

Reliable Britain

What Britain's electricity would have cost on gas



£141.1bn

Extra cost of net zero on electricity bills, 2002–24. Modelled, in 2024 prices.

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THIS VERSION

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Summary

What did Britain's climate-policy programme since 2002 add to the cost of the electricity Britain actually used? This paper answers by setting two full bills side by side for every calendar year from 2002 to 2024. One is the bill Britain actually paid. The other is a modelled bill for the same electricity on **the road Britain was on** in 2002: the system it then had, carried forward with the same demand and sized to a 7.4% de-rated margin derived from NESO's 2027/28 recommendation, closing plant only for age or pollution law, building the cheapest new plant where it was needed, and paying actual fuel prices with no carbon price. The actual system's margin on that basis is not computed. The climate-policy programme is **the departure** from that road, and **the gap** is the difference between the two bills.

The answer, modelled. From 2002 to the end of 2024 Britain paid £947.7bn for its electricity, in 2024 prices. The same electricity on the road would have cost £806.6bn. The gap, the extra cost of net zero on electricity bills, paid by bill-payers, is £141.1bn. Its range runs from £123.6bn (kept output at the full actual price) to £152.9bn (gas-price feedback at Krichene's world long-run pair, 0.61): the lowest and highest results among the options ranked to set it, each changed on its own (§15.2). A method check gives £116.7bn, below it: it takes the 2021–23 merit-order uplift from O'Shea, Horne and Maslin's short-term model (their Table 4), whose results the authors say “do not appear reasonable” (p.24), and it sits outside the range because it changes how one part of the machine is estimated, not what the road is (§8.3, §15.2). The range is neither a combined envelope nor a confidence interval.

Per household. Divided among Great Britain's households year by year, the gap comes to £5,294 over 2002–24: each household's average share of a national bill, not any household's own bill. What an average household paid directly, on its own electricity bills, is smaller: £2,285, the households' share of the gap, built line by line (§2.7). The rest reached households indirectly, through prices in shops and the cost of public services.

2025, provisional and apart. Full data for 2025 are not yet published, so 2025 sits outside the headline. On the data so far, the gap in 2025 is £14.2bn (each rounded separately: £54.78bn less £40.53bn is £14.25bn), or £504 per household.

What drives it. The three largest steps from the road's bill to the actual bill are the Renewables Obligation (£84.5bn), wholesale power before carbon (–£82.1bn), which lowers the gap and carbon in the wholesale price (£74.1bn).

How much rests on carbon. The paper measures cost only. It counts the carbon charges in the wholesale price as a policy charge like any other levy. Of the gap, £74.1bn is carbon in the price: £23.7bn of tax collected and £50.4bn of carbon in the power price not collected as UK carbon tax (the rest). A reader who takes the mainstream view of carbon pricing can subtract either and check the rest (§2.6).

What is set aside. The headline leaves out **lost value**, what people and firms gave up by using less electricity because it was dearer: a labelled estimate, kept apart, whose working and figures follow in version 1.1 (§12.6).

Key points

- The gap, 2002–24, modelled, 2024 prices: £141.1bn.
- Range, one ranked choice at a time: £123.6bn (kept output at the full actual price) to £152.9bn (gas-price feedback at Krichene's world long-run pair, 0.61) (a method check on O'Shea, Horne and Maslin's short-term model, whose results the authors say “do not appear reasonable”, gives £116.7bn, below it).
- An average share per household: £5,294.
- On a household's own bills: £2,285.
- Carbon in the price, which readers may subtract: £74.1bn.

Independence and declaration

This paper was not commissioned or paid for by anyone. Commissioned reports in this series will name their funder on their first page. Richard Lyon researched and wrote it, and he built the engine that produces its figures. His wider views are set out in his book, *The Energy Trap* (Swift Press, 2026), which argues that the renewable energy transition cannot work, and sets out what can. He writes the newsletter *The State of Britain* and runs the Subsidy

Clock, and he seeks paid work writing commissioned reports and analysis on energy costs. The free reports in this series are not part of that work and are not funded.

The author has no financial interests in energy companies, including through any pension or fund he directs.

Throughout this paper, “the gas case” means the road Britain was on. The gas case is a yardstick for measuring cost, not a proposal.

Review and use of AI

This paper had automated hostile review against the programme’s review standard, which will be published with the model release. AI tools were used for research, model code and drafting, under the author’s direction. The author checked the work and takes responsibility for it. Annex A lists each release figure with its key. A numbered register of claims and their primary sources is to follow in version 1.1. The frozen release also holds the engine’s working files, including briefs (source/work/briefs/), as part of the open record. Annex F lists known issues.

The paper will be open for public review for six weeks from publication. Errors may be sent to corrections@richardlyon.net. Each will be logged on a public corrections page, and version 1.1 will credit every accepted correction.

How to rebuild every figure

The frozen engine release behind this paper is tag v4-s37, at the commit and with the figures file named on the title page. It is to be made public at <https://github.com/richardjlyon/gas-counterfactual/releases/tag/v4-s37> when the paper is published. One command rebuilds every figure in the paper from the code and data at that tag and checks each against the release’s figures file; it does not run the release’s test suite. Third-party inputs whose licence does not allow republication are not in the public copy: the release lists each with its publisher, and reviewers can have the full set on request. The release names one failed test, `tests/test_fossil_like_for_like.py::test_early_years_gap_close_to_net_zero_extras_pooled`, the early-years check of §5.3, which fails and is reported there. The code at the tag is the authority wherever this paper and the code differ.

Conventions

Years are calendar years. Data published by financial year (April to March) are put on calendar years by the rule each chapter states. Money is in 2024 prices, using the Office for National Statistics’ CPIH index (series L522, 2015 = 100), unless marked as cash, meaning pounds as paid at the time. The basis is Great Britain; where a source covers the United Kingdom, the text says how it is scaled. Household figures divide by Great Britain’s households in the same year. Each headline number is tagged **measured**, **modelled** or **labelled estimate**, as §2.8 defines them. Figures for 2025 are provisional throughout.

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1 The question and the answer

1.1 The two bills

Every electricity bill in Britain mixes two costs: the cost of the power, and the cost of the programme that changed how the power is made. The Government last estimated the second in 2014, in a series that the National Audit Office later said the department had failed to continue (DECC 2014; NAO 2016, para 3.13). This paper separates them by building a second bill. For each year from 2002 to 2024 it sets the bill Britain actually paid beside a modelled bill for the same electricity on the road Britain was on in 2002: the gas case.

That road is the baseline, defined in §2.2: the system Britain had in 2002, carried forward, sized to a 7.4% de-rated margin derived from NESO's 2027/28 recommendation, paying the actual price of fuel and no carbon price of any kind. The climate-policy programme Britain followed instead is **the departure**, and §2.3 lists it instrument by instrument.

The question is then a precise one. What did the departure add to what Britain paid for the electricity it actually used, in each calendar year from 2002 to 2024? The answer is **the gap**: the actual bill less the road's bill, an amount in pounds, summed over the years.

1.2 The answer

The answer is modelled, because one of its two bills describes a Britain that did not happen. From 2002 to the end of 2024, Britain paid £947.7bn for its electricity, in 2024 prices. The same electricity on the road would have cost £806.6bn. The gap, the extra cost of net zero on electricity bills, paid by bill-payers, is £141.1bn.

In 2024, the latest full year, the actual bill was £52.2bn against £39.3bn on the road, a gap of £12.9bn. For 2025 the data are not yet final, so the year is kept wholly apart from the headline and labelled provisional. On the data so far, the actual bill was £54.8bn against £40.5bn, a gap of £14.2bn (each rounded separately: £54.78bn less £40.53bn is £14.25bn). No total for 2002 to 2025 is given anywhere in this paper.

The headline rests on judgements, and eight of them are open to reasonable dispute. Each is a chapter of this paper (§6 to §13), and each chapter re-runs the headline under the other options. The printed range, £123.6bn (kept output at the full actual price) to £152.9bn (gas-price feedback at Krichene's world long-run pair, 0.61), runs from the lowest to the highest of the one-at-a-time results among the options ranked to set the range; options run only as method checks are shown but sit outside it (§15.2). One, a method check on O'Shea, Horne and Maslin's short-term model (their Table 4), whose results the authors say "do not appear reasonable" (p.24), gives £116.7bn, below the range. The range is neither a confidence interval nor a combined envelope (§15.2).

Per household, the gap comes to £5,294 over 2002–24, £463 in 2024 and £504 in 2025 (provisional): each household's average share of a national bill. On its own bills an average household paid less, £2,285 over 2002–24, £191 in 2024 and £208 in 2025, mainly because households buy only part of the electricity sold, 36.5% in 2024 (§2.7).

1.3 What drives it

The two bills differ line by line, so the gap can be built as a waterfall: start from the road's bill and add, one at a time, each difference that takes it to the actual bill. Figure 1.1 does that for 2002–24.

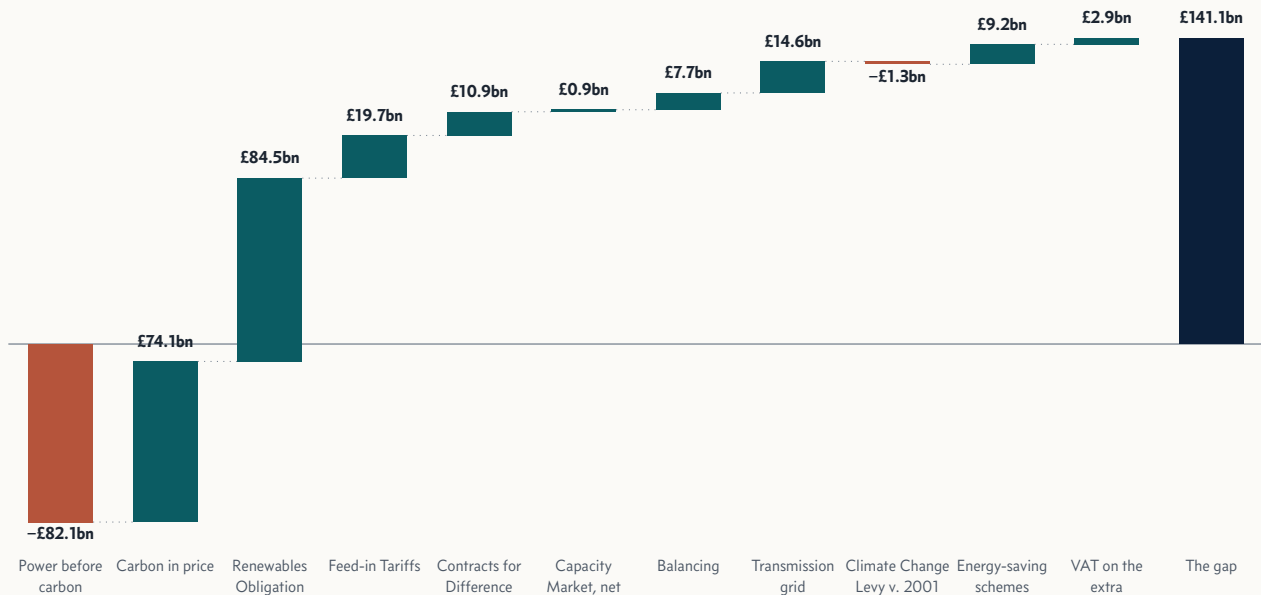


Figure 1.1 From the road's bill to the actual bill: the steps that make up the gap, 2002–24, £bn, 2024 prices. Modelled. The first bar starts from the road's bill; the last bar is the gap. Drawn from the release's waterfall table (table_waterfall_2002_24).

Each bar is one line of the bill, and Table 14.2 gives the same steps with the engine's formula for each.

The three largest steps are the Renewables Obligation (£84.5bn), wholesale power before carbon (–£82.1bn), which lowers the gap and carbon in the wholesale price (£74.1bn). A step can be negative where the road would have paid more on that line, and the waterfall shows such a step as it falls. §14 gives the same steps as a table.

1.4 What the paper does not do

The paper takes no position on climate science, and it puts no value on carbon dioxide. It measures what electricity cost, and it treats the carbon charges in the price as one of those costs (§2.6).

The paper also leaves out a second cost. Dearer electricity leads people and firms to use less of it, and what they give up by doing so, **lost value**, is a real loss that no bill records. It is described in §12.6 as a labelled estimate, kept apart from the gap, whose figures follow in version 1.1. Lost output from industry moving abroad is a different matter and is left to a later report.

Finally, the gap is not to be added to the figure in Report No. 2 of this series, *The Price of the Climate Bill*. The two answer different questions: that report counts what was paid for climate policy, while this paper measures the departure from a road. A line-by-line reconciliation of the two is to follow in version 1.1.

1.5 How this paper is built

The paper gives the answer first and then tests it: what is measured (§2), the rival estimates (§3), the engine (§4) and its calibration (§5), the eight contested choices, one to a chapter (§6 to §13), the results, how sure they are and what is not counted (§14 to §16), what else the engine can answer (§17), and a proposed change in the law (§18).

2 What is measured

2.1 The gap, two full bills, and what sits in both

The gap is an amount, never a ratio. The question is how much more Britain paid, and a bill is a sum of money, so the answer is one too. The obvious objection is that an amount means little without its scale. The answer is to print both full bills beside it every time, as the Treasury’s appraisal guidance asks: costs “should usually be presented in absolute terms, rather than as incremental differences from BAU” (HM Treasury 2026, para 4.19). A reader can then form any ratio they like; the paper itself states none.

Both bills are full bills. Some costs are the same on both roads: distribution networks, metering and suppliers’ own costs. They sit in both bills at the same value, £13.0bn in 2024, and so cancel in the gap. Holding them equal is a choice with a direction. A critic could argue that the departure raised some of these costs too; if so, the gap here is too small, not too large, because none of that is counted.

2.2 The road Britain was on, and why it is the baseline

The road Britain was on is the electricity system Britain had in 2002, carried forward year by year to 2024, at the demand Britain actually had. Nuclear, interconnectors and pumped storage are as they actually were. Coal and gas stations close only for age or for pollution law. When wind and solar are taken away, their output is replaced first by the fleet that remains running harder, then by the cheapest new plant, gas or coal fitted with pollution filters, priced from the Government’s published generation cost reports. Fuel is bought at actual prices, 2022 included, and Britain’s own gas output is as it actually was. The road is sized to a 7.4% de-rated margin derived from NESO’s 2027/28 recommendation; the actual system’s margin on that basis is not computed (§2.5). There is no carbon price of any kind.

Richard Lyon chose this as the baseline because in 2002 it was the system; the climate-policy programme is what changed. The strongest objection is that a system frozen in 2002 is a straw man, and that calling net zero “the departure” is rhetoric. Both halves of the objection fail on the facts of the method. The road is not frozen: it closes plant, builds plant, and meets the reliability standard every year. That is what the Treasury’s **Green Book** asks of a business-as-usual case: “BAU does not mean doing nothing. It considers how individuals and organisations will act to try to achieve their objectives in the absence of new government intervention” (HM Treasury 2026, para 4.15). As for the label, the gap is the same number whichever of the two worlds is called the baseline, because it is one bill less the other.

The approach has an official precedent. The Department of Energy and Climate Change presented the impact of its policies as “the difference between an energy bill in a given year compared with what that bill would have been in the same year if the policies had never been in place (the no policy ‘baseline’)” (DECC 2014, para 43). The National Audit Office later recorded that it had recommended in 2013 that the department establish routine reporting of this kind and “failed to do so, with its last report on this topic in 2014” (NAO 2016, para 3.13). The Government accepted the recommendation of the Public Accounts Committee to resume it (HM Treasury 2017, Cm 9433, p.18), and a later progress report marked it as implemented without a new edition (HM Treasury 2021, CP 549, pp.25–26). This paper answers DECC’s question looking back, with an open model.

2.3 The departure, instrument by instrument

The departure is the climate-policy programme since 2002, measured as the lines by which the actual bill differs from the road’s. Each has a line label, which §4 uses:

- the Renewables Obligation (NZ2), with its Non-Fossil Fuel Obligation contracts to 2019 (Ofgem, RO annual report 2017-18, para 2.30) counted only above the 2001 level of the Fossil Fuel Levy that funded them (HC Deb 5 November 1997, c356);
- Feed-in Tariffs, valued as the levelisation fund that suppliers pay through bills (NZ3);
- Contracts for Difference (NZ4);
- carbon in the wholesale price, from the EU and UK emissions trading schemes and Carbon Price Support (part of NZ1);

- the Climate Change Levy above its 2001 level (NZ8), a separate line, never counted as carbon;
- the energy-saving supplier schemes above the 2001 level of their predecessor (NZ10);
- the extra Capacity Market, balancing and transmission costs (NZ5, NZ6 and NZ7, each less the road's own line);
- VAT on the extra.

Charges already on bills in 2001 are part of the road at their 2001 level, so only rises above that level count; §13 argues the rule. A target is not a charge, so the renewables target of 2000 is not on the road.

VAT on the extra is counted in the departure. The objection is that VAT is a general tax, not climate policy. The answer is that VAT is charged on the bill, so a bill that is larger because of the departure carries more VAT, and households pay it as part of the cost. The step is shown on its own in the waterfall, £2.9bn, so a reader who disagrees can take it out.

2.4 The one-country rule

On the road, Britain leaves the departure while the rest of the world stays as it actually was. European wind farms are still built and still affect the gas price; continental carbon prices still sit in the price of imported power; the world market for liquefied gas is unchanged. This **one-country rule** is a choice of question: what did Britain's own programme cost Britain? The main rival estimate asks a different one, in which Europe as a whole builds less wind (§3.3). There is no run on that premise, because it would answer that other question, so no headline is shown under it, and this paper sets no bound on what such a run would give. The rule is tested where it matters most, in the gas price (§9).

2.5 What "Reliable" means

The road is sized to a 7.4% de-rated margin derived from NESO's 2027/28 recommendation; the actual system's margin on that basis is not computed. The title does not imply that the actual system was unreliable; it says that the road it is compared with would have been as reliable, so that the comparison is between two systems that keep the lights on to the same degree.

Two standards could be meant, and both are stated. The legal standard is a loss-of-load expectation of 3 hours per capacity year, set in the Electricity Capacity Regulations 2014. The engine instead sizes the road's fleet to a de-rated margin of 7.4% over the gross winter peak. The National Energy System Operator (NESO) did not publish that percentage; this paper derives it from two figures that NESO did publish. For the T-1 Capacity Market auction for delivery in 2027/28, NESO equates its recommendation with a de-rated margin in the range 4 to 5 GW (NESO 2026, p.5). NESO's Base Case peak demand for the same year, 2027/28, is 61 GW (NESO 2026, Data Workbook, Figure B1). The central margin is the midpoint of that range divided by that peak; the low and high options of §7 divide the two ends of the range by the same peak. The engine applies the share to the gross peak of every year from 2002. For that auction NESO estimates that its recommendation gives a Base Case expected loss of load of "around" 0.1 hours a year, before any "future unknown" non-delivery. If the 3.5 GW of future unknown non-delivery that it models materialised, on top of the 4.3 GW of known non-delivery already in the Base Case, the figure would be 2.1 hours (NESO 2026, p.5). The Government's own Panel of Technical Experts has observed that, while the 3-hour LOLE Reliability Standard is defined in The Electricity Capacity Regulations 2014, its actual implementation for setting the target capacity "has allowed for a degree of discretion", and that NESO and the Secretary of State have in practice preferred a higher level of security (DESNZ 2026, para 8). The road is therefore sized to a margin derived from the one NESO recommends, which is more secure than the legal floor, not to the legal floor itself.

Firm capacity is capacity counted at its de-rated, dependable value. In 2024 the actual Capacity Market held 52.5 GW of de-rated obligations; that is not the whole firm fleet, because capacity outside the Capacity Market is not in it, so it is not compared with the road's firm fleet in §7.

One phrase helps here, and the paper uses it only once. Wind and solar output depends on the weather, so a system built on them needs a second system for when the wind does not blow: **two systems**, one for when it does and one for when it does not. The road has one system that runs whatever the weather. §6 to §11 let the figures make that point and do not repeat the phrase.

2.6 Carbon: where this paper stands

This paper measures cost only. It treats the carbon charge in the wholesale price as a policy charge like any other levy. Its level follows from the cap and the tax rate the Government chose in order to meet its targets, not from any measured harm, so its whole effect on bills counts as a cost of the departure.

The mainstream case is different. The Climate Change Committee holds that carbon pricing “can help ensure that private incentives are aligned to the social goal of reducing emissions, through the ‘polluter pays’ principle” (CCC 2025, p.116). The UK’s own carbon values for appraisal are set on a “target consistent” basis, from the marginal cost of abatement needed to meet its targets, not from an estimate of damage (BEIS 2021). The Committee also notes that “carbon taxes raise funds for the Exchequer ... but increase household energy bills” (CCC 2017, p.12). The disagreement is mainly about values, and partly about accounting.

So the paper shows how much rests on it. Carbon in the price is £74.1bn of the £141.1bn gap for 2002–24: £23.7bn tax collected, which went to the Treasury, and £50.4bn carbon in the power price not collected as UK carbon tax (the rest). A reader may subtract either and check the rest. §13 covers the years of free allowances, 2005–12. The Climate Change Levy at its main rates is a separate line (§13.3), not included.

2.7 Household figures

The headline is the extra cost of net zero on electricity bills, paid by bill-payers. Two household figures translate it. **Extra cost of net zero on electricity bills, per household** divides each year’s gap by the number of households in Great Britain that year and sums the results; it is each household’s average share of a national bill, and never “your bill”. **On your own bills** is what an average household paid directly. It is built line by line: households’ share of electricity sold by suppliers is applied to each line of the gap, except that the Energy Company Obligation (ECO), whose costs businesses do not face (DECC 2014, para 75), is counted in full, and the Climate Change Levy, a tax on non-domestic use of energy (ONS 2015, Environmental Taxes 2014, PDF p.11), is left out. VAT is then added at the domestic rate that applied throughout 2002–25, 5% (VAT Act 1994, s.29A(1)). The working for 2024 is in the release’s run file but not printed here (Annex D, in version 1.1). (Domestic electricity in Great Britain is zero-rated from 1 October 2026 to 31 March 2027, after the paper’s period: HMRC, VAT Notice 701/19.) The two differ because the rest of the gap is paid by businesses and public bodies, and reaches households indirectly through the prices of goods and services and through taxes.

The households’ share counts electricity bought from suppliers only: 36.5% in 2024. That share is a United Kingdom figure, households’ share of electricity sold by suppliers (DUKES 2026, Tables 5.2 and 5.5.D), applied unchanged to Great Britain. A Great Britain figure exists on a different basis: domestic meters took 39.1% of Great Britain’s electricity consumption in 2024 (DESNZ, sub-national electricity consumption statistics). It is given for context and is not used. Power that households generate and use themselves, mostly from rooftop solar, is left out, because levies and network charges fall on electricity bought, not on power used at home. Households numbered 27.867 million in Great Britain in 2024 (ONS 2025, household size by regions and countries, sheets England, Wales, Scotland, 2024, summed).

One further shift makes the household figure slightly too low. Energy-intensive industries in Great Britain can be exempted from the indirect costs of funding the Renewables Obligation, Feed-in Tariffs and Contracts for Difference on the electricity they use to make eligible products (DBT, EII guidance, paras 2–5), and from April 2024 from the Capacity Market (SI 2024/434, reg. 1 and explanatory note), so that cost falls on other consumers. Until March 2024 the exemption was capped at 85% of a site’s eligible electricity, because the certified share is that percentage multiplied by the eligible share, so a site’s actual exemption could be lower (SI 2015/721, reg. 11(2)); from 1 April 2024 it is 100% (SI 2024/419). It moves cost between consumers and does not change the gap.

2.8 Measured, modelled and estimated

Three kinds of number appear in this paper, and each is labelled where it appears. **Measured** figures are taken from a published record: what the Renewables Obligation cost, what the Capacity Market paid, what the transmission charges were. The actual bill is almost all measured. **Modelled** figures come from the engine: the road’s bill, and therefore the gap, are modelled throughout, because the road did not happen. **Labelled estimates** are figures computed outside the measured gap, each with its method and range, kept apart and never added to it: in version 1.1, lost value (§12.6) and the cost to other gas users (§9.8).

2.9 The conservative rule and its exceptions

Where the evidence leaves a choice open, the paper takes the sourced option that makes the gap smaller, and says so. Most of the central settings in §6 to §13 follow that rule. A few do not, and each is argued in its own chapter: of the six in Table 2.1, in two the gap-lowering option fails a test that the central option passes, and four depart from the rule for a stated reason that is not a failed test, given in their chapters. Table 2.1 is the release's own list, drawn up mechanically: every switch in the range that has an option giving a lower headline than the central setting, with the lowest such option and its size. Which of them are exceptions to the rule is argued in each chapter, not in the table.

Table 2.1 Every switch in the range with an option that lowers the headline: the lowest such option, 2002–24, £bn, 2024 prices (modelled; lowest first)

Choice	Lowest-gap option of the switch	Headline 2002–24	Change
3	Power from plant Britain had, priced at the actual market price with carbon left in	£123.6bn	–£17.5bn
5	Grid carried forward on the price controls' own X values (RPI minus X) instead of RPI	£136.5bn	–£4.6bn
6	Balancing: the NAO's £642m for 2005/06 as the baseline in every year, with the FY2024/25 energy share (70.3%)	£136.5bn	–£4.6bn
2	Capacity Market: coal stations the road keeps open also need Capacity Market payments	£140.6bn	–£0.5bn
2	Interconnectors counted at their metered flow at the peak (the v4-s35 basis) instead of their Capacity Market contracts	£140.9bn	–£0.2bn
2	Spare plant margin of 8.2% (central 7.4%)	£141.0bn	–£0.1bn

Source: gas-counterfactual release v4-s37, figures.json key table_exceptions_register. Modelled, £bn in 2024 prices (CPIH) unless stated; figures rounded separately.

2.10 Every choice the author made

Table 2.2 lists each choice the author made that a reader might dispute, where it is argued, and where the headline under the other option is shown, or why it is not.

Choice	In brief	Strongest objection	Other option
The road as baseline	The 2002 system carried forward (§2.2)	A straw man; the label is rhetoric	None: the gap is the same either way
The gap, not a ratio	An amount, with both bills beside it (§2.1)	Meaningless without scale	Both bills printed
Same-in-both lines	Distribution, metering, supplier costs equal (§2.1)	The departure raised them too	Not computed; would raise the gap
VAT on the extra	Counted in the departure (§2.3)	VAT is not climate policy	Waterfall step, §1.3
One-country rule	Britain alone leaves the road (§2.4)	Europe moved together	Not run: a different question (§3.3)
Reliability standard	De-rated margin derived from NESO's recommendation, gross peak (§2.5)	"Reliable" implies the real system was not	§7
Carbon stance	A policy charge, counted in full (§2.6)	Polluter pays for real harm	Subtract the carbon line
No value on carbon	Cost only (§1.4)	Ignores the benefit	Outside scope
Demand at actual	Both roads buy the same electricity (§12)	Cheaper power means more use	Not computable (§12.5)
Choices 1 to 8	§6 to §13	Stated in each chapter	In each chapter and §15

Source: the author's choices, as argued in the sections named. The table holds no figures.

3 How this compares

The answer has rivals, and a reader should meet them before the method, so that each later chapter can show where a difference arises. This chapter compares on a matched basis where the engine can produce one, explains each difference in the order scope, period, price basis and method, and then stops. Which method is better is argued in the chapters that follow.

3.1 The mainstream case: bills fell

The strongest mainstream statement on bills comes from the Climate Change Committee:

“Household bills in 2016 were below 2008 levels as higher prices resulting from low-carbon policies and network costs were more than offset by reductions in energy use”

Climate Change Committee, Energy Prices and Bills – impacts of meeting carbon budgets, March 2017, p.7, Executive Summary

The Committee’s figure is not an electricity bill. It is a dual-fuel bill, for households that use “gas for heating and hot water and electricity for lights and appliances”, the large majority of UK households (p.7). It compares 2016 with 2008, in the Committee’s real 2016 prices (GDP deflator; p.14, note 3): bills were about £115 lower in real terms than in 2008, after a larger rise from 2004 to 2008 “as international gas prices rose” (p.7). And it is net of falling use: on the Committee’s figures, lower use of gas and electricity since 2008 saved the average household £290 a year, while around £105 of the 2016 bill “resulted from the shift towards a UK-based low-carbon electricity supply and support for energy efficiency improvements in homes” (p.7). It credits the saving to “improved appliance, lighting and boiler efficiency driven through minimum standards” (p.7). The Committee calls for “an effective policy package ... with strong product standards” to deliver further savings (p.38). On its account, climate policy both raised prices and cut use, and the second outweighed the first.

This paper does not dispute the arithmetic. It answers a different question, on a different measure: the Committee’s is a dual-fuel bill in 2016 prices, net of lower use of both fuels; this paper’s gap is for electricity alone, in 2024 prices, with use held at actual. Both of its bills buy the electricity Britain actually used, so a saving from appliance and boiler standards sits in both bills and cancels in the gap: the road gets the efficient fridge too. What remains is what the departure added to the cost of the electricity that was used. The Committee’s comparison runs across time, from 2008 to 2016; this paper’s runs across roads, in the same year. A fall in bills over time is compatible with a gap between roads in every year, and the two findings can both be true. §12 argues the choice to hold demand at actual and states its strongest objection.

3.2 The case that gas drives the cost

A second mainstream case holds that the rise in bills was driven by the price of gas, not by climate policy. The Climate Change Committee puts it in the same report: bills rose sharply from 2004 to 2008 “as international gas prices rose” (CCC 2017, p.7), and price pressures “have largely been driven by higher wholesale energy prices” (CCC 2017, p.14, chapter 1 key messages). The report dates from March 2017. The Committee’s more recent advice includes the Seventh Carbon Budget (CCC 2025, February 2025), which §2.6 cites on carbon pricing. The Government’s 2022 consultation on electricity market arrangements states: “Gas plants are frequently the marginal plant in GB, meaning the price of gas generation often sets the wholesale electricity price” (BEIS 2022, REMA consultation, p.73). A study of Europe’s power markets concludes: “Hence, Europe’s electricity markets are highly exposed to the geopolitical risk of gas supply and natural gas price volatility, and the economic risk of currency exchange” (Zakeri and others 2023, p.2778).

The paper accepts the premise and builds it in. The road pays the actual price of gas in every month, 2022 included. A rise in the gas price raises both bills, and raises the road’s more, because the road burns more gas; so the gas price lowers the gap rather than causing it. Gas can still drive the gap in one way: the road burns more gas than Britain did, and so may pay more for it. §9.5 measures that effect, and §15.3 asks how large it would have to be for the gap to vanish.

3.3 Earlier estimates

Two earlier estimates address the same territory. Kathryn Porter (Watt-Logic, 2025) compares the actual system with a continued “legacy gas-based power system” from 2006, in 2025 money, and counts renewables subsidies, extra network costs, backup generation and real-time balancing. Her question is close to this paper’s; her period starts later and her prices are 2025’s. No figure of hers is printed here. Kathryn Porter provided an endorsement for the author’s book *The Energy Trap* (Swift Press, book page, reviews).

O’Shea, Horne and Maslin (2025), of University College London (O’Shea, Maslin) and COMAC Capital LLP (O’Shea, Horne), reach the opposite sign. They find that wind delivered a net benefit of £104.3bn to UK consumers over the 14 years from 2010 to 2023 (preprint, version 1, p.1); the parts of their Table 10 add to £109.2bn (pp.31–32). The differences, in order, are these. In scope, Europe builds less wind as well as Britain, so the gas price rises across the regional market, and gas consumers’ bills are counted beside electricity bills. In period, they cover 2010 onwards. In price basis, the paper states none. In method, most of their benefit, by their own account, comes from a long-run rise in the European gas price, which this paper’s one-country rule excludes by design (§2.4). Over UCL’s own years, on this paper’s method, the gap is £110.7bn. The two figures answer different questions and are not offered as confirming or refuting each other.

What both studies show, and this paper does not contradict, is that wind and solar lower the wholesale price when they run, by pushing dearer plant out of the merit order. That effect is real. The road loses it, and §8 prices the loss into the road’s bill.

A wider literature estimates the system costs of integrating wind and solar: Ueckerdt and others (2013), Hirth, Ueckerdt and Edenhofer (2015), the studies for the Committee by NERA and Imperial College (2015) and for DECC by Frontier Economics (2016), and the review by Heptonstall and Gross (2021). That literature estimates the system costs of integrating wind and solar, mostly per megawatt-hour in modelled future systems, to compare technologies; Frontier Economics (2016) sets out a framework for those costs and gives no estimates. This paper measures something else: bills actually paid, set against a modelled bill for the same years. The two are complements, and the full survey of estimates is left to Report No. 3 of this series.

4 How the engine builds the two bills

4.1 The machine in one pass

The engine builds the road's bill half-hour by half-hour, year by year, from published data, and sets it against the actual bill line by line. Figure 4.1 shows the order of the steps.

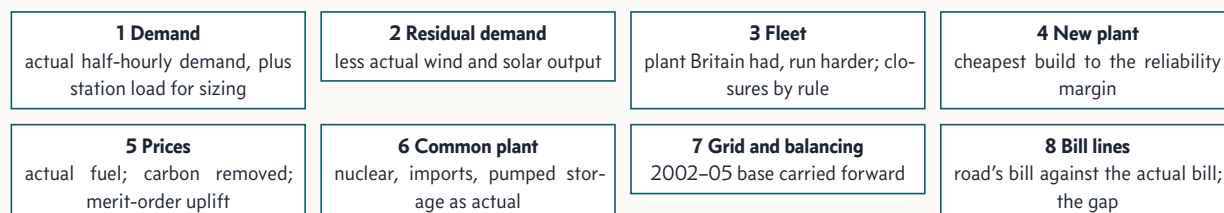


Figure 4.1 The engine in one pass

It starts from the electricity Britain actually used, half-hour by half-hour, from the system operator's demand data. It takes away the output that wind and solar actually produced. What is left is **residual demand**: the demand that other plant must meet when wind and solar are not there. Power used inside power stations, **station load**, is added to residual demand for sizing and running the fleet, because the road's stations must generate it, but it is not billed, because customers do not buy it. That keeps the volume priced on the two roads the same. Station load on the road averages 4.7 TWh a year over 2002–24.

Residual demand is met first by the plant Britain had in 2002, with nuclear, interconnectors and pumped storage as they actually ran. The coal and gas stations that remain on the road run harder than they did, and some stay open beyond their actual closure dates (§6). Where they cannot meet the demand and the reliability margin, the engine builds the cheapest new plant, sized afresh each year (§7).

The **merit order** sets the price: plant runs in order of running cost, and the last plant needed sets the price for all. On the actual road, wind and solar push the dearer plant out of the merit order when they run. On the road Britain was on, they are not there, so the price is higher. That rise is the **merit-order uplift**. Power from the plant Britain had is valued at the actual wholesale price with the carbon taken out, plus the merit-order uplift (§8). **Kept output**, the power from plant that runs on both roads (nuclear, imports and pumped storage), is valued in the same way. New plant is paid its full cost from the Government's generation cost reports. Fuel is bought at actual prices, with a rise in the gas price for the road's extra burn (§9).

Grid and balancing costs on the road start from their level in 2002–05, the **base window**, before the departure had changed them much, and are carried forward by the price controls' own rules and an allowance for renewal (§10, §11).

4.2 The bill lines and the identities

Each bill is a set of labelled lines. The actual bill's lines carry the label NZ, the road's lines GO, and lines the same on both roads S. Table 4.1 lists every line for 2024 with its value on each road. The release's table does not carry each line's tag (measured, modelled or estimated); Annex B will.

Table 4.1 Every bill line on both roads, 2024, £bn, 2024 prices (modelled)

Line	What it is	Bill	2024, £bn
NZ1	Power: wholesale energy	Actual	£20.0bn
NZ2	Renewables Obligation	Actual	£7.3bn
NZ3	Feed-in tariffs (levelisation cost)	Actual	£1.7bn
NZ4	Contracts for Difference (wind, solar, other)	Actual	£2.0bn
NZ4b	Contracts for Difference: biomass	Actual	£0.4bn
NZ5	Backup: Capacity Market extra over the road's own backup	Actual	£0.2bn
NZ6	Running the grid (balancing)	Actual	£3.0bn
NZ7	High-voltage grid	Actual	£3.2bn
NZ8	Climate Change Levy, electricity	Actual	£0.0bn
NZ10	Energy-saving schemes (EEC, CERT, CESP, ECO, GBIS), electricity share	Actual	£0.7bn

NZ11	VAT, 5%, on households' share of the lines above	Actual	£0.7bn
NZ1c	<i>of which carbon in the wholesale price</i>	Actual	£5.6bn
NZ1c_tax	<i>of which carbon price receipts</i>	Actual	£1.3bn
NZ1c_price	<i>of which carbon in the price, the rest</i>	Actual	£4.3bn
GO1	Power: the actual plant less carbon, renewables' output replaced by fossil	Road	£17.2bn
GO1k	Kept nuclear, imports and pumped storage, priced as actual less carbon	Road	£5.4bn
GO2	Backup payments (inside GO1)	Road	£0.0bn
GO3	Carbon	Road	£0.0bn
GO4	Running the grid (balancing)	Road	£1.4bn
GO5	High-voltage grid	Road	£1.8bn
GO6	CCL, subsidies, taxes	Road	£0.0bn
GO7	VAT, 5%, on households' share of the lines above	Road	£0.5bn

Source: gas-counterfactual release v4-s37, figures.json key table_lines_2024. Modelled, £bn in 2024 prices (CPIH) unless stated; figures rounded separately.

Two identities hold in every year and are tested in the release. The waterfall steps add up to the gap. Both bills price the same volume of electricity. A third, that a line-by-line bridge to the figure in Report No. 2 closes to nil, is to follow in version 1.1.

4.3 A worked half-hour

Two half-hours from 2024 show the machine at work: the half-hour with the highest residual demand, and the half-hour at the median. The median sits beside the peak so that the example cannot be called a choice made to flatter the result. Prices are in pounds per megawatt-hour in cash.

At the peak, 15 January 2024, 12:00–12:30 (settlement period 25), residual demand was 44.5 GW. The actual day-ahead price in these two half-hours is not computed for this release. On the road, the last plant running was a new open-cycle gas turbine, with a running cost of £179.1 per MWh. The merit-order uplift in that half-hour was £171.8 per MWh: the engine's own estimate from the shape of the road's fleet in that half-hour, scaled so that over the year it matches the yearly estimate described in §8.

At the median, 15 August 2024, 10:00–10:30 (settlement period 21), residual demand was 22.0 GW. The last plant running on the road was a combined-cycle gas station, at £62.2 per MWh, and the uplift was £37.7 per MWh.

The two half-hours show where the road's costs come from. At the peak, the road runs its dearest plant, and the gap in that half-hour depends mainly on how much that plant costs to hold in reserve. At the median, the road runs the plant Britain had, and the gap depends mainly on the price at which its power is valued.

4.4 Where the detail lives

Annex C summarises the engine's equations, parameters and switches. The full specification, the register of station closures and the log of calibration tests are published with the release.

5 Calibration

5.1 What calibration can and cannot show

No test can validate the gap, because the road never happened. That is the first limit of this paper, and it is stated before the method is described. What can be tested is each part of the machine. The actual bill can be checked against published statements. The road's bill can be checked in the early years, when the two roads had barely parted. And the mechanisms and identities can be checked against data. The ranges in §15 carry what calibration cannot.

5.2 The actual side against its sources

Each line of the actual bill is checked against the published statement it comes from: the Renewables Obligation and Feed-in Tariffs against Ofgem's annual reports, Contracts for Difference against the Low Carbon Contracts Company's data, the Capacity Market against the delivery body's records, and the transmission and balancing charges against the system operator's statements. The release does not yet give these checks, or their results, as a table.

5.3 The early years

In 2002 the two roads had only just parted: the Renewables Obligation began in April 2002 (Ofgem 2004, RO first annual report, PDF p.2). So in the early years the two bills should differ by little more than the climate-policy charges then in force: if the engine's road differed from the actual system by much more than that, something in the machine would be wrong. This is the early-years check.

The check is judged pooled over 2002–04. The difference between the two bills, other than the climate-policy lines, is measured as a share of those climate-policy lines, and the limit is 30.0% (£25.00 per household, in 2025 prices). Year by year the result is 55.4% in 2002, 29.0% in 2003 and 34.9% in 2004. The test was first set year by year. It was changed to the pooled form after the results were seen, because the climate-policy lines in 2002 were small, so a few pounds moved the percentage a lot; the paper says so, and prints every year.

On the release, the pooled check fails. It gives 36.6% against the limit of 30.0%, or –£7.11 per household in 2025 prices. The cause is a rule set out in §13: charges already on bills in 2001 stay on the road at their 2001 level, so only rises count. That rule takes £664m (2025 prices) out of the climate-policy lines over 2002–04, which shrinks the denominator of the check and so raises the percentage. Richard Lyon chose not to change the check again, and to state the failure and its cause. The check is one of the release's tests, `tests/test_fossil_like_for_like.py::test_early_years_gap_close_to_net_zero_extras_pooled`, and the only one the release records as failing (§5.4).

Table 5.1 The early-years check, by year and pooled over 2002–04, £ a household, 2025 prices (modelled)

Year	Difference outside the climate-policy lines, £ a household	Climate-policy lines, £ a household	Difference as % of the lines	Within £25.00	Within 30.0%
2002	–£6.11	£11.03	55.4%	yes	no
2003	–£6.13	£21.10	29.0%	yes	yes
2004	–£9.10	£26.06	34.9%	yes	no
2002–04, pooled	–£7.11	£19.41	36.6%	yes	no

Source: gas-counterfactual release v4-s37, figures.json key `table_calibration_early`. Modelled, £ a household in 2025 prices (CPIH), and percentages; figures rounded separately.

Two more readings come from the same window. The pricing difference inside 2002–05 is positive, £162m in 2025 prices: the road must replace the renewable output there was, and that outweighs the uplift on kept output. Grid and balancing lines net to about nil inside 2002–05, –£0.7m and £4.0m (2024 prices), as they should, since the road's grid and balancing costs start from that window.

5.4 Mechanisms and identities

Three further checks test the machine's parts. The running cost of the fleet is compared with the actual day-ahead price in half-hours when gas set the price, which tests the price rules. The engine's method for residual demand before 2016 is compared with the settlement data by fuel type, which tests the early years where data are thinnest. And the identities of §4.2 are tested in every year. The release names one failed test: `tests/test_fossil_like_f`

or `like.py::test_early_years_gap_close_to_net_zero_extras_pooled`, the pooled early-years check of §5.3. The release records mutation checks for some of its older modules (`plant.py`, `capacity.py` and `fleeta.py` are each noted as mutation-checked), but the ten mutation checks of ticket 34 were not built.

Table 5.2 Residual demand from 2016: Elexon's half-hourly generation data against NESO's demand data, by year (measured; each difference is NESO's figure less Elexon's, as a share of Elexon's)

Year	Energy difference	Peak difference	Passes (loosened rule)
2016	1.7%	2.4%	yes
2017	0.4%	-1.1%	yes
2018	0.7%	0.6%	yes
2019	0.6%	-1.8%	yes
2020	0.4%	0.5%	yes
2021	0.3%	-1.4%	yes
2022	0.1%	0.9%	yes
2023	-0.2%	-1.0%	yes
2024	-0.6%	-3.9%	yes
2025	-1.1%	-1.2%	yes

Source: gas-counterfactual release v4-s37, figures.json key `table_calibration_residual`. Measured, percentages; figures rounded separately.

6 Choice 1. Which plant stays open, and how hard it runs

6.1 The question

When wind and solar are taken away, which of the coal and gas stations Britain had stay open on the road, and how hard do they run?

6.2 The options

The central option closes stations by rule. A station closes on the road when it reaches the end of its life, when pollution law requires it, or when it fails a margin test with the carbon price taken out: a station whose earnings before carbon would not have covered its costs closes when it actually did. Kept coal can run harder than it did, but never above the coal capacity that actually existed, and never above a maximum load factor of 65.0%.

The critic's option closes every station on its actual date. A third option would test each class of closure separately: those caused by the carbon price, those with mixed causes, and Drax's conversion from coal to biomass. That option is not computed for this release, because the release carries no switch for it.

6.3 The evidence

The register of closures lists 51 stations. On the road, 5 stay open beyond their actual closure date, and 1 pass the margin test without carbon. By 2024 the road keeps 6.2 GW of coal open, de-rated; in the actual system the last coal station, Ratcliffe-on-Soar (CCC 2025, Progress report, PDF p.92), closed on 30 September 2024 (Uniper, Annual Report 2024, p.38).

Two stations show the test at work. Longannet, in Fife, closed on 24 March 2016 (ScottishPower, 24 March 2016). In its last year before closure, its modelled margin before carbon was -£0.8m in cash. Rugeley closed in 2016 (DUKES 2026, Table 5.11); Reuters and The Energyst reported Engie's announcement on 8 and 9 February 2016. Its modelled margin before carbon in its last year was £3.1m in cash. The engine's 448 MW, from that table's list of changed stations, differs from the 1,006 MW of its 2004–16 edition sheets, unexplained (Annex F). The test asks a narrow question of each: with the carbon price removed, would the station have earned enough to stay open? It does not ask whether the owner would have chosen to, which no model can know.

Kept coal pays for the pollution filters that the law of the day required, in every year it is kept, so the road meets the pollution law that the actual system met. Nuclear closes on its actual dates, and interconnectors and pumped storage run as they actually did.

6.4 The choice made, and why

Richard Lyon chose closures by rule. The road is the system Britain had, carried forward without the departure; closing stations whose closure the carbon price caused would carry part of the departure into the road. Keeping those stations open makes the road cheaper, because old plant costs less to run than new plant costs to build, so the central option raises the gap compared with closing every station on its actual date.

The strongest objection is that the road keeps coal burning without capture: "a dirtier Britain whose pollution you don't count". The answer has two parts. The road meets the pollution law of each year and pays for the filters that law required. The wider costs of air pollution are outside the scope of a paper about electricity bills, and §16 lists them as not counted.

6.5 The headline under each option

Table 6.1 The headline under each fleet option, 2002–24, £bn, 2024 prices (modelled; grey rows are method checks, outside the range)

Choice	Option	Row	Headline 2002–24	Change
1	Demand left for fossil plant from 2016 measured from Elexon's half-hourly generation data instead of NESO's demand data	range	£141.5bn	+£0.4bn
1	Kept coal not capped at its highest recorded load factor	method check	£150.7bn	+£9.6bn
1	Every power station closes on its real date	method check	£130.7bn	-£10.4bn

Source: gas-counterfactual release v4-s37, figures.json key table_choice1. Modelled, £bn in 2024 prices (CPIH) unless stated; figures rounded separately.

With every station closed on its actual date, the gap for 2002–24 is £130.7bn, against £141.1bn at the central setting. The test by closure class is not computed.

6.6 The check

The margin test was designed with the stations it classifies in view. Its results are therefore a consistency check, not an independent validation: they show the rule does what it says, not that owners would have behaved that way.

6.7 What would settle it

Station-level accounts for the closure decisions would settle it, and they are not published. For Rugeley, the owner's own closure statement would replace the reports of it.

7 Choice 2. What is built new, at what cost, to what standard

7.1 The question

Where the plant Britain had cannot meet demand and the reliability margin, what does the road build, at what cost, to what margin, and what does it pay for backup?

7.2 The options

The central option builds the cheapest new plant, sized each year from the shape of residual demand, at costs from the Government's generation cost reports, using the edition current at the time. It holds the fleet to a de-rated margin on the gross winter peak, derived from NESO's recommendation (§2.5), and counts interconnectors at the capacity they were contracted to provide in the Capacity Market.

The other options are these. A low and a high margin are computed, and so is a case in which all new plant is gas. A high plant-cost case is not computed for this release, because the release carries no switch for it. Interconnectors counted at the imports actually metered at the peak, rather than their contracted capacity, are computed. So is a case in which coal kept open on the road takes Capacity Market payments.

7.3 The evidence

New plant and its cost

New plant is sized afresh each year, not built once and kept, so the figure for any year is what stands that year. In 2024 the road's new plant comes to 8.7 GW, excluding the spare plant held for the margin; by type, all open-cycle gas turbines, with no new combined-cycle gas or coal plant. The road builds no new combined-cycle gas plant in any year to 2024, so the disputed cost of new combined-cycle plant does not touch the headline. Costs for 2024 come from DESNZ's 2023 edition, whose earliest estimates are for projects commissioning in 2025 (Annex A).

The margin

The road's fleet equals the gross winter peak, plus the margin, less contracted imports. That makes the road's fleet slightly larger than a margin on the net peak would, by 0.4 GW in 2024, built as open-cycle gas turbines; the gap falls as a result. The central margin is 7.4%, the low option 6.6% and the high option 8.2%: the midpoint and the two ends of NESO's de-rated margin range for the T-1 auction for 2027/28, each divided by NESO's Base Case peak for 2027/28 (§2.5). These are this paper's percentages, not NESO's. In 2024 the fleet is sized on the half-hour of 18 January 2024 (settlement period 26), which is not the half-hour of highest residual demand used in §4.3, because sizing uses the gross series.

Interconnectors, nuclear and the Capacity Market

Interconnectors are counted at their de-rated Capacity Market contracts both when the road's fleet is sized and in its Capacity Market line, the same basis as the actual Capacity Market uses. Contracts start in calendar 2016, at nil that year; before then the road uses metered imports. The Capacity Market runs in delivery years from October to September (SI 2014/2043, reg. 2, "capacity year"), so each calendar year takes nine months of one delivery year and three of the next. In 2024 that gives 5,673 MW. In 2019, for example, the time-weighted figure is 722 MW, while the delivery year in force at the 2019 sizing peak, 2019/20, had 2,887 MW contracted. The figure for delivery year 2017/18 comes from the delivery body's results for the early auction (EMR Delivery Body 2017, Table 1).

A fleet sized net of contracted imports could fall short in some half-hours of the residual demand actually metered, and the shortfall would then be met by contracted imports called on, priced like kept output. On this release it never happens: 0.0 TWh over 0 half-hours in 2016–24, because the road's fleet is dispatched to the metered residual demand. The test that the road meets its standard counts interconnectors on the same basis on both sides.

Nuclear in the Capacity Market split is counted at its de-rated obligations after secondary trading, less the agreements NESO's register flags as suspended. Against counting nuclear at its output at the peak, that treatment changes the Capacity Market line by –£0.1bn over 2002–24. Counting nuclear at the obligation won at auction instead is not computed for this release.

The Capacity Market line in the gap is the actual Capacity Market less what the road's own fleet would have needed: £0.9bn over 2002–24. Payments deferred during the market's suspension in 2018–19, £987.3m in cash for Delivery

Year 2018/19, were due from suppliers on 21 November 2019 (ESC 2020, p.8 and the text above Table 1). The Secretary of State had told Parliament that “the vast majority of the back-payments will reach capacity providers in January 2020” (HCWS38, 24 October 2019). Annex C records the year to which the release assigns them.

7.4 The choice made, and why

Richard Lyon chose the central option. Contracted interconnector capacity puts both roads on the basis the Capacity Market itself uses.

The strongest objection is to the title: “‘Reliable’ implies the real system wasn’t. Show it.” The paper makes no such claim. Reliability is a condition both roads meet, not a finding about either. The road’s firm fleet in 2024 was 58.7 GW, sized to the margin of §2.5. What the paper shows is the cost of meeting the same standard in two ways.

7.5 The headline under each option

Table 7.1 The headline under each new-build, standard and Capacity Market option, 2002–24, £bn, 2024 prices (modelled; grey rows are method checks)

Choice	Option	Row	Headline 2002–24	Change
2	Spare plant margin of 6.6% (central 7.4%)	range	£141.2bn	+£0.1bn
2	Spare plant margin of 8.2% (central 7.4%)	range	£141.0bn	–£0.1bn
2	Interconnectors counted at their metered flow at the peak (the v4-s35 basis) instead of their Capacity Market contracts	range	£140.9bn	–£0.2bn
2	Capacity Market: coal stations the road keeps open also need Capacity Market payments	range	£140.6bn	–£0.5bn
2	Capacity Market: its whole cost counted as a cost of net zero	range	£147.7bn	+£6.6bn
2	New plant gas only, no new coal (the s22 rule)	method check	£141.1bn	£0.0bn

Source: gas-counterfactual release v4-s37, figures.json key table_choice2. Modelled, £bn in 2024 prices (CPIH) unless stated; figures rounded separately.

At the low margin the gap is £141.2bn. With interconnectors at metered imports it is £140.9bn. If kept coal took Capacity Market payments it would be £140.6bn. The high margin and the all-gas build are in Table 7.1; the all-gas build leaves the headline unchanged, because the road builds no new coal. A high plant-cost case is not computed.

7.6 The check

The firm test checks in every year that the road’s de-rated fleet, with contracted imports, covers the gross peak plus the margin, counting interconnectors on the same basis on both sides.

7.7 What would settle it

A sourced series of de-rated Capacity Market obligations by technology and calendar year would settle the Capacity Market split. The delivery body’s results for each auction give the pieces; no single official series joins them.

8 Choice 3. The price of power from the plant Britain had

8.1 The question

At what price is power from the plant Britain had valued on the road?

8.2 The options

The central option values it at the actual wholesale price with the carbon taken out, plus the merit-order uplift. The uplift in each year is estimated by the method of Shao and others (2022). Kept output, from plant that runs on both roads, is valued the same way.

The critic's option removes the uplift altogether. A second option uses the engine's own estimate from the fleet's running costs instead. A third values kept output at the full actual price, carbon included. A fourth applies to the crisis years 2021–23 only, and replaces the wind part of the uplift with the estimate from the short-term model of O'Shea, Horne and Maslin (2025, Table 4), keeping the solar part. Two further rules are run as method checks (Table 8.1): the smaller of the two estimates in each year, and the larger of the two, the rule of an earlier release.

8.3 The evidence

Taking carbon out of the price

On the road there is no carbon price, so the actual price must have its carbon removed. The engine removes the carbon cost of the plant that set the price: the emissions of that plant per megawatt-hour, times the allowance price, plus Carbon Price Support. Why carbon counts at all is argued in §13; this is the mechanics.

The merit-order uplift

Wind and solar have almost no running cost, so when they run they push the dearest plant out of the merit order and lower the price. The effect is well established. Shao and others (2022), at Swansea University and Peking University, estimated it for Britain from daily data between April 2009 and March 2021. This paper applies their method to wind and solar output in every year. The result is the paper's own estimate, not a figure Shao and others published. Over 2002–24 the uplift adds £57.3bn to the road's bill. The Shao-method estimate is the larger of the two in 22 of the years 2002–24.

Kept output

Kept output, 71.0 TWh in 2024 from nuclear, imports and pumped storage net of exports and pumping, is sold into the same market as every other plant. In any half-hour there is one market price. On the road that price has no carbon in it, so kept output is valued at the road's price.

The crisis years

In 2021–23 the gas price rose to extremes, and the uplift with it. Using the Shao method, the uplift in 2022 was £15.9 per MWh in cash, a time-weighted average. O'Shea, Horne and Maslin give two estimates. Their short-term model (Table 4, p.22) puts their total effect in 2021–23 at 1.6 to 3.5 times the Shao-method estimate, and their wind effect at 2.2 to 4.9 times; they say it “produces results which do not appear reasonable” (p.24). It is behind the method check in Table 8.1. Their headline rests on their long-term model (Table 5, p.25): its effect on the price in 2022, –£18.18 per MWh, is larger than the Shao-method uplift. It is named here and not run.

8.4 The choice made, and why

Richard Lyon chose the central option. Against the engine's own estimate, the Shao method gives the road the higher price, and so lowers the gap. The rule of the earlier release, the larger of the two estimates in each year, lowers it slightly further; it is shown as a method check in Table 8.1.

Valuing kept output at the road's price, without carbon, is an exception to the conservative rule: valuing it at the full actual price would lower the gap. The objection writes itself: “Kept nuclear priced without carbon makes your gap bigger: so much for erring low.” The answer is that there is one price in a half-hour, and on the road that price contains no carbon. Paying nuclear a carbon price on a road with no carbon price would charge the road for the departure. The full actual price, which sets the low end of the range, is still defensible: imported power did carry carbon prices from abroad (§2.4). The exception is listed in Table 2.1, with its size.

The Shao method stays central for 2021–23 because the larger estimates come from the short-term model of a preprint not yet peer reviewed, a model its authors discount (p.24). They are run as a sensitivity, and the gap is printed both ways. The central uplift for 2021–23 is therefore probably low: the Shao estimate comes from data between April 2009 and March 2021, and in 2021–23 gas cost several times its level in that sample (Table 15.2, row 3B); keeping it central is a stated exception to the conservative rule (§2.9), and UCL’s long-term model is to be run in version 1.1.

8.5 The headline under each option

Table 8.1 The headline under each power-price option, 2002–24, £bn, 2024 prices (modelled; grey rows are method checks)

Choice	Option	Row	Headline 2002–24	Change
3	Wholesale price before mid-2010: the lower published series instead of Ofgem's chart	range	£141.1bn	£0.0bn
3	Wholesale price before mid-2010: the engine's own modelled price instead of Ofgem's chart	range	£141.1bn	£0.0bn
3	Power from plant Britain had, priced at the actual market price with carbon left in	range	£123.6bn	–£17.5bn
3	Power from plant Britain had, priced at the fossil fleet's average cost	range	£135.1bn	–£6.0bn
3	No merit-order uplift (the spec's §15.3 rule)	method check	£199.4bn	+£58.3bn
3	Merit-order uplift: the larger of the engine's estimate and Shao et al. (the s22 rule)	method check	£140.5bn	–£0.6bn
3	Merit-order uplift: the smaller of the engine's estimate and Shao et al.	method check	£174.8bn	+£33.7bn
3	Merit-order uplift in 2021–23 scaled to UCL's short-run estimate (preprint)	method check	£116.7bn	–£24.4bn
3	Merit-order uplift from the engine's own estimate instead of Shao et al. (2022)	method check	£174.3bn	+£33.2bn
3	Extra running of the plant Britain had charged its fuel, running and transport cost, not the market price (the v4-s36 mix)	method check	£164.2bn	+£23.1bn

Source: gas-counterfactual release v4-s37, figures.json key table_choice3. Modelled, £bn in 2024 prices (CPIH) unless stated; figures rounded separately.

With no uplift the gap is £199.4bn; with kept output at the full actual price it is £123.6bn. With the engine’s own estimate of the uplift alone, from its four-block supply stack, it is £174.3bn, a change of £33.2bn: a method check, outside the range, kept as a sensitivity row (Table 15.2). For 2021–23, the gap is £34.9bn with the Shao method and £10.5bn with the wind effect of O’Shea and others’ short-term model, a difference of –£24.4bn.

8.6 The check

The road’s running costs are compared with the actual day-ahead price in half-hours when gas set the price (§5.4). In those half-hours the two should be close, because the same kind of plant sets the price on both roads.

8.7 What would settle it

A peer-reviewed merit-order series for Britain covering 2021–23 would settle the crisis years. So would the version of record of O’Shea, Horne and Maslin, if peer review confirms their estimates.

9 Choice 4. The gas price

9.1 The question

What does the road pay for gas, given that it burns more gas than Britain did?

9.2 The options

The central option buys gas at the actual price each month, plus a rise for the road's extra burn, the **gas feedback**. When one buyer wants more gas, the price rises until suppliers produce more and other buyers use less. The rise is the extra burn, as a share of the market's gas use, divided by the sum of two **elasticities**: the percentage rise in supply and the percentage fall in other buyers' use for a one per cent rise in price. The central sum is 0.23: supply 0.06 plus demand 0.17.

A high option takes Krichene's world long-run pair, 0.61, which gives a smaller rise. A case with no feedback is a method check, outside the range (Table 9.1). Two further options are not run, and are answered in words: the Europe-wide premise of O'Shea, Horne and Maslin, and a gas price based on contracts rather than the day-ahead market.

9.3 The evidence

The gas price series

Both bills use the price from Ofgem's wholesale data. Before October 2009 the road's gas uses the same series, so one series runs through the whole period. Using the Government's contract-price series instead before October 2009 would move the headline by £1.0bn.

Generators often buy gas under contracts rather than day-ahead. There is no engine run on contract prices, because there is no matching contract price for power: pricing the road's gas on contracts while the actual bill stays on the day-ahead market would mix two bases.

The feedback

The road burns 159.9 TWh more gas than Britain did in 2024. At the central pair, that raises the road's gas price in 2024 by 14.9%. The pair is the one Albrizio and others use to price a twelve-month cut in Europe's gas supply (2022, IMF Working Paper 22/143), dividing the shift in supply by the sum of the two elasticities (their equation 5, pp.13–14). The demand half is this paper's weighting of their four sector elasticities (Table 2, p.12) by the EU shares of gas use in the same table, which gives 0.169, printed as 0.17 Annex A sets out the sum. The authors name no source or year for those shares. The supply half, 0.06, they take from Krichene (2002, *Energy Economics*), who prints the same short-run figure for world gas supply in 2005 (IMF Working Paper 05/32, Table 5, p.20). The high option is Krichene's long-run pair (Table 2, vector error correction, 1918–2004): demand 0.45, and a larger supply elasticity. Casoli, Manera and Valenti put the short-run supply elasticity for the euro area at a median of 0.34 (FEEM working paper 045.2022, updated 2023).

The central pair is a twelve-month pair, but the road's extra burn builds up over two decades, long enough for supply and demand to respond more fully, which would mean a smaller feedback and a larger gap. The long-run pair, the high end of the range, shows by how much.

The one-country rule tested

The rule matters most here. On the road, only Britain's demand for gas rises; Europe's wind farms are still built. O'Shea, Horne and Maslin instead ask what happens if Europe as a whole relies on gas, and find a large rise in the regional gas price. The objection is that the paper's feedback is one country's. That is true by design: the paper asks what Britain's own programme cost Britain (§2.4). A Europe-wide departure is a different question, and its answer is not the cost of Britain's own choices.

2022 and bill support

Both bills price gas and power on the day-ahead market in 2022, as in every year, so the basis is matched. The gap in 2022 is £11.3bn.

The Energy Price Guarantee and the Energy Bills Support Scheme are left out of both bills. The gap measures the cost of supplying the electricity, whoever paid it, bill-payer or taxpayer (§16).

Britain's own gas output is held at what actually happened. On the road, higher prices might have drawn out more British gas, which would damp the feedback. No source sizes that response, so its direction is stated and no figure is given.

9.4 The choice made, and why

Richard Lyon chose the central pair. Its source sets out the formula that combines the two halves (Albrizio and others, equation 5), it is for the European market whose gas use the engine counts, and of the paired options it gives the smaller gap, as the conservative rule asks (§2.9). Its weakness is stated in §9.3.

9.5 The headline under each option

Table 9.1 The headline under each gas option, 2002–24, £bn, 2024 prices (modelled; grey rows are method checks)

Choice	Option	Row	Headline 2002–24	Change
4	No gas transport cost added to the road's fuel	range	£141.5bn	+£0.4bn
4	Gas-price feedback at Krichene's world long-run pair, supply 0.16 plus demand 0.45 (smaller feed-back)	range	£152.9bn	+£11.8bn
4	No gas-price feedback	method check	£159.9bn	+£18.8bn

Source: gas-counterfactual release v4-s37, figures.json key table_choice4. Modelled, £bn in 2024 prices (CPIH) unless stated; figures rounded separately.

At Krichene's long-run pair, 0.61, the gap is £152.9bn, a change of £11.8bn; this is the high end of the range. For the gap in 2024 to vanish, the road's gas price would have to rise by 90.6% (§15.3).

9.6 The check

Every line of the road's bill that buys gas uses the same raised price. That includes the energy part of the road's balancing costs, which carries the feedback too; doing so moves the headline by –£0.6bn.

9.7 What would settle it

A pair of supply and demand elasticities from one source, for the gas market Britain buys in over 2002–24, would settle the central value. A sourced estimate of how much more gas Britain would have produced on the road would size the damping, and a matched contract price for power would allow a run on contract prices.

9.8 Beside the gap: other gas users

The road's higher gas price would fall on homes and industry as well as on power stations. That cost is outside the electricity bill, so it is not in the gap. It is a labelled estimate, net of the gain to British gas producers, kept apart and never added to the gap. Its figures are not given in this release; the working and figures follow in version 1.1.

10 Choice 5. The grid

10.1 The question

What would the transmission grid have cost on the road?

10.2 The options

The central option starts from the grid's cost in the base window, 2002–05, and carries it forward by the price-control index, adding an allowance for renewing the assets as they age, counted in full above its 2002–05 level. A second option leaves the renewal allowance out altogether. A third carries the base forward at the price controls' own allowed changes, the X values Ofgem set for each period, instead of the index alone. A fourth would test other base windows, such as 2002–04 or 2003–06; it is not computed, and §16 lists it.

10.3 The evidence

Why 2002–05

The window is set by dated changes in the rules, not by the results. Ofgem's final proposals set National Grid's transmission price control to apply from 1 April 2001 (Ofgem 2000, TPCR final proposals, PDF p.6). The Renewables Obligation began in April 2002. The transmission price controls set from 1 April 2007 took in investment already approved to connect renewable generation in Scotland under the TIRG mechanism, but left links to the Scottish Islands out, with competition for them to be consulted on during 2007 (Ofgem 2006, TPCR4 final proposals). The window test in §5.3 checks the choice: inside 2002–05 the grid lines on the two roads net to about nil.

The generators' share

Generators pay part of the transmission charges out of the wholesale price and, for renewables, out of their subsidy income, both of which are already counted. So the generators' share, 27%, is removed from the grid line on both roads, to avoid counting the same money twice. That share is confirmed from primary sources for England and Wales in 2003/04 (Ofgem and DTI 2003, para 4.16, p.17) and 2004/05 (Ofgem 2004, 241/04, para 4.118). For 2001/02 and 2002/03 it is inferred from Ofgem's later working paper (Ofgem 2017, p.36).

No source gives a Scottish share before April 2005. The same share is applied to Scotland, and the paper says so; OFFER's 1999 consultation on the Scottish transmission price control noted that ScottishPower's split of infrastructure charges between generation and demand "can differ from that of NGC" (Ofgem 1999, para 6.10, p.44). The choice barely touches the gap, £0.1m over 2002–05 under the other treatment, because it moves both roads' grid lines together, each by about £260m; both figures are in 2024 prices.

The Scottish starting point

The Scottish grid enters the base at its non-load-related allowance for 2005/06, £55.9m in 2002/03 prices: £44.8m for SP Transmission and £11.1m for SHETL (Ofgem 2004, 279/04, Appendices 5 and 6). The £2.8m in Appendix 8 of the same document is a British trading arrangements (BETTA) incremental adjustment to SP Transmission's 2005/06 non-load-related spending for the post-Vesting upgrades to the England–Scotland interconnector. It sits outside the two companies' renewal allowances, so it is left out.

The lines

Over 2002–24 the actual grid line, the demand share of transmission charges, is £50.6bn, and the road's is £36.0bn, of which £4.0bn is the allowance for renewal. The grid step in the gap is £14.6bn.

10.4 The choice made, and why

Richard Lyon chose the central option. Two objections carry weight. The first is that the grid of 2002–05 was ageing, so carrying its cost forward understates what renewal would have needed. The renewal allowance answers it: the road's grid pays to replace its assets as they wear out, at £4.0bn over the period. The second is that the window was picked after the fact. The dated rule changes above fix it independently of the results, and the window test checks it.

The price controls' own X values are a sensitivity, not the central case. Ofgem's one-year reset for 2012/13 is left out of that sensitivity; counting the whole reset would credit the road with grid spending the departure caused.

10.5 The headline under each option

Table 10.1 The headline under each grid option, 2002–24, £bn, 2024 prices (modelled)

Choice	Option	Row	Headline 2002–24	Change
5	Grid renewal allowance not counted at all	range	£145.2bn	+£4.1bn
5	Grid renewal allowance at its high setting, which equals central	range	£141.1bn	£0.0bn
5	Grid carried forward on the price controls' own X values (RPI minus X) instead of RPI	range	£136.5bn	–£4.6bn

Source: gas-counterfactual release v4-s37, figures.json key table_choice5. Modelled, £bn in 2024 prices (CPIH) unless stated; figures rounded separately.

Without the renewal allowance the road's grid costs less, so the gap rises (Table 10.1). The table's other renewal row, the allowance at its high setting, is the central setting itself, so it leaves the headline unchanged at £141.1bn. With the price controls' own X values the gap is £136.5bn, a change of –£4.6bn. Other base windows are not computed.

10.6 The check

Inside the window, the two roads' grid lines net to –£0.7m (§5.3).

10.7 What would settle it

Transmission spending split by its cause, renewal or new connections, would settle the renewal allowance; only totals by company and year are published. The Scottish companies' charging statements for 2001/02 to 2004/05 would settle the Scottish share; none has been found online.

11 Choice 6. Balancing

11.1 The question

What would balancing the system have cost on the road?

11.2 The options

The central option starts from National Grid's own measure of its balancing costs in the base window, the incentivised cost, and applies NESO's share of energy costs in 2018/19 to every year. The lowest-gap option starts instead from the National Audit Office's figure for 2005/06, £642m (NAO 2014, para 2.2; price basis not stated by NAO; treated as cash), carried forward by CPIH, and applies NESO's energy share for 2024/25.

11.3 The evidence

The actual balancing line is the demand share of the balancing charge (BSUoS): £23.2bn over 2002–24. The generators' share is removed on both roads, for the reason given for the grid in §10.3: generators pay it out of income that is already counted. From 2017 the line is summed from NESO's daily data by calendar year. Before 2017, financial-year totals are put on calendar years: each calendar year takes a quarter of one financial year and three quarters of the next.

The road's balancing starts from the incentivised cost in the base window. That measure covers only the costs National Grid paid outside its own business, so it is raised to the basis of the balancing charge, which also recovers the operator's own costs, by a factor of 1.198, and from England and Wales to Great Britain by a factor of 1.1086. The share of constraint and energy-imbalance costs in NESO's 2018/19 outturn, 54.8% (NESO 2025, Annual Balancing Costs workbook), is applied to the external part of the base, and that energy part carries the road's own gas price (§9.6). The incentivised cost in the window runs above the actual cost, by between £70.7m and £102.6m a year in cash over 2001/02 to 2004/05 (National Grid 2005, p.2, "Historical performance" table; National Grid 2010, Table 1, p.9). Over 2002–24 the road's balancing line is £15.5bn, and the balancing step in the gap is £7.7bn.

11.4 The choice made, and why

The central option is an exception to the conservative rule, and Richard Lyon chose it openly. The base window exists to fix the road's balancing cost at a time when the two roads had barely parted, so the test of any base is whether the two roads' balancing lines agree inside the window. The central option passes it. The lowest-gap option fails it. Inside 2002–05 it gives the road a higher balancing cost than the actual system in every year, –£343m in all, when the two should be about equal. It does so because it carries two things into the road that belong to neither the window nor the road: the gas price spike of 2005/06, and the share of wind constraint costs in 2024/25 (NESO's 2024/25 energy share, 70.3%, includes constraints; NESO 2025, Annual Balancing Costs workbook, "Total outturn", row 2024/25).

The low end is shown beside the central. At the lowest-gap option the balancing step is £3.3bn, and the exception costs the headline £4.6bn over 2002–24, and £0.5bn in 2025 (provisional). The exception is listed in Table 2.1.

11.5 The headline under each option

Table 11.1 The headline under each balancing option, 2002–24, £bn, 2024 prices (modelled)

Choice	Option	Row	Headline 2002–24	Change
6	Balancing: National Grid's incentivised-cost baseline, with the FY2022/23 energy share (41.9%)	range	£142.1bn	+£1.0bn
6	Balancing: National Grid's incentivised-cost baseline, with the FY2024/25 energy share (70.3%)	range	£139.9bn	–£1.2bn
6	Balancing: the NAO's £642m for 2005/06 as the baseline in every year, with the FY2018/19 energy share (54.8%)	range	£138.0bn	–£3.1bn
6	Balancing: the NAO's £642m for 2005/06 as the baseline in every year, with the FY2022/23 energy share (41.9%)	range	£139.2bn	–£1.9bn
6	Balancing: the NAO's £642m for 2005/06 as the baseline in every year, with the FY2024/25 energy share (70.3%)	range	£136.5bn	–£4.6bn

Source: gas-counterfactual release v4-s37, figures.json key table_choice6. Modelled, £bn in 2024 prices (CPIH) unless stated; figures rounded separately.

Energy shares: NESO 2025, Annual Balancing Costs workbook, "Total outturn", rows 2022/23 and 2024/25.

11.6 The check

Inside the window, the central option nets to £4.0m over 2002–05, against –£343m for the lowest-gap option.

11.7 What would settle it

A published series of balancing costs for Great Britain before 2005, on one basis, would settle the base. None exists; the England and Wales figures must be grossed up.

12 Choice 7. Demand at actual, and lost value

12.1 The question

Should the road buy the electricity Britain actually used, or the larger amount it would have used at the road's lower prices?

12.2 The options

The central option holds demand at what Britain actually used, on both roads. A second option would size the road to a growing Britain, using more power at lower prices; it is deferred to a later report. A third would credit the road with the electricity the energy-saving schemes saved; it is not taken.

12.3 The evidence

Two bills for different quantities of electricity cannot be subtracted without mixing a difference in price with a difference in volume. The gap would then measure partly what the departure added to the cost of power and partly how much more power Britain would have bought, which is not a cost of the departure but a choice consumers would have made. DECC's series held the same distinction, separating the effect of policies on prices from the effect of lower consumption on bills (DECC 2014, Annex D, Table D1, p.72).

The schemes' savings cannot be credited for a plainer reason: none was measured. Every official figure for the electricity saved by the supplier schemes is deemed or forecast in advance, not measured afterwards (§16).

The schemes line is therefore one-sided: the actual bill carries the schemes' cost above their 2001 level, £9.2bn over 2002–24, while both bills are priced on actual demand, which the schemes lowered, so the road has their savings without their cost (Table 15.2, row 7B).

12.4 The choice made, and why

Richard Lyon chose demand at actual. The strongest objection is that cheaper power would have meant more demand, so the road needed more plant and more grid, and the paper understates its cost. The answer is that extra use at lower prices is a gain to those who choose it, not a cost; what the departure took from them is the value of the electricity they did not use. That is the second cost, below, and it is kept apart from the gap.

12.5 The headline under the other option

None. A bill at forecast demand is not comparable with a bill at actual demand, so no headline is shown under the second option. A gap in the average price per megawatt-hour could be computed at actual demand, and is not computed for this release.

12.6 Lost value

Dearer electricity leads people and firms to use less of it. What they give up by doing so is **lost value**: the value of the electricity they would have used at the road's prices and did not, less what it would have cost them. It is not lost GDP. Lost value is a labelled estimate, computed outside the measured gap and never added to it. The two costs add in principle and never offset, so leaving it out makes the headline smaller than the full cost.

The estimate needs to know how strongly demand responds to price. For households it uses the United Kingdom's long-run residential elasticity, -0.607 (Pellini 2021, Table 4). For every other user it uses -0.52 , the long-run average for electricity across all consumers in an international review (Labandeira, Labeaga and López-Otero 2016, working paper RSCAS 2016/25, Table 3); the paper has no figure for industrial electricity alone; its average for industrial consumers, -0.508 long-term, covers all energy goods (Table 3). Weighted by who uses the power, the central elasticity is -0.55 . The range runs from -0.203 , the review's short-run average for electricity (Table 3), to -0.677 , its long-run average (Table 4): international averages, which mix a short-run response with a long-run one.

The price rise is measured against the whole bill customers pay, network and supply costs included, because people respond to the price they pay. The estimate uses a demand curve of constant elasticity, anchored on actual demand at actual prices; a straight-line curve would give a higher figure. Long-run elasticities applied from 2002 overstate the response in the early years.

The figures for lost value, over 2002–24 and for 2025, are not given in this release; the working and figures follow in version 1.1.

12.7 What would settle it

Measured electricity savings from the supplier schemes, year by year, would allow a credit; none exists. A sourced path for a growing Britain's demand would allow the second option to be built.

13 Choice 8. What counts as the departure

13.1 The question

Which costs belong to the departure, and which were already part of the road?

13.2 The options

The central option puts no carbon price of any kind on the road. Three charges that were already on bills in 2001, the Climate Change Levy, the supplier energy-saving scheme then running (EESoP) and the Fossil Fuel Levy that funded the Non-Fossil Fuel Obligation, stay on the road at their 2001 levels, carried forward in real terms, so only rises count.

The critic's strongest option puts the EU emissions trading scheme on the road and removes only Carbon Price Support. Directive 2003/87/EC was adopted on 13 October 2003 and bound the United Kingdom from its entry into force on 25 October 2003, the day of its publication in the Official Journal (Article 32), with national laws due by 31 December 2003 (Article 31) and permits required of installations from 1 January 2005 (Article 4), so, the critic says, the road Britain was on included it. Further options put both the trading scheme and Carbon Price Support on the road; count the 2001 levels of the three old charges as part of the departure; hold those levels flat in cash rather than in real terms; and value the Fossil Fuel Levy's 2001 level at the estimate of payments from the obligation and comparable arrangements in Scotland in 2001–02, £85.5m (HC Deb 18 April 2002, c1139W), rather than at the £92m of central-government receipts from the levy in 2001/02.

13.3 The evidence

The trading scheme

The Directive set up the scheme “in order to promote reductions of greenhouse gas emissions in a cost-effective and economically efficient manner” (Article 1). The United Kingdom ran its own scheme from 2002 (NAO 2004, HC 517, para 2), before the Directive bound it.¹

A referee will spot a tension, and the paper states it. The one-country rule keeps continental carbon prices inside the price of imported power, yet takes Britain out of a scheme it was legally bound to join. The paper's answer is that the road is a road of policy, not a forecast of law. A reader who rejects that answer can subtract the carbon line (§2.6).

Free allowances

Carbon in the price in 2005–12 was £16.6bn, against £1.3bn of tax collected. The cost reached bills, even though the generators paid little or nothing for the allowances.

Power's share of the trading scheme's auction revenue is set by its share of verified emissions, an assumption no source publishes. Attributing revenue instead by each sector's shortfall of free allowances gives £14.4bn of tax collected over 2013–20. These rules move money between the two parts of the carbon line, not the headline.

The Climate Change Levy

The levy began in April 2001, charged on non-domestic use of energy (ONS 2015, Environmental Taxes 2014, PDF p.11), with a cut in employers' National Insurance to 11.9% (SI 2001/477). Its 2001 rate for electricity, carried forward by CPIH, is 0.766p per kilowatt-hour in 2024 prices, against a main rate of 0.775p in cash for the financial years 2023/24 and 2024/25 (HMRC, Environmental taxes: historical rates, Table 1, electricity, rows April 2023 and April 2024), so the 2024 levy is close to its 2001 level in real terms. The road carries the 2001 level, £18.3bn over 2002–24, and the gap counts only the difference from it, –£1.3bn. The difference is negative because, over 2002–24 as a whole, the levy on electricity ran below its 2001 level in real terms.

Renewable power was exempt from the levy until August 2015 (HMRC 2016, Excise Notice CCL1/4, para 1.2). On the road, which has less renewable power, the exemption is capped each year at the road's own volume of replaced renewables, which is worth £1.2bn; the headline with the exemption uncapped is not computed for this release.

¹ Defra's results for 2006 list £198.13m of incentive payments for participants still in the scheme, without saying how much was paid or still due (Defra 2007, p.2).

The reduced rate for firms with climate change agreements is named, not counted; its upper bound is not computed for this release.

EESoP and the Fossil Fuel Levy

The road carries each at its 2001/02 level in pounds, held flat in real terms: the Fossil Fuel Levy at £92m for Great Britain (ONS, series CIQY; the levy did not extend to Northern Ireland, ONS, Economic Trends 609, 2004) and EESoP, of whose energy-saving target 44.8% (4,981 GWh of 11,125 GWh) was electricity (Ofgem and EST 2003, Figure 3.1, p.14). The Fossil Fuel Levy's level is netted against the obligation's contracts inside the Renewables Obligation line until 2019, when those contracts ended; EESoP's against all its successor schemes, whose line on the actual bill comes to £9.2bn over 2002–24. Years below the 2001 level count as negative. The netting changes the gap by –£4.1bn: –£1.1bn on the schemes and –£3.0bn on the Renewables Obligation. A target is not a charge, so the renewables target of 2000 is not on the road.

13.4 The choice made, and why

Richard Lyon chose the central option, for three reasons. The road is a road of policy, not a forecast of law, so it carries no carbon price of any kind. The United Kingdom chose emissions trading before it was bound to, with its own scheme from 2002. And the three old charges were on bills when the road began, so only their rises belong to the departure. Crediting the road with the electricity the energy-saving schemes saved would make the gap smaller, and is not done for want of any measured saving (§12).

The trading-scheme options are not computed for this release.

13.5 The headline under each option

Table 13.1 The headline under each 'what counts' option, 2002–24, £bn, 2024 prices (modelled)

Choice	Option	Row	Headline 2002–24	Change
8	Climate Change Levy counted above its 2001 rate held in cash, not raised with inflation	range	£145.1bn	+£4.0bn
8	Fossil Fuel Levy and EESoP 2001 levels held in cash, not raised with inflation	range	£141.8bn	+£0.7bn
8	Fossil Fuel Levy 2001 level set at the £85.5m NFFO payments estimate instead of £92m	range	£141.3bn	+£0.2bn

Source: gas-counterfactual release v4-s37, figures.json key table_choice8. Modelled, £bn in 2024 prices (CPIH) unless stated; figures rounded separately.

With the Climate Change Levy's 2001 rate frozen in cash the gap is £145.1bn; with the Fossil Fuel Levy and EESoP 2001 levels held flat in cash it is £141.8bn; with the Fossil Fuel Levy at the payments estimate it is £141.3bn. The trading scheme on the road with Carbon Price Support removed, and the 2001 levels counted in the departure, are not computed.

13.6 The check

Carbon is counted once, in the wholesale price, and no printed carbon figure includes the Climate Change Levy.

13.7 What would settle it

Power's share of the UK trading scheme's revenue in 2025, and HMRC's next estimate of receipts from the Carbon Price Floor for 2025, in the Environmental Taxes Bulletin tables due in March 2027, would settle the provisional carbon figures for 2025. The actual spending of EESoP and its split between fuels would settle the 2001 level of the schemes.

14 Results

14.1 The two bills by year

Table 14.1 gives both bills and the gap for every year from 2002 to 2024, in 2024 prices, with the 2002–24 totals and then 2025 on a line of its own, labelled provisional. Every figure in it is modelled, because the gap is. Years in which the gap falls below nil would be shown as they fall; there are none. The columns in 2024 prices put every year on the CPIH basis of the headline, so years can be compared and summed. The release does not yet give cash columns or each year's data basis (Annex F).

Table 14.1 Both bills and the gap by year, 2002–24, with 2025 provisional apart, 2024 prices (modelled)

Year	Actual bill, £bn	Road's bill, £bn	Gap, £bn	Gap per household, £	of which carbon in the price, £bn	CCL against its 2001 level, £bn
2002	£17.2bn	£17.1bn	£0.1bn	£4.74	£0.0bn	£0.0bn
2003	£22.8bn	£22.5bn	£0.4bn	£14.42	£0.0bn	£0.0bn
2004	£24.3bn	£23.9bn	£0.4bn	£16.33	£0.0bn	–£0.1bn
2005	£34.3bn	£30.4bn	£3.9bn	£157	£3.3bn	–£0.1bn
2006	£36.0bn	£32.6bn	£3.4bn	£139	£2.6bn	–£0.1bn
2007	£28.9bn	£27.8bn	£1.0bn	£41.49	£0.1bn	–£0.1bn
2008	£51.2bn	£46.6bn	£4.6bn	£181	£3.2bn	–£0.1bn
2009	£32.0bn	£28.2bn	£3.8bn	£149	£2.2bn	–£0.1bn
2010	£34.3bn	£30.5bn	£3.8bn	£149	£2.3bn	–£0.1bn
2011	£36.3bn	£33.2bn	£3.1bn	£119	£1.9bn	–£0.2bn
2012	£36.3bn	£33.7bn	£2.6bn	£99.76	£1.0bn	–£0.2bn
2013	£40.2bn	£37.3bn	£2.9bn	£111	£1.2bn	–£0.3bn
2014	£37.1bn	£31.8bn	£5.3bn	£203	£2.0bn	–£0.3bn
2015	£37.3bn	£29.9bn	£7.3bn	£279	£3.3bn	–£0.1bn
2016	£39.5bn	£31.6bn	£8.0bn	£303	£3.3bn	£0.0bn
2017	£41.3bn	£31.5bn	£9.7bn	£369	£3.2bn	£0.0bn
2018	£46.5bn	£35.9bn	£10.6bn	£394	£4.3bn	£0.0bn
2019	£43.0bn	£31.0bn	£12.0bn	£445	£5.2bn	£0.2bn
2020	£41.1bn	£30.6bn	£10.5bn	£387	£4.9bn	£0.2bn
2021	£70.4bn	£59.4bn	£11.0bn	£403	£6.6bn	£0.2bn
2022	£89.8bn	£78.4bn	£11.3bn	£411	£10.5bn	£0.1bn
2023	£55.9bn	£43.3bn	£12.5bn	£454	£7.3bn	£0.0bn
2024	£52.2bn	£39.3bn	£12.9bn	£463	£5.6bn	£0.0bn
2002–24	£947.7bn	£806.6bn	£141.1bn	£5,294	£74.1bn	–£1.3bn
2025 (provisional)	£54.8bn	£40.5bn	£14.2bn	£504	£6.6bn	£0.0bn

Source: gas-counterfactual release v4-s37, figures.json key table_results_by_year. Modelled, £bn in 2024 prices (CPIH) unless stated; figures rounded separately.

14.2 The waterfall, households and the carbon split

Table 14.2 gives the steps of Figure 1.1 for 2002–24 as a whole; the release does not yet give them year by year. Each step's formula is the engine's own (the release's src/gascf/waterfall.py): NZ lines are the actual bill's, GO lines the road's, and a minus sign means the line is subtracted. Carbon in the wholesale price (NZ1c) is part of the actual wholesale line NZ1, so the power step takes it out and the carbon step shows it on its own; it is counted once. Table 14.3 gives both household figures by year. The carbon step is split as in §2.6.

Table 14.2 The waterfall steps, 2002–24, £bn, 2024 prices (modelled)

Step	Engine formula (signed bill lines)	2002–24, £bn
Power before carbon	NZ1 – NZ1c – GO1 – GO1k	–£82.1bn
Carbon in price	NZ1c	£74.1bn
of which tax collected		£23.7bn
of which carbon in the power price not collected as UK carbon tax (the rest)		£50.4bn
Renewables Obligation	NZ2	£84.5bn
Feed-in Tariffs	NZ3	£19.7bn
Contracts for Difference	NZ4 + NZ4b	£10.9bn
Capacity Market, net	NZ5	£0.9bn
Balancing	NZ6 – GO4	£7.7bn
Transmission grid	NZ7 – GO5	£14.6bn
Climate Change Levy v. 2001	NZ8	–£1.3bn
Energy-saving schemes	NZ10	£9.2bn

VAT on the extra	NZ11 – GO7	£2.9bn
The gap		£141.1bn

Source: gas-counterfactual release v4-s37, figures.json key table_waterfall_2002_24. Modelled, £bn in 2024 prices (CPIH) unless stated; figures rounded separately.

Table 14.3 Households, the extra cost of net zero on electricity bills per household and the cost on households' own bills, by year, 2002–24 with 2025 provisional, £ a household, 2024 prices (modelled; households and their share of electricity bought are measured)

Year	Households, million	Extra cost of net zero on electricity bills, per household, £	On households' own bills, £ a household	Households' share of electricity bought
2002	24.1	£4.74	£3.06	37.5%
2003	24.3	£14.42	£7.75	37.9%
2004	24.3	£16.33	£8.83	38.4%
2005	24.5	£157	£66.21	37.9%
2006	24.7	£139	£60.26	37.9%
2007	24.9	£41.49	£22.11	37.3%
2008	25.2	£181	£80.87	36.1%
2009	25.3	£149	£74.26	37.8%
2010	25.5	£149	£76.22	37.1%
2011	25.7	£119	£63.65	36.2%
2012	25.9	£99.76	£56.72	37.0%
2013	25.9	£111	£58.46	36.8%
2014	26.0	£203	£94.08	36.8%
2015	26.3	£279	£119	36.8%
2016	26.4	£303	£128	37.0%
2017	26.4	£369	£150	36.8%
2018	26.8	£394	£160	37.0%
2019	27.0	£445	£175	36.8%
2020	27.1	£387	£166	40.2%
2021	27.4	£403	£172	39.7%
2022	27.5	£411	£169	37.5%
2023	27.6	£454	£182	36.0%
2024	27.9	£463	£191	36.5%
2025 (provisional)	28.3	£504	£208	36.5%

Source: gas-counterfactual release v4-s37, figures.json key table_household_by_year. Modelled, £ a household in 2024 prices (CPIH); households in millions, and their share of electricity bought as a percentage, are measured; figures rounded separately.

Two items in the carbon split for 2025 are provisional estimates, and both are labelled so. Carbon Price Support for 2025 is taken as £428m in cash (2025 money), with a range up to £468m.² Power's share of the UK trading scheme's 2025 revenue is estimated as £900m in cash: the 2025 auction revenue times power's 2024 share, scaled to Great Britain. Both will be replaced by final figures when they are published (§13.7), with an entry on the corrections page.

²HMRC's Environmental Taxes Bulletin of 31 March 2026 (Table 1b) prints a much higher provisional figure for 2025. It is not used. From April 2025 HMRC's estimated split of receipts between the Climate Change Levy and Carbon Price Support reversed while total receipts barely moved. HMRC itself says the split is an estimate to be treated with caution.

15 How sure

15.1 One choice at a time

Table 15.1 sets every option the release runs for §6 to §13 beside the headline it gives for 2002–24, each changed on its own with every other choice at its central setting. Figure 15.1 draws the options that set the range as a tornado, ranked by how far each moves the headline.

Each row answers one question: if a reader rejects this one choice and accepts the rest, what is the gap? Options that are not computed for this release are named in their chapters and are not in the table. The release does not give each option's figure for 2025, so the table cannot yet show whether an option's effect is growing or fading.

Table 15.1 Every option and its headline, one at a time, 2002–24, £bn, 2024 prices (modelled; grey rows are method checks, outside the range)

Choice	Option	Row	Headline 2002–24	Change
3	Wholesale price before mid-2010: the lower published series instead of Ofgem's chart	range	£141.1bn	£0.0bn
3	Wholesale price before mid-2010: the engine's own modelled price instead of Ofgem's chart	range	£141.1bn	£0.0bn
3	Power from plant Britain had, priced at the actual market price with carbon left in	range	£123.6bn	–£17.5bn
3	Power from plant Britain had, priced at the fossil fleet's average cost	range	£135.1bn	–£6.0bn
2	Spare plant margin of 6.6% (central 7.4%)	range	£141.2bn	+£0.1bn
2	Spare plant margin of 8.2% (central 7.4%)	range	£141.0bn	–£0.1bn
1	Demand left for fossil plant from 2016 measured from Elexon's half-hourly generation data instead of NESO's demand data	range	£141.5bn	+£0.4bn
2	Interconnectors counted at their metered flow at the peak (the v4-s35 basis) instead of their Capacity Market contracts	range	£140.9bn	–£0.2bn
2	Capacity Market: coal stations the road keeps open also need Capacity Market payments	range	£140.6bn	–£0.5bn
2	Capacity Market: its whole cost counted as a cost of net zero	range	£147.7bn	+£6.6bn
6	Balancing: National Grid's incentivised-cost baseline, with the FY2022/23 energy share (41.9%)	range	£142.1bn	+£1.0bn
6	Balancing: National Grid's incentivised-cost baseline, with the FY2024/25 energy share (70.3%)	range	£139.9bn	–£1.2bn
6	Balancing: the NAO's £642m for 2005/06 as the baseline in every year, with the FY2018/19 energy share (54.8%)	range	£138.0bn	–£3.1bn
6	Balancing: the NAO's £642m for 2005/06 as the baseline in every year, with the FY2022/23 energy share (41.9%)	range	£139.2bn	–£1.9bn
6	Balancing: the NAO's £642m for 2005/06 as the baseline in every year, with the FY2024/25 energy share (70.3%)	range	£136.5bn	–£4.6bn
5	Grid renewal allowance not counted at all	range	£145.2bn	+£4.1bn
5	Grid renewal allowance at its high setting, which equals central	range	£141.1bn	£0.0bn
4	No gas transport cost added to the road's fuel	range	£141.5bn	+£0.4bn
4	Gas-price feedback at Krichene's world long-run pair, supply 0.16 plus demand 0.45 (smaller feedback)	range	£152.9bn	+£11.8bn
5	Grid carried forward on the price controls' own X values (RPI minus X) instead of RPI	range	£136.5bn	–£4.6bn
8	Climate Change Levy counted above its 2001 rate held in cash, not raised with inflation	range	£145.1bn	+£4.0bn
8	Fossil Fuel Levy and EESoP 2001 levels held in cash, not raised with inflation	range	£141.8bn	+£0.7bn
8	Fossil Fuel Levy 2001 level set at the £85.5m NFFO payments estimate instead of £92m	range	£141.3bn	+£0.2bn
3	No merit-order uplift (the spec's §15.3 rule)	method check	£199.4bn	+£58.3bn
3	Merit-order uplift: the larger of the engine's estimate and Shao et al. (the s22 rule)	method check	£140.5bn	–£0.6bn
3	Merit-order uplift: the smaller of the engine's estimate and Shao et al.	method check	£174.8bn	+£33.7bn
3	Merit-order uplift in 2021–23 scaled to UCL's short-run estimate (preprint)	method check	£116.7bn	–£24.4bn
4	No gas-price feedback	method check	£159.9bn	+£18.8bn
1	Kept coal not capped at its highest recorded load factor	method check	£150.7bn	+£9.6bn
1	Every power station closes on its real date	method check	£130.7bn	–£10.4bn
2	New plant gas only, no new coal (the s22 rule)	method check	£141.1bn	£0.0bn
3	Merit-order uplift from the engine's own estimate instead of Shao et al. (2022)	method check	£174.3bn	+£33.2bn
3	Extra running of the plant Britain had charged its fuel, running and transport cost, not the market price (the v4-s36 mix)	method check	£164.2bn	+£23.1bn

Source: gas-counterfactual release v4-s37, figures.json key table_one_at_a_time. Modelled, £bn in 2024 prices (CPIH) unless stated; figures rounded separately.

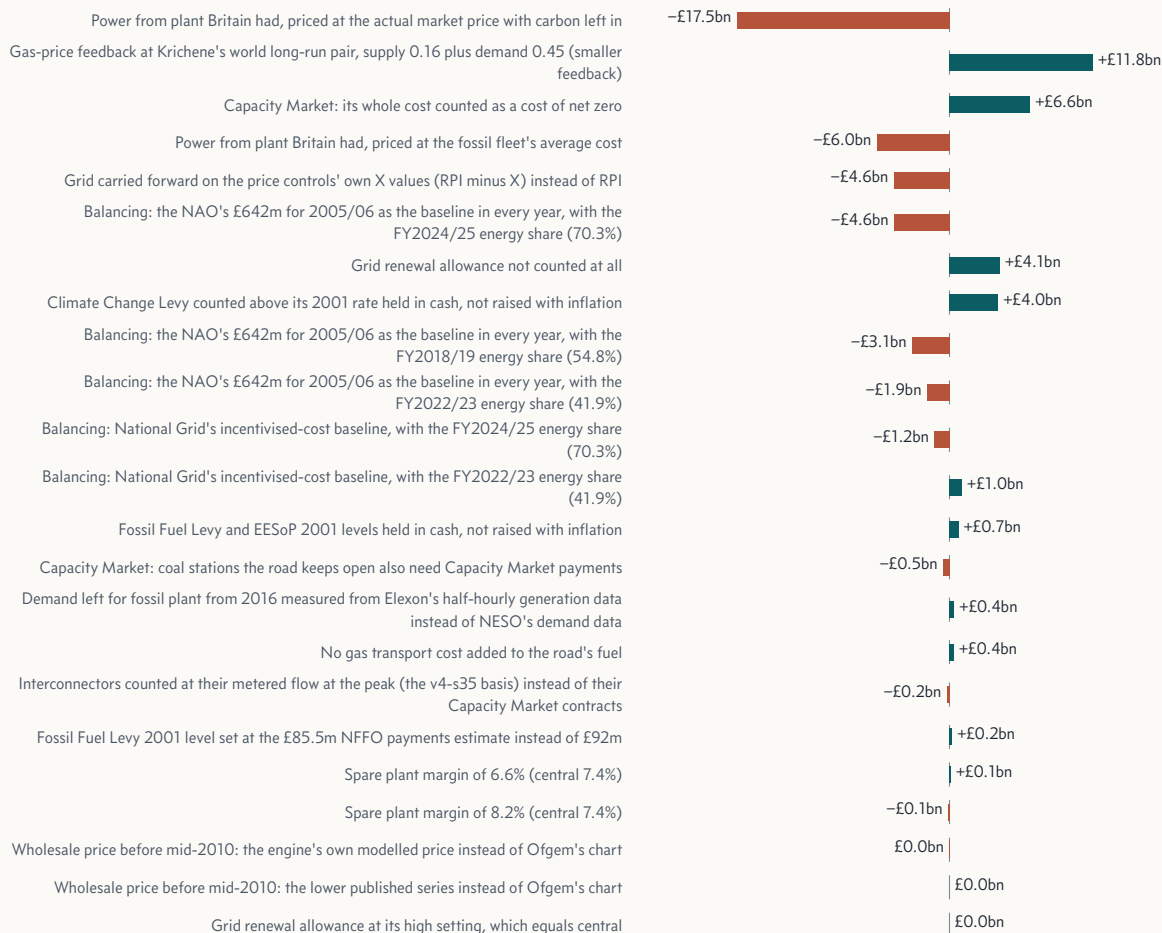


Figure 15.1 How far each option that sets the range moves the headline, 2002–24, £bn, 2024 prices. Modelled. Row labels are the release's plain-English labels. Drawn from `table_one_at_a_time`.

15.2 What the range is

The printed range runs from £123.6bn to £152.9bn. The low end is set by kept output at the full actual price (§8) and the high end by gas-price feedback at Krichene's world long-run pair, 0.61 (§9). The rows that can set an end are the ranked options of §6 to §13, together with six further options: the gas-price feedback at Krichene's world long-run pair, interconnectors at metered imports, the price controls' own X values, the Climate Change Levy's 2001 rate frozen in cash, the 2001 levels held flat in cash, and the Fossil Fuel Levy at the payments estimate. Rows that check a method sit outside the range; Table 15.1 marks each row the release treats as a method check. One is the row on UCL's short-run estimate, which uses O'Shea, Horne and Maslin's short-term model (their Table 4), whose results the authors say "do not appear reasonable" (p.24); row 3B of Table 15.2 is the same run. A method row changes how one part of the machine is estimated for a few years, not what the road is; it tests the machine, as §5 does, rather than offering another answer to the question.

The range is the lowest and highest of the one-at-a-time results that can set an end. That method check on O'Shea, Horne and Maslin's short-term model gives £116.7bn, below it. It is not a confidence interval, because no probability attaches to a judgement, and it is not a combined envelope, because changing several choices together is a different exercise. Setting every choice at its lowest-gap option at once is not shown: some of those options fail tests that the central options pass, as the balancing option does in §11.

Table 15.2 states each judgement call raised in the independent review of the model as a sensitivity row: the headline under the other option, every other choice at its central setting. Row 2B is also the ranked option that sets the high end of the range; rows 1C, 3B and 4 are method checks in Table 15.1, outside it; rows 5bB and 7B appear only here. Row 5bB is B's measurable part, a partial whole-Britain view, not the headline.

Table 15.2 The judgement calls of the model review as sensitivity rows: the headline 2002–24 under the other option and its change from the central, £bn, 2024 prices (modelled)

Row	Sensitivity	Headline 2002–24	Change
1C	Extra running of the plant Britain had at its fuel, running and transport cost (the v4-s36 mix), not the market price (finding 1, option C)	£164.2bn	+£23.1bn
2B	Gas-price feedback at Krichene's world long-run pair, supply 0.16 + demand 0.45 = 0.61 (finding 2, option B)	£152.9bn	+£11.8bn
3B	Merit-order uplift for 2021–23 from the UCL short-run estimate, a preprint (finding 3, option B)	£116.7bn	–£24.4bn
4	Merit-order uplift from the engine's own four-block supply stack (finding 4; on the methods page, out of the range)	£174.3bn	+£33.2bn
5bB	B's measurable part, a partial whole-Britain view: carbon price receipts and VAT netted out, the road's non-power gas cost counted (finding 5b, option B)	£105.8bn	–£35.3bn
7B	Energy-saving schemes line (EEC to GBIS) taken out of the gap (finding 7, option B)	£131.9bn	–£9.2bn

Source: gas-counterfactual release v4-s37, figures.json key table_sensitivity_rows_0144. Modelled, £bn in 2024 prices (CPIH) unless stated; figures rounded separately.

15.3 What would have to be true for the gap to vanish

The case that gas drives the cost (§3.2) meets its number here. For the gap in 2024 to vanish, the gas price the road pays would have to be 90.6% higher than the price Britain actually paid. At the central elasticity, the road's extra burn raises it by 14.9% (§9.3). The distance between the two figures is the room the case that gas drives the cost has to work in.

15.4 Which choices matter most

By the one-at-a-time table, the two choices that move the headline most are the price of power from the plant Britain had (§8), where kept output at the full actual price moves the headline by –£17.5bn, and the gas price (§9), where gas-price feedback at Krichene's world long-run pair, 0.61 moves it by +£11.8bn. Figure 15.1 gives the ranking.

16 What is not counted

The gap leaves out some costs and some offsets. Each is listed with its direction, so a reader can see which way the headline would move.

16.1 Would raise the gap

- **Lost value.** What people and firms gave up by using less electricity because it was dearer (§12.6). A labelled estimate, kept apart.
- **Coal's exclusion from the Capacity Market.** About 11 GW of older coal can no longer take part in the Capacity Market's four-year-ahead auctions, because of "CM emissions limits which apply from 1st October 2024 for Capacity in operation before July 2019" (Ofgem, Capacity Market annual report 2020/21 and 2021/22, para 3.49, p.37). That may have raised the clearing price. No source separates the effect, so it is not counted.
- **Contracts for Difference after 2024.** Payments under contracts already signed are outside the period.
- **The energy-intensive industries shift** raises the household figures, not the gap (§2.7).

16.2 Would lower the gap, or a critic would net it

- **Electricity saved by the supplier schemes.** It is not credited to the road, because no scheme measured it. The largest official figures are deemed or forecast, not measured: about 6.1 TWh a year by 2010 for the first two Energy Efficiency Commitments (Lees for DECC 2008, p.33), and a forecast of 7.78 TWh a year in 2012 for CERT (DECC 2009, impact assessment, para 38). No measured series exists to credit, and §13 states the direction.
- **Other gas users.** The road's higher gas price would have cost homes and industry more (§9.8). A labelled estimate, kept apart.
- **More British gas.** Higher prices on the road might have drawn out more British gas and damped the feedback (§9.3). No source sizes it.
- **Bill support.** The Energy Price Guarantee cost about £23,999m across the United Kingdom, for gas and electricity together, from October 2022 (November 2022 in Northern Ireland) to March 2024, and the Energy Bills Support Scheme about £11,364m in Great Britain from October 2022 to March 2023 (NAO 2024, HC 232, pp.6–7). Neither is scaled to Great Britain's electricity: both are left out of both bills, because the gap measures the cost of supply whoever paid it.
- **The Electricity Generator Levy.** It raised £1.473bn in 2023/24 and £0.749bn in 2024/25, in cash (HMRC 2026, Table 1A). It is netted off neither bill.
- **Other base windows** for grid and balancing are not computed (§10).
- **Imports.** A lower price in Britain on the road might have drawn in fewer imports; the road holds imports at their actual level.
- **Air pollution.** The road burns more coal and gas. The costs of the extra air pollution are outside the scope of a paper about bills.

17 What else the model can answer

The engine answers one question in this paper, and it is built to answer others. Each would need an extra input, and each has limits.

One user's bill. Given one user's demand profile and reliefs, the engine can cost the departure for one sector or one site, such as an energy-intensive works. Reliefs are published by scheme, not by site, so a site study needs the user's own records.

One scheme or decision. The engine can isolate a single instrument or decision: one allocation round of Contracts for Difference, the date set for the end of coal, or Drax's conversion to biomass. Each needs a switch the release does not yet carry, and each answers a narrower question than the gap: what one decision added, with everything else as it actually was.

Other roads. The engine can cost other roads Britain might have taken, such as one led by nuclear or one using gas with carbon capture. It needs cost and build-rate assumptions for each, and its answer would be only as good as those assumptions.

The gas-bill spillover. The labelled estimate in §9.8 could become a full study of what the road's gas price would have meant for homes and industry. It would need the gas side of the bill built as carefully as the electricity side is here.

The road taken forward. Report No. 3 of this series follows the road Britain actually took forward from here, and tests it against the Climate Change Committee's published costs. The same engine supplies the costs of the road Britain was on.

The engine and its outputs are open for reuse: the code under the MIT licence, and the author's own data and figures under CC BY 4.0.

18 Conclusion and the proposed change

18.1 What is known, and how surely

From 2002 to the end of 2024 the departure added £141.1bn to what Britain paid for its electricity, in 2024 prices, against the same electricity on the road Britain was on. The figure is modelled, because the road did not happen, and no test can validate it directly. The machine's parts are tested against data (§5.4), and the one check that fails, in the early years, fails for a stated reason; its form was changed after the results were seen, and it still fails (§5.3). The checks of the actual bill against its published sources are not yet given in the release (§5.2).

The answer rests most on two choices, the price of power from the plant Britain had (§8), where kept output at the full actual price moves the headline by –£17.5bn, and the gas price (§9), where gas-price feedback at Krichene's world long-run pair, 0.61 moves it by +£11.8bn. Changing any one of the ranked choices on its own keeps the gap between £123.6bn (kept output at the full actual price) and £152.9bn (gas-price feedback at Krichene's world long-run pair, 0.61); a method check on O'Shea, Horne and Maslin's short-term model, whose results the authors say "do not appear reasonable" (p.24), gives £116.7bn, below it (§15.2). Three kinds of data would narrow the range: a peer-reviewed merit-order series for 2021–23, a long-run elasticity of gas supply estimated for Britain, and station-level accounts for the closures of 2002–24. Two releases will settle the provisional figures for 2025: power's share of the 2025 trading revenue, and HMRC's next estimate of receipts from the Carbon Price Floor for 2025, in the Environmental Taxes Bulletin tables due in March 2027.

18.2 Five objections, and where they are answered

The five strongest objections a hostile review raised are answered where they land. Not reproduced: one command rebuilds and checks every figure, and the 2025 subtraction holds as printed (§1.2). A range built to exclude the result that hurts: the method check below it is printed beside it, with its source's verdict (§8.3), and the early-years check still fails (§5.3). The Committee answered as if about electricity: §3.1. The measured half unchecked and the Europe-wide effect not run: both so, and stated (§2.4, §5.2, §9.3). The author's views and the working files: declared in the front matter.

18.3 The change: a duty to publish what each policy adds

No official figure now says what the departure has cost, instrument by instrument, and some of the series this paper needed do not exist at all: transmission spending by its cause, and measured savings from the energy-saving schemes (§16).

The Climate Change Act 2008 already requires the Secretary of State to lay before Parliament, in respect of each year, a statement of the United Kingdom's emissions (section 16). A matching duty would require a statement of what Britain pays to cut them. Draft wording for a new section 16A follows.

Annual statement of policy costs in electricity supply

After section 16 of the Climate Change Act 2008 insert—

"16A Annual statement of policy costs in electricity supply

- (1) It is the duty of the Secretary of State to lay before Parliament in respect of each year, beginning with the year 2026, a statement containing the following information.
- (2) For each relevant scheme, the statement must state the amount paid in the year by or on behalf of electricity consumers in Great Britain, whether through charges made by electricity suppliers, network or balancing charges, or the wholesale price of electricity.
- (3) In this section "relevant scheme" means— (a) a renewables obligation imposed by an order under section 32 of the Electricity Act 1989; (b) feed-in tariffs under arrangements made by virtue of section 41 of the Energy Act 2008; (c) contracts for difference under Chapter 2 of Part 2 of the Energy Act 2013; (d) capacity agreements under Chapter 3 of Part 2 of that Act; (e) any greenhouse gas emissions trading scheme, and carbon price support under paragraph 42A of Schedule 6 to the Finance Act 2000, to the extent reflected in the wholesale price of electricity; (f) climate change levy charged on supplies of electricity; (g) any other scheme which the Secretary of State considers adds to the cost of supplying electricity for the purpose of reducing greenhouse gas emissions.

- (4) The statement must also state the Secretary of State’s estimate of the amounts paid in the year for— (a) balancing the national electricity transmission system, (b) reinforcing electricity transmission networks, and (c) capacity held in reserve, that are attributable to the connection and operation of generating stations powered by wind or sunlight.
- (5) The statement must— (a) state each amount in the prices of the year and in the prices of a base year stated in the statement; (b) state the value added tax charged on those amounts; and (c) identify the methods and data used.
- (6) The first statement must also contain the information required by subsections (2) to (5) for each year from 2002 to 2025.
- (7) The statement must be laid before Parliament not later than 30th September in the year following that to which it relates.
- (8) The Secretary of State must publish, at the same time as each statement, the data and calculations used in a form that allows the amounts to be reproduced.”

Each part of the clause follows from a finding. Subsection (3) lists the instruments of the departure as §2.3 defines them. Subsection (4) asks for the extra balancing, grid and backup costs that §7, §10 and §11 had to rebuild. Subsection (5) asks for the price basis and the VAT, which §2 shows matter. Subsection (8) holds the Government to the standard this paper holds itself to: anyone can rerun the figures.

18.4 Decision point, models and the objection

The vehicle is the Energy Independence Bill. The King’s Speech of 13 May 2026 said: “My Ministers will therefore introduce an Energy Independence Bill” (GOV.UK, “The King’s Speech 2026”, www.gov.uk/government/speeches/the-kings-speech-2026). The Government answered on 28 July 2026 that “The Bill will be introduced as soon as parliamentary time allows” (Lords written question HL2076), and on 15 September 2026 that its scope and content “will be set out in due course when it is introduced to Parliament” (Commons written question 27409, Department for Energy Security and Net Zero). Parliament’s bills search found no such Bill on 21 October 2026. The clause could be offered as a new clause to that Bill, or as a private member’s bill.

An existing body shows how such a duty can be met. The Office for Budget Responsibility has a statutory duty “to examine and report on the sustainability of the public finances” (Budget Responsibility and National Audit Act 2011, s.4(1)), with “complete discretion in the performance of its duty under section 4 (but subject to subsections (2) and (3) of this section and sections 6 and 7)” (s.5(1)); it “must perform that duty objectively, transparently and impartially” (s.5(2)) and “may not consider what the effect of any alternative policies would be” (s.5(3)(b)).

The strongest objection is that the duty is a costly burden, and that an official baseline back to 2002 would be contested and politicised. The answer is that DECC produced such estimates for years, so the work can be done; that section 16 already requires the matching statement on emissions; and that subsection (8) lets anyone check the figures, so a contested baseline would be contested in the open.

18.5 Two other candidates

Two smaller changes were also considered. One would end Carbon Price Support a year earlier than the Government plans (HCWS1519, 16 April 2026, first sentence). The other would let any refurbishing power station, not only low-carbon plant, bid for nine-year Capacity Market agreements (DESNZ 2024, Clean Power 2030, PDF p.89).

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A Figure register

Every figure this paper prints from the release, with its figures.json key, the release's label for it (with “the road” for the release's “fossil Britain” or “Reliable Britain”, and “extra cost of net zero on electricity bills, per household” for its “cost to Britain per household”), its units and period, its value as printed and, for figures quoted from documents, its entry in the claims register, or “to be numbered” where the release has not yet numbered it. For eighteen keys the label or units given here are this paper's, not the release's, because the release's wording falls short of its source: the three gas-feedback elasticities (gas_feedback_e_central, gas_feedback_e_supply_central and gas_feedback_e_demand_central; the demand label sets out the weighting of Albrizio and others' Table 2 that gives 0.169, §9.3), the Capacity Market exclusion of coal (coal_cm_excluded_gw, with the whole of the sentence §16.1 quotes), the National Audit Office's balancing cost (nao_balancing_2005_06_gbp_m, whose price basis the NAO does not state) and the Energy Price Guarantee (epg_cost_gbp_m, a United Kingdom figure for gas and electricity together). The section where each appears is not yet in the table. A figure shown as “table or text” is printed inside a table, or as words, rather than as a number in the text.

Table A.1 Figure register: the release's register (annex_a_figure_register), for the keys this paper prints

Key	What it is	Units and period	As printed	Claims register
headline_2002_24_gbp_bn	Extra cost of net zero on electricity bills, paid by bill-payers, 2002-24 (0144 item 5b)	£bn, 2024 prices, 2002-2024	£141.1bn	
carbon_line_2002_24_gbp_bn	Carbon in the power price (NZ1c only), 2002-24; excludes the CCL at its main rates	£bn, 2024 prices, 2002-2024	£74.1bn	
carbon_price_receipts_2002_24_gbp_bn	Carbon prices collected as tax on power (NZ1c_tax: CPS + carbon auctions on power), 2002-24; excludes the CCL at its main rates	£bn, 2024 prices, 2002-2024	£23.7bn	
carbon_price_receipts_2005_12_gbp_bn	Carbon prices collected as tax on power (NZ1c_tax), 2005-12; excludes the CCL at its main rates	£bn, 2024 prices, 2005-2012	£1.3bn	
carbon_rest_in_price_2002_24_gbp_bn	Carbon in the power price not collected as UK carbon tax (the rest) (NZ1c_price; 0144 item 5a), 2002-24; excludes the CCL at its main rates	£bn, 2024 prices, 2002-2024	£50.4bn	
carbon_in_price_2005_12_gbp_bn	Carbon in the power price (NZ1c, tax plus price), 2005-12; excludes the CCL at its main rates	£bn, 2024 prices, 2005-2012	£16.6bn	
wf_schemes_gbp_bn	Energy-saving schemes (NZ10)	£bn, 2024 prices, 2002-2024	£9.2bn	
wf_vat_gbp_bn	VAT on households' share of the extra (NZ11 less GO7)	£bn, 2024 prices, 2002-2024	£2.9bn	
nz_bill_2002_24_gbp_bn	Net-zero Britain's bill, 2002-24	£bn, 2024 prices, 2002-2024	£947.7bn	
rb_bill_2002_24_gbp_bn	the road's bill, 2002-24	£bn, 2024 prices, 2002-2024	£806.6bn	
gap_2025p_gbp_bn	Extra cost of net zero, 2025 (provisional)	£bn, 2024 prices, 2025	£14.2bn	
gap_2024_gbp_bn	Extra cost of net zero, 2024	£bn, 2024 prices, 2024	£12.9bn	
gap_2022_gbp_bn	Extra cost of net zero, 2022	£bn, 2024 prices, 2022	£11.3bn	
nz_bill_2024_gbp_bn	Net-zero Britain's bill, 2024	£bn, 2024 prices, 2024	£52.2bn	
rb_bill_2024_gbp_bn	the road's bill, 2024	£bn, 2024 prices, 2024	£39.3bn	
nz_bill_2025p_gbp_bn	Net-zero Britain's bill, 2025 (provisional)	£bn, 2024 prices, 2025	£54.8bn	
rb_bill_2025p_gbp_bn	the road's bill, 2025 (provisional)	£bn, 2024 prices, 2025	£40.5bn	
s1_same_in_both_2024_gbp_bn	Same in both bills, 2024	£bn, 2024 prices, 2024	£13.0bn	
firm_capacity_rb_gw_2024	the road's firm capacity, 2024	GW, 2024	58.7	
firm_capacity_nz_gw_2024	Net-zero Britain's firm capacity, 2024	GW, 2024	52.5	
grid_window_2002_05_gbp_m	Grid line (NZ7 less GO5), 2002-05	£m, 2024 prices, 2002-2005	−£0.7m	
balancing_window_2002_05_gbp_m	Balancing line (NZ6 less GO4), 2002-05	£m, 2024 prices, 2002-2005	£4.0m	
nz5_2002_24_gbp_bn	Capacity Market line NZ5, 2002-24	£bn, 2024 prices, 2002-2024	£0.9bn	

nz6_2002_24_gbp_bn	Balancing line NZ6, 2002-24	£bn, 2024 prices, 2002-2024	£23.2bn
go4_2002_24_gbp_bn	the road's balancing GO4, 2002-24	£bn, 2024 prices, 2002-2024	£15.5bn
nz7_2002_24_gbp_bn	High-voltage grid line NZ7, 2002-24	£bn, 2024 prices, 2002-2024	£50.6bn
go5_2002_24_gbp_bn	the road's grid GO5, 2002-24	£bn, 2024 prices, 2002-2024	£36.0bn
nz10_2002_24_gbp_bn	Energy-saving schemes NZ10 as netted in the run, 2002-24	£bn, 2024 prices, 2002-2024	£9.2bn
grid_line_2002_24_gbp_bn	Grid line (NZ7 less GO5), 2002-24	£bn, 2024 prices, 2002-2024	£14.6bn
balancing_line_2002_24_gbp_bn	Balancing line (NZ6 less GO4), 2002-24	£bn, 2024 prices, 2002-2024	£7.7bn
moe_uplift_2002_24_gbp_bn	Merit-order uplift, 2002-24	£bn, 2024 prices, 2002-2024	£57.3bn
years_shao_larger_count	Years 2002-24 in which Shao's uplift exceeds the model's	years (of 23), 2002-2024	22
gas_price_rise_2024_pct	Gas-price rise from the road's extra gas burn, 2024	%, 2024	14.9%
rb_extra_gas_twh_2024	the road's extra gas burn, 2024	TWh, 2024	159.9
break_even_gas_rise_2024_pct	Gas-price rise at which the 2024 gap is zero	%, 2024	90.6%
plant_cost_edition_2024	Plant cost edition in force, 2024	text, 2024	2023 edition (Annex A)
rb_new_build_gw_2024	New plant standing in the road's fleet, 2024, without the margin spare (Q-KEYS-5)	GW, nameplate, 2024	8.7
negative_gap_years	Years 2002-24 with a negative gap	years, 2002-2024	none
cost_per_household_2002_24_gbp	Extra cost of net zero on electricity bills, per household, summed 2002-24	£ per household, 2024 prices, 2002-2024	£5,294
cost_per_household_2024_gbp	Extra cost of net zero on electricity bills, per household, 2024	£ per household, 2024 prices, 2024	£463
cost_per_household_2025p_gbp	Extra cost of net zero on electricity bills, per household, 2025 (provisional)	£ per household, 2024 prices, 2025	£504
own_bills_per_household_2002_24_gbp	Net-zero cost on households' own bills, summed 2002-24 (CCL excluded, 0025)	£ per household, 2024 prices, 2002-2024	£2,285
own_bills_per_household_2024_gbp	Net-zero cost on households' own bills, 2024	£ per household, 2024 prices, 2024	£191
own_bills_per_household_2025p_gbp	Net-zero cost on households' own bills, 2025 (provisional)	£ per household, 2024 prices, 2025	£208
margin_central_pct	Spare margin, central	%, parameter	7.4%
margin_low_pct	Spare margin, low	%, parameter	6.6%
margin_high_pct	Spare margin, high	%, parameter	8.2%
coal_lf_cap_pct	Coal load-factor cap: highest DUKES 5.10.B coal load factor	%, parameter	65.0%
table_lines_2024	Bill lines, 2024: net-zero Britain and the road; the CCL (NZ8) its own row; NZ1c and its tax and price parts shown as 'of which' inside NZ1, never added	table, £bn, 2024 prices, 2024	table or text
table_results_by_year	Results by year, 2002-25 (2025 provisional); no column is built from a group	table, £bn and £ per household, 2024 prices, 2002-2025	table or text
table_waterfall_2002_24	Waterfall 2002-24: the 11 printed steps in step order, adding to the headline	table, £bn, 2024 prices, 2002-2024	table or text
gap_ucl_period	the road's gap on our method over UCL's period, 2010-23	£bn, 2024 prices, 2010-2023	£110.7bn
headline_2002_24_low_gbp_bn	Low end of the range: lowest one-at-a-time headline, each option on its own; printed with its switch's name (headline_low_end_switch, 0144 item 4A)	£bn, 2024 prices, 2002-2024	£123.6bn
headline_2002_24_high_gbp_bn	High end of the range: highest one-at-a-time headline, each option on its own; printed with its switch's name (headline_high_end_switch, 0144 item 4A)	£bn, 2024 prices, 2002-2024	£152.9bn
headline_low_end_option	Option that sets the low end	text, 2002-2024	kept output at the full actual price (\$8)

headline_high_end_option	Option that sets the high end	text, 2002-2024	gas-price feedback at Krichene's world long-run pair, 0.61 (\$9)
headline_low_end_switch	Switch that sets the low end of the range (its registry name)	text, 2002-2024	kept output at the full actual price
headline_high_end_switch	Switch that sets the high end of the range (its registry name)	text, 2002-2024	gas-price feedback at Krichene's world long-run pair, 0.61
table_choice1	One-at-a-time rows for Choice 1 (R-A6 map)	table, £bn, 2024 prices, 2002-2024	table or text
table_choice2	One-at-a-time rows for Choice 2 (R-A6 map)	table, £bn, 2024 prices, 2002-2024	table or text
table_choice3	One-at-a-time rows for Choice 3 (R-A6 map)	table, £bn, 2024 prices, 2002-2024	table or text
table_choice4	One-at-a-time rows for Choice 4 (R-A6 map)	table, £bn, 2024 prices, 2002-2024	table or text
table_choice5	One-at-a-time rows for Choice 5 (R-A6 map)	table, £bn, 2024 prices, 2002-2024	table or text
table_choice6	One-at-a-time rows for Choice 6 (R-A6 map)	table, £bn, 2024 prices, 2002-2024	table or text
table_choice8	One-at-a-time rows for Choice 8 (R-A6 map)	table, £bn, 2024 prices, 2002-2024	table or text
table_one_at_a_time	One-at-a-time table (Table 15.1): ranked block, then the unranked methods page	table, £bn, 2024 prices, 2002-2024	table or text
headline_ccl_cash_frozen_2002_24_gbp_bn	Headline 2002-24 with the 2001 CCL rate held cash-frozen (0044)	£bn, 2024 prices, 2002-2024	£145.1bn
sens_pre2002_cash_flat_2002_24_gbp_bn	Headline 2002-24 with the 2001 on-the-road levels held cash-flat (NZ2 and NZ10 only, 0097)	£bn, 2024 prices, 2002-2024	£141.8bn
sens_pre2002_nffo_payments_2002_24_gbp_bn	Headline 2002-24 with the 2001 Fossil Fuel Levy level at the £85.5m NFFO payments estimate (0097; HC Deb 18 Apr 2002 c1139W)	£bn, 2024 prices, 2002-2024	£141.3bn
sens_closures_actual_2002_24_gbp_bn	Headline 2002-24 with closures as they actually happened (methods page)	£bn, 2024 prices, 2002-2024	£130.7bn
sens_margin_low_2002_24_gbp_bn	Headline 2002-24 with the spare margin at 6.6%	£bn, 2024 prices, 2002-2024	£141.2bn
sens_ic_metered_2002_24_gbp_bn	Headline 2002-24 with interconnectors counted at metered flow (v4-s35 basis)	£bn, 2024 prices, 2002-2024	£140.9bn
sens_cm_kept_coal_2002_24_gbp_bn	Headline 2002-24 with kept coal also needing the Capacity Market	£bn, 2024 prices, 2002-2024	£140.6bn
sens_no_moe_2002_24_gbp_bn	Headline 2002-24 with no merit-order uplift (methods page)	£bn, 2024 prices, 2002-2024	£199.4bn
sens_kept_price_actual_2002_24_gbp_bn	Headline 2002-24 with kept output priced at the actual price	£bn, 2024 prices, 2002-2024	£123.6bn
sens_grid_base_high_2002_24_gbp_bn	Headline 2002-24 with the grid renewal allowance R at its high setting, which equals central (the whole allowance above the 2002-05 level, v4-s35 T4), so the row equals central exactly	£bn, 2024 prices, 2002-2024	£141.1bn
lost_value_elasticity_central	average elasticity across households and non-households, weighted by each year's gap, 2002-24	elasticity (dimensionless), 2002-2024	-0.55
rb.s7.new_ccgt_built_by_2024	Whether the road's fleet has any new CCGT standing in any year 2002-24 (the engine sizes new plant afresh each year, no vintages); metadata lists the years and the same check on new coal	boolean, 2002-24	no
rb.s7.new_build_mix_gw_2024	New plant standing in the road's fleet in 2024, by type, GW nameplate: the engine sizes new plant afresh each year (no vintages), so this is the plant standing in 2024, not a cumulative build; printed at the new-build-sized total without the margin spare (Q-KEYS-5)	table, GW nameplate (not derated), 2024	all open-cycle gas turbines, with no new combined-cycle gas or coal plant

ic_peak_dy_contracted_mw_2019	Contracted interconnector capacity in the delivery year in force at the 2019 sizing-peak half-hour ({{{ic_peak_dy_2019}}}), printed for information only (0066); sizing uses the calendar-year value	MW, 2019	2,887
ic_peak_dy_2019	Delivery-year label in force at the 2019 sizing-peak half-hour ("2018/19" if January to September, "2019/20" if October to December)	text, 2019	2019/20
wh_peak_halfhour	Date and half-hour (span on the UK clock, e.g. 12:00-12:30) of the worked peak half-hour: the 2024 half-hour with the highest residual demand	datetime, 2024	15 January 2024, 12:00-12:30
wh_peak_settlement_period	Settlement period of the worked peak half-hour (number only; the date is wh_peak_halfhour)	number, 2024	25
wh_peak_residual_gw	Residual demand in the worked peak half-hour	GW, 2024	44.5
wh_peak_uplift_gbp_mwh	Shao-scaled renewables uplift to the price in the worked peak half-hour (raw step × the year's mult + flat; the value that feeds the headline)	£/MWh, cash, 2024	£171.8 per MWh
wh_peak_rb_cost_gbp_mwh	the road's marginal cost in the worked peak half-hour (R-A3)	£/MWh, cash, 2024	£179.1 per MWh
wh_peak_marginal_plant	Marginal plant type on the road in the worked peak half-hour (the top running block)	text, 2024	a new open-cycle gas turbine
wh_median_halfhour	Date and half-hour (span on the UK clock, e.g. 12:00-12:30) of the worked median half-hour: the 2024 half-hour with the median residual demand	datetime, 2024	15 August 2024, 10:00-10:30
wh_median_settlement_period	Settlement period of the worked median half-hour (number only; the date is wh_median_halfhour)	number, 2024	21
wh_median_residual_gw	Residual demand in the worked median half-hour	GW, 2024	22.0
wh_median_uplift_gbp_mwh	Shao-scaled renewables uplift to the price in the worked median half-hour (raw step × the year's mult + flat; the value that feeds the headline)	£/MWh, cash, 2024	£37.7 per MWh
wh_median_rb_cost_gbp_mwh	the road's marginal cost in the worked median half-hour (R-A3)	£/MWh, cash, 2024	£62.2 per MWh
wh_median_marginal_plant	Marginal plant type on the road in the worked median half-hour (the top running block)	text, 2024	a combined-cycle gas station
shao_uplift_2022_gbp_mwh	Merit-order uplift in 2022, time-mean, modelled: this paper's estimate using the method of Shao and others (2022) (their coefficients, wind and solar), applied by the engine; not a figure published by Shao and others	£/MWh, cash, 2022	£15.9 per MWh
rugeley_margin_ex_carbon_last_year_gbp_m	Rugeley's modelled margin before carbon in its last full year of operation (2015), before the abatement filters	£m, cash, 2015	£3.1m
longannet_margin_ex_carbon_last_year_gbp_m	Longannet's modelled margin before carbon in its last full year of operation (2015), before the abatement filters	£m, cash, 2015	-£0.8m
wf_largest_three_steps	The three largest of the 11 printed waterfall rows by size, sign shown; a negative row lowers the gap (R-A5 option A)	text (ranked list; £bn, 2024 prices, 2002-24), 2002-24	the Renewables Obligation (£84.5bn), wholesale power before carbon (-£82.1bn), which lowers the gap and carbon in the wholesale price (£74.1bn)

largest_two_choices_by_effect	The two choices (1-8) with the largest effect on the 2002-24 headline: each choice's largest headline - central over its ranked options	text (ranked list; £bn, 2024 prices, 2002-24), 2002-24	the price of power from the plant Britain had (£8), where kept out-put at the full actual price moves the headline by -£17.5bn, and the gas price (£9), where gas-price feedback at Krichene's world long-run pair, 0.61 moves it by + £11.8bn £136.5bn
sens_grid_rpi_x_2002_24_gbp_bn	Headline 2002-24 with the grid index at the price controls' own X values (RPI-X, 0091)	£bn, 2024 prices, 2002-2024	
rpi_x_effect_2002_24_gbp_bn	Change in the 2002-24 headline with the grid index at the price controls' own X values (RPI-X, 0091), against central; negative = the gap falls	£bn, 2024 prices, 2002-2024	-£4.6bn
scot_share_alt_gap_effect_2002_05_gbp_m	Gap effect 2002-05 of the alternative Scottish treatment before April 2005 (0102); not in the range	£m, 2024 prices, 2002-2005	£0.1m
scot_share_alt_level_shift_gbp_m	Shift in the NZ7 level 2002-05 under the alternative Scottish treatment (0102); GO5 moves about the same	£m, 2024 prices, 2002-2005	£260m
ets_power_2025p_gbp_m	2025 ETS power receipts, GB, provisional (0079: 2025 auctions x 2024 share)		£900m
cps_2025p_gbp_m	2025 Carbon Price Support, provisional (0054, about £428m; HMRC's next estimate of receipts from the Carbon Price Floor for 2025, in the Environmental Taxes Bulletin tables due in March 2027)		£428m
cps_2025p_range_high_gbp_m	2025 Carbon Price Support, top of range (0054 Method B)		£468m
carbon_shortfall_rule_price_receipts_2013_20_gbp_bn	Carbon prices collected as tax on power under the shortfall rule (0058 sensitivity, option (b), 0110), 2013-20; excludes the CCL at its main rates	£bn, 2024 prices, 2013-2020	£14.4bn
gap_2021_23_shao_gbp_bn	Gap 2021-23, Shao uplift (central), £bn 2024 prices		£34.9bn
gap_2021_23_ucl_gbp_bn	Gap 2021-23, UCL short-run uplift (sensitivity), £bn 2024 prices		£10.5bn
gap_2021_23_ucl_difference_gbp_bn	Gap 2021-23, UCL less Shao, £bn 2024 prices		-£24.4bn
ucl_over_shao_total_low	UCL Table 4 over Shao's total uplift, lowest of 2021-23		1.6
ucl_over_shao_total_high	UCL Table 4 over Shao's total uplift, highest of 2021-23		3.5
ucl_over_shao_wind_low	UCL Table 4 over Shao's wind part, lowest of 2021-23		2.2
ucl_over_shao_wind_high	UCL Table 4 over Shao's wind part, highest of 2021-23		4.9
household_share_2024_pct	Households' share of UK electricity sales, 2024 (DUKES 2026 5.2 / 5.5.D), %		36.5%
ccl_extra_2002_24_gbp_bn	CCL counted above its 2001 level, Σ2002-24 (netted NZ8, 0044/0101)	£bn, 2024 prices, 2002-2024	-£1.3bn
ccl_2001_level_netted_2002_24_gbp_bn	The 2001-levy part netted off NZ8 (D3, bridge row 8b), Σ2002-24	£bn, 2024 prices, 2002-2024	£18.3bn
lec_exemption_effect_2002_24_gbp_bn	The capped LEC exemption part of NZ8 (D5, bridge row 8c), Σ2002-24	£bn, 2024 prices, 2002-2024	£1.2bn
pre2002_netting_nz2_2002_19_gbp_bn	Fossil Fuel Levy netted at its 2001 level, -(line + VAT), Σ2002-19 (0097)	£bn, 2024 prices, 2002-2019	-£3.0bn
pre2002_netting_nz10_2002_24_gbp_bn	EESoP netted at its 2001 level, -(line + VAT), Σ2002-24 (0097)	£bn, 2024 prices, 2002-2024	-£1.1bn

pre2002_netting_total_2002_24_gbp_bn	Pre-2002 netting, NZ2 + NZ10 incl. VAT, Σ 2002-24 (0097)	£bn, 2024 prices, 2002-2024	−£4.1bn
pre2002_netting_2002_04_gbp_m	0097 netting over 2002-04, NZ2 + NZ10 incl. VAT, amount removed from the net-zero-only lines (0111)	£m, 2025 prices, 2002-2004	£664m
nuclear_ic_ps_net_twh_2024	Output of nuclear, imports and pumped storage held at actual, net of exports and pumping, 2024 (TWh)	TWh	71.0
rb.balancing.bsuos_basis_grossup_factor	Gross-up of the incentivised balancing base to the BSUoS basis (system operator's internal costs): $1 + \text{internal} \div \text{external}$, 2007/08	ratio	1.198
rb.balancing.gb_over_ew_factor	England and Wales to GB gross-up: GB demand over England and Wales demand, mean of 2002-05	ratio, 2002-2005	1.1086
calib_pooled_2002_04_pct	Early-years check, pooled 2002-04: gap - net-zero-only lines as % of the lines (fails the 30% limit; 0111, stated in §5)	%, 2002-2004	36.6%
calib_pooled_2002_04_gbp_hh	Early-years check, pooled 2002-04: gap less net-zero-only lines, £ a household	£ a household, 2025 prices, 2002-2004	−£7.11
calib_2002_pct	Early-years check, 2002 alone, % of the lines (printed, never judged; 0061)	%, 2002-2004	55.4%
calib_2003_pct	Early-years check, 2003 alone, % of the lines (printed, never judged; 0061)	%, 2002-2004	29.0%
calib_2004_pct	Early-years check, 2004 alone, % of the lines (printed, never judged; 0061)	%, 2002-2004	34.9%
calib_limit_pct	Early-years check limit: within 30% of the net-zero-only lines	%, 2002-2004	30.0%
calib_limit_gbp_hh	Early-years check limit: within £25 a household	£ a household, 2025 prices, 2002-2004	£25.00
calib_pooled_2002_04_passed	Early-years check, pooled 2002-04, passed both limits (False: disclosed failure, 0111)	true/false, 2002-2004	no
station_load_twh_yr	Station load in a typical year (the 2002-24 mean), TWh	TWh a year, 2002-2024	4.7
pricing_residual_2002_05_gbp_m	Pricing residual 2002-05: (NZ1 - NZ1c) - GO1 market part - GO1k (§5.3)	£m, 2025 prices, 2002-2005	£162m
gas_feedback_e_central	Gas-price feedback, elasticity, central: supply 0.06 plus demand 0.169, the pair of Albrizio et al. 2022 (IMF WP/22/143), combined by their equation 5, pp.13-14 (§9.3)	elasticity	0.23
gas_feedback_e_supply_central	Gas-price feedback, supply elasticity in the central pair: Albrizio et al. 2022 (p.12) take 0.06 from Krichene (2002), Energy Economics 24(6); Krichene 2005 (IMF WP/05/32), Table 5, p.20, prints the same short-run figure (§9.3)	elasticity	0.06
gas_feedback_e_demand_central	Gas-price feedback, demand elasticity in the central pair: Albrizio et al. 2022, Table 2 (p.12), sector elasticities weighted by the EU gas consumption shares in the same table: $0.084 \times 0.23 + 0.24 \times 0.34 + 0.136 \times 0.32 + 0.22 \times 0.11 = 0.169$, printed 0.17. Albrizio et al. name no source or year for the shares (§9.3)	elasticity	0.17
gas_feedback_e_high	Gas-price feedback, elasticity at the high end of the range (Krichene 2005 Table 2 world long-run	elasticity	0.61

	pair, supply 0.16 + demand 0.45; 0144)		
closures_register_stations_count	Stations in the fossil-Britain closure register (distinct station names)	count, 2002-2025	51
closures_kept_count	Stations kept open in the road in at least one year (distinct station names)	count, 2002-2025	5
closures_margin_test_pass_count	Mixed-reason closures kept open because the margin test without carbon passed (distinct station names)	count, 2002-2025	1
rb_coal_kept_gw_2024	the road's kept coal, 2024, de-rated GW (CM split)	GW, 2024	6.2
margin_gross_extra_gw_2024	Extra GW from setting the margin on the gross peak (0065), 2024	GW, 2024	0.4
ic_contracted_mw_2024	Interconnectors' CM contracted de-rated MW, calendar 2024 (time-weighted over delivery years)	MW, 2024	5,673
ic_timewighted_mw_2019	Interconnectors' CM contracted de-rated MW, calendar 2019, time-weighted over delivery years	MW, 2019	722
ic_called_twh_2016_24	Energy the road calls from contracted interconnectors, 2016-24 (0 on the s36 build: the fleet is dispatched to the metered residual, 0063)	TWh, 2016-2024	0.0
ic_called_halfhours_2016_24	Half-hours in which the road calls contracted interconnectors, 2016-24 (0 on the s36 build, 0063)	count, 2016-2024	0
cm_nuclear_effect_2002_24_gbp_bn	NZ5 with the nuclear CM column (0089) less NZ5 with nuclear at peak (v4-s35 rule), 2002-24	£bn, 2024 prices, 2002-2024	−£0.1bn
nbp_qep_pre2009_effect_2002_24_gbp_bn	Effect on the gap of NBP in place of QEP for balancing gas before October 2009 (B4), as the v4-s35 to s36 difference, 2002-24 (not a QEP run)	£bn, 2024 prices, 2002-2024	£1.0bn
f1_effect_2002_24_gbp_bn	Effect on the gap of pricing the road's balancing energy at its own feedback-raised gas price (F1), on against off, 2002-24	£bn, 2024 prices, 2002-2024	−£0.6bn
renewal_allowance_2002_24_gbp_bn	Grid renewal allowance R inside GO5 (GO5 less the carried 2002-05 baseline), 2002-24	£bn, 2024 prices, 2002-2024	£4.0bn
balancing_low_end_2002_24_gbp_bn	Balancing step (NZ6 less GO4) under the low-end balancing option (NAO 2005 baseline, top workbook share), 2002-24	£bn, 2024 prices, 2002-2024	£3.3bn
balancing_exception_cost_2002_24_gbp_bn	Central gap less the gap under the low-end balancing option (the cost of the stated exception to the conservative rule), 2002-24	£bn, 2024 prices, 2002-2024	£4.6bn
balancing_exception_cost_2025p_gbp_bn	The same, 2025 provisional	£bn, 2024 prices, 2025	£0.5bn
balancing_low_window_2002_05_gbp_m	Balancing step (NZ6 less GO4) under the low-end option, 2002-05	£m, 2024 prices, 2002-2005	−£343m
sizing_peak_halfhour_2024	Half-hour at which the road's fleet is sized, 2024 (gross demand peak, contracted interconnector basis); not the §4.3 residual peak	text (date and settlement period), 2024	18 January 2024 (settlement period 26)
table_exceptions_register	Exceptions register (glossary, §2): every range switch with an option that gives a lower 2002-24 headline than central, with the lowest such option and its change; lowest first. Mechanical list: which of these the paper	table, £bn, 2024 prices, 2002-2024	table or text

	argues as exceptions is not decided here			
table_household_by_year	Households, the extra cost of net zero on electricity bills per household, and the net-zero cost on households' own bills (CCL excluded, 0025), by year 2002-25 (2025 provisional)	table, million households, £ a household, 2024 prices, %, 2002-2025		table or text
annex_c_engine_summary	Annex C: engine summary, the run's own record (version, run date, money, households source, central settings, residual method, calibration rule, provisional years, every declared fallback with its size)	record, release		table or text
annex_e_bridge	Annex E: bridge to the prior release (the one before this in releases.yaml; columns named by version), headline keys in that release and this one, 2024 prices	table, £bn and £ a household, 2024 prices, 2002-2025		table or text
household_share_gb_2024_pct	Domestic meters' share of Great Britain's electricity consumption, 2024 (DESNZ sub-national statistics, GB incl. unallocated), %; context only	%, 2024		39.1%
release_commit	Commit the release was cut at (its code and suite); the tag names the commit that adds the release files to it and changes no code	git commit, release	d2692e204efc77b873a4722bd64071817f3716bb	
sens_feedback_krichene_pair_2002_24_gbp_bn	Headline 2002-24 with gas-price feedback at Krichene's world long-run pair 0.16 + 0.45 (finding 2, option B)	£bn, 2024 prices, 2002-2024		£152.9bn
sens_feedback_krichene_pair_change_gbp_bn	Change from the central headline 2002-24 with gas-price feedback at Krichene's world long-run pair 0.16 + 0.45 (finding 2, option B)	£bn, 2024 prices, 2002-2024		£11.8bn
sens_uplift_ucl_2021_23_2002_24_gbp_bn	Headline 2002-24 with merit-order uplift 2021-23 from UCL's short-run estimate, preprint (finding 3, option B)	£bn, 2024 prices, 2002-2024		£116.7bn
sens_uplift_engine_stack_2002_24_gbp_bn	Headline 2002-24 with merit-order uplift from the engine's four-block stack estimate (finding 4, methods page)	£bn, 2024 prices, 2002-2024		£174.3bn
sens_uplift_engine_stack_change_gbp_bn	Change from the central headline 2002-24 with merit-order uplift from the engine's four-block stack estimate (finding 4, methods page)	£bn, 2024 prices, 2002-2024		£33.2bn
table_sensitivity_rows_0144	Sensitivity rows for the review findings (decision 0144): name, headline 2002-24 and change from the central	table, £bn, 2024 prices, 2002-2024		table or text
reliability_standard_lole_hours_yr	The Electricity Capacity Regulations 2014 (SI 2014/2043), reg. 6 'Reliability standard' (legislation.gov.uk, as made and revised; amendments of 2016 and 2025 leave reg. 6(1) unchanged): reg. 6(1): "The reliability standard is 3 hours of expected loss of load per capacity year."	hours of expected loss of load per capacity year		3 to be numbered
ecr2026_base_case_lole_hours_yr	NESO, Electricity Capacity Report 2026 (May 2026): p.5 (PDF p.5), right-hand column, T-1 recommendation for 2027/28: "a Base Case LOLE of around 0.1 hours/year"	hours a year		0.1 CR-S052
ecr2026_nondelivery_gw	NESO, Electricity Capacity Report 2026 (May 2026): p.5 (PDF p.5), left-hand column: "a further	GW		3.5 to be numbered

	3.5 GW future unknown non-delivery"; right-hand column: "Should the 3.5 GW modelled non-delivery materialise"			
ecr2026_nondelivery_lole_hours_yr	NESO, Electricity Capacity Report 2026 (May 2026): p.5 (PDF p.5), right-hand column: "we estimate that the Base Case LOLE would be 2.1 hours/year, still within the reliability standard"	hours a year	2.1	to be numbered
ecr2026_known_nondelivery_gw	NESO, Electricity Capacity Report 2026 (May 2026): p.5 (PDF p.5), left-hand column: "Our Base Case includes 4.3 GW of known non-delivery"	GW	4.3	to be numbered
ecr2026_t1_derated_margin_low_gw	NESO, Electricity Capacity Report 2026 (May 2026): p.5 (PDF p.5), 'T-1 capacity to secure', right-hand column, T-1 recommendation for delivery in 2027/28: "This is equivalent to a de-rated margin in the range 4 to 5 GW" (low end)	GW, de-rated	4	to be numbered
ecr2026_t1_derated_margin_high_gw	NESO, Electricity Capacity Report 2026 (May 2026): p.5 (PDF p.5), 'T-1 capacity to secure', right-hand column, T-1 recommendation for delivery in 2027/28: "This is equivalent to a de-rated margin in the range 4 to 5 GW" (high end)	GW, de-rated	5	to be numbered
ecr2026_base_case_peak_2027_28_gw	NESO, Electricity Capacity Report 2026 Data Workbook (May 2026): sheet 'Figure B1' (Peak Demand next 10 years), row 'Base Case 2026', column '2027/28'	GW, ACS peak demand	61	to be numbered
vat_domestic_rate_pct	Value Added Tax Act 1994, s.29A(1) (inserted by Finance Act 2001 s.99); HMRC VAT Notice 701/19: s.29A(1): "shall be charged at the rate of 5 per cent"; Notice 701/19 s.2.1	%	5%	to be numbered
gb_households_2024_m	ONS, Families and households: household size by regions and countries 2025 (Labour Force Survey), England + Wales + Scotland: sheets England, Wales and Scotland, row 'All households', 2024 column (thousands), summed	million households	27.867	CR-S001
eii_exemption_pct_to_mar2024	The Electricity Supplier Obligations (Amendment & Excluded Electricity) Regulations 2015 (SI 2015/721); Explanatory Memorandum to SI 2024/419: SI 2015/721 reg. 11(2) ("0.85 multiplied by"); EM to SI 2024/419 para 6.2 ("The exemption level is currently 85%")	% of metered electricity (ceiling)	85%	to be numbered
eii_exemption_pct_from_apr2024	The Electricity Supplier Obligations (Excluded Electricity) (Amendment) Regulations 2024 (SI 2024/419): reg. 1 (in force 1 April 2024; extends to England and Wales and Scotland) and reg. 6; explanatory note ("from 85% ... to 100 %")	% of metered electricity (ceiling)	100%	to be numbered
ccc_2017_bill_fall_since_2008_gbp	Committee on Climate Change, Energy Prices and Bills: impacts of meeting carbon budgets (16 March 2017): Executive Sum-	£ per dual-fuel household a year, real, CCC basis	£115	CR-S002

ccc_2017_household_saving_gbp_yr	mary, p.7, 'Current bills' bullet: "Bills are about £115 lower in real terms since the Climate Change Act was passed in 2008"	£ per household a year, CCC basis	£290	CR-S003
ccc_2017_lowcarbon_bill_2016_gbp	Committee on Climate Change, Energy Prices and Bills (16 March 2017): Executive Summary, p.7, 'Current bills' bullet, fourth sub-bullet: "Gas and electricity use have been cut by 23% and 17% respectively since 2008, saving the average household £290 a year"	£ per dual-fuel household, 2016, CCC basis	£105	CR-S004
ucl_net_benefit_gbp_bn	Committee on Climate Change, Energy Prices and Bills (16 March 2017): Executive Summary, p.7, 'Current bills' bullet, third sub-bullet: "Around £105 (9%) of the 2016 bill resulted from the shift towards a UK-based low-carbon electricity supply and support for energy efficiency improvements in homes"	O'Shea, Horne and Maslin (2025), UCL Open: Environment Preprints, v1: abstract, PDF p.3 (printed p.1) ("From 2010 to 2023, wind power delivered a net benefit of £104.3 billion to UK consumers"); Table 9 Total row, printed p.31	£bn, as published	£104.3bn CR-S005
ucl_period_years	O'Shea, Horne and Maslin (2025), UCL Open: Environment Preprints, v1: abstract, PDF p.3 (printed p.1): "From 2010 to 2023"	calendar years (2010 to 2023 inclusive)	14	CR-S007
ucl_table10_sum_gbp_bn	O'Shea, Horne and Maslin (2025), UCL Open: Environment Preprints, v1: Table 10 'Distributed benefits of gas model savings', Total row, printed p.32: net benefit to electricity users, col. (6), 12.8, plus net benefit to other gas users, col. (9), 96.4	£bn, as published (sum of two printed totals)	£109.2bn	CR-S006
cm_standstill_deferred_paid_gbp_m	Electricity Settlements Company, Annual Report and Accounts 2019/20: Key outcomes in 2019/20 table, fn 7, PDF p.8 ("£987.3m (for Delivery Year 2018/19)"); text above Table 1, PDF p.18 ("The deferred payments for this period (£987.3m) were due on 21 November 2019")	£m, cash	£987.3m	CR-S043
ucl_lt_moe_2022_gbp_mwh	O'Shea, Horne and Maslin (2025), UCL Open: Environment Preprints, v1: Table 5 'Long-Term MOE Model Results', col. (2) Total MOE, 2022 row, printed p.25 (PDF p.27)	£/MWh	-£18.18 per MWh	CR-S046
casoli_sr_gas_supply_median	Casoli, Manera and Valenti (2022, updated version July 2023), FEEM Nota di Lavoro 045.2022: Figure 3, Panel 8; text: "Panel 8 reports the posterior distribution of the short-run price elasticity of gas supply, with a median of 0.34"	dimensionless (short-run price elasticity of gas supply, posterior median)	0.34	CR-S047
albrizio_eu_weighted_gas_demand_elasticity	Albrizio, Bluedorn, Koch, Pescatori and Stuermer (2022), Market Size and Supply Disruptions: Sharing the Pain from a Potential Russian Gas Shut-off to the Euro-	dimensionless (price elasticity of natural gas demand, absolute value, EU-consumption-weighted)	0.169	to be numbered

	pean Union, IMF Working Paper WP/22/143: Table 2 'Price elasticities of demand by sector': industry 0.084 (EU share 23%), households 0.24 (34%), power sector 0.136 (32%), other sectors 0.22 (11%)			
krichene_sr_gas_supply_table5	Krichene (2005), A Simultaneous Equations Model for World Crude Oil and Natural Gas Markets, IMF Working Paper WP/05/32: Table 5 'World Crude Oil and Natural Gas: The SEM Extended to Include the NEER', printed p.20 (PDF p.21): Natural gas Supply, Price elasticity, short-run 0.06 (t = 1.85), 1974-2004	dimensionless (short-run price elasticity of world natural gas supply)	0.06	to be numbered
krichene_lr_gas_demand_table2	Krichene (2005), A Simultaneous Equations Model for World Crude Oil and Natural Gas Markets, IMF Working Paper WP/05/32: Table 2 'World Crude Oil and Natural Gas: Long-Run Elasticities', PDF p.13, 1. Vector error correction method, Period 1918-2004: Natural gas demand, Price elasticity -0.45 (t = -4.742); Natural gas supply, Price elasticity 0.16	dimensionless (long-run price elasticity of world natural gas demand, absolute value; printed -0.45)	0.45	to be numbered
generator_share_pct	National Grid TNUoS statements (docs 50671, 2013/14, and 50676, 2012/13): "27% of total transmission revenue is recovered from generation customers ... This ratio is fixed in the charging methodology" (doc 50671); doc 50676: "27% of the increase in the total transmission allowed revenue is recovered from generation (as per the charging methodology)" (the engine checks both sentences, grid.tnuos_gen_share_fy); 2003/04 confirmed by Ofgem/DTI 86/03 §4.16, p.17 ("27% is recovered from generation", NGC TNUoS); 2001/02-2002/03 inferred	% of transmission revenue recovered from generators	27%	CR-S009
scottish_nlr_2005_06_gbp_m	Ofgem 279/04, Transmission price controls and BETTA: Final proposals and impact assessment (December 2004): Appendix 5 (SP Transmission), printed p.86 (PDF p.91), and Appendix 6 (SHETL), printed p.88 (PDF p.93): 'Non Load related', 2005/6 roll forward	£m, 2002/03 prices	£55.9m	CR-S012
spt_nlr_2005_06_gbp_m	Ofgem 279/04 (December 2004): Appendix 5, 'SP Transmission price controls', 'Roll forward price controls (without BETTA adjustments)', 'Non Load related', 2005/6, printed p.86 (PDF p.91)	£m, 2002/03 prices	£44.8m	CR-S013
shetl_nlr_2005_06_gbp_m	Ofgem 279/04 (December 2004): Appendix 6, 'SHETL price controls, roll forward (without BETTA adjustments)', 'Non Load related', 2005/6, printed p.88 (PDF p.93)	£m, 2002/03 prices	£11.1m	CR-S014
app8_spt_interconnector_allowance_gbp_m	Ofgem 279/04 (December 2004): Appendix 8 (BETTA adjustments: SP Transmission), 'Non Load related', 2005/6,	£m, 2002/03 prices	£2.8m	CR-S011

	printed p.92 (PDF p.97); break-down 'Post Vesting E-S interconnector' 2.8, printed p.93 (PDF p.98)			
nao_balancing_2005_06_gbp_m	National Audit Office, Electricity Balancing Services (2014): para 2.2: "from £642 million in 2005-06"	£m; price basis not stated by NAO; treated as cash	£642m	CR-S017
balancing_energy_share_central	NESO, annual balancing costs workbook (2025), sheet 'Total outturn': row FY 2018/19: (Constraints (£) + Energy Imbalance (£)) / sum of the cost categories	% of external balancing cost	54.8%	CR-S015
balancing_energy_share_low_option	NESO, annual balancing costs workbook (2025), sheet 'Total outturn': row FY 2024/25, same categories: the highest yearly share, used by the stacked low end (nao_2005 with the top share)	% of external balancing cost	70.3%	CR-S016
balancing_ibc_over_actual_low_gbp_m	NGET, System Operator Incentive Performance (Ofgem ref 12409, Dec 2005); National Grid, SO Incentives Review: Initial Proposals for 1 April 2011 (24 Nov 2010): NG 2005, PDF p.2, table under 'Historical performance' (unnumbered), Outturn IBC 2003/04 351.5; NG 2010, Table 1 'Summary of historic BSIS parameters', p.9, Actual Costs 2003/04 280.8	£m, money of the day	£70.7m	to be numbered
balancing_ibc_over_actual_high_gbp_m	NGET, System Operator Incentive Performance (Dec 2005); National Grid, SO Incentives Review: Initial Proposals for 1 April 2011 (24 Nov 2010): NG 2005, PDF p.2, Outturn IBC 2001/02 365.6; NG 2010, Table 1, p.9, Actual Costs 2001/02 263.0	£m, money of the day	£102.6m	to be numbered
elasticity_households	Pellini (2021), Energy Economics 101:105411, accepted version: Table 4, UK long-run residential, -0.607 [-0.703, -0.562], PDF p.15	dimensionless (long-run price elasticity)	-0.607	CR-S018
elasticity_non_households	Labandeira, Labeaga and López-Otero (2016), RSCAS working paper 2016/25: Table 3, Good block, Electricity, long term (516 observations), PDF p.15; label "electricity, all consumers, long-run average (Labandeira et al. 2016, Table 3)" (0081 option 2)	dimensionless (long-run price elasticity)	-0.52	CR-S019
elasticity_low	Labandeira, Labeaga and López-Otero (2016), RSCAS working paper 2016/25: Table 3, Good block, Electricity, short term, PDF p.15 (0082)	dimensionless (short-run price elasticity)	-0.203	CR-S020
elasticity_high	Labandeira, Labeaga and López-Otero (2016), RSCAS working paper 2016/25: Table 4, Electricity, long-term meta-regression (GLS), PDF p.16 (printed p.8) (0082)	dimensionless (long-run price elasticity)	-0.677	CR-S021
ffl_nffo_payments_fy2001_02_gbp_m	HC Deb 18 April 2002, vol 383, cc1139-40W, 'Renewable Energy' (written answer, Brian Wilson, DTI): c1139W: "Estimated payments from NFFO and comparable arrangements in Scotland in 2001-02 were £85.5 million."	£m, cash, FY2001/02, estimate	£85.5m	to be numbered

ffl_fy2001_02_level_gbp_m	ONS series CIQY, 'CG receipts: taxes on expenditure: fossil fuel levy' (EDP dataset, released 22 Sep 2026): quarters 2001 Q2 to 2002 Q1, 23 each (CSV lines 310-313); geography GB: ONS Economic Trends 609, PDF p.4 ("The FFL did not extend to Northern Ireland")	£m, cash, FY2001/02	£92m	CR-S026
ukets_incentives_defra_2006_results_gbp_m	Defra, UK Emissions Trading Scheme: Results of the 2006 commitment period (18 May 2007), Internet Archive capture 14 Aug 2007: p.2 (PDF p.2; no printed folios), penultimate column '2002 - 2006 Incentive Payments', row 'Totals': £198,134,982.88	£m, cash	£198.13m	CR-S042
employers_ni_secondary_rate_2001_pct	The Social Security (Contributions) (Re-rating and National Insurance Funds Payments) Order 2001 (SI 2001/477): art. 2 ("for '12.2' (percentage rate) there shall be substituted '11.9'" and the explanatory note; HL Deb 19 Feb 2001 (the cut recycles climate change levy revenue)	%	11.9%	CR-S045
ccl_2001_rate_real_p_kwh	Finance Act 2000, Sch. 6 para 42(1) (electricity, £0.0043 per kWh from April 2001); ONS CPIH (L522): CPIH 2024 / CPIH 2001	p/kWh, 2024 prices (CPIH)	0.766p	CR-S024
ccl_2024_rate_p_kwh	HMRC, Environmental taxes: historical rates (Climate Change Levy, electricity main rate): electricity main rate in force from 1 April 2024: £0.00775 per kWh	p/kWh, cash	0.775p	CR-S025
eesop_elec_share_pct	Ofgem and Energy Saving Trust, A Review of the EESoP programmes (July 2003): Figure 3.1, PDF p.14: EESoP 3 targets, electricity 4,981 GWh, gas 6,144 GWh (outturn 5,041 and 6,201 in App. 5, pp.63-64 (PDF pp.69-70))	%	44.8%	CR-S028
coal_cm_excluded_gw	Ofgem, Annual report on the operation of the Capacity Market in 2020/21 and 2021/22 (August 2022): para 3.49, PDF p.37: "Coal cannot take part in the T-4 auctions anymore due to CM emissions limits which apply from 1st October 2024 for Capacity in operation before July 2019. Therefore the 11 GW of Coal that previously took part in the T-4 auctions from 2017/18 are no longer able to gain CM agreements."	GW	11	CR-S032
egl_fy2023_24_gbp_bn	HMRC, Corporation Tax statistics 2026, data tables: Table_1A 'Corporate Tax receipts by tax type', row 13 'Electricity Generator Levy (EGL)', column 2023-24: 1,473 (£m)	£bn, cash	£1.473bn	CR-S033
egl_fy2024_25_gbp_bn	HMRC, Corporation Tax statistics 2026, data tables: Table_1A, row 13 'Electricity Generator Levy (EGL)', column 2024-25: 749 (£m)	£bn, cash	£0.749bn	CR-S034
eec_deemed_twh_2010	Lees, Evaluation of the Energy Efficiency Commitment 2005-08, for DECC (2008): s.4.1 sum-	TWh a year, electricity	6.1	CR-S035

	mary, p.33 (PDF p.33): "EEC1 and EEC2 by 2010 will be saving 6.1 and 7.4 TWh of electricity and natural gas respectively"			
cert_forecast_twh_2012	DECC, Impact Assessment, the Electricity and Gas (Carbon Emissions Reduction) (Amendment) Order 2009: para 38, PDF p.23: "Projected annual savings from the policy in 2012 are: 7.78 TWh/year electricity"	TWh a year, electricity	7.78	CR-S036
epg_cost_gbp_m	National Audit Office, Energy bills support: an update (HC 232, 14 November 2024): Summary table 'Summary of energy bills support schemes, 2022-2024', printed pp.6-7 (PDF p.8); Figure 6, p.24 (PDF p.25)	£m, cash, estimate; United Kingdom, gas and electricity together	£23,999m	CR-S037
ebss_gb_cost_gbp_m	National Audit Office, Energy bills support: an update (HC 232, 14 November 2024): Summary table, printed pp.6-7 (PDF p.8): "£11,364 million for GB"; Figure 6, p.24 (PDF p.25)	£m, cash, estimate	£11,364m	CR-S038

Source: gas-counterfactual release v4-s37, figures.json key annex_a_figure_register. Keys, labels, units and printed values as the release records them, except where the text above says otherwise; figures rounded separately.

B Annual tables

Both bills, every line, every year 2002–24, with 2025 provisional, in £bn at 2024 prices, central settings only. “Of which” lines are shown in italics and are not added. The release does not yet give these tables in cash, at the low and high ends, or with each line tagged measured, modelled or estimated. There is no total for 2002–25.

Table B.1 Every bill line, 2002–09, £bn, 2024 prices (the road's lines are modelled; most actual lines are measured)

Line	What it is	Bill	2002	2003	2004	2005	2006	2007	2008	2009
NZ1	Power: wholesale energy	Actual	7.2	12.5	13.6	23.0	24.2	16.7	37.8	18.6
NZ2	Renewables Obligation	Actual	0.2	0.5	0.6	0.8	0.9	1.1	1.3	1.4
NZ3	Feed-in tariffs (levelisation cost)	Actual	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
NZ4	Contracts for Difference (wind, solar, other)	Actual	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
NZ4b	Contracts for Difference: biomass	Actual	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
NZ5	Backup: Capacity Market extra over the road's own backup	Actual	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
NZ6	Running the grid (balancing)	Actual	0.4	0.4	0.4	0.5	0.5	0.5	0.7	0.6
NZ7	High-voltage grid	Actual	1.2	1.2	1.2	1.2	1.5	1.5	1.6	1.6
NZ8	Climate Change Levy, electricity	Actual	0.0	0.0	–0.1	–0.1	–0.1	–0.1	–0.1	–0.1
NZ10	Energy-saving schemes (EEC, CERT, CESP, ECO, GBIS), electricity share	Actual	0.0	0.1	0.1	0.1	0.2	0.2	0.4	0.6
NZ11	VAT, 5%, on households' share of the lines above	Actual	0.2	0.3	0.3	0.5	0.5	0.4	0.8	0.4
<i>NZ1c</i>	<i>of which carbon in the wholesale price</i>	<i>Actual</i>	<i>0.0</i>	<i>0.0</i>	<i>0.0</i>	<i>3.3</i>	<i>2.6</i>	<i>0.1</i>	<i>3.2</i>	<i>2.2</i>
<i>NZ1c_tax</i>	<i>of which carbon price receipts</i>	<i>Actual</i>	<i>0.0</i>	<i>0.0</i>	<i>0.0</i>	<i>0.0</i>	<i>0.0</i>	<i>0.0</i>	<i>0.1</i>	<i>0.3</i>
<i>NZ1c_price</i>	<i>of which carbon in the price, the rest</i>	<i>Actual</i>	<i>0.0</i>	<i>0.0</i>	<i>0.0</i>	<i>3.3</i>	<i>2.6</i>	<i>0.1</i>	<i>3.1</i>	<i>1.9</i>
GO1	Power: the actual plant less carbon, renewables' output replaced by fossil	Road	5.4	9.5	10.5	15.1	16.9	14.1	29.1	13.9
GO1k	Kept nuclear, imports and pumped storage, priced as actual less carbon	Road	1.9	3.1	3.3	4.8	5.1	3.0	6.2	3.3
GO2	Backup payments (inside GO1)	Road	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
GO3	Carbon	Road	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
GO4	Running the grid (balancing)	Road	0.4	0.4	0.4	0.6	0.6	0.5	0.7	0.5
GO5	High-voltage grid	Road	1.2	1.2	1.2	1.3	1.3	1.3	1.3	1.3
GO6	CCL, subsidies, taxes	Road	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
GO7	VAT, 5%, on households' share of the lines above	Road	0.2	0.3	0.3	0.4	0.5	0.4	0.7	0.4
S1.duos	Same in both: duos	Both	5.0	5.0	5.3	5.4	5.5	5.7	5.7	5.7
S1.metering	Same in both: metering	Both	0.1	0.1	no value †	no value †	no value †	0.0	0.0	0.0
S1.supplier	Same in both: supplier	Both	2.6	2.6	2.6	2.6	2.6	2.6	2.7	2.8
S1.vat	Same in both: vat	Both	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.3
† S1.metering	2004–06: the release gives no value: 2004–2006 metering outside DNO control and before the CSS series (the supplier range's high end includes it)									

Source: gas-counterfactual release v4-s37, figures.json key annex_b_annual_tables_1. Modelled, £bn in 2024 prices (CPIH) unless stated; figures rounded separately.

Table B.2 Every bill line, 2010–17, £bn, 2024 prices (the road's lines are modelled; most actual lines are measured)

Line	What it is	Bill	2010	2011	2012	2013	2014	2015	2016	2017
NZ1	Power: wholesale energy	Actual	20.3	21.4	19.8	21.7	17.3	16.3	16.7	17.4
NZ2	Renewables Obligation	Actual	1.6	1.8	2.3	3.1	3.7	4.5	5.4	6.2
NZ3	Feed-in tariffs (levelisation cost)	Actual	0.0	0.2	0.6	0.9	1.1	1.4	1.6	1.7
NZ4	Contracts for Difference (wind, solar, other)	Actual	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2
NZ4b	Contracts for Difference: biomass	Actual	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3
NZ5	Backup: Capacity Market extra over the road's own backup	Actual	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
NZ6	Running the grid (balancing)	Actual	0.6	0.6	0.6	0.7	0.7	0.7	0.8	0.8
NZ7	High-voltage grid	Actual	1.7	1.7	1.9	2.1	2.3	2.6	2.9	2.9
NZ8	Climate Change Levy, electricity	Actual	–0.1	–0.2	–0.2	–0.3	–0.3	–0.1	0.0	0.0
NZ10	Energy-saving schemes (EEC, CERT, CESP, ECO, GBIS), electricity share	Actual	0.7	0.6	0.6	0.5	0.5	0.5	0.5	0.4
NZ11	VAT, 5%, on households' share of the lines above	Actual	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.6
<i>NZ1c</i>	<i>of which carbon in the wholesale price</i>	<i>Actual</i>	<i>2.3</i>	<i>1.9</i>	<i>1.0</i>	<i>1.2</i>	<i>2.0</i>	<i>3.3</i>	<i>3.3</i>	<i>3.2</i>
<i>NZ1c_tax</i>	<i>of which carbon price receipts</i>	<i>Actual</i>	<i>0.4</i>	<i>0.3</i>	<i>0.2</i>	<i>0.6</i>	<i>1.4</i>	<i>1.9</i>	<i>1.6</i>	<i>1.6</i>
<i>NZ1c_price</i>	<i>of which carbon in the price, the rest</i>	<i>Actual</i>	<i>1.9</i>	<i>1.6</i>	<i>0.8</i>	<i>0.5</i>	<i>0.6</i>	<i>1.4</i>	<i>1.7</i>	<i>1.7</i>
GO1	Power: the actual plant less carbon, renewables' output replaced by fossil	Road	15.8	16.7	16.2	17.8	13.4	11.9	13.2	13.5
GO1k	Kept nuclear, imports and pumped storage, priced as actual less carbon	Road	3.3	4.5	4.9	5.8	4.6	4.6	4.6	4.5
GO2	Backup payments (inside GO1)	Road	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
GO3	Carbon	Road	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
GO4	Running the grid (balancing)	Road	0.5	0.6	0.6	0.7	0.6	0.5	0.5	0.5

GO5	High-voltage grid	Road	1.4	1.4	1.4	1.5	1.5	1.6	1.8	1.9
GO6	CCL, subsidies, taxes	Road	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
GO7	VAT, 5%, on households' share of the lines above	Road	0.4	0.4	0.4	0.5	0.4	0.3	0.4	0.4
S1.duos	Same in both: duos	Both	6.2	6.6	7.0	7.5	8.0	7.3	7.3	7.1
S1.metering	Same in both: metering	Both	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S1.supplier	Same in both: supplier	Both	2.7	2.7	2.8	3.3	3.1	3.3	3.5	3.4
S1.vat	Same in both: vat	Both	0.2	0.3	0.3	0.3	0.3	0.3	0.3	0.3

Source: gas-counterfactual release v4-s37, figures.json key annex_b_annual_tables_2. Modelled, £bn in 2024 prices (CPIH) unless stated; figures rounded separately.

Table B.3 Every bill line, 2018–25, 2025 provisional, £bn, 2024 prices (the road's lines are modelled; most actual lines are measured)

Line	What it is	Bill	2018	2019	2020	2021	2022	2023	2024	2025 (prov.)
NZ1	Power: wholesale energy	Actual	21.2	15.5	12.3	42.0	61.4	26.1	20.0	21.7
NZ2	Renewables Obligation	Actual	6.9	7.3	7.0	7.2	6.9	6.7	7.3	7.4
NZ3	Feed-in tariffs (levelisation cost)	Actual	1.8	1.9	1.9	1.6	1.6	1.7	1.7	1.8
NZ4	Contracts for Difference (wind, solar, other)	Actual	0.6	1.3	2.1	0.7	−0.3	1.4	2.0	2.0
NZ4b	Contracts for Difference: biomass	Actual	0.5	0.5	0.7	0.5	0.0	0.0	0.4	0.5
NZ5	Backup: Capacity Market extra over the road's own backup	Actual	0.0	0.1	0.1	0.2	0.1	0.1	0.2	0.2
NZ6	Running the grid (balancing)	Actual	0.8	1.0	1.3	1.9	2.7	2.9	3.0	3.8
NZ7	High-voltage grid	Actual	2.8	2.9	3.0	3.0	3.0	3.4	3.2	3.6
NZ8	Climate Change Levy, electricity	Actual	0.0	0.2	0.2	0.2	0.1	0.0	0.0	0.0
NZ10	Energy-saving schemes (EEC, CERT, CESP, ECO, GBIS), electricity share	Actual	0.4	0.4	0.4	0.4	0.5	0.6	0.7	0.8
NZ11	VAT, 5%, on households' share of the lines above	Actual	0.7	0.6	0.6	1.2	1.4	0.8	0.7	0.8
NZ1c	of which carbon in the wholesale price	Actual	4.3	5.2	4.9	6.6	10.5	7.3	5.6	6.6
NZ1c_tax	of which carbon price receipts	Actual	2.0	1.1	2.0	3.0	3.7	2.3	1.3	1.3
NZ1c_price	of which carbon in the price, the rest	Actual	2.4	4.1	3.0	3.6	6.7	5.1	4.3	5.3
GO1	Power: the actual plant less carbon, renewables' output replaced by fossil	Road	16.5	13.1	13.0	33.9	52.0	21.5	17.2	19.5
GO1k	Kept nuclear, imports and pumped storage, priced as actual less carbon	Road	5.5	3.6	3.3	10.0	9.4	5.9	5.4	5.1
GO2	Backup payments (inside GO1)	Road	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
GO3	Carbon	Road	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
GO4	Running the grid (balancing)	Road	0.6	0.5	0.4	1.0	1.6	1.4	1.4	1.4
GO5	High-voltage grid	Road	1.9	2.0	2.1	1.9	1.8	1.8	1.8	1.8
GO6	CCL, subsidies, taxes	Road	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
GO7	VAT, 5%, on households' share of the lines above	Road	0.5	0.4	0.4	0.9	1.2	0.6	0.5	0.5
S1.duos	Same in both: duos	Both	6.9	7.1	7.0	7.1	7.7	6.9	8.2	7.2
S1.metering	Same in both: metering	Both	0.1	0.4	0.5	0.5	0.5	0.5	0.5	0.3
S1.supplier	Same in both: supplier	Both	3.4	3.6	3.6	3.6	4.0	4.4	4.0	4.4
S1.vat	Same in both: vat	Both	0.3	0.3	0.3	0.3	0.4	0.4	0.4	0.4

Source: gas-counterfactual release v4-s37, figures.json key annex_b_annual_tables_3. Modelled, £bn in 2024 prices (CPIH) unless stated; figures rounded separately.

C Engine specification, in summary

The engine's equations, parameters with their sources, switches and tests, in summary. The full specification, the register of station closures and the log of calibration tests are in the release; the code at the release tag is the authority. Table C.1 is the run's own record: version, run date, money, the source of household numbers, every central setting by its engine name, and every declared fallback with its size. The equations and parameters are not yet in it. Its field names and values are the engine's internal ones, printed as the engine writes them, and two of them are not this paper's: "headline year" is an engine field set to the run's provisional year, and "run price base" is the price base the engine works in before its figures are restated in 2024 prices ("figures price base"). This paper's headline is the gap over 2002–24, in 2024 prices, and it gives no total that includes 2025.

Table C.1 Engine summary: the run's own record, in the engine's internal field names (annex_c_engine_summary). "Headline year" and "run price base" are engine fields, not this paper's headline (2002–24) or price base (2024 prices)

Field	Value (the release's own record)
engine version	v4-s37
schema version	4.0
run date	2026-10-20
headline year	2025
latest full year	2024
provisional years	2025
deflator	ONS CPIH L522
households source	ons_ifs_households_by_size_2025;ons-adhoc-005374-households-regi on-1996-2017 (GB: England + Wales + Scotland)
counterfactual	fossil Britain, like for like (s22): the actual system with net zero taken out; re- newables' output replaced by extra running of existing fossil plant, then new CCGT/OCGT; merit-order uplift = Shao et al. 2022 (spec §15.5 item 1); extra running of the plant Britain had at the market price (O144 item 1A); gas-price feedback $dQ / ((e_s + e_d) Q)$, $e = 0.06 + 0.169$ (Albrizio et al. 2022's pair, O144 item 2A); kept coal capped at the DUKES 5.10.B load factor
residual method	NESO demand-side, every year (departure from §4.1 2016+ FUELHH; see bills.py)
calibration rule	loosened
pre2016 publishable	True
run price base	2025
figures price base	2024 £ (CPIH L522)
input checksums count	232
central setting: route	ofgem_chart
central setting: kept_price	less_carbon
central setting: margin	central
central setting: residual	neso
central setting: coal_rule	forced
central setting: cm_rule	extra
central setting: ic_basis	contracted
central setting: nuclear_cm_column	post_trade_less_suspended
central setting: sl_all_new_price	less_carbon
central setting: sl_kept_price	less_carbon
central setting: otr_indexation	real_cpih
central setting: otr_nz2_level_gbp_m	92.0
central setting: otr_nz2_end_year	2019
central setting: otr_nz10_level_gbp_m	24.62516853932584
central setting: otr_nz10_end_year	none
central setting: ccl_baseline	cpih_2001
central setting: ccl_lec_cap	True
central setting: bal_share	none
central setting: bal_option	none
central setting: renewal	central
central setting: transport	True
central setting: fleet	like_for_like
central setting: moe	shao
central setting: moe_crisis	shao
central setting: closures	legitimate
central setting: newbuild	cheapest
central setting: gas_feedback	central

<i>central setting: extra_running</i>	<i>market</i>
<i>central setting: coal_lf</i>	<i>dukes_max</i>
<i>central setting: tnuos_gen</i>	<i>removed</i>
<i>central setting: bsuos_gen</i>	<i>removed</i>
<i>central setting: go5_index</i>	<i>rpi</i>
<i>central setting: fit_basis</i>	<i>levelisation</i>
<i>central setting: cfd_split</i>	<i>True</i>
<i>central setting: carbon_split</i>	<i>True</i>
<i>central setting: bal_choice</i>	<i>ibc first</i>
<i>fallback: bsuos-fy2006-ibc-grossup (2006)</i>	No measured balancing-cost total for FY2006/07: National Grid 2010 Table 1 GB IBC outturn x (1 + the FY2007/08 SO internal/external ratio, Ofgem TAR 2008-09 T22) (NZ6; s36 B11). Size: 593.1 £m nominal (FY).
<i>fallback: bsuos-fy2010-cpih-interpolation (2010)</i>	No balancing-cost total found for FY2010/11: the real-terms (CPIH) mean of FY2009/10 and FY2011/12 (NZ6). Size: 851.4 £m nominal (FY).
<i>fallback: bsuos-gen-share-interpolated (2013)</i>	Size: 0.5 share of BSUoS (FY).
<i>fallback: bsuos-gen-share-interpolated (2014)</i>	Size: 0.5 share of BSUoS (FY).
<i>fallback: bsuos-gen-share-interpolated (2015)</i>	Size: 0.5 share of BSUoS (FY).
<i>fallback: bsuos-gen-share-interpolated (2016)</i>	Size: 0.5 share of BSUoS (FY).
<i>fallback: bsuos-gen-share-interpolated (2018)</i>	Size: 0.5 share of BSUoS (FY).
<i>fallback: bsuos-gen-share-interpolated (2019)</i>	Size: 0.5 share of BSUoS (FY).
<i>fallback: bsuos-gen-share-interpolated (2020)</i>	Size: 0.5 share of BSUoS (FY).
<i>fallback: bsuos-gen-share-interpolated (2021)</i>	Size: 0.5 share of BSUoS (FY).
<i>fallback: bsuos-gen-share-interpolated (2022)</i>	Size: 0.5 share of BSUoS (FY).
<i>fallback: coal_efficiency_mean_2015_2023 (2025)</i>	DUKES 5.10.C prints no coal-fleet efficiency (O) for a year with no coal fleet (2025): the 2015-2023 coal-fleet mean is used for coal kept open in fossil Britain. Size: 34.5 % GCV.
<i>fallback: cpf-receipts-2013 (2013)</i>	HMRC Table 1b prints no Carbon Price Support split for 2013: total CCL+CPF receipts 2013 less 2012 (carbon tax collected). Size: 262.1 £m nominal.
<i>fallback: fit-sy1-5-levelisation-ratio (2010)</i>	FiT levelisation fund not stored for scheme years 1-5 (FY2010/11-2014/15): scheme value x the SY6 levelisation / scheme-value ratio (NZ3). Size: 14.5 £m nominal (scheme year).
<i>fallback: fit-sy1-5-levelisation-ratio (2011)</i>	FiT levelisation fund not stored for scheme years 1-5 (FY2010/11-2014/15): scheme value x the SY6 levelisation / scheme-value ratio (NZ3). Size: 149.5 £m nominal (scheme year).
<i>fallback: fit-sy1-5-levelisation-ratio (2012)</i>	FiT levelisation fund not stored for scheme years 1-5 (FY2010/11-2014/15): scheme value x the SY6 levelisation / scheme-value ratio (NZ3). Size: 506.3 £m nominal (scheme year).
<i>fallback: fit-sy1-5-levelisation-ratio (2013)</i>	FiT levelisation fund not stored for scheme years 1-5 (FY2010/11-2014/15): scheme value x the SY6 levelisation / scheme-value ratio (NZ3). Size: 692.5 £m nominal (scheme year).
<i>fallback: fit-sy1-5-levelisation-ratio (2014)</i>	FiT levelisation fund not stored for scheme years 1-5 (FY2010/11-2014/15): scheme value x the SY6 levelisation / scheme-value ratio (NZ3). Size: 863.2 £m nominal (scheme year).
<i>fallback: gb_gas_share_nearest_year (2012)</i>	GB share of UK gas consumption (DESNZ sub-national Table 7.2, 2015-24) for a year outside the table: the nearest published year (ticket 38, the non-power gas estimate only; never the gap). Size: 1 share.
<i>fallback: gb_gas_share_nearest_year (2013)</i>	GB share of UK gas consumption (DESNZ sub-national Table 7.2, 2015-24) for a year outside the table: the nearest published year (ticket 38, the non-power gas estimate only; never the gap). Size: 1 share.
<i>fallback: gb_gas_share_nearest_year (2014)</i>	GB share of UK gas consumption (DESNZ sub-national Table 7.2, 2015-24) for a year outside the table: the nearest published year (ticket 38, the non-power gas estimate only; never the gap). Size: 1 share.
<i>fallback: ni_fossil_nearest_year (2002)</i>	Northern Ireland fossil MW (taken off the UK DUKES 5.7 totals) for a year the NI source does not cover: the nearest covered year. Size: 996 MW.
<i>fallback: ni_fossil_nearest_year (2003)</i>	Northern Ireland fossil MW (taken off the UK DUKES 5.7 totals) for a year the NI source does not cover: the nearest covered year. Size: 996 MW.
<i>fallback: ni_fossil_nearest_year (2004)</i>	Northern Ireland fossil MW (taken off the UK DUKES 5.7 totals) for a year the NI source does not cover: the nearest covered year. Size: 996 MW.
<i>fallback: ni_fossil_nearest_year (2005)</i>	Northern Ireland fossil MW (taken off the UK DUKES 5.7 totals) for a year the NI source does not cover: the nearest covered year. Size: 996 MW.
<i>fallback: shao_wind_pooled (2002)</i>	Shao et al. 2022 wind coefficient for a calendar year partly or wholly outside its April 2009 - March 2021 sample: the pooled coefficient (Table 4) for the missing part. Size: 1.3 £/MWh per GW.
<i>fallback: shao_wind_pooled (2003)</i>	Shao et al. 2022 wind coefficient for a calendar year partly or wholly outside its April 2009 - March 2021 sample: the pooled coefficient (Table 4) for the missing part. Size: 1.3 £/MWh per GW.
<i>fallback: shao_wind_pooled (2004)</i>	Shao et al. 2022 wind coefficient for a calendar year partly or wholly outside its April 2009 - March 2021 sample: the pooled coefficient (Table 4) for the missing part. Size: 1.3 £/MWh per GW.

fallback: shao_wind_pooled (2005)	Shao et al. 2022 wind coefficient for a calendar year partly or wholly outside its April 2009 - March 2021 sample: the pooled coefficient (Table 4) for the missing part. Size: 1.3 £/MWh per GW.
fallback: shao_wind_pooled (2006)	Shao et al. 2022 wind coefficient for a calendar year partly or wholly outside its April 2009 - March 2021 sample: the pooled coefficient (Table 4) for the missing part. Size: 1.3 £/MWh per GW.
fallback: shao_wind_pooled (2007)	Shao et al. 2022 wind coefficient for a calendar year partly or wholly outside its April 2009 - March 2021 sample: the pooled coefficient (Table 4) for the missing part. Size: 1.3 £/MWh per GW.
fallback: shao_wind_pooled (2008)	Shao et al. 2022 wind coefficient for a calendar year partly or wholly outside its April 2009 - March 2021 sample: the pooled coefficient (Table 4) for the missing part. Size: 1.3 £/MWh per GW.
fallback: shao_wind_pooled (2009)	Shao et al. 2022 wind coefficient for a calendar year partly or wholly outside its April 2009 - March 2021 sample: the pooled coefficient (Table 4) for the missing part. Size: 1.4 £/MWh per GW.
fallback: shao_wind_pooled (2021)	Shao et al. 2022 wind coefficient for a calendar year partly or wholly outside its April 2009 - March 2021 sample: the pooled coefficient (Table 4) for the missing part. Size: 1.4 £/MWh per GW.
fallback: shao_wind_pooled (2022)	Shao et al. 2022 wind coefficient for a calendar year partly or wholly outside its April 2009 - March 2021 sample: the pooled coefficient (Table 4) for the missing part. Size: 1.3 £/MWh per GW.
fallback: shao_wind_pooled (2023)	Shao et al. 2022 wind coefficient for a calendar year partly or wholly outside its April 2009 - March 2021 sample: the pooled coefficient (Table 4) for the missing part. Size: 1.3 £/MWh per GW.
fallback: shao_wind_pooled (2024)	Shao et al. 2022 wind coefficient for a calendar year partly or wholly outside its April 2009 - March 2021 sample: the pooled coefficient (Table 4) for the missing part. Size: 1.3 £/MWh per GW.
fallback: shao_wind_pooled (2025)	Shao et al. 2022 wind coefficient for a calendar year partly or wholly outside its April 2009 - March 2021 sample: the pooled coefficient (Table 4) for the missing part. Size: 1.3 £/MWh per GW.
fallback: wind_gw_dukes_flat (2002)	Mean wind GW removed (for the Shao uplift) where the NESO generation mix is missing or estimated: DUKES 5.6.E wind supplied spread flat over the year. Size: 0.1 GW mean.
fallback: wind_gw_dukes_flat (2003)	Mean wind GW removed (for the Shao uplift) where the NESO generation mix is missing or estimated: DUKES 5.6.E wind supplied spread flat over the year. Size: 0.1 GW mean.
fallback: wind_gw_dukes_flat (2004)	Mean wind GW removed (for the Shao uplift) where the NESO generation mix is missing or estimated: DUKES 5.6.E wind supplied spread flat over the year. Size: 0.2 GW mean.
fallback: wind_gw_dukes_flat (2005)	Mean wind GW removed (for the Shao uplift) where the NESO generation mix is missing or estimated: DUKES 5.6.E wind supplied spread flat over the year. Size: 0.3 GW mean.
fallback: wind_gw_dukes_flat (2006)	Mean wind GW removed (for the Shao uplift) where the NESO generation mix is missing or estimated: DUKES 5.6.E wind supplied spread flat over the year. Size: 0.5 GW mean.
fallback: wind_gw_dukes_flat (2007)	Mean wind GW removed (for the Shao uplift) where the NESO generation mix is missing or estimated: DUKES 5.6.E wind supplied spread flat over the year. Size: 0.6 GW mean.
fallback: wind_gw_dukes_flat (2008)	Mean wind GW removed (for the Shao uplift) where the NESO generation mix is missing or estimated: DUKES 5.6.E wind supplied spread flat over the year. Size: 0.8 GW mean.

Source: gas-counterfactual release v4-s37, figures.json key annex_c_engine_summary. The run's own record, as the engine writes it; figures rounded separately.

DUKES 5.7 totals: DUKES 2026, Table 5.7, sheet 5.7.

D Derived figures

Annex D will give the working for each figure derived from model output: the household figures, their divisor and the household share; VAT on the extra; the carbon split; the 2001 levels and their netting; the energy-intensive industries shift; and lost value and the estimate for other gas users, whose figures will be given with their working. Annex D is to follow in version 1.1. For the household figures the working is already in the release's run file (the household bill by step), though not printed here.

E Reconciliation

To follow in version 1.1: the bridge from this paper's gap to the figure in Report No. 2, line by line, from both frozen releases (Table E.1); the comparison with O'Shea, Horne and Maslin on a matched period (§3.3); Porter's approach, described in words only; and DECC's no-policy frame (§2.2). The bridge to Report No. 2 is not in this release. This draft gives Table E.2 only, which bridges the headline figures to the previous release of the engine, v4-s36.

Table E.2 Headline figures in releases v4-s36 and v4-s37, £bn and £ a household, 2024 prices (modelled)

Key	v4-s36	v4-s37	Change
Extra cost of net zero on electricity bills, paid by bill-payers, 2002-24	£161.2bn	£141.1bn	−£20.1bn
Extra cost of net zero, 2024	£14.0bn	£12.9bn	−£1.1bn
Extra cost of net zero, 2025 (provisional)	£15.5bn	£14.2bn	−£1.3bn
Extra cost of net zero on electricity bills, per household, 2024	£502	£463	−£39.09
Extra cost of net zero on electricity bills, per household, 2025 (provisional)	£550	£504	−£45.22
Net-zero cost on households' own bills, 2024	£206	£191	−£14.73
Net-zero cost on households' own bills, 2025 (provisional)	£225	£208	−£17.04
Net-zero Britain's bill, 2002-24	£947.7bn	£947.7bn	£0.0bn
the road's bill, 2002-24	£786.5bn	£806.6bn	+£20.1bn
Power, before carbon	−£62.2bn	−£82.1bn	−£19.9bn
Carbon in the power price (NZ1c)	£74.1bn	£74.1bn	£0.0bn
Renewables Obligation (NZ2)	£84.5bn	£84.5bn	£0.0bn
Feed-in Tariffs (NZ3)	£19.7bn	£19.7bn	£0.0bn
Contracts for Difference (NZ4 + NZ4b)	£10.9bn	£10.9bn	£0.0bn
Backup (Capacity Market extra, NZ5)	£0.9bn	£0.9bn	£0.0bn
Running the grid (NZ6 less GO4)	£7.6bn	£7.7bn	+£0.1bn
High-voltage grid (NZ7 less GO5)	£14.6bn	£14.6bn	£0.0bn
Climate Change Levy, electricity (NZ8)	−£1.3bn	−£1.3bn	£0.0bn
Energy-saving schemes (NZ10)	£9.2bn	£9.2bn	£0.0bn
VAT on households' share of the extra (NZ11 less GO7)	£3.3bn	£2.9bn	−£0.4bn

Source: gas-counterfactual release v4-s37, figures.json key annex_e_bridge. Modelled, £bn and £ a household in 2024 prices (CPIH); figures rounded separately.

F Version and change log

The change log between engine releases v4-s36 and v4-s37 (what changed, why, and what each change moved) is not in this release, and Annex F is to follow in version 1.1. Table E.2 gives what the changes moved in the headline figures.

F.1 Known issues in version 1.0

Each point below is open, and each is stated so that a reader can weigh it.

How the final checks were run. The final checks of this paper were made by an AI fact-checker running on Claude Opus, the same family of model as the AI agents that built the engine and that reviewed it. The fact-checker's seeded test, a run against copies of a paper and release with errors planted in them, was passed on a different model, Grok, not on Opus. The year-by-year audit of the main inputs to the headline, which the review standard asks for, was not done for version 1.0 and follows in version 1.1.

Held for the author's decision. The independent review of release v4-s37 found one error introduced by the release's last change to the engine. On the road, kept coal's running cost for pollution filters is charged on top of the market price for its share of the extra output, so that cost is counted twice. Removing it would make the road's bill slightly smaller and the gap slightly larger; the review put the effect at a hundredth of one per cent of the central figure. The fix is a change to the engine, which is frozen for this version, and it is held for Richard Lyon's decision.

For version 1.1: points that need a change to the engine. The engine is frozen at release v4-s37 for this version, so these wait for a new release.

- Rugeley's capacity: 448 MW in the engine, against 1,006 MW in the DUKES editions of 2004 to 2016 (§6.3).
- The closure test for Cottam and Fiddler's Ferry uses each station's actual load factor, not the load factor it would have run at on the road. The model review expects that Cottam would then stay open on the road, which would raise the gap; the effect is not measured on this release.
- Kept coal is charged its whole keep-open fixed cost, while other existing plant on the road is paid the Capacity Market rate. On one market basis kept coal would get the Capacity Market rate, or its fixed cost less its market margin; the model review expects that paying it the Capacity Market rate would raise the gap; the effect is not measured.
- Points the author ruled to version 1.1 after the review of the earlier release: no life-extension cost for kept coal; a gas feedback that works in one direction only; carbon taken out of the price at gas intensity in every hour; actual fossil output priced at the monthly baseload price; the option of crediting the road with the energy-saving schemes' savings; and a back-test of the merit-order uplift against outturn in 2021–23.
- Wording inside the release that this paper does not print as it stands: the release's labels for the per-household figures and for the eighteen keys named in Annex A, its citation of the supply elasticity (Albrizio and others take it from Krichene 2002, §9.3), and stale descriptions in code comments.
- Figures the release does not yet give: each line's tag (measured, modelled or estimated) in Table 4.1 and Annex B; cash columns and each year's data basis (Table 14.1, Annex B); each option's figure for 2025 (§15.1); the waterfall year by year (§14.2); a table of the checks of the actual bill against its sources (§5.2); and the options named in §6 to §13 as not computed.

For version 1.1: text and annexes. Annex D, the working for each derived figure, with the figures for lost value and for other gas users; Annex E's bridge to Report No. 2; Annex F's change log; a numbered register of claims and their primary sources; and the section where each figure in Annex A appears. The cover photograph is a placeholder until publication.