Department of Energy & Climate Change

Updated energy and emissions projections 2015

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Executive Summary

This report presents projections of the UK's energy demand and Greenhouse Gas (GHG) emissions up to 2035. It projects UK energy use over the next two decades and assesses our progress towards national targets.

The national emission targets are called *carbon budgets*, legally binding limits on the total volume of carbon dioxide and other greenhouse gas emissions which can be emitted over a five year period. The UK emissions were below the first carbon budget (CB1: 2008 to 2012) of 3,018 $MtCO_2e$ (million tonnes of carbon dioxide equivalent) by 36 $MtCO_2e$. Table i indicates that the second and third carbon budgets, covering 2013 to 2022, are also likely to be achieved.

Taking into account the uncertainty around the projections, there is currently a shortfall against the fourth carbon budget (2023 to 2027) where our emissions are projected to be greater than the cap set by the budget. This challenge was acknowledged when the budget was set in 2011[1] and in the Government's recent response to the Annual Progress Report of the Committee on Climate Change[2].

Projections for emissions have increased since the 2014 update. This means that the shortfall we have over the fourth carbon budget has increased, from 133 $MtCO_2e$ last year[3] to 187 $MtCO_2e$. Previous projections[4] have reported a gap of this size. Much of the change is due to methodological revisions in the Land Use, Land Use Change and Forestry Sector (LULUCF), resulting in 44 $MtCO_2e$ out of an overall increase in emissions of 54 $MtCO_2e$ during the fourth carbon budget (CB4). The other major drivers of increased emissions (accounting for 26 $MtCO_2e$) are revisions to macroeconomic and demographic projections and, to a lesser extent, fossil fuel prices. Some of this is offset by updates to Government and EU policies which reduce emissions by an additional 16 $MtCO_2e$ over the fourth carbon budget CB4 compared with their 2014 estimates.

The Government is currently considering the right approach to reducing emissions over the fourth carbon budget period. After it sets the fifth carbon budget (by the end of June 2016) it will be able to set out more detail about its expectation for how it intends to meet the targets. It will publish a new emissions reduction plan at the end of 2016 which will set out the proposals in full.

UK primary energy demand is projected to fall 11% over the next 10 years reflecting an underlying energy efficiency trend and energy saving policies that step up the pace of gains in energy efficiency. Primary energy demand is expected to fall to 3% below current levels by the end of 2035.

The projections depict an illustrative pathway in which carbon dioxide emissions from electricity generation fall to around 100 gCO_2e/kWh in 2030 and to a sixth of current levels by 2035 as generation by low carbon technologies expands. This level of decarbonisation was assumed in last year's projections and is broadly consistent with the central case in the Electricity Market Reform Impact Assessment[5]. The Government may determine that other decarbonisation pathways are possible.

[1] The Fourth Carbon Budget – reducing emissions through the 2020s:
https://www.theccc.org.uk/publication/the-fourth-carbon-budget-reducing-emissions-through-the-2020s-2/

[2] Government response to 2015 progress report:
https://www.theccc.org.uk/publication/government-response-to-2015-progress-report/

[3] Energy and emissions projections 2014:
https://www.gov.uk/government/publications/updated-energy-and-emissions-projections-2014

[4] See Energy and Emissions Projections in 2011, 2012:
https://www.gov.uk/government/collections/energy-and-emissions-projections

[5] See DECC, "Electricity Market Reform Impact Assessment":
https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/225981/emr_delivery_plan_ia.pdf

Table i: Actual and projected emissions, $MtCO_2e$

Carbon budget:	1 (2008 – 2012)	2 (2013 – 2017)	3 (2018 – 2022)	4 (2023 – 2027)
Target	3,018	2,782	2,544	1,950
Central reference projection	2,982 (actual)	2,722	2,493	2,137
Range	—	2,707 to 2,738	2,444 to 2,540	2,072 to 2,206

These are cumulative values over five year carbon budget periods from 2008 to 2027. The entire range of uncertainty for carbon budget four exceeds the target indicating that this is unlikely to be met without further action.

1 Introduction

- Legally binding carbon budgets[6] are set for five year periods and are aimed at reducing emissions by at least 80% by 2050. Our carbon budgets are:
  - 2008 to 2012 (CB1); 2013 to 2017 (CB2); 2018 to 2022 (CB3);
  - and 2023 to 2027 (CB4)
- CB5 (2028 to 2032) will be set in June 2016
- Carbon budgets are particularly binding on emissions from sectors outside the EU ETS—so called non-traded emissions
- Chapter 4 sets out the projections of final and primary energy demand and reviews key trends. Chapter 5 sets out the projections of the electricity generation sector and its influence on non-traded emissions

About this document

Since the late 1970s, the Government has published projections of UK energy demand and supply, and in the 1990s these were extended to include projected carbon dioxide (CO_2) and other greenhouse gas (GHG) emissions as well. Today, the Department of Energy and Climate Change (DECC) is responsible for publishing these projections annually. This is the latest report in a series, providing up-to-date projections to 2035.

The projections bring together statistical and modelled information from a wide variety of different sources. Further details of the sources and methods are available in the methodology sections of previous publications[7].

The energy and emissions projections assess how likely it is that the UK will achieve future targets for GHG emissions. The targets, introduced by the 2008 Climate Change Act, are legally binding limits on the volume of GHGs that can be emitted. They are called *carbon budgets*[8] and each spans five years. They are set with a view to reducing total GHG emissions by at least 80% by 2050[9] from their 1990 level.

The first carbon budget covered 2008-2012 inclusive and the UK met it. Budgets have been set, and confirmed through secondary legislation, for three further periods: 2013 to 2017 inclusive, 2018 to 2022 and 2023 to 2027. The fifth carbon budget will be set by June 2016, covering the period for 2028 to 2032.

Compliance with the budgets is assessed by comparing the UK "Net Carbon Account" (NCA) against the carbon budget level. This has two components: emissions covered by the EU Emissions Trading Scheme (EU ETS) and those outside it.

[6] Progress on meeting carbon budgets:
https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/467818/DECC_CCC_Summary.pdf

[7] Energy and emissions projections:
https://www.gov.uk/government/collections/energy-and-emissions-projections

[8] For more details on the UK's climate change targets, including the carbon budgets, see:
https://www.gov.uk/government/publications/2010-to-2015-government-policy-greenhouse-gas-emissions/2010-to-2015-government-policy-greenhouse-gas-emissions

[9] Compared with a base year of 1990 for CO_2, CH_4 and N_2O, and 1995 for fluorinated gases:
https://www.theccc.org.uk/publication/building-a-low-carbon-economy-the-uks-contribution-to-tackling-climate-change-2/

GHG emissions which are part of the EU ETS include those from power generation and from large energy-intensive industrial plants. The actual level of these "traded sector emissions" is not incorporated in the NCA. Instead, the account includes the "cap" on the traded sector, based on the UK's share of the emissions allowed under the EU ETS. If UK emissions are above the cap, allowances must be purchased from elsewhere in the EU to cover the excess UK emissions.

The expected future level of the traded sector cap is included for comparison. Projections for the *actual* level of traded sector emissions can be found in the web tables[10].

The second part of the NCA covers all other non-traded GHG emissions. These emissions are not covered by the emissions trading system (EU ETS) and will change over time in line with key drivers such as changes in demographics and economic activity. This component is known as "non-traded sector emissions".

Chapter 2 assesses how likely the UK is to meet its carbon budget obligations and gives an overview of non-traded emissions by different economic sectors.

The UK Government develops and implements policies, including EU regulations, with the aim of reducing GHG emissions in line with the carbon budgets and EU commitments. These projections indicate the broad scale of further action that may be needed to keep emissions within the carbon budgets. This is the subject of chapter 3.

Emission estimates are underpinned by projections of the future demand for energy. Chapter 4 sets out final and primary energy use projections to 2035 and includes a discussion of trends within the key consuming sectors. Chapter 5 sets out the projections for the power sector and briefly reviews the influence of power sector activity on non-traded emissions.

[10] See, for example, the 2015 update to EEP (2014) table 2.3.

2 UK emissions projections

- The UK has met carbon budget one and is on track to meet carbon budgets two and three based on current and planned policies
- The latest projections point to a 10% shortfall in carbon budget four
- Total non-traded emissions fall by around a quarter by the end of carbon budget three from their current level
- There are relatively large reductions in several sectors (industry, services, agriculture and waste), but a projected increasing population weighs against greater energy savings in the household sector leaving emissions 5% higher in 2035

Progress towards the carbon budgets

The first carbon budget was achieved[11]: the National Carbon Account was 2,982 $MtCO_2e$ over the five year period which was 1% (36 $MtCO_2e$) below the target of 3,018 $MtCO_2e$.[12] The Government is making significant progress towards meeting the second and third carbon budgets. Table 2.1 shows the reference case estimate of the NCA is 50 to 60 $MtCO_2e$ below the maximums allowed by both carbon budgets (2% in each case).

The analysis shows that there is a shortfall against the fourth carbon budget, which is highly unlikely to be met under current projections without further action. The central reference estimate is around 187 $MtCO_2e$ (10%) in excess of the target of 1,950 $MtCO_2e$.

There are inherent uncertainties in any set of projections. For modelled emissions, four factors which are especially uncertain and which have a material impact on the projections are:

- Macroeconomic drivers such as Gross Domestic Product (GDP) and Gross Value Added (GVA)
- The number of households and population
- Key Government policies
- Future temperatures

The modelling uses a Monte Carlo approach[13] to take account of these uncertainties and generate statistical confidence intervals for the projections. The results confirm that whilst the UK is well placed to meet carbon budgets two and three, the fourth budget will be much more challenging.

Figure 1.1 shows the Monte Carlo results. The 95% confidence interval produced by the simulations shows the range of likely values of future emissions from the modelling. The carbon budget target is at the upper end of the confidence interval for the NCA in carbon budget three, while for carbon budget four the confidence interval does not include the target. This confirms that further action will be required to meet the fourth carbon budget.

[11] Final statement for the first Carbon Budget period:
https://www.gov.uk/government/statistics/final-statement-for-the-first-carbon-budget-period

[12] This was assessed in May 2014, using the 2012 greenhouse gas inventory, in accordance with the requirements of the Climate Change Act 2008. See:
http://www.legislation.gov.uk/ukpga/2008/27/section/18

[13] A technique widely used to translate uncertainty on model inputs to the outputs.

Table 2.1: Actual and projected emissions, $MtCO_2e$

Carbon budget:	1 (2008 – 2012)	2 (2013 – 2017)	3 (2018 – 2022)	4 (2023 – 2027)
Target	3,018	2,782	2,544	1,950
Central reference projection	2,982 (actual)	2,722	2,493	2,137
Met budget by	36 (1%)	60 (2%)	51 (2%)	-187 (-10%)
Uncertainty	—	44 to 75 (2% to 3%)	4 to 100 (0% to 4%)	-122 to -256 (-6% to -13%)
Memorandum item:				
Average annual emissions	596	544	499	427

These are cumulative values over five year carbon budget periods from 2008 to 2027. The entire range of uncertainty for carbon budget four exceeds the target indicating that this is unlikely to be met without further action.

Changes since 2014

Projections of non-traded emissions have increased very slightly for all carbon budget periods since the 2014 update[14]: by 16 (1%), 29 (2%) and 54 $MtCO_2e$ (4%) in carbon budgets two, three and four respectively.

The majority of the change is due to methodological changes in the Land Use, Land Use Change and Forestry sector (LULUCF)[15], resulting in an increase of 44 $MtCO_2e$ in CB4. The other major drivers of increased emissions (accounting for 26 $MtCO_2e$) are revisions to macroeconomic and demographic projections and, to a lesser extent, fossil fuel prices. Some of this is offset by updates to Government and EU policies which reduce emissions by an additional 16 $MtCO_2e$ over the fourth carbon budget CB4 compared with their 2014 estimates.

Emissions by economic sector

Overall, non-traded emissions fall rapidly, by about 12% from 2015 levels, until the end of CB3 in 2022 (Figure 1.2a). They continue to fall slightly (a further 2%) until the end of CB4 in 2027 before returning to 2022 levels by 2035. The projections show how different sectors of the economy[16] contribute to the total.

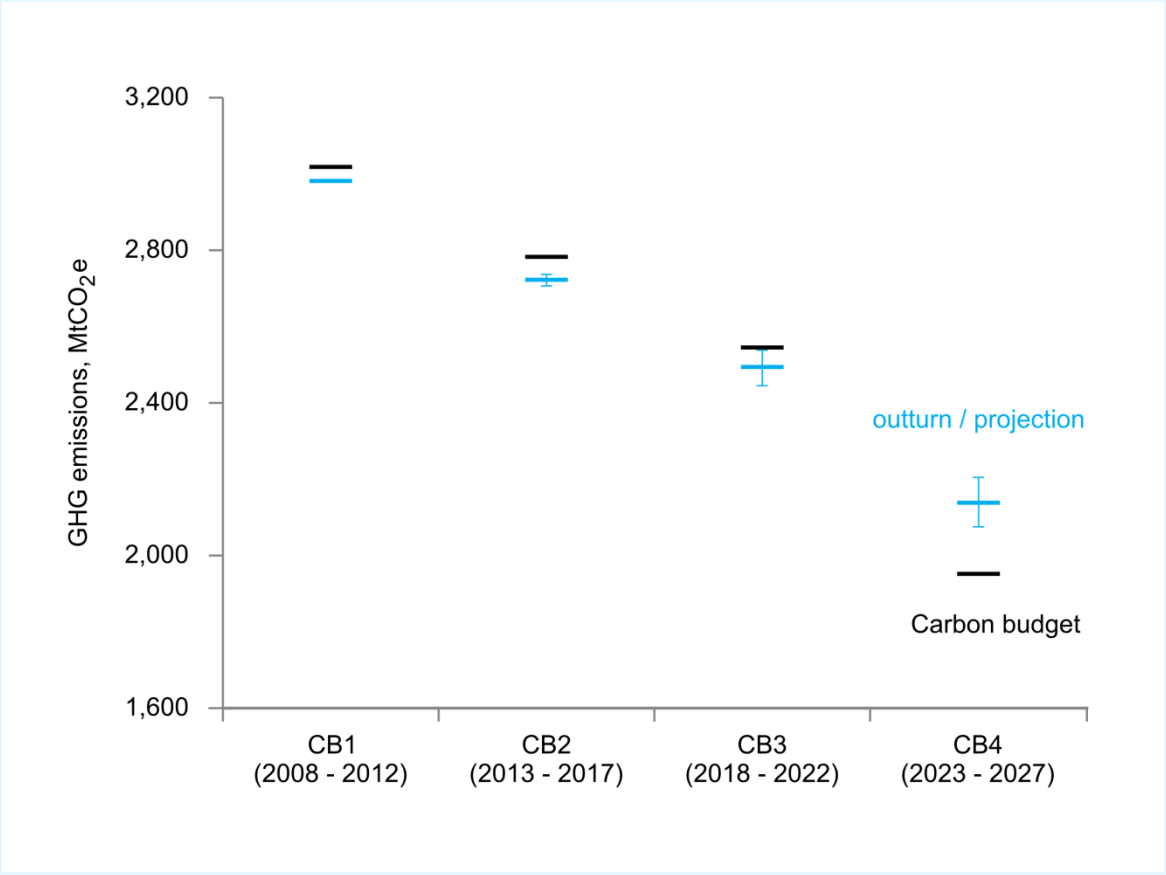
[14] Updated energy and emissions projections: 2014:
https://www.gov.uk/government/publications/updated-energy-and-emissions-projections-2014

[15] There are three main reasons for the change: 1) revised assumptions on policy incentives for tree-planting; 2) the correction of a data processing error which led to the double counting of CO_2 removals due to tree-planting; 3) a more realistic treatment of the rotation of farmland between grass and arable.

[16] These are as defined in the Digest of UK Energy Statistics (DUKES), see:
https://www.gov.uk/government/collections/digest-of-uk-energy-statistics-dukes

Figures 1.2 b), c) and d) depict the projected trends in sector emissions. Note that the categories here are different to those for reporting to international organisations. Annex C, "Carbon dioxide emissions by IPCC category", contains values and definitions for these.

Figure 1.1: The carbon budgets and GHG emissions



Cumulative values over five year periods from 2008 to 2027. *Vertical bars* show uncertainty in the projections and indicate 95% confidence intervals for the central reference scenario. The chart shows the UK is projected to meet carbon budgets two and three but further action will be required to meet carbon budget four since the level of this lies below the minimum projected level of emissions (lower of the uncertainty bars).

Industry[17]**, commercial services** and **public administration** ("services"; Figure 1.2b), **agriculture** and **waste** currently contribute around 40% of non-traded emissions, the largest source of non-traded emissions. Of this, almost half is from industry and services—mainly CO_2 from burning gas for heating and manufacturing. The remainder is due to other GHG emissions from farming and waste landfill. Total emissions across these five sectors taken in aggregate fall by almost 22% over the next 20 years: this is driven by reductions in CO_2 emissions from industry, services and agriculture and non-CO_2 emissions from waste.

Land Use, Land Use Change and Forestry contributes to the carbon budgets although its emissions do not result from a use of energy. It includes emissions from forest land, cropland, grassland, human settlements, and due to a change of land use between any of these categories[18]. It differs from other

[17] This includes CO_2 emissions from agriculture due to the burning of fuels and fertiliser use.

[18] A detailed discussion of the components of LULUCF is available here:
http://www.ipcc-nggip.iges.or.jp/public/gpglulucf/gpglulucf_files/GPG_LULUCF_FULL.pdf

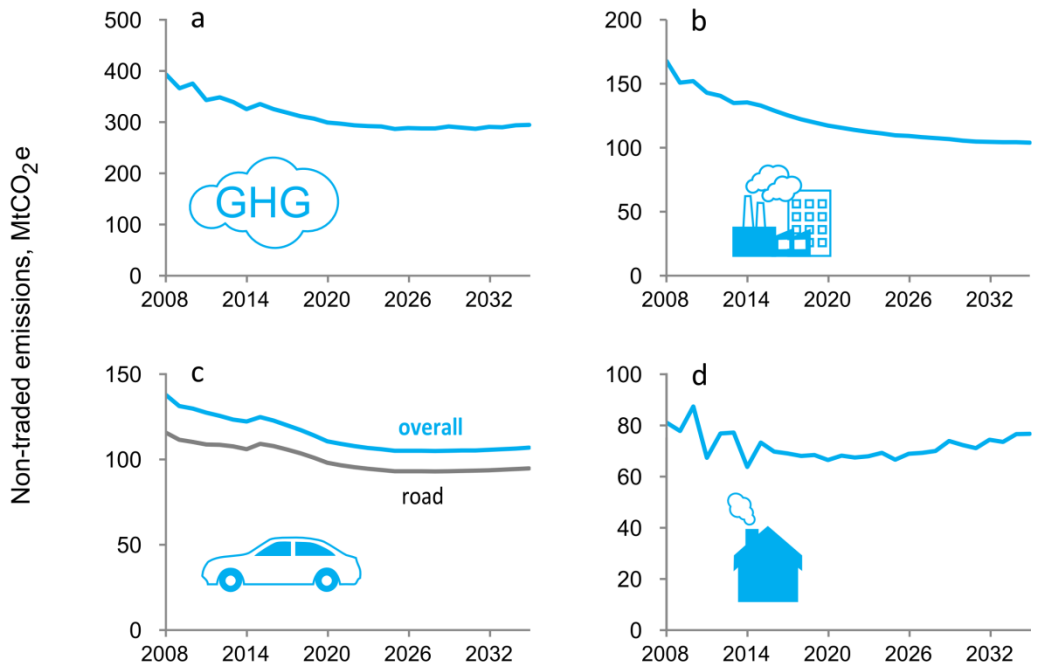
sectors in that it contains both sources and sinks[19] of CO_2. Overall, this sector currently removes around 2% of emissions. However, this is projected to fall until the sector becomes a small but growing GHG emitter from 2030 onwards.

Transport, mostly road transport, contributed around 37% of UK non-traded emissions in 2015 (Figure 1.2c). The projections show a steep decline to the end of carbon budget four (by around 16%) due to improvements in road vehicle fuel efficiencies and, to a lesser extent, the inclusion of biofuels in road transport fuels. The decrease occurs despite a projected 25% growth in demand for transport. At the end of the 2020s, emissions from road transport begin to increase as the effect of current EU road vehicle fuel efficiency regulations start to flatten out and rising demand pushes the projections higher.

The **domestic** residential sector (Figure 1.2d) is the third largest source of non-traded emissions, responsible for between a fifth and a quarter of non-traded emissions over the period 2015 to 2035. Most emissions are from burning natural gas and oil for space and water heating. These emissions are projected to fall slightly and then rise by around 5% over the next 20 years due to an increasing number of households.

[19] Sinks are processes which remove CO_2 from the atmosphere and can therefore give rise to negative figures.

Figure 1.2: Emissions in the economy



Non-traded emissions by economic sector, 2008 to 2035. a) All non-traded emissions, b) Industry, services and agriculture, c) Transport (road transport in grey), d) Domestic. Nearly all sectors see declines in emissions, but rises in household numbers drive an increase in projected domestic emissions of 5% over the next 20 years.

Annexes A and B contain detailed emission projections by economic sector and GHG. Chapter 4 discusses the projections of energy demand which lead to these emissions.

3 Effect of policies on emissions

- Government policies are projected to lead to a large reduction in non-traded GHG emissions
- Overall policy savings in the non-traded sector are broadly unchanged from the 2014 update of these projections
- In CB4 this reduction will be around 328 $MtCO_2e$ or about 23% of total non-traded GHG emissions. More than 80% of these savings are from recent (post-2009) policies
- Government policies also produce substantial GHG savings from electricity generation. In CB4, these are 345 $MtCO_2e$

Policies for emissions reduction

The Government has a package of policies to meet domestic and international GHG emissions reductions targets[20]. DECC estimates policy impacts by comparing GHG emissions from scenarios which contain the policies with scenarios which do not. The savings from some policies cannot currently be explicitly identified, particularly in the agriculture and waste management sectors. Nonetheless, these policy savings *do* contribute to the projections of emissions and energy demand discussed elsewhere in this report.

In the analysis, policies are grouped according to whether they were adopted before ("earlier policies") or after ("later policies") the Low Carbon Transition Plan of 2009. This was the UK's first comprehensive plan for becoming a low carbon economy. The savings discussed in this chapter refer only to the later policies unless otherwise stated; estimates for these are more robust than for earlier policies.

This chapter focuses on policies that produce savings in the non-traded sector, since they contribute to meeting the carbon budgets. It also includes a discussion of the Government policies which reduce emissions from electricity generation. The coverage for both traded and non-traded sectors includes all policies consistent with UNFCCC definitions, as explained on the notes tab of Annex D[21].

Government policies deliver substantial GHG emission reductions. Current estimates for savings from all policies suggest they will result in a reduction of around 690 $MtCO_2e$ in the non-traded sector across carbon budget periods two, three and four. This is around 80% of the effort required to meet carbon budget four. The projection for all policy savings in the non-traded sector during CB4 from earlier and later policies is 328 $MtCO_2e$, 84% of which is from later policies.

[20] Details of these targets can be found in *UK progress towards GHG emissions reductions targets* at: https://www.gov.uk/government/statistics/final-uk-emissions-estimates

[21] Annex D also displays the savings for only those policies which are beyond the planned stage. This is also known as the "with existing measures" scenario.

Changes to emissions savings since EEP 2014

There has not been any substantial change to the overall value of policy savings since the 2014 edition of these projections—16 $MtCO_2e$ in CB4 (about 1%). In the domestic sector, savings due to the Zero Carbon Homes and Green Deal policies have been removed from projections in line with recent Government announcements. This reduction has been more than offset by increases in savings from other policies and other methodological changes in the industry and services sectors as discussed below.

Table 3.1: GHG emissions savings from policies, $MtCO_2e$

Carbon budget:	2 (2013 – 2017)	3 (2018 – 2022)	4 (2023 – 2027)
Savings from later policies [a]	53	189	274
Savings from all policies	110	252	328

Note

a. From "later policies" only: see main text for definition. Non-traded emissions savings from pre-2009 policies total 57 $MtCO_2e$ (CB2), 63 $MtCO_2e$ (CB3), 54 $MtCO_2e$ (CB4) and 41 $MtCO_2e$ (CB5).

This table shows that Government policies will deliver an emission reduction of around 690 $MtCO_2e$ across carbon budgets two to four in non-traded emissions. This is about 80% of the effort required to meet carbon budget four.

Emissions savings from policies by economic sector

Over CB2 to CB4, policies in the **industry, services and agriculture** sectors contribute just over 40% of total non-traded policy savings whilst this sector is responsible for a lower proportion of total emissions (34%)[22]. Around a third of the savings are a result of the EU F-gas regulations[23] which have been explicitly identified for the first time this year. A further third (31%) of the savings are due to the Renewable Heat Incentive (RHI). The projected level of these savings has more than doubled since the 2014 update[24] due to an increase in the projected uptake of renewable heat under the policy and a change in the methodology used to estimate the savings. Details of the emissions savings from all policies, grouped by economic sector, can be found in Annex D.

The **transport** sector accounts for around 37% of all non-traded emissions. In line with this, 36% of all non-traded emissions savings from later policies during CB2 to CB4 come from transport policies. Measures to improve road vehicle fuel efficiency contribute around 70% of the savings, with most of the rest coming from targets for biofuel use in petrol and diesel. In CB4, transport policies save 17% of total transport emissions in the non-traded sector. There has not been a substantial change to these policies since the previous update of the projections[25].

[22] This figure is averaged over carbon budgets two, three and four. All other figures in this section are on the same basis, unless stated otherwise.

[23] See F-Gas Regulation (EC 517/2014).

[24] In absolute terms, this is an increase in savings of 19 $MtCO_2e$ in CB4.

[25] The *absolute* savings from transport policies have decreased since the previous update (by 20 $MtCO_2e$ over CB4). However, there is very little change as a *proportion* of transport demand.

At around a fifth of the total from later policies, savings in the **domestic** sector are in line with the sector's contribution to non-traded emissions over CB2 to CB4. The Building Regulations Part L, which set energy efficiency standards for new buildings, contribute more than one third (37%) of these reductions. Other policies with substantial savings in this sector are: those which oblige energy suppliers to help households improve their energy efficiency; the Renewable Heat Incentive; EU regulations to phase out the use of fluorinated gases ("F-gas regulations"); and real-time ("smart") metering of energy consumption. In CB4, later policies are estimated to save almost 15% of non-traded emissions in this sector: this is broadly unchanged from last year's update.

Emissions savings from policies in electricity generation

The vast majority of savings from Government policies and EU regulations in the traded sector are to emissions from electricity generation. These can be achieved in two ways: through a reduction in electricity demand or a change in the primary energy sources used to generate electricity towards those which produce fewer GHGs.

Demand reduction policies (both "earlier" and "later" policies) reduce emissions from electricity generation by 79 $MtCO_2e$ in CB2, 118 $MtCO_2e$ in CB3 and 119 $MtCO_2e$ in CB4. Across all three carbon budget periods, this means that emissions from the electricity generation sector are reduced by 21% compared with if these policies were not in place. The policies making the largest contribution to this are the Products Policy (55% of the savings) and the Building Regulations (14%). Savings from all electricity demand reduction policies can be found in the "Traded, by sector" section of Annex D.

Policies that promote the generation of electricity from lower carbon energy sources are: the Large Combustion Plant Directive; the Industrial Emissions Directive; Carbon Capture and Storage Programme; the EU ETS and UK Carbon Price Support; Feed-in-Tariffs for small scale generation and the Renewables Obligation; and, more recently, Contracts for Difference (CfDs) for large-scale generation. Taken together they give total emissions reductions of 36 $MtCO_2e$ in CB2, 120 $MtCO_2e$ in CB3 and 226 $MtCO_2e$ in CB4 for those policies[26] for which savings can currently be quantified. These policies save emissions in the traded sector but do not contribute to the carbon budgets under the Net Carbon Account as this scores traded sector emissions at the level of the EU ETS cap for the UK.

[26] All "later" policies, described as "decarbonisation policies in the electricity supply industries", are listed in Annex D on the "Traded, by sector" tab.

4 Demand for energy

- UK primary energy demand is projected to fall 11% over the next 10 years reflecting an underlying energy efficiency trend and energy saving policies that step up the pace of gains in energy efficiency
- Primary energy demand is then projected to rise 10% from 2025 as energy saving policies come to an end and energy use gradually reverts towards its underlying trend in the absence of further policies
- By the end of the projection period in 2035, primary energy demand has fallen 3% below current levels
- Among the components of UK final energy demand, oil has the most substantial decline in energy use over the next decade, while growing demand for electricity and renewables drives an overall increase in these of around 2%

The demand for energy

There are two ways of presenting demand for energy: by primary or final demand. Primary demand describes the requirements for raw energy sources such as renewables (wind turbines, solar cells) or fossil fuels (gas, oil and coal). Final demand describes the need for energy in the final form that it is used by consumers, such as electricity or transport fuels. Conversion from primary to final energy involves some use and loss of energy, in processes such as oil refining, and the generation and transmission of electricity[27]. The final energy basis enables electricity consumption to be compared with that of other fuels.

Primary energy demand

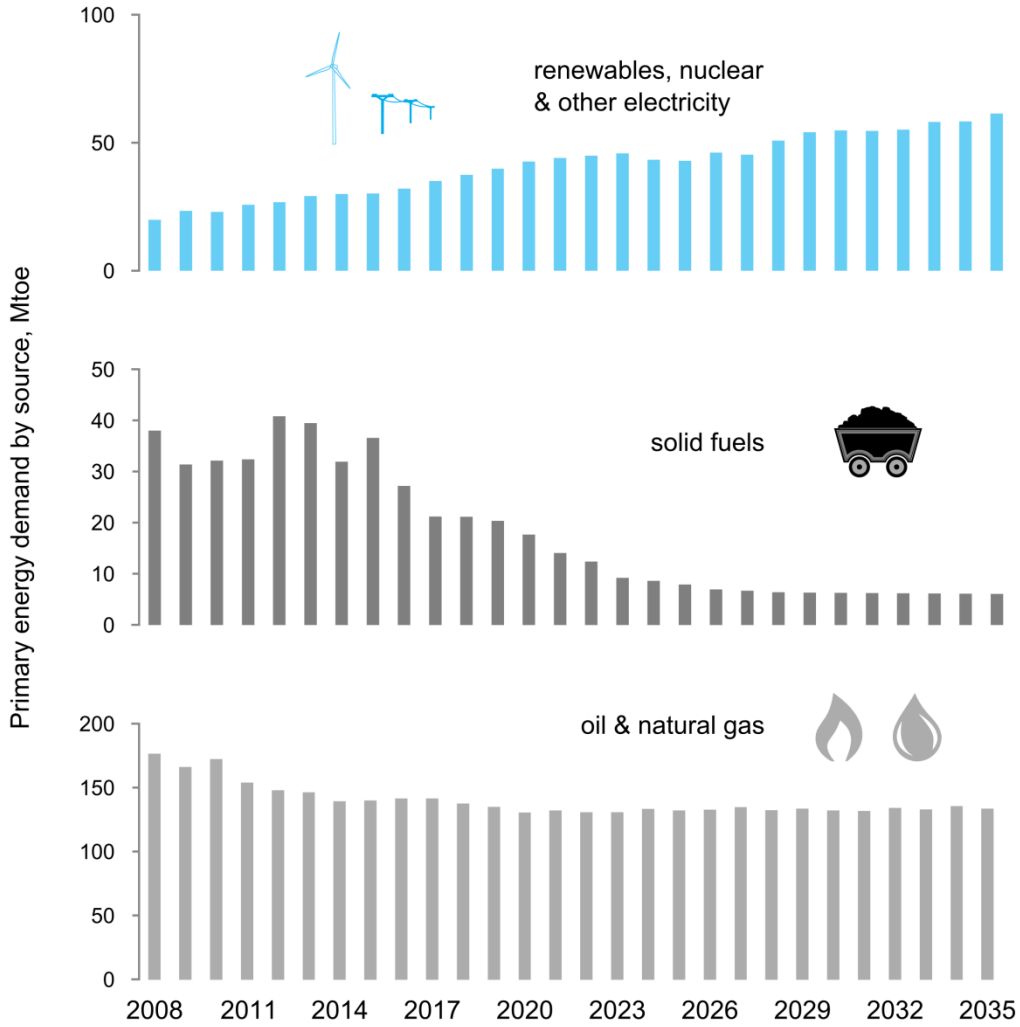
Primary energy demand is projected to follow the same trend as the 2014 projections. Demand falls steadily to 2025 but then increases as the impact of existing policies declines. This is because, in the absence of further policy intervention, trend improvements in energy efficiency and the impact of changes in fossil fuel prices are insufficient to offset the impact of economic and population growth.

This year's total primary energy demand projections are similar to last year's. Primary energy demand is projected to fall to 183 Mtoe (million tonnes of oil equivalent) in 2025 from 207 Mtoe in 2015 before rising back to 3% below current levels in 2035.

Figure 4.1 depicts a large projected decline in solid fuel use while natural gas use remains relatively stable through the whole projections period. Oil use declines slowly to 2025, reflecting lower use in road transport and industry, before increasing slightly to 2035. In contrast, fuel use for renewables and nuclear increases strongly although the latter only starts increasing in the mid-2020s as new nuclear generating capacity comes on line.

[27] The projections only include the energy use and losses for energy produced within the UK.

Figure 4.1: Primary energy demand by fuel



The figure shows that primary energy demand for oil and gas stays relatively static over the projection period. Demand for renewables, nuclear electricity and other electricity grows steadily whilst demand for solid fossil fuels like anthracite declines rapidly.

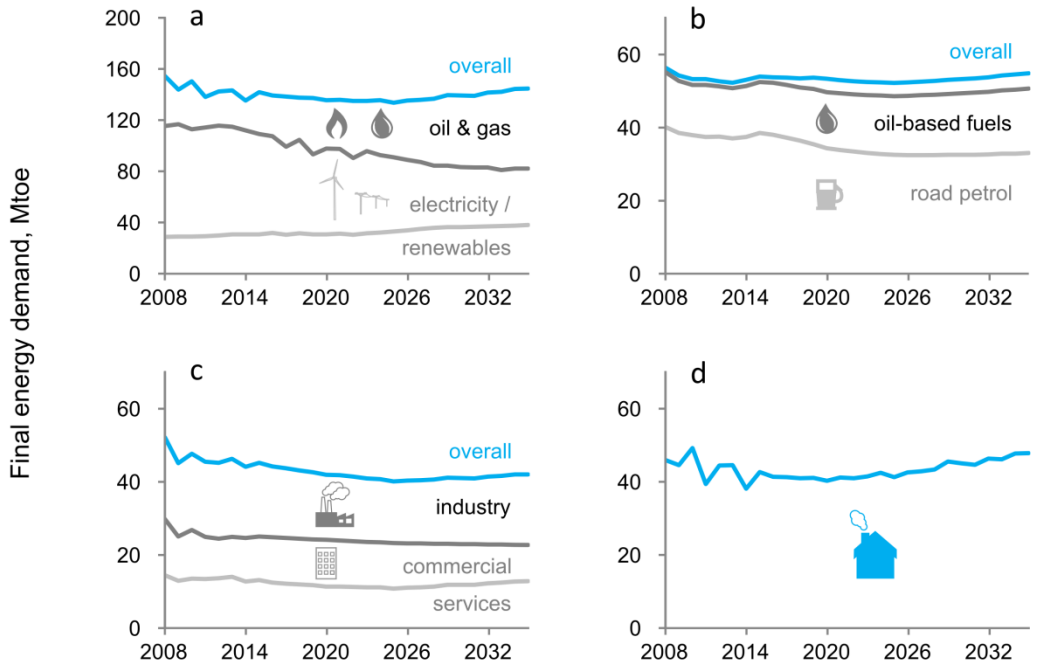
Annexe E contains the detailed data for primary energy demand. Renewable fuel inputs decline slightly from the mid-2020s despite continued growth in electricity supplied from renewable sources. This reflects a change in the composition of renewables generation from biomass and waste to solar and wind.

Final energy demand

Final energy demand is projected to fall by 6% from 2015 until the mid-2020s, then return to 2015 levels by 2033 before ending around 2% higher than currently in 2035 (Figure 4.2a). The shape of this trend reflects the underlying demands for oil and gas which together provide around three-quarters of energy in 2015. However, the overall *increase* in final energy demand between 2015 and 2035 reflects an increase in demand for electricity and renewable energy, up by nearly 20% and just over 200% respectively.

Compared with the previous update of the projections, final energy demand is up in all years. This increase grows with time, to 5% by 2035. It is mainly due to increases in the domestic sector, discussed below.

Figure 4.2: Patterns of final energy demand



a) Summary of demand by fuel type. The figure shows the overall shift from final demand from oil and gas to electricity and renewables. b) Final energy demand by transport. *Dark grey* all oil-based fuels. *Light grey* road petrol. Demand for oil-based fuels for transport declines slightly due to substitution with biofuels. c) Final energy demand by industry, services and agriculture. *Dark grey* industry only. *Light grey* commercial services only. Final energy demand in industry, services and agriculture declines by 6% by 2035. d) Domestic final energy demand. Increasing household numbers drive projected domestic final energy demand higher in 2035 than currently.

Transport is the largest consumer of energy; its proportion of total final energy demand is currently almost 40% and this stays static for the next 20 years (Figure 4.2b). The vast majority is oil-based fuels, although these fall from 97% to 92% of all transport fuel over that period. This is mainly due to a rise in

road transport biofuel consumption stemming from the renewable transport fuel obligation. Policy measures also substantially reduce total fuel consumption: it increases by only 2% from current levels over the projection period. This compares with a rise of almost 15% if policies were not in place.

Industry, services and agriculture are responsible for 32% of final energy demand consumption[28]. Demand from these sectors (Figure 4.2c) is projected to fall over the next 20 years, particularly in industry which shows a decrease of almost 10%. This is despite an estimated increase in industrial output of around 30% (mainly in construction, engineering and the production of chemicals), and is due to projecting increasing energy efficiency in line with recent trends. The situation in services is similar: economic growth drives consumption up but overall there is a decrease in final energy demand of 6% which is driven by assumed improvements in energy efficiency (again consistent with recent trends).

The mix of fuels used in services is estimated to change over the next 20 years[29], due to a projected shift from gas to electricity in the commercial services sector. The fuel mix in industry stays relatively constant.

The **domestic** sector is also a substantial consumer of energy: currently 30% of the total (Figure 4.2d). This proportion is projected to rise slightly from 2023 onwards. The reasons for this are: more households and a rising average household income, and a decrease in estimated savings from policies from 2025[30]. Revisions to the demographic inputs also explain why domestic demand in this year's edition is substantially greater than last year: around 5% greater by 2020 and almost 10% greater by 2035.

Gas and electricity make up two-thirds and one-fifth of domestic energy demand respectively. The proportion of electricity used is projected to rise slightly over the next 20 years as the demand for solid fuels such as coal falls further from its current low level to almost zero. The proportion of energy from renewable sources remains static at around 4%, almost one-fifth of which is motivated by the renewable heat incentive by 2025.

[28] The contribution of each sub-sector to the total across all these sectors is: industry (18%), services (13%), and agriculture (1%).

[29] In 2015, 45% of energy in the services was from electricity and 47% from gas. In 2035 this is projected to be 60% from electricity and 35% from gas.

[30] Total energy demand in this sector rises by 12% between 2015 and 2035. The number of households rises by almost 20% and the average household income by 31%. Total policy savings decrease by 27% from 2025 to 2035, returning to 2015 levels.

5 Electricity generation

- The projections assume emissions from major generators are entirely traded (outside the carbon budgets) but there are impacts on non-traded emissions from autogenerators

Projecting electricity generation

This chapter presents key aspects of the electricity generation projections. It focuses on generation by Major Power Producers (MPPs) which currently produce around 94% of all electricity[31]. Annexes G to L contain detailed results from the modelling.

Electricity generation links to non-traded emissions

The carbon budgets treat emissions from MPPs as occurring in the traded sector. Therefore, MPP activities have no direct impact on the UK's ability to meet these targets. Nevertheless, MPPs are important for carbon budgets for two reasons. Firstly, decarbonisation of power facilitates emissions reductions elsewhere by enabling a switch over time from fossil fuel use in non-traded sectors to low carbon electricity. Secondly, the marginal costs of MPP generation affect both wholesale and retail electricity prices and thus influence fuel and technology choices in other sectors.

Emissions from major generators

Since 2009, MPP emissions have fluctuated with no clear trend. The five most recent years of data from the Greenhouse Gas Inventory[32] show that annual power station emissions have averaged around 151 Mt CO_2e[33]. The 2015 Energy and Emissions Projections indicate that this will fall steeply in the next few years as a result of the Industrial Emissions Directive (IED)[34], the carbon price support mechanism[35] and other electricity market reform measures. These are projected to cause a steady decline in coal-fired capacity and an associated decline in the extent to which the remaining plants are used. Activity at gas-fired generating plants picks up in the near- to medium-term, offsetting some of the reduction in coal-fired generation.

Figure 5.1 shows the percentage of electricity generation which is from fossil fuels[36]. There is a steady decline over the projection period from a 60% share in 2015 to around a 13% share in 2035 (note that this shows all generators, not just MPPs). The increase in the fossil fuel share in 2024 is due to the closure of some nuclear capacity.

[31] The coverage of the MPP category is defined and discussed in paragraph 5.66 and following of DUKES: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/450302/DUKES_2015.pdf
EEP redefines the MPP sector to include all renewables generators whereas DUKES only includes a subset of these.

[32] See UK greenhouse gas emissions statistics - GOV.UK. Latest figures are for 2013.

[33] The figure quoted is only for CO_2 emissions: it does not include other GHGs.

[34] Coal plant operators have referred to the influence of environmental legislation in announcements about the closure of existing generating capacity.

[35] The assumptions for this are the same as in EEP 2014.

[36] Conventional fossil generation only—this excludes generation from CCS.

Figure 5.1: Transitioning away from unabated fossil fuel generation

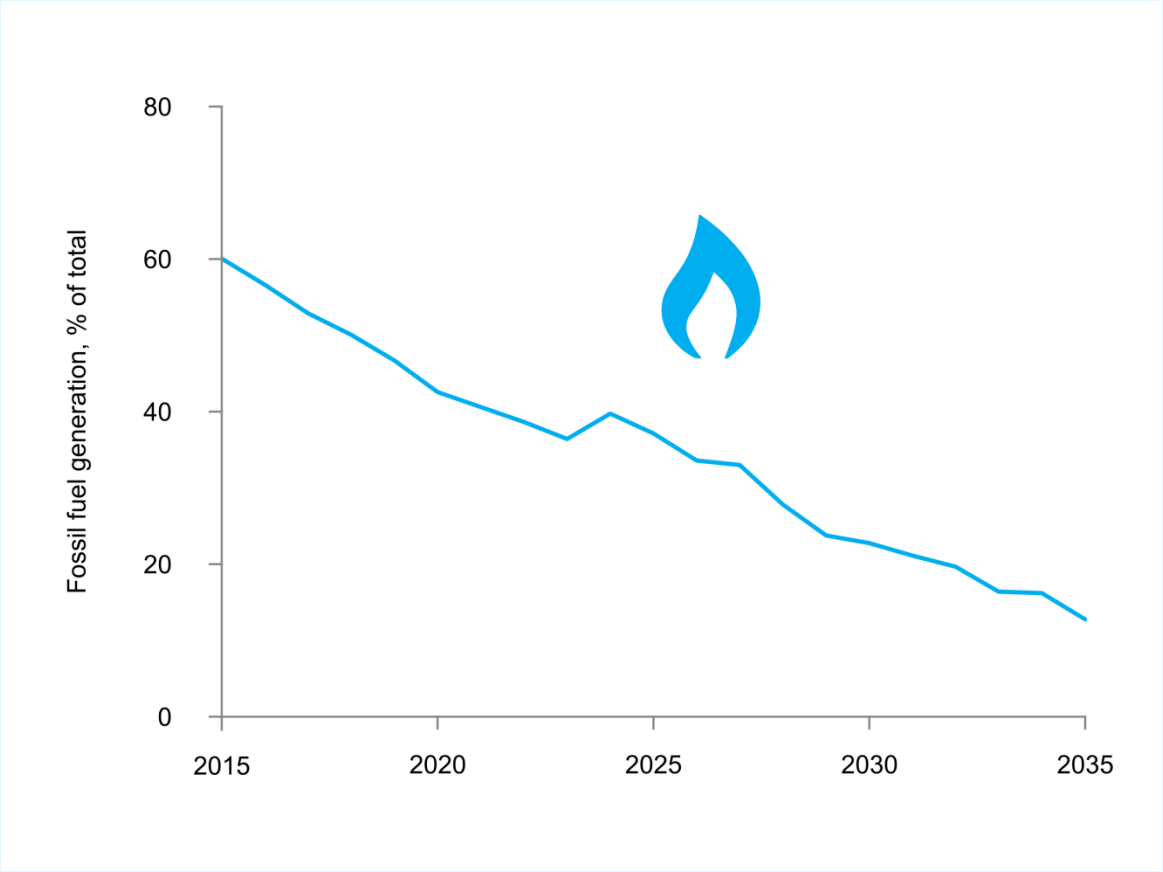


Figure 5.1 shows how the percentage of electricity generated from unabated fossil fuel sources declines steadily over the projection period.

In the longer term, the projections depict an illustrative pathway in which emissions intensity falls to around 100g CO_2e/kWh by 2030 (Figure 5.2). This level of decarbonisation was assumed in last year's projections and is broadly consistent with the central case in the Electricity Market Reform Impact Assessment[37]. This scenario is illustrative and the Government may determine other decarbonisation pathways to be possible.

[37] See DECC, "Electricity Market Reform Impact Assessment": https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/225981/emr_delivery_plan_ia.pdf

Figure 5.2: Decarbonising electricity generation

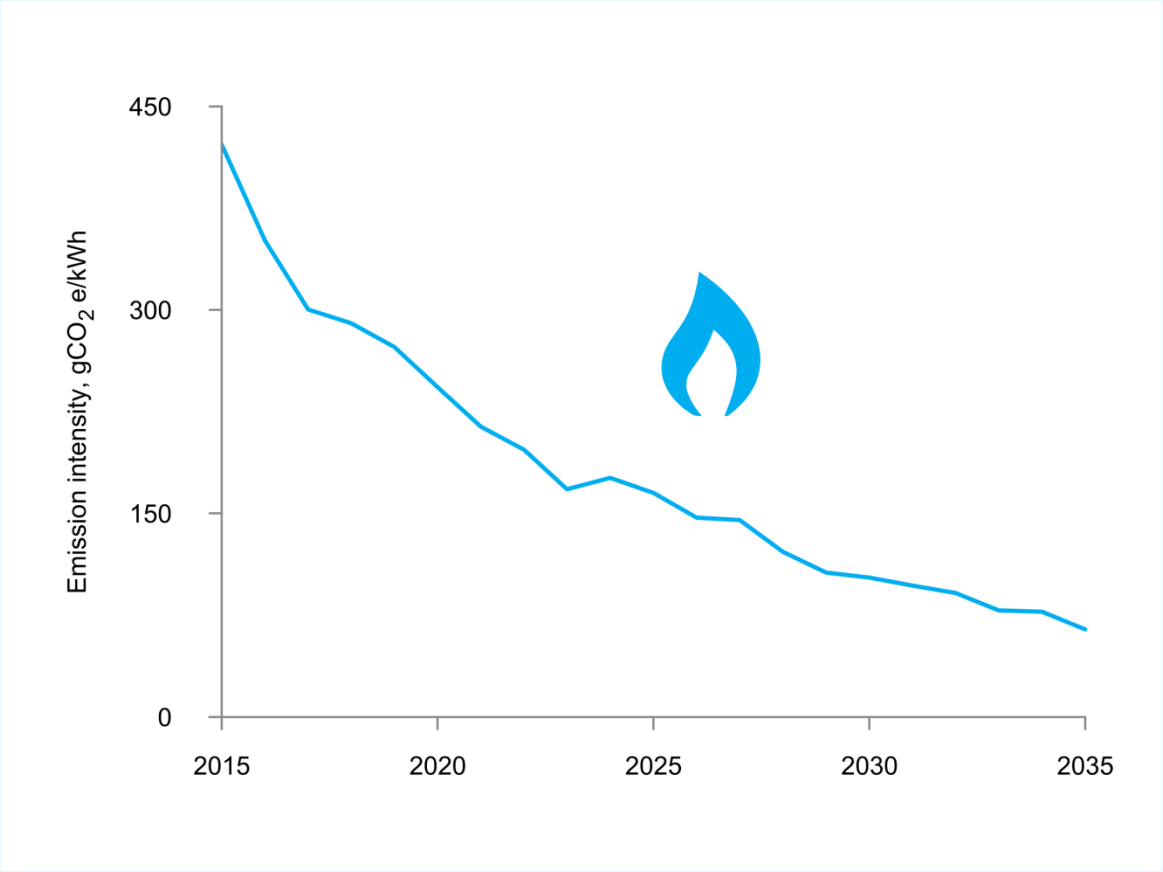


Figure 5.2 shows how the decreasing proportion of electricity generated from unabated fossil fuels (Figure 5.1) translates into changes in the emission intensity of generation. The curved decline above is due to the fact that those plants with the highest emissions intensity close before the mid-2020s leading to slower declines later.

Autogeneration and CHP

Autogenerators are electricity plants owned by businesses whose main activity is not electricity generation. These are mostly CHP (Combined Heat and Power) plants. Each year, DECC uses updated figures for the costs and benefits of CHP to estimate what capacities of CHP would be cost-effective. Table 5.1 gives values for these from recent editions. They show a consistent pattern with greatest capacity at around 2020 followed by a slow decline through to 2035. The peak is substantially driven by developments in the liquefied natural gas sector; the later decline is related to a general reduction in fossil fuel fired plant.

Table 5.1: Projections of total installed CHP capacity [a], GW

	2010	2015 [b]	2020	2025	2030	2035
EEP 2013	6.1	8.1	8.4	9.2	8.8	—
EEP 2014	6.2	7.3	9.2	8.1	7.1	6.9
EEP 2015	6.2	7.4	9.9	9.4	8.3	7.7

Notes

a. These are the projections of total CHP capacity including CHP MPPs and renewable plant. CHP MPPs and renewable CHP are excluded from the autogenerator category elsewhere but are included in the MPP tables.

b. The values for this year are interpolated from the last historic year's data (2014) and those for the first modelled year (2020).

The table shows that projections of cost-effective CHP capacity consistently peak at around 2020, declining thereafter.

Differences from EEP 2014

The broad contours of the MPP projections are similar to last year with declining use of conventional fossil fuel generation and increasing uptake of low carbon technologies in the future.

The main changes affecting projections of electricity supply since the 2014 EEP are:

- Updated assumptions for fossil fuel prices, which are substantially lower in all years
- More and earlier interconnector capacity is assumed than previously
- Inclusion of the outcome of CfD and Capacity Market auctions
- Updates to the nuclear build profile with new capacity added from 2025 rather than 2023
- Assumptions about deployment and generation under the Renewables Obligation have been revised upwards[38]

As a result of these changes:

- Unabated coal-fired generation declines more slowly until 2023
- Overall power station emission projections are lower to 2024 due to higher deployment of renewables and electricity imports. This more than offsets the increased emissions from coal-fired generation
- Higher generation from renewables is projected up to the early 2020s

[38] They are based on the 2016/17 Obligation, estimates of deployment post-2017 under the Renewables Obligation grace periods and independent research about load factors for new-build plants.

6 Lists of supporting material

Annexes

Annex A:	Greenhouse gas emissions by source
Annex B:	Carbon dioxide emissions by source
Annex C:	Carbon dioxide emissions by IPCC category
Annex D:	Policy savings in the projections
Annex E:	Primary energy demand
Annex F:	Final energy demand
Annex G:	Major power producers' generation by source
Annex H:	Major power producers' cumulative new electricity generating capacity
Annex I:	Major power producers' total electricity generating capacity
Annex J:	Total electricity generation by source
Annex K:	Total cumulative new electricity generating capacity
Annex L:	Total electricity generating capacity
Annex M:	Growth assumptions and prices
Annex N:	Report: Identification of superfluous Energy Demand Model variables

Web tables and charts

This year's publication includes updates to the tables and charts published in EEP (2014). The list of these as they appeared in EEP (2014) is as follows:

Figures

Tables

Appendix A: List of abbreviations

CB	Carbon budget
CfD	Contracts for Difference
CHP	Combined Heat and Power
CO_2	Carbon dioxide
CO_2e	Carbon dioxide equivalents
DECC	Department of Energy and Climate Change
DUKES	Digest of UK Energy Statistics
EEP	Energy and Emissions Projections
ETS	Emissions Trading System
EU	European Union
F-gas	Fluorinated (greenhouse) gases
g	Grammes
GDP	Gross Domestic Product
GHG	Greenhouse gas
GVA	Gross Value Added
GW	Gigawatt
IED	Industrial Emissions Directive
IPCC	Intergovernmental Panel on Climate Change
kWh	Kilowatt-hours
LULUCF	Land Use, Land-Use Change, and Forestry
MPP	Major Power Producer
Mt	Million tonnes
Mtoe	Million tonnes of oil equivalent
NCA	Net Carbon Account
RHI	Renewable Heat Incentive
UK	United Kingdom

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