Department for
Business, Energy
& Industrial Strategy

Updated energy and emissions projections 2021 to 2040

October 2022

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This publication is available for download at:
https://www.gov.uk/government/collections/energy-and-emissions-projections

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Executive summary

The Department of Business, Energy, and Industrial Strategy (BEIS) publishes annual projections of UK energy demand and greenhouse gas emissions (EEP)[1]. 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. These policies are together referred to as "EEP-ready" policies[2]. Policies that are at an earlier stage of development are not included. The projections are the baseline against which new and early-stage policies are assessed between EEP editions.

This report contains outputs from the latest projections, Energy and Emissions Projections 2021-2040 (EEP 2021-2040). The most recent previous full update is Energy and Emissions Projections 2019 (EEP 2019) published in October 2020[3]. A more recent partial interim update, the Net Zero Strategy (NZS) Baseline, was published in December 2021[4]. These projections are an update to that baseline.

Compared to the NZS Baseline, these updated projections of emissions are slightly lower for most of the projected period (2021-2040) but slightly higher in the last three years. Under EEP-ready policies, emissions are projected to fall by 18% between 2020 and 2040.

The Climate Change Act[5] (CCA), passed in 2008, established a system of legally binding interim targets called carbon budgets, covering successive five-year periods. Since June 2019, the 2050 target under the CCA is to reach net zero[6]. EEP provides projections of performance against carbon budget targets under EEP-ready policies. Carbon Budgets 3 and 4 (CB3 and CB4), covering 2018-2022 and 2023-2027 respectively, are projected to be met. Under EEP-ready policies, projected gaps between target and performance remain for Carbon Budgets 5 and 6 (CB5 and CB6, covering the periods 2028-2032 and 2033-2037 respectively) but these are smaller than projected in the NZS Baseline.

The Net Zero Strategy (NZS)[7], published in October 2021, included an illustrative pathway referred to as the "delivery pathway" which showed indicative emissions reductions across sectors to meet UK targets up to the sixth carbon budget (2033-2037). These pathways were constructed by modelling policies and proposals

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[1] Energy and emissions projections:
https://www.gov.uk/government/collections/energy-and-emissions-projections
[2] Note this equates to the UNFCCC international reporting scenario "With Additional Measures" (WAM), which includes Existing and Planned policies.
[3] EEP 2019, published October 2020:
https://www.gov.uk/government/publications/updated-energy-and-emissions-projections-2019
[4] EEP Net Zero Strategy baseline (partial interim update), published December 2021:
https://www.gov.uk/government/publications/energy-and-emissions-projections-net-zero-strategy-baseline-partial-interim-update-december-2021
[5] See this link:
http://www.legislation.gov.uk/ukpga/2008/27/contents/enacted
[6] The amendment is here:
http://www.legislation.gov.uk/uksi/2019/1056/article/1/made
[7] Net Zero Strategy, Build Back Greener, published October 2021:
https://www.gov.uk/government/publications/net-zero-strategy

additional to those included in the NZS Baseline. Some of these additional policies and proposals are included in EEP 2021-2040 whilst other policies are yet to reach the EEP-ready stage of development. The updated EEP 2021-2040 projections are within the range of uncertainty assumed in the NZS Baseline when modelling the delivery pathway. This report does not contain an update to the NZS delivery pathway.

In EEP 2021-2040, policies outside the power sector are included if they had reached the required stage of development by January 2022. Power sector policies are included where they were near final by July 2022. It is not possible to provide separate quantified estimates of impacts for all EEP-ready policies under current EEP modelling processes. Updated policy savings from EEP-ready policies excluding power sector interventions[8] increased by 110 $MtCO_2e$ compared to the NZS Baseline over the projection period. Section 3 and Annex D contain further details on policy impacts.

The projections do not take account of proposals to limit the adverse impact of high fossil fuel prices on households, businesses and public sector organisations as these proposals had not been finalised at the time of modelling. Fuel consumption and emissions in the CB4 period (2023-2027) are therefore likely to be higher than projected in this EEP.

[8] Within this figure, we exclude power sector interventions: these are shown in the final row of the 'All, by_sector' sheet in Annex D.

1 Introduction

- This report contains projections of energy consumption, electricity generation and greenhouse gas emissions under EEP-ready policies out to 2040. See section 2.1 for further details.
- 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.
- Section 4 of this report contains details of policies that are new to this latest edition of EEP and changes to the estimated impacts of policies that were already included in the NZS Baseline.
- Policies that have been announced but have not reached the required EEP-ready state of development are not included.
- The Government sets legally binding carbon budgets for five-year periods. They aim to make sure the UK reaches its target of net zero emissions by 2050. This report shows projected performance against these targets under EEP-ready policies. See section 2.2 for further details.
- Analysis of the reasons for changes between the NZS Baseline and EEP 2021-2040 projections is provided in section 5.

1.1 About this document

This report sets out the 2021-2040 Energy and Emissions Projections[6]: referred to as EEP 2021-2040. 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 the detailed design of the policy and, if funding is required, the level of funding approved. In this report, policies that have reached the required stage of development are referred to as “EEP-ready” policies. The projections provide the baseline against which new policies are assessed between EEP editions.

Policies outside the power sector are included if they had reached the EEP-ready stage of development by January 2022. Policies outside the power sector are included if they had reached the EEP-ready stage by July 2022. Policies outside the power sector have an earlier cut-off date because these affect electricity demand, which is an essential input required before power sector modelling.

This report provides an overview of the updated projections and includes comparisons against the Net Zero Strategy Baseline (NZS Baseline), published December 2021. 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[10]. These are legally binding limits on the total amount of greenhouse gas (GHG) emissions the UK can

emit over five-year periods and are required to be set 12 years in advance of the start of each period. The metric used to assess performance against CCA targets is called the "Net Carbon Account" (NCA). Projections of performance against CCA targets under EEP-ready policies are shown in section 2.2. International Aviation and Shipping (IAS) emissions are included in the NCA metric used to assess performance against CCA targets for Carbon Budget 6 (CB6) but are not included in the metric for earlier carbon budgets. We therefore include IAS in section 2.2 in the projections where we refer to performance against the CB6 target, but these emissions are not included in projections of performance for CB3, CB4 and CB5.

Outside of section 2.2 we present projections for UK territorial emissions which exclude IAS. Therefore, all commentary, tables, and charts in this report outside of section 2.2 exclude IAS. We use the carbon budget periods to summarise projection results within this report for convenience. IAS is excluded from all references to emissions or consumption except when reporting performance against the CB6 carbon budget target in section 2.2.

These projections bring together statistical and modelled information from many different sources[7]:

- At the time of modelling, the main source of energy consumption data was the annual Digest of UK Energy Statistics[9] (DUKES), published July 2021. The first projection year for energy consumption is therefore 2021 and we report energy consumption trends against a comparison year of 2020.
- The main source of emissions statistics is the final UK greenhouse gas emissions national statistics: 1990-2020 (GHGI 1990-2020), published February 2022. The first projection year for emissions is therefore 2021, and we report emission trends against 2020 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 2022[10].
- The latest BEIS fossil fuel price assumptions incorporated into the modelling are those to be published in autumn 2022[11].
- Land Use, Land Use Change and Forestry (LULUCF) projections aligned with the GHGI 1990-2020 were not yet available at the time of modelling. The projections have been updated to LULUCF projections aligned to the GHGI 1990-2019. These are produced by the Centre for Ecology and Hydrology (CEH). This leads to a small discontinuity in LULUCF in the first projected year 2021.

[9] There is more detail here:
https://www.gov.uk/government/collections/digest-of-uk-energy-statistics-dukes\#2021
[10] Available at this link:
https://obr.uk/efo/economic-and-fiscal-outlook-march-2022/
[11] Available at this link:
https://www.gov.uk/government/collections/fossil-fuel-price-assumptions

- Non-CO2 projections, excluding those from LULUCF, have been updated and are consistent with the GHGI 1990-2020. These are produced by BEIS, Defra and REE[12] as part of their contract for the GHGI.

We produce projections of energy demand and emissions outside the power sector by applying standard statistical techniques. These project forward energy demand and emissions based on trends and relationships in past data. We adjust these projections to take account of estimated reductions in energy consumption from existing and well-developed planned policies at the cut-off point (January 2022).

We base our projection of electricity supply on a model of supplier behaviour rather than statistical analysis of past trends.

The accompanying methodology summary[13] provides further details of the projection methodology.

1.2 The reference and other scenarios

Our main projection is the "reference scenario"[14]. 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. Results from other EEP scenarios are provided in the accompanying annex tables.

The reference scenario only includes 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[15]. 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. The cut-off date for inclusion for EEP-ready policies outside the power sector was January 2022. The cut-off for EEP-ready power sector policies was July 2022. The reference scenario is an update of the NZS Baseline.

The annexes contain projections and past estimates of what we would have expected to happen in the absence of any policies or plans implemented after the Low Carbon Transition Plan (LCTP) published in 2009. This is referred to as the

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[12] Ricardo Energy & Environment

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

[14] The report and annexes contain outputs from projections under various different macroeconomic assumptions. The "baseline" projection projects energy and emissions without policies brought in since the 2009 Low Carbon Transition Plan. This is the closest scenario to the UNFCCC "without measures" (WoM) projection. A WoM scenario has all mitigation removed. The UK does not produce a WoM projection because we cannot remove the impacts of pre-LCTP climate change measures. Our "existing policies" scenario matches the UNFCCC "with [existing] measures" (WEM) projection. It includes implemented and adopted measures but not planned policies. Our main projection, the reference scenario, also includes planned policies. This matches the UNFCCC "with additional measures" (WAM) scenario.

[15] This equates to expired, implemented, adopted, and planned policies as defined by the United Nations Framework Convention on Climate Change (UNFCCC). See Part II, Section V(A) paragraph 13, page 83 of:
http://unfccc.int/resource/docs/cop5/07.pdf
This is a UNFCCC "with additional measures" (WAM) scenario. Annex D gives details of the policies we include.

“pre-LCTP” baseline. The LCTP was the UK’s first comprehensive plan for moving to a low carbon economy. The difference between the pre-LCTP reference case and the EEP 2021 reference case therefore shows the cumulative impact of the package of policies developed since the LCTP. We also include the “WEM policies[16]” policy scenario which only includes implemented policies.

The projections are sensitive to macro-economic assumptions. We provide projections under alternative fossil fuel price and economic growth assumptions in the accompanying annexes.

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

[16] “WEM” stands for the “With Existing Measures” scenario used for international reporting to UNFCCC.

2 UK emissions projections

- Under EEP-ready policies, emissions are projected to fall by 18% between 2020 and 2040. EEP-ready policies in this edition include some of the policies and proposals from the Net Zero Strategy, whilst others are yet to reach the required state of development and will therefore be included in later editions.
- The UK met the first and second carbon budgets with headroom of 36 and 384 $MtCO_2e$ respectively[17]. Under the reference scenario, we project that the UK will meet the third carbon budget with headroom of around 352 $MtCO_2e$.
- 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, referred to as EEP-ready policies.
- Under EEP-ready policies, the projections show headroom against the fourth carbon budgets of 20 $MtCO_2e$, and shortfalls against the fifth and sixth carbon budgets of 73 and 976 $MtCO_2e$ respectively. The NCA metric used to assess performance against carbon budget targets includes International Aviation and Shipping for CB6.

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

Emissions estimates in this publication include six greenhouse gases as defined by the Climate Change Act 2008[18]: carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), and sulphur hexafluoride (SF_6). HFCs, PFCs and SF_6 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). GWP values are set out in Intergovernmental Panel on Climate Change (IPCC) assessment reports[19].

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 framework using 100-year GWPs

[17] The Government fixes its carbon budget performance against emissions from the greenhouse gas inventory for the end of each budget period. Note that later inventories may adjust these emission estimates. Summary figures for the first two carbon budgets are in Table 9 of the Statistical Summary here:
https://www.gov.uk/government/statistics/final-uk-greenhouse-gas-emissions-national-statistics-1990-to-2018

[18] Climate Change Act 2008:
https://www.legislation.gov.uk/ukpga/2008/27/part/1/crossheading/targeted-greenhouse-gases

[19] We use the Global Warming Potentials (GWPs) from Table 8.A.1 of Working Group 1 of the IPCC Fifth Assessment Report: Climate Change 2007: AR4135 GWPs. See:
https://www.ipcc.ch/site/assets/uploads/2018/02/ar4-wg1-chapter2-1.pdf
This is consistent with the Greenhouse Gas Inventory and BEIS emission statistics.

listed in table 8.A.1 of the Fifth IPCC Assessment Report (AR5 without climate-feedback)[20]. Therefore, emissions estimates are reported on this basis for EEP 2021-2040 in this publication.

2.1 UK emissions projections and uncertainty

Figure 2.1 compares the main territorial emissions trends from EEP 2021-2040 with those from the Net Zero Strategy Baseline (NZS Baseline) which was the last (interim) update to the EEP. We give more detail about the changes to the projections in Chapter 5**.** In this section, we describe emissions in comparison to the NZS Baseline (both in the GWP AR5 without feedback), excluding International Aviation and Shipping. Annex A additionally includes reference case emissions in GWPs consistent with AR4.

In this section, we use the carbon budget periods to summarise projection results for convenience. These are not the same as the Net Carbon Account (NCA) metric used to assess performance against carbon budget targets, see section 2.2 for details.

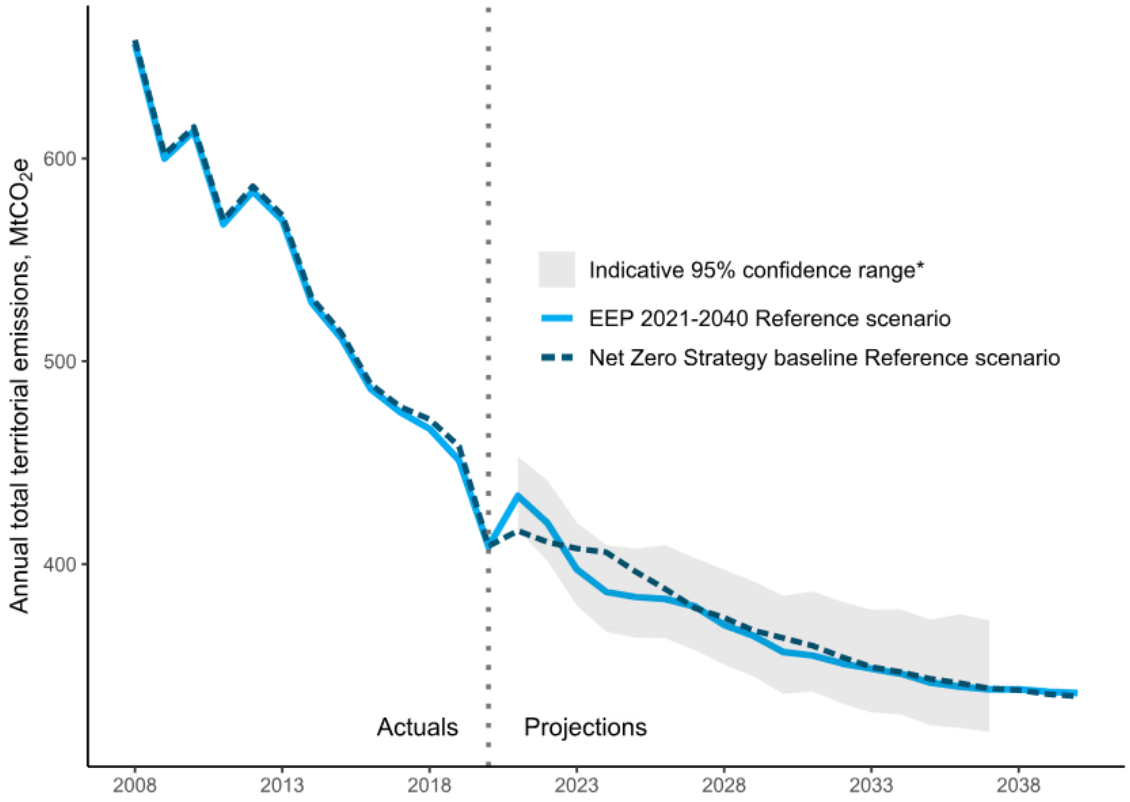
When we compare total UK territorial emissions (excluding IAS) for carbon budget periods three to six in EEP 2021-2040:

- We project higher territorial emissions than the NZS Baseline in the CB3 period and lower emissions in CB4 to CB6. For the third carbon budget period they are 15 $MtCO_2e$ (1%) higher and for the fourth 46 $MtCO_2e$ or 2% lower.
- In the fifth carbon budget period territorial emissions are lower than in the NZS Baseline—by 21 $MtCO_2e$ or 1%. We discuss these changes in section 5.
- Territorial emissions are lower in the sixth carbon budget period than the equivalent period in the NZS Baseline by 6 $MtCO_2e$ or <0.5%.

The projections are sensitive to macro-economic and other input assumptions and to modelling uncertainty. For EEP 2018 (published in 2019) we carried out Monte Carlo analysis to assess the impact of the main sources of uncertainty of our projections. The 95% confidence range shown in Figure 2.1 provides an indication of uncertainty, derived from the EEP 2018 analysis by assuming the percentage uncertainty around the projections is the same in EEP 2021-2040.

[20] Fifth IPCC Assessment Report: https://unfccc.int/documents/311138

Figure 2.1: Uncertainty in UK projected territorial emissions (excluding IAS), $MtCO_2e$



Notes:
*- * The uncertainty ranges are indicative and are based on modelling from EEP 2018. The chart includes LULUCF*

2.2 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 is 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 UK "Net Carbon Account" (NCA). See Box 1 below for details of how the NCA is calculated[21].

[21] Carbon Accounting Regulations: https://www.legislation.gov.uk/uksi/2009/1257/contents/

Box 1: The UK net carbon account (NCA)

2018 - 2020:

The NCA is defined as the sum of three components:

1. **Emissions allowances the UK receives under the EU Emissions Trading System (EU ETS)[22]**
   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 2020[23].
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:

Carbon accounting regulations have not yet been set. The UK left the EU ETS on 31st December 2020, so for consistency with other recent BEIS publications (in particular the Net Zero Strategy) it is assumed in compiling these figures that adjustments for any ETS trading will not apply going forwards. Therefore, 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 scope.
2. **Credits/debits from international trading systems**
   This is currently assumed to be zero[24].

Figure 2.2 shows projected performance against the carbon budgets under EEP-ready policies.

Table 2.1 shows how our projections compare with those in the previous edition.

We project the UK will meet the third carbon budget with headroom of 352 $MtCO_2e$.

We project headroom of 20 $MtCO_2e$ in the fourth carbon budget under EEP-ready policies, and shortfalls of 73 and 976 $MtCO_2e$ in the fifth and sixth carbon budgets respectively. Projections of performance under EEP-ready policies has improved slightly in all carbon budget periods. The NCA metric used to assess performance

[22] In previous EEP publications, the UK's share of EU ETS emissions allowances were not known for CB3-5, therefore estimates assumed by Government at the time of setting each carbon budget were used instead

[23] Annual Statement of Emissions for 2020:
https://www.gov.uk/government/annual-statement-of-emissions-for-2020

[24] While the UK intends to meet its climate targets for each of carbon budgets 3 to 6 through reducing emissions domestically, it reserves the right to use such 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.

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.

Figure 2.2: Projected performance against carbon budgets under EEP-ready policies, $MtCO_2e$

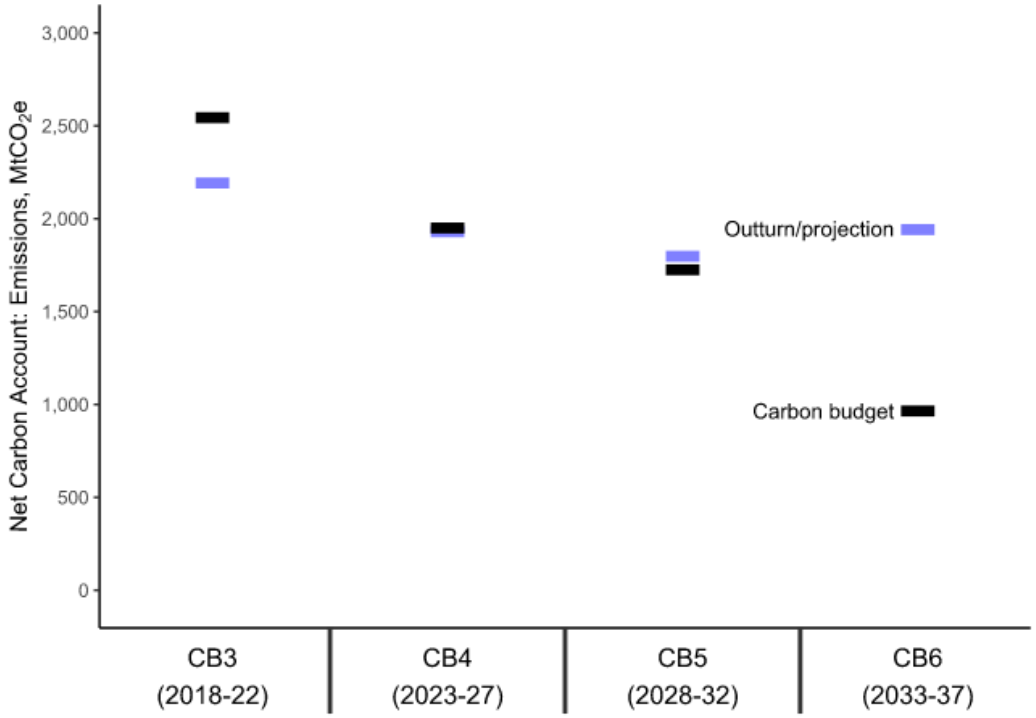


Table 2.1: Comparison of emissions figures across carbon budget periods, $MtCO_2e$ and per cent

		Carbon budget			
		CB3 (2018 -22)	**CB4 (2023 -27)**	**CB5 (2028 -32)**	**CB6 (2033 -37)**
Average annual required reduction vs. base emissions	%	-38%	-52%	-58%	-77%
EEP Net Zero Strategy baseline					
Territorial emissions exc. IAS	projected emissions, $MtCO_2e$	2,166	1,976	1,819	1,720
Territorial emissions inc. IAS	projected emissions, $MtCO_2e$	2,353	2,197	2,058	1,962
EEP 2021-2040					
Territorial emissions exc. IAS	projected emissions, $MtCO_2e$	2,181	1,930	1,798	1,714
Territorial emissions inc. IAS	projected emissions, $MtCO_2e$	2,354	2,152	2,024	1,941
Net Carbon Account [2]	projected emissions, $MtCO_2e$	2,192	1,930	1,798	1,941
Result vs. Budget with reference scenario	emissions, $MtCO_2e$	-352	-20	73	976
Projected average annual reduction vs. base emissions [3]	*%*	*-46%*	*-53%*	*-56%*	*-54%*

Notes:
- All data based on reference case and in AR5 without feedback GWPs.
- [1] CB3 level shown as set out in the 2009 legislation. 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. See footnote 2 of the Annual Statement of Emissions for 2020[25].
- [2] See Box 1 for further information on how the NCA is calculated. For the period 2021 onwards, territorial emissions have been assumed. IAS emissions are included in CB6 in accordance with the basis on which the budget was set. For the NZS Baseline EEP, the NCA for CB4 would therefore be 1,976 $MtCO_2e$, for CB5 1,819 $MtCO_2e$, and for CB6 1,962 $MtCO_2e$.
- [3] The base year is 1990 for CO_2, CH_4 and N_2O, and 1995 for fluorinated gases. For CB3-5, base year emissions are currently estimated to be 817.1 $MtCO_2e$. CB6 base year emissions include an additional 23.6 $MtCO_2e$ for international aviation and

[25] Annual Statement of Emissions for 2020: https://www.gov.uk/government/annual-statement-of-emissions-for-2020

shipping. Base year emissions estimates on which CB percentage reductions are based are revised annually and are therefore subject to change.

Table 2.2 below shows the EEP 2021-2040 projections of the UK Net Carbon Account under EEP-ready policies against the indicative delivery pathway shown in the Net Zero Strategy. This pathway is the most up to date trajectory published by the Government that takes into account both EEP-ready policies and those separately quantified policies and proposals which have not yet met the threshold for inclusion in EEP. EEP 2021-2040 is an update to the NZS Baseline against which the indicative delivery pathway was modelled.

Table 2.2: Comparison of NCA performance against NZS emission pathways, $MtCO_2e$

		CB4 (2023-27) projected	**CB5 (2028-32) projected**	**CB6 (2033-37) projected**
EEP 2021-2040	emissions, $MtCO_2e$	1,930	1,798	1,941
NZS delivery pathway	emissions, $MtCO_2e$	1,793	1,255	911

Notes:
- All figures are presented in AR5 without feedback GWPs.
- The EEP 2021-2040 row restates the NCA presented in table 2.1.
- NZS Emissions Pathway drawn from Table 9 of the Net Zero Strategy Technical Annex. This includes policies which had not yet reached EEP-ready status at the cut-off date for EEP 2021-2040.
- Figures for Carbon Budget 6 include international aviation and shipping in both rows.

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 (January 2022 for policies outside the power sector and July 2022 for power sector policies). These are together referred to as “EEP-ready” policies.
- We project that EEP-ready quantified Government policies excluding power sector interventions will reduce territorial emissions by around 239 $MtCO_2e$ in the third carbon budget period, 328 $MtCO_2e$ in the fourth, 398 $MtCO_2e$ in the fifth and 460 $MtCO_2e$ in the sixth carbon budget period.
- The new individually quantified policies that are included for the first time in EEP 2021-2040 are: the Public Sector Decarbonisation Scheme, Green Homes Grant, Social Housing Decarbonisation Fund, Green Gas Support Scheme, Heat Networks Metering and Billing Regulations, Boiler Upgrade Scheme, Industrial Energy Transformation Fund, Warm Home Discount, and the Green Network Fund. New policy savings for Energy Company Obligation 4 (ECO4) are also included.

The Government estimates individual policy impacts by comparing modelled emissions from scenarios which contain a policy against those which do not. Box 2 provides more detail on how policies reduce greenhouse gas emissions. It is not possible to quantify the impact of all individual policies. Power sector policies are modelled together, 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 are taken into account in the modelling, but we do not have estimates of the individual impacts. Some types of policy do not directly reduce fossil fuel consumption or emissions but instead are enabling policies, such as innovation funding or investment in infrastructure. These types of policies cannot be taken into account under current EEP modelling processes. The quantified impact of policies implemented by Devolved Administrations are also not currently included and nor are initiatives undertaken by local government unless these are directly driven by a central government initiative.

3.1 The EEP and policies from the Net Zero Strategy

In 2019, the Government passed legislation which requires the UK to reduce emissions by 100% compared to 1990 levels. The Net Zero Strategy (NZS), published in October 2021, sets out the Government’s plans to meet this goal.

The baseline against which policies and proposals in the NZS were assessed (the EEP NZS Baseline) was published in December 2021. This was a partial update to EEP 2019 (including some economic updates[26] and some methodological improvements) which was developed to provide the NZS Baseline. It did not include

[26] See more detail at the link below, and in the Net Zero Strategy Technical Annex: https://www.gov.uk/government/publications/energy-and-emissions-projections-net-zero-strategy-baseline-partial-interim-update-december-2021/net-zero-strategy-baseline-covering-note

any additional policies to those in EEP 2019 and nor did it contain updated estimates for EEP 2019 policies.

EEP contains implemented policies and those that are planned where the policy design was near final at the policy cut-off date (January 2022 for policies outside the power sector and July 2022 for power sector policies). Policies at an earlier stage of development were 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. Some of the policies and proposals set out in the NZS had reached the stage of developed required for inclusion in EEP 2021-2040 by the policy cut-off. Others had not yet reached the required stage.

3.2 Policies for emissions reduction

Box 2: How policies reduce emissions

Policies can reduce greenhouse gas emissions in several ways.

Energy supply policies reduce emissions from the energy source, for instance, electricity supply policies make the generation of one unit of electricity less carbon intensive.

Energy demand policies reduce emissions by reducing the use of carbon intensive fuels in other sectors of the economy.

Energy demand policies can have direct and indirect savings.

- **Direct** savings occur when a policy reduces energy demand at the point of use. *Example*: a policy which replaces household gas boilers with more efficient models produces direct savings, as it reduces the gas required to provide the same amount of heat.
- **Indirect** savings occur when a policy intervention in one sector leads to changes in emissions in a different sector. For instance, a policy that increases electric vehicle demand within the transport sector will increase emissions in the power sector. Currently within EEP modelling we only individually quantify indirect savings from policies that affect electricity demand. Policies with indirect savings impact emissions from the power sector, not the sector where the energy is used. Some policies affect emissions without impacting energy demand e.g. regulation of fluorinated gases. We classify these as **direct savings**.

Table 3.1 shows that we estimate that quantified Government policies (excluding power sector interventions) will reduce territorial emissions by 1,425 $MtCO_2e$ over carbon budgets three to six. We estimate 1,311 $MtCO_2e$ of these savings are direct and 114 $MtCO_2e$ are indirect. We estimate savings of 804 $MtCO_2e$ from power sector

policies over the same period[27]. We report policy savings in Annex D: this gives brief information about the policies we include.

Table 3.1: Projected GHG emissions savings from EEP-ready policies excluding power sector interventions, $MtCO_2e$

	Carbon budget				
	CB3 (2018-22)	**CB4 (2023-27)**	**CB5 (2028-32)**	**CB6 (2033-37)**	**Total (2018-37)**
Savings from policies excluding power sector interventions	239	328	398	460	1,425

Note that in contrast to previous editions of these projections, this table excludes savings from power sector interventions. We will be reviewing the method for calculating savings from power sector interventions before the next publication.

3.3 Changes to individually quantified policy savings since EEP 2019 and NZS Baseline

From the fourth carbon budget period onwards, we project higher territorial GHG savings from EEP-ready Government policies excluding power sector interventions compared with the NZS Baseline projections (for which policies had not been updated since EEP 2019). These policy savings for the fourth carbon budget have increased from 309 to 328 $MtCO_2e$ (19 $MtCO_2e$ more).

In the long term we project higher EEP-ready policy savings excluding power sector interventions than in previous projections. For the fifth carbon budget these savings have increased overall in EEP 2021-2040, from 360 to 398 $MtCO_2e$ (a rise of 39 $MtCO_2e$). For the sixth carbon budget period, they are 460 $MtCO_2e$, an increase of 54 $MtCO_2e$ from the NZS Baseline.

Policies with the largest change in policy savings from previous projections include:

- **New Policies:** The Public Sector Decarbonisation Scheme, Green Homes Grant, Social Housing Decarbonisation Fund, Green Gas Support Scheme, and the Heat Networks Metering and Billing Regulations are new policies in EEP 2021-2040. Other new policies are the Boiler Upgrade Scheme (BUS), Industrial Energy Transformation Fund (IETF), Warm Home Discount, the Green Heat Network Fund, and ECO4. Together they are projected to contribute 12, 16 and 15 $MtCO_2e$ of savings in the fourth, fifth and sixth carbon budget periods respectively.

[27] The total of power sector interventions is slightly lower than seen in EEP 2019 (see Annex D: "All, by_sector" sheet for the full series). We are reviewing the methodology for the pre-2010 baseline (used to quantify power sector interventions) and the 'with existing measures' scenario, due to the effect that higher fossil fuel prices have had on these scenarios which represent a counterfactual to the main reference case.

- **Resources and Waste Strategy:** EEP 2021-2040 does not include estimates of savings from the Deposit Return Scheme, the Reform of the UK Packaging Producer Responsibility System, and the Consistency in Household and Business Recycling Collections. These policies were included in the NZS Baseline. We will include estimates of these policies in the projections when they are more developed. This is in line with the Net Zero Strategy commitment to deliver these reforms and to explore options for the near elimination of biodegradable municipal waste to landfill from 2028. Together, in EEP 2019 (and in the NZS Baseline which shared the same policy assumptions) these savings previously contributed 1 $MtCO_2e$, 4 $MtCO_2e$ and 8 $MtCO_2e$ of savings in the fourth, fifth and sixth carbon budget periods respectively.
- **Transport road vehicle policies:** Transport policies now include greater ambition on the uptake of electric vehicles. For EEP 2021-2040, the savings we attribute to road vehicle policies are 10 $MtCO_2e$ higher in the fourth and 39 $MtCO_2e$ higher in the fifth carbon budget period than in the Net Zero Strategy baseline. Savings are 54 $MtCO_2e$ greater in the sixth carbon budget period. The main driver is an increased forecast of electric vehicle uptake. This is driven by statistics which show consumers opting for battery electric and plug-in hybrid cars, and lower battery cost projections which make battery electric vehicles more attractive for consumers.
- **Aviation:** Changes in emissions savings are driven by updated modelling for the Jet Zero Strategy. More detail can be found in the Jet Zero Strategy and its Analytical Annex[28].

3.4 Emissions savings from policies in electricity supply

A range of Government policies have reduced emissions in the Electricity Supply Industry (ESI) since the LCTP. Supply-side policies comprise:

- 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

Power supply markets are highly interconnected. This means we cannot disentangle the impacts of individual policies.

We report aggregated emissions savings from power supply policies in the “All, by sector” section of Annex D.

[28] Available at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1096929/jet-zero-strategy-analytical-annex.pdf

4 Electricity supply

We undertook the electricity supply sector modelling in August 2022 using BEIS's "Dynamic Dispatch Model" (DDM)[29]. The DDM models the impact of relevant policies including small scale Feed-in Tariffs, the Renewables Obligation, Contracts for Difference (CfD), Carbon Price Support, the Capacity Market and Industrial Emissions Directive.

As in previous years, the report annexes give separate results for "Major Power Producers" (MPPs: annexes G-I) and "All Power Producers" (which includes autogenerators: annexes J-L). In 2020, MPPs accounted for around 94% of the UK's electricity generation.

Electricity supply policies are included if they had reached the "EEP-ready" stage by July 2022 i.e. were either implemented or were planned and at a near final stage of design with funding agreed by that date. We project that the low carbon share of UK electricity generation[30] will rise from 59% in 2020 to 87% in 2040, accounting for EEP-ready electricity supply policies. This is the proportion of all generation from renewables, nuclear or Carbon Capture and Storage (CCS) power producers.

As well as the updated EEP 2021-2040 reference case for the power sector, BEIS will also publish an update to Annex O in due course, with illustrative strategic scenarios showing what a Net Zero-consistent power sector could look like. These go beyond EEP-ready policies and reflect the increased ambitions outlined by the Government in the British Energy Security Strategy[31]. They are also consistent with the Government's commitment to have all electricity by 2035 come from low carbon sources, subject to security of supply.

4.1 Summary of projections

The projections show the biggest power sector changes from the NZS Baseline are in the generation mix.

The main power sector changes since the NZS Baseline were:

- inclusion of updated fuel price assumptions
- new UK ETS, EU ETS and UK Carbon Price Support projections
- updated known capacities from the capacity market results and Contract for Difference results for Auction Round 3
- updated Transmission Network Use of System (TNUoS) charges

[29] For background information on the DDM please see: https://www.gov.uk/government/publications/dynamic-dispatch-model-ddm

[30] The figures we quote in this chapter are for "All Power Producers". They do not include electricity imports or exports.

[31] Available at: https://www.gov.uk/government/publications/british-energy-security-strategy/british-energy-security-strategy

- modelling improvements including improvements made to the investment algorithm

Figure 4.1 shows our projections of generation by technology for all power producers up to 2040:

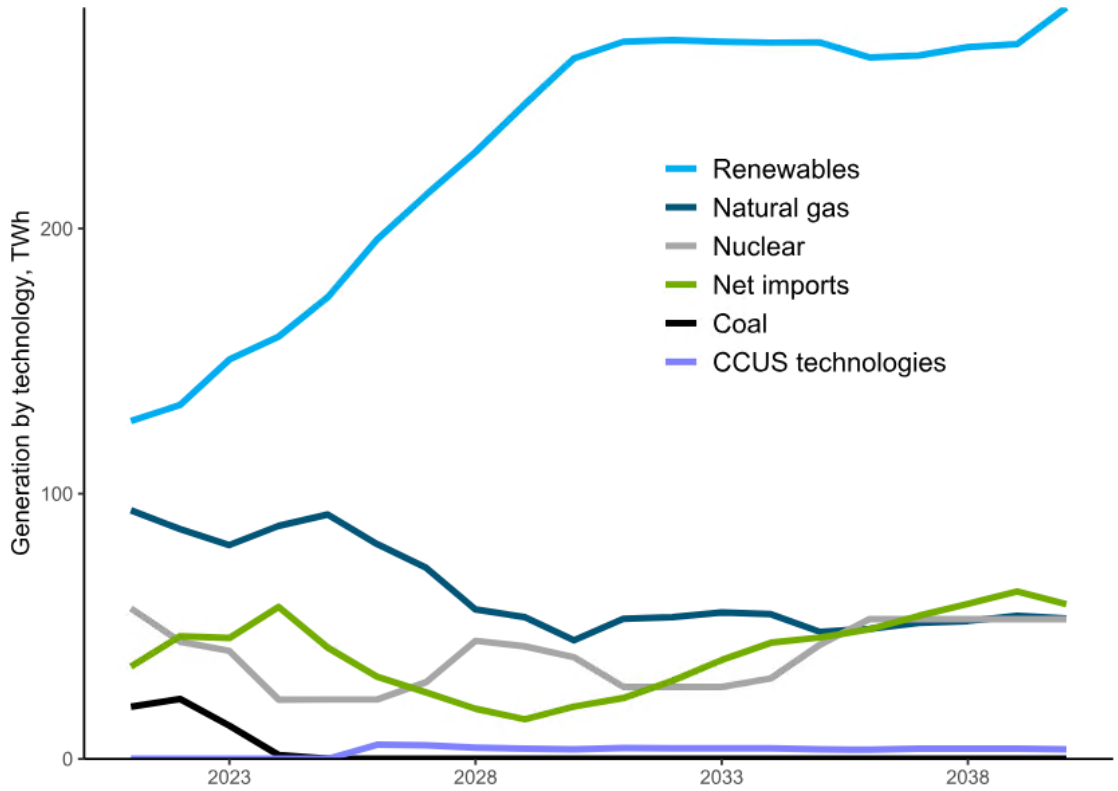


Figure 4.1: Electricity generation by fuel source, TWh

We project emissions from electricity production will fall steadily as generation switches away from fossil fuels (annexes B and C).

4.2 Net Zero-consistent power sector scenarios

In April 2022 the Government published the British Energy Security Strategy; this increased the ambitions for several key technologies in the power sector, and included ambitions to have:

- up to 50 GW of offshore wind (including up to 5 GW of floating offshore wind) capacity by 2030
- up to 70 GW of solar capacity by 2035, and
- up to 24 GW nuclear capacity by 2050.

To reflect this increased ambition, BEIS's indicative Net Zero-consistent power sector scenarios have been updated and will be published as Annex O. These scenarios show how the power sector might evolve in response to increasing electricity demand; they do not indicate a preferred outcome.

5 Detailed comparisons with the NZS Baseline

This chapter gives more information about the major changes to the projections since the NZS Baseline.

This section provides a breakdown for changes in territorial emissions excluding IAS. For the sixth carbon budget, the NCA metric used to assess performance against carbon budget targets includes IAS emissions. These were 15 $MtCO_2e$ lower in CB6 (falling from 242 in the Net Zero Strategy Baseline to 227 $MtCO_2e$).

5.1 Changes in territorial projections since the EEP Net Zero Strategy baseline

The differences between this edition and the NZS Baseline stem from model improvements, and updates to policy savings and other inputs[32].

Table 5.1: Changes which affect total territorial emissions projections (in comparison with NZS Baseline), $MtCO_2e$

	Carbon budget period			
Type of change since EEP Net Zero Strategy baseline	**CB3 (2018-22)**	**CB4 (2023-27)**	**CB5 (2028-32)**	**CB6 (2033-37)**
Modelling and assumption changes	3	28	21	29
Policy savings updates (DfT, Defra, DLUHC)	9	0	-18	-25
Policy savings updates (BEIS)	1	-19	-23	-20
Model inputs	2	-57	-2	11
Total change since EEP Net Zero Strategy baseline	**15**	**-46**	**-21**	**-6**

We summarise the main changes that affect overall territorial emissions above in table 5.1. These are:

- **Modelling and assumption changes** lead to higher projected emissions than in the NZS Baseline in all carbon budget periods, mainly because of revisions to the refinery projection assumptions. The equations used to project energy consumption

[32] It should be noted that non-CO2 policies here are compared against policies in AR4 GWPs (AR5 was not available at the point policy savings were calculated for EEP 2019), so policy savings include the change from AR4 to AR5 without feedback.

in manufacturing and construction sub-sectors were also redeveloped. The emissions are higher by 3, 28, 21 and 29 $MtCO_2e$ respectively.

- **Policy savings updates for DfT, Defra and DLUHC climate change policies**. Compared with the NZS Baseline, savings from other departmental policies result in emissions revisions upwards in CB3-4 as some resources and waste policies were removed from these projections. However substantial projected emissions reductions in later carbon budget periods are due to increased transport policy savings, particularly for electric vehicles. In total, the change due to other departmental policies is an increase of 9 $MtCO_2e$ for CB3 and no change for CB4. For later periods, emissions are projected to be 18 $MtCO_2e$ lower for CB5 and 25 $MtCO_2e$ lower in CB6. We discussed policy savings in Chapter 3.

- **Policy savings updates for BEIS climate change policies** lead to lower projected emissions for the fourth to sixth carbon budget periods (reductions of 19, 23, and 20 $MtCO_2e$ respectively). For the third carbon budget, there is a very slight increase of 1 $MtCO_2e$. We discussed policy savings in Chapter 3.

- **Revisions to model inputs** mean that although emissions projections are similar to the NZS Baseline in CB3, emissions are projected to be 57 $MtCO_2e$ lower than the NZS Baseline by CB4; this is mainly driven by higher fossil fuel price assumptions for this period and slightly lower GDP short-term projections than the NZS Baseline. After this, the fifth CB period is projected to be 2 $MtCO_2e$ lower than the NZS Baseline, and the sixth CB period has an increase of 11 $MtCO_2e$. In some instances we have accounted for the Covid-19 pandemic by projecting from 2019, so as to avoid long-term distortion of energy demand in some sectors.

5.1.1 Improvements in the projection methodology and assumptions

Over the past couple of years, the BEIS modelling team have concentrated on quality assurance[33] and modelling methodology updates. Many of these changes were included in the interim update in December 2021, described in more detail in the Net Zero Strategy Technical Annex[34]. All model changes use more up to date data and evidence to improve the accuracy of the projections. Our modelling improvements and changes to assumptions led to revisions upwards to projected territorial emissions compared to the NZS Baseline in each of carbon budget periods three to six: by 3, 28, 21, and 29 $MtCO_2e$ respectively.

[33] See BEIS Modelling Quality Assurance tools and guidance here: https://www.gov.uk/government/collections/quality-assurance-tools-and-guidance-in-decc
[34] Net Zero Strategy, published October 2021: https://www.gov.uk/government/net-zero-strategy

Table 5.2: Improvements in the projection methodology and assumptions which affect territorial emissions (in comparison with NZS Baseline), $MtCO_2e$

	Carbon budget period			
Modelling and assumption changes	**CB3 (2018-22)**	**CB4 (2023-27)**	**CB5 (2028-32)**	**CB6 (2033-37)**
Industry equations adjustment (EEP 2021-2040)	-1	13	-1	2
Refineries (EEP 2021-2040)	2	8	14	18
North Sea Transition Authority updates	2	4	3	3
Domestic solid fuel trend revision (EEP 2021-2040)	0	3	4	5
Other [1]	0	0	0	0
Total change from modelling and assumption changes	**3**	**28**	**21**	**29**

Notes:
- [1] "Other" includes inputs with impacts less than 5 $MtCO_2e$ across the combined total of carbon budgets three to six.

These modelling and assumption changes are:

- **Industry equation adjustment (EEP 2021-2040)**: We reviewed and updated equations for the Gross Value Added (GVA) Index, and useful energy demand met by fuel consumption with the impact of policy removed for all energy types (Electricity, Gas, Oil, Renewable, and Solid) for the following sectors: Chemicals, Construction, Engineering and Vehicles, Food, drink and tobacco, Non-ferrous metals, Non-metallic mineral products, Pulp, paper and printing, Textile products, and other industries. These revisions led to an emissions increase of 13 $MtCO_2e$ in CB4, a slight decrease in CB5 (1) and a slight increase in CB6 (2 $MtCO_2e$).

- **Refineries projections**: Refineries projections in the NZS Baseline were aligned with Climate Change Committee (CCC) assumptions to reflect the impact of UK and global decarbonisation under a net zero consistent world scenario. They are therefore lower than would be the case under EEP standard reference case assumptions which only take account of EEP-ready UK policies. In EEP 2021-2040 refinery projections revert to standard reference case assumptions and do not assume any reduction in refineries output or emissions as a result of international decarbonisation. Instead, we assume output and therefore emissions, change in proportion to EEP projections of UK primary oil demand under existing UK policies. This leads to slightly higher emissions: a change of 8, 14, and 18 $MtCO_2e$ in carbon budget periods 4, 5 and 6 respectively.

- **North Sea Transition Authority** projections: Improvements to the method used to align projections of emissions from oil and gas production and extraction with Oil and

Gas Authority projections, led to small emissions increases of 4, 3 and 3 $MtCO_2e$ in CB4, 5 and 6 respectively.

- **Domestic solid fuel trend revision**: A review was carried out in summer 2022 of the trend projected for domestic solid fuels which indicated that using only more recent historic data to estimate the trend would provide results more in keeping with evidence from other sources such as the English Housing Survey. The modelled demand for domestic solid fuel now declines at a slower rate than previous projections because there was a steeper decline in domestic coal consumption in earlier years that has levelled off in more recent data. This leads to slightly higher emissions: a change of 3, 4, and 5 $MtCO_2e$ in CB4, 5 and 6 respectively.

5.1.2 Changes to projections of territorial emissions due to input updates

We list the main input updates and their effects on emissions in Table 5.3. The overall impact of changes to inputs varies over time. CB3 input updates resulted in no net change from the NZS Baseline. There was then a substantial decrease of 57 $MtCO_2e$ in CB4, a small decrease (-2 $MtCO_2e$) in CB5 and an increase of 11 $MtCO_2e$ in CB6.

Table 5.3: Input updates which affect territorial emissions projections (in comparison with NZS Baseline), $MtCO_2e$

	Carbon budget period			
Input update	**CB3 (2018-22)**	**CB4 (2023-27)**	**CB5 (2028-32)**	**CB6 (2033-37)**
LULUCF and non-CO2	9	11	-6	-15
Power sector updates & interaction	23	10	18	38
DUKES update [1]	3	0	-5	-9
Transport assumptions and Covid adjustment (exc. policy)	-16	-2	2	4
Economic and GDP assumptions	7	-12	5	18
Greenhouse Gas Inventory (GHGI) update	-23	-15	-9	-12
Fossil fuel and carbon prices (EEP 2021-2040)	0	-49	-8	-15
Other [2]	-1	0	0	0
Total change due to input updates	**2**	**-57**	**-2**	**11**

Notes:
- [1] The DUKES update row does not include transport: the "Transport assumptions

and Covid adjustment (exc. policy)" row captures these changes. It also excludes the indirect impact of our projection equation adjustments which we made after the DUKES revisions to past oil demand.
- [2] "Other" includes inputs with impacts less than 5 $MtCO_2e$ across the total of carbon budgets three to six.

Compared with the NZS Baseline, the biggest upwards revisions to territorial emissions come from updates to:

- **Transport assumptions and Covid adjustment (exc. policy):** This includes the latest assumptions from DfT (excluding policy savings) and some revisions to ensure that our projections are not unduly impacted by the reduced transport seen in 2020 as a result of Covid. Over the short-term, emissions have been reduced, leading to falls of 16 and 2 $MtCO_2e$ in CB3 and CB4. Emissions for the fifth and sixth carbon budget periods are higher than the NZS Baseline, by 2 and 4 $MtCO_2e$ respectively.

- **LULUCF and non-CO_2** emission data: updated historic data and new projections of non-CO_2 emissions mean that emissions have been revised upwards from the Net Zero Strategy baseline—by 9 $MtCO_2e$ in the third Carbon Budget period, and 11 $MtCO_2e$ in the fourth. They are lower than the Net Zero Strategy baseline by 6 $MtCO_2e$ in the fifth carbon budget period and 15 $MtCO_2e$ in the sixth. LULUCF projections consistent with the 1990-2020 GHG Inventory were not available in time for inclusion in this edition of the EEP. The set of LULUCF projections included in EEP 2021-2040 are consistent with the 1990-2019 GHG Inventory, and as such include the impact of the IPCC Wetlands supplement.

- **Power sector updates and interaction:** We have revised the power sector assumptions since the NZS Baseline.

Compared with the NZS Baseline, the biggest downwards revisions to emissions come from updates to:

- **DUKES update:** The update to DUKES led to a slight increase in CB3, and a small reduction in emissions in the later carbon budget periods.

- **Economic and GDP assumptions:** Economic assumptions have been revised since the NZS Baseline[35]. This has resulted in emissions projections being 7 $MtCO_2e$ higher in CB3 and 12 $MtCO_2e$ lower in CB4. For the fifth and sixth carbon budget periods, emissions are 5 and 18 $MtCO_2e$ higher than the NZS Baseline.

- **Fossil fuel and carbon price assumptions:** For the third carbon budget period, emissions are similar to the NZS Baseline. However short-term assumptions for oil and gas prices are substantially higher than in the NZS Baseline[36] leading to much lower projected emissions for the fourth carbon budget period of 49 $MtCO_2e$, and continued decreased projected emissions of 8 $MtCO_2e$, and 15 $MtCO_2e$ for the fifth and sixth carbon budget periods. The projections do not take account of measures to ease the adverse impact of high fossil fuel prices on households, businesses and

[35] We give these assumptions in Annex M.
[36] We give these assumptions in Annex M.

public sector organisations as these measures had not been finalised at the time of modelling. It is therefore likely that the impact of high fossil fuel prices will be smaller than projected in the reference case and over the short term. The fossil fuel price sensitivities contain a scenario with lower retail prices which can be used to assess the sensitivity of the projections to these price trajectories.

- **Greenhouse Gas Inventory (GHGI update):** The latest GHGI update led to a decrease in emissions. In CB3, this led to a decrease of 23 $MtCO_2e$.

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: 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 L: Total electricity generating capacity

Annex M: Growth assumptions and prices

Annex N: 2021 non-CO_2 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 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.
Extended High Prices	Similar assumptions to reference scenario but with a longer period of high fossil fuel prices.

Scenario	Description
Low Growth	Similar assumptions to reference scenario but with lower projected economic growth.
High Growth	Similar assumptions to reference scenario but with higher projected economic growth.
Existing Policies	UNFCCC “With Existing Measures” scenario. Contains central price and growth assumptions but without any planned policies included.
Pre-LCTP Baseline Policies	Contains central price and growth assumptions but only policies that existed before the Low Carbon Transition Plan 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.