term projections for public spending and tax revenue and setting out summary indicators of the long-term sustainability of public finances.

Table 17: OBR's Long-term GDP Growth Projections - Per cent[293]

Projections, released July 2018.

	2017-18 to 2027-28	2027-28 to 2037-38	2037-38 to 2047-48	2047-48 to 2057-58	2057-58 to 2067-68
GDP Growth – Per cent	1.6	2.2	2.2	2.2	2.2

[291] Analysis based on latest available data up to 31 January 2020, does not account from impacts resulting from COVID-19. Some statistics may have been updated in publications released after 31 January 2020.
[292] OBR's Economic Fiscal Outlook, March 2019, https://obr.uk/efo/economic-fiscal-outlook-march-2019/
[293] OBR's Fiscal Sustainability Report, July 2018, https://obr.uk/fsr/fiscal-sustainability-report-july-2018/

Table 18: ONS's Projected Population of the UK, mid-2018 to mid-2043 - Millions[294]

Projections, released October 2019.

	2018	2023	2028	2033	2038	2043
UK Population - Million	66.4	68.1	69.4	70.5	71.4	72.4

4.1.ii Sectoral changes with impacts on the energy system and GHG emissions

Projections of energy demand in manufacturing industries and construction and in the commercial sector are calculated using projections of sectorial economic growth. Growth projections are calculated using historical relationships with GDP.

These are set out in section 4.2.1.

4.1.iii. Global energy trends, international fossil fuel prices, EU ETS carbon price

Fossil fuel prices, carbon prices and exchange rates

BEIS updates fossil fuel price projections[295] and carbon price projections[296] annually. Table 19 sets out key fossil fuel and carbon price values and Table 20 gives exchange rates.

Table 19: Central Fossil Fuel and Carbon Prices, 2018 prices

Projections.

2018 prices	2018	2020	2025	2030	2035
Crude oil (Brent 1 month), $/bbl	73.7	71.7	77.7	84.7	84.7
Gas (NBP), p/therm	57.0	48.0	56.0	63.0	63.0
Coal (CIF ARA), $/tonne	89.7	85.7	85.7	86.7	86.7
EU ETS short-term traded carbon values for modelling purposes, £/tCO2*	12.8	13.8	17.7	42.7	42.7

*Following the end of the Transition Period, the UK will no longer continue to be part of the EU ETS. The UK government is committed to carbon pricing policy and the future approach will be as least as ambitious as the EU ETS.

[294] ONS's Population Projections, October 2019, www.ons.gov.uk/peoplepopulationandcommunity/populationandmigration/populationprojections/bulletins/nationalpopulationprojections/2018based

[295] Fossil Fuel Price Assumptions, 2018, www.gov.uk/government/publications/fossil-fuel-price-assumptions-2018

[296] Carbon valuation, April 2019, www.gov.uk/government/collections/carbon-valuation--2

Table 20: Exchange Rates, Against Sterling

2018 prices	2018	2020	2025	2030	2035
Euros (€ per £)	1.1	1.1	1.1	1.1	1.1
US Dollars ($ per £)	1.4	1.4	1.4	63.0	63.0

Making assumptions about fossil fuel prices far into the future is very challenging, as they depend on many unknowns (e.g. future economic growth rates across the world, development of new technologies, global climate change policies, technological developments and strategies of resource holders). BEIS produces a set of fossil fuel price assumptions based on available evidence around fundamentals and their potential development over time to yield a plausible range for future prices. We need these assumptions for long-term modelling of the UK energy system and economic appraisal. They are not forecasts of future energy prices.

We combine scenarios of high supply with low demand and low supply with high demand to construct the long term low and high price assumptions for each fuel. This yields long term price assumptions that span a wide range of possible outcomes. While the long-term demand projections and supply outlooks are from different sources, we consider that these combinations are plausible for each fuel.

The Carbon Price

Carbon pricing provides a cost-effective and technology-neutral way of reducing carbon emissions and mobilising the private sector. In the UK, the EU Emissions Trading System (EU ETS) and the Carbon Price Support (CPS) in GB, have already helped to drive a switch from coal to gas generation in the power sector.

Until the end of 2020 the UK will continue to participate in the EU ETS. UK government and Devolved Administrations are firmly committed to carbon pricing as an effective tool for achieving carbon emissions reductions and a consultation on The Future of UK Carbon Pricing, was carried out from May to July in 2019, to seek views on policy proposals after the UK's exit from the EU. The UK future approach will be at least as ambitious as the current EU ETS, will provide a smooth transition for relevant sectors and will form part of the UK's pathway to its net zero target to end its contribution to global warming by 2050.

BEIS' short-term traded carbon values for modelling purposes, under current arrangements, are used to demonstrate the financial cost of purchasing allowances under the EU ETS. Its counterpart, the short-term traded carbon values for UK public policy appraisal are produced for the period up to 2020 under all three scenarios (central, high and low), and are linearly extended beyond 2020 to reach BEIS's long-term carbon values for the period from 2030 onward. BEIS's latest short-term traded values can be found in the Updated Short-Term Traded Carbon Values publication.[297]

4.1.iv Technology cost developments

Electricity generation costs are a fundamental part of energy market analysis, and a good understanding of these costs is important when analysing and designing policy.

[297] Carbon valuation, April 2019, www.gov.uk/government/collections/carbon-valuation--2

BEIS regularly produces updated estimates of the costs and technical specifications for different generation technologies.

Costs in the report are presented as levelised costs, which is a measure of the average cost per MWh generated over the full lifetime of a plant including planning costs, construction costs, operating costs, and carbon costs. It reflects the cost of building, operating and decommissioning a generic plant for each technology. Potential revenue streams are not considered.

BEIS's most recent assessment of electricity generation costs can be found in the Electricity Generation Cost Report[298] which covers both renewable and non-renewable technologies; Table 21 (below) gives the most recent levelised cost estimates for key technologies in a range of commissioning years from this report.

Table 21: Levelised Cost Estimates for NOAK Projects Commissioning in 2025

Technology-specific Hurdle rates, £/MWh, 2018 prices	CCGT H Class	OCGT 600MW (500hrs)	Offshore Wind	Large Scale Solar PV	Onshore Wind
Pre-Development Costs	0	5	3	3	3
Construction Costs	7	63	31	30	27
Fixed O&M	2	18	19	10	10
Variable O&M	4	4	3	0	6
Fuel Costs	40	61	0	0	0
Carbon Costs	31	48	0	0	0
Decommissioning and Waste	0	0	1	0	0
Total	**84**	**197**	**57**	**44**	**46**

[298] Electricity Generation Cost Report, 2019, https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/566567/BEIS_Electricity_Generation_Cost_Report.pdf

4.2 Decarbonisation

4.2.1 GHG emissions and removals

i Trends in current GHG emissions and removals in the EU ETS, effort sharing and LULUCF sectors and different energy sectors

In this section we first examine historic trends of GHG emissions in the UK as well as historical development in emissions by sector. Projections of future emission trends in the UK are then discussed, which are based on the 2018 GHG inventory.[299]

Historical emissions trends

This section references statistics from the UK's latest Greenhouse Gas Emissions Inventory (1990-2017).[300] The UK GHGI is an inventory tool that provides insight into the sources and magnitudes of greenhouse gas emissions in the UK. The UK GHGI is compiled in line with international guidance from the International Panel on Climate Change (IPCC) and contains the UK's official estimates of greenhouse gas emissions from 1990 to the latest available year of reporting, currently 2017. Note that the latest projected emissions referenced in the next section (Energy and Emissions Projections 2018284) are based on a slightly older inventory (1990-2016).[301] Any other datasets are referenced throughout.

UK net GHG emissions decreased by 42% between 1990 and 2017 as shown by Figure 4.[302] This has been driven by several factors such as restructuring in the energy supply industry (concerted move away from coal towards the use of gas and renewables), energy efficiency, pollution control measures in the industrial processes sector and other policies that reduced emissions of non-CO2 GHGs, most notably the increase in landfill methane capture and oxidation. Between 1990 and 2017, UK net CO2 emissions decreased by 37%. In 2017, net CO2 emissions made up approximately 81% of all net GHG emissions. More details can be found in the UK's annual GHG emissions inventory.

[299] Updated UK energy and emissions projections: 2018 www.gov.uk/government/publications/updated-energy-and-emissions-projections-2018
[300] Final Greenhouse Gas Emissions Statistics: 1990-2017, BEIS, www.gov.uk/government/statistics/final-uk-greenhouse-gas-emissions-national-statistics-1990-2017
[301] Final UK greenhouse gas emissions national statistics 1990-2016 www.gov.uk/government/statistics/final-uk-greenhouse-gas-emissions-national-statistics-1990-2016
[302] Covers total UK emissions excluding the impact of Gibraltar.

Figure 4: UK net GHG emissions, UK only, 1990–2017, MtCO2e

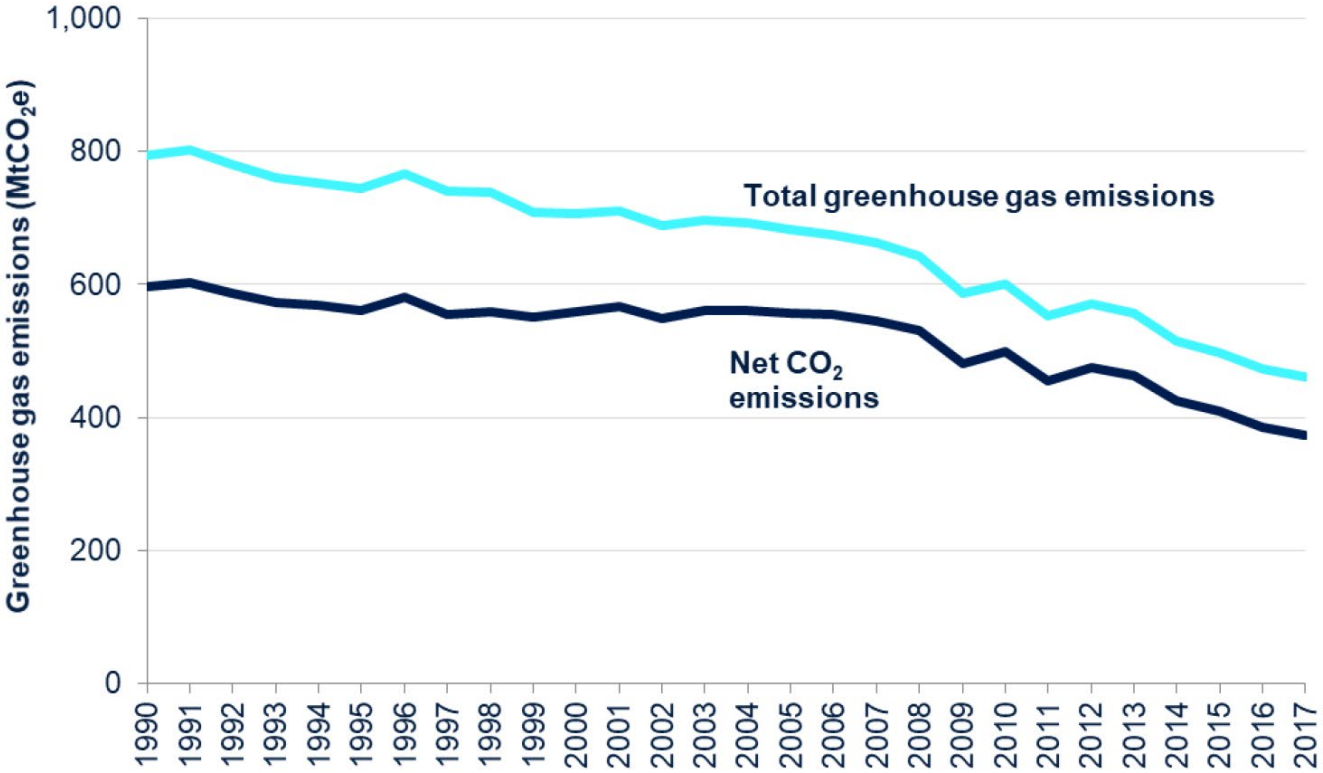


Table 22 below summarises the UK's historical GHG emissions by National Communications source sector.

Table 22: Net UK GHG emissions by national communications source sector, UK only, 1990-2017, MtCO2e

Source sector	1990	1995	2000	2005	2010	2015	2016	2017
Transport	128.1	129.7	133.3	136.0	124.5	123.5	125.9	125.9
Energy supply	277.9	238.0	221.6	231.5	207.4	145.3	121.8	112.6
Business	114.0	111.8	115.4	108.9	94.1	85.1	81.4	80.1
Residential	80.1	81.6	88.7	85.7	87.5	67.4	69.8	66.9
Agriculture	54.0	52.9	50.3	47.9	44.6	45.1	45.2	45.6
Waste management	66.6	69.1	62.9	49.0	29.7	20.6	20.0	20.3
Industrial processes	59.9	50.8	27.1	20.6	12.6	12.7	10.6	10.8
Public	13.5	13.3	12.1	11.2	9.5	8.0	8.2	7.8
LULUCF	0.3	-1.7	-3.9	-7.1	-9.1	-9.7	-9.8	-9.9
Total	794.4	745.6	707.5	683.7	600.9	498.0	473.1	460.2

The emissions in Figure 4 and Table 22 above have been reported on the same basis as the UK Climate Change Act, covering the UK only and excluding Gibraltar.

Historical developments by sector

Transport

The transport sector consists of emissions from road transport, railways, domestic aviation, shipping, fishing and aircraft support vehicles. Transport accounted for just over a quarter (27%) of UK GHG emissions in 2017. Since 1990 emissions in this sector have reduced by around 2%. These emissions are predominantly from road transport, and the volume of road traffic increased over this period.[303] However, this was largely offset by lower petrol consumption outweighing an increase in diesel consumption[304] and, more recently, improvements in fuel efficiency of both petrol and diesel cars.[305] The number of registered vehicles increasing over the same period from 24.7 million to 37.7 million.[306]

Energy supply

The energy supply sector consists of emissions from fuel combustion for electricity generation and other energy production sources. In 2018, CO2 emissions from power stations accounted for nearly 18% of the UK's total CO2 emissions.[307] However, overall emissions per GWh of electricity generated have been decreasing as the mix of fuels used has changed. There have been large reductions in coal use and big increases in renewables, with biomass conversions also playing an important transitional role. This is also coupled with general improvements in the efficiency of our economy.

For context, in 2018, nearly 53% of our electricity came from low-carbon sources, with the rest mainly coming from gas.[308] Coal use fell to record low levels in 2017; on 21 April 2017, Great Britain did not use any coal for a 24-hour period for the first time since 1882.[309] Further, in May 2019, the UK went a record 18 days without using coal.[310] The UK government has also committed to ending all unabated coal generation from 2025, while at the same time ensuring a secure supply of electricity.

Business

The business sector includes emissions from combustion in industrial/commercial sectors, industrial off-road machinery, and refrigeration and air conditioning. In 2017, emissions from this sector were estimated to be 30% below 1990 levels and represented an estimated 17% of

[303] DfT (2017) Road traffic estimates in Great Britain: 2017 www.gov.uk/government/statistics/road-traffic-estimates-in-great-britain-2017 Measured in 'vehicle miles' which combines the number of vehicles on the road and how far they drive.
[304] Transport Statistics Great Britain, Energy and environment (TSGB03), Table TSGB0301 (ENV0101) Petroleum consumption by transport mode and fuel type: United Kingdom from 2000: www.gov.uk/government/statistical-data-sets/tsgb03
[305] Transport Statistics Great Britain, Energy and environment (TSGB03), Table TSGB0303 (ENV0103) Average new car fuel consumption: Great Britain from 1997, www.gov.uk/government/statistical-data-sets/tsgb03
[306] DfT (2017) Licensed vehicles and new registration tables, www.gov.uk/government/statistical-data-sets/all-vehicles-veh01
[307] Digest of UK Energy Statistics (DUKES) 2019, Chapter 5 www.gov.uk/government/statistics/electricity-chapter-5-digest-of-united-kingdom-energy-statistics-dukes
[308] Digest of UK Energy Statistics (DUKES) 2019, Chapter 5 www.gov.uk/government/statistics/electricity-chapter-5-digest-of-united-kingdom-energy-statistics-dukes
[309] Financial Times (2017) Britain passes historic milestone with first days of coal-free power www.ft.com/content/fc2c8d12-191d-11e6-bb7d-ee563a5a1cc1 BEIS (2017) Energy Trends June 2017 www.gov.uk/government/collections/energy-trends
[310] https://environmentjournal.online/articles/uks-longest-ever-coal-free-run-comes-to-an-end/

total emissions. Several factors contributed to this decrease; primarily due to a reduction in emissions from industrial combustion, including iron and steel, which has led to a 41% reduction in CO2 emissions since 1990. Each tonne of steel produced in the UK requires 40% less energy to produce than 40 years ago.[311]

Residential

Emissions in the residential sector arise from fuel combustion for heating, cooking, garden machinery, and fluorinated gases released from aerosols and metered dose inhalers (such as those used for asthma sufferers). In 2017 residential sector emissions made up 15% of the UK total, estimated as 67 MtCO2e, compared to 1990 emissions of 80 MtCO2e, a reduction of 16%. A number of factors have had a major influence on emissions from homes, including a growth in demand for underlying energy services (such as warmer homes and hot water) and background improvement in energy efficiency.

Agriculture

The agriculture sector consists of emissions from livestock and agricultural soils, stationary combustion sources and off-road machinery (e.g. tractors). There are also small amounts of emissions of CO2 from the breakdown of pesticides. It is estimated to have been responsible for 10% of UK greenhouse gas emissions in 2017. In 1990, GHG emissions from agriculture were estimated to be 54 MtCO2e or 7% of total UK GHG emissions. Emissions from this sector have fallen by an estimated 16% between 1990 and 2017. This was driven by a fall in animal numbers over the period, together with a decrease in synthetic fertiliser use.

Waste management

The waste management sector includes emissions from waste disposed to landfill sites, waste incineration, and the treatment of waste water. It is estimated to have been responsible for 4% of UK greenhouse gas emissions in 2017. The vast majority of these emissions are from landfill sites. Emissions from disposal of waste have decreased by 69% since 1990. This was due to a combination of factors, including improvements in the standards of landfilling, changes to the types of waste going to landfill (such as reducing the amount of biodegradable waste), and an increase in the amount of landfill gas being used for energy.

Industrial processes

The industrial processes sector consists of emissions from industry except for those associated with fuel combustion. It is estimated to have been responsible for 2% of UK greenhouse gas emissions in 2017. The largest source of emissions was cement production, with other processes such as sinter, lime, and iron and steel production also contributing significantly. Industrial process emissions have decreased by an estimated 82% since 1990. This was most notably due to a large reduction in emissions from adipic acid production and halocarbon production between 1998 and 1999 (combined emissions from which are now almost zero).

Public sector

The public sector consists of emissions from combustion of fuel in public sector buildings. It is estimated to have been responsible for less than 2% of UK greenhouse gas emissions in 2017. The main source of emissions from this sector is the use of natural gas for heating public

[311] WSP and Parsons Brinckerhoff & DNV GL (2015) Report prepared for DECC & BIS: Industrial Decarbonisation & Energy Efficiency Roadmaps to 2050 www.theccc.org.uk/2015/03/27/industrial-decarbonisation-and-energy-efficiency-roadmaps-to-2050/

buildings. Public sector emissions fell from an estimated 13 MtCO2e in 1990 to 8 MtCO2e in 2017, a reduction of 42%.[312]

Land use, land use change and forestry (LULUCF)

The LULUCF sector consists of emissions and removals from forest land, cropland, grassland, settlements and harvested wood products. In the UK the LULUCF sector is estimated to have gone from a small net emitter of greenhouse gases in 1990 (0.3 MtCO2e) to a net sink in every year from 1991-2017, with the estimated size of the sink in 2017 being 9.9 MtCO2e. This has been driven by a reduction in emissions from land being converted to cropland and an increase in the sink provided by forest land. There has also been some reduction in emissions since 1990 due to less intensive agricultural practices.

EU Effort Sharing Decision

Under the ESD, the United Kingdom has a target of reducing its total emissions to 16% below the 2005 level by 2020 for non-ETS sectors.

In November 2018 the European Commission confirmed for each Member State their performance against ESD for 2016.[313] UK greenhouse gas emissions for 2016 under the ESD were confirmed to be 333.9 MtCO2e, 11.3 MtCO2e below the UK's annual limit for 2016 of 345.2 MtCO2e, meaning that the UK met its fourth annual target in the period. Provisional estimates indicate that greenhouse gas emissions for 2017 under the Effort Sharing Decision will also be below the annual emissions limit, by around 29 MtCO2e.

Table 23: Progress towards the EU Effort Sharing Decision, UK and Gibraltar, 2013-2017, MtCO2e

	2013	2014	2015	2016	2017
Total greenhouse gas emissions excl. LULUCF and NF3 (A)	566.5	524.0	503.5	482.8	470.5
Total verified emissions from stationary installations under the EU ETS (B)	225.3	197.9	175.9	147.4	137.0
CO2 emissions from civil aviation (C)	1.7	1.6	1.6	1.5	1.6
Total ESD emissions (D = A - B - C)	339.5	324.4	326.0	333.9	331.9
Annual emissions allocation (E)	358.7	354.2	349.7	345.2	360.4
Difference (E - D)	**19.3**	**29.8**	**23.7**	**11.3**	**28.5**

EU Emissions Trading System

Until the end of 2020 the UK will continue to participate in the EU ETS. UK government and Devolved Administrations are firmly committed to carbon pricing as an effective tool for achieving carbon emissions reductions and a consultation on The Future of UK Carbon Pricing

[313] Greenhouse Gas Emissions under the Effort Sharing Decision 2018 dataset, European Environment Agency: www.eea.europa.eu/data-and-maps/data/esd-1

was carried out from May to July in 2019, to seek stakeholder views on policy proposals after the UK's exit from the EU.

Phase II of the EU ETS coincided with the first Kyoto Commitment Period (2008-12). During this period each Member State held a specific quantity of allowances based on their EU-approved National Allocation Plan (NAP). This then resulted in net 'sales' or 'purchases' of emissions allowances reported from UK installations depending on whether total emissions were below or above the UK's Phase II allocation.[314]

The third phase of the EU ETS (2013-20) builds upon the previous two phases and has been significantly revised to make a greater contribution to tackling climate change. Amongst other changes to the operating rules, the system shifted away from NAPs in favour of an EU-wide cap on the number of available allowances across Member States. In the absence of a UK-specific allocation plan, a notional cap has been estimated for the purpose of calculating carbon budget performance. Further details of this methodology are laid out in the UK's Annual Statement of Emissions.[315]

[314] A negative net value indicates that the reported emissions from UK installations in the EU ETS were below the cap, i.e. there was a net selling or withholding of units by UK installations. This means that emissions are either emitted elsewhere or emitted at a later stage, so they may not be used to offset UK emissions. The opposite occurs when reported emissions from EU ETS installations exceed the cap.
[315] UK Annual Statement of emissions for 2017: www.gov.uk/government/publications/annual-statement-of-emissions-for-2017.

Table 24: EU ETS net trading position as reported for carbon budgets performance, UK, 2008-2017, MtCO2e[316,317]

	Phase 1					Phase 2				
	2008	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**
Net purchases/(sales) by UK installations	19.3	(13.5)	(7.6)	(24.9)	(14.5)	44.2	59.1	29.1	1.3	(27.6)
Net cancelled unallocated allowances/(sales) by UK government	0.9	0.9	0.9	0.9	0.9	-	-	-	-	-
Net UK domestic aviation emissions against aviation cap	-	-	-	-	-	(0.1)	(0.3)	(0.2)	(0.3)	(0.3)
Net UK purchases/(sales)	20.2	(12.6)	(6.7)	(24.0)	(13.6)	44.1	58.8	28.9	1.0	(27.9)

Emission projections

The 2018 Energy and Emissions Projections[318] underpin the discussion of future trends below. In them, our estimates of future energy demand and greenhouse gas emissions extend to 2035. They incorporate information from the 2018 Inventory (latest actuals 2016). This means that the figures underlying the projections we discuss are slightly different to those in the section on historical trends, which uses data from the 2019 Inventory. However, the broad patterns we present are unlikely to change much when we incorporate the new data.[319] The UK updates its national emissions projections for CO2 and the other GHGs annually to take account of new data. These include revisions to policy savings estimates, fossil fuel prices, carbon price projections, growth projections, and cost estimates for the power sector. We also regularly review and improve the underlying energy and emissions projection models. Projections presented here are from the 'with existing measures' scenario in contrast to the national emissions projections report which refers to 'with additional measures' (also called the reference scenario).

[316] At the end of Phase II of the EU ETS, the UK was required to cancel all allowances which have not been either issued or auctioned by that point. Consequently, allowances totalling 4.5 MtCO2e were cancelled in 2012. This had the effect of reducing the overall cap for the whole of Phase II. For presentational purposes, this amount has been distributed evenly over the five years 2008-2012, effectively reducing the cap by 0.9 MtCO2e each year, www.gov.uk/government/statistics/final-statement-for-the-first-carbon-budget-period. Domestic aviation emissions are included in carbon budgets accounting from 2013. From 2013, the EU ETS entered its third phase, which will end in 2020. Changes to the operating rules in this period mean that Member States no longer receive a national cap as the ETS operates at installation level. Therefore a 'notional' cap is estimated for the purpose of carbon budgets accounting.

[317] At the end of Phase II of the EU ETS, the UK was required to cancel all allowances which have not been either issued or auctioned by that point. Consequently, allowances totalling 4.5 MtCO2e were cancelled in 2012. This had the effect of reducing the overall cap for the whole of Phase II. For presentational purposes, this amount has been distributed evenly over the five years 2008-2012, effectively reducing the cap by 0.9 MtCO2e each year. Domestic aviation emissions are included in carbon budgets accounting from 2013.
From 2013, the EU ETS entered its third phase, which will end in 2020. Projections of sectoral developments with existing national and Union policies and measures at least until 2040 (including for the year 2030).

[318] Updated EEP 2018, www.gov.uk/government/publications/updated-energy-and-emissions-projections-2018

[319] This statistical release explains how the Inventory has changed: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/776085/2017_Final_emissions_statistics_-_report.pdf

We use a set of key assumptions about future UK economic growth, demographic changes and fuel price trajectories to underpin the projections. These mainly come from the forecasts made by the UK's Office for Budget Responsibility and the Office for National Statistics (BEIS produces the fuel prices). We publish all the main assumptions we use with the projections.[320]

The UK produces energy and emissions projections to 2035. The development required to produce projections to 2040 is ongoing and we will publish projections to 2040 under our national reporting framework from 2020 onwards.

The Carbon Price

Putting a price on emissions provides a cost-effective and technology-neutral way of reducing carbon emissions and mobilising the private sector. In the UK, pricing policies like Carbon Price Support (CPS), and the EU Emissions Trading System (EU ETS) have already helped to drive a switch from coal to gas generation in the power sector.

The Carbon Price Support rate

In Great Britain, the Total Carbon Price (TCP) for energy generation is made up of the EU Emissions Trading System price and the Carbon Price Support (CPS) rate. The CPS was implemented to support the EU ETS and underpins the price of carbon at a level that drives low-carbon investment and taxes fossil fuels used to generate electricity. The CPS rate does not apply to energy generators in Northern Ireland.

HM Treasury confirms CPS rates in advance of delivery at Budget, and all revenue from the CPS is retained by the Treasury.

Past rates

The CPS rate was introduced in April 2013. At Budget 2014, the UK government announced that the CPS rate would be capped at £18/tCO2 from 2016-17 to 2019-20 to limit the competitive disadvantage faced by business and reduce energy bills for consumers. At Budget 2016, the cap was maintained at £18/tCO2 from 2016-17 to 2019-20. At Budget 2018, the UK government announced that CPS rates will be frozen at £18/CO2 in 2020-21 following the rise in the EU ETS price. From 2021-22, the UK government will seek to reduce CPS rates if the TCP remains.

The UK considers that long-term certainty on carbon pricing is crucial for businesses, and, as set out in the CGS, is committed to a robust carbon price. The UK remains firmly committed to carbon pricing as an emissions reduction tool, whilst ensuring energy and trade intensive businesses are appropriately protected from any detrimental impacts on competitiveness.

BEIS' short-term traded carbon values for modelling purposes are used to demonstrate the financial cost of purchasing allowances under the EU ETS. The short-term traded carbon values for UK public policy appraisal are produced for the period up to 2020 under all three scenarios (central, high and low), and are linearly extended beyond 2020 to reach BEIS's long-term carbon values for the period beyond 2030. These long-term carbon values reflect the costs required to limit global temperature increases to 2 degrees centigrade above pre-

[320] See also: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/802478/Annex-m-price-growth-assumption_16-May-2019.ods

industrial levels. BEIS's latest short-term traded values can be found in the Updated Short-Term Traded Carbon Values publication.[321]

4.2.1. ii Projections of sectoral developments with existing national policies and measures at least until 2040 (including for the year 2030)

Emissions projections by sector

In this section, we present values from the 'With Existing Measures' projection scenario. These include those policies which have been implemented or adopted: they exclude planned measures. These data are taken from the 2018 Energy and Emissions Projections (EEP).[322] The primary purpose of the EEP is to provide an indication of the UK's performance against carbon budgets. The last carbon budget set, carbon budget 5, ends in 2032, and the UK has not yet produced a projection out to 2040. The development required to produce projections to 2040 is ongoing and we will publish projections to 2040 under our national reporting framework from 2020 onwards.

We project that UK GHG emissions including LULUCF will be around 399 MtCO2e, (about 50% below the 1990 level) by 2020 and roughly 365 MtCO2e by 2030 (54% below the 1990 level).[323] The percentages are very similar if we exclude LULUCF. Table 25 shows our projections of emissions by sector.

[321] Carbon valuation, January 2018, www.gov.uk/government/collections/carbon-valuation--2
[322] Energy and Emissions Projections 2018, www.gov.uk/government/publications/updated-energy-and-emissions-projections-2018
[323] See https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/802475/Annex-a-greenhouse-gas-emissions-by-source__16-May-2019_.ods

Table 25: Projected greenhouse gas emissions by sector, MtCO2e (with existing measures, UK coverage)

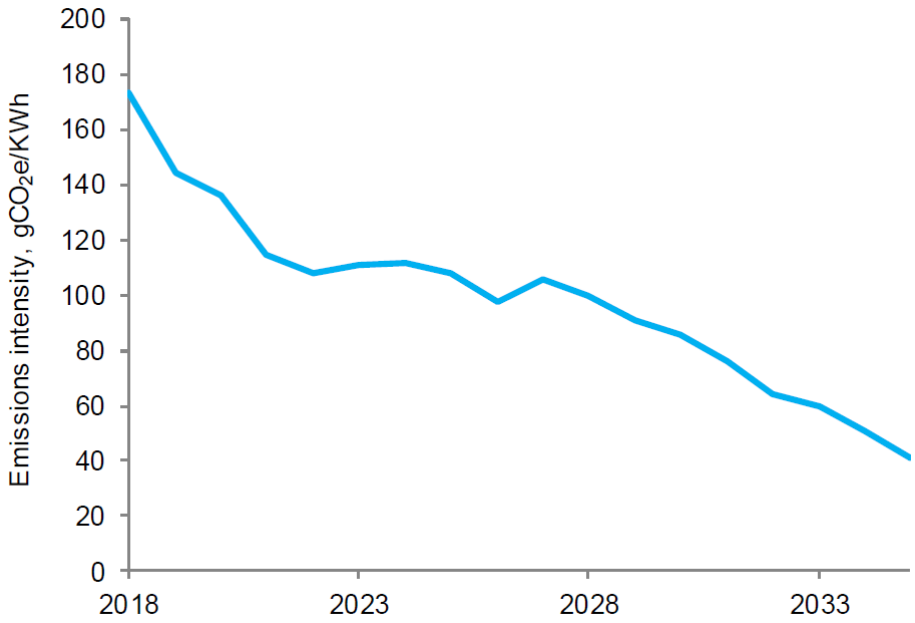
	Projections, MtCO2e				
Sector	**2018**	**2020**	**2025**	**2030**	**2035**
Transport	120	116	109	105	102
Energy supply	82	70	59	56	45
Business	89	83	73	69	69
Residential	71	68	70	73	77
Agriculture	46	44	42	41	41
Waste management	18	16	15	14	13
Industrial processes	11	11	10	9	9
Public	7	7	7	7	8
LULUCF	-16	-16	-14	-11	-8
Total	**428**	**399**	**370**	**365**	**356**
Change from 1990 (%)	*-46*	*-50*	*-53*	*-54*	*-55*

Transport

We project transport emissions will be around 10% lower than 1990 levels by 2020 and 18% lower by 2030. We also project that the underlying growth in road transport use will resume following the interruption of the recession in 2008. However, we expect that measures to improve vehicle efficiency or to directly reduce emissions (such as mandating greater use of biofuels and providing incentives to encourage the adoption of electric vehicles), will reduce annual emissions between now and 2030.

Energy Supply By 2020, we project energy supply emissions will be 75% lower than 1990 levels and 80% lower by 2030. Following recent sharp falls in coal-fired generation, we project a further gradual decline in fossil fuel-based generation out to 2035: it is displaced by more renewables and (eventually) nuclear generation in the 2030s. As a consequence, we project emissions from electricity production will fall steadily over the full period to 2035. Figure 5 shows this.

Figure 5: Emissions intensity of electricity supply (UK coverage, with additional measures), gCO2e/KWh



Business

We project that emissions in this area will be 28% lower than 1990 levels by 2020, and 40% lower by 2030. We can attribute improvements over time to the impact of policies that encourage energy efficiency, such as building regulations and minimum energy efficiency standards for new products, together with economic measures such as the Carbon Reduction Commitment and the Renewable Heat Incentive.

Residential

The principal long-term driver of emissions from UK households is household numbers themselves. We project these will increase over the whole period due both to population growth in the UK and to a continuing trend for households to be smaller. Up to 2020, the impact of increases in population and housing are offset by the impact of existing energy and emission reduction policies through (for example) improved insulation of homes. The overall impact of these factors is projected to increase domestic emissions by 7 MtCO2e (9%) by 2035 compared with 2018.

Agriculture

Our projections suggest that emissions from this sector will decline by around 7% between 2020 and 2030. The CGS set out further proposals for the agricultural sector: we want low emission, highly productive land while ensuring we pass the environment on to the next generation in a better state than we received it.

Waste management

Waste emissions from landfill have fallen since 1990 because more waste is being preferentially disposed of in alternative ways (incineration, biological waste treatment (BWT) and recycling). This is largely due to introduction of the Landfill Tax in 1996 and small improvements in landfill efficiency. Emissions are expected to continue to fall due to government measures, including actions outlined in the Resources and Waste Strategy for England, incentivising material to be managed higher up the waste hierarchy. These include

introduction of consistency in recycling collections, extended producer responsibility for packaging and a deposit return scheme for drinks containers for which we will consult on our final proposals in 2021. Targets to recycle 65% of municipal waste (by weight) by 2035 and reduce municipal waste sent to landfill to 10% or less by 2035 are also set to reduce the tonnage of material sent to landfill and the resulting GHG emissions.

Industrial processes

By 2020, we project that emissions from industrial processes will fall to 82% below 1990 levels and 84% below by 2030.

Public

We project emissions from public services will remain broadly constant until the mid-2020s before rising slightly in the late 2020s and 2030s.

Land Use, Land Use Change and Forestry

The UK tracks progress by annually projecting removals and emissions in the land use, land use change and forestry (LULUCF) inventory sector, based on the most recent emission inventory. Projections in Table 25 above show that the sector is expected to remain a net sink but of smaller magnitude over the coming decade.

The UK has domestic carbon targets which are to deliver a reduction of 57% in 2028 to 2032 compared to 1990 on a reported basis. To assist with meeting these targets there are a number of recent policy initiatives that will further reduce emissions and strengthen removals in the sector.

- The UK Clean Growth Strategy puts land in a central role in delivering climate mitigation. We are committed to; accelerating tree planting, having a stronger and more effective domestic carbon offsetting market, unlocking private sector investment through forestry investment zones, restoring peatlands and encouraging the use of wood in construction. We will seek to overcome the decline in soil health and support innovation in the forestry sector.
- The 25 Year Environment Plan provides a strategy to protect and enhance the natural environment. The Plan provides targets for a range of environmental outcomes which include cutting greenhouse gas emissions including from land use, land use change, the agriculture sectors.
- Forest development will be supported through rural development programmes, the woodland creation planning grant helps enable projects to develop and the Forestry Investment Zones.
- The Woodland Carbon Fund announced in 2016, supports the planting of large productive woodland in England.
- The Woodland Carbon Guarantee, announced during the Autumn 2018 Budget Statement, will support the price of woodland carbon credits. The scheme is intended to provide up to £50m of support over its lifetime and helps to meet our commitment in the 25 Year Environment Plan and Clean Growth Strategy to strengthen the market for domestic offsets.
- In the 2018 Autumn Budget Statement, £10m of funding for up to 130,000 urban trees was announced leading to the Urban Tree Challenge competition.

- The UK government have provided grants to encourage the restoration of English peatlands for example in 2018 they provided £10m for 4 landscape scale projects seeking to restore 6,850 hectares.
- In Northern Ireland, Scotland and Wales responsibility sits with the relevant Devolved Administration who have funded a number of landscape carbon mitigation initiatives. For example; the Scottish Government has committed £11m to restore 20,000 hectares of peatland by 2020 and 250,000 by 2030. The Welsh Government is seeking to restore 66,000 ha of seminatural bog to good condition.

4.2.2 Renewable energy

i Current share of renewable energy in gross final energy consumption and in different sectors (heating and cooling, electricity and transport) as well as per technology in each of these sectors

All tables used in this section are 2018 outturn data, taken from Digest of UK Energy Statistics 2019, Tables 6.6 and 6.7.[324] Tables 26 to 29 use data from Table 6.7 which is measured using net calorific values; it also normalises wind and hydro generation and includes only heat pumps with a seasonal performance factor above 2.5. In contrast, Tables 30 to 33 use data from Table 6.6 which uses gross calorific values and includes all heat pumps.

Table 26 shows that renewable energy makes up 11% of capped gross final energy consumption. Of all final consumption of renewable energy, electricity generation makes up over 60%, heating and cooling almost 30% and transport biofuels less than 10%.

Table 26: Overall renewables

Sector	Thousand tonnes of oil equivalent (measured using net calorific values)
Electricity generation	9,395
Heating and cooling	4,073
Transport biofuels (restricted to those meeting sustainability criteria from 2011)	1,270
Total Final Consumption of Renewable Energy	14,738
Capped Gross Final Energy Consumption (CGFEC)	134,230
Share of renewable energy in gross final energy consumption (headline 2009 Renewable Energy Directive percentage)[325]	11.0%

[324] Digest of UK Energy Statistics 2019, www.gov.uk/government/statistics/digest-of-uk-energy-statistics-dukes-2019

[325] Includes adjustments for losses, and generation own use of electricity, combined with the capping mechanism for air transport as specified in the Directive.

Table 27 shows the renewable make up of the electricity generation component; over 30% of all electricity came from renewable sources. This component has the highest renewable share, versus heating and cooling and transport. Half of all renewable electricity came from wind generation.

Table 27: Electricity generation component

Component	Thousand tonnes of oil equivalent (measured using net calorific values)
Total renewable generation from all compliant sources[326]	9,395
Total Gross Electricity Consumption[327]	30,237
Percentage of electricity from renewable sources	31.1%

Table 28 shows the renewable make-up of the heating component; around 7% of all heating and cooling came from renewable sources.

Table 28: Heat component

Component	Thousand tonnes of oil equivalent (measured using net calorific values)
Renewable energy for heating and cooling	4,073
Total Gross energy consumption for heating and cooling	56,042
Percentage of heating and cooling energy from renewable sources	7.3%

Table 29 shows the renewable make-up of the transport component. DUKES (2019)[328] states that around 6% of all energy used for transport came from renewable sources. This is largely made up of renewable electricity and compliant biofuels. However, this is an estimate; see DUKES (2018)[329] data for the most recent published actuals.

[326] The electricity figure under overall directive target excludes the renewable electricity component of transport to prevent double counting – this is the cause of the 4 ktoe discrepancy between renewable energy used for electricity generation and total renewable generation from all compliant sources.
[327] Excludes generation from pumped storage.
[328] See page 110 for transport component, DUKES 2019, www.gov.uk/government/statistics/digest-of-uk-energy-statistics-dukes-2019
[329] DUKES 2018, dataset for main report, www.gov.uk/government/statistics/digest-of-uk-energy-statistics-dukes-2018-main-report

Table 29: Transport component (excluding air transport)

Component[330]	Thousand tonnes of oil equivalent (measured using net calorific values)
Total transport component numerator (including weighted components)	1,270
Total transport component denominator (including weighted components)	41,620
Percentage of transport energy from renewable sources	6.2%

Table 30 shows the renewable sources used to generate electricity. Bioenergy makes up the largest proportion of this (58%), with plant biomass being the largest contributor within this. Onshore wind and offshore wind make up the next largest proportion of this; 17% and 15% respectively.

Table 30: Renewable sources used to generate electricity

Source	Energy values, thousand tonnes of oil equivalent (measured using gross calorific values)	Share of total
Onshore Wind	2,958	17%
Offshore Wind	2,295	15%
Marine energy[1]	1	0%
Solar photovoltaics	1,106	7%
Small scale hydro	111	1%
Large scale hydro[2]	361	2%
Bioenergy:	8,956	58%
of which Landfill gas	1,284	8%
of which Sewage gas	325	2%
of which Biodegradable energy from waste	1,405	9%
of which Co-firing with fossil fuels	0	0%
of which Animal biomass[3]	219	1%
of which Anaerobic digestion	879	6%

[330] Some sustainable biofuels are double weighted in the numerator of this calculation, as specified by the Directive.

Source	Energy values, thousand tonnes of oil equivalent (measured using gross calorific values)	Share of total
of which Plant biomass[4]	4,843	31%
Total	15,428	100%
Non-biodegradable wastes[5]	1,411	-

[1] Wave and tidal stream, including EMEC test facility
[2] Excluding pumped storage stations.
[3] Includes heat from farm waste digestion, and meat and bone combustion.
[4] Includes heat from straw, energy crops, paper and packaging.
[5] Non-biodegradable part of municipal solid waste plus waste tyres, hospital waste, and general industrial waste.

Note: For wind, solar PV and hydro, the figures represent the energy content of the electricity supplied but for bioenergy the figures represent the energy content of the fuel used.

Table 31 shows the renewable sources used to generate heat. Similar to electricity, bioenergy makes up by far the largest proportion (81%), of which wood is the largest contributor (41% of total).

Table 31: Renewable sources used to generate heat

Source	Energy values, thousand tonnes of oil equivalent (measured using gross calorific values)	Share of total
Active solar heating	53	1%
Bioenergy:	4,412	81%
of which Landfill gas	14	0%
of which Sewage gas	83	2%
of which wood	2,239	41%
of which waste wood	321	6%
of which Animal biomass[331]	26	0%
of which Anaerobic digestion	394	7%
of which Plant biomass[332]	1,245	23%
of which Biodegradable energy from waste	91	2%
Deep geothermal	1	0%

[331] Includes heat from farm waste digestion, and meat and bone combustion.
[332] Includes heat from straw, energy crops, paper and packaging.

Source	Energy values, thousand tonnes of oil equivalent (measured using gross calorific values)	Share of total
Heat Pumps	979	18%
Total	5,445	100%
Non-biodegradable wastes[333]	165	-

Table 32 shows the renewable sources used as transport fuels. Biodiesel makes up the largest proportion, at 69%, while bioethanol makes up 31%.

Table 32: Renewable sources used as transport fuels

Fuel	Energy values, thousand tonnes of oil equivalent (measured using gross calorific values)	Share of total
Bioethanol	429	31%
Biodiesel	935	69%
Total	1,364	100%

Table 33 shows the renewable sources used for total renewable energy. Bioenergy is the largest proportion, at over 60%, followed by onshore wind (12%) and offshore wind (10%).

Table 33: Total use of renewable sources and wastes

Source	Energy values, thousand tonnes of oil equivalent (measured using gross calorific values)	Share of total
Solar heating and photovoltaics	1,158	5%
Onshore wind	2,598	12%
Offshore wind	2,295	10%
Marine energy (wave and tidal stream)	1	0%
Hydro	472	2%
Bioenergy	13,369	60%

[333] Non-biodegradable part of municipal solid waste plus waste tyres, hospital waste, and general industrial waste.

Source	Energy values, thousand tonnes of oil equivalent (measured using gross calorific values)	Share of total
Deep geothermal	1	0%
Heat Pumps	979	4%
Transport biofuels	1,364	6%
Total	22,236	100%
Non-biodegradable wastes[334]	1,364	-

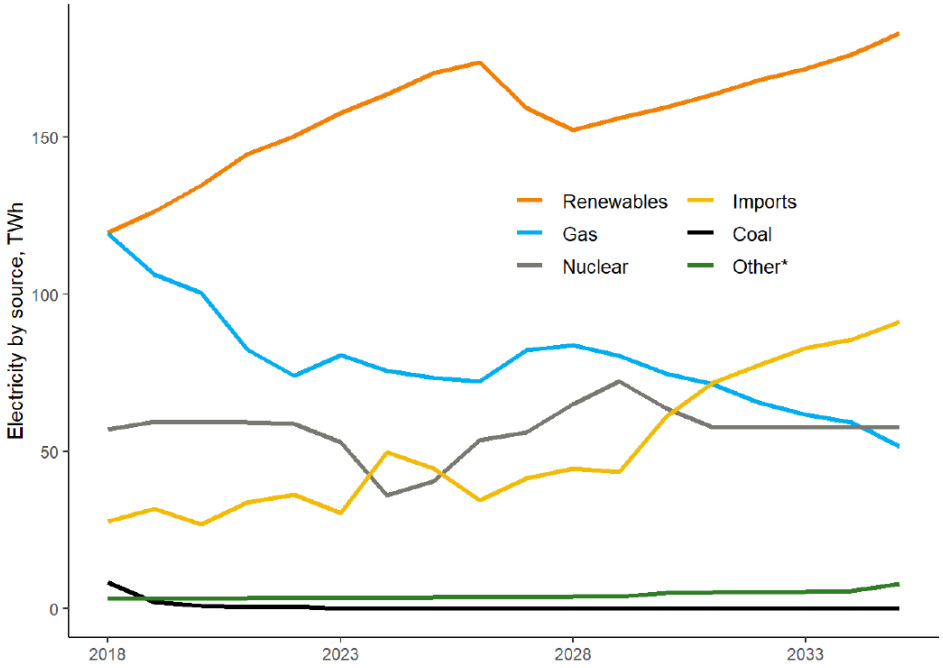
ii Indicative projections of development with existing policies for the year 2030 (with an outlook to the year 2040)

Under existing policies, EEP 2018 projects 159 TWh of renewable electricity generation by 2030. This is likely to be just over 50% of total electricity capacity. If we include planned policies, there could be 185 TWh of renewable electricity generation by then. This would be about 60% of all electricity generation. Note that up to 2020, this scenario reflects current power sector policies. After that year, it includes some assumptions that go beyond existing UK government policy and is therefore illustrative: the results do not indicate a preferred outcome.

We expect that renewables deployment will be sensitive to fossil fuel prices: if these are high, there could be as much as 209 TWh of renewable generation (65%) by 2030. Figure 6, below, shows the projections of generation by technology for all power producers to 2035.

[334] Non-biodegradable part of municipal solid waste plus waste tyres, hospital waste, and general industrial waste.

Figure 6: UK electricity by source technology, TWh (with existing measures)



* Other includes generation from coal/gas Carbon Capture and Storage (CCS), oil, and from other thermal plants as well as electricity storage

Under the RTFO, renewable transport energy is expected to be 16% of total generation when including multipliers in 2030. This is expected to rise to 17% by 2032 which is where current projections finish. Forecasts show that there will be 33 TWh of renewable transport generation (excluding multipliers) in 2030, rising to 33.5 TWh by 2032.

Due to uncertainty on heat policy, please see section 2.1.2(ii) for indicative trajectories out to 2030.

4.3 Energy efficiency

i Current primary and final energy consumption in the economy and per sector (including industry, residential, service and transport)

Table 34: Primary and Final Energy Consumption[335]

Energy consumption	2007	2015	2016	2017	2018	Unit
primary energy consumption	212.1	183.0	179.6	177.7	177.3	Mtoe (ncv)
total final energy consumption	145.2	131.0	132.8	132.6	134.0	Mtoe (ncv)
of which; industry	28.9	23.0	21.2	21.4	21.4	Mtoe (ncv)
transport (passenger)	42.2	38.1	38.4	39.2	39.2	Mtoe (ncv)
transport (freight)	14.4	13.9	14.5	14.7	14.6	Mtoe (ncv)
household	41.7	37.2	38.0	36.8	38.1	Mtoe (ncv)
services (excl agriculture)	17.2	17.8	19.2	19.0	19.2	Mtoe (ncv)
agriculture	0.9	1.0	1.5	1.5	1.5	Mtoe (ncv)

ii Current potential for the application of high-efficiency cogeneration and efficient district heating and cooling[336]

Cogeneration & district heating

In 2016, the Department of Energy & Climate Change published the national comprehensive assessment of the potential for combined heat and power (CHP) and district heating and cooling in the UK[337], which laid out the technical and socially cost-effective potential for CHP (referred to as high-efficiency cogeneration in Member States) and efficient district heating and cooling in the UK, up to 2030. Table 35 sets outs the conclusions of cost and benefit analysis to determine the social cost-effectiveness under three potential scenarios:

1. A scenario where there is no government policy around de-risking investments in infrastructure, and with IAG 2014 central scenario carbon prices ('full financing costs').
2. A scenario where the cost of securing the necessary finance is set at zero; in other words, a totally de-risked capital-raising scenario and with IAG central scenario carbon prices ('zero financing costs').

[335] Digest of UK Energy Statistics 2019, www.gov.uk/government/statistics/digest-of-uk-energy-statistics-dukes-2019
[336] In accordance with Article 14(1) of Directive 2012/27/EU.
[337] Ricardo Energy & Environment (2015) Report for DECC: National Comprehensive Assessment of the Potential for Combined Heat and Power and District Heating and Cooling in the UK, www.gov.uk/government/publications/the-national-comprehensive-assessment-of-the-potential-for-combined-heat-and-power-and-district-heating-and-cooling-in-the-uk

3. A scenario with a very high carbon price of £500/tCO2 for all years and the same assumption as 1 for cost of capital ('extreme carbon price').

Table 35: Summary of UK cost-effective potential of high-efficiency solutions by scenario, TWh of heat output pa

Solution	i) Full financing costs TWh pa	ii) Zero financing costs TWh pa	iii) Extreme carbon price TWh pa
High-efficiency, total	131	314	358
Individual	116	128	200
District heating	15	186	158
Conventional, total	334	168	120
Total heat output	465	481	477

Table 36: Summary of the recent development of CHP[338]

	Unit	2014	2015	2016	2017	2018
Number of schemes		2,071	2,130	2,224	2,409	2,473
Net No. of schemes added during year		47	59	94	185	64
Electrical capacity	MWe	5,888	5,708	5,625	5,919	5,985
Net capacity added during year	MWe	-32	-179	-83	293	66
Capacity added in percentage terms	%	-0.5	-3.0	-1.5	5.2	1.1
Heat capacity	MWh	22,223	20,091	19,975	20,586	20,722
Heat to power ratio		2.13	2.06	1.99	1.95	1.85
Fuel input	GWh	86,184	82,576	85,123	91,315	92,523
Electricity generation (CHP)	GWh	19,690	19,534	20,405	21,785	22,867
Heat generation (CHP)	GWh	41,950	40,234	40,671	42,521	42,416
Overall efficiency	%	71.5	72.4	71.7	70.4	70.6
Load factor (CHPQA)	%	38.2	39.1	41.4	42.0	43.6
Load factor (Actual)	%	52.3	51.0	60.0	56.4	57.2

[338] DUKES 2019, www.gov.uk/government/statistics/combined-heat-and-power-chapter-7-digest-of-united-kingdom-energy-statistics-dukes

In the UK, Good Quality CHP denotes schemes that have been certified as being highly efficient through the UK's CHP Quality Assurance (CHPQA) programme. The criteria used are in line with the requirements for high efficiency CHP set down in the Energy Efficiency Directive (2012/27/EU). Table 36 shows the change in installed CHP capacity since 2001, when the CHPQA programme began. Installed capacity is now at 5,985 MWe, with 68 new schemes between 2017 and 2018.

In March 2018 BEIS published the first Experimental statistics on heat networks[339], based on data collected under the Heat Network (Metering and Billing) Regulations. According to these, there are 2,087 heat networks in the UK, which supply 10,074 GWh of heating and hot water and 202 GWh of cooling.

iii Projections considering existing energy efficiency policies, measures and programmes as described in section 1.2.(ii) for primary and final energy consumption for each sector at least until 2040 (including for the year 2030)[340]

The UK's 2032 pathway, as set out by the CGS[341], would result in changes in fuel consumption across the whole economy, with estimated impacts set out in Table 37 below. In total, the 2032 pathway would reduce final consumption by around 14% in 2032 relative to projected energy consumption under existing polices outlined in the 2016 EEP. This is as a result of further improvements in fuel efficiency. The reduction in fossil fuel consumption will help improve energy security but the pathway is also characterised by a shift from end-user fossil fuel consumption towards biomass and electricity.

Table 37: Change in Annual Final Energy Consumption in 2032, Relative to the Existing Policies Scenario[342]

	Potential saving (-) or additional consumption (+) in 2032 (TWh/year)	Percentage impact relative to existing policies
Electricity	+14	+4%
Gas	-124	-23%
Coal	-6	-38%
Oil	-126	-25%
Bioenergy	+28	+29%
Total	**-215**	**-14%**

[339] Experimental statistics on heat networks, March 2018 www.gov.uk/government/publications/energy-trends-march-2018-special-feature-article-experimental-statistics-on-heat-networks
[340] This reference business as usual projection shall be the basis for the 2030 final and primary energy consumption target which is described in 2.3 and conversion factors.
[341] Clean Growth Strategy, 2017, www.gov.uk/government/publications/clean-growth-strategy
[342] Clean Growth Strategy, 2017, www.gov.uk/government/publications/clean-growth-strategy

Figure 7: Final Home Energy Use Per Household (MWh/household)[343]

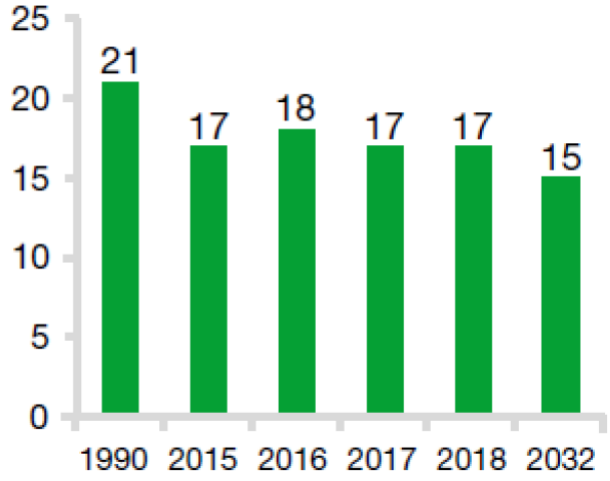
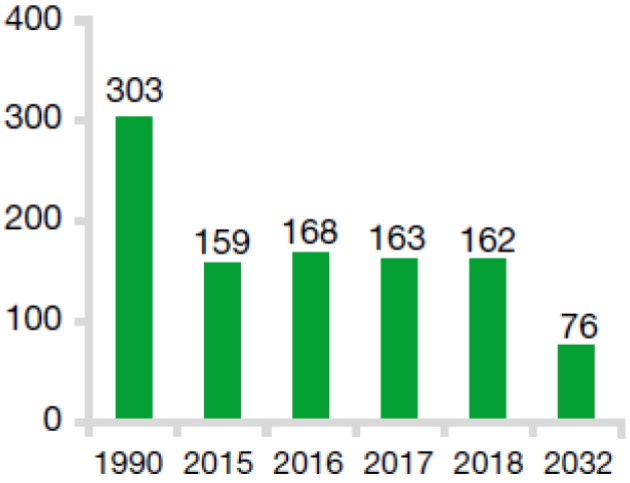


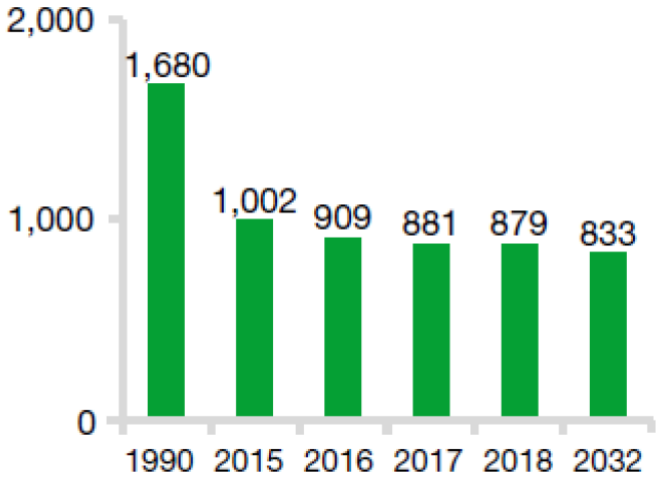
Figure 8: Final Energy Use per £million Output for Non-Industrial Business and Public Sectors (MWh/£million)[344]



[343] Committee on Climate Change's 2019 Progress Report: Government Response, www.gov.uk/government/publications/committee-on-climate-changes-2019-progress-reports-government-responses

[344] Committee on Climate Change's 2019 Progress Report: Government Response, www.gov.uk/government/publications/committee-on-climate-changes-2019-progress-reports-government-responses

Figure 9: Final Energy Use per £million Output for Industrial Business (MWh/£million)[345]



iv Cost-optimal levels of minimum energy performance requirements resulting from national calculations, in accordance with Article 5 of Directive 2010/31/EU

The UK has submitted a report to the European Commission that contains this information.[346]

4.4 Energy security

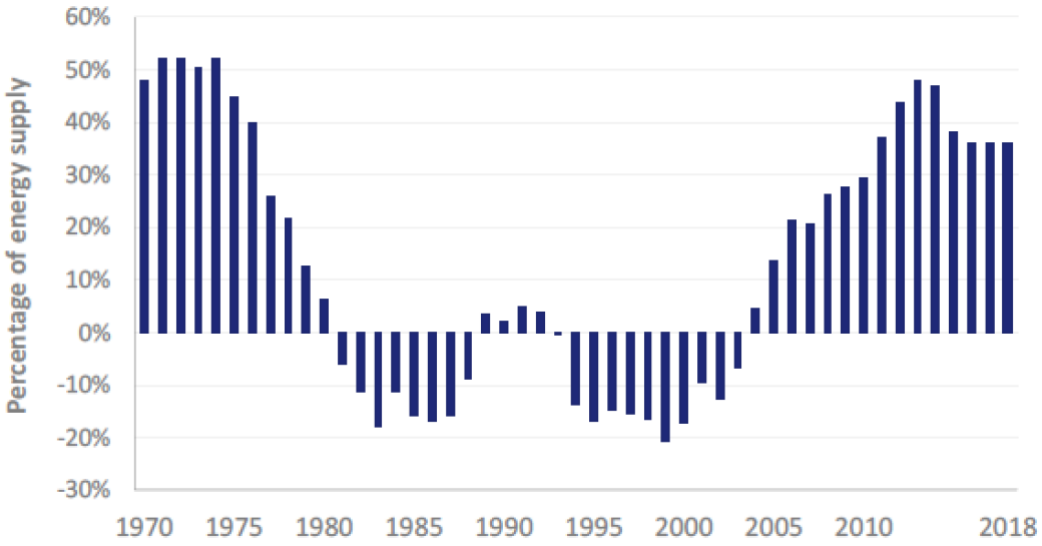
i Current energy mix, domestic energy resources, import dependency, including relevant risks

In 2018, the share of primary energy consumption from fossil fuels decreased further to a record low of 79.4% whilst that from low-carbon sources increased from 18.3% to a record 19% share.

The UK's net import dependency has fallen 2.2% since 2015 but still accounts for 36% of energy supplies. Figure 10 below shows that the UK's net import dependency has fluctuated since 1970.[347]

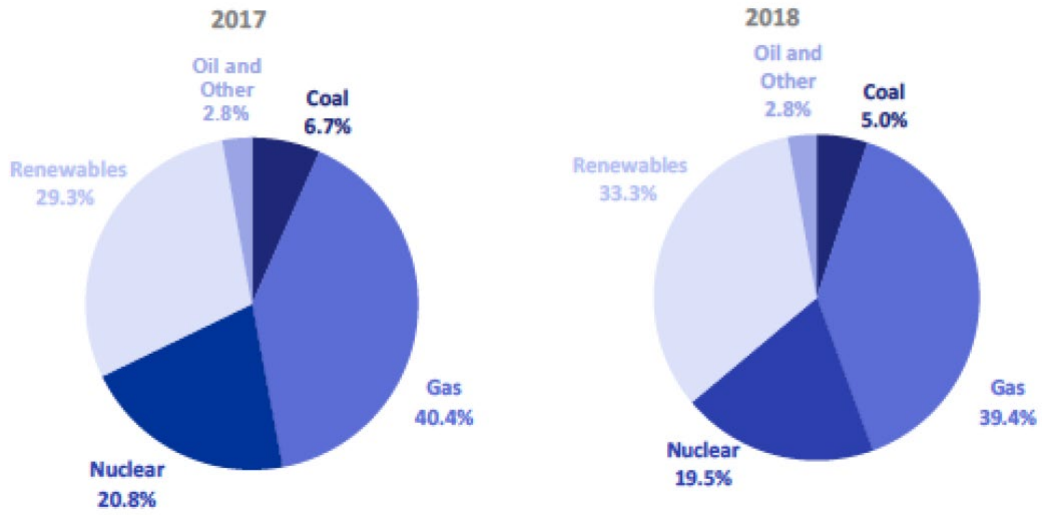
[345] Committee on Climate Change's 2019 Progress Report: Government Response, www.gov.uk/government/publications/committee-on-climate-changes-2019-progress-reports-government-responses
[346] The Energy Performance of Buildings Directive, MHCLG, available at: www.gov.uk/government/publications/energy-performance-of-buildings-directive-second-cost-optimal-assessment
[347] DUKES 2019, Main Chapter and Annexes, available at: www.gov.uk/government/statistics/digest-of-uk-energy-statistics-dukes-2019

Figure 10: The UK's net import dependency since 1970



The UK's sources of electricity generation can be seen in Figure 11 below. This shows the shift in fuel mix away from coal and a rise in low-carbon generation including renewables, which now account for 33.3% of UK's electricity supply. The UK remained a net importer of electricity in 2018, accounting for 5.4% of total supply, up from 4.2% of supply in 2017.[348]

Figure 11: UK electricity generation by fuel type



[348] DUKES 2019, Chapter 5 available at: www.gov.uk/government/statistics/electricity-chapter-5-digest-of-united-kingdom-energy-statistics-dukes

Gas

Domestic UKCS production (also referred to as North Sea gas) is a key source of gas for the UK. In 2018, UKCS production was equivalent to approximately 51%[349] of UK gas supply, however, by 2035, it is estimated that UKCS production will fall to the equivalent of just 28% of gas demand. The 'Projections of UK Oil and Gas Production and Expenditure Report' published in March 2019, estimates that UK oil and gas production over the period 2016–2050 is projected to be 3.9 billion barrels of oil equivalent (boe) higher than projections four years ago (in March 2015). The UK remains, along with the Netherlands, one of the two major gas-producing nations within the EU.

Natural gas plays a key role in the UK economy, powering industry, heating homes (85% of the households (in the UK) currently use gas for heating, and 56% for cooking) and supporting a flexible and resilient electricity system. The reliability and flexibility afforded by gas-fired electricity generation also enables ever greater levels of intermittent renewables to come forward. The UK has a diverse range of sources of gas supply, including domestic production, pipeline imports from Norway and mainland Europe, LNG from global markets, and storage (which is not strictly speaking a 'source' of gas but is an important source of system flexibility).

Currently, the UK has an import capacity[350] of ~56 bcm/y from Norway, ~43 bcm/y from capacity connected to the Continent, and ~49 bcm/y from LNG import terminals[351]. As UKCS production declines, imports will play an increasing role in meeting UK gas demand.

Oil

The Oil and Gas Authority estimates that there are 507 million tonnes of proven and probable (2P) oil reserves at the end of 2018, of which 360 million tonnes are proven reserves.[352]

Crude Oil

The UK is a net importer of crude oils, although there are large volumes of crude oil exports depending on the prevailing market conditions. Gross crude oil exports increased by nearly one-fifth in 2018 to reach over 40 million tonnes – the highest level since 2009. - This is due mainly to the new North Sea projects that opened in late 2017, which were exported. Crude oil was principally exported to the Netherlands, Germany, Korea and China, which together comprised 80% of total crude exports in 2018.[353]

The UK's own production of crude oil would have been sufficient to meet roughly 90% of UK refinery demand in 2018, but an increase in the diversity of sources coming into the UK has reduced the impact of a disruption to any one source of supply on the UK. In 2018, 12% of UK crude oil production was used by UK refineries.

[349] National Statistics Digest of UK Energy Statistics (DUKES) 2019 Chapter 4 Natural gas (Commodity Balances - DUKES 4.1: using net import figures) https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/820686/DUKES_4.1.xls
[350] Nameplate capacity figures may differ from actual operational deliverability.
[351] Gas Ten Year Statement 2018, www2.nationalgrid.com/UK/Industry-information/Future-of-Energy/Gas-Ten-Year-Statement/. Nameplate deliverability figures may differ from actual operational deliverability.
[352] UK Oil and Gas Reserves and Resources Report: 2018, www.ogauthority.co.uk/news-publications/publications/2019/uk-oil-and-gas-reserves-and-resources-report-as-at-end-2018/
[353] Statutory security of supply report: 2018, www.gov.uk/government/publications/statutory-security-of-supply-report-2018

Refined product

In 2018, UK refinery production was around 30% petrol, 20% diesel and 9% aviation fuel, with the remaining volumes primarily being other light and heavy distillates. This is significantly different from the demand pattern. To balance demand, the UK trades widely and is one of the largest importers of jet fuel and road diesel in the OECD and one of the largest exporters of petrol.[354]

Approximately 40% of fuel produced by UK refineries in 2018 was exported, of which nearly half was petrol.

Imports of diesel road fuel and jet fuel to the UK are increasing. In 2013, the UK became a net importer of petroleum products for the first time since 1984. In 2018, the UK was a net importer by 13.0 million tonnes, up 14% on 2017.

ii Projections of development with existing policies and measures at least until 2040 (including for the year 2030)

Each year National Grid publishes its Future Energy Scenarios.[355] This publication sets out a range of credible projected scenarios for Great Britain's energy landscape to 2050. These four scenarios are based on the speed of decarbonisation (driven by policy, economics and consumer attitudes) and the level of decentralisation (proximity of production and management of energy to the end consumer). This is not a UK government publication, however the scenarios can be used as an illustration of the potential development of the UK's energy mix. The 2019 scenarios were developed prior to the introduction of the UK government's net zero target. National Grid included a sensitivity to provide an indication about the potential implications of this increase in government policy ambition.

Scenarios:

1. **Consumer Renewables**: sets out what Great Britain's energy system could look like if the 2050 decarbonisation target is met and there is a more decentralised energy landscape.

   - Achieves the 2050 decarbonisation target.
   - Decentralised pathway.

   In Community Renewables, local energy schemes flourish, consumers are engaged

   and improving energy efficiency is a priority. UK homes and businesses transition to mostly electric heat. Consumers opt for electric transport early and simple digital solutions help them easily manage their energy demand. Policy supports onshore generation and storage technology development, bringing new schemes which provide a platform for other green energy innovation to meet local needs.

2. **Two Degrees**: explores how the 2050 decarbonisation target can be achieved using large, centralised technologies.

   - Achieves the 2050 decarbonisation target.

[354] Statutory security of supply report: 2018, www.gov.uk/government/publications/statutory-security-of-supply-report-2018
[355] National Grid, Future Energy Scenarios 2019, http://fes.nationalgrid.com/fes-document/

- Large-scale centralised solutions.

In Two Degrees, large-scale solutions are delivered and consumers are supported to choose alternative heat and transport options to meet the 2050 target. UK homes and businesses transition to hydrogen and electric technologies for heat. Consumers choose electric personal vehicles and hydrogen is widely used for commercial transport. Increasing renewable capacity, improving energy efficiency and accelerating new technologies such as carbon capture, usage and storage are policy priorities.

3. **Steady Progression**: predicts a scenario in which Great Britain makes progress towards but does not meet the 2050 decarbonisation target using centralised technologies.

- 2050 decarbonisation target not met.
- Large-scale centralised solutions.

In Steady Progression, the pace of the low-carbon transition continues at a similar rate to today but then slows towards 2050. Consumers are slower to adopt electric vehicles and take up of low-carbon alternatives for heat is limited by costs, lack of information and access to suitable alternatives. Although hydrogen blending into existing gas networks begins, limited policy support means that new technologies such as carbon capture, usage and storage and battery storage develop slowly.

4. **Consumer Evolution**: a more decentralised scenario which makes progress towards the decarbonisation target but fails to achieve 80% carbon emissions reduction by 2050.

- 2050 decarbonisation target not met.
- Decentralised landscape.

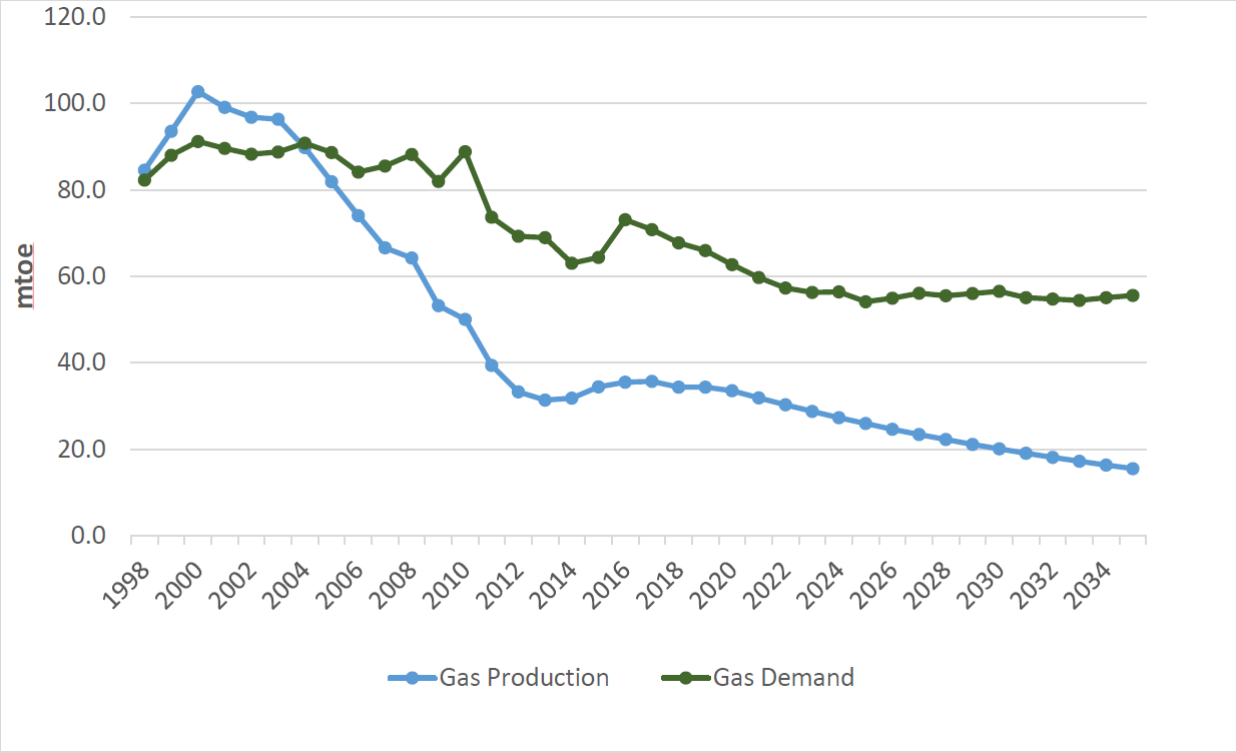
In Consumer Evolution, there is a shift towards local generation and increased consumer engagement, largely from the 2040s. In the interim, alternative heat solutions are taken up mostly where it is practical and affordable, e.g. due to local availability. Consumers choose electric vehicles and energy efficiency measures. Cost-effective local schemes are supported but a lack of strong policy direction means technology is slow to develop, e.g. for improved battery storage.

Gas

The UK imports a large portion of its supply – in 2018 49% of total gas supply came from imports[356]- and this is expected to increase, even if we assume the most ambitious domestic production projections alongside reductions in natural gas demand (see Figure 12).

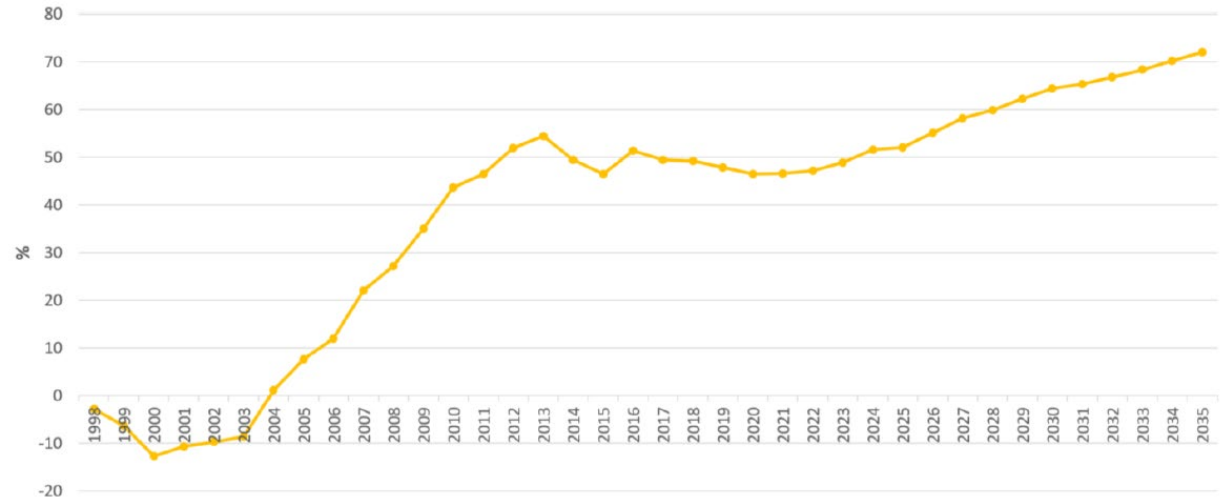
[356] National Statistics Digest of UK Energy Statistics (DUKES) 2019 Chapter 4 Natural gas (Commodity Balances - DUKES 4.1: using net import figures), https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/820686/DUKES_4.1.xls

Figure 12: UK gas production and demand projections[357]



The long-term decline in UK production means that imports will play an increasing role in meeting UK gas demand (see Figure 13 below).

Figure 13: Gas import dependency projection to 2035[358]



The UK is well placed to adapt to the changing profile of supply sources due to the significant investment in additional gas supply and flexibility which has been delivered by the market since GB became a net importer of gas in 2004, including direct connections with Norway, the Netherlands and Belgium, and LNG terminals including Europe's largest in terms of LNG storage capacity.

[357] OGA Projections of UK Oil and Gas Production and Expenditure March 2019, page 12.
[358] OGA Projections of UK Oil and Gas Production and Expenditure March 2019, page 12.

As is currently the case across Europe, in the future there will be competition between traditional piped gas suppliers and liquified natural gas (LNG), and how this will play out in the future remains uncertain. However, the UK consistently has one of the largest and most liquid gas markets in Europe, supported by an effective regulatory regime and dynamic pricing signals. This ensures that the UK is well-placed to attract gas supplies, and to respond to future changes in supply sources.

4.5 Internal energy market

4.5.1 Electricity interconnectivity

i Current interconnection level and main interconnectors[359]

The GB electricity system is connected with north-west Europe via 4GW interconnector capacity; 2GW with France (IFA), 1GW with the Netherlands (BritNed) and 1GW with Belgium (Nemo). 1GW of interconnection also links GB and the Single Electricity Market (SEM) on the island of Ireland (Moyle 500MW and East-West Interconnector 500MW). An overview of existing and future interconnector projects can be found on Ofgem's website.[360]

ii Projections of interconnector expansion requirements (including for the year 2030)

The UK government will work to ensure significant private investment in new electricity interconnectors, which will help reduce prices for consumers, ensure a more secure grid and help integrate clean generation. In addition to the 5GW already operational, 4.8GW of capacity is already in construction, and a further 8.1GW is progressing through regulatory process. This is expected to increase our level of interconnection by 2030.[361]

4.5.2 Energy transmission infrastructure

i Key characteristics of the existing transmission infrastructure for electricity and gas[362]

This is set out in 2.4.2(i).

ii Projections of network expansion requirements at least until 2040 (including for the year 2030)[363]

The system operator for Great Britain, National Grid Electricity System Operator, publishes two main reports each year which consider the future needs of the electricity system. The first is the Network Options Assessment[364], which describes the major projects considered to meet the needs of GB's electricity transmission system as described by the Electricity Ten Year

[359] Overviews of operational interconnector capacity can be found at the following websites: EWIC www.eirgridgroup.com/customer-and-industry/interconnection/, Moyle www.mutual-energy.com/, NemoLink www.nemolink.co.uk/, BritNed www.britned.com/, IFA http://ifa1interconnector.com/
[360] Source, Electricity interconnectors, Ofgem website, www.ofgem.gov.uk/electricity/transmission-networks/electricity-interconnectors
[361] Source: Clean Growth Strategy, 2017, page 100, www.gov.uk/government/publications/clean-growth-strategy
[362] With reference to overviews of existing transmission infrastructure by TSOs.
[363] With reference to national network development plans and regional investment plans of TSOs.
[364] www.nationalgrid.com/sites/default/files/documents/Network-Options-Assessment-2017-18.pdf

Statement.[365] The second is the Future Energy Scenarios document, which identifies long term demand options where scenarios are unconstrained by network issues.[366]

4.5.3 Electricity and gas markets, energy prices

i Current situation of electricity and gas markets, including energy prices

Wholesale

The GB wholesale electricity market is where generators and suppliers trade electricity products ahead of final delivery to the consumer.

Energy companies are legally required to be licensed by the Office of Gas and Electricity Markets (Ofgem) to operate in the market. Trading occurs within GB, but also with European partners over electricity interconnectors. British electricity generation comes from diversified sources comprising nuclear, natural gas, coal, and varied renewable sources including wind, solar, and biomass. The GB wholesale electricity market is well connected with neighbouring countries, including France, Ireland, Belgium and the Netherland, with substantial capacity of further interconnection planned. Most electricity is generated at large power stations connected to the national transmission network, but it can also be generated in smaller scale power stations that are connected to the regional distribution networks, or even generated off-grid.

The Single Electricity Market (known as the 'SEM') is a single, shared wholesale electricity market between Ireland and Northern Ireland. Following reforms, the new market is designed to put downward pressure on consumer electricity prices, facilitate the integration of renewables and continue to provide security of supply. The SEM one-year ahead auction in December 2018 secured just under 2GW of capacity, which ensures that there will be sufficient capacity to meet demand in Northern Ireland during winter 2019/20.

The four-year ahead capacity auction on 28 March 2019 secured 1.9GW of capacity for Northern Ireland with an auction clearing price of £43,030 per MW per year, which ensures sufficient capacity to meet expected demand for the year 2022-2023.

The SEM was established following the signing of a Memorandum of Understanding (MoU) by the UK and Irish Governments in 2006 and required parallel legislation to be enacted in Northern Ireland (NI) and Ireland (IE).

The SEM is operated by the SEM Operator (SEMO), which is a joint venture between EirGird (the Ireland System Operator) and SONI (the System Operator of Northern Ireland). Both SONI and SEMO are part of the EirGrid Group.

The SEM Committee is the decision-making forum for SEM regulatory matters. The SEM Committee is formed of the separate committees of the Ireland regulator: the Commission for Regulation of Utilities (CRU), and the Northern Ireland Utility Regulator (UR) and is made up of representatives of each regulator and an independent and a deputy independent member.

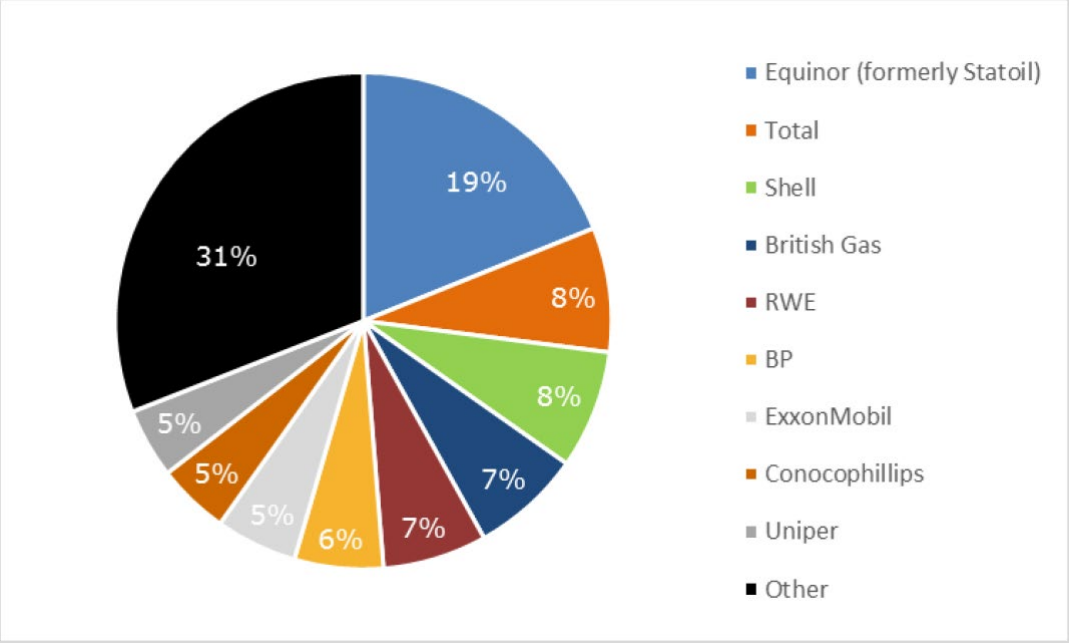
The UK has one of the largest and most liquid gas markets in Europe. High levels of liquidity on the UK's natural gas trading hub, the National Balancing Point (NBP), are evidenced by the

[365] www.nationalgrid.com/sites/default/files/documents/ETYS%202017.pdf
[366] http://fes.nationalgrid.com/media/1363/fes-interactive-version-final.pdf

level of trades there: alongside the Netherlands the UK dominates gas trade in Europe.[367] In 2018, there were 158 licensed entities trading in the NBP market.[368]

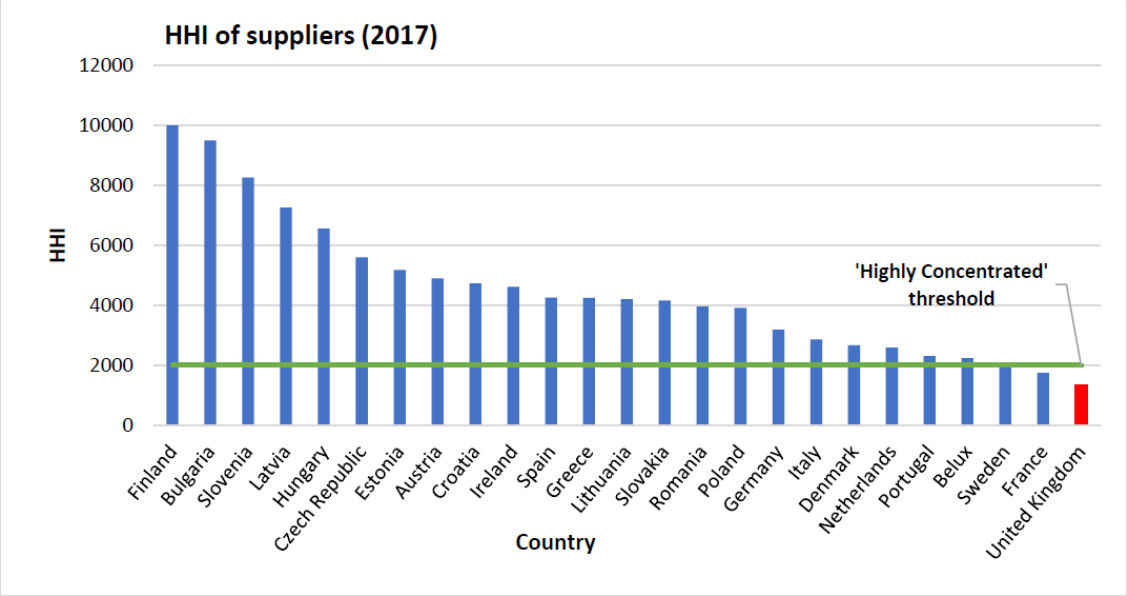
There is a low level of concentration in the wholesale gas market, and this is reflected in the large number and diversity of gas producers. The six largest gas suppliers accounted for 55% of the market in 2018/19 (see Figure 14 below) compared to 58% in 2016-17. The level of concentration in the wholesale gas market, as measured by the HHI, remained relatively low at 1329 in 2018[369], the lowest in the EU (see Figure 15 below). This level of HHI is below the threshold of 2,000, above which the CMA generally considers the market to be highly concentrated. This suggests that gas suppliers are unlikely to be able to exercise unilateral market power to increase the price of wholesale gas.

Figure 14: Share of UK gas supply 2018/2019[370]



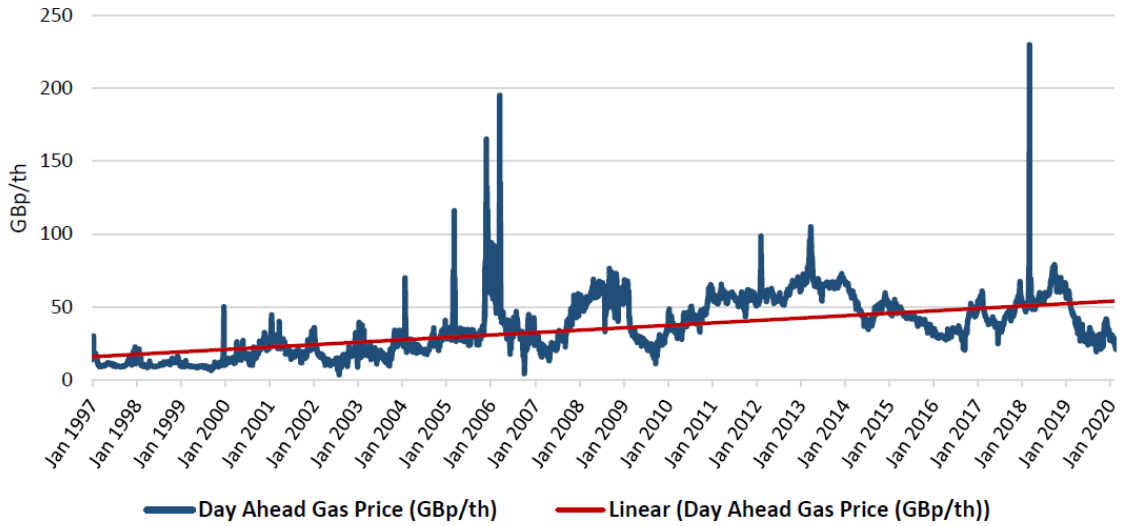
[367] European Commission, Quarterly Reports on European Gas Markets, https://ec.europa.eu/energy/en/data-analysis/market-analysis
[368] Ofgem, State of the Energy Market 2019, www.ofgem.gov.uk/publications-and-updates/state-energy-market-2019
[369] Ofgem, State of the Energy Market 2019, www.ofgem.gov.uk/publications-and-updates/state-energy-market-2019
[370] Ofgem, State of the Energy Market 2019, www.ofgem.gov.uk/publications-and-updates/state-energy-market-2019

Figure 15: The Herfindahl-Hirschman Index (HHI) of Suppliers, EU excluding Malta and Cyprus (2017)[371]



GB wholesale gas prices correlate with global conditions since imports make up a large portion of GB gas supply. Wholesale prices have been increasing since the early 2000's as a result of decreased GB production and upwards pressure on European prices, and throughout most of 2018 prices traded higher than in previous years. The average day ahead trading price in September and October 2018 was 73.5p/therm and 67.0p/therm (see Figure 16 below).[372] Since 2019 gas prices have notably fallen as an LNG supply glut led to an oversupplied global market, causing gas prices to fall around the globe. The global market is expected to rebalance in the coming years, with gas prices forecasted to increase in the long term.

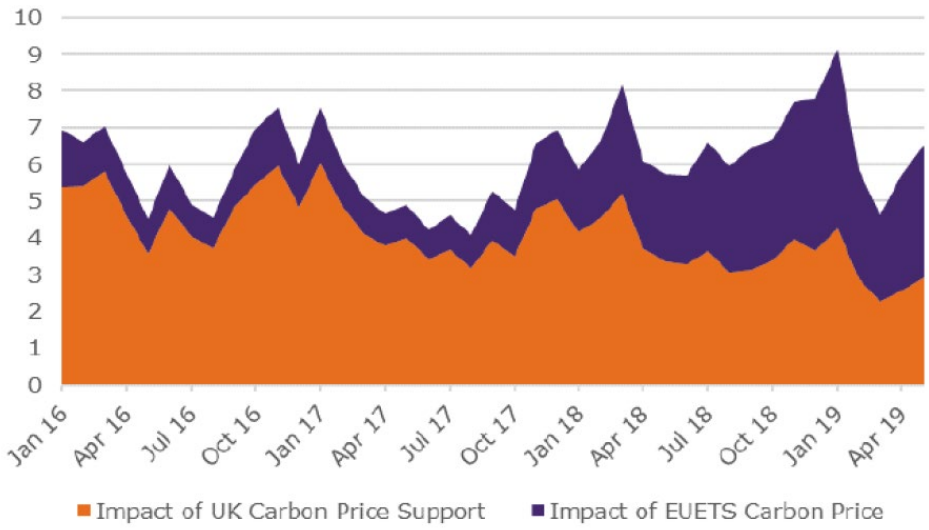
Figure 16: Wholesale gas prices: day ahead contracts, GB[373]



[371] ACER, Market Monitoring Report, Gas Wholesale Markets Volume 2017 Underlying Dataset, https://acer.europa.eu/en/Electricity/Market%20monitoring/Pages/Current-edition.aspx
[372] Ofgem, State of the Energy Market 2019, www.ofgem.gov.uk/publications-and-updates/state-energy-market-201
[373] ICIS HEREN National Balancing Point Day Ahead Contract Prices.

Electricity prices have generally been increasing as well in the long run, in large part because of the importance of gas in electricity generation in the UK.[374] The correlation coefficient between day ahead gas and electricity prices in the year up to April 2019 was 0.90.[375] Coal prices play a decreasing role in determining electricity prices, reflecting the declining importance of coal in electricity generation. Carbon costs have also driven up the price in recent years, particularly with the implementation of the Carbon Price Support (CPS). Divergence between this and the EU Emissions Trading System (ETS) has contributed to differences in electricity prices between GB and other European countries, even as increased interconnection capacity has worked to align international prices. The increase in ETS price in recent years has meant a greater share of price impacts comes from the ETS relative to the CPS (see Fgure 17 below).[376]

Figure 17: Carbon price impact on wholesale electricity price (£/MWh, nominal)[377]



Retail

On 1 January 2019, the Default Tariff Cap came into force in Great Britain. This will remain in place until the end of 2020 but can be extended each year until 2023. Analysis from Ofgem (the independent regulator) suggests that the cap will save around 11 million default tariff customers c.£75-100/year compared to if the cap was not introduced.[378] From October 2019, the default tariff cap was set at £1,179/year for a typical domestic customer, with the level updated by the regulator every six months based on changes In underlying costs.[379] This sits

[374] GOV.UK, Quarterly Energy Prices, www.gov.uk/government/statistics/quarterly-energy-prices-september-2019
[375] Ofgem, State of the Energy Market 2019, www.ofgem.gov.uk/publications-and-updates/state-energy-market-2019
[376] Ofgem, State of the Energy Market 2019, www.ofgem.gov.uk/publications-and-updates/state-energy-market-2019
[377] Ofgem, State of the Energy Market 2019, www.ofgem.gov.uk/publications-and-updates/state-energy-market-2019
[378] Figure based on typical domestic consumption values of 3100kwh electricity, 12000kwh gas. Source: Ofgem, Higher wholesale costs push up default and pre-payment price caps from April, www.ofgem.gov.uk/publications-and-updates/higher-wholesale-costs-push-default-and-pre-payment-price-caps-april
[379] Figure based on typical domestic consumption values of 3100kwh electricity, 12000kwh gas. Source: Ofgem, default tariff cap level – Letter (1 April 2019 to 30 September 2019). www.ofgem.gov.uk/publications-and-updates/default-tariff-cap-level-1-april-2019-30-september-2019

alongside a prepayment meter price cap introduced in April 2017, which continues to protect the c.4 million households with prepayment meters.[380]

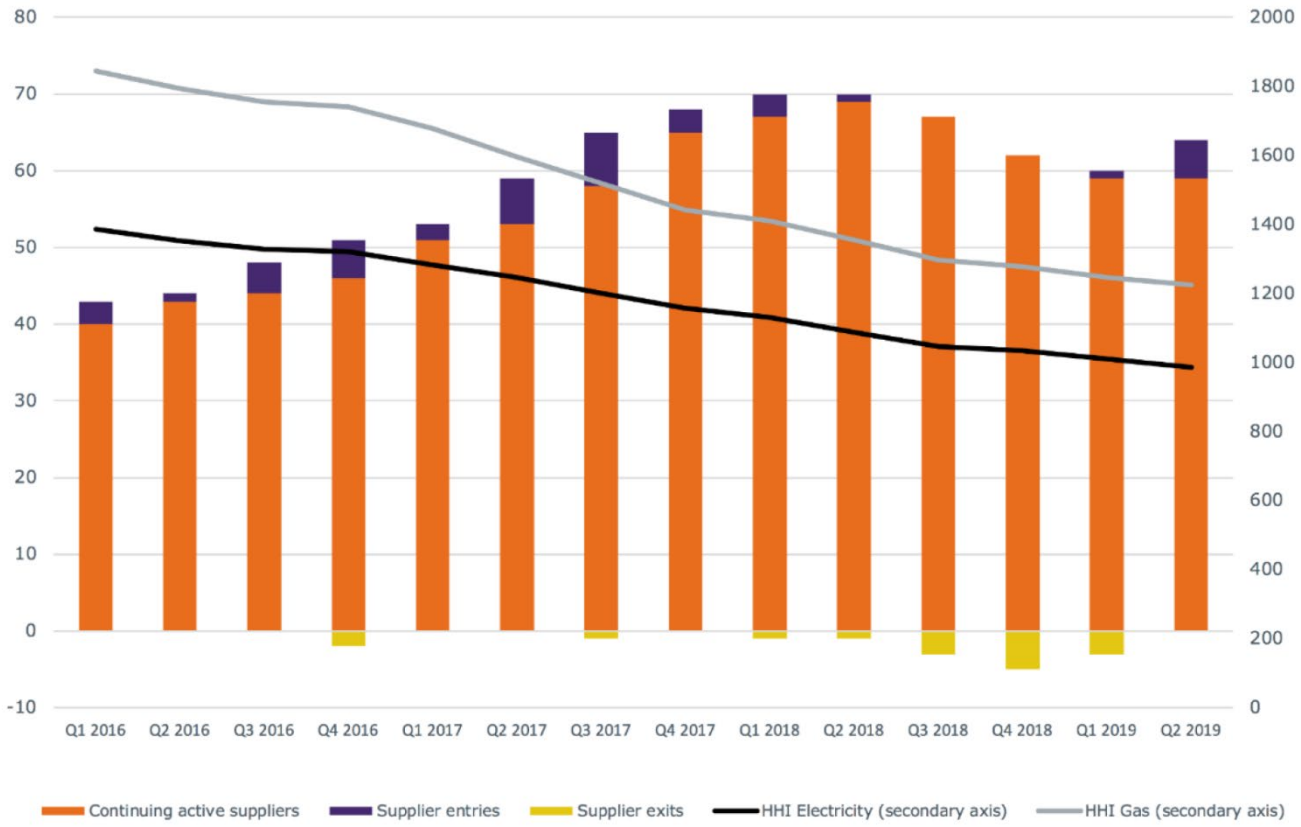
In the second quarter of 2019, there were 56 suppliers offering both gas and electricity in the GB domestic retail market, in addition to five gas-only, and three electricity-only suppliers. The six largest suppliers serve just over 70% of domestic gas and electricity customers. These suppliers together lost around six percentage points of gas and five percentage points of electricity market share between the second quarter of 2018 and the second quarter of 2019. British Gas, owned by parent company Centrica, is the largest supplier, covering 28% of the gas market and 19% of the electricity market.[381]

As of June 2019, there were 23.5 million gas meter points and 28.5 million electricity meter points in the domestic market, accounting for 60% (309 TWh) and 35% (105 TWh) of total (domestic and non-domestic) gas and electricity demand respectively and spending around £30 billion per year.[382]

Concentration of the domestic energy market is declining due to sustained new entry and expansion of new suppliers. This follows the trend of recent years, as shown in Figure 18 below. In June 2019, the Herfindahl-Hirschman Index (HHI) of concentration was around 1,224 in gas and around 987 in electricity. Typically, the Competition and Markets Authority (CMA) regards markets with an HHI below 1,000 as un-concentrated, markets with HHI between 1,000 and 2,000 as concentrated, and markets with an HHI above 2,000 as highly concentrated.[383]

[380] Ofgem, 'Energy price caps to fall this winter due to lower wholesale costs', www.ofgem.gov.uk/publications-and-updates/energy-caps-fall-winter-due-lower-wholesale-costs
[381] Ofgem, Data Portal (updated frequently, accessed on 04/11/2019), www.ofgem.gov.uk/data-portal/retail-market-indicators
[382] Ofgem, State of the Energy Market 2019, www.ofgem.gov.uk/publications-and-updates/state-energy-market-2019
[383] Ofgem, State of the Energy Market 2019, www.ofgem.gov.uk/publications-and-updates/state-energy-market-2019

Figure 18: Evolution of concentration and number of active licensed suppliers[384]



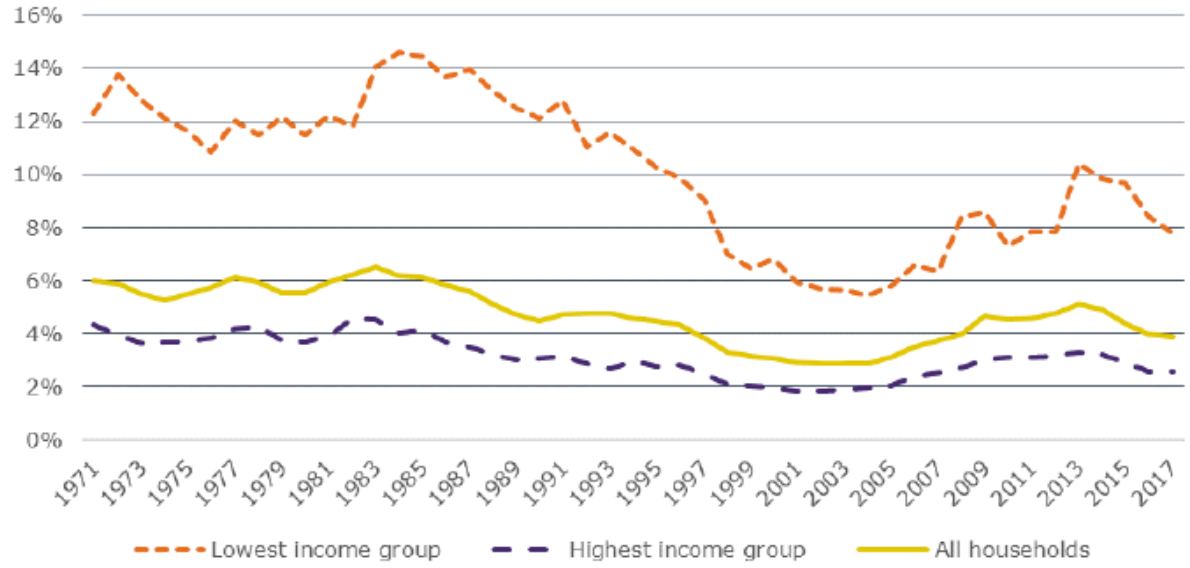
In Northern Ireland, there are five active domestic electricity suppliers, and nine industrial and commercial suppliers. Analysis using figures for Q3 2019 highlights how, at 56.1%, a significant number of customers remain with the previously incumbent supplier Power NI, whose retail prices are currently subject to a price control for domestic consumers. However, the 43.9% of customers with a non-incumbent supplier marks an increase from 42.8% in Q3 2018.[385]

Prices

The average dual-fuel energy bill for a consumer in Great Britain with one of the large energy suppliers was £1,184 in 2018. This was an increase of 4% in real terms relative to the previous year. As a proportion of household spending, energy accounted for 3.9% (7.8%) of average income (low-income) households in the financial year 2017/18. This is below the high in 2013 (see Figure 19 below).[386]

[384] Ofgem, State of the Energy Market 2019, www.ofgem.gov.uk/publications-and-updates/state-energy-market-2019
[385] Northern Ireland Utility Regulator Retail market monitoring: Quarterly transparency report July to September 2019, www.uregni.gov.uk/sites/uregni/files/media-files/2019-11-14%20Transparency%20Report%20Q3%202019%20FINAL.pdf
[386] Ofgem, State of the Energy Market 2019, www.ofgem.gov.uk/publications-and-updates/state-energy-market-2019

Figure 19: Energy costs as a proportion of total household expenditure[387]



ii Projections of development with existing policies and measures at least until 2040 (including for the year 2030)

Long term price projections

Retail gas prices across domestic, industrial and commercial sectors are forecast to increase throughout the 2020s and up to 2030. The same is also true for retail electricity prices, although to a much lesser extent (see Table 38 below). However, UK government-published statistics show retail gas and electricity prices flatlining beyond 2030.[388] This is because uncertainty in many of the drivers of energy prices is considered too great to form a meaningful judgement on long-term future price trends. For instance, macroeconomic indicators, such as GDP, income and population levels, and long-term climate conditions are particularly important here since uncertainty compounds over time.[389] Additionally, factors such as the possibility of technological breakthroughs or changes in strategic behaviour of major resource holders are highly difficult to predict and are key drivers for fossil fuel prices, including gas, which in turn drive the electricity price.[390]

Uncertainty with current energy policies on prices in the future is small compared to that of wider economic and climate conditions.[391] Beyond 2030, however, it is speculative to predict what policies will be in place as new energy policies develop in response to external factors, both economic and environmental. Generally, the low-carbon transition suggests that carbon

[387] Ofgem, State of the Energy Market 2019, www.ofgem.gov.uk/publications-and-updates/state-energy-market-2019
[388] GOV.UK, Green Book supplementary guidance: valuation of energy use and greenhouse gas emissions for appraisal. Updated 11 April 2019. www.gov.uk/government/publications/valuation-of-energy-use-and-greenhouse-gas-emissions-for-appraisal
[389] GOV.UK, Updated energy and emissions projections: 2018. Updated 16 April 2019. www.gov.uk/government/publications/updated-energy-and-emissions-projections-2018
[390] GOV.UK, Fossil Fuel Price Assumptions: December 2018. www.gov.uk/government/publications/fossil-fuel-price-assumptions-2018
[391] GOV.UK, Updated energy and emissions projections: 2018. Updated 16 April 2019. www.gov.uk/government/publications/updated-energy-and-emissions-projections-2018

costs would increase, and fossil fuel prices would decrease as demand falls[392], but the implication for electricity prices is unclear.

Table 38: Long-term retail gas and electricity prices[393]

	Retail Electricity prices (2018 p/kWh)			Retail Gas prices (2018 p/kWh)		
Year	Domestic	Commercial /Public	Industrial	Domestic	Commercial /Public	Industrial
2020	18.5	13.7	12.3	4.58	2.87	2.23
2025	18.7	14.5	12.8	4.48	3.52	2.69
2030	18.6	14.5	12.6	4.77	3.83	2.98
2035	18.6	14.5	12.6	4.77	3.83	2.98
2040	18.6	14.5	12.6	4.77	3.83	2.98

[392] GOV.UK, Fossil Fuel Price Assumptions: December 2018. www.gov.uk/government/publications/fossil-fuel-price-assumptions-2018 and GOV.UK, Green Book supplementary guidance: valuation of energy use and greenhouse gas emissions for appraisal. Updated 11 April 2019. www.gov.uk/government/publications/valuation-of-energy-use-and-greenhouse-gas-emissions-for-appraisal

[393] GOV.UK, Green Book supplementary guidance: valuation of energy use and greenhouse gas emissions for appraisal. Updated 11 April 2019. www.gov.uk/government/publications/valuation-of-energy-use-and-greenhouse-gas-emissions-for-appraisal

4.6 Research, innovation and competitiveness

Consumers are at the heart of our development of the system, which can give them choice and control over how they use electricity, including any that they generate themselves. Our approach is firmly rooted in enabling competition and markets to deliver on price, quality and choice, and we want flexible solutions to compete with each other and with more traditional solutions.

i Current situation of the low-carbon-technologies sector and, to the extent possible, its position on the global market (that analysis is to be carried out at Union or global level)

In 2018, nearly 53% of the UK's electricity came from low-carbon sources[394] and coal use has fallen dramatically, with periods of coal free generation in both 2017 and 2018.

The CGS outlines how UK homes and commercial buildings have become more efficient in the way they use energy which helps to reduce emissions and also cut energy bills; for example, in 2016, average household energy consumption fell by 17% compared with 1990 levels. Automotive engine technology has helped reduce emissions per kilometre driven by up to 16% and driving a new car bought in 2015 will save car owners up to £200 on their annual fuel bill, compared to a car bought new in 2000. In 2016, England recycled nearly four times more than it did in 2000.[395]

This progress has been aided by the falling costs of many low-carbon technologies: renewable power sources like solar and wind are comparable in cost to coal and gas in many countries; energy efficient light bulbs were over 80% cheaper in 2016 than in 2010; and the cost of electric vehicle battery packs has tumbled by over 70% in this time.[396]

As a result of this technological innovation, new high value jobs, industries and companies have been created. And this is driving a new, technologically innovative, high growth and high value 'low-carbon' sector of the UK economy. Not only are we rapidly decarbonising parts of the domestic economy, but thanks to our world leading expertise in technologies such as offshore wind, power electronics for low-carbon vehicles and electric motors, and global leadership in green finance, we are successfully exporting goods and services around the world; for example, in 2018 one in every five electric vehicles sold in Europe was made in the UK. The latest published data found that in 2017 there were nearly 400,000 jobs in low-carbon businesses and their supply chains, employing people in locations across the country.[397]

This progress has altered the way that we see many of the trade-offs between investing in low-carbon technologies that help secure our future but that might incur costs today. It is clear that actions to cut our emissions can be a win-win: cutting consumer bills, driving economic growth, creating high value jobs and helping to improve our quality of life[398].

[394] Digest of UK Energy Statistics (DUKES) 2019, Chapter 5 www.gov.uk/government/statistics/electricity-chapter-5-digest-of-united-kingdom-energy-statistics-dukes
[395] The Clean Growth Strategy, www.gov.uk/government/publications/clean-growth-strategy
[396] The Clean Growth Strategy, www.gov.uk/government/publications/clean-growth-strategy
[397] ONS (2019). Low Carbon and Renewable Energy Economy Survey: 2017 Final Estimates www.ons.gov.uk/economy/environmentalaccounts/bulletins/finalestimates/2017
[398] The Clean Growth Strategy, www.gov.uk/government/publications/clean-growth-strategy

ii Current level of public and, where available, private research and innovation spending on low-carbon-technologies, current number of patents, and current number of researchers

This is set out in section 2.5(i).

The UK's Office of National Statistics (ONS) publishes estimates of total private sector R&D, but this is not broken down by ETRDI. We are not aware of any formal reporting of data broken down in this way as there is no formal record of different private sector ETRDI projects.

The UK government actively encourages private sector participation in public ETRDI Programmes, recognizing the clear economic benefits such as supporting jobs and increasing export potential.

iii Breakdown of current price elements that make up the main three price components (energy, network, taxes/levies)

UK Energy price breakdowns 2018[399]

Table 39: Household Gas and Electricity price breakdowns

	Gas (D2)		Electricity (DC)	
Per MWh	**Euros**	**Pounds**	**Euros**	**Pounds**
Energy & Supply	32.20	28.70	95.60	85.00
Network Costs	11.30	10.10	40.90	36.40
Taxes, Fees, Levies & Charges	4.40	3.90	57.60	51.20
Total Price	**47.90**	**42.70**	**194.10**	**172.60**

Table 40: Medium Business energy price breakdowns, excluding VAT

	Gas (I3)		Electricity (DI)	
Per MWh	**Euros**	**Pounds**	**Euros**	**Pounds**
Energy & Supply	20.40	18.20	73.10	65.00
Network Costs	4.90	4.30	26.50	23.60
Taxes, Fees, Levies & Charges	6.20	5.50	55.00	48.90
Total Price	**31.50**	**28.00**	**154.60**	**137.50**

[399] Eurostat Energy Statistics, https://ec.europa.eu/eurostat/data/database?p_p_id=NavTreeportletprod_WAR_NavTreeportletprod_INSTANCE_nPqeVbPXRmWQ&p_p_lifecycle=0&p_p_state=normal&p_p_mode=view&p_p_col_id=column-2&p_p_col_pos=1&p_p_col_count=2

Table 41: Large Gas Business & Extra-Large Electricity Business energy price breakdowns, excluding VAT

	Gas (I4)		Electricity (IF)	
Per MWh	**Euros**	**Pounds**	**Euros**	**Pounds**
Energy & Supply	16.30	14.50	68.90	61.30
Network Costs	3.90	3.50	22.40	19.90
Taxes, Fees, Levies & Charges	4.90	4.40	48.60	43.20
Total Price	**25.10**	**22.40**	**139.90**	**124.40**

iv Description of energy subsidies, including for fossil fuels

As set out in section 3.1.3(iv), the UK uses a definition of fossil fuel subsidies agreed and used by the Commission, and Member States which are members of the G20, in making returns to the G20. Unlike the definition used in the Commission's Energy Prices and Costs Report of earlier this year, this definition excludes tax treatment. The UK has no fossil fuel subsidies.

5. Impact assessment of planned policies and measures

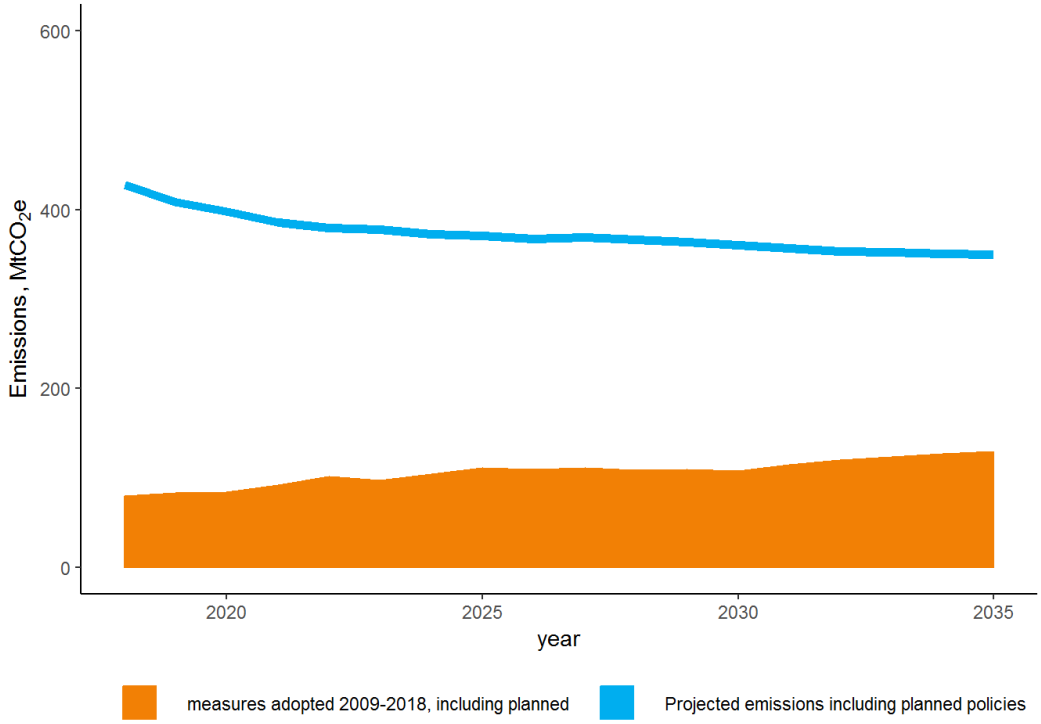
5.1 Impacts of planned policies and measures described in section 3 on energy system and GHG emissions and removals including comparison to projections with existing policies and measures (as described in section 4)

i Projections of the development of the energy system and GHG emissions and removals as well as, where relevant of emissions of air pollutants in accordance with Directive (EU) 2016/2284 under the planned policies and measures at least until ten years after the period covered by the plan (including for the last year of the period covered by the plan), including relevant Union policies and measures

The projections presented in section 4 (the 'with existing measures' scenario) include the impact of all the UK's implemented and adopted policies and measures. It does not include those policies which are classified as planned. Policies and proposals for mitigating climate change go through an established development process. As the development is completed, the impact of policies is quantified in updated Energy and Emissions Projections (EEP), which are published by the UK government annually. This is a continuous process and the latest EEP, published in April 2019, shows future emissions under the suite of policies that were fully developed as of 2018.

The UK treats the policies adopted before 2009, when carbon budgets were set at the time of the 2009 Budget and the Low Carbon Transition Plan (LCTP), as part of the baseline. Figure 20 and Table 42 show the estimated emissions savings and the effect on projected emissions attributable to policies adopted between April 2009 and July 2018, as published in the 2018 UK EEP. For example, in 2020 we project that existing UK policies adopted since the LCTP will deliver emissions reductions of over 84 MtCO2e. Further emissions reductions are expected from planned policies.

Figure 20: Projected impact of policies



To avoid double counting in the calculation of savings from policies, our projections use a hierarchy of mitigation actions which consider energy demand and emissions reductions after the application of measures further up the hierarchy. This hierarchy considers the level of imperative imposed by a policy, that is to say whether there is regulation, incentive or advice, and the date of implementation of a policy.

Table 42: Projected impact of policies adopted in the period 2009-2018, MtCO2e[400]

Scenario	2018	2020	2025	2030	2035
Baseline	514	490	488	475	486
…with existing measures	428	398	370	364	356
…with additional measures	428	398	371	361	350

The differences in projected emissions between scenarios does not exactly match the sum of emissions reductions provided by individual policies due to price interactions and adjustments to policy impacts to improve accuracy.

The CGS set out over fifty policies and proposals that will drive emissions down throughout the next decade and beyond. Through preparing this Strategy, the UK government identified areas where it will need to see the greatest progress, both through technological breakthroughs and large-scale deployment, in order to meet its national emissions reduction targets.

[400] Updated Energy and Emissions Projections, 2018, Annex A www.gov.uk/government/publications/updated-energy-and-emissions-projections-2018

Air quality

The UK government has pledged that this will be the first generation to leave the environment in a better state than we inherited it.

The UK has ambitious 2020 and 2030 emission reduction commitments in place for five key air pollutants. The UK government published a comprehensive Clean Air Strategy in January 2019 setting out a plan to meet these goals and reduce emissions, with subsequent technical analysis published in March. To measure progress towards these commitments, the UK government annually compiles national air pollutant emissions in the National Atmospheric Emissions Inventory (NAEI), which includes the UK Greenhouse Gas Inventory, used for reporting to the UNFCCC. We also produce air pollutant emissions projections for 2020, 2025 and 2030 which rely on data from various sources, key among which are the Updated Energy and Emissions Projections which take account of measures in place as far as is possible, given the data available.

UK government analysis indicated in its NAPCP that our selected PaMs have the potential to reduce GHG emissions by between 2.2 and 2.9 Mt CO2e per annum by 2030. We will work across government to realise the opportunities for mitigating climate change and improving air quality building on the work already achieved. The Clean Air Strategy included a commitment to consult on making coal to biomass conversions ineligible for future rounds of the Contracts for Difference scheme.

We also consulted on banning new Renewable Heat Incentive (RHI) biomass applications installed in urban areas that are on the gas grid, as well as introducing mandatory maintenance checks for those installations already accredited on the RHI. The RHI is a UK government subsidy scheme for eligible renewable heating technology, including biomass. The RHI has air quality requirements that participants using biomass are required to meet before they can claim support under the scheme. These include: limits on the emissions of particulate matter (PM) and oxides of nitrogen (NOX), a requirement to use sustainable fuel that is listed on the emissions certificate of the accredited boiler, and an annual obligation to submit relevant permits and exemptions to evidence compliance with all local and national environmental regulations, including those relating to air quality impacts.

As outlined in the Clean Air Strategy, the UK Department for Environment, Food and Rural Affairs (DEFRA) and BEIS have worked together to ensure air quality is considered at the outset of policy development, and that appropriate tools and evidence are used to assess the impact on air pollution emissions. Building on the framework established for bioenergy, we seek to strengthen the collaboration between DEFRA and BEIS, so that we fairly and objectively articulate the trade-offs between energy and air pollution emissions when developing strategies to meet air quality and carbon targets. Similarly, the UK Department for Transport has committed to end the sale of conventional petrol and diesel cars and vans by 2040, which is factored into the NAPCP air quality analysis.

ii Assessment of policy interactions at least until the last year of the period covered by the plan, in particular to establish a robust understanding of the impact of energy efficiency / energy savings policies on the sizing of the energy system and to reduce the risk of stranded investment in energy supply

To avoid double counting in the calculation of savings from policies, our projections use a hierarchy of mitigation actions; energy demand and emissions reductions for a given policy are considered after the application of measures further up the hierarchy. This hierarchy considers the level of imperative imposed by a policy (i.e. whether it enforces regulation, incentive or advice) and the date of implementation of a policy.

The Updated EEP 2018, Annex D[401], gives details on how policy interactions are addressed in our modelling of energy savings. For example, when evaluating the potential savings of a particular policy, the savings of existing policies are taken into account to ensure that the savings are only attributed to one policy. New policies will be incorporated once they are sufficiently advanced to meet the criteria set out in the UNFCCC definitions. Where possible, policies are modelled by incorporating them into the BEIS Energy and Emissions Projection Model. Other policies enter the model as demand reductions or as an off-model adjustment.

iii Assessment of interactions between existing policies and measures and planned policies and measures

This information is set out in 3.1.1, which details the policies and measures drawn from, and updated since, the 7th National Communication.[402]

Table 43 provides a summary of impact assessments of energy efficiency policies and regulations expected up to 2030.

Table 43: Summary of energy efficiency policy impact assessments expected up to 2030

Policy	Description	Total NPV (Social)	Carbon Savings
The Private Rented Sector Energy Efficiency Regulations - Domestic	This policy is intended to amend the current domestic Private Rented Sector Energy Efficiency Regulations to ensure that action is taken to upgrade the energy efficiency of the sector. The intended effects are to: make progress against the UK government's statutory fuel poverty and climate change commitments; reduce energy demand in the Private Rented Sector, thereby lowering energy bills and improving energy security; and improve thermal comfort and associated health outcomes.	£580m (2017 Prices)	0.4 MtCO2e over CB4

[401] Updated Energy and Emissions Projections, 2018, Annex D www.gov.uk/government/publications/updated-energy-and-emissions-projections-2018

[402] 7th National Communication, December 2017, http://unfccc.int/files/national_reports/annex_i_natcom/submitted_natcom/application/pdf/19603845_united_kingdom-nc7-br3-1-gbr_nc7_and_br3_with_annexes_(1).pdf

Policy	Description	Total NPV (Social)	Carbon Savings
The Private Rented Sector Energy Efficiency Regulations – Non-Domestic	This policy is intended to amend the current domestic Private Rented Sector Energy Efficiency Regulations to ensure that action is taken to upgrade the energy efficiency of the sector. The intended effects are to: make progress against the UK government's statutory fuel poverty and climate change commitments; reduce energy demand in the Private Rented Sector, thereby lowering energy bills and improving energy security; and improve thermal comfort and associated health outcomes.	£2bn (2013 Prices)	3 MtCO2e over CB3 and CB4
Energy Savings Opportunity Scheme	The objectives of the policy are to promote the take up of cost effective energy efficiency measures whilst minimising the cost to business of complying with the mandatory auditing requirements. By providing enterprises with tailored information about how they can make cost-effective savings ESOS should increase the take up of cost effective energy efficiency measures. This will increase productivity, support higher economic growth, reduce carbon emissions and improve security of supply.	£1.6bn (2014 prices)	10.1 MtCO2e over 2014-2030
Streamlined Energy and Carbon Reporting Framework (SECR)	The policy objectives of a SECR framework are to reduce the overall administrative burdens on participants, whilst improving the incentive for organisations to save energy through energy efficiency – thus reducing energy bills and carbon emissions. Requiring organisations to report on their energy use is intended to drive behaviour change by raising awareness of energy efficiency with organisational decision makers, and increasing the importance of energy efficiency to organisations through reputational drivers. Increased transparency for investors and others will make them more able to hold companies to account.	£1,549m (2017 Prices)	12.9 MtCO2e over 2019 - 2035
Smart metering (Non-domestic)	To roll-out smart metering to GB residential and small and medium sized non-domestic gas and electricity customers in a cost-effective way, optimising the benefits to consumers, energy suppliers, network operators and other energy market participants and delivering environmental and other policy goals.	£5,746m (2011 Prices)	29.67 MtCO2e over lifetime of the policy (2013-2027)

Policy	Description	Total NPV (Social)	Carbon Savings
Carbon Emissions Reduction Target	The purpose of the CERT obligation is to help electricity and gas consumers in the household sector to reduce the carbon impact (footprint) of their home by using energy more efficiently, reducing consumption and using energy from renewable/microgeneration sources. In doing so they will reduce their fuel costs (and/or enjoy greater comfort). Through achieving carbon dioxide savings, the primary aim of the CERT is to make a significant contribution to the UK's legally binding target under the Kyoto protocol to cut greenhouse gas emissions by 12.5% below 1990 levels by 2008–2012 and its domestic goal to cut emissions of carbon dioxide by 20% below 1990 levels by 2010. It is expected that it will also contribute to the alleviation of fuel	£10.3bn (2007 Prices)	154 MtCO2e over the lifetime measures (2008-2051) 4.2 MtCO2 over 2008-2011
Community Energy Savings Programme	Community Energy Savings Programme has the twin objective of significantly reducing the fuel bills of some of those living in deprived areas (proposed to be defined as Super Output Areas in bottom decile of the income domain of the Indices of Multiple Deprivation); and contributing to the improvement of the energy efficiency of the existing housing stock in order to reduce the UK's GHG emissions.	£122mn (2009 Prices)	2.9 MtCO2e Over 2009-2011
Energy Company Obligation – ECO3	The policy is intended to drive uptake of energy efficiency measures in the residential sector that would not have occurred in the absence of intervention, in particular among low income and vulnerable households in or at risk of fuel poverty. The intended effects are to: make progress against the UK government's statutory fuel poverty and climate change commitments; reduce energy demand in the residential sector, thereby lowering energy bills and improving energy security; improve thermal comfort and subsequent health outcomes; and support jobs and growth.	£718m (2017 Prices)	1.32 MtCO2e over CB5 (2028-2032) 11.08 MtCO2e over the lifetime of policy measures

Policy	Description	Total NPV (Social)	Carbon Savings
Boiler Plus	The policy objectives are to deliver additional energy and carbon savings from the domestic heating sector in England by lowering overall gas demand from domestic properties, thereby reducing fuel bills for these properties and contributing towards meeting the UK's legally binding carbon budgets. It aims to do this by increasing the deployment of devices which increase the efficiency of domestic heating systems, through controls and measures to make gas boilers heat homes more efficiently.	£483m (2016 Prices)	2 MtCO2e in CB4, 3.2 MtCO2e in CB5

The UK government has a rigorous monitoring and reporting framework to track progress against its domestic and international targets. Each year the UK government publishes its Greenhouse Gas Inventory, and Energy and Emissions Projections.

The Climate Change Act (2008) requires the UK government to set five yearly carbon budgets, and then produce a plan to meet these budgets. The most recent was the Clean Growth Strategy, published in October 2017. The CCC, the UK's independent advisory body, published an assessment of this plan in January 2018.

The CCC also produces an annual progress report, with the UK government laying a response before Parliament later in the same year. From 2018, the UK government has used its response to the CCC's annual progress report to bring together reporting against the Clean Growth Strategy on the Emissions Intensity Ratio, metrics and actions. The UK government also provides updates on key elements of the Strategy, as we look ahead towards setting the sixth carbon budget by the statutory deadline of 30 June 2021.

See section 1.1(ii) for more detail on the CCC's net zero recommendation and other UK commitments.

5.2 Macroeconomic and, to the extent feasible, the health, environmental, employment and education, skills and social impacts including just transition aspects (in terms of costs and benefits as well as cost-effectiveness) of the planned policies and measures described in section 3 at least until the last year of the period covered by the plan, including comparison to projections with existing policies and measures

It is clear that the continued transition away from coal generation, which has been underway for some years, will have an impact on jobs and communities given the number of people employed at a typical power station. In addition, jobs associated with supply chains, such as port and rail infrastructure will be affected, as will the coal mining industry, although there remain other markets for UK coal. These changes can have a secondary effect on local economies.

Our analysis suggests that the majority of coal plants are likely to close ahead of the intervention in 2025. However, regardless of whether the end of the coal generation sector is a result of direct intervention or other factors, we recognise that there will be an effect on a number of people, largely in the Yorkshire/Humber region, and in South Wales.

The UK government is clear that we need to build an economy that delivers good, skilled, well-paid jobs and creates the conditions for competitive, world leading businesses to prosper and grow right across the UK. Since the consultation was held in November 2016, the UK government has published the Clean Growth Strategy[403] and the Industrial Strategy White Paper.[404]

The move to cleaner growth, including through low-carbon technologies, is one of the most significant and foreseeable global economic trends, and represents one of the greatest industrial opportunities of our time. The UK is well placed to benefit; according to one estimate, our clean economy could grow at four times the rate of GDP. We are determined to make the most of these opportunities. We are already seeing jobs, regional investment and export sales flowing from UK supply chains for clean power technologies, as a result of the on-going transition to a cleaner, smarter power sector. We expect that the losses in activity associated with the closure of unabated coal generators will be compensated by increased activity in new, clean generation. There is a notable opportunity for the UK to become one of the most advanced economies for smart energy and related technologies. The Smart Systems and Flexibility Plan[405] we launched in July 2018 aims to grow the markets for these technologies, and the new innovation challenge announced in our Industrial Strategy, ‘Prospering from the energy revolution’, aims to accelerate innovation so that cutting edge technologies and systems are developed in the UK.

The UK is likely to feel the impact of climate change both directly and through impacts in other parts of the world. In its recent UK Climate Change Risk Assessment, the UK government

[403] Clean Growth Strategy, 2017, available at: www.gov.uk/government/publications/clean-growth-strategy
[404] Building a Britain fit for the future, 2017, available at www.gov.uk/government/publications/industrial-strategy-building-a-britain-fit-for-the-future
[405] Upgrading our energy system: Smart systems and flexibility plan, 2017, available at: www.gov.uk/government/publications/upgrading-our-energy-system-smart-systems-and-flexibility-plan

endorsed the six key climate change risks for the UK identified in an independent review by the Adaptation Sub-Committee: flooding and coastal change; shortages in public water supply; risks to health, wellbeing and productivity from high temperatures; risks to natural capital and our ecosystems; risks to food security and trade; and new pests and diseases. Therefore, future investments are likely to be highly sensitive to how climate change evolves over the next two to three decades.

Actions to mitigate climate change can have wider positive impacts on the economy, the environment and health, beyond the direct benefits of avoided climate change. Co-benefits can include substantial air quality improvements from avoided fuel combustion, the health and wellbeing benefits of active travel, and warmer homes that have lower bills.

The transition to a net zero economy also presents a major opportunity for the UK to be a world-leading hub for jobs, businesses and exports in low-carbon sectors. Already there are almost 400,000 jobs in low-carbon businesses and their supply chains across the country and low-carbon exports are worth billions of pounds each year. According to one estimate, the UK low-carbon economy could grow more than four times faster than the rest of the economy between 2015 and 2030 – delivering up to £170 billion of exports and supporting up to 2 million jobs.

To realise these opportunities, the UK government has placed Clean Growth at the heart of our Industrial Strategy by making it one of four ‘Grand Challenges’ – global trends that the UK is determined to be at the forefront of. By aligning our Clean Growth and Industrial Strategies, we are ensuring that our policies across government on skills, business support, innovation, infrastructure and regional growth help to deliver emissions reductions and promote our strengths in low-carbon technologies, systems and services.

We are focusing on areas where the UK has established or emerging strengths, in order to capitalise on significant future markets and export opportunities. These include technologies and approaches central to the shift to a net zero economy such as electric vehicles, smart systems, green finance and offshore wind. For example, the UK is a global leader in offshore wind with the largest installed capacity in the world, and our Offshore Wind Sector Deal sets out how we will work with industry to deliver increased capacity while boosting the economy, creating new export opportunities and thousands of new jobs.

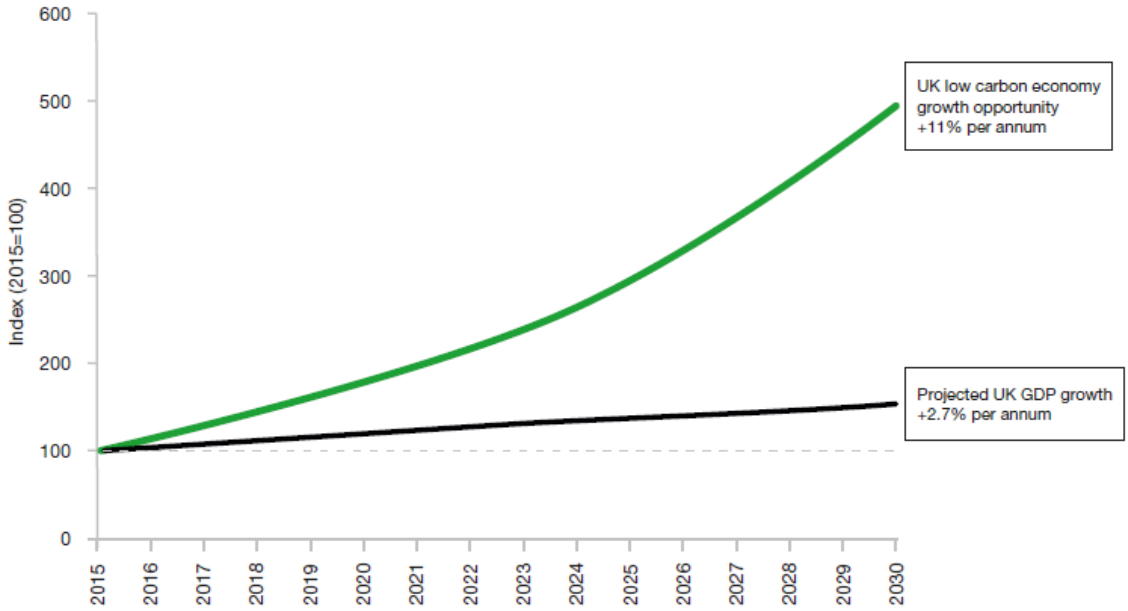
We are investing in the UK’s most important asset – our workforce – to ensure that people have the right skills to deliver the low-carbon transition and thrive in the high-value jobs this will create. STEM, digital and technical skills will be essential, and the UK government has announced substantial spending commitments to develop these skills in schools. We have also introduced T Levels as the technical equivalent of A Levels – including T Levels for Construction, which will help to develop the skills needed for sustainable construction so that our buildings are energy efficient and fit for the future.

Industry has pledged to provide 1,000 work placements for T Level students through the Construction Sector Deal. In addition, the Offshore Wind Sector Deal commits to supporting the development of a sector-wide curriculum to deliver a skilled and diverse workforce across the country, whilst challenging the sector to more than double the proportion of women working in the industry to at least 33% by 2030.

As our economy evolves, it is vital that this transition is managed in a way that is fair and just. This is why alongside the UK government’s announcement of legislating for net zero, it also announced that HM Treasury will be conducting a review into the costs of decarbonisation

including how to achieve this transition, in a way that works for households, businesses and public finances, as well as the implications for UK competitiveness. We are committed to supporting workers and communities who may face disruption as we move away from high-carbon industries, by providing them with opportunities to retrain and re-skill so that the benefits of clean growth are experienced by people across the UK. This was underlined when the UK signed up to the Silesia Declaration in December 2018, promoting efforts to ensure that no workers or communities are left behind in this transition.

Figure 21: Potential Growth in the UK Low Carbon Economy[406]



However, there is inherent uncertainty around projecting what any existing or future policy can achieve, and this uncertainty becomes even more challenging when looking at the longer-term economy out to 2050. Recent years have shown that we should be flexible in our approach to our future energy mix, as global action can transform the cost and installation of different technologies. Other uncertainties include macroeconomic factors, such as gas prices, policy impacts and how society will respond to incentives, developments in the science evidence base, and future shifts in consumer and business behaviour.

In the CGS, we outlined how we explore this uncertainty by testing different potential versions of the future, based on current knowledge, and we described one possible pathway (the '2032 pathway') for meeting the fifth carbon budget through domestic action. Delivering the 2032 pathway would result in a wide range of costs and benefits as illustrated in Table 44 below.

[406] The Clean Growth Strategy, 2017 www.gov.uk/government/publications/clean-growth-strategy

Table 44: Costs and benefits of the 2032 pathway[407]

Capital and operating costs	The incremental costs of installing and running low carbon technologies
Finance costs	The real social cost of providing finance for capital investments, which varies between sectors
Energy savings	The value of lower energy use due to improved efficiency of energy consumption, or switching from fossil fuels to low carbon alternatives
Greenhouse Gas emissions impacts	The benefits associated with reduced emissions. Where emissions are covered by the EU ETS, this benefit will be the avoided financial cost of purchasing EU emissions allowances. Reductions in non-traded emissions are valued using the government's non-traded carbon values.
Impacts on air quality	The benefits associated with lower emissions of NO_x, $PM_{2.5}$ and other air pollutants detrimental to the health of individuals.
Other cost and benefits	These include the hassle cost to households for installing measures, benefits of shorter journey times due to low congestion, less noise pollution and warmer homes from energy efficiency improvements.

These costs and benefits can vary significantly. In particular, they will depend on a wide range of social and economic factors such as growth in population and gross domestic product, on how innovation results in new and lower cost low-carbon technologies, and on the precise actions that are taken in the years ahead.

The extent of these costs and benefits is not fully known at this time because they will depend on the final design of the policies and proposals to meet carbon budgets. When setting the fifth carbon budget, an indicative set of costs and benefits was estimated and set out in the accompanying impact assessment.[408] Overall, it was estimated that meeting the fifth carbon budget through domestic action alone could be achieved with a net benefit to the UK of up to £5.5 billion over the fifth carbon budget period. The impact assessment also set out the sensitivity of these estimates to a range of underlying social and economic factors. These factors in particular included uncertainty around technology costs, energy prices, underlying drivers of UK emissions, and non-cost barriers to delivery.

As noted, these estimates only provide an illustration of the potential scale of impacts. The 2032 pathway shows what is considered possible through domestic action, although this is only one of several plausible pathways. As the UK government continues to deliver the Clean Growth Strategy and finalise policies, these will be accompanied with their own impact assessments where appropriate, which will set out the specific costs and benefits of the proposals.

[407] Costs and benefits of the 2032 pathway, page 150 of the Clean Growth Strategy, published 2017 www.gov.uk/government/publications/clean-growth-strategy
[408] DECC (2016) Impact Assessment for the level of the fifth carbon budget www.legislation.gov.uk/uksi/2016/785/impacts section 4.1.

5.3 Overview of investment needs

i existing investment flows and forward investment assumptions with regard to the planned policies and measures

The CGS set out proposals across the economy, – in homes, business, transport, and the natural environment; building on the progress made so far, to meet the UK's carbon budgets.

Table 45: Examples of UK Investment Pledges in the Clean Growth Strategy[409]

Investment Amount	Investment Area
£2.5 billion, with more recent announcements increasing this to £3 billion[410]	Supporting low-carbon innovation from 2015 to 2021.
£162 million	Research and innovation in energy, resource and process efficiency.
Up to £20 million	Support new clean technology early investment funding.
Up to £100 million	Innovation in carbon capture usage and storage technologies.
£14 million	Support innovative energy technologies and processes through the Entrepreneurs Fund.
Around £3.6 billion	Upgrade around a million homes through the Energy Company Obligation (ECO), and to extend support for home energy efficiency improvements until 2028 at the current level of ECO funding.
£4.5 billion	Invest in low-carbon heating, reforming the Renewable Heat Incentive and supporting innovative low-carbon heat technologies in homes and businesses between 2016 and 2021.
£1.5 billion	Supporting the take-up of ultra low emission vehicles.
£184 million + two new £10 million innovation programmes	Develop new energy efficiency and heating technologies to enable lower cost low-carbon homes.
£80 million	Electric vehicle charging infrastructure deployment.

[409] The Clean Growth Strategy, 2017, www.gov.uk/government/publications/clean-growth-strategy. This is not an exhaustive list of all future UK Government investments.
[410] BEIS internal analysis.

Investment Amount	Investment Area
£250 million (matched by industry)	Research, development and demonstration of Connected and Autonomous Vehicle technologies.
£841 million	Innovation in low-carbon transport technology and fuels.
Up to £557 million	Further Contract for Difference auctions.
£900 million	Innovation in smart systems, renewable and nuclear energy.
£99 million	Innovation technology and research for agri-tech, land use, greenhouse gas removal technologies, waste and resource efficiency.
£255 million	Funding for public sector energy efficiency improvements in England.

Since publishing the CGS the UK has announced a range of further measures to drive investment in support of our climate targets. For example, since setting the net zero target in June 2019, the UK has committed more than £2 billion to support decarbonisation in sectors across the economy from industry to transport, including:

- £390 million of investment in hydrogen and low-carbon technology to reduce emissions from industry, including steel - which accounts for 15% of industry emissions in the UK;
- up to £1 billion additional funding to develop and embed the next generation of cutting-edge electric vehicle technologies;
- £400 million of investment in new charging infrastructure for electric vehicles;
- plans to use new financing models to roll out more new nuclear, including up to £18 million for the UK's first mini nuclear reactor to be operational in the early 2030s - creating 40,000 jobs at its peak and powering 750,000 homes;
- £26 million of additional funding for carbon capture technology, including investment in the UK's largest project to be operational by next year;
- £222 million investment in a visionary fusion reactor design programme;
- £5 million to help the financial sector develop green financial products, including green mortgages;
- £10 million innovation fund to cut the cost of retrofitting old homes.

More broadly, the National Productivity Investment Fund will provide an additional £4.7 billion, with an extra £2 billion a year by 2020-21, representing the largest increase in public spending on UK science, research and innovation since 1979.[411]

[411] The Clean Growth Strategy, 2017 www.gov.uk/government/publications/clean-growth-strategy

The Green Finance Strategy

Green finance will be central in delivering the Clean Growth Strategy and the UK's international climate objectives. The UK government's Green Finance Strategy[412], published on 2 July 2019, sets out the UK's approach to accelerating green finance, with the overarching objective to align private sector financial flows with clean, environmentally sustainable and resilient growth, and strengthen the competitiveness of the UK financial sector.

The Strategy sets out the UK governments approach to accelerating green finance, with actions grouped under three themes:

1. **Greening finance**: Integrating climate and environmental factors into mainstream decision making in the private sector to ensure climate-related financial risks and opportunities are effectively managed.
2. **Financing green**: accelerating investment to support the UK's Clean Growth and Environmental ambitions, and international objectives.
3. **Capturing the opportunity**: ensuring the UK is well placed to capture the commercial opportunities in green finance.

The Green Finance Strategy is in part a response to the work of the Green Finance Taskforce, which was established in 2017 by the UK government to provide recommendations on how to accelerate the growth of green finance. The Taskforce identified a range of barriers to green investment, such as access to climate data and transparency of green investment opportunities; and set out a series of recommendations to overcome them in their report published in March 2018.[413] The UK government has taken action to implement the Taskforce's recommendations in a range of areas, for example:

- Announcing the establishment of a new Green Finance Institute with the overarching mission to accelerate the domestic and global transition to a clean, resilient and environmentally sustainable economy through accelerating UK leadership in green finance.
- Launching a new clean growth venture capital fund to support the development and commercialisation of innovation clean technologies.
- Strengthening engagement with local actors on green finance through a series of regional green finance workshops and conferences.
- Introducing new regulation to clarify and strengthen trustees' investment duties in relation to ESG factors, including climate change.
- Setting out an expectation for all listed companies and large asset owners to disclose in line with the Task Force on Climate-related Financial Disclosures (TCFD) recommendations by 2022.
- Setting out a package of measures to drive demand and supply of green lending products, such as through a new Green Home Finance Innovation Fund.

[412] The Green Finance Strategy, 2019 www.gov.uk/government/publications/green-finance-strategy
[413] Accelerating green finance: Green Finance Taskforce report, 2018, www.gov.uk/government/publications/accelerating-green-finance-green-finance-taskforce-report

We continue to work closely with stakeholders to build our understanding of investment barriers and risks, for example, through hosting the inaugural Public Sector Green Finance Summit on 17 October 2019.

The UK clean growth sector has invested over £94 billion of public and private green investment in clean energy in the UK since 2010.[414] The UK was the first country in the world to establish a Green Investment Bank (GIB) attracting much needed private finance to address the challenge of climate change. Thanks in part to the GIB, the green investment market has improved in terms of the private sector capital available, which in turn has meant that green investment has now become more mainstream.

Through the UK's Clean Growth Strategy, the 25 Year Environment Plan and the Industrial Strategy the UK government is putting in place policy frameworks capable of building on this momentum.

The UK has put in place supporting policies to leverage private investment in key clean growth sectors:

Power:

- The sector has attracted more than £94 billion of investment in clean energy in the UK since 2010 (BNEF 2019).

Homes:

- The Heat Networks Investment Project seeks to leverage in around £1 billion of private sector and other investment.
- The Private Rented Property EPC E Minimum Standard for England and Wales has the potential to attract around £500 million of investment.
- The Clean Growth Strategy's aspiration of upgrading as many homes as possible to EPC Band C is estimated to require investment of between £35 billion and £65 billion.

Transport:

- We are investing nearly £1.5 billion between April 2015 and March 2021, with grants available for ULEV cars, vans, lorries, buses, taxis, and motorcycles, and schemes to support charge point infrastructure at home and workplaces on residential streets.
- The UK government has announced up to £1 billion of additional funding to develop UK supply chains for the large-scale production of electric vehicles, and for further EV research and development.

Business and Industrial Energy Use:

- The £315 million Industrial Energy Transformation Fund will support businesses with high energy use transition to a low-carbon future and cut their bills through increased energy efficiency.

[414] Bloomberg NEF (2018), Statement of Clean Energy Investment, https://about.bnef.com/clean-energy-investment/

- We are developing an Industrial Energy Transformation Fund, backed by up to £315 million of investment, to support businesses with high energy use to transition to a low-carbon future and to cut their bills through increased energy efficiency. The UK government has consulted on the design of the fund.

Public sector:

- Fund improvements in the public sector through the public sector energy efficiency loan scheme.

To improve access to finance the UK government has allocated substantial resource to fund investment in clean energy and natural capital growth. These funds are levering in larger sums from the private sector in order to achieve the overall level of investment required. For example, the Heat Networks Investment Project, provided as 'gap funding' to grow the market, aims to have a transformational impact on the development of cost-effective carbon savings required to meet the UK's future carbon reduction commitments. In return for a public investment of £320 million, the project is aiming to lever in around £1 billion of private and other capital by 2021.

The UK government is expanding its portfolio of blended innovation funds to ensure that public investment acts as a catalyst, increasing access to finance for promising new technologies and investment models:

- A new clean growth venture capital fund will be launched with £20 million capital contribution from BEIS with a view to attracting a matching or potentially greater capital sum from the private sector. In addition to catalysing clean growth equity financing market, this money will be invested on commercial terms in UK companies seeking to commercialise promising clean technologies.
- The £400 million Charging Infrastructure Investment Fund will accelerate the roll-out of charging infrastructure by providing access to finance to companies that deliver public charge points. The UK government will invest up to £200 million in the Fund, to be matched by private investors.
- We are developing an Industrial Energy Transformation Fund, backed by up to £315 million of investment, to support businesses with high energy use to transition to a low-carbon future and to cut their bills through increased energy efficiency. The UK government has consulted on the design of the fund.
- We are investigating options to increase the size of the Public Sector Energy Efficiency Loan Scheme (managed by Salix Finance). The scheme has funded over 17,000 projects, enabling public sector organisations to reduce their bills, with savings recycled into a dedicated fund for reinvestment.

Through the Green Finance Strategy, the UK government has also committed to developing and enhancing our approach for measuring progress on our objectives, including how best to monitor flows of green finance in the UK.

ii sector- or market-risk factors or barriers in the national or regional context

Decarbonisation must be achieved while maintaining security of supply (including a diversity of generation) and in the most cost-effective way, to provide affordable electricity for consumers and the UK economy more generally.

New low-carbon generators and investors often have to overcome relatively high barriers to market entry. High construction costs and market liquidity make it more difficult for low-carbon generation to compete with fossil fuels and impede market access. Small and independent players are also particularly affected by the risk of not being able to find long-term buyers for their electricity.

As highlighted by the CCC, greenhouse gas removal (GGR) technologies are likely to have an important role to play in offsetting difficult to cut emissions, by removing greenhouse gases from the air. However, there are uncertainties around their costs, deployment potential and impacts on the environment.

iii analysis of additional public finance support or resources to fill identified gaps identified under section ii

The Contracts for Difference (CfD) scheme for renewables is designed to decarbonise the electricity system cost-effectively, making the development of renewable generation cheaper for both investors and consumers. The CfD is designed to increase certainty over returns to the generator in order to bring forward investment in new low-carbon electricity generating capacity at minimum cost to consumers, whilst retaining the need for the generator to sell its power in the commercial market. The CfD provides greater long-term predictability of revenues to developers by reducing the exposure to volatile wholesale prices, thereby reducing the cost of capital and thus the level of support required. The two-way nature of the CfD also reduces or removes support for generators when electricity wholesale prices are high.

The CfD also mitigates problems faced by independent generators by reducing the long-term price risk they face, which will make Power Purchase Agreements (PPAs) simpler and less costly for offtakers to provide and should lead to greater competition in the market. The ‘Offtaker of Last Resort’ scheme provides eligible independent renewable generators holding a CfD with a guaranteed ‘backstop’ route-to-market, which enables them to have more flexibility in their contracting strategy for the sale of their power, supporting competition and reducing overall support costs. The total budget of the CfD scheme (as set out in the State aid approval for the scheme, 2014) is £15 billion. In the first auction held in 2014/15, developers of 27 projects (over 2GW) were offered contracts. At the time of contract award, the estimated budget spend was calculated as £315 million (2012 prices). In the second auction in 2017, developers of 11 projects (3.3GW capacity) were offered contracts. At the time of contract award, the estimated budget spend was calculated as £176 million (2012 prices). In the third auction in 2019, developers of 12 projects (5.8GW capacity) were offered contracts. At the time of contract award, due to all strike prices being below the reference prices forecast at the time of the auction, the estimated budget impact in the valuation years considered was calculated as zero.

To help promote and support GGR technologies, the UK government has created a programme of research and development, which aims to improve our understanding and overcome uncertainties. We have been working with the Research Councils, who launched a new £8.6 million research programme looking at all GGR technologies in April 2017. The UK government will also consider the scope for removing barriers and strengthening incentives to support the deployment of FFR, for example by developing a carbon offset market and exploring how UK timber could be used in construction.

The Smart Export Guarantee has been introduced to address concern that smaller-scale generators of low-carbon electricity may find it difficult to access a competitive market for the electricity they produce. It requires most licensed electricity suppliers to provide at least one

tariff for power exported from small-scale low-carbon installations. It does this in an intentionally flexible manner that enables a range of smart approaches such as small-scale electricity storage to be incorporated. By allowing suppliers to choose both the type, and the level, of the tariff(s) they offer, this policy encourages the creation of a competitive market between suppliers. The UK government has asked independent market regulator Ofgem to report annually on the provisions made by suppliers for smaller scale exporters, including the range, nature and uptake of tariffs offered by suppliers in response to SEG obligations (as well as any other similar tariffs suppliers are willing to share details of).

5.4 Impacts of planned policies and measures described in section 3 on EU Member States and regional cooperation at least until the last year of the period covered by the plan, including comparison to projections with existing policies and measures

i Impacts on the energy system in neighbouring EU Member States in the region to the extent possible

The UK remains a net importer of electricity and imported 19.1 TWh of electricity in 2018.

Table 46: Net Imports Via Interconnectors, 2016-2018[415]

Net Imports (GWh)

	France – GB	Ireland – N. Ireland	Netherlands – GB	Ireland – Wales	Total
Capacity (MW)	2,000	540	1,000	500	4,040
Net Imports (GWh)					
2016	9,728	399	7,306	313	17,745
2017	7,181	-110	6,858	831	14,760
2018	12,890	-471	6,185	504	19,108
Utilisation (%)					
2016	71%	19%	86%	33%	63%
2017	67%	14%	83%	46%	61%
2018	78%	26%	75%	47%	67%

ii Impacts on energy prices, utilities and energy market integration

The new Capacity Market that was introduced as part of the redesign of the SEM has provided a significant saving in terms of the overall cost to the consumer of making sure that sufficient capacity is available to meet demand. The cost of the previous capacity arrangements was

[415] Figures taken from the demand data available on the National Grid website at www2.nationalgrid.com/UK/Industryinformation/Electricity-transmission-operational-data/Data-Explorer
Figures taken from data available on the SEMO website at www.semo.com/marketdata/pages/energysettlement.aspx
Utilisation is total imports and exports across the interconnector in the year divided by the total possible imports and exports.

around £500 million per year for the whole island.[416] There have now been three T-1 auctions to secure capacity between 2018 and 2021. These have averaged £309 million per year, offering a clear saving which is passed directly to consumers. The redesign of the SEM to align with the European Target Model also allows for implicit / efficient electricity trading over interconnectors, with the SEM having access to the Single Day Ahead Coupling mechanism until the end of the Transition Period. Both of these factors have placed a downwards pressure on wholesale electricity prices. The future model of electricity trading over interconnectors the SEM will enjoy is dependent on the energy outcome of the UK-EU Future Relationship. In the absence of an agreed outcome, default arrangements are likely to be less efficient, with possible inflationary impacts on prices and a negative effect on security of supply.

Since its introduction in 2007, the SEM has been an excellent example of energy market integration. The structures which have been put in place to govern the SEM require cooperation at regulatory, technical and governmental levels.

iii Where relevant, impacts on regional cooperation

Not applicable.

[416] Single Electricity Market Operator, http://lg.sem-o.com/Pages/MDB_ValueOfMarket.aspx

Annex A – Commission recommendations following review of the draft NECP and UK government responses

	Commission Recommendation	UK Government Response
1	Further specify and quantify the impacts of the additional policies and measures, also beyond the building and transport sectors, to achieve the 2030 greenhouse gas target for sectors not covered by the EU emissions trading system of -37% compared to 2005. This includes the corresponding commitment under Regulation (EU) 841/2018 of the European Parliament and of the Council that land use, land use change and forestry emissions do not exceed removals and requires applying the underpinning accounting rules.	We have provided a list of our policies and measures in section 3.1.1. The Clean Growth Strategy includes ambitious policies on housing, business, transport and the natural environment, and the UK government is already transparent in publishing quantitative data on the impact of those policies in the National Archives.[417] As we said in the Strategy, some policies and proposals are yet to be fully developed, and these go through an established development process and are quantified at the appropriate time. As this work is completed, the impact of these policies is reflected in our updated energy and emissions projections, which are published each year. As of 31 January 2020, the UK has left the EU and will therefore not contribute to EU targets after the Transition Periods ends. The UK's legally binding domestic carbon emissions reduction targets are among the most stringent in the world. Our fifth carbon budget requires an average reduction in emissions of 57% over 2028-32, compared with a 1990 baseline. We have met our first two carbon budgets and are on track to meet the third. The latest published emissions projections suggest we are on track to deliver over 90% of the required performance against 1990 levels for the fourth and fifth carbon budgets, even before many of the policies and proposals in the Clean Growth Strategy are taken into account.

[417] Leiglsation.gov.uk delivered by the National Archives, www.legislation.gov.uk/ukia

	Commission Recommendation	UK Government Response
2	Put forward, as United Kingdom's contribution to the EU 2030 target for renewable energy, a renewable energy share of at least 27 % indicated by the formula in Annex II under Regulation (EU) 2018/1999. Include an indicative trajectory in the final integrated national energy and climate plan that reaches all the reference points pursuant to Article 4(a)(2) of Regulation (EU) 2018/1999 in accordance with that share, in view of the need to increase the level of efforts for reaching this target collectively. Put forward detailed and quantified policies and measures that are in line with the obligations laid down in Directive (EU) 2018/2001 of the European Parliament and of the Council, to enable a timely and cost-effective achievement of this contribution. Increase the level of ambition in the heating and cooling sector to meet the indicative target included in Article 23 of Directive (EU) 2018/2001, and increase the level of ambition to meet the transport target in Article 25 of Directive (EU) 2018/2001. Provide additional details on the enabling frameworks for renewable self-consumption and renewable energy communities, in line with Articles 21 and 22 of Directive (EU) 2018/2001.	See section 2.1.2.
3	Set national contributions that would be substantially more ambitious than the projections from the modelling quoted in the draft integrated national energy and climate plan in view of the need to increase the level of efforts to reach the Union's 2030 energy efficiency target. Propose more ambitious policies and measures that would deliver additional energy savings by 2030. Indicate policies and measures for the whole 2021 to 2030 period. Provide an impact assessment for the planned policies and measures in energy efficiency, in particular in terms of expected energy savings they are to deliver.	See section 2.2. Policies and proposals for mitigating climate change go through an established development process. As the development is completed, the impact of policies is quantified in updated EEP, which are published by the UK government annually. A summary of policies that would contribute to energy efficiency savings up to 2030 and their impact assessments is set out in section 5.1(iii).

	Commission Recommendation	UK Government Response
4	Specify the measures supporting the energy security objectives on diversification and reduction of energy dependency, including measures ensuring flexibility and the long-term supply of nuclear fuel, in view of the possible development of its nuclear generation capacity.	See section 2.3(ii).
5	Define forward-looking objectives and targets concerning market integration, in particular outline a strategy and timeline for progressing towards fully market-based prices.	See sections 2.4.2(i), 2.4.3 and 4.5.3. Given that interconnection from the UK to most neighbouring markets requires subsea connection, this has meant the UK has historically had lower levels of interconnection relative to other European countries. With regard to the Great Britain electricity market, the UK's Clean Growth Strategy has stated that there is potential for at least 17.9GW of interconnection to the Great British electricity market. This figure is based on projects that have all either entered the construction phase or undergone regulatory assessment, and which are all targeting delivery by 2030. This strong pipeline of projects will significantly increase the UK level of interconnection by 2030. We are continuing to develop more electricity interconnection to open-up trade with neighbouring markets, with interconnector capacity in Great Britain recently increasing by 25% with the construction of Nemo Link between England and Belgium. The development of further interconnection is supported by Ofgem's Cap and Floor regime, which is the regulated route for interconnector investment in Great Britain (England, Scotland and Wales).

	Commission Recommendation	UK Government Response
		This regime has reduced risks with financing interconnector projects and unlocked substantial investment in interconnection, reflected in the number of new interconnectors under construction, including from England to France, Norway and Denmark, and those that have received regulatory approval for projects. In addition to this, the Single Electricity Market on the island of Ireland increases UK capacity through existing shared transmission lines and a future North-South interconnector, linking the wholesale electricity systems of Ireland and Northern Ireland. There are two temporary price caps in place in GB's retail energy market, the Default Tariff Cap and the Pre-Payment Meter (PPM) Cap, both of which strike the balance between protecting consumers and ensuring competition. In 2018, the UK the Domestic Gas and Electricity (Tariff Cap) Act placed a duty on Ofgem, the GB energy market regulator, to introduce a cap on the rate at which suppliers could charge consumers on standard variable and default rate tariffs ('the Default Tariff Cap'). The temporary measure is a response to the 2016 energy market investigation (EMI) conducted by the Competition and Markets Authority (CMA), which found consumers to be paying £1.4 billion per annum more than they would do in a fully competitive market. The Default Tariff Cap will cease to have effect by the end of 2023 at the latest, although may be removed beforehand. The Pre-Payment Meter (PPM) Cap (the 'PPM Cap') was put in place in 2017 by order of the CMA following its 2016 EMI, which found pre-payment meter customers were overpaying for their energy and were less able to switch tariffs than other energy consumers.

	Commission Recommendation	UK Government Response
		The PPM Cap is also a targeted measure to protect consumers on variable and default pre-payment tariffs from being overcharged, and is now being maintained by Ofgem. These measures are focused interventions designed to protect a specific segment of consumers from non-competitive pricing practices by limiting the upper boundary of charges. Therefore, market participants remain in control of how they purchase wholesale energy and setting their retail tariffs.
6	Clarify the national objectives and funding targets in research, innovation and competitiveness, specifically related to the Energy Union, to be achieved between 2023 and 2030, so that they are readily measurable and fit for purpose to support the implementation of targets in the other dimensions of the integrated national energy and climate plan. Underpin such objectives with specific and adequate policies and measures, including those to be developed in cooperation with other Member States, such as the Strategic Energy Technology Plan.	See section 2.5. As of 31 January 2020, the UK has left the EU and is no longer part of the Energy Union. Our future research and innovation activities will be designed to achieve our legally binding domestic carbon budgets and our new commitment to achieve net zero greenhouse gas emissions from the UK by 2050. Our research and innovation priorities and related spending to deliver these targets are in the process of being considered and agreed, but in the meantime, our intention is to remain closely engaged with international research and innovation activities to meet these world leading commitments. We have an overall target of spending an amount equal to 2.4% of GDP on UK research and innovation more generally, with energy research and innovation a part of this.
7	Build on the framework of the North Seas Energy Cooperation regarding the exchange of good practices for offshore wind support schemes and potential projects, in order to deliver on the Energy Union objectives of greater energy security, sustainability and competitiveness. In light of the United Kingdom's decision to leave the European Union, it should foresee measures to ensure continued regional cooperation with Ireland on emergency preparedness and response for electricity, and security of supply for gas and oil.	Section 1.4 includes text on the UK's participation in the North Seas Energy Cooperation. Sections 1.4 and 3.3 include further detail on gas and electricity security of supply, emergency preparedness and oil stocking arrangements, all in relation to regional cooperation (particularly with Ireland). As of 31 January 2020, the UK has left the EU and is no longer part of the Energy Union.

	Commission Recommendation	UK Government Response
8	Improve its analysis of investment expenditures and sources across Energy Union dimensions, including appropriate financing at national and regional level, which is currently provided for a list of areas, and complement it by a general overview of investment needs, risks and barriers.	Section 5.3 (i) sets out the supportive policies in place to leverage private investment in key clean growth sectors. As of 31 January 2020, the UK has left the EU and is no longer part of the Energy Union. Green finance will be central in delivering the UK's emission reduction targets and the UK's international climate objectives. The UK government's Green Finance Strategy, published on 2 July 2019, set out the UK's approach to accelerating green finance, with the overarching objective to align private sector financial flows with clean, environmentally sustainable and resilient growth, and strengthen the competitiveness of the UK financial sector. As part of the Green Finance Strategy the UK government has committed to developing and enhancing our approach for measuring progress on our green finance objectives, including how best to monitor flows of green finance in the UK.
9	List all energy subsidies, including in particular for fossil fuels, and actions undertaken as well as plans to phase them out.	See sections 3.1.3(iv) and 4.6(iv).
10	Present the impacts on air pollution for the various scenarios, providing underpinning information, and considering synergies and trade-off effects.	See section 5.1(i). The UK government has pledged that this will be the first generation to leave the environment in a better state than we inherited it. The UK has ambitious 2020 and 2030 emission reduction commitments in place for five key air pollutants. The UK government published a comprehensive Clean Air Strategy in January 2019 setting out a plan to meet these goals and reduce emissions, with subsequent technical analysis published in March.

	Commission Recommendation	UK Government Response
		To measure progress towards these commitments, the UK government annually compiles national air pollutant emissions in the National Atmospheric Emissions Inventory (NAEI), which includes the UK Greenhouse Gas Inventory, used for reporting to the UNFCCC. We also produce air pollutant emissions projections for 2020, 2025 and 2030 which rely on data from various sources, key among which are the Updated Energy and Emissions Projections which take account of measures in place as far as is possible, given the data available.
11	Detail just and fair transition aspects, notably by designating the assessment of energy poverty, stating related objectives and describing the social, employment and skills impacts of the policies, measures and objectives. Special attention should be given to coal and carbon-intensive regions and how they will be impacted by the energy transition. Include a dedicated assessment of energy poverty issues, along with any related objectives or specific policies or measures, as required by the Regulation (EU) 2018/1999.	The UK government carries out a full impact assessment for each carbon budget at the point when that budget is set. The latest impact assessment available is that for the fifth carbon budget (2028-32) and was published in 2016. This included a set of costs and benefits that was indicative because the extent of these costs and benefits was not fully known at the time, as they were dependent on the final design of policies and proposals. The impact assessment also set out the sensitivity of these estimates to a range of underlying social and economic factors. As the UK government continues to deliver the Clean Growth Strategy and to finalise policies in line with established development processes, these policies will be accompanied with their own impact assessments where appropriate, which will set out the specific costs and benefits. The sixth carbon budget (2033-37) must be set by June 2021 and the UK government will produce a full impact assessment ahead of introducing any legislation to set it. Further information on energy poverty, which is a devolved area, has been provided in sections 2.4.4 and 3.4.4 to address this recommendation.

Annex B – Further information pursuant to requirements under Annex III of the Governance Regulation

Methodology pursuant to point 5 of Annex V to Directive 2012/27/EU for the operation of the energy efficiency obligation schemes and alternative policy measures referred to in Articles 7a and 7b and Article 20(6) of that Directive.

1. Calculation of the level of the energy savings requirement to be achieved over the whole period from 1 January 2021 to 31 December 2030, showing how the following elements are taken into account:

	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Cumulative savings (ktoe)	1,124	2,248	3,372	4,496	5,620	6,745	7,869	8,993	10,117	11,241

(a) the annual final energy consumption, averaged over the most recent three-year period prior to 1 January 2019;

	Final Energy Consumption (ktoe)			
	2016	2017	2018	Average over 2016-18
All sectors	140,789	139,397	141,346	140,511

(b) the total cumulative amount of end-use energy savings to be achieved;

Total savings before exemption (ktoe)	**61,825**

(c) data used in the calculation of final energy consumption and sources of such data;

Data Source	**Energy Emissions Projections 2018**[418]

The Energy Emissions Projections (EEP) give an accurate picture of the UK's final energy consumption after incorporating the effects of energy policies and macroeconomic drivers behind energy demand.

Our calculations for Article 7 take the final energy consumption data (including aviation) from the EEP to form an average over 2016-2018. The required 0.8% level of savings to be achieved annually is then calculated from this average cumulatively from 2021 to 2030. This results in total energy savings of 61,825 ktoe to be achieved by 2030 (or 719 TWhs).

[418] Energy and Emissions Projections 2018, available at: www.gov.uk/government/publications/updated-energy-and-emissions-projections-2018

2. Calculation of the level of the energy savings to be achieved over the whole period from 1 January 2021 to 31 December 2030

As of 31 January 2020, the UK has left the EU and will not be bound by EU targets after the Transition Period ends. Beyond the end of the Transition Period, the UK has already put in place a range of policies and measures domestically which are projected to achieve significant energy savings between 2021-2030 (see Table 1). Total estimated energy savings are equivalent to around 938 Terawatt hours (TWh).

Table 1: Estimated energy savings from UK policies 2021 - 2030 (TWh)

Policy	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	Total (TWh)
Energy Company Obligation	5	5	5	5	5	5	5	5	5	5	49
Building Regulations - non-domestic (Existing build)	12	14	15	16	17	18	20	21	22	23	177
Building Regulations - domestic (Existing build)	13	14	15	16	17	18	19	20	21	21	172
Building Regulations - domestic (New build)	7	8	9	10	11	12	13	14	14	15	114
Building Regulations - non-domestic (New build)	5	6	7	7	8	8	9	9	10	10	79
Climate Change Agreements	2	2	2	2	1	1	1	1	1	1	14
Climate Change Levy	4	5	5	6	6	6	7	7	7	7	61
CRC Energy Efficiency Scheme	5	5	5	5	5	3	2	0	0	0	31
Energy Savings Opportunity Scheme	3	3	3	3	3	3	3	3	3	3	30
Low Emission Vehicle policies	1	1	1	1	1	1	1	1	1	1	6
Private Rented Sector Regulation (England & Wales) - domestic	1	1	1	1	1	1	1	1	1	1	5
Private Rented Sector Regulation (England & Wales) - non-domestic	3	5	7	9	9	10	10	11	11	12	87
Rail electrification	1	1	1	1	1	1	1	1	1	1	7
Re:Fit	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	1
Salix public sector finance	1	2	2	2	2	3	3	3	3	3	22

Policy	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	Total (TWh)
Smart metering (Non-domestic)	3	3	3	3	3	3	3	3	3	3	31
Sustainable Energy Programme (Northern Ireland)	0.4	0.4	0.4	0.4	0.3	0.2	0.2	0.1	0.1	0.0	3
Welsh Government Energy Service	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	1
Warm Homes Programme	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	1
Boiler Plus	1	1	2	2	2	2	3	3	3	3	23
Streamlined Energy and Carbon Reporting Framework (SECR)	2	2	2	2	2	2	2	2	2	2	23
Total (TWh)	**71**	**77**	**84**	**90**	**95**	**98**	**101**	**104**	**107**	**112**	**938**

Note: totals may not sum due to rounding

3. Policy measures in view of the achievement of the savings requirement referred to in Article 7(1) of Directive 2012/27/EU

As of 31 January 2020, the UK has left the EU and will not be bound by the Energy Efficiency Directive after the Transition Period ends. However, for the purposes of this Annex we provide a description of policy measures below which are projected to achieve significant energy savings for the UK between 2021-2030.

3.1. Energy efficiency obligation schemes referred to in Article 7a

Measure	Description	Obligated parties and their responsibilities	Target sectors	Eligible actions provided for under the measure	Specific actions and share of savings to be achieved in households affected by energy poverty	Savings achieved by energy service providers or other third parties	'Banking and borrowing' in accordance with point (b) of Article 7a(6)	Information on trading of energy savings
Energy Company Obligation (ECO)	The Energy Company Obligation (ECO) scheme is set by the Department for Business, Energy and Industrial Strategy (BEIS) and administered by the Office of Gas and Electricity Markets (OFGEM). ECO is a GB energy efficiency scheme. ECO places an obligation on larger energy suppliers to	OFGEM is the administrator of the ECO scheme. Currently, energy suppliers with over 200,000 domestic customer accounts and supply volumes of over 1,100 GWh/year gas and/or 400 GWh/year electricity are obligated under the scheme and from April 1 2020, suppliers with over 150,000 domestic customer accounts	This policy targets low income, vulnerable and fuel poor homes. It is open to all domestic tenures with certain restrictions for social and private rented sector housing.	Details of eligible measures are contained in the statutory instrument[419] and set out in OFGEM guidance.[420] Eligible measures include insulation (for example, solid, cavity, underfloor and loft) and heating	The current ECO scheme is fully focused on those who are low income, vulnerable or fuel poor. The target for the current scheme, which has been running since December 2018, is £8.253bn in notional	The obligated energy suppliers are ultimately responsible for ensuring the measures are delivered under the ECO scheme. This saving is currently estimated	In previous iterations of ECO, as well as the current scheme, we have allowed obligated suppliers to 'carry over' certain measures from a previous obligation to the next. This enables suppliers to deliver above their obligation to manage risk, enabling surplus savings to count towards a future scheme. Whether this will be permitted beyond March 2022 will depend on what	Suppliers may, subject to approval, trade energy savings as it may simplify administration of their obligation. Suppliers may also choose to trade all or part of their obligation, subject to approval, as this could be economically more efficient. Ofgem

[419] www.legislation.gov.uk/uksi/2018/1183/contents/made and www.legislation.gov.uk/uksi/2019/1441/contents/made
[420] www.ofgem.gov.uk/publications-and-updates/eco3-measures-table

Measure	Description	Obligated parties and their responsibilities	Target sectors	Eligible actions provided for under the measure	Specific actions and share of savings to be achieved in households affected by energy poverty	Savings achieved by energy service providers or other third parties	'Banking and borrowing' in accordance with point (b) of Article 7a(6)	Information on trading of energy savings
	deliver energy efficiency and heating measures to low income, vulnerable and fuel poor homes. The scheme is funded at an estimated £640m per year and has been in place since January 2013; delivering around 2.6 million improvements in over 2 million homes. The current iteration of the ECO scheme runs till 31 March 2022.	and supply volumes of over 700GWh/year gas and/or 300 GWh/year electricity. It is the energy suppliers' responsibility to deliver set lifetime energy bill savings targets through the installation of specified measures. These are generally delivered by installers who are contracted by the energy suppliers. The target for the current scheme is £8.253bn in notional lifetime bill savings to be achieved by March 2022. These are apportioned to suppliers based on their market share.		measures (gas, electric, district and renewable). There is also an allowance and process for encouraging measures not previously installed under the scheme.	lifetime bill savings to be achieved by March 2022. Suppliers' individual targets are based on their market share.	to be 49 TWh over the eligible period.	policy follows the current scheme.	administers the trading process.

3.2 Alternative measures referred to in Article 7b and Article 20(6) of Directive 2012/27/EU (except taxation)

Measure	Description	Implementing public authorities, obligated parties and their responsibilities	Target sectors	Eligible actions provided for under the measure
Building Regulations – Domestic and Non-Domestic (New and existing build)	Building Regulations in England are set and administered by the Ministry of Housing, Communities & Local Government (MHCLG). In Scotland, Wales and Northern Ireland, the administration of Building Regulations are a devolved matter, and are made and maintained by the Welsh Government and the Northern Ireland Department of Finance and Personnel. The regulatory framework is similar to that in England (regulations supported by guidance) having similar target sectors. In England and Wales, enforcement of the regulations can be carried out by either the local authority or the private sector (approved inspectors). However, the enforcement of the Northern Ireland building regulations is carried out by District Councils.	Ministry of Housing, Communities & Local Government (MHCLG), Welsh Government, Northern Ireland Government. Local authority or private sector building control bodies in England & Wales. District councils in Northern Ireland. The person carrying out building work is responsible for ensuring that the work complies with the relevant requirements of the building regulations. They usually arrange for their work to be checked by an independent third party to make sure that their work meets the required standards. In some cases, the installer can certify themselves that their work complies.[421]	New homes, new non-domestic buildings and when building work is carried out to existing properties for which Part L of the building regulations applies including extensions, conversions, renovation of the building envelope and replacement boilers and windows.	Details of eligible measures are contained in the statutory guidance (Approved Documents). These Approved Documents set minimum standards for new buildings for the thermal transmittance for walls, roofs, windows and doors together with minimum efficiency standards for heating systems. Work to existing buildings must meet similar standards when extensions and conversions are planned together with standards for replacement heating systems (e.g. the requirement to fit a high efficiency condensing boilers).

[421] Details of building regulations and enforcement can be found: www.gov.uk/government/policies/providing-effective-building-regulations-so-that-new-and-altered-buildings-are-safe-accessible-and-efficient/supporting-pages/building-control-system

Measure	Description	Implementing public authorities, obligated parties and their responsibilities	Target sectors	Eligible actions provided for under the measure
Climate Change Agreements	Climate Change Agreements (CCAs), which were introduced alongside the Climate Change Levy (CCL), have the dual policy aims of mitigating the impact of the CCL on energy intensive industry and delivering energy/carbon savings. CCAs are voluntary agreements giving participants from eligible sectors a discount on the main rates of CCL in exchange for signing up to energy efficiency or carbon reduction targets. As of 1 April 2019, the relief currently provides a 93% CCL discount on electricity and 78% discount on gas and other taxable fuels. These are increased discount rates introduced on1 April 2019 to take account of the increased rates of CCL which took effect on the same date. The current CCA scheme will be in place until 31 March 2023.	Participation in the Scheme is on a voluntary basis. Once entered into, the conditions of a CCA are binding in order to claim the discount on the CCL. The scheme is administered by the Government's Environment Agency (EA). The EA enters into Umbrella Agreements with sector trade associations and underlying agreements with CCA participants or 'Target Units'. The role of the EA as administrator includes administration of applications from companies wishing to join the scheme and the unit targets of companies, the reporting process, administration of buyout and surplus, and audits and compliance. Government is responsible for eligibility of sectors and setting of sector commitments.	The scheme covers 53 sectors, chiefly in industrial energy-intensive sectors.	Targets were set in 2012 on a biannual basis (with 4 target periods covering 2013 to 2020) and cover electricity and non-traded direct emissions. Scheme participants or 'target units' ('Tus') are able meet their targets either by direct action, or by using a buy-out mechanism for any shortfall against targets. The buy-out was increased in 2017 from £12/t to £14/t CO2e. Any over-achievement by a target unit ('surplus') may be banked and used by that target unit in subsequent target periods.

Measure	Description	Implementing public authorities, obligated parties and their responsibilities	Target sectors	Eligible actions provided for under the measure
CRC Energy Efficiency Scheme	The CRC Energy Efficiency Scheme (CRC, formally the Carbon Reduction Commitment) is a mandatory scheme aimed at improving energy efficiency and cutting emissions in large users of energy in the public and private sectors. These organisations are responsible for around 10% of the UK's greenhouse gas emissions. The scheme features a range of drivers which aim to encourage organisations to develop energy management strategies that promote a better understanding of energy usage. It is designed to target energy supplies not already covered by Climate Change Agreements (CCAs) and the EU Emissions Trading System. The Environment Agency administers the scheme for the UK i.e. maintaining the CRC Registry into which information on energy use is entered by participants, through which allowances are obtained through trading on the secondary market – and surrendered, and from which the annual reports on emissions are generated for publications.	Organisations within the UK fell within the CRC if they had: • At least one settled half hourly electricity meter • Consumed at least 6,000 megawatt hours (MWh) or more of qualifying electricity supplied on the settled half hourly market. Some public bodies were required to take part in CRC regardless of how much electricity they used. These are called mandated participants and they include all UK central government departments and devolved administrations.	Non-domestic large energy users.	The CRC is technology neutral and so incentivises a range of measures (measuring, recording, reporting and managing of energy use). The modelling distinguished between behavioural and technical measures. Behavioural measures may not have a capital cost associated with them but require a change in use of energy consuming products to generate savings. Technical measures in contrast require a piece of equipment to be installed to generate energy savings and have a capital cost.

Measure	Description	Implementing public authorities, obligated parties and their responsibilities	Target sectors	Eligible actions provided for under the measure
	The 2018/19 financial year was the final CRC compliance year, with the scheme having now closed (other than requirements for participants to keep records for potential auditing and some duties on the scheme administrator which run to 2025).			
Energy Savings Opportunity Scheme (ESOS)	The Energy Savings Opportunity Scheme (ESOS) is an energy assessment scheme that is mandatory for all large undertakings (non-SMEs) in the UK. The objectives of the policy are to promote the take up of cost-effective energy efficiency measures whilst minimising the cost to business of complying with the mandatory energy auditing requirements. By providing enterprises with tailored information about how they can make cost-effective savings ESOS should increase the take up of cost-effective energy efficiency measures. This will increase productivity, support higher economic growth, reduce carbon emissions and improve security of supply.	ESOS is mandatory for large undertakings registered in the UK. These are organisations that carry out a trade or business which employ 250 or more people or employ fewer than 250 people but have both an annual turnover exceeding €50m and a balance sheet exceeding €43m. An undertaking will also qualify for ESOS if it is part of a corporate group containing at least one 'large undertaking' as defined above. The UK Environment Agency (EA) is responsible for administering the scheme, and the EA and regional agencies are responsible for enforcing and auditing compliance with the scheme. Energy audits will be carried out by the private sector.	Non-domestic sector (non-SMEs enterprises.	Energy audits carried out for/by non-SMEs in scope of the scheme will result in recommendations being made to those organisations of measures that could be taken in order to make energy savings. The nature of the recommended measures will depend on the nature of the audited organisation's energy use and will be determined on a case-by-case basis by the auditors in question, depending on the energy efficiency opportunities that are relevant to participant organisations. Organisations which are in scope of ESOS must carry out energy audits on assets and activities relating to buildings, industrial processes and transport, that account for at least 90% of their total annual energy consumption to identify cost-effective energy saving measures.

Measure	Description	Implementing public authorities, obligated parties and their responsibilities	Target sectors	Eligible actions provided for under the measure
	SMEs across the UK are encouraged through ESOS guidance to undertake an energy audit on a voluntary basis to identify ways to reduce energy consumption and to demonstrate their commitment to energy efficiency. Those who notify compliance have their details published by the Environment Agency to show they have complied. Research conducted by BEIS in 2017 showed that 42% of organisations of a medium size (50-249 employees) had undertaken an energy audit. ESOS is a regulation that does not have an end date i.e. it will remain active until such time that it is repealed through legislation. There are intermediate obligation periods of 4 years for conducting ESOS assessments (with deadlines to confirm compliance by December 2019 and every 4 years thereafter).			

Measure	Description	Implementing public authorities, obligated parties and their responsibilities	Target sectors	Eligible actions provided for under the measure
Low Emission Vehicles	The policy purpose of the Office for Low Emission Vehicles (OLEV) is to reduce the level of greenhouse gas emission (particularly CO2) from road transport by supporting the early market for ultra-low emission vehicles. Ultra-Low Emission Vehicles (ULEVs) will present opportunities for better and more efficient energy management.	OLEV is made up of officials from the Department for Transport and the Department for Business, Energy and Industrial Strategy. OLEV work across UK government to support the early market for ULEVs. OLEV provides support to position the UK at the global forefront of ULEV development, manufacture and use. This support is intended to contribute to economic growth and help reduce greenhouse gas emissions and air pollution on UK roads.	Transport sector – road.	The UK government's investment in low-carbon vehicles has a primary aim of saving carbon which is met through a combination of energy efficiency and low-carbon energy sources. The energy savings presented are the net final energy saving. Two schemes run to incentivise low-emission light vehicles (one for vans and one for cars). These cover new cars and vans, with type approval and meeting certain performance criteria, with CO2 emissions below 75g/km. Manufacturers must demonstrate that vehicles meet these criteria: a list of eligible vehicles is published on the gov.uk website[422]. The increase in ULEVs will present opportunities for better and more efficient energy management. This will be particularly true with the introduction of intelligent power supply networks (smart grids) and the roll-out of electricity and gas smart meters to domestic properties (and several million smaller non-domestic businesses) which is underway in Great Britain.

[422] www.gov.uk/plug-in-car-van-grants/overview

Measure	Description	Implementing public authorities, obligated parties and their responsibilities	Target sectors	Eligible actions provided for under the measure
Private Rented Sector Regulation (England & Wales) – Domestic and Non-Domestic	This policy is intended to ensure that action is taken to upgrade the energy efficiency of the sector. The intended effects are to make progress against the UK government's statutory fuel poverty and climate change commitments; reduce energy demand in the Private Rented Sector, thereby lowering energy bills and improving energy security; and improve thermal comfort and associated health outcomes. This policy required landlords improve their properties to an EPC rating of E or above prior to entering into new tenancies, or the renewal/extension of an existing tenancy. Domestic landlords of EPC Band F and Band G rated homes are required to invest, or co-invest, in improving the energy performance of these properties to EPC Band E, if no third-party funding is available or is insufficient. The landlord spend requirement is capped at £3,500 inclusive of VAT.	Local authorities are the enforcement authorities. Landlords owning domestic and non-domestic private rented sector properties which are below an EPC rating of E are required to improve their property to at least an EPC rating of E or register an exemption.	The policy is primarily aimed at improving the energy performance of the least energy efficient properties in the domestic and non-domestic private rented sector.	Landlords are required to install 'relevant energy efficiency improvements' which are defined under the regulations, to meet the minimum EPC E rating. The landlord may register for exemptions, including where the cost of measures exceeds the £3,500 domestic cost cap, or fails to meet the 7-year payback for non-domestic properties.

Measure	Description	Implementing public authorities, obligated parties and their responsibilities	Target sectors	Eligible actions provided for under the measure
	Prohibition on granting a new tenancy or renewing / extending a tenancy applied from the 1 April 2018. The backstop date from which the regulations will apply to all existing tenancies is the 1 April 2020 for domestic properties, and 1 April 2023 for non-domestic properties.			
Rail Electrification	The Department for Transport (DfT) set out a rail electrification policy and associated funding for nominated schemes through its former Rail Investment Strategy covering rail investments in the period 2014 to 2019. Some of the planned electrification schemes under development have been delivered, including part of the Midland Main Line and Great Western Main Line. Some of the electrification schemes were paused when the programme was re-scoped. DfT is now working with Network Rail, the owner of the rail infrastructure in the UK, on a Traction Decarbonisation Network Strategy (TDNS). This will consider the most appropriate technology, including electrification, for decarbonisation of the remaining unelectrified lines in the country.	Network Rail, the owner of the rail infrastructure in the UK, is responsible for delivering the electrification schemes identified with the funding agreed with DfT.	Transport sector – railway.	The UK government's investment in rail electrification is driven by the cost savings, carbon benefits and improved reliability and performance of running electric trains instead of diesels. A significant element of the cost savings arise from the improved energy efficiency of electric trains combined with the use of electricity instead of diesel as a fuel. Following the completed electrification schemes, 80% of passenger km are undertaken on the electrified network.

Measure	Description	Implementing public authorities, obligated parties and their responsibilities	Target sectors	Eligible actions provided for under the measure
Re:Fit	The Re:Fit programme is a procurement framework for public sector organisations to procure energy efficiency improvements to their buildings from Energy Service Companies (ESCOs). This is an embryonic market in the UK, and the Greater London Authority provides support for public bodies in accessing this novel contracting arrangement within London. BEIS and Local Partnerships work jointly to provide similar support in the rest of England. Government support, through BEIS, for the current Re:Fit programme is due to end in March 2020. Local Partnerships and Welsh Government are currently designing a successor programme which will operate without BEIS support. In Wales, the Re:Fit Cymru Programme Implementation Unit[423] provides end to end support to the Welsh public sector to develop and implement projects using the Re:Fit framework.	The Re:Fit framework is open to all public sector bodies. They are able to use the framework in order to make energy efficiency improvements to their estate. It is an entirely voluntary programme; the public bodies chose to make use of the framework, securing financing and working with ESCOs to ensure the measures are properly designed and implemented. The role of the ESCO is to design and implement the energy efficiency improvements, then monitor their performance to guarantee the energy savings.	All public sector buildings in England and Wales.	Re:Fit is an output based procurement tool – as such any energy efficiency building improvement measure that relates to the fabric of the building is within scope.

[423] www.gov.wales/topics/environmentcountryside/energy/efficiency/re-fit-cymru/?lang=en

Measure	Description	Implementing public authorities, obligated parties and their responsibilities	Target sectors	Eligible actions provided for under the measure
Salix Public Sector Finance	The Public Sector Energy Efficiency Loan Scheme[424] provides interest-free loans, via a revolving fund, to public sector and higher education organisations, for energy efficiency projects. Total funds will rise to £385m by 2020.	Salix Finance is funded by BEIS, and the Welsh and Scottish Governments and provides interest-free loans to Public Sector bodies to fund energy efficiency improvement projects. The energy savings made enable the Public Sector body to repay the loan to Salix over an agreed repayment period. The majority of repayments are then allocated to further energy-efficiency projects by agreeing further loans. Salix loans are available to all public sector bodies, other than central government and NDPBs.	Public sector organisations.	Salix Finance supports a broad range of energy-efficiency technologies, which all have lifetime energy saving estimates based on an established methodology. Examples of commonly funded energy-efficiency technologies include: • Energy efficient lighting eg. LED/T5 lamps • Installation and upgrading of building energy management systems • Energy efficient street lighting eg. part night dimming systems/LED replacements • Improvements to heating systems eg. implementing heat recovery and switching from oil to gas boilers • Building fabric insulation improvements, such a cavity wall and loft insulation

[424] www.salixfinance.co.uk

Measure	Description	Implementing public authorities, obligated parties and their responsibilities	Target sectors	Eligible actions provided for under the measure
Smart Metering (Non-Domestic)	Smart Meters are the next generation of gas and electricity meters and provide consumers with more accurate information, putting an end to estimated billing. Smart meters can provide near real-time information to help consumers control and manage their energy use, save money and reduce emissions. Alongside the roll-out of smart meters to all homes in Great Britain (GB), the Government's vision is for all smaller non-domestic premises to benefit from smart metering. In the period to end-September 2019, over 1.1 million smart and advanced meters are in operation in smaller non-domestic sites.[425] Energy suppliers are responsible for the provision and installation of smart meters in non-domestic premises and are required under conditions in their licences to take all reasonable steps to install smart (or advanced) meters in all relevant non-domestic premises by the end of 2020.	Energy suppliers are responsible for the provision and installation of smart meters in non-domestic premises. They are required under conditions in the gas and electricity supply licences to take all reasonable steps to install smart (or advanced) meters in all non-domestic premises covered by the rollout by the end of 2020, and report progress to Ofgem, the GB independent energy regulator with a responsibility for regulating the roll-out.	Smaller and medium-sized non-domestic premises in GB. This captures electricity meters in profile classes 3 and 4 (Non-domestic Unrestricted Customers and Non-domestic Economy 7 Customers) and gas meters where average annual gas consumption is below 732MWh. These are the least energy intensive non-domestic customers and are, typically, smaller non-domestic organisations.	The non-domestic roll-out covers around three million meters in around two million sites. These sites are very varied, including private and public sector organisations, small shops to chain stores and compact industrial units to schools. Microbusiness consumers must be provided with a smart meter which complies with the latest version of the Smart Metering Equipment Technical Specification (SMETS2). Non-microbusiness consumers can be offered a choice between a SMETS2 meter and an Advanced meter (these meters provide half-hourly data, and are established in the larger industrial and commercial sector).

[425] BEIS (2019) Statistical release and data: Smart Meters, Great Britain, quarter 3 2019, available at: www.gov.uk/government/statistics/statistical-release-and-data-smart-meters-great-britain-quarter-3-2019

Measure	Description	Implementing public authorities, obligated parties and their responsibilities	Target sectors	Eligible actions provided for under the measure
	Since June 2019 the 'new and replacement obligation' has applied, which (subject to certain exceptions) requires energy suppliers to take all reasonable steps to ensure a smart is installed where a meter is replaced or installed for the first time (e.g. in new build premises). In September 2019 the Government consulted on a number of proposals to help inform the policy framework for energy suppliers to continue installing smart meters after 31 December 2020, when the current rollout duty ends.[426]			
Northern Ireland Sustainable Energy Programme (NISEP)	The NISEP is a voluntary energy efficiency programme in which money is collected from electricity customers through a Public Service Obligation (PSO). The charge is a flat rate (around 0.113 pence) per kilowatt hour which means that customers who use higher volumes pay more than those who use less. A competition to bid for funds to run energy efficiency schemes is carried out on an annual basis.	NISEP is set up and overseen by the Northern Ireland Authority for Utility Regulation (UR). The Energy Saving Trust (EST) acts as Programme Administrator to manage the programme on behalf of UR. NIE Ltd, the owner of the distribution network in NI, collects the fund and pays it out to organisations running approved energy saving schemes, in accordance with a condition in its distribution licence.	Domestic & non-domestic buildings, where 80% of the funding is ring-fenced for schemes that target priority (vulnerable/low-income) households. The other 20% of funding is used for schemes that target non-priority domestic households and/or the commercial sector. All energy types are targeted for savings including electricity, gas, oil, coal etc.	Insulation – loft, cavity wall, solid wall (internal or external), hot water cylinder and pipe; Heating systems, including high heat retention storage heaters and boiler and controls – natural gas or oil (if not on the gas network); Energy efficient lighting (in domestic sector can be included in a scheme but lighting only schemes are no longer allowed); Domestic refrigeration and appliances (these measures have not been included in schemes for a number of years);

[426] www.gov.uk/government/consultations/smart-meter-policy-framework-post-2020

Measure	Description	Implementing public authorities, obligated parties and their responsibilities	Target sectors	Eligible actions provided for under the measure
		All Northern Ireland licenced electricity and gas companies are eligible to become Primary Bidders and bid for funds to undertake schemes – in practice only five electricity and gas suppliers participate in the programme – Power NI, SSE Airtricity, firmus energy, Energia and Electric Ireland. Primary Bidders are totally responsible for the undertaking of their schemes and must sign an agreement with UR to agree to undertake the schemes in accordance with the NISEP Framework Document.		Other technologies for commercial sector e.g. variable speed drives and compressors, heat exchangers, high bay lighting and liquid refrigerant pumping technology. This is not an exhaustive list, other measures will be considered if they are proven technologies that meet or exceed relevant standards (e.g. safety, quality), the present value of the lifetime customer benefits exceeds the cost of the measures and if approved by the Energy Savings Trust. There should be no overlap with other grant or incentive schemes external to the NISEP for the particular measure eg. most renewable micro generation measures are no longer eligible for NISEP funding since Government incentives have been introduced.

Measure	Description	Implementing public authorities, obligated parties and their responsibilities	Target sectors	Eligible actions provided for under the measure
Welsh Government Energy Service	The Welsh Government Energy Service succeeds Green Growth Wales and offers technical, commercial and financial support for Welsh energy efficiency, renewable and heat projects. Available to public sector organisations, the capital finance is available through Salix (above) and is interest-free. With funding from the Welsh Government, Salix Finance SEELS (Salix Energy Efficient Loan Scheme) loans have been used by 47 different Welsh public sector bodies since 2009. More than £80m has been invested by our clients in Welsh energy efficiency projects which, over their lifetime, are forecasted to save approximately £140m. The service has further stimulated another £27m of investment from other sources.	Paid for by Welsh Government, the fund is administered by Salix.	Public sector organisations.	Only those projects where the resultant energy savings, over the lifetime of the project, go directly back to the public sector and the public sector gains a direct financial benefit are eligible.

Measure	Description	Implementing public authorities, obligated parties and their responsibilities	Target sectors	Eligible actions provided for under the measure
Warm Homes Programme	The Welsh Government's Warm Homes Programme has been in place since 2009. Investment has reached over £327m in the past decade. It has improved the energy efficiency of more than 55,000 homes in Wales. By the end of the current funding period in March 2021, Welsh Government investment will have reached more than £344m and over 75,000 homes will have benefitted. Over 129,506 people have received energy efficiency advice through the programme since 2011. As part of the programme, the Warm Homes Nest and Arbed Schemes have supported some of the most vulnerable people in society by improving their resilience to avoidable ill health and preventing premature death.	The programme has received funding from European, UK and Welsh Governments.	Domestic households living in fuel poverty.	Between 2018-19, the Nest scheme has helped people claim their entitlement to a Warm Homes Discount from their energy supplier and more than 3,800 homes have benefited from home energy efficiency measures during this reporting period. Although the Arbed Scheme is not predominantly a decarbonisation scheme, it's approach to retrofitting housing does contribute to wider decarbonisation efforts.

Measure	Description	Implementing public authorities, obligated parties and their responsibilities	Target sectors	Eligible actions provided for under the measure
Boiler Plus	The policy objectives are to deliver additional energy and carbon savings from the domestic heating sector in England by lowering overall gas demand from domestic properties, thereby reducing fuel bills for these properties and contributing towards meeting the UK's legally binding carbon budgets. It aims to do this by increasing the deployment of devices which increase the efficiency of domestic heating systems, through controls and measures to make gas boilers heat homes more efficiently. New standards for domestic boilers in the Building regulations for England came into force in April 2018 and will remain in force indefinitely.	The standards create an obligation on the person carrying out the work when a gas boiler is installed in and existing dwelling in England. Compliance and enforcement of standards pertaining to fixed building services is the responsibility of Building Control, which are teams of surveyors responsible for checking all aspects of construction.	Existing domestic buildings in England dependent on gas boilers.	The measure applies to all households in England in the domestic sector with an existing combi gas boiler. The standards require: All gas boilers installed into existing systems to have Energy Related Products (ErP) methodology rating of at least 92%; Time and temperature controls to be installed at the same time, if not already present and working; Combination boiler replacements to include the provision of an additional energy efficiency measure to be installed at the same time. But to reflect the diverse needs and circumstances of homes and households, the requirement will provide flexibility to allow a wide range of technology options to be considered.

Measure	Description	Implementing public authorities, obligated parties and their responsibilities	Target sectors	Eligible actions provided for under the measure
Streamlined Energy and Carbon Reporting Framework (SECR)	SECR reporting came into force on 1 April 2019 to coincide with the removal of the CRC Energy Efficiency Scheme allowance price and the increase in CCL rates. SECR aims to reduce the administrative burdens of the current overlapping suite of reporting requirements while increasing corporate transparency, further incentivising energy efficiency and reducing carbon emissions. SECR builds on – but does not replace – existing requirements that companies may face, such as mandatory greenhouse gas (GHG) reporting for quoted companies, the Energy Savings Opportunity Scheme (ESOS), Climate Change Agreements (CCA) Scheme, and the EU Emissions Trading Scheme (ETS).	SECR extends the reporting requirements for quoted companies and mandates new annual disclosures for large unquoted and limited liability partnerships (LLPs).	Large or quoted UK businesses.	Requiring organisations to report on their energy use is intended to drive behaviour change by raising awareness of energy efficiency with organisational decision makers and increasing the importance of energy efficiency to organisations through reputational drivers. Increased transparency for investors and others will make them more able to hold companies to account.

3.3. Information on taxation measures

Taxation Measure	Description	Duration	Implementing public authority	Expected cumulative and annual amount of savings	Target sectors and segment of taxpayers	Calculation methodology
Climate Change Levy	The CCL is a levy on the supply of energy to business and public-sector consumers. Each of the four main groups of taxable commodities (electricity, gas, coal, and liquefied petroleum gas) has its own main rate per unit of energy. The main rates of the CCL are intended to change business behaviour to reduce energy consumption. CCL rates will be increased from 1 April 2019 by 31% on electricity and 40% for gas and other taxable fuels.[427]	The CCL was introduced in 2001. There is no planned end date so is assumed to continue for the whole period 2014-2020. The CCL rate is set each year by HMRC.	HM Revenue & Customs	The estimated energy savings from the CCL over the period 2014-20 have been set out in Table 1. These are presented as annual savings over the seven-year period. The savings presented are based on the impact of the duty charged that is additional to the EU Energy Taxation Directive (ETD) minimum rates for CCL taxable commodities.	The main rates of climate change levy are paid on supplies of taxable commodities to business consumers including consumers in industry, commerce, agriculture, public administration, and other services. The main rates of CCL do not apply to taxable commodities supplied for use by domestic consumers or to charities for non-business use, while use in metallurgical and mineralogical processes, non-fuel and dual use applications, transport and the production of electricity and energy products is exempt. Commodities must register with HMRC and account for tax due on a quarterly basis.	The calculation of energy savings has been made based on long-run price elasticities applicable to the sectors within the UK from published academic literature. Organisations within a range of sectors can claim partial exemption from the CCL if they have a Climate Change Agreement (CCA). For participants within the Climate Change Agreement, their CCL rate is reduced to approximately the Energy Tax Directive (ETD) minimum rate. Savings within the CCA sector are presented separately. Given the CCL is an existing policy measure the analysis estimates what increase in energy consumption would be observed if the CCL was not charged above the ETD minimum.

[427] www.gov.uk/government/publications/rates-and-allowances-climate-change-levy/climate-change-levy-rates

4. Calculation methodology for measures notified under Articles 7a and 7b and Article 20(6) of Directive 2012/27/EU (except for taxation measures)

Scheme/Measure	Measurement methods used	Method to express the energy savings (primary or final savings)	Lifetime of measures	Description of the calculation methodology	Information on how double counting of energy savings is avoided	Climatic variations and approach used
Energy Company Obligation (ECO)	Scoring is delegated to the administrator of the scheme, Ofgem. Ofgem work with the Building Research Establishment to produce 'deemed' scores for each energy efficiency measure. Savings from this policy are considered deemed savings.	Final savings.	Assumptions are made about the lifetime of each eligible energy efficiency measure under the scheme. The lifetime assumptions are integrated into scores attributed to each energy efficiency measure delivered under the scheme.[428]	Deemed scores are lifetime scores and they relate to the average treatable area for the measure type.	We model the scheme net of the counterfactual and consider overlap with other related policies.	There is no variation based on climatic conditions.

[428] www.ofgem.gov.uk/publications-and-updates/eco3-deemed-scores

Scheme/Measure	Measurement methods used	Method to express the energy savings (primary or final savings)	Lifetime of measures	Description of the calculation methodology	Information on how double counting of energy savings is avoided	Climatic variations and approach used
Building Regulations – Domestic and Non-Domestic (New and existing build)	Savings are calculated by measuring the uplifts to Part L of building regulations against a counterfactual scenario of energy savings that would have occurred without Part L changes.	Final savings.	Assumptions were made about the approximate asset life of each measure. Building fabric (external walls, floors, roofs) – 60 years External windows and doors – 30 and 25 years respectively. Heating, ventilation and air conditioning (HVAC) equipment and lighting – 15 and 20 years respectively. The policy is assumed to apply to all building developments over a 10-year period from introduction.	Calculation of overall building energy performance for new buildings is undertaken using the UK National Calculation Methodology approved for use in transposition of Article 3 of Directive 2010/31/EU. This considers the range of criteria set out within Annex 1 of that Directive and is applied for new dwellings through the UK government's Standard Assessment Procedure (SAP) and, for new non-domestic buildings, the Simplified Building Energy Model (SBEM).	The policy impacts estimated does not overlap with other policies, so any estimated impacts are considered additional.	The methodology for calculating the energy performance of buildings approved by the regulations includes climate data. The UK methodology for dwellings (SAP[429]) applies average UK data for heating load assessment and regional factors for solar radiation and cooling loads. The UK methodology for non-domestic buildings (SBEM39) does include a number of climate zones across the UK.

[429] www.bre.co.uk/sap2009/

Scheme/Measure	Measurement methods used	Method to express the energy savings (primary or final savings)	Lifetime of measures	Description of the calculation methodology	Information on how double counting of energy savings is avoided	Climatic variations and approach used
			The estimated energy savings and incremental costs associated with tightening the Regulations are accumulated and discounted over the 60-year life of each building developed during the policy period.	Calculation of the performance of building elements is demonstrated through reference to the relevant standards.		
Climate Change Agreements	Targets are set for the energy use of a firm. To set relative targets a throughput measure is needed that relates accurately to energy consumption or carbon emissions - the actual production level in the target year is compared with the energy that would have been used for the same level of production and mix of products at the efficiency of production in the base year.	Final savings.	It is not possible to give an estimate of the average lifetime of these measures as conditions may vary between technologies and sectors.	CCAs have been in place since 2001 and DECC has collected data from a consultation exercise and has received feedback from participants; this forms the basis of much of this analysis. Many of proposals been consulted on previously and have provided further evidence that has improved the quantification of costs and benefits.	A CCA double counting mechanism ensures there is no double counting. Where an operator has surplus EU ETS allowances, this is offset by the CCA target being tightened to become more demanding. This is an emissions reduction but is achieved by tightening the CCA target to make it more demanding.	These are not deemed significant in the non-domestic sector.

Scheme/Measure	Measurement methods used	Method to express the energy savings (primary or final savings)	Lifetime of measures	Description of the calculation methodology	Information on how double counting of energy savings is avoided	Climatic variations and approach used
					Alternatively, if operators do not want to use the double counting mechanism they can avoid it completely by retiring all their surplus EU ETS allowances that form the overlap. Any failure to retire all the surplus EU ETS allowances leads to the full implementation of the double counting mechanism, with no allowance being made for any part of the EU ETS surplus that might have been retired.	

Scheme/Measure	Measurement methods used	Method to express the energy savings (primary or final savings)	Lifetime of measures	Description of the calculation methodology	Information on how double counting of energy savings is avoided	Climatic variations and approach used
CRC Energy Efficiency Scheme	The analysis on the impact of CRC on energy savings is based on modelling take up rates[430] of energy efficiency potential in response to carbon prices. It assumes that CRC organisations will take up measures that equate to a cost of up to the corresponding price of CRC allowances.	Final savings.	The weighted average lifetime of technical/capital measures is nine years, while behavioural measures are assumed to be replaced/reintroduced every three years. The analysis also assumes that measures continue to be replaced at an annual rate of 0.3% a year (however the actual rate may be higher than this if the introduction of the CRC stimulates additional research and development).	Analysis on the impacts of the CRC on carbon savings and energy bills is based on two databases of technological and behavioural measures: BRE's abatement cost curves for the non-domestic sector and the ENUSIM model for industrial sectors as modified by Enviros for the Energy Efficiency Innovation Review (2005). It assumes that over time (and in response to the introduction of the scheme) the existing cost-effective potential for emission reductions will be taken up by participant organisations.	These measures are expected to target energy savings potential not already covered by the policies operational at the time CRC was conceived (i.e. CCA and EU ETS). The analysis then deducts the impact of other policies that were implemented before the actual start of CRC and would have overlapped with the scheme, which include non-domestic Smart Meters, Energy Performance of Building Directive, Green Deal and Products Policy.	These are not deemed significant in the non-domestic sector.

[430] Energy Efficiency and Trading Part II: Options for the Implementation of a New Mandatory UK Emissions Trading Scheme. Department for the Environment, Food and Rural Affairs. 28 April 2006.

Scheme/Measure	Measurement methods used	Method to express the energy savings (primary or final savings)	Lifetime of measures	Description of the calculation methodology	Information on how double counting of energy savings is avoided	Climatic variations and approach used
					The scheme coverage has been adjusted to account for the exclusion of metallurgical and mineralogical processes from the CRC, following the introduction of an exemption from the Climate Change Levy (CCL) for energy used for these processes.[431] Finally, energy savings have been adjusted to remove the impact of savings incentivised by these policies prior to 2014. This is done by removing legacy savings of technologies that the abatement potential analysis suggests will be adopted up to 2013.	

[431] The impacts of this change have been presented in the February 2014 Impact Assessment – 'Finalising CRC simplification: treatment of renewable energy & the metallurgical and mineralogical sectors': www.gov.uk/government/consultations/finalising-crc-simplification-treatment-of-renewable-energy-the-metallurgical-and-mineralogical-sectors

Scheme/Measure	Measurement methods used	Method to express the energy savings (primary or final savings)	Lifetime of measures	Description of the calculation methodology	Information on how double counting of energy savings is avoided	Climatic variations and approach used
Energy Savings Opportunity Scheme (ESOS)	Energy savings from energy efficiency measures implemented as a result of ESOS assessments. This is net of the counterfactual in which measures would be implemented due to rising energy prices of another government policy.	Final savings.	Organisations in scope of ESOS will not be legally obligated to implement energy efficiency measures recommended through an ESOS assessment. Therefore, we cannot anticipate the lifetime of energy efficiency measures implemented, though it would be reasonable to assume measures implemented will be permanent rather than temporary.	For the building sector, the estimate of technical potential is based on the Non-Domestic Energy and Emission Model (N-DEEM) dataset, which provides data on the total potential in non-domestic buildings and the associated capital costs. The costs are incurred upfront, and have been adjusted to include the cost of replacement for measures. For industrial processes, cost and potential estimates are based on a number of datasets from AEA and Arup.	Energy savings are calculated compared to the counterfactual. Overlaps with other policies are currently being considered.	These are not deemed significant in the non-domestic sector.

Scheme/Measure	Measurement methods used	Method to express the energy savings (primary or final savings)	Lifetime of measures	Description of the calculation methodology	Information on how double counting of energy savings is avoided	Climatic variations and approach used
Low Emission Vehicles	Data is collated for each vehicle sold, meaning information is held on how many vehicles emitting a certain level of CO2 have been sold.	Final savings.	The DVLA database indicates that the typical operational lifetime of a car is around twelve years, so it is expected that vehicles already purchased with the support of OLEV will remain in the UK fleet until the mid to late 2020s.	Total emissions from vehicles receiving grant funding can be calculated and compared to average emissions from the UK fleet.	Dealerships are required to check the identity of grant claimants to ensure they are UK residents. The claims progress through a number of stages prior to payment. The key stage is an online verification process which automatically cross checks the vehicle's registration number against the DVLA database to ensure it is an eligible vehicle and has not already received the grant.	Not applicable. Vehicles supported under OLEV schemes are in use throughout the UK and designed for use in a range of European climatic conditions.

Scheme/Measure	Measurement methods used	Method to express the energy savings (primary or final savings)	Lifetime of measures	Description of the calculation methodology	Information on how double counting of energy savings is avoided	Climatic variations and approach used
Private Rented Sector Regulation (England & Wales) – Domestic	Energy savings are net of counterfactual uptake (that is, measures that would be delivered in the absence of the Regulations – i.e., uptake due to self-financing, or through other Government policies).	Final savings.	The assumed lifetimes of the most common measures for the domestic sector are: Loft insulation – 42 years Low energy light bulbs – 10 years Cavity wall insultation – 42 years Hot water cylinder insulation – 10 years	Energy savings are calculated based on the Standard Assessment Procedure (SAP), which is operated by the Building Research Establishment (BRE) on behalf of the Department for Business, Energy and Industrial Strategy. Energy savings are net of counterfactual uptake (that is, measures that would be delivered in the absence of the Regulations – i.e., uptake due to self-financing, or through other Government policies). The profile of take up in the counterfactual in the domestic sector has been determined from modelling in the Green Deal Household Model (GDHM).	We model the scheme net of the counterfactual and consider overlap with other related policies.	The UK methodology for dwellings (SAP) applies average UK data for heating load assessment and regional factors for solar radiation and cooling loads. A full explanation of the methodology is available from the Building Research Establishment.[432]

[432] www.bre.co.uk/sap2012

Scheme/Measure	Measurement methods used	Method to express the energy savings (primary or final savings)	Lifetime of measures	Description of the calculation methodology	Information on how double counting of energy savings is avoided	Climatic variations and approach used
Private Rented Sector Regulation (England & Wales) – Non-Domestic	Energy savings are net of counterfactual uptake (that is, measures that would be delivered in the absence of the Regulations – i.e., uptake due to self-financing, or through other Government policies). The analysis is based on scaled energy savings.	Final savings.	The assumed lifetimes of the most common measures for the non-domestic sector are: Condensing boilers – 12 years Air source heat pump – 15 years Properties in scope of this policy (those with EPC F or G) are assumed as part of business as usual to carry out replacement/upgrades when measures come to the end of their life.	Energy savings are calculated based on the Building Research Establishment's SBEM. The non-domestic counterfactual is based on research underpinning the non-domestic green deal model, both referenced in the Green Deal and ECO 2012 Final Impact Assessment annexes.[433] The National Household Model (NHM) discards packages that are above the £3,500 cost cap. The NHM then finds the package of that minimises costs of reaching an 'E' rating.	We model the scheme net of the counterfactual and consider overlap with other related policies.	SBEM methodology.

[433] www.gov.uk/government/uploads/system/uploads/attachment_data/file/42984/5533-final-stage-impact-assessment-for-the-green-deal-a.pdf

Scheme/Measure	Measurement methods used	Method to express the energy savings (primary or final savings)	Lifetime of measures	Description of the calculation methodology	Information on how double counting of energy savings is avoided	Climatic variations and approach used
				Where measures can be installed under the cost cap, but the property cannot reach an EPC rating of E, the NHM installs the package of measures that maximises the improvement in energy efficiency of the property whilst still remaining under the cost cap.		

Scheme/Measure	Measurement methods used	Method to express the energy savings (primary or final savings)	Lifetime of measures	Description of the calculation methodology	Information on how double counting of energy savings is avoided	Climatic variations and approach used
Rail Electrification	Savings data is an output of Department for Transport's Rail Emission Model (REM). REM estimates energy consumption of each rail passenger service operating in GB on the basis of each service's characteristics (stock type, stopping pattern, speed, etc.). The model is calibrated to actual annual energy (gas oil and electricity) consumption as reported by individual train operating companies. REM was run twice, once with rail electrification schemes and once without.	Final savings.	60 years which is the nominal life of the electrification infrastructure.	REM was run twice, once with rail electrification schemes and once without. The expected savings are the difference between the outputs of these two runs, converted to TWh. The savings presented by electrification are considered additional to business as usual. This is because government intervention – both in terms of policy and funding - is required to deliver rail electrification schemes. This is partly because of the high capital costs involved but also because of the impact of electrification on the wider rail system (such as the need to introduce new electric trains).	We model the scheme net of the counterfactual and consider overlap with other related policies.	The design of electrification schemes takes account of expected changes in climate eg. wind loadings and temperature variation, over the design life of the infrastructure.

Scheme/Measure	Measurement methods used	Method to express the energy savings (primary or final savings)	Lifetime of measures	Description of the calculation methodology	Information on how double counting of energy savings is avoided	Climatic variations and approach used
Re:Fit	Energy saving estimates are based on the performance of previous projects under the London Re:Fit scheme, which have been used to estimate: • The expected number of projects that will be completed each year • The expected average capital value of projects • The expected average payback timescale of the projects	Final savings.	Given the wide variety of measures, there is a large range of lifetimes, as is standard in energy efficiency measures, for the improvements from 6-15 years.	Energy saving estimates are considered deemed savings which are based on the performance of previous projects under the London Re:Fit scheme, which have been used to estimate: • The expected number of projects that will be completed each year • The expected average capital value of projects • The expected average payback timescale of the projects. This has been used to estimate the average annual energy bill saving arising from the projects, which has been combined with an assumed electricity price to estimate the total energy savings from Re:Fit projects in a particular year out to 2020.	The Re:Fit team checks estimated savings and ensures that these are reported through the client's mechanism with Re:Fit maintaining an overview.	Every proposal under the scheme contains a measurement and verification plan which takes account of climatic variation in calculating the technological savings to be achieved.

Scheme/Measure	Measurement methods used	Method to express the energy savings (primary or final savings)	Lifetime of measures	Description of the calculation methodology	Information on how double counting of energy savings is avoided	Climatic variations and approach used
				This has been used to estimate the average annual energy bill saving arising from the projects, which has been combined with an assumed electricity price to estimate the total energy savings from Re:Fit projects in a particular year out to 2020. All projects within the scheme are additional and we have assumed that all savings are expressed as electricity.		

Scheme/Measure	Measurement methods used	Method to express the energy savings (primary or final savings)	Lifetime of measures	Description of the calculation methodology	Information on how double counting of energy savings is avoided	Climatic variations and approach used
Salix Public Sector Finance	The forecast number of Salix projects is determined by the level of funding. While some elements are confirmed due to the recycling of funding from loan repayments, there is no guarantee that the scheme will receive new funding in any year.	Final savings.	Where a public sector body identifies that a project will be installed on a site with an estimated lifespan which is lower than the technology lifespan, the site life will be used in the lifetime savings calculations. A distribution of persistence factors has been calculated based on the persistence factors for different types of energy efficiency projects. The energy savings from an energy efficiency project are assumed to reduce with time. Energy savings are assumed to reduce from 100% in years 1, 2, 3 and 4 to 98% in year 5 and 96% in year 6.	An average annual energy saving of 2.6 kWh per £1 invested is assumed, and this is based on SEELS projects carried out in 2012/13, 2013/2014 & 2014/2015. There are a number of factors which can affect this, primarily the mix of projects which reduce heating consumption (predominantly gas) or electricity use. It is worth noting that Salix has funded a number of projects, largely CHP, which give carbon and financial savings through a reduction in electricity consumption, but result in a net increase in kWh consumption, due to the increase in gas usage. These projects are factored into the average.	All applications are subject to the same technical assessment procedures. Checks made include a comparison of variables such as payback with a knowledgebase consisting of previously funded projects. This allows Salix to check for any which fall out of normal limits. Additional checks include manual review of supporting information such as calculations and technical literature for the proposed energy-efficiency technology.	The impact of climatic variation, such as varying hours of darkness or heating degree-days, may have on the savings estimated for projects will differ dependent on the type and location of the project being undertaken. As public sector bodies are aware of the specific climatic variations for their region and how these impact projects, this impact will form part of their estimation of savings prior to submission to Salix.

Scheme/Measure	Measurement methods used	Method to express the energy savings (primary or final savings)	Lifetime of measures	Description of the calculation methodology	Information on how double counting of energy savings is avoided	Climatic variations and approach used
				In this analysis it has been assumed that over two-thirds of the energy savings are additional to existing measures and would not have been realised without Salix.		
Smart Metering	In the non-domestic sector, we assume that smart/advanced meters, together with provision of data, reduce energy consumption by 2.8% (electricity) and 4.5% (gas) per meter in central scenarios. The primary source of evidence for this is a trial of advanced metering in 538 SME sites carried out by the Carbon Trust in 2007.[434] The savings for this policy are considered deemed savings.	Final savings.	An installed smart meter has an assumed lifetime of 15 years. Savings are included since the beginning of the smart meter rollout in 2013.	The calculation methodology used is consistent with the approach set out in the 2019 Smart Meter Cost Benefit Analysis[435].	Double counting is avoided by the method utilised. An energy savings rate is calculated, and then applied to a fixed average consumption figure for non-domestic properties covered by the smart meters mandate. The energy savings percentage was derived from a controlled study, which removed any possible impacts from other energy saving measures.	No climatic variations are considered in the analysis. Energy savings assumptions have been informed by trials both in the UK and internationally and, as a result of this, the observed energy reduction anticipated will already reflect climatic variations.

[434] www.carbontrust.com/resources/reports/technology/advanced-metering-for-smes
[435] www.gov.uk/government/publications/smart-meter-roll-out-cost-benefit-analysis-2019

Scheme/Measure	Measurement methods used	Method to express the energy savings (primary or final savings)	Lifetime of measures	Description of the calculation methodology	Information on how double counting of energy savings is avoided	Climatic variations and approach used
Northern Ireland Sustainable Energy Programme (NISEP)	The Energy Saving Trust (EST) uses a SAP based model[436] as the main source of assessing the energy savings from domestic schemes. The model calculates the energy requirements of domestic dwellings and estimates the likely savings resulting from energy efficiency improvements.	Final savings.	Cavity wall insulation (40 years) Internal/external solid wall insulation (36 years) Loft insulation (30 years) Efficient boiler (15 years) Hot water cylinder and pipe insulation (10 years) Energy efficient lighting (various) Domestic refrigeration and appliances (various) Commercial technologies (various)	Primary Bidders are required, as part of the post-implementation reporting of schemes, to fill in a spreadsheet with the number of and types of measures installed in different types of properties. The spreadsheet, compiled by EST, then automatically calculates the energy savings achieved. So that the savings of different fuels can be expressed in a consistent manner, the savings are calculated in 'fuel standardised' terms that reflect the fuel's carbon content. The carbon factors used are consistent (with the exception of electricity which is derived from the generation mix on the island of Ireland) with those published by Defra.	UR/EST works with the Northern Ireland Housing Executive/ Department for Communities (DfC) to ensure there is no double counting of measures installed under NISEP with the DfC funded Affordable Warmth Scheme. This includes annual assessment of data provided by DfC/NIHE.	Not applicable. The NISEP funding is only for measures installed within Northern Ireland and there is no substantial climatic variation across the country.

[436] Housing model build using the government's Standard Assessment Procedure (SAP) methodology 2012.

Scheme/Measure	Measurement methods used	Method to express the energy savings (primary or final savings)	Lifetime of measures	Description of the calculation methodology	Information on how double counting of energy savings is avoided	Climatic variations and approach used
Welsh Government Energy Service	The project is deemed completed when all installations have taken place, the equipment has been commissioned and has started generating savings for the PSB and all internal completion documents have been signed off. Only then will funding be provided.	Final savings.	Where a public sector body identifies that a project will be installed on a site with an estimated lifespan which is lower than the technology lifespan, the site life will be used in the lifetime savings calculations. A distribution of persistence factors has been calculated based on the persistence factors for different types of energy efficiency projects. The energy savings from an energy efficiency project are assumed to reduce with time. Energy savings are assumed to reduce from 100% in years 1, 2, 3 and 4 to 98% in year 5 and 96% in year 6.	The repayment value is expected as a direct result from savings projected in energy bills achieved from the completion of the project, making the funding self-sufficient.	All applications are subject to the same technical assessment procedures. Checks made include a comparison of variables with a knowledge base consisting of previous projects.	Not applicable.

Scheme/Measure	Measurement methods used	Method to express the energy savings (primary or final savings)	Lifetime of measures	Description of the calculation methodology	Information on how double counting of energy savings is avoided	Climatic variations and approach used
Warm Homes Programme	The average improvement in the energy performance rating (which is measured by Standard Assessment Procedure, or SAP) of each property receiving assistance in 2018/19 was 14.1 points.	Final savings.	Not currently estimated as beneficiaries of the schemes are not currently able to apply for a further grant once a grant for works has been approved.	Warm Homes Programme schemes publish annual reports setting out carbon savings for schemes during the reporting year.	Improvements in energy efficiency are reported to Welsh Government by the scheme agents. Benefits delivered by the scheme agents using funding from UK government schemes are disaggregated.	Not applicable. The Warm Homes Programme treats Wales as a single climatic zone and offers the same set of range of solutions to all households regardless of location and local climate.
Boiler Plus	The energy savings estimates as a result of this regulation change are considered in terms of how the energy savings benefits will accrue in the case that all households make the same technology choice e.g. the installation of load compensators.	Final savings.	Heating controls are expected to have a lifetime of 15 years, so this policy covers one replacement cycle of the English household stock. The benefits are continued to be collected for a further period of 15 years from the last year of installations.	Consumers are assumed to be driven by two distinct motives when making the choice, cost minimisation (minimise up-front costs, so choosing the lowest technology cost option i.e. load compensator) or benefit maximisation (optimising annual bill savings over the lifetime i.e. choose the highest performing technology of the choice list which is the learning thermostat).	The policy impacts estimated does not overlap with other policies, so any estimated impacts are considered additional.	Not applicable.

Scheme/Measure	Measurement methods used	Method to express the energy savings (primary or final savings)	Lifetime of measures	Description of the calculation methodology	Information on how double counting of energy savings is avoided	Climatic variations and approach used
Streamlined Energy and Carbon Reporting Framework (SECR)	In addition to information on GHG emissions, energy usage and a chosen emissions intensity ratio, reports must include a narrative description of measures taken to improve the businesses' energy efficiency in that year. Where possible, resulting energy saving from the actions reported should also be stated. If no measures have been taken this should also be included.	Final savings.	Reporting is done annually.	The methodology used by companies must be disclosed in their reporting and although no methodology is prescribed, it must be robust, transparent and widely accepted.	Detailed guidance published to assist companies in adopting best practice and thereby avoid double counting.	Not applicable. Reporting is done at entity level.

5. Monitoring and verification

Scheme/Measure	Description of the monitoring and verification system and the process of verification	Implementing public authority	Independence of monitoring and verification from obligated parties	Reporting obligations for obligated parties	Member State law on penalties to be applied in the case of non-compliance
Energy Company Obligation (ECO)	There is a statutory requirement on OFGEM, the administrator of the ECO scheme to determine whether an obligated supplier has achieved its obligation. In line with requirements under EED, OFGEM requires suppliers to conduct technical and score monitoring inspections on ECO measures to ensure the required standards of installation are met and measures are scored accurately. Technical monitoring verifies whether measures have been installed to the relevant installation standards by a person of appropriate qualification and expertise. Score monitoring verifies that the installer of a measure has selected the correct deemed score based on the characteristics of the property where the measure was installed	OFGEM is currently required to oversee monitoring of the ECO scheme and verify that an obligated supplier has met its targets. It was recently decided to integrate a Government Endorsed Quality Scheme, TrustMark, into the ECO scheme, requiring that relevant measures must be installed by a TrustMark registered business or equivalent. The greater oversight across the market, provided by Trustmark, is expected to increase standards and give the consumers better protection.	Monitoring must be carried out by a suitably qualified monitoring agent which is independent from the obligated supplier, installer, any party involved in the installation or assessment of the measure and any party that has control or ownership of the premises.	When notifying an installed measure to OFGEM, obligated suppliers provide information about that measure. OFGEM may audit suppliers' compliance with their legislative requirements so suppliers must make sure that they have relevant documents available on request. OFGEM is required to submit to the Secretary of State a report each month setting out the progress which participants have made towards achieving their obligation. BEIS publishes monthly government statistics on ECO.[437]	OFGEM, which is also the energy market regulator, deals with compliance and enforcement. There has only been minor non-compliance since the scheme began in 2013, which has generally been dealt with by way of 'alternative action' agreed between OFGEM and the relevant supplier, such as non-statutory undertakings or assurances to ensure future compliance or voluntary action by a company. For example, in one case a supplier paid into a redress fund. OFGEM also has statutory enforcement options including issuing final/provisional orders, imposing financial penalties and making consumer redress orders. Where OFGEM has concerns around a supplier's delivery progress, they increase the level of engagement to identify what the delivery barriers are and assist where possible in overcoming them.

[437] https://data.gov.uk/dataset/1656fb7d-1ca3-462d-a11b-8078acc33275/household-energy-efficiency-statistics

Scheme/Measure	Description of the monitoring and verification system and the process of verification	Implementing public authority	Independence of monitoring and verification from obligated parties	Reporting obligations for obligated parties	Member State law on penalties to be applied in the case of non-compliance
	To ensure that monitoring conducted by a supplier is representative of both the installers used and the measure types notified, for both technical and score monitoring, a supplier must: Monitor at least 5% of measures of each measure type notified in a quarter; Monitor at least 3% of measures notified as being installed by a single installer in a quarter; Monitor at least one measure for any subset that is fewer than 100 measures. Using notification data, OFGEM can determine whether these 'minimum monitoring rates' have been met. Where they haven't, they request further inspections. For each installer, OFGEM set a minimum pass rate. If this is not met, OFGEM will place the set of measures on a pathway to compliance, which requires suppliers to take further actions to provide them with confidence in the quality and accuracy of the measures concerned.	The TrustMark Framework requires compliance and certification with installation standards for relevant ECO measures and has developed systems for checking that certification is current and in place for the measures being delivered by installers. TrustMark is in the process of creating a monitoring framework that takes over from Ofgem the responsibility of administering technical monitoring for measures delivered within the TrustMark framework. The expectation is that responsibility for technical monitoring will start to be transitioned to TrustMark for such measures. TrustMark is due to begin a pilot programme during spring 2020 as part of the development of their framework.			With regard to those measures that are to be installed by TrustMark registered businesses, to ensure a smooth transition embedding the new TrustMark quality scheme into the ECO scheme, OFGEM will retain a role in dealing directly with compliance and enforcement of specific installation standards and financial protection requirements for a transitional period, after which compliance and enforcement in respect of those specific requirements will be directly dealt with by TrustMark in line with its own framework.[438]

[438] www.trustmark.org.uk/docs/default-source/framework-operating-requirements/trustmark-framework_version-1_4oct2018.pdf?sfvrsn=51659307_12

Scheme/Measure	Description of the monitoring and verification system and the process of verification	Implementing public authority	Independence of monitoring and verification from obligated parties	Reporting obligations for obligated parties	Member State law on penalties to be applied in the case of non-compliance
		During this pilot programme, we expect Ofgem to continue to administer technical monitoring as normal. TrustMark will assume full responsibility for technical monitoring for measures delivered within the TrustMark framework once the pilot is completed successfully, which is expected by June 2021 at the latest.			

Scheme/Measure	Description of the monitoring and verification system and the process of verification	Implementing public authority	Independence of monitoring and verification from obligated parties	Reporting obligations for obligated parties	Member State law on penalties to be applied in the case of non-compliance
Building Regulations – Domestic and Non-Domestic (New and existing build)	The Building Regulations require that an approved methodology be used for showing compliance with energy performance requirements. The national calculation methodology for setting and showing compliance with the energy performance requirements for new houses and apartments is the Standard Assessment Procedure (SAP). For most non-residential buildings the approved methodology is the Simplified Building Energy Model (SBEM). Dynamic Simulation Models are approved for use to calculate energy performance requirements for more complex non-residential buildings. These approved methodologies take into account all of the requirements of the common general framework for the calculation of energy performance at Annex 1 of the Energy Performance of Buildings Directive (EPBD).	Building control bodies check that building work has been carried out according to the building regulations. Building control bodies can either be from the local council or the private sector (called 'approved inspectors'). In some cases the installer can certify themselves that their work complies. The Ministry of Housing, Communities and Local Government (MHCLG) is in charge of authorising competent person schemes. To make sure that the standards are consistent, there are rules that scheme operators must follow and conditions of authorisation they must meet including having robust systems for assessing members competences, physically checking members work and effective sanctions for cases of non-compliance or breaches of scheme rules.	Only Building Regulations compliance submissions that use approved calculation methodologies and software applications will be accepted as evidence of compliance by Building Control Bodies enforcing the energy performance requirements. Building Control Bodies cannot give a compliance certificate for a new building until they are satisfied that the building's actual carbon dioxide emission rate does not exceed its target emission rate as calculated using approved calculation methodologies and their software applications.	Not applicable. Compliance and enforcement of standards pertaining to fixed building services is the responsibility of Building Control.	The Local Authority has a duty to enforce the Building Regulations in its area and will seek to do so by informal means wherever possible. If a person carrying out building work contravenes the Building Regulations, the Local Authority may decide to take them to the magistrates' court where they could be fined up to £5,000 for the contravention, and up to £50 for each day the contravention continues after conviction (section 35 of the Building Act 1984). This action will usually be taken against the builder or main contractor, and proceedings must be taken within two years from the completion of the work. Alternatively, or in addition, the local authority may serve an enforcement notice on the owner requiring them to alter or remove work which contravenes the regulations (section 36 of the 1984 Act).

Scheme/Measure	Description of the monitoring and verification system and the process of verification	Implementing public authority	Independence of monitoring and verification from obligated parties	Reporting obligations for obligated parties	Member State law on penalties to be applied in the case of non-compliance
			Similarly, only qualified and accredited energy assessors using approved calculation methodologies and software applications can lodge data onto the national register of energy performance certificates. Register security protocols automatically prevent all other software and persons from doing so.		

Scheme/Measure	Description of the monitoring and verification system and the process of verification	Implementing public authority	Independence of monitoring and verification from obligated parties	Reporting obligations for obligated parties	Member State law on penalties to be applied in the case of non-compliance
Climate Change Agreements	Data on scheme participants' energy use or total number of tonnes of carbon dioxide equivalent emitted is reported to the Environment Agency by Target Units every two years. A report is published by the Environment Agency following the end of each Target Period. Guidance on data reporting and verification is contained within the CCA Operations Manual (Chapter 10).[439] Audits may be conducted by the Environment Agency. The Environment Agency carries out audits on selected target unit operators and sector associations through the lifetime of the scheme to verify eligibility and performance. This follows a mixed risk based and random selection approach. There is no quota for the number of participants to be audited. If an operator does not take action in response to audit recommendations within the agreed timescale, a penalty may be imposed on the operator or, in the worst case, their agreement may be terminated due to non-compliance.	Environment Agency (EA)	The EA is independent of obligated parties.	Data on scheme participants' energy use or total number of tonnes of carbon dioxide equivalent emitted is reported to the Environment Agency by Target Units every two years.	As part of the milestone reviews, the EA may issue financial penalties to an operator. In line with article 13 the penalty system in the new CCA scheme is designed to be flexible and aims to promote compliance to ensure the success of the scheme. Financial penalties may be issued on the basis that an operator: Fails to report by 1 May following the end of the target period; Fails to provide any further information the EA has requested by the deadline set; Provides inaccurate information; Doesn't tell the EA about any changes to their operations that would affect its CCA.

[439] www.gov.uk/government/publications/climate-change-agreements-operations-manual--2

Scheme/Measure	Description of the monitoring and verification system and the process of verification	Implementing public authority	Independence of monitoring and verification from obligated parties	Reporting obligations for obligated parties	Member State law on penalties to be applied in the case of non-compliance
CRC Energy Efficiency Scheme	CRC participants must keep records to validate any information they have submitted about their organisation, energy supplies and use. They should keep this in an evidence pack that the regulators can examine during an audit. They also need to carry out their own internal audit of their records at least once a year. Their evidence pack must include an audit certificate signed by a senior officer.	The CRC is fully monitored by the Environment Agency (EA). The EA ensures compliance amongst participants with a programme of audits based on risk assessment with additional financial penalties levied on those found not to have complied, along with publication of non-compliance. The enforcement action is set in legalisation and a guide is published to help participants understand how this works.	An organisation's regulator in England, Scotland, Wales or Northern Ireland may carry out an audit to check they are keeping sufficient records in their evidence pack and reporting their emissions accurately. The regulator will either carry out the audit itself or use its trained and approved contractors.	CRC participants must keep records to validate any information they have submitted about their organisation, energy supplies and use. They should keep this in an evidence pack that the regulators can examine during an audit. They also need to carry out their own internal audit of their records at least once a year. Their evidence pack must include an audit certificate signed by a senior officer.	The Environment Agency can issue civil penalties to organisations that don't comply with the CRC obligations by the deadlines set. It can also publish on this website the name of the organisation receiving the civil penalty, details of the failure and the penalty amount. Organisations could incur civil penalties if they don't: • Register • Disclose info on registration • Submit an annual report on time • Provide accurate info or notifications • Provide an accurate annual report • Surrender allowances • Maintain an evidence pack

Scheme/Measure	Description of the monitoring and verification system and the process of verification	Implementing public authority	Independence of monitoring and verification from obligated parties	Reporting obligations for obligated parties	Member State law on penalties to be applied in the case of non-compliance
Energy Savings Opportunity Scheme (ESOS)	ESOS audits can be conducted in-house or by external professionals but audits must be reviewed for compliance with ESOS by a qualified lead assessor, who must belong to a register maintained by a professional body and approved by the scheme administrator. ISO 50001 is also a valid compliance route if covering at least 90% of an organisations total energy consumption, requiring a valid ISO certification.	The Environment Agency is the scheme administrator for the whole of the UK. As such, it is responsible for receiving notifications of compliance from ESOS participants, maintaining guidance on compliance and approving registers of Lead Assessors. Responsibility for compliance and enforcement rests with the EA in England and the equivalent devolved agencies in Scotland, Wales and Northern Ireland.	Responsibility for monitoring and enforcing ESOS will lie with independent public bodies (the EA in England, the Scottish Environment Protection Agency, Natural Resources Wales and, in Northern Ireland, the Northern Ireland Environment Agency).	Qualifying organisations must measure their total energy consumption and carry out audits of the energy used by their buildings, industrial processes and transport to identify cost-effective energy saving measures, to help stimulate uptake of cost-effective energy efficiency potential by 5 December 2015 and every four years thereafter.	Three types of notice are available under the ESOS Regulations. 1. A compliance notice – This is an information request from the regulator to the participant requesting information to enable the regulator to determine if the participant is complying with its obligations under ESOS 2. An enforcement notice – informing the participant what to do to comply with a requirement of ESOS 3. A penalty notice – this imposes civil penalties for breaches of the ESOS regulations. Participants who fail to comply with the scheme could be fined in the region of £5,000 to £50,000 for non-compliance as per paragraph 43-47 of the ESOS Regulations; however penalties are subject to the nature of the non-compliances and are at the discretion of the regulators.

Scheme/Measure	Description of the monitoring and verification system and the process of verification	Implementing public authority	Independence of monitoring and verification from obligated parties	Reporting obligations for obligated parties	Member State law on penalties to be applied in the case of non-compliance
Low Emission Vehicles	Vehicles are accepted onto the scheme on the basis of a clear, published set of eligibility criteria.[440] Applications are assessed by an expert panel made up of officials from Vehicle Certification Agency (VCA), Department for Transport (DfT) and Department for Business, Energy and Industrial Strategy (BEIS). Dealerships are required to check the identity of grant claimants to ensure they are UK residents. Plug-in grant claims are submitted by dealerships via an online claims portal administered on behalf of OLEV by DVLA-. The key stage is an online verification process which automatically cross checks the vehicle's registration number against the DVLA database to ensure it is an eligible vehicle – i.e. one that meets the PICG eligibility criteria and is registered for use on UK roads. In order to be eligible for the grants, vehicles must meet criteria for carbon emissions and zero emission range.	OLEV is made up of officials from DfT and BEIS. OLEV is a team working across UK government to support the early market for ultra-low emission vehicles (ULEVs). OLEV provides support to position the UK at the global forefront of ULEV development, manufacture and use.	Vehicles are assessed by a cross-departmental panel of BEIS, DfT and VCA specialist experts on their eligibility criteria, including checking the emissions of the vehicles.	5% of claims are randomly selected for audit through the online claims process. The current sample size is dependent on the level of inaccuracies found so is kept under review. This audit is administered by DVLA who administer the online claims process. Those selected are required to produce additional documentation including invoices to demonstrate that a sale of an eligible vehicle took place, and that the grant was applied correctly. OLEV are in contact with manufacturers whose responsibility it is to ensure that the claims are accurate.	Not applicable. There are no penalties outlined for non-compliance as it is not a statutory scheme.

[440] www.gov.uk/government/publications/plug-in-car-grant

Scheme/Measure	Description of the monitoring and verification system and the process of verification	Implementing public authority	Independence of monitoring and verification from obligated parties	Reporting obligations for obligated parties	Member State law on penalties to be applied in the case of non-compliance
Private Rented Sector Regulation (England & Wales) – Domestic	When a tenant makes a request for consent for energy efficiency improvements under the Regulations, the installation of those improvements must be undertaken by a person who meets the relevant installer standards. Where works are paid for by a Green Deal finance plan, only an authorised Green Deal Installer can install energy efficiency improvements. Additionally, only authorised installers can identify themselves as 'Green Deal Installers' and use the Green Deal Quality Mark.	The Regulations state that Local Authorities will be the enforcement body for the domestic sector.	A review of the regulations is required at least every 5 year. An evaluation has been commissioned to collect evidence on the impact of the regulations and is being delivered by an independent.	There are no formal reporting duties for local authorities who are the enforcement body for the domestic PRS.	Enforcement bodies will determine whether and when a civil penalty should be imposed. Any penalty notice must be reviewed by the enforcement body at the landlord's request, and in the event of a dispute, the matter may be referred to a Tribunal. Non-compliance occurs where a private rental property leased to a new tenant or a renewing tenant after 2018 (or all tenants after the back-stop date) which does not meet the E EPC rating and is not registered on the PRS Exemptions database. There are also penalties for providing false or misleading information.

Scheme/Measure	Description of the monitoring and verification system and the process of verification	Implementing public authority	Independence of monitoring and verification from obligated parties	Reporting obligations for obligated parties	Member State law on penalties to be applied in the case of non-compliance
Private Rented Sector Regulation (England & Wales) – Non-Domestic	The enforcement authority is responsible for ensuring properties meet the minimum energy efficiency standards of EPC E. They have access to the PRS Exemptions Register and rights to issue compliance notice and penalties to ensure properties in scope meet requirements.	The Regulations state that local weights and measures authorities will be the enforcement body for the non-domestic sector.	A review of the regulations is required at least every 5 years. The enforcement authority may carry out audits on exemptions registered on the PRS Register to verify evidence submitted.	There are no formal reporting duties for local weights and measures who are the enforcement body for the domestic PRS.	Enforcement bodies will determine whether and when a civil penalty should be imposed. Any penalty notice must be reviewed by the enforcement body at the landlord's request, and in the event of a dispute, the matter may be referred to a Tribunal. Non-compliance occurs where a private rental property leased to a new tenant or a renewing tenant after 2018 (or all tenants after the back-stop date) which does not meet the E EPC rating and is not registered on the PRS Exemptions database. There are also penalties for providing false or misleading information.

Scheme/Measure	Description of the monitoring and verification system and the process of verification	Implementing public authority	Independence of monitoring and verification from obligated parties	Reporting obligations for obligated parties	Member State law on penalties to be applied in the case of non-compliance
Rail Electrification	Trains using this new electrification infrastructure will be fitted with energy meters complying with accuracy limits prescribed by domestic (Railway Group Standards) or EU Regulations that will measure electricity consumption and allow this to be compared to historic diesel consumption data. Network Rail has established a comprehensive protocol governing how this data is provided through a metering data interface specification. In this way the energy and carbon benefits (using diesel and power generating emission factors) can be accurately assessed.	Railway Group Standards	As part of its rail franchising programme, the Department for Transport will require operators of train franchises to collect robust data on environmental impacts including energy consumption and carbon emissions. This includes a requirement to have environmental and energy management systems compliant with and audited against ISO14001 and ISO50001.	In order to be billed for electricity consumption, the electrification infrastructure provider (Network Rail) requires train operators to introduce appropriate monitoring and verification processes and also stipulates minimum accuracy requirements for the electricity meters themselves.	The fitting of energy metering equipment (on ground and on board) is now covered in the EU Energy Technical Specification for Interoperability; 'COMMISSION IMPLEMENTING REGULATION (EU) 2018/868 of 13 June 2018 amending Regulation (EU) No 1301/2014 and Regulation (EU) No 1302/2014 as regards provisions on energy measuring system and data collecting system'. These standards are enforced by the ORR under the Railways Interoperability Regulations 2011.

Scheme/Measure	Description of the monitoring and verification system and the process of verification	Implementing public authority	Independence of monitoring and verification from obligated parties	Reporting obligations for obligated parties	Member State law on penalties to be applied in the case of non-compliance
Re:Fit	All contractors will have been through an OJEU tender process to verify their suitability to be part of the Re:Fit framework. Overall the public body is assessing the contractor's ability to deliver alongside its partner fit with the public sector for the duration of the project. Public bodies wishing to procure energy efficiency improvements through the Re:Fit scheme detail the requirement for the tender in terms of the nature of their buildings, the amount of capital they are prepared to invest, the level of energy saving they would like to achieve and the payback periods. A mini procurement competition is then run amongst the pre-tendered panel of 13 Energy Service Companies (ESCOs) who will produce bids based on the requirement including visiting the buildings.	Local Partnerships, which runs the England-wide roll-out of Re:Fit, provides BEIS with quarterly returns detailing the projects delivered under the scheme and the level of estimated savings attached to each, along with any additional information that is required. If it became clear the scheme was not delivering value for money Local Partnerships and BEIS would consider whether it was appropriate to continue to fund the programme.	How the ESCOs monitor is a contractual decision between the ESCO and the client. Some choose to employ third parties, whilst others will leave the monitoring to the relevant ESCO.	After bidding, the ESCOs will then produce an investment grade proposal including the detailed design of the improvements along with a guaranteed forecast for how the building’s energy bills will reduce. The forecast energy savings do not include energy price inflation and exclude savings in maintenance costs. The performance of the improvements is then monitored through the energy bills of the relevant buildings relative to the ESCO’s plan. There is a requirement for ESCOs to monitor built into both the Re:Fit framework and the contract between the ESCOs and the client.	Not applicable. If the agreed cost savings are not met, ESCOs must install extra measures to reach the agreed cost savings or pay the clients the difference. This model provides a financial motivation for the ESCOs to ensure the guaranteed savings are achieved.

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Salix Public Sector Finance	The assessment methodology undertaken by Salix does not in itself directly confirm that the reported savings will be achieved. It is a framework that delivers energy saving measures, ensuring that everything possible is done to complete the projects and realise the associated energy savings. The methodology includes procedures for detecting those projects with unusual costs or forecast savings so that Salix can check that the approach taken by the Public Sector bodies is appropriate for estimating the likely savings.	As the key funder of the Salix scheme, if the scheme does not effectively perform, BEIS can simply cease funding.	Salix has engaged KPMG LLP (UK) (Chartered Accountants) to provide assurance over the application of the procedures and processes which Salix operates in order to ensure the consistency of approach, reliability and appropriateness of the estimates of carbon savings generated by clients for the projects which they undertake. As part of this audit, projects committed in the previous financial year are selected at random so that they can be tested, and the client interviewed to ensure all required processes have been followed. If an audit highlighted any issue, it would be raised with the board. If the issue continued, DECC could be consulted.	Business cases for larger projects include details of monitoring and verification plans to be put in place on completion of projects. Post-project audits on specific funded projects are undertaken as part of the limited assurance audit and this will include confirming that the savings have been achieved.	Not applicable. There are no penalties outlined for non-compliance as it is not a statutory scheme.

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Smart Metering	Energy suppliers are required to install smart meters which are compliant with the Smart Metering Equipment Technical Specifications (or advanced meters which meet the requirements of gas and electricity supply licence conditions).	Ofgem's role as the energy industry regulator is to ensure that consumers remain protected during the rollout and to monitor suppliers' compliance with their obligations, as well as enforce these where needed through their financial penalties and consumer redress policy.	Ofgem is the GB independent energy regulator.	Energy suppliers are required by licence conditions to submit plans and report the progress of their non-domestic smart meter roll out to Ofgem. For larger suppliers, these plans must consist of two sections: a) progress against annual milestones, including quantitative data highlighting the percentage of domestic and smaller non-domestic premises which have a smart or relevant advanced meter installed by the end of the calendar year; b) a narrative section, in which suppliers explain any difference between their submitted milestone for the previous calendar year and their actual performance.	Ofgem hold all responsibility for imposing penalties in the case of non-compliance, as laid out in the Gas Act 1986 and the Electricity Act 1989. The Acts provide that any penalty must be reasonable. Ofgem must have regard to its statement of policy with respect to penalties, which provides that penalties should be proportionate and act as a deterrent; penalties imposed must pay regard to the principle that 'non-compliance should be more costly than compliance' and that enforcement should deliver strong deterrence against future non-compliance.[441] Ofgem have outlined that they will consider enforcement action where annual milestones have been missed, as well where the overall 2020 obligation has not been achieved.[442]

[441] www.ofgem.gov.uk/publications-and-updates/statement-policy-respect-financial-penalties-and-consumer-redress
[442] www.ofgem.gov.uk/publications-and-updates/decision-supplier-reporting-ofgem-during-smart-meter-rollout

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				Smaller suppliers are required to submit annual progress updates on the number of smart meters they have installed by the end of the preceding calendar year. Ofgem have also published proposals for a new reporting framework in light of the Government consultation on a proposed new post-2020 smart meter rollout obligation.[443]	

[443] www.ofgem.gov.uk/publications-and-updates/statutory-consultation-post-2020-smart-meter-rollout-reporting-requirements

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Northern Ireland Sustainable Energy Programme (NISEP)	The Energy Saving Trust (EST) engages a professionally qualified auditor or accountant to carry out audits on all completed schemes to ensure Primary Bidders are implementing the schemes as required. This includes checking paperwork that provides evidence that the quality assurance requirements have been carried out. If any quality issues are discovered at the audit stage, the Primary Bidder will be asked to rectify them and any incentive payment (Primary Bidders can earn an incentive by exceeding cost-effectiveness targets set for individual schemes) due will be withheld until the necessary work has been carried out. The Utility Regulation (UR) will seek assurance from Primary Bidders that any quality issues with previous schemes have been sorted out before any further funding is awarded in the next round of bidding.	The UR oversee the NISEP and have overall responsibility, including final approval of decisions and policy direction, for the programme. The EST acts as Programme Administrator responsible for day to day management of the programme including liaison with Primary Bidders (organisations undertaking schemes), processing payment claims, reporting and auditing.	Primary Bidders are responsible for quality assurance and monitoring of installations carried out under their schemes. Primary Bidders must engage a qualified inspector, independent from the party carrying out the installations, to carry out the quality inspections. The Primary Bidder must meet all relevant standards in accordance with the Framework Document. It is the responsibility of the Primary Bidder to ensure that any work carried out by scheme participants conforms to best practice customer satisfaction and quality standards, and that all customers are provided with the appropriate guarantees and warranties.	The EST selects a sample of schemes from each Primary Bidder for audit. The audit covers, financial information, procurement, installation of measures, delivery mechanisms, energy savings, additionality and monitoring (customer and quality) processes.	Agreement between UR and the Primary Bidder permits the UR to ask for the return of any funds that have been mis-spent or not spent in accordance with the Framework Document. The UR adopts a policy of zero intolerance to fraud and as part of the registration process to become a Primary Bidder a company's policy on fraud must be submitted.

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			The Primary Bidder must apply for Building Control for all domestic measure installs i.e. heating and insulation, evidence of which is requested as part of the monthly claim process and the audit. A valid cavity wall insulation guarantee certificate must be provided to the customer when cavity wall insulation work has been completed. A copy of the certificate is requested as part of the monthly claim process and the audit.		

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Welsh Government Energy Service	The project is deemed complete when all installations have taken place, the equipment has been commissioned and has started generating savings for the Public Sector Body (PSB) and all internal completion documents have been signed off. At this stage the applicant will submit the Completion Certificate to Salix, clearly outlining any changes to costs and scope of the project since application and the reasons. Any changes to the project scope, which includes the number of fittings or size of equipment and their impact on energy savings, must be supported by the submission of a compliance tool with the updated annual energy savings figures and attached savings calculations to support the changes.	The key funder of the energy service is the Welsh Government.	Responsibility for monitoring and enforcing will lies with Salix. Where required, Salix will conduct a technical assessment on the revisions before proceeding with the completion and payment steps.	Successful applicants must provide regular updates on progress of the project in order to ensure that project completion is progressing as agreed. Failure to do so may result in funding being returned. Projects which increase in cost to the extent that they are no longer compliant with the programme's criteria cannot be funded unless the public sector body is prepared to cover the additional costs. Clear visibility on key project milestones, inclusion of contingencies and evaluation of any risks to the project delivery is included in the application and forms a key part of the technical assessment.	Not applicable. There are no penalties outlined for non-compliance as it is not a statutory scheme.

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Warm Homes Programme	The measures installed will depend on the recommendations of a qualified and independent energy assessor following a Whole House Assessment of each property.	Welsh Government	The Warm Homes Programme are subject to independent periodic evaluation and subject to scrutiny by the Office of the Auditor General for Wales.	Not applicable. Compliance and enforcement of standards is the responsibility of the Office of the Auditor General for Wales.	Not applicable. There are no penalties outlined for non-compliance as it is not a statutory scheme.
Boiler Plus	The standards create an obligation on the person carrying out the work when a gas boiler is installed in and existing dwelling in England.	Compliance and enforcement of standards pertaining to fixed building services is the responsibility of Building Control.	Building Control have direct responsibility for ensuring quality standards are met, while the Gas Safe Register also contributes to quality assurance, although required only to monitor safety considerations. The boiler industry also adopts a range of self-regulation procedures, most notably the Benchmark checklist.	Not applicable. Compliance and enforcement of standards pertaining to fixed building services is the responsibility of Building Control.	Enforcement of these standards will be conducted through the present Building Regulations framework. The Local Authority has a duty to enforce the Building Regulations in its area and will seek to do so by informal means wherever possible. If a person carrying out building work contravenes the Building Regulations, the Local Authority may decide to take them to the magistrates' court where they could be fined up to £5,000 for the contravention, and up to £50 for each day the contravention continues after conviction (section 35 of the Building Act 1984). This action will usually be taken against the builder or main contractor, and proceedings must be taken within two years from the completion of the work.

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Streamlined Energy and Carbon Reporting Framework (SECR)	Qualifying companies will need to include information in line with the SECR framework in their Directors' Report, or an equivalent Energy and Carbon Report for LLPs, for financial years beginning on or after 1 April 2019.	Department for Business, Energy and Industrial Strategy (BEIS)	Whilst not a requirement, external verification or assurance is recommended as best practice to ensure the accuracy, completeness and consistency of data for both internal and external stakeholders.	The reporting requirements differ for quoted companies, large unquoted companies and LLPs. Requirements include energy use from electricity, gas and transport fuel, GHG emissions and emissions intensity metric for the current and previous reporting periods. Reporting exemptions exists for companies that can confirm their energy use is low - 40MWh or less over the reporting period. These companies will still need to include a statement in their report confirming that they are a low energy user. If preparing a group report, the low energy user threshold applies to the energy consumption of the parent group and its subsidiaries.	Aligned with requirements for UK companies to submit annual reports to Companies House – with, for example, financial (civil) penalties for late or incomplete filings.

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