



Department for
Energy Security
& Net Zero

Energy and emissions projections 2022 to 2040

November 2023



© Crown copyright 2023

This publication is licensed under the terms of the Open Government Licence v3.0 except where otherwise stated. To view this licence, visit nationalarchives.gov.uk/doc/open-government-licence/version/3 or write to the Information Policy Team, The National Archives, Kew, London TW9 4DU, or email: psi@nationalarchives.gsi.gov.uk.

Where we have identified any third-party copyright information you will need to obtain permission from the copyright holders concerned.

Any enquiries regarding this publication should be sent to us at: emissionsprojections@energysecurity.gov.uk

Contents

Executive summary	4
1 Introduction	6
1.1 About this document	6
1.2 The “reference scenario” and other scenarios	9
2 UK emissions projections	10
2.1 Introduction	10
2.2 UK emissions projections	11
2.3 Progress towards the carbon budgets	12
3 Effect of policies on emissions	16
3.1 Introduction	16
3.2 Policies for emissions reductions	17
3.3 Changes to individually quantified policy savings since EEP 2021-2040	17
3.3.1 New EEP-ready policies	18
3.3.2 Changes to existing EEP-ready policies	18
3.3.3 Resources and waste strategy	19
3.4 Emissions savings from policies in electricity supply	19
3.5 The EEP and policies from the Carbon Budget Delivery Plan	20
4 Electricity supply	22
4.1 Introduction	22
4.2 Summary of projections	22
4.3 Power sector changes since EEP 2021-2040	24
5 Detailed comparisons with EEP 2021-2040	26
5.1 Introduction	26
5.2 Changes in territorial projections since EEP 2021-2040	26
5.2.1 Improvements in the projection methodology and assumptions	28
5.2.2 Changes to projections of territorial emissions due to power sector updates and other model inputs	30
6 Lists of supporting material	32
6.1 Annexes	32
6.2 Web tables and figures	33

Executive summary

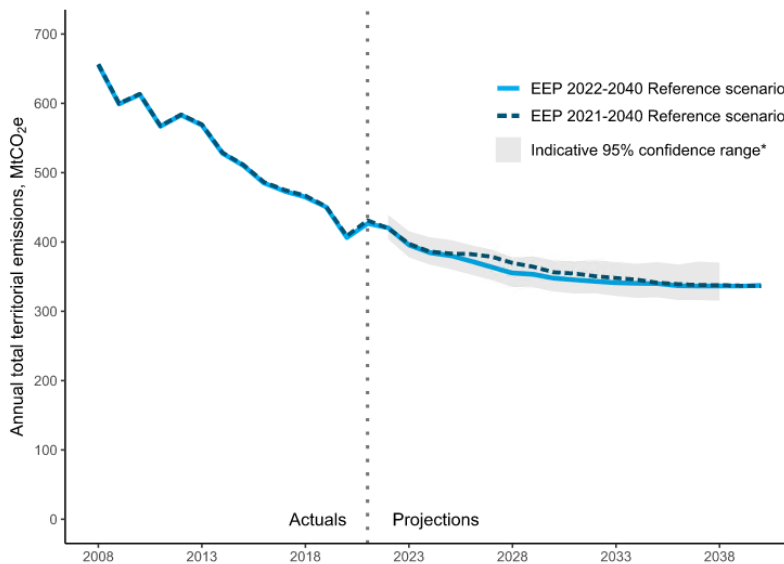
The Department for Energy Security & Net Zero (DESNZ), formerly part of BEIS, publishes annual projections of UK energy demand and greenhouse gas emissions (EEP)¹. This report contains outputs from the latest projections, Energy and Emissions Projections 2022-2040. This more detailed report follows the shorter summary briefing published in October 2023.

The DESNZ Energy and Emissions Projections (EEP) provides projections of greenhouse gas emissions, under policies that have already been implemented and planned policies where funding has been agreed and the policy design is near final. These are referred to as EEP-ready policies. Policies at an earlier stage of delivery are not included. Therefore EEP 2022-2040 does not contain the full list of policies and proposals set out in the Carbon Budget Development Plan (CBDP) published in March 2023².

The Energy and Emissions Projections show what the UK would expect to happen if no further policies were planned or implemented. As such, they provide the baseline assumptions for assessing future climate and energy policy proposals before they become EEP-ready. The projections are also used to meet the UK's international reporting obligations under the United Nations Framework Convention on Climate Change³.

Figure i shows how EEP 2022-2040 projects slightly lower emissions than EEP 2021-2040⁴ for almost all years.

Figure i: Projected UK emissions EEP 2022-2040 compared to EEP 2021-2040, Territorial emissions, excluding International Aviation and Shipping (MtCO_{2e})



¹ Energy and emissions projections: <https://www.gov.uk/government/collections/energy-and-emissions-projections>

² Annex D contains a list of quantified policies included in EEP 2022-2040.

³ <https://unfccc.int/>

⁴ All comparisons against last year's projections are with respect to EEP 2021-2040, published in October 2022, revised March 2023. EEP 2021-2040 was first published in October 2022 (<https://www.gov.uk/government/publications/energy-and-emissions-projections-2021-to-2040>), with a revision to projected emissions (of less than 1 MtCO_{2e} per year) published in the Annex tables on 10th March 2023.

Projected emissions are lower for each of the five-year periods for which the UK has set internal interim greenhouse gas reduction targets. We project that the UK will meet its next legislated interim greenhouse gas reduction target (carbon budget 4 2023-2027). Under EEP-ready policies, compared to EEP 2021-2040, the latest projections show a smaller gap between projected performance and targets for carbon budgets 5 and 6 (2028-2032 and 2033-2037 respectively).

Projected emissions are lower than EEP 2021-2040 for most sectors (see Annex A). However, projected emissions from domestic transport are higher across the projection period. This is mainly due to updated assumptions on use of Plug-in-Hybrid Electric Vehicles (PHEVs). Updated evidence suggests PHEVs are less efficient than previously assumed, because for example they are driven in electric mode for a smaller proportion of kilometres travelled than previously assumed. The Vehicle Emissions Trading Schemes Order 2023 (the legal name for the Zero Emissions Vehicle mandate), is not included because it reached the required stage of development too late for inclusion. Projections of Non-CO₂ emissions from Agriculture are also slightly higher due to the use of a different economic model, Defra's UK Agricultural Market Model (UKAMM)⁵, to project agricultural activity. UKAMM projects a larger UK sheep herd during the projection period than the previously used model, FAPRI⁶.

There are several drivers of the overall lower projected emissions. The largest of these is updates to scientific evidence on emissions from Land Use, Land Use Change and Forestry (LULUCF). Other factors also contribute to lower projected emissions, including methodology improvements and the impact of policies included for the first time this year. These are explained in more detail later in this report.

⁵ <https://www.gov.uk/government/publications/uk-agricultural-market-model-ukamm>

⁶ <https://www.afbini.gov.uk/fapri-publications>

1 Introduction

- This report contains projections of energy consumption, electricity generation, and greenhouse gas emissions under EEP-ready policies out to 2040.
- The projections take account of policies that have been implemented and those that are planned where the level of funding has been agreed and the design of the policy is near final i.e., where there are no outstanding decisions on intervention design or funding that might materially affect their impact. These policies together are referred to as “EEP-ready” policies.
- Policies that have been announced but have not reached the required EEP-ready state of development are not included.
- The Energy and Emissions Projections show what the UK would expect to happen if no further policies were planned or implemented. As such, they provide the baseline assumptions for assessing future climate and energy policy proposals before they become EEP-ready. The projections are also used to meet the UK’s international reporting obligations under the United Nations Framework Convention on Climate Change⁷.
- All comparisons to the EEP 2021-2040 projections are made against the March 2023 revision to EEP 2021-2040⁸, which was published on 10th March 2023.
- Chapter 2 looks at our projections for overall UK territorial emissions and performance against carbon budget targets.
- Chapter 3 explores the impact of policies that are new to this latest edition of EEP as well as changes to the estimated impacts of policies that were already included in EEP 2021-2040.
- Chapter 4 looks at the drivers and changes to projected electricity supply.
- Chapter 5 sets out more information about the major changes to the projections between EEP 2021-2040 and EEP 2022-2040.

1.1 About this document

This report sets out the 2022-2040 Energy and Emissions Projections: referred to as EEP 2022-2040⁹. The projections were published on 26 October 2023 together with a short summary briefing covering the main changes between EEP 2021-2040 and EEP 2022-2040. The Government’s response to the Climate Change Committee (CCC)¹⁰, published on 26

⁷ <https://unfccc.int/>

⁸ Available at: <https://www.gov.uk/government/publications/energy-and-emissions-projections-2021-to-2040>

⁹ Available at: <https://www.gov.uk/government/publications/energy-and-emissions-projections-2022-to-2040>

¹⁰ Available at: <https://www.gov.uk/government/collections/government-responses-to-the-committee-on-climate-change-ccc-annual-progress-reports>

October contained figures from EEP 2022-2040. The summary briefing was published on the same day to align with good practice in the publication of statistics. This report contains more detailed commentary on the projections and underlying changes since last year. The accompanying annex tables have also been updated to include additional “what-if” projection scenarios (such as projections with higher or lower economic growth or fossil fuel prices).

EEP provides projections of energy, emissions, and electricity generation under policies that have been implemented and those that are planned where the level of funding has been agreed and the design of the policy is near final. Policies at an earlier stage of development are not included. This is because the estimated impact of a planned policy will be sensitive to decisions on its design and/or level of funding. In this report, policies that have reached the required stage of development are referred to as “EEP-ready” policies.

Policies outside the power sector are included if they had reached the EEP-ready stage of development by June 2023. Policies in the power sector are included if they had reached the EEP-ready stage by July 2023. Policies outside the power sector have an earlier cut-off date because these affect projected demand for electricity, which is an essential input to power sector projections.

The Energy and Emissions Projections are produced to meet the UK’s international reporting obligations under the United Nations Framework Convention on Climate Change¹¹ and to provide essential assumptions for government modelling of energy and climate change policies. The Energy and Emissions Projections show what the UK would expect to happen if no further policies were planned or implemented. As such, they provide the baseline against which future climate and energy policy proposals are assessed before they become EEP-ready. Other uses include the provision of short-term electricity demand assumptions for power sector policy modelling and future industrial output assumptions for industrial decarbonisation modelling.

This report provides an overview of the updated projections and includes comparisons against EEP 2021-2040. Detailed annual breakdowns for energy, emissions and electricity generation under EEP-ready policies are contained in the accompanying annexes.

The Climate Change Act 2008 (CCA) introduced carbon budgets. These are legally binding limits on the total amount of greenhouse gas (GHG) emissions the UK can emit over five-year periods. Carbon budgets have been set out to 2037, with Carbon Budget 6 (2033-2037) being the latest target set. We present projected performance against carbon budgets under EEP-ready policies in Chapter 2.

The metric used to assess performance against carbon budgets is called the “Net UK Carbon Account” (NCA). The NCA for CB6 includes International Aviation and Shipping (IAS) whilst earlier targets do not. Therefore, we include IAS when reporting against CB6. We exclude IAS from all other references to emissions and consumption in this report. Annex tables contain projections with and without IAS.

¹¹ <https://unfccc.int/>

These projections bring together statistical and modelled information from many different sources:

- At the time of modelling, the main source of energy consumption data was the annual Digest of UK Energy Statistics (DUKES)¹², published July 2022. The projections have not been updated to incorporate the latest estimates of energy consumption published in DUKES July 2023. The first projection year for energy consumption is therefore 2022 and we report energy consumption trends against a comparison year of 2021.
- The main source of emissions data is the final UK greenhouse gas emissions national statistics: 1990-2021 (1990-2021 UK Greenhouse Gas Inventory (GHGI)¹³), published February 2023. The first projection year for emissions is therefore 2022, and we report emission trends against 2021 unless we state otherwise.
- The latest Office for Budget Responsibility (OBR) short- and long-run economic growth projections available at the time of modelling were from March 2023¹⁴.
- The Department for Energy Security & Net Zero (DESNZ) updated fossil fuel price projections. See Fossil Fuel Price Assumptions for further details of the latest update¹⁵.
- The Department for Energy Security & Net Zero (DESNZ) updated traded carbon values for modelling. See Update to Traded Carbon Values for further details of the latest update¹⁶.
- Non-energy, non-CO₂ projections have been updated and are consistent with the 1990-2021 Greenhouse Gas Inventory (GHGI). See Annex N for details of this. These are produced by Department for Energy Security & Net Zero (DESNZ), Defra, Ricardo¹⁷ and the UK Centre for Ecology and Hydrology (CEH).
- Land Use, Land Use Change and Forestry (LULUCF) projections are aligned with the GHGI 1990-2021 and are consistent with the inventory. These are produced by the Centre for Ecology and Hydrology (CEH).

We produce projections of energy demand outside the power sector by applying standard statistical techniques. These project forward energy demand based on trends and relationships in past data. We adjust these projections to take account of estimated reductions in energy consumption from EEP-ready policies. We then project energy-related emissions by multiplying energy demand by the relevant emissions factors¹⁸.

We produce projections of power sector generation and associated emissions by feeding our projections of electricity demand into a model of electricity supplier behaviour.

¹² There is more detail here: <https://www.gov.uk/government/collections/digest-of-uk-energy-statistics-dukes#2021>

¹³ Final UK greenhouse gas emissions national statistics: 1990 to 2021:

<https://www.gov.uk/government/statistics/final-uk-greenhouse-gas-emissions-national-statistics-1990-to-2021>

¹⁴ Available at this link: <https://obr.uk/efo/economic-and-fiscal-outlook-march-2023/>

¹⁵ Available at this link: <https://www.gov.uk/government/collections/fossil-fuel-price-projections>

¹⁶ Available at this link: <https://www.gov.uk/government/collections/carbon-valuation--2>

¹⁷ Ricardo Energy & Environment.

¹⁸ EEP emissions factors are derived from: https://uk-air.defra.gov.uk/reports/cat09/2304171442_Energy_background_data_uk_2023.xlsx

We obtain separate projections for non-energy related emissions from the Department for Environment, Farming and Rural Affairs (Defra), Ricardo, the Centre for Ecology & Hydrology (CEH)¹⁹ and the North Sea Transition Authority²⁰. The accompanying methodology summary²¹ (originally published alongside EEP 2018) provides further details of the projection methodology.

1.2 The “reference scenario” and other scenarios

We refer to our main projection as the “reference scenario”. This is our core analysis of how the UK energy and emissions system could evolve under EEP-ready policies and our central assumptions about how the system drivers will change. Results in this report are from the reference scenario unless stated otherwise. They are the baseline or counterfactual projection showing what the UK would expect to happen if no policies at an earlier stage of development were implemented. Results from other EEP scenarios are provided in the accompanying annexes. These include the “With Existing Measures (WEM)²²” policy scenario which only includes policies that have already been implemented.

Finally, since the projections are sensitive to macro-economic assumptions, the annexes also include projections under alternative fossil fuel price and economic growth assumptions.

We publish our projections for the reference scenario and other scenarios in annexes alongside this report. Each chapter of this report notes the relevant annexes. The data underlying the report’s tables and figures are in the web tables and web figures supplementary files. Chapter 6 lists these resources in full.

¹⁹ Centre for Ecology & Hydrology: <https://www.ceh.ac.uk/>

²⁰ Projections from the North Sea Transition Authority were included in August 2023. These included allowances for recently consented developments including the Rosebank oil and gas field.

²¹ Available at:

https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/794741/energy-emissions-projections-methodology-overview.pdf

²² The “WEM” (“With Existing Measures”) scenario is used for international reporting to UNFCCC.

2 UK emissions projections

- Under EEP-ready policies only, emissions are projected to fall by 21% between 2021 and 2040. Under the reference scenario, we project that the UK will meet the third carbon budget, set at 2,544 MtCO_{2e}, with headroom of 364 MtCO_{2e}.
- Under EEP-ready policies only, the projections show headroom against the fourth carbon budget of 53 MtCO_{2e}, and a shortfall of 20 MtCO_{2e} for the fifth carbon budget period.
- The scope of the NCA metric used to assess performance against carbon budget targets widens in CB6 to include International Aviation and Shipping. For the sixth carbon budget (CB6), the projected shortfall is 956 MtCO_{2e}.

2.1 Introduction

This chapter looks at our projections for overall UK territorial emissions and performance against carbon budget targets.

Emissions estimates in this publication include seven greenhouse gases²³ as defined by the Climate Change Act 2008²⁴: carbon dioxide (CO₂), methane (CH₄), nitrous oxide (N₂O), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), sulphur hexafluoride (SF₆), and nitrogen trifluoride (NF₃). HFCs, PFCs, SF₆, and NF₃ are collectively referred to as fluorinated or F-gases.

Emissions from each greenhouse gas are weighted by its Global Warming Potential (GWP), so that total greenhouse gas emissions can be reported on a consistent basis in terms of carbon dioxide equivalent (CO_{2e}). In November 2021, it was agreed by the international community at the 2021 United Nations Climate Change Conference (COP26) that greenhouse gases shall be reported under the Paris Agreement transparency framework²⁵ using 100-year GWPs listed in table 8.A.1 of the Fifth IPCC Assessment Report (AR5 without climate-feedback)²⁶. Therefore, all projections and comparisons in this report and in the accompanying EEP 2022-2040 annex tables are reported on this basis.

²³ NF₃ emissions are less than 0.1 MtCO_{2e} per year. They are included for the first time in EEP 2022-2040 following the Climate Change (Targeted Greenhouse Gases) Order 2023, which extends the scope of emissions captured and reported under the CCA 2008, to include NF₃.

²⁴ Climate Change Act 2008 - Targeted Greenhouse Gases Order 2023:

<https://www.legislation.gov.uk/ukpga/2008/27/part/1/crossheading/targeted-greenhouse-gases>

²⁵ Enhanced transparency framework guidance: <https://unfccc.int/documents/311138>

²⁶ We use the Global Warming Potentials (GWPs) from table 8.A.1 (without climate-carbon feedback) of Working Group 1 of the IPCC Fifth Assessment Report: Climate Change 2013, consistent with the Greenhouse Gas Inventory. See <https://www.ipcc.ch/report/ar5/wg1/>. Climate-carbon feedback reflects indirect effects of GHG emissions on the climate system. 100-year AR5 GWPs without feedback do not reflect these effects from non-CO₂ GHGs.

2.2 UK emissions projections

In this section, we compare emissions with EEP 2021-2040²⁷. For convenience, we use the carbon budget periods to summarise projection results. These are not the same as the Net Carbon Account (NCA) metric used to assess performance against carbon budget targets: see Section 2.3 and Box 1 for details.

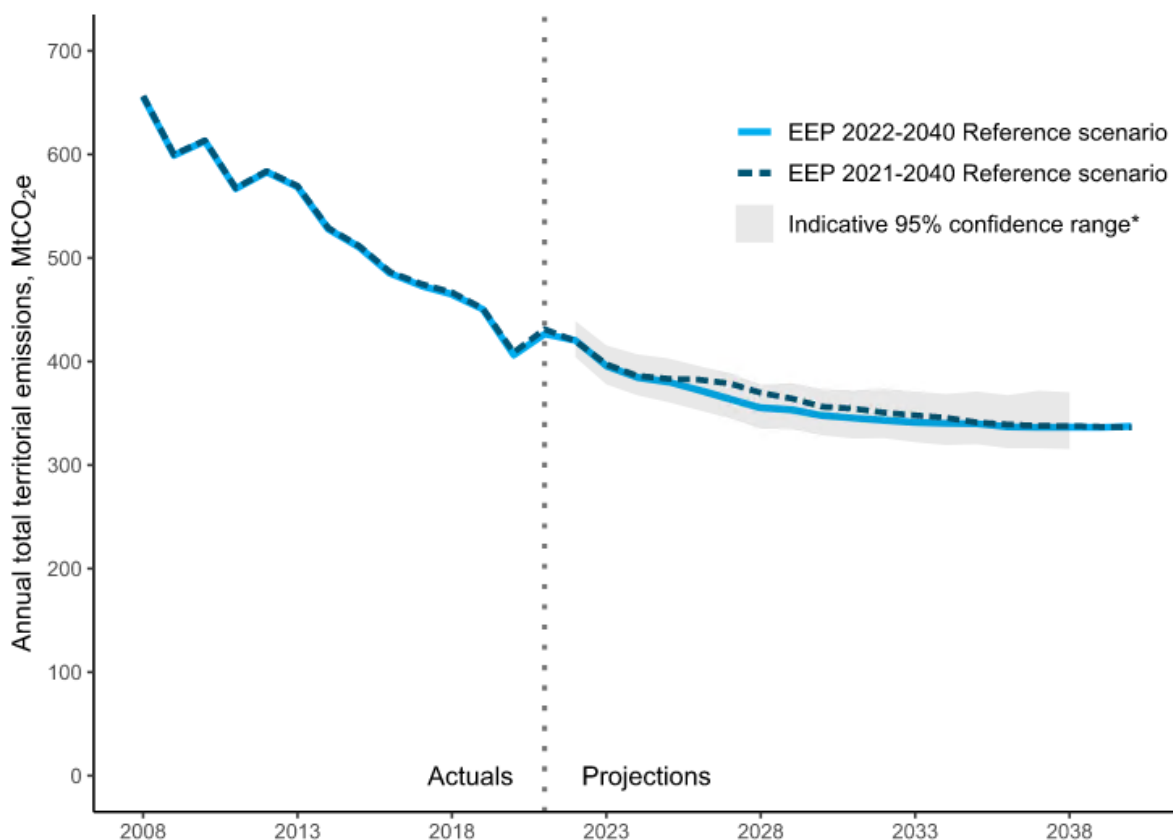
Figure 2.1 compares the main territorial emissions trends from EEP 2022-2040 with those from EEP 2021-2040.

When we compare total UK territorial emissions (excluding IAS) for carbon budget periods three to six, EEP 2022-2040 has lower projected emissions than EEP 2021-2040 for all carbon budget periods:

- For the third carbon budget period they are 9 MtCO_{2e} (<0.5%) lower and for the fourth 31 MtCO_{2e} or 2% lower.
- In the fifth carbon budget period, territorial emissions are lower than EEP 2021-2040 by 50 MtCO_{2e} or 3%.
- The difference between the updated and previous projections slightly narrows towards the end of the projection period. For the sixth carbon budget period, territorial emissions are 17 MtCO_{2e} lower than EEP 2021-2040 (1%).

²⁷ EEP 2021-2040 was published in October 2022. A revision to projected emissions (of less than 1 MtCO_{2e} per year) was published in the Annex tables on 10th March 2023. All comparisons against last year's edition are against the March 2023 revision to EEP 2021-2040: <https://www.gov.uk/government/publications/energy-and-emissions-projections-2021-to-2040>

Figure 2.1: UK projected territorial emissions (excluding IAS), MtCO₂e



Notes:

* The uncertainty ranges are indicative and are based on modelling from EEP 2018.

2.3 Progress towards the carbon budgets

The UK has domestic targets for reducing greenhouse gas emissions under the Climate Change Act 2008 (CCA). In June 2019, the CCA was amended to commit the UK to achieving a 100% reduction in net emissions by 2050 (Net Zero).

The UK met the first (2008-12) and second (2013-17) carbon budgets. A final statement for the third carbon budget, covering the period 2018-22, will be published in May 2024. The latest carbon budget to be set was the sixth carbon budget covering the period 2033 to 2037.

Performance against carbon budget targets is assessed by comparing the budget level against a metric called the “Net UK Carbon Account” (NCA). Box 1 outlines details of how the NCA is calculated.

Box 1: The Net UK carbon account (NCA)

2018 – 2020 (before the UK left the EU ETS):

The NCA is defined as the sum of three components:

1. Emissions allowances the UK receives under the EU Emissions Trading System (EU ETS).
UK share of tradable allowances for emissions in scope of the EU ETS (e.g. power sector emissions, heavy industry and domestic aviation) as reported in the Annual Statement of Emissions for 2021²⁸.
2. Emissions not covered by the EU ETS.
UK territorial emissions outside scope of the EU ETS (e.g. non-aviation transport, heating buildings, waste, light industry).
3. Credits/debits from other international trading systems.
None have been used.

Beyond 2020:

The UK left the EU ETS on 31st December 2020. Therefore, adjustments for trading under the EU ETS are no longer required. In this publication, the net carbon account beyond 2020 is defined as the sum of two components:

1. All UK territorial emissions
In the sixth carbon budget (2033-37), emissions from UK international aviation and shipping (IAS) are also in scope²⁹.
2. Credits/debits from international trading systems
This is assumed to be zero when presenting projections of performance against carbon budgets in this report³⁰.

Figure 2.2 shows projected performance against the carbon budgets under EEP-ready policies. Table 2.1 also details projected performance against carbon budgets.

We project the UK will meet the third carbon budget (2018-2022), set at 2,544 MtCO_{2e}, with headroom of 364 MtCO_{2e}.

²⁸ Annual Statement of Emissions for 2021: <https://www.gov.uk/government/publications/annual-statement-of-emissions-for-2021>

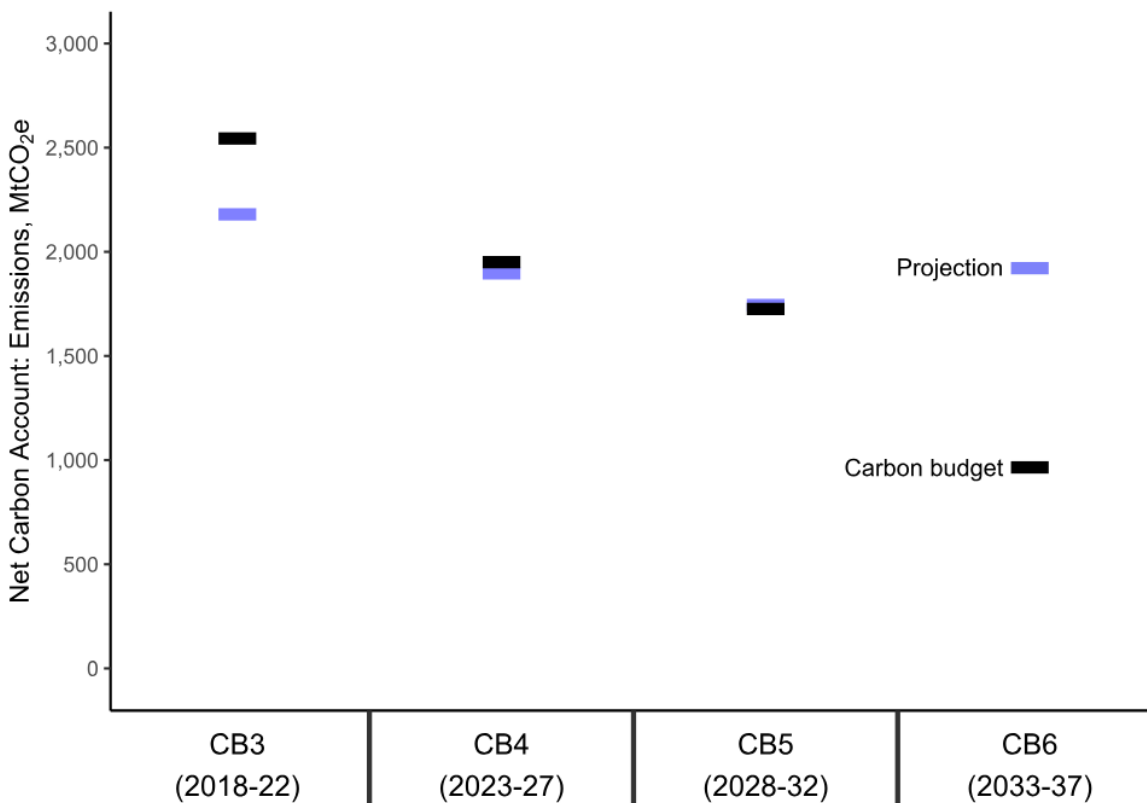
²⁹ In line with current international reporting guidelines, IAS emissions estimates are assumed to be based on the amount of refuelling from bunkers at UK airports and ports, whether by UK or non-UK operators, for onward international journeys.

³⁰ We will update this assumption, as appropriate, should the UK exercise its right to use voluntary cooperation under Article 6 of the Paris Agreement. This could occur through linking the UK ETS to another emissions trading system, or through the use of international emissions reductions or removals units.

Under EEP-ready policies only, the projections show headroom against the fourth carbon budget of 53 MtCO_{2e}, and a shortfall of 20 MtCO_{2e} for the fifth carbon budget period. For the sixth carbon budget (CB6), the shortfall is 956 MtCO_{2e}. For CB6, the NCA metric used to assess performance against carbon budget targets includes International Aviation and Shipping.

Projections of performance under EEP-ready policies has improved slightly in all carbon budget periods, compared with the previous edition.

Figure 2.2: Projected performance against carbon budgets under EEP-ready policies, MtCO_{2e}



Notes:

- [1] The NCA metric used to assess performance against targets includes IAS in the sixth carbon budget but not in earlier carbon budgets. Therefore, projected NCA emissions are higher in CB6 than in CB5.

Table 2.1: Territorial and Net Carbon Account emissions projections across carbon budget periods, MtCO_{2e}

	Carbon Budget			
	CB3 (2018-22)	CB4 (2023-27)	CB5 (2028-32)	CB6 (2033-37)
Carbon budget target [1]	2,554	1,950	1,725	965
Projected territorial and Net Carbon Account (NCA) emissions				
Territorial emissions exc. IAS	2,168	1,897	1,745	1,695
Territorial emissions inc. IAS	2,341	2,115	1,973	1,921
Net Carbon Account emissions [2]	2,180	1,897	1,745	1,921
Projected performance vs target (projected NCA minus CB target)	-364	-53	20	956
Average annual percentage reduction on base year [3] emissions				
Implied carbon budget/NCA target	-38%	-52%	-58%	-77%
Projected Net Carbon Account	-47%	-54%	-57%	-54%

Notes:

- All data based on reference case.
- [1] All comparisons against CB3 in this report are for the level set out in the 2009 legislation (2,544 MtCO_{2e}). The Government raised the budget level to 2,632 MtCO_{2e} by carrying forward 88 MtCO_{2e} of over-achievement from the second carbon budget period, in accordance with s.17 of the CCA. See footnote 2 of the Annual Statement of Emissions for 2021³¹.
- [2] The NCA is the metric used to measure performance against carbon budget targets. For CB4 and CB5 the projected NCA is the same as projected UK territorial emissions excluding IAS. For CB6 it is the same as projected UK territorial emissions including IAS. See Box 1 for further information on how the NCA is calculated.
- [3] The base year is 1990 for CO₂, CH₄ and N₂O, and 1995 for fluorinated gases. For CB3-5, base year emissions are currently estimated to be 816 MtCO_{2e}. CB6 base year emissions include an additional 24 MtCO_{2e} for international aviation and shipping. Base year emissions estimates are revised annually, therefore percentage reductions implied by CB levels are subject to change.

³¹ Annual Statement of Emissions for 2021: <https://www.gov.uk/government/publications/annual-statement-of-emissions-for-2021>

3 Effect of policies on emissions

- Policies are included in these projections if they had either been implemented or were planned and at a near final stage of development by the policy cut-off point (June 2023 for policies outside the power sector, and July 2023 for power sector policies). These are together referred to as “EEP-ready” policies.
- Relative to no policy intervention, we project that EEP-ready quantified Government policies (excluding power sector interventions) will reduce territorial emissions by around 224 MtCO_{2e} in the third carbon budget period, 294 MtCO_{2e} in the fourth, 355 MtCO_{2e} in the fifth and 414 MtCO_{2e} in the sixth carbon budget period.
- The new individually quantified policies that are included for the first time in EEP 2022-2040 are: the Clean Heat Market Mechanism, Heat Network Efficiency Scheme (HNES), Social Housing Decarbonisation Fund (Wave 1), Social Housing Decarbonisation Fund (Wave 2), Sustainable Warmth (Local Authority Delivery 3 and Home Upgrade Grant 1), Home Upgrade Grant 2, Great British Insulation Scheme. New policy savings for Building Regulations 2021 Part L are also included.

3.1 Introduction

This chapter explores the impact of policies that are new to this latest edition of EEP as well as changes to the estimated impacts of policies that were already included in EEP 2021-2040.

A full list of policies included in EEP 2022-2040 is available in Annex D. We also provide quantified impacts for individual policies in Annex D where these are available.

Most policies included in EEP have individually quantified impacts. However, we cannot currently provide separate quantified impacts for some types of policy due to limitations with our modelling approach:

- Power sector, forestry and agriculture policies are modelled as three separate policy groupings, and the impact of individual policies cannot be separated out due to interactions between them.
- Policies which operate fully or partly through a price impact such as the Climate Change Levy (an environmental tax charged on the energy that businesses use) cannot be quantified due to limitations with our modelling approach. These are taken into account in the modelling (through their impact on energy demand), but we do not have estimates of the individual impacts.
- Some policies and initiatives are not taken into account in our modelling. These will only be picked up in the projections if their combined past impact is sufficiently large to affect long term trends. These include:

- Enabling policies, such as innovation funding or investment in infrastructure.
- Policies implemented by Devolved Administrations (DAs)
- Initiatives by local authorities or other public, voluntary, or private sector organisations unless these are directly driven by a central government initiative.

3.2 Policies for emissions reductions

Table 3.1 shows that we estimate that quantified Government policies (excluding power sector interventions) will reduce territorial emissions by 1,287 MtCO_{2e} over carbon budgets three to six (compared with no policy). We report policy savings in more detail in Annex D: this gives further information about the policies included in these projections.

Table 3.1: Projected GHG emissions savings from EEP-ready policies excluding power sector interventions, MtCO_{2e}

	Carbon budget				Total (2018-37)
	CB3 (2018-22)	CB4 (2023-27)	CB5 (2028-32)	CB6 (2033-37)	
Savings from policies excluding power sector interventions	224	294	355	414	1,287

As in the previous edition of these projections, this table excludes savings from power sector interventions. By this, we mean the policies mentioned in Section 3.4: decarbonisation policies in the electricity supply industries. This includes, for example, the Large Combustion Plant Directive, Industrial Emissions Directive, UK Carbon Price Support, Feed-in-Tariffs (for small scale generation), Renewables Obligation and Contracts for Difference (for large-scale generation). We are reviewing the method for calculating savings from power sector interventions but expect to complete this before the next publication.

3.3 Changes to individually quantified policy savings since EEP 2021-2040

The net effect of policy updates in EEP 2022-2040 – that is, emissions savings from newly introduced policies and changes to estimated emissions savings from previously included policies - means that EEP 2022-2040 projects slightly lower GHG savings from EEP-ready Government policies (excluding power sector interventions) compared with EEP 2021-2040. The main reason for this is that revised assumptions about the performance of Plug-in Hybrid Electric Vehicles (PHEVs) has led to lower estimated policy savings from transport road

vehicle policies. The impact of this change offsets the savings from policies new to EEP 2022-2040.

3.3.1 New EEP-ready policies

There were nine new EEP-ready policies in EEP 2022-2040, which together are projected to contribute 5, 12 and 14 MtCO_{2e} of emissions savings in the fourth, fifth and sixth carbon budget periods respectively. These new policies are the Clean Heat Market Mechanism, Heat Network Efficiency Scheme (HNES), Social Housing Decarbonisation Fund (Wave 1), Social Housing Decarbonisation Fund (Wave 2), Sustainable Warmth (Local Authority Delivery 3 and Home Upgrade Grant 1), Home Upgrade Grant 2, Great British Insulation Scheme and Building Regulations 2021 Part L. Annex D contains more details of these and other EEP-ready policies.

3.3.2 Changes to existing EEP-ready policies

Since EEP 2021-2040, there has been a downward revision to the estimated emissions savings from transport policies, due to transport assumption updates (see the detail on transport road vehicle policies below). This meant a reduction in overall transport policy savings by 5 MtCO_{2e} in CB3, and larger downward revisions of 26, 43 and 49 MtCO_{2e} in CB4, 5 and 6 respectively.

Most of this downward revision was from the transport road vehicle policies. This was partly due to the impact of lower projected oil prices (meaning demand is expected to rise slightly) but mainly because of updated assumptions. Primarily there were downward adjustments to Plug-in Hybrid Electric Vehicles (PHEVs) assumptions, based on evidence which showed they spend substantially less time in electric mode than previously believed, due to charging behaviours, and that their real-world efficiency performance is worse than previously assumed. For EEP 2022-2040, the savings we attribute to road vehicle policies are 27 MtCO_{2e} lower in the fourth and 45 MtCO_{2e} lower in the fifth carbon budget period than in EEP 2021-2040. Savings are 52 MtCO_{2e} lower in the sixth carbon budget period. It is worth noting that these savings do not include the Vehicle Emissions Trading Schemes Order 2023 (the legal name for the Zero Emissions Vehicle (ZEV) mandate, covering the period 2024-2030) confirmed in September 2023. This is because it reached the required stage of development too late for inclusion.

For the Renewable Heat Incentive policy, there has also been a downward revision to previously estimated emissions reductions, meaning projected policy savings are lower by 6 MtCO_{2e} in CB3, 8 in CB4, 8 in CB5 and 6 in CB6. This was mainly due to improvements in the method used to estimate the amount of natural gas displaced by biomethane injection into the grid.

3.3.3 Resources and waste strategy

We have not updated projections for emissions from landfill nor included estimated savings from Simpler Recycling (formerly known as consistent collections of household and business recycling), the introduction of Extended Producer Responsibility (EPR) for packaging, and a Deposit Return Scheme (DRS). This is because the methodology is being reviewed to reflect interactions between waste reduction and energy policies. Projections for other sources of emissions in the waste sector adhere to the previous EEP trajectory, with the exception of anaerobic digestion from domestic wastewater treatment, where new historical evidence from the 1990-2021 GHG Inventory has been included.

3.4 Emissions savings from policies in electricity supply

A range of Government policies have reduced emissions in the Electricity Supply Industry since the Low Carbon Transition Plan³² (LCTP).

Supply-side policies include:

- Large Combustion Plant Directive
- Industrial Emissions Directive
- UK Carbon Price Support
- Feed-in-Tariffs (for small-scale generation)
- Renewables Obligation and Contracts for Difference (for large-scale generation)
- Phase out of coal-fired generation
- Capacity Market

Power supply markets are highly interconnected, meaning it is not possible to robustly disentangle the impacts of individual policies. We are currently reviewing the method for calculating savings from overall power interventions, which we hope to complete before the next publication. For this edition, we have excluded the aggregated emissions savings from power supply policies in the “All, by sector” section of Annex D.

³²

Published in 2009, and available at: <https://www.gov.uk/government/publications/the-uk-low-carbon-transition-plan-national-strategy-for-climate-and-energy>

3.5 The EEP and policies from the Carbon Budget Delivery Plan

In 2019, the Government passed legislation which requires the UK to reduce net emissions by 100% compared to 1990 levels.

EEP only contains implemented policies and those that are planned where the policy design was near final at the policy cut-off date (June 2023 for policies outside the power sector and July 2023 for power sector policies). Policies at an earlier stage of development are not included because the impact of these policies will be sensitive to decisions that have not yet been taken on the design of the intervention. Since last year's publication, some further policies and proposals set out in the Net Zero Strategy or Carbon Budget Delivery Plan had reached the stage of development required for inclusion in EEP 2022-2040 by the policy cut-off. Others had not yet reached the required stage.

The Carbon Budget Delivery Plan (CBDP)³³ published on 30 March 2023 set out a package of quantified and unquantified proposals and policies, to enable Carbon Budgets 4-6 to be met – many of these are not EEP-ready.

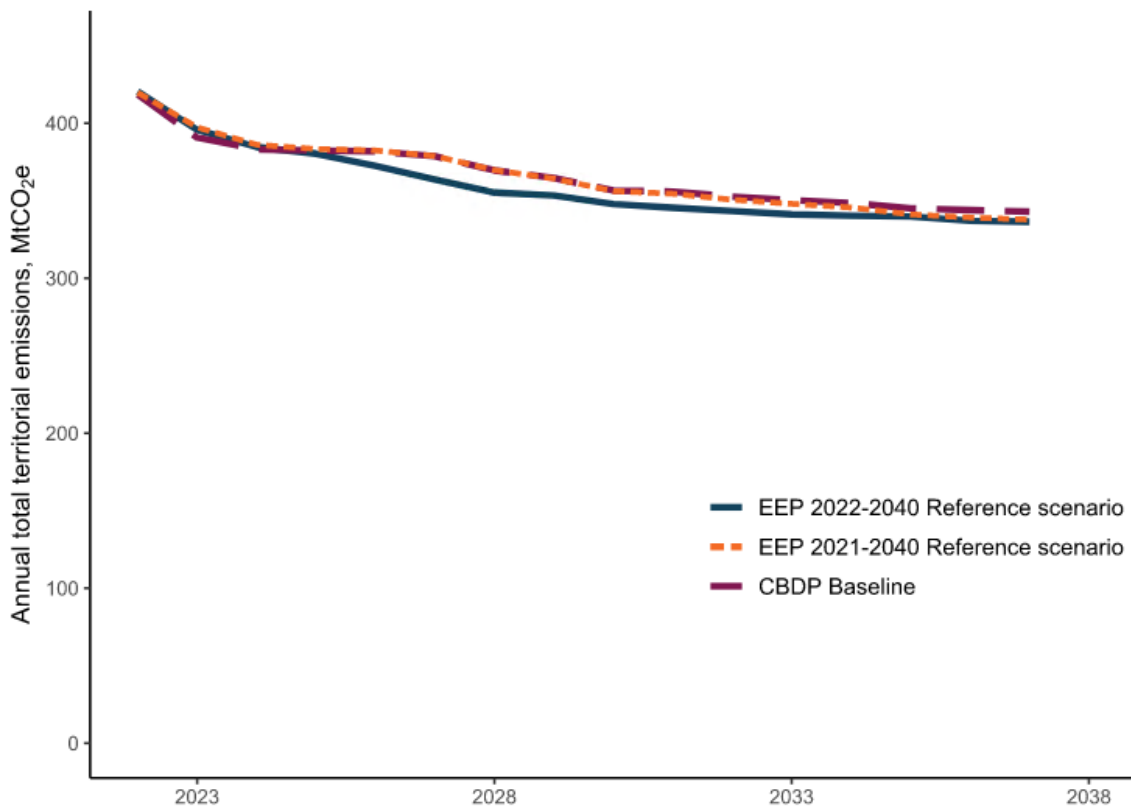
The impact of these additional (non-EEP ready) policies and proposals was assessed against a baseline derived from the previous edition of EEP (EEP 2021-2040) – referred to here as the Carbon Budget Delivery Plan (CBDP) baseline. Adjustments were made to the EEP 2021-2040 projections to incorporate updated evidence (for instance on PHEVs) and ensure it was suitable for the CBDP. These were explained in the CBDP technical annex: Net Zero Growth Plan and Carbon Budget Delivery Plan: analysis methodology³⁴. The CBDP baseline is available in the technical annex tables (Powering up Britain: charts and tables).

Following these adjustments, the CBDP baseline was slightly higher than the EEP 2021-2040 emissions projections. This is mainly because the CBDP was adjusted up for the expected impact of changes to assumptions for plug in hybrid electric vehicles (PHEVs) – see section 3.3 for details. Projected EEP 2022-2040 emissions for the Carbon Budgets 4, 5 and 6 are respectively 20 MtCO_{2e}, 54MtCO_{2e} and 36 MtCO_{2e} lower than the CBDP baseline (excluding IAS). Figure 3.1 below shows the CBDP baseline compared to EEP 2022-2040.

³³ Available at: <https://www.gov.uk/government/publications/carbon-budget-delivery-plan>

³⁴ Available at: <https://www.gov.uk/government/publications/net-zero-growth-plan-and-carbon-budget-delivery-plan-analysis-methodology>

Figure 3.1: Carbon Budget Delivery Plan Baseline (March 2023) compared to EEP 2022-2040 and EEP 2021-2040. Territorial emissions projections, excluding International Aviation and Shipping, MtCO₂e



4 Electricity supply

- We project that the low carbon share of UK electricity generation will rise from 54% in 2021 to 91% in 2040, accounting for EEP-ready electricity supply policies. This is the proportion of all generation from renewables, nuclear or carbon capture, usage, and storage (CCUS) power producers.

4.1 Introduction

This chapter explores the drivers and changes to projected electricity supply and associated emissions.

We produce projections of power sector generation and associated emissions by feeding our projections of electricity demand into a model of electricity supplier behaviour. We undertook this electricity supply sector modelling in August 2023 using DESNZ’s “Dynamic Dispatch Model” (DDM)³⁵. The DDM simulates the dispatch of electricity in half-hourly periods out to 2050 taking into account numerous factors such as fuel costs and balancing requirements. The model also projects what new generation capacity will be required to ensure security of supply in future years.

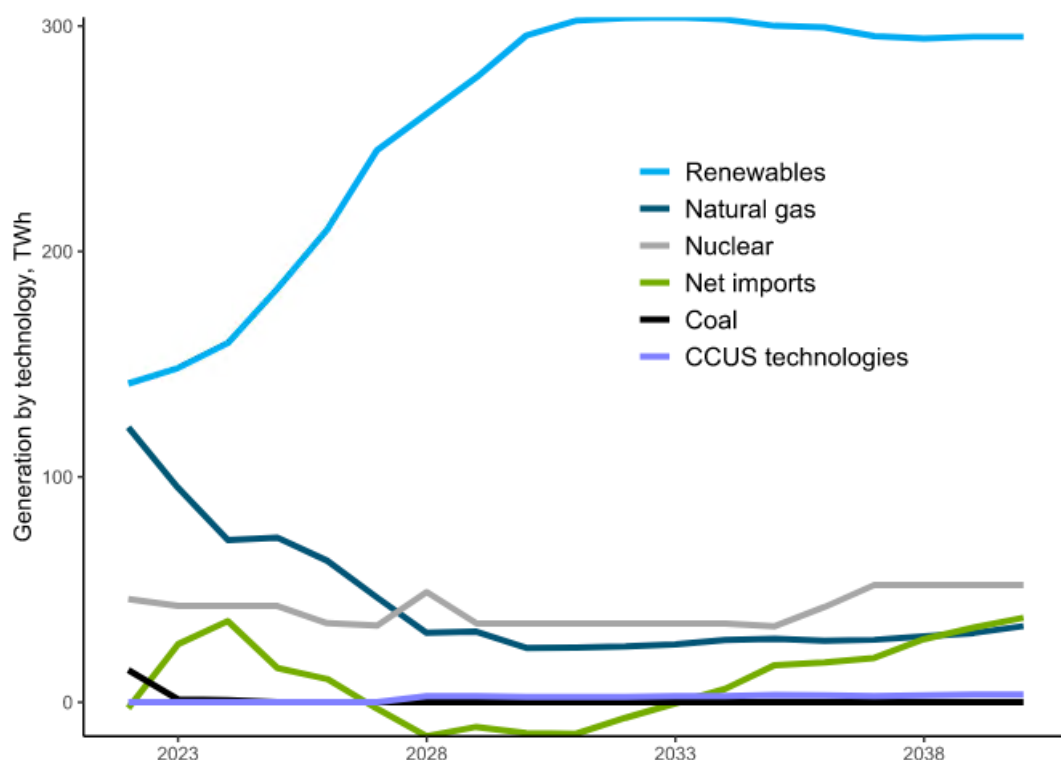
Electricity supply policies are included if they had reached the “EEP-ready” stage by July 2023 – that is, were either implemented or were planned and at a near final stage of design with funding agreed by that date.

4.2 Summary of projections

Our projections of electricity generation by fuel source over time is shown in Figure 4.1 below³⁶. See Section 4.3 for a summary of changes in comparison to EEP 2021-2040.

³⁵ For background information on the DDM please see: <https://www.gov.uk/government/publications/dynamic-dispatch-model-ddm>

³⁶ We cannot provide a breakdown of projected renewable electricity generation, capacity or new build by technology. This is for legal and commercial reasons, as it could distort the competitive allocation process in bidding for financial support in this sector.

Figure 4.1: Electricity generation by fuel source, TWh

We project that the low carbon share of UK electricity generation³⁷ will rise from 54% in 2021 to 91% in 2040, accounting for EEP-ready electricity supply policies. This is the proportion of all generation from renewables, nuclear or carbon capture, usage and storage (CCUS) power producers.

- We project generation from renewables will rise, as renewable projects are confirmed to come online through Allocation Rounds 4 through 6. Total renewables generation is projected to reach 77% of UK generation by 2040. This analysis was completed before Allocation Round 5 (AR5) results were released, so the wind capacities (and thus generation) reported here will be higher in the short-term than would now be expected. However, it is possible that future allocation rounds will bring online more wind capacity than has been assumed here in AR6, so the projected medium to long-term capacity and generation outputs remain plausible.
- Natural gas generation responds to this increasing share of low carbon generation by falling rapidly until the late 2020s. It then stabilises as less new low carbon generation capacity comes online. By 2040 it is projected to be around 34 TWh, 9% of total generation and 72% lower than 2021 levels.
- We project that nuclear generation will fall slightly as older plants retire but rise again as Hinkley Point C and Sizewell C come online.
- We project net flows through from interconnectors will rise as more connections with neighbouring markets open in the 2020s.

³⁷ The figures we quote in this chapter are for “All Power Producers”. They do not include electricity imports or exports.

- More storage comes online through the capacity market as a more renewables-intensive generation mix means more opportunities for storage technologies to make profit, taking advantage of lower wholesale prices during times where renewables would otherwise be curtailed.

4.3 Power sector changes since EEP 2021-2040

Figure 4.2: Electricity generation by fuel source compared with EEP 2021-2040, TWh

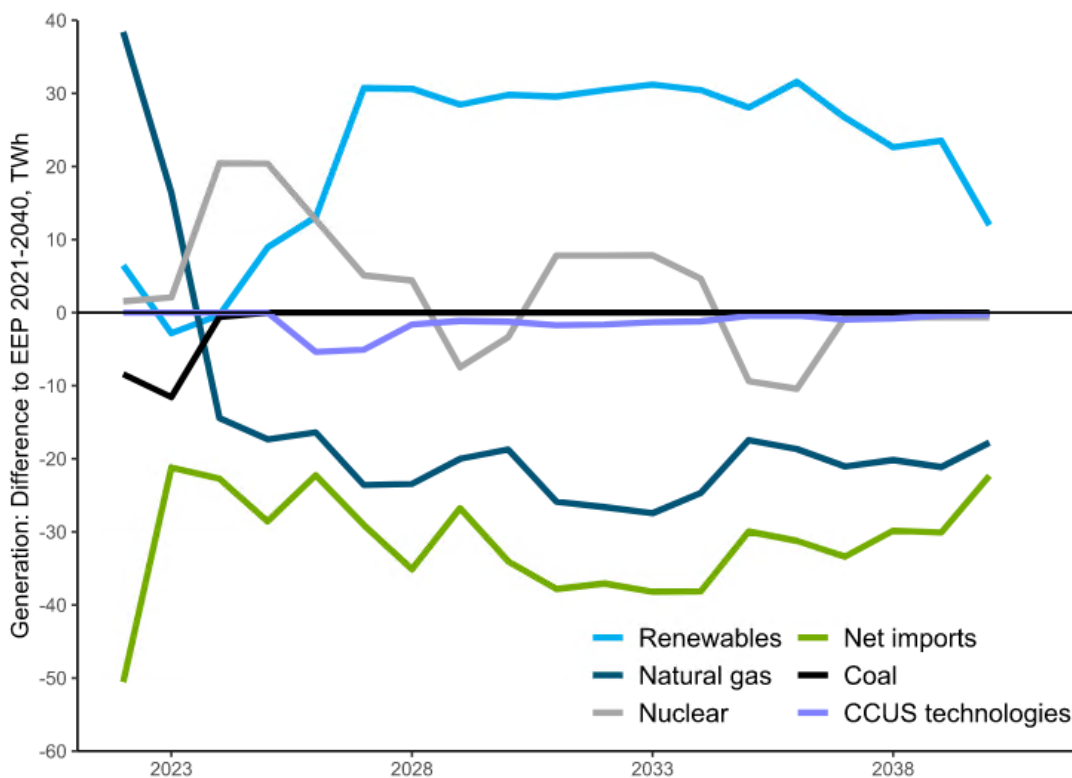


Figure 4.2 above shows the difference in generation compared with EEP 2021-2040 for all power producers up to 2040. The main power sector changes driving these differences were:

- inclusion of updated fossil fuel price and carbon price assumptions (see Section 1.1 for further details on these).
- updated known capacities from the capacity market results and Contract for Difference results for Auction Round 4.
- increase in renewables projects projected to come online through Allocation Rounds 4 to 6. Increased renewable deployment has displaced natural gas generation in EEP 2022-2040. Alongside increased storage capacity, it has also reduced net imports by bringing more opportunities for exporting otherwise curtailed energy, as well as renewables being the marginal plant more often instead of interconnectors.

- calibration of interconnector activity to more closely model historical behaviour. This has meant a decrease in projected net imports and correspondingly more generation from natural gas in the early 2020s.
- some lifetime extensions or changes to start date for some nuclear plants and carbon capture, usage and storage (CCUS) capacity.
- reduced projected electricity demand.

5 Detailed comparisons with EEP 2021-2040

5.1 Introduction

This chapter sets out more information about the major changes to the projections since last year. As in the rest of this report, all comparisons are against the March 2023 revision of EEP 2021-2040³⁸. For convenience, we use the carbon budget periods to summarise projection results.

All breakdowns here are based on territorial emissions excluding International Aviation and Shipping (IAS).

5.2 Changes in territorial projections since EEP 2021-2040

We update the projections each year to incorporate a range of updated scientific evidence, statistics, and projections of economic and demographic drivers, as well as updated estimates of policy impacts and improvements to projections methodology and modelling. Table 5.1 summarises the contribution of each of these changes to overall territorial emissions estimates.

³⁸ EEP 2021-2040 was published in October 2022. A revision to projected emissions (of less than 1 MtCO_{2e} per year) was published in the Annex tables on 10th March 2023. All comparisons against last year's edition are against the March 2023 revision to EEP 2021-2040: <https://www.gov.uk/government/publications/energy-and-emissions-projections-2021-to-2040>

Table 5.1: Changes which affect total territorial emissions projections (in comparison with EEP 2021-2040), MtCO₂e

Type of change since EEP 2021-2040	Carbon budget period			
	CB3 (2018-22)	CB4 (2023-27)	CB5 (2028-32)	CB6 (2033-37)
Transport assumption and policy updates	7	21	33	43
Policy savings updates (DESNZ and DLUHC)	1	2	-7	-9
Policy savings updates (Defra)	-2	-3	-2	-2
Modelling and assumption changes	-5	-22	-22	-23
Inventory, Non-CO ₂ and LULUCF updates	-17	-26	-21	-21
Power sector updates and other model inputs	8	-3	-32	-6
Total change since EEP 2021-2040	-9	-31	-50	-17

In more detail these changes are:

- **Transport assumption and policy updates:** This is the combined effect of updates to inputs, assumptions, and policies, but excludes the effect of fossil fuel price and economic updates (split out separately in Table 5.2 in the next section). The net effect of these was to increase emissions by 7 and 21 MtCO₂e in CB3 and CB4. Projected emissions for the fifth and sixth carbon budget periods were also substantially higher in these updates, by 33 and 43 MtCO₂e respectively. This is due to updated assumptions on Plug-in Hybrid Electric Vehicles (PHEVs). See Chapter 3 for more details.
 - Compared with EEP 2021-2040, there has been a large downward revision to transport policy savings, resulting in higher emissions across all years. See Section 3.3 for details.
 - In total, the emissions change due to lower DfT policy savings is an increase of 5 MtCO₂e for CB3 and an increase of 26 MtCO₂e for CB4. For later periods, emissions are projected to be 43 MtCO₂e higher in the fifth carbon budget and 49 MtCO₂e in CB6.
- **Policy savings updates for DESNZ and DLUHC climate change policies:** Chapter 3 provides further details of these changes. The new policies helped to reduce emissions over all carbon budget periods. However, revisions to existing policies, particularly the Renewable Heat Incentive (RHI), led to a slight upward revision in emissions for the third and fourth carbon budget periods (increases of 1 and 2 MtCO₂e respectively). For the fifth and sixth carbon budget periods, changes in DESNZ and DLUHC projected policy savings led to an overall reduction of 7 and 9 MtCO₂e respectively.

- **Power sector updates and other model inputs:** This group combines revisions to power sector modelling and other model inputs (for example, fossil fuel price updates and economic growth). See sub-section 5.2.2 for more details.
 - In aggregate, these combined input updates mean that emissions projections are higher in CB3 but lower in subsequent CB periods.
- **Policy savings updates for Defra climate change policies.** Defra policy savings were slightly higher than EEP 2021-2040, meaning they caused a consistent reduction of emissions across all carbon budgets.
- **Modelling and assumption changes** (mainly a downward revision in our projections for residential natural gas) led to lower projected emissions than in EEP 2021-2040 in all carbon budget periods. See sub-section 5.2.1 for details of these changes.
- **Inventory, Land Use, Land Use Change and Forestry (LULUCF) and Non-CO₂ emissions update:** updates to evidence here led to a reduction in projected emissions compared to EEP 2021-2040 across all carbon budget periods.

More specifically for emissions from Land Use, Land Use Change and Forestry (LULUCF) we have incorporated recent scientific evidence on land use, including evidence showing that emissions from peat in certain land types are lower than previously thought. This has led to reductions in projected emissions from EEP 2021-2040 — by 17 MtCO_{2e} in CB3, 21 MtCO_{2e} in CB4, 19 MtCO_{2e} in CB5 and 20 MtCO_{2e} in CB6.

5.2.1 Improvements in the projection methodology and assumptions

Since EEP 2021-2040, we have made numerous modelling improvements, using up-to-date data and improved evidence to improve the accuracy of the projections. In aggregate, these improvements led to reduced emissions estimates compared to EEP 2021-2040 in each of carbon budget periods three to six: by 5, 22, 22, and 23 MtCO_{2e} respectively, as summarised in Table 5.1 (above), and further broken down in Table 5.2 (below).

Table 5.2: Improvements in the projection methodology and assumptions which affect territorial emissions (in comparison with EEP 2021-2040), MtCO₂e

Modelling and assumption changes	Carbon budget			
	CB3 (2018- 22)	CB4 (2023- 27)	CB5 (2028- 32)	CB6 (2033- 37)
Autogeneration methodology update	-2	-8	-8	-8
Residential gas downward revision	-3	-13	-13	-13
Other [1]	-1	-1	-1	-2
Total change from modelling and assumption changes	-5	-22	-22	-23

Notes:

- [1] "Other" includes all modelling and assumption updates with impacts less than 5 MtCO₂e across the combined total of carbon budgets three to six.

These modelling and assumption changes are:

- **Improved modelling of pure autogeneration:** We use the term "pure autogeneration" to refer to generation of electricity by organisations who are not major power producers (MPPs) and are not using CHP (combined heat and power). (MPPs are power suppliers whose primary business is the public supply of electricity). As part of this year's EEP development programme we reviewed our CHP and pure autogeneration projection methodology with respect to the latest available data. This showed that most pure autogenerators use zero carbon fuels (such as biofuels and biomass), not natural gas as we had previously assumed. We have therefore updated our assumptions accordingly. This led to a downward revision of 8 MtCO₂e in CB4 and subsequent carbon budget periods, compared to last year's projections.
- **Residential gas downward revision EEP 2022-2040:** our review of projections found a structural over-estimate of residential gas demand since 2016. Adjusting for this led to a downward revision of 13 MtCO₂e in CB4, CB5 and CB6. We will aim to review and improve the modelling ahead of next year's projections.

5.2.2 Changes to projections of territorial emissions due to power sector updates and other model inputs

Table 5.3 further breaks down the changes in ‘Power sector updates and other model inputs’ (as featured in aggregate in Table 5.1) and their effect on emissions. The overall impact of changes to inputs varies over time. CB3 input updates resulted in an increase of 8 MtCO_{2e} against EEP 2021-2040. There was then a decrease of 3 MtCO_{2e} in CB4, a larger decrease (32 MtCO_{2e}) in CB5 and a smaller decrease of 6 MtCO_{2e} in CB6.

Table 5.3: Power sector and other model input updates which affect territorial emissions projections (in comparison with EEP 2021-2040), MtCO_{2e}

Power sector and other model input updates	Carbon budget			
	CB3 (2018- 22)	CB4 (2023- 27)	CB5 (2028- 32)	CB6 (2033- 37)
Fossil fuel, retail and carbon prices (EEP 2022-2040)	-6	8	-10	-4
Power sector updates & interaction	19	-1	-18	-6
Economic, GDP and demographic assumptions	2	-2	4	7
North Sea Transition Authority update	-4	-7	-8	-2
Other [2]	-4	-1	0	-1
Total change due to power sector and other model input updates	8	-3	-32	-6

Notes:

- [1] The DUKES update row does not include transport: the “Transport assumption and policy updates” row in Table 5.1 captures these changes.

- [2] “Other” includes inputs with impacts less than 5 MtCO_{2e} across the total of carbon budgets three to six.

Compared with EEP 2021-2040, the main revisions to emissions (in decreasing order) came from updates to:

- **Fossil fuel, retail, and carbon price assumptions:** the projected oil price is substantially lower than assumed for EEP 2021-2040, particularly for later carbon budget periods. For gas, the price is higher until around 2030 and then at similar levels

to EEP 2021-2040. For coal, the price is higher for all years. Overall, operating through changing levels of demand, this leads to slightly higher projected emissions (mainly in the domestic sector) for the fourth carbon budget period of 8 MtCO_{2e}, and lower projected emissions of 10 MtCO_{2e}, and 4 MtCO_{2e} for the fifth and sixth carbon budget periods.

- **Power sector updates and interaction:** Since EEP 2021-2040, power sector modelling has been updated. See Chapter 4 for more details.
- **North Sea Transition Authority (NSTA) updates:** This update covers the combined modelling updates of two years, as new projections were not available for EEP 2021-2040. The update to new North Sea Transition Authority (NSTA) projections has caused a downwards revision of c. 8 MtCO_{2e} per carbon budget period in CB4 and CB5. This is mostly due to changes in expected dates that some offshore oil and gas plants will cease production.

6 Lists of supporting material

6.1 Annexes

Annex A: Greenhouse gas emissions by source

Annex A NZS Categories: Greenhouse gas emissions by source

Annex B: Carbon dioxide emissions by source

Annex C CO₂: Carbon dioxide emissions by IPCC category

Annex C Non-CO₂: Non-CO₂ greenhouse gas 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: 2022 non-CO₂ GHG emissions projections report

Our annexes contain projections for the following scenarios, most of which we publish each year:

Scenario	Description
Reference Scenario	Based on central estimates of economic growth and fossil fuel prices. Contains policies that have already been implemented and those planned policies (“EEP-ready” policies). See annex D on policy savings for definitions of each policy implementation status.
Low Prices	Similar assumptions to reference scenario but with lower projected fossil fuel prices.
High Prices	Similar assumptions to reference scenario but with higher projected fossil fuel prices.
Low Growth	Similar assumptions to reference scenario but with lower projected economic growth (0.25 percentage points lower e.g. growth of 3% would become 2.75%).
High Growth	Similar assumptions to reference scenario but with higher projected economic growth (0.25 percentage points higher e.g. growth of 3% would become 3.25%).
Existing Policies	UNFCCC With Existing Measures scenario. Contains central price and growth assumptions but without any planned policies included.
<i>(not yet available)</i>	<i>The scenario below will be published once it is available.</i>
Pre-LCTP Baseline Policies	Contains central price and growth assumptions but only policies that existed before the Low Carbon Transition Plan (LCTP) of July 2009.

6.2 Web tables and figures

We publish web tables and figures alongside this report. Some of these replicate tables and figures in the report text while others are supplementary. These also include data from the tables and figures in the summary report (published 26th Oct 2023).

If you need a version of this document in a more accessible format, please email alt.formats@energysecurity.gov.uk. Please tell us what format you need. It will help us if you say what assistive technology you use.