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INDEPENDENT REVIEW OF OFGEM'S DRAFT DETERMINATION APPROACH TO ONGOING EFFICIENCY

A report for FEN

Economic Insight

CONTENTS

1

INTRODUCTION AND EXECUTIVE SUMMARY

INTRODUCTION

In its Draft Determinations (DDs), Ofgem set an ongoing efficiency (OE) target of 1.0% pa. The regulator did not set out any material new evidence / analysis or arguments to support its decision. Rather, its approach was to start from a broad range of 0.1%-1.3% pa, as proposed in a report by Grant Thornton (GTh), and then apply judgement to firstly narrow the range (to 0.7%-1.3% pa), and then select a point estimate.

This target is materially higher than the targets proposed by companies in their business plans (0.2%-0.7% pa). All gas companies (i.e. GDNs and NGT) proposed an OE challenge of 0.5% pa, while SPT proposed an OE challenge of 0.4% pa. SHET proposed the lowest target, 0.2% pa, and NGET the highest, 0.7% pa.

In this context, we have been commissioned by the regulated gas distribution and transmission networks (herein 'the gas networks') to evaluate Ofgem's approach to setting the OE target.

OUR FINDINGS

Ofgem's proposed OE target for RIIO-3 is flawed because it has made three errors in its approach to determine its "narrow" range of 0.1%-1.3% and, subsequently, select its 1.0% point estimate from the range. Specifically, Ofgem has erred by: (i) relying on precedent of outcome; (ii) using incomplete business cycles in its analysis; and (iii) placing disproportionate weight on unsubstantiated arguments to justify a target from the upper end of the range.

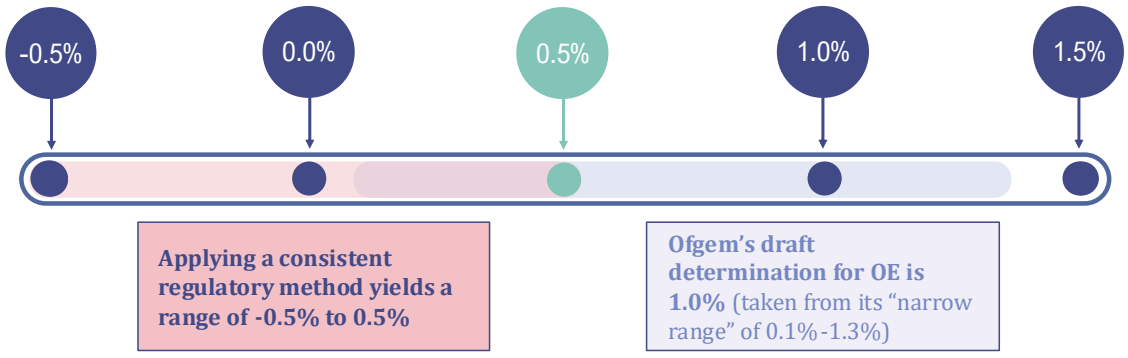
1 Error 1: In setting its final OE target, Ofgem has erroneously relied on precedent of outcomes at previous regulatory decisions, rather than precedent of methods previously applied to determine those outcomes.

In making its regulatory decisions, Ofgem may reasonably draw on analytical methods previously used to set regulatory targets, refining them where there is sound justification. This approach not only makes the regulatory process more predictable and efficient, it is also the approach Ofgem follows for other aspects of the price control – for example, RPEs, the regional labour adjustment, and cost benchmarking.

In setting OE, however, Ofgem started with the outcome of its RIIO-2 decision (i.e. the 1% OE target itself) and considered whether this remained an appropriate target for RIIO-3. As such, Ofgem has relied on the outcome of a previous regulatory decision to justify its decision at RIIO-3, rather than the precedent of method.

Relying on precedent of the outcomes of prior regulatory decisions, rather than precedent of analytical methods, will tend to result in regulatory decisions remaining unchanged over time, even if the evidential basis for them has changed. This is against the interests of customers and investors, because economic regulation is intended to promote efficient prices/output, rather than the status-quo price/output. Following precedent in method, rather than outcome, and re-applying its approach at RIIO-2 yields an OE range of -0.5% to 0.5%. Accounting for this error excludes Ofgem's proposed 1% target from the plausible range.

Figure 1: Relying on precedent of the outcomes of prior regulatory decisions yields an OE range of -0.5% to 0.5%



Source: Economic Insight analysis of RIIO-2 CEPA methodology.

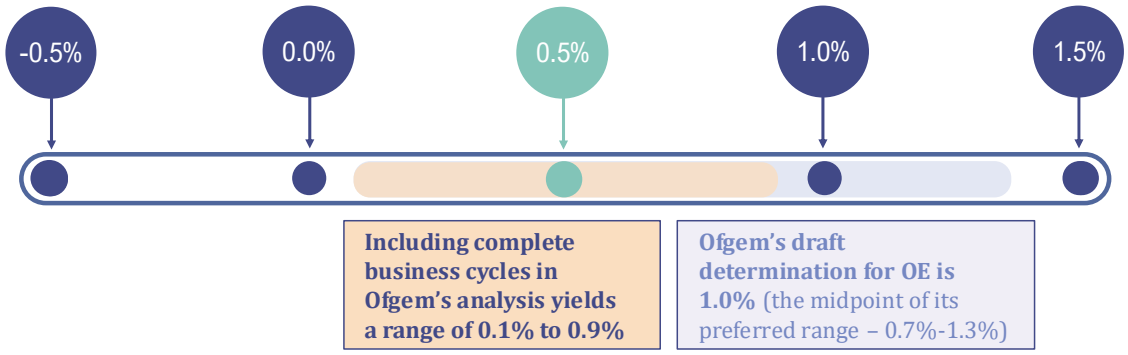
2 Error 2: In calculating its OE range, Ofgem has erroneously: (i) relied on incomplete business cycles; and (ii) removed three years from its analysis (2008, 2009, 2020), incorrectly referring to them as outliers.

The upper bound of Ofgem's range is upwardly biased, as it relies on a period of only positive GDP growth (1997-2007), rather than a complete business cycle. The importance of including complete business cycles in the estimation of productivity growth is well established in previously applied regulatory methods (including Ofgem's own prior methods, and by the CMA), and in the economics literature.

To justify the bounds of this time period, Ofgem has relied on the years 2008 and 2009[1] being designated as 'outliers', claiming these years are sufficiently unusual such that (in Ofgem's view) they should be removed from the time period used for setting OE. These years, when considered in the round, and when appropriate statistical tests are applied, are in fact not outliers in relation to TFP growth. There is, therefore, no rationale for Ofgem to depart from its regulatory precedent (and best practice treatment of business cycles) on this point.

By mistreating business cycles and outliers, Ofgem has erroneously inflated the upper bound of its "narrow" range to 1.3%. Following the correct and established treatment of business cycles and outliers would yield an upper bound of only 0.9%. Accounting for this error also excludes Ofgem's target from the plausible range.

Figure 2: Applying the correct treatment of business cycles changes Ofgem's "narrow" range to 0.1% to 0.9%



Source: Economic Insight analysis of Ofgem's method.

[1] *While the removal of 2020 is also an error, the erroneous removal of 2008 and 2009 is most important in this context because it truncates the end of a complete business cycle.*

3 Error 3: Ofgem has placed disproportionate weight on unsubstantiated arguments to select a target from the upper end of the range, whilst failing to consider countervailing reasons to give weight to the lower end of the range.

Ofgem ultimately justifies its choice of an OE target for RIIO-3 towards the top of its range by espousing the benefits that innovation and technology will have for the sector. To justify this Ofgem has relied on: (i) a number of unsubstantiated comments about the scope for energy companies to benefit from new technologies at RIIO-3; and (ii) incorrect claims about how improvements in productivity translate from one industry to another. Furthermore, no consideration has been given to the numerous reasons to consider a more conservative target at RIIO-3. Thus, these claims are both 'incorrect', and 'asymmetric'.

Through this error, in only considering (albeit not in a detailed and evidence-based way) the reasons for setting an OE target towards the top of the range, Ofgem are implicitly accepting a greater risk of underfunding networks at RIIO-3. By contrast, selecting a figure from the midpoint takes a more balanced approach. The midpoint of Ofgem's "narrow" range is 0.7%.

Report structure.

The remainder of this report is structured as follows:

- In Chapter 2, we explain the rationale and evidence relating to Error 1 (erroneously relying on precedent of outcomes).
- In Chapter 3, we explain the rationale and evidence relating to Error 2 (erroneously relying on incomplete business cycles and an incorrect approach to outlier removal).
- In Chapter 4, we explain the rationale and evidence relating to Error 3 (erroneously relying on unsupported and incorrect claims to justify the use of a number at the top of its range).
- In Chapter 5, we summarise how correcting each error influences Ofgem's OE range and conclude that the method set out in our May 2024 Report remains our preferred method for estimating OE at RIIO-3.
- In the Appendix, we summarise where our views differ from Ofgem's in relation to the most appropriate way of setting the OE target and provide further details on our analysis.

2

RELYING ON PRECEDENT OF OUTCOME

Error 1: In setting its final OE target, Ofgem has erroneously relied on the precedent of outcomes at previous regulatory decisions, rather than the precedent of methods previously applied to determine those outcomes.

2A Chapter structure

In this chapter, we first explain why Ofgem's chosen target of 1.0% is contingent on the reliance of regulatory precedent of outcome rather than of method (in Section 2B). We then explain the rationale as to why this is an error, specifically:

- In Section 2C, we discuss that this approach is illogical and against the interests of customers and investors.
- In Section 2D, we show that relying on the outcome of a previous regulatory decision as precedent is inconsistent with Ofgem's broader approach to the price control.

We find that correcting this error by following precedent in method, rather than outcome, and re-applying its approach at RIIO-2 yields an OE range of -0.5% to 0.5%.

2B Ofgem relies on regulatory precedent of outcome rather than of method

In making its regulatory decisions, Ofgem may reasonably rely on analytical methods previously used to set regulatory targets. This approach makes the regulatory process more predictable and efficient. Ofgem appears to recognise this – for instance, in relation to totex benchmarking, it states that: "*Having a stable regulatory approach to determining the core funding for GDNs is also important in the context of the broader uncertainties that face the sector over the medium to long term*" [emphasis added].[2]

Consistent with the above, for most elements of the price control, Ofgem's approach is typically to: start with the method used at the previous price control, update it for the latest data, and, in some cases, consider refinements to the methodology (see Table 1 for examples). The reason for this is self-explanatory: namely, the purpose of economic regulation is to promote efficient prices/outputs. If a regulator (such as Ofgem) has established a broadly appropriate method for achieving this (which is then applied to relevant input data when making a price determination); it stands to reason that at subsequent price determinations a sensible starting point is to re-apply that method to the latest available data/evidence (because this will mean that future determinations continue to promote efficient prices/outputs, which is in the best interests of customers and investors).

From an economics perspective, we consider that there are circumstances where one might reasonably depart from this – for example, where:

- there was clear evidence that the method in question was materially deficient for the purpose of meeting regulatory objectives, meaning it needed to be reconsidered more fundamentally;
- a small, but clear, methodological refinement was identified that would increase the prospects of regulatory objectives being met; and/or
- the outcomes of the previous method were deemed undesirable (against the regulatory objectives) even if no obvious deficiency in the method had been identified.

[2] *'RIIO-3 Draft Determinations Overview Document', Ofgem (July 2025); paragraph 5.186.*

In the spirit of the second point, in our May 2024 report 'Ongoing Efficiency for Gas Networks at RIIO-3'[3] (herein, our '**May 2024 Report**'), we provide a method of estimating OE that can be applied over the long term, which is guided by clear principles (for example, a data driven approach to comparator selection) and can be updated simply with the addition of new data in future price controls.

In setting OE at RIIO-3, rather than a targeted methodological refinement, Ofgem has relied on the precedent of the actual OE target it had set at RIIO-2 (i.e. it has relied on the precedent of outcome). Indeed, at RIIO-3, a stated objective of Ofgem was to "*assess whether a 1% annual OE target is still reasonable for RIIO-3*"[4] and it ruled out "*the bottom half of the range identified in the GTh report…[which] would represent a significant departure from regulatory precedent*"[5] (of the OE target). We consider that this is:

- **Illogical and against the interests of consumers and investors**. Relying on regulatory precedent of outcome (rather than of method) runs contrary to promoting efficient prices/outputs, because it means (all else equal) regulatory decisions remain fixed over time, even if the evidential basis for those decisions has changed. In this case, since the evidence regarding the level of OE an energy network is likely to achieve can change over time (just as productivity in other industries, or the UK as a whole, can change – and has changed – over time), the level of OE set by Ofgem in the past is of little evidential value. A regulatory approach that places weight on precedent of outcome, and no weight on precedent of method, is illogical in this context – it is an extreme approach and one which logically results in the OE target being unchanged over time, irrespective of changes in evidence. Such an approach thus makes it less likely that Ofgem's determinations promote efficient prices/outputs.

- **Inconsistent with its approach to other elements of the price control**. Ofgem has relied, sensibly, on established methods across the rest of its proposed RIIO-3 methodology. Ofgem does not properly explain why it considers precedent of outcome, rather than precedent of method, to be an appropriate approach to adopt in relation to OE (but not other elements of its determinations). However, the regulator appears to somewhat attempt to justify this on the basis that: "*there is no agreed consensus on the preferred approach or methodology for determining OE*"[6] (despite later stating that using the growth accounting approach has "*strong regulatory precedent*"[7]).

Relying on the outcome of a previous regulatory decision as precedent is illogical and against the interests of customers and investors

Within a broader regulatory determination, regulators must make a series of individual decisions (in this case, the setting of an OE target). When making these individual decisions, to the extent that a regulator makes them on the basis of the precedent of its prior decisions (i.e. precedent of outcome, over precedent of method) it follows that the decision (e.g. the OE target) will remain the same in perpetuity. By extension, future decisions will be invariant to changes in the underlying evidence that the regulator relied upon when *making said decision in the first place.*

[3] *'Ongoing Efficiency for Gas Networks at RIIO-3'. Economic Insight (May 2024).*
[4] *'RIIO-3 Draft Determinations Overview Document'. Ofgem (July 2025); paragraph 8.23.*
[5] *'RIIO-3 Draft Determinations Overview Document'. Ofgem (July 2025); page 92.*
[6] *'RIIO-3 Draft Determinations Overview Document'. Ofgem (July 2025), page 91.*
[7] *'RIIO-3 Draft Determinations Overview Document'. Ofgem (July 2025), page 92.*

This is illogical and against the interests of customers and investors, because **it is inconsistent with promoting efficient prices/outputs** (which, by definition, must be informed by the best and latest available evidence as to the relevant demand and supply side factors that determine them). By way of example, suppose Ofgem adopted 'precedent of outcome' to every individual decision within its determinations: the price for energy, and the outputs companies are tasked with delivering, would never change (irrespective of fundamental changes to demand and supply conditions).

Ofgem does not consider the extent to which the underlying *evidence* pertinent to setting OE at RIIO-3 may itself have *'significantly departed'* from the same evidence it relied upon at RIIO-2, when the regulator set a target of 1.0%. If the relevant underlying evidence between RIIO-2 and RIIO-3 significantly varied, then logically so should the OE target. An approach of 'precedent of outcome' would only be consistent with promoting efficient prices/outputs 'by luck', and would tend to only occur in circumstances whereby the underlying evidence had itself, not changed (relative to the previous outcome relied upon by the regulator).[8] Thus, in relying on precedent of outcome, Ofgem is **implicitly assuming** that the input values and assumptions that applied when it previously set OE are still the same today. In reality, however, the relevant inputs and evidence have changed (most obviously, economic conditions today – including those pertinent to productivity performance – are different to those of RIIO-2 determinations, and different again to those of determinations prior to that). Ofgem's reasoning appears to ignore this, thus being an error.

2D Relying on the outcome of a previous regulatory decision as precedent is inconsistent with Ofgem's broader approach

Ofgem typically relies on precedent of method, rather than precedent of outcome, across the other elements of the RIIO-3 price determination.

For aspects of the determination where Ofgem has implemented material method changes, these are primarily motivated by an attempt to improve its method (so as to better promote efficient prices/outputs). However, in these instances, a departure from precedent of method does not imply Ofgem is placing weight on precedent of outcome; potential refinements in method are separate to the logical issue flagged above and is not a basis for reliance on precedent of outcome.

Ofgem's approach to OE (where it has started with the RIIO-2 target of 1.0% and sought to assess whether it *"is still reasonable for RIIO-3"*[9]) is, therefore, **contradictory and inconsistent with its approach to other elements of the price control**. To illustrate the effect of this, in Table 1, we present, for selected elements of the price control, what the RIIO-3 determination would be if:

(i) Ofgem relied on precedent of outcome (i.e. used the RIIO-2 outcome) for each element, as it has for OE; and

(ii) Ofgem relied on the precedent of method (rather than outcome). For the purpose of this exercise, we assume this is Ofgem's RIIO-3 DD position for all elements other than OE. For OE, we use the 'complete update' of CEPA's RIIO-2 approach that we presented in our May 2024 Report, since this reflects the OE range if the RIIO-2 approach was updated for the latest data.[10]

[8] *Of, if multiple changes in evidence had occurred, but in offsetting directions, so that (when considered in net terms) the implied decision would be identical to the one relied upon by the regulator.*

[9] *'RIIO-3 Draft Determinations Overview Document'. Ofgem (July 2025); paragraph 8.23.*

[10] *'Ongoing Efficiency for Gas Networks at RIIO-3'. Economic Insight (May 2024); table 24.*

This comparison highlights that, for many aspects of the price control (e.g. the WACC and RPEs), the outcome changes significantly when you update the inputs, rather than maintaining the outcome from the previous price control. This *correctly* reflects that the inputs used to reach the previous regulatory conclusion have changed (e.g. economic conditions have changed and new data points are now available). If Ofgem is to rely on regulatory precedent for OE (i.e. to correct this error), it should follow the same approach and update its RIIO-2 method – leading to a range of -0.5% to 0.5%.[11,12]

We also note that Ofgem and GTh appear to recognise these principles, but do not apply them consistently in practice. For example:

- GTh stated that, according to Ofgem, the setting of OE targets should be "*consistent with wider price control determinations. The methodology for setting the OE target should be consistent with the wider RIIO-3 determinations and specific elements, in particular with cost assessment*"; and the "*methodology for setting the OE target should be consistent with best practices and decisions made in comparable regulated sectors. The proposed approach should follow the rationale from previous RIIO determinations, whilst drawing on lessons from other sectors and being consistent with principles upheld in recent CMA decisions*" [emphasis added].[13]

- GTh also highlighted that its "*assessment was informed by economic theory; the analytical choices made by 'Cambridge Economic Policy Associates' ("CEPA") at RIIO-2; wider precedent for making these choices; and stakeholders' views on the key choices (including consultancy reports)*" [emphasis added].[14]

Thus, Ofgem has committed an error in arbitrarily deviating from its approach, against its own stated objectives and best practice.

[11] We have only included the TFP values from our 'complete update' of CEPA's RIIO-2 method in this range (and excluded the partial factor productivity measures). This is because Ofgem is now setting a single totex target (rather than separate repex/capex and opex targets), and the partial factor productivity measures were only used to inform the opex target.
[12] In our May 2024 Report we provide a superior method of estimating OE that can be applied over the long term, which is guided by clear principles (for example, a data driven approach to comparator selection) and can be updated simply with the addition of new data in future price controls. This yields a range of 0.2% to 0.8% and is consistent with the principle of making a small, but clear, methodological refinement to increase the prospects of regulatory objectives being met.
[13] 'Independent Report on Ongoing Efficiency'. Grant Thornton (June 2025); page 10.
[14] 'Independent Report on Ongoing Efficiency'. Grant Thornton (June 2025); page 12.

Table 1: Ofgem has relied on regulatory precedent of method (rather than of outcome) from RIIO-2 across the other elements of RIIO-3

Price control element	Ofgem's RIIO-3 approach	Determination if Ofgem relies on precedent of outcome	Determination if Ofgem relies on precedent of method
OE	Ofgem stated it would "*assess whether a 1% annual OE target is still reasonable for RIIO-3*".[15]	**1.0%**	**-0.5% to 0.5%**
RPEs	Ofgem "*decided to broadly maintain [its] RIIO-2 approach to RPEs for RIIO-3.*" However, it made small modifications to the approach, including "*incorporate[ing] additional indices into the RPE model*".[16]	**1.06%** (GDN) **1.08%** (NGT)[17]	**0.64%** (GDN) **1.31%** (NGT)[18]
Cost benchmarking	Ofgem largely maintained its RIIO-2 approach to cost benchmarking, continuing to use the same aggregation level, estimation technique, model specification and cost drivers – but updating the model to use the latest available data.[19]	**£10.0bn** (GD modelled totex)[20] **£2.1bn** (NGGT modelled totex)[21]	**£12.4bn** (GD modelled totex)[22] **£2.6bn** (NGGT modelled totex)[23]
Regional labour adjustment	Ofgem largely maintained its RIIO-2 method, but updated the underlying wage data to use the latest 5 years available.[24]	**1.18** (London) **1.10** (Southern) **1.012** (East of England)	**1.17** (London) **1.09** (Southern) **1.011** (East of England)[25]
WACC (CPIH real)	Ofgem largely maintained its RIIO-2 method to estimating the components of the WACC, updating for the latest data, and, in some cases, made modifications to refine the approach (often to align with UKRN guidance published since RIIO-2[26]). For example: ● **Cost of debt.** Ofgem maintained its broad RIIO-2 approach, in that the cost of debt is set with reference to a trailing average of a benchmark index. However, it updated the benchmark index from that used at RIIO-2 (iBoxx Utilities 10+) to an average of the iBoxx GBP A and iBoxx BBB non-financial 10+ corporate indices, due to its concerns around "*sectorial and issuer specific events in the Water sector*".[27] ● **Risk free rate.** Ofgem maintained its RIIO-2 approach of basing its estimate of the risk free rate on the none-month average of 20-year index linked gilts, and updated this for the latest data.[28] ● **Beta.** Ofgem maintained its broad approach to setting beta, however it expanded the comparator set used.	**2.81%** (Cadent, SO, and GT) **2.85%** (SC, NGN, and WWU)[29]	**4.22%**[30]

Source: Economic Insight analysis of Ofgem RIIO-2 FD and RIIO-3 DD.

[15] *'RIIO-3 Draft Determinations Overview Document'. Ofgem (July 2025); paragraph 8.23.*
[16] *'RIIO-3 Draft Determinations Overview Document'. Ofgem (July 2025); paragraph 6.33 & 6.36.*
[17] *We use the average RIIO-2 forecast RPE across the 5 years of the price control. For NGT, we use a simple average of NGGT (To) and NGGT (SO). See: 'RIIO-2 Final Determinations - Core Document'. Ofgem (December 2020); table 9.*
[18] *We use the average proposed RIIO-3 forecast RPE across the 5 years of the price control. See: 'RIIO-3 Draft Determinations Overview Document'. Ofgem (July 2025); table 13.*
[19] *'RIIO-3 Draft Determinations Overview Document'. Ofgem (July 2025); pages 133-147.*
[20] *'RIIO-2 Final Determinations – GD Sector Annex (REVISED)'. Ofgem (February 2021); table 9.*
[21] *'RIIO-2 Final Determinations - NGGT Annex (REVISED)'. Ofgem (February 2021); table 1.*
[22] *'RIIO-3 Draft Determinations Overview Document'. Ofgem (July 2025); table 19.*
[23] *'RIIO-3 Draft Determinations – Gas Transmission'. Ofgem (July 2025); table 7.*
[24] *'RIIO-2 Final Determinations – GD Sector Annex (REVISED)'. Ofgem (February 2021); pages 107-114.*
[25] *'RIIO-2 Final Determinations – GD Sector Annex (REVISED)'. Ofgem (February 2021); paragraph 5.71.*
[26] *'RIIO-3 SSMC Finance Annex'. Ofgem (December 2023); page 24-25.*
[27] *'RIIO-3 Draft Determinations - Finance Annex'. Ofgem (July 2025); page 14-16.*
[28] *'RIIO-3 Draft Determinations - Finance Annex'. Ofgem (July 2025); paragraph 3.16.*
[29] *'RIIO-2 Final Determinations – Finance Annex (REVISED)'. Ofgem (February 2021); table 20 and 21.*
[30] *'RIIO-3 Draft Determinations - Finance Annex'. Ofgem (July 2025); table 20.*

3

APPROACH TO OUTLIERS

Error 2: In calculating its upper and lower range, Ofgem has erroneously: (i) relied on incomplete business cycles, biasing its results; and, relatedly; (ii) removed three years from its analysis (2008, 2009, 2020), incorrectly referring to them as outliers.

3A Chapter structure

In this chapter, we explain why the upper bound of Ofgem's "narrow" range (1.3%) is upwardly biased; the error that has led to this figure; and what happens to the upper bound of Ofgem's range when this is corrected. In particular:

- In Section 3B, we explain that the upper bound of Ofgem's range is upwardly biased, because it relies on a period of only positive GDP growth (1997-2007), rather than a complete business cycle. Ofgem should instead, and in-line with best practice, rely on a complete business cycle.[31] To rely on an incomplete business cycle is an error, and inconsistent with the CMA's view of best practice.

- In Section 3C, we explain that, while outlier removal in this context is not part of an established regulatory precedent of method, or indeed best practice (one should rely on complete business cycles), *if outliers were to be excluded* from the data for the purpose of setting OE (which we do not recommend), it should be done on an robust statistical basis. We explore two methods of removing outliers that Ofgem could have used if, hypothetically, it was appropriate to remove outliers from business cycles.

- In Section 3D, we then demonstrate that Ofgem's approach to outlier removal is arbitrary and inconsistent by examining what happens if Ofgem's implicit rationale/approach to removing 2008, 2009 and 2020 was applied across the rest of the data. Specifically, we firstly identify what outlier threshold would need to be applied for Ofgem to find that 2008, 2009 and 2020 are outliers. We find that this threshold is very strict, arbitrary, and not in line with conventional outlier thresholds. Then, we apply this arbitrary threshold to the dataset as a whole, finding that many (indeed, most) other years are also 'outliers' by this definition. Hence, Ofgem's arbitrary threshold is applied inconsistently to the data.

- In Section 3E, we describe how adjusting Ofgem's analysis to correct this error (i.e. include full business cycles) substantially reduces the upper bound of its range (down to 0.9% from 1.3%). This involves adding back in their chosen 'outliers' to the end of the period, but also extending the start of the period to include the beginning of the business cycle, which Ofgem also erroneously removes.

We find that Ofgem's outlier removal is an error both in principle (because the benchmarking analysis requires the use of full business cycles) and in practice (because its approach to outlier removal is not based on evidence and is internally inconsistent).

3B The upper bound of Ofgem's range is upwardly biased as it relies on a period of only positive GDP growth (1997-2007), rather than a complete business cycle

It is well-established under previously applied regulatory methodologies that analysis of productivity growth should be conducted over complete business cycles.[32] For example:

[31] *Though we do not necessarily consider that the 1992-2009 business cycle specifically is the most appropriate business cycle for forming an upper bound for the OE range.*

[32] *This is because productivity is pro-cyclical. One is more likely to obtain a balanced OE estimate by ensuring any analysis includes a full 'peak-and trough' business cycle.*

- **At the PR19 redeterminations for the water sector, the CMA concluded that:** "*Productivity growth should be assessed over full business cycles because productivity growth is typically procyclical*".[33]

- **CEPA, in its advice to Ofgem at RIIO-2, highlighted that:** "*If the sample includes an incomplete business cycle, it may result in a biased estimate of the expected conditions for the upcoming price control period.*"[34]

- **In its advice to Ofwat for PR24, CEPA maintained that:** "*The most robust approach to assessing historical productivity growth is to assess average productivity growth over a complete business cycle*".[35]

> *"Productivity growth should be assessed over full business cycles because productivity growth is typically procyclical"- CMA (2021)*

The rationale for using complete business cycles is that, as identified by the CMA, productivity growth is procyclical (i.e. it is positively correlated with GDP growth). This means that complete business cycles should be used to avoid biasing any estimates of OE.[36]

Ofgem and its advisors appear to be in agreement with this, respectively stating that "*we think that it is reasonable to give consideration to longer time periods, to reflect productivity cycles*"[37] and that it is "*common practice to look at average productivity growth over at least a business cycle, to smooth these cyclical fluctuations*"[38].

However, in a departure from both regulatory precedent (of method) and the best practice described above, Ofgem has removed the years 2008, 2009 and 2020 from its data set. We note that:

- Ofgem did not remove these years in its RIIO-2 approach (i.e. this is a departure of precedent of method).

- Ofgem has provided no new (or indeed any) evidence to suggest that these years are 'special'. Ofgem's advisors only make the following, unevidenced, claims:

  - "*the Great Financial Crisis of 2008-2009 was a generational event that had a large negative impact on economic growth, both immediately and during its aftermath*"[39]; and

  - *"[t]he years of the Great Financial Crisis (2008 and 2009) and of the Covid-19 pandemic (2020 and 2021) were excluded given that these were (1) outliers in terms of productivity growth; (2) unprecedented events in recent history that have a low likelihood of being repeated in the near future*"[40].

[33] *'PR19 redeterminations: final report'. CMA (March 2021); paragraph 4.533.*
[34] *'RIIO-GD2 and T2: Cost Assessment – Frontier shift methodology paper'. CEPA (May 2020); page 11.*
[35] *'Frontier Shift, Real Price Effects and the energy crisis cost adjustment mechanism'. Ofwat (June 2024); page 63.*
[36] *We discuss this further in our May 2024 Report. See: 'Ongoing efficiency for gas networks at RIIO-3'. Economic Insight (May 2024); page 22.*
[37] *'RIIO-3 Draft Determinations Overview Document'. Ofgem (July 2025); page 93.*
[38] *'Independent Report on Ongoing Efficiency – RIIO-3 Technical Annex'. Grant Thornton (June 2025), page 21.*
[39] *'Independent Report on Ongoing Efficiency – RIIO-3 Technical Annex'. Grant Thornton (June 2025), page 21.*
[40] *'Independent Report on Ongoing Efficiency – RIIO-3 Technical Annex'. Grant Thornton (June 2025), page 21.*

Furthermore, GTh make it clear that it has not adequately investigated business cycles in its analytical process. It states that "[w]*hilst individual business cycles have not been identified the time span covered by each of these three time periods* [1970-1996, 1997-2007 and 2010-2019] *is large enough to contain multiple full business cycles*"[41]. This statement demonstrates that GTh has missed a critical step in its analysis and, as a result, incorrectly concluded that its periods of analysis contain complete business cycles. We consider this to be an error.

As we explain in our May 2024 Report, business cycles should be identified using credible independent sources. This avoids the critique that the chosen time periods are arbitrary. For example, the Economic Cycle Research Institute (ECRI) has published peak and trough dates for business cycles across 22 different countries (including the UK) since the 1970s. Table 2 provides a summary of the business cycles it has identified for the UK.

Table 2: ECRI UK business cycle peak and trough dates, 1974 - 2020

Business cycle	Peak / Trough	Dates
1974-75	Peak	September 1974
	Trough	August 1975
1975-1981	Peak	June 1979
	Trough	May 1981
1981-1992	Peak	May 1990
	Trough	March 1992
1992-2009	Peak	August 2008
	Trough	January 2010
2010-2020	Peak	October 2019
	Trough	April 2020

Source: Economic Insight analysis of 'Business Cycle Peak and Trough Dates, 22 Countries, 1948-2020.' (ECRI) (last accessed 9 February 2023).

In comparison to these business cycles, the time periods GTh has identified – 1970-1996, 1997-2007 and 2010-2019 – are respectively: too long; too short; and too short. While the identification of business cycles is inherently *somewhat* subjective, GTh has not engaged with the issue at all and, moreover, has not given any evidence to support its chosen dates. This is unusual, given the extensive discussion of business cycles by Ofgem's advisors CEPA at RIIO-2 (which, notably, reach different conclusions to GTh).[42]

Of particular concern is that Ofgem's proposed 1.0% OE target is, under its current approach, justified only by estimates drawn from a period of entirely *positive* GDP growth – which, as a result, are upwardly biased. Ofgem's proposed OE range (0.1%-1.3%) is based on four time periods:

(i) **1970-1996** – which results in an estimate of 0.5%;

[41] *'Independent Report on Ongoing Efficiency – RIIO-3 Technical Annex'. Grant Thornton (June 2025), page 21.*

[42] *'RIIO-GD2 and T2: Cost Assessment – Advice on Frontier Shift policy for Final Determinations'. CEPA (November 2020), page 18.*

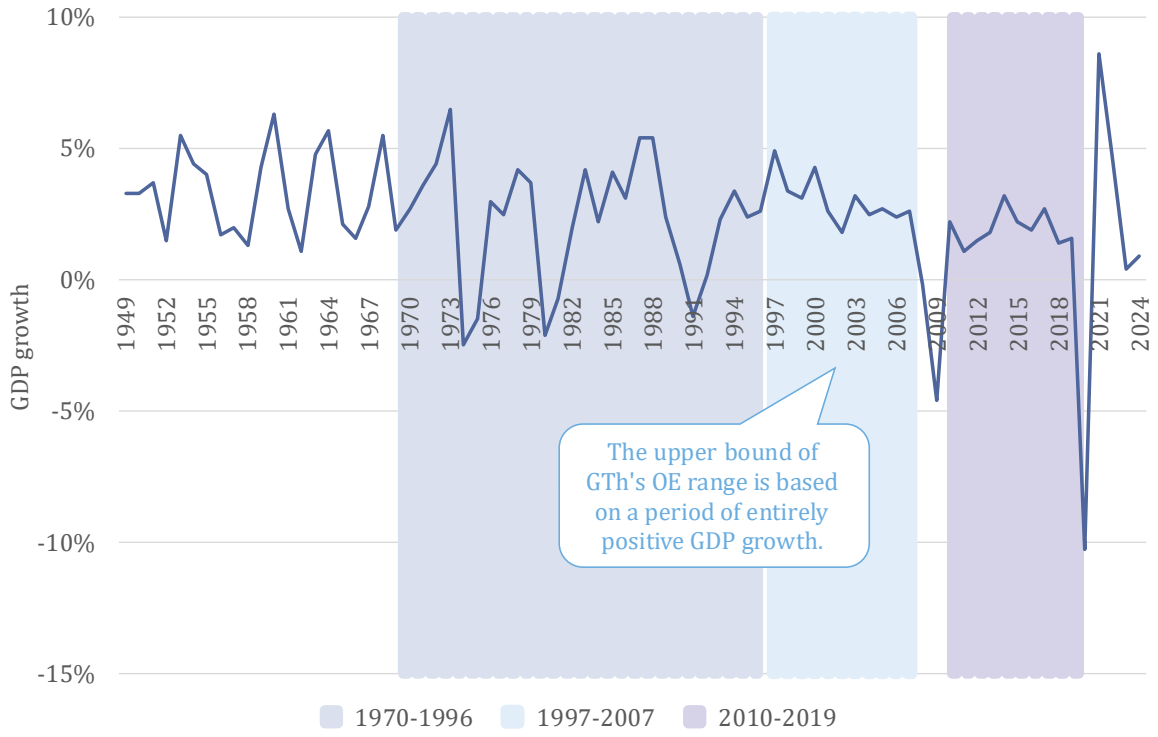
(ii) **1997-2007** – 1.3%;

(iii) **2010-2019** – 0.1%; and

(iv) **1970-2019 average**, excluding 2008 and 2009 – 0.7%.

Figure 3 shows how these time periods compare to UK GDP growth. We observe that the time period (1997-2007) which corresponds to the upper bound of Ofgem OE range (1.3%) coincides with a period of entirely *positive* GDP growth (rather than a complete business cycle). Given that GDP growth and productivity growth are positively correlated, it follows that any OE estimates based on this time period are upwardly biased. Excluding the time period, reduces Ofgem's OE range to 0.1%-0.7%, which no longer supports its proposed target (1.0%).

Figure 3: The upper bound of GTh's OE range is not based on a complete (trough to trough) business cycle



Source: Economic Insight analysis of ONS data.

3C We do not recommend removing outliers for the purpose of setting OE, but if outlier removal were to be done, it should be done on an established and consistent statistical basis

While outlier removal in the context of analysing complete business cycles is not part of an established regulatory precedent (of method), or indeed best practice, if outlier removal *were* to be done when setting OE (which we do not recommend), it should be implemented on a robust statistical basis. That is to say, outlier removal is a technical issue and should be treated as such. Ofgem's advisors state that *"every care was taken … to choose sectors and time periods in an evidence-*

based way";[43] but this is plainly untrue. Ofgem's current approach is asymmetrical and only removes observations where, in their view, productivity growth is abnormally low. A balanced method would be symmetrical and consider both outliers where productivity growth is abnormally high and abnormally low equally.

While we reiterate that 'outlier' removal is inconsistent with the proper treatment of business cycles, we demonstrate how two statistical, evidence based, methods for identifying outliers contradict Ofgem's claims that its chosen outlier years are, in some way, *"unprecedented"*[44]:

- **Z-score method**. We first take the average growth rates of Ofgem's chosen comparator industries[45] in each year to create a single, aggregated comparator. Then, we define an individual year as an outlier if it is more than three standard deviations[46] above or below the mean TFP growth over the period. Under this approach, 0 years are outliers in the NACE 2 dataset (from 1996-2020); and 1 year is an outlier in the NACE 1 dataset (from 1971-2007). Namely, the only 'outlier' year under an application of this method is 1974.

- **Mahalanobis distance method**. Instead of combining the comparator industries into a single average, this method looks at the productivity growth of all comparator industries together in each year. It identifies a year as an outlier if the overall pattern of growth across all industries is unusually different from the typical pattern – regardless of whether the growth is unusually high or low.[47] Under this approach: 1 year is an outlier in the NACE 2 dataset; and 3 years are outliers in the NACE 1 dataset. Namely, the only 'outlier' years are: 1973, 1980, 1982 and 2020.

Hence, in contrast to Ofgem's supposition, there is very limited evidence to suggest that:

- 2008, 2009 and 2020 are remarkable years worthy of removal from the data (i.e. there is something uniquely 'special' about these three years that warrants their exclusion from the data, with no implication for any other years within the data).

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[43] 'Independent Report on Ongoing Efficiency – RIIO-3 Technical Annex', Grant Thornton (June 2025), page 7.

[44] The full results of this analysis can be found in Section 6D of the appendix.

[45] For NACE 1: 'Construction', 'Trade', 'Transport and storage', 'Financial intermediation', 'Chemicals and chemical products', 'Rubber and plastics products', 'Electrical and optical equipment', 'Machinery, nec', 'Transport equipment', 'Manufacturing nec; recycling', 'Post and telecommunications', 'Renting of m&eq and other business activities', where annual TFP growth for manufacturing industries is aggregated by simple average. For NACE 2: 'Construction', 'Wholesale and retail trade; repair of motor vehicles and motorcycles', 'Transportation and storage', 'Financial and insurance activities', 'Chemicals; basic pharmaceutical products', 'Manufacture of rubber and plastic products and other non-metallic mineral products', 'Computer, electronic, optical products; electrical equipment', 'Manufacture of machinery and equipment n.e.c.', 'Manufacture of motor vehicles, trailers, semi-trailers and of other transport equipment', 'Manufacture of furniture; jewellery, musical instruments, toys; repair and installation of machinery and equipment', 'Information and communication', 'Professional, scientific and technical activities; administrative and support service activities', where annual TFP growth for manufacturing industries is aggregated by simple average.

[46] That is to say, its Z-score is greater than three, where for an observation with value 'x' the Z-score = (x – mean)/standard deviation. Classing outliers based on a Z-score of greater than 3 is widely practiced in the literature and statistical textbooks. For further details see Leys (2019) [https://rips-irsp.com/articles/10.5334/irsp.289], Bakker and Wicherts (2014) [https://pubmed.ncbi.nlm.nih.gov/24773354/], Tabachnick (2013) [http://ndl.ethernet.edu.et/bitstream/123456789/27657/1/Barbara G. Tabachnick_2013.pdf], Theriault (2024) [https://remi-theriault.com/papers/Theriault_et_al_2024.pdf].

[47] In this case, the standard threshold for an outlier is determined by using the chi-squared distribution, with degrees of freedom equal to the number of comparator industries and a confidence level of 95% or above . This yields a threshold of 14.06, based on 7 degrees of freedom (the number of comparator industries in NACE 1 and NACE 2). The Mahalanobis distance measures how far each year's vector of industry growth rates is from the multivariate mean, while accounting for the variance and correlation structure between industries.

- No years other than 2008, 2009 and 2020 might be remarkable and worthy of investigation. We note, for example that the highly productive year in 1982 is not considered as an outlier worthy of removal. We consider that Ofgem's focus on removing supposed outlier years is therefore not only inconsistent, but also asymmetric.

These results and the subsequent results in this chapter are based on our replication of GTh's analysis, which we detail in the Appendix. While we have been unable to replicate GTh's results perfectly, our replication leads to the same overall range. We understand that Ofgem were asked to provide GTh's analysis but it stated it was "*unable to share the underlying calculations*".[48]

3D Ofgem's approach to outlier removal is arbitrary and inconsistent

As a further exercise, in the following section we set out the implications for outlier removal if criteria consistent with the exclusion of 2008; 2009; and 2020 from the data, were applied across the dataset as a whole (i.e. what would happen if Ofgem's approach was applied consistently). Again, we reiterate that we do not recommend that 'outliers' should be removed for the purpose of setting OE since it is not part of an established regulatory precedent of method, or indeed best practice (one should rely on complete business cycles).

To do this, we consider what thresholds would be required (under the two statistical approaches to outlier removal set out in the previous section – the Z-score and Mahalanobis distance methods) in order for 2008, 2009 and 2020 to be identified as 'outliers' within the dataset. For example, in relation to the Z-score, rather than a standard threshold of '3' (which would not result in those three years being removed) we identify what threshold, would, in fact, be consistent with their removal. We then assess what the application of that (lower) threshold for outlier identification would imply for other years within the dataset. We then do similarly for the Mahalanobis distance method. Having undertaken this analysis, we find that[49]:

- **Z-score method**. A significantly lower threshold Z-score of 0.60 would be required (rather than 3). This would necessitate the removal of 13 of a total of 25 years of data in NACE 2 and a removal of 18 of a total of 37 years of data in NACE 1.

- **Mahalanobis distance method**. A significantly lower threshold Mahalanobis distance of 2.37 would be required (rather than 14.06). This would necessitate the removal of 22 of a total of 25 years of data in NACE 2 and a removal of 33 of a total of 37 years of data in NACE 1.

Plainly, to remove such a large quantity of data further contradicts the principle of including full business cycles in the analysis and demonstrates the scale of inconsistency in GTh's outlier removal approach (and therefore, as arises under Ofgem's decision in relation to OE). In any case, as previously stated, we do not support the removal of outliers in relation to the setting of OE targets (again, because it is best practice to include complete business cycles).

[48] *'Cadent-DDQ41 follow up Ofgem response'. Cadent (August 2025); page 3.*

[49] *The full results of this analysis can be found in Section 6D of the appendix.*

3E Adjusting Ofgem's analysis to add back in the outliers and include full business cycles, substantially reduces the upper bound of its range

Ofgem has made an error in using an incomplete business cycle to calculate the upper bound of its "narrow" range. This error results from its truncating of:

- the end of the business cycle (2008-09), motivated by an unevidenced removal of "outliers"; and
- the start of the business cycle (1992-1997), which is unmotivated and appears to only result from a failure to identify any business cycles in the first place.

To correct the error made in the use of incomplete business cycles (and relatedly, the treatment of outliers) under Ofgem's OE decision, we re-calculate the regulator's "narrow" OE range as follows:

- We firstly reverse the erroneous outlier removal, by taking the period that forms the upper bound of GTh's range (1997-2007) and adding back in Ofgem's proposed outliers (2008 and 2009) that are present within this date range. In doing so, the upper bound of Ofgem's "narrow" OE range falls from 1.3% to 0.8%.
- Then, given that 1997-2009 does not represent a complete business cycle, we next extend the time period to include the nearest complete business cycle (1992-2009). As a result, the upper bound rises slightly to 0.9%.

4

ASYMMETRICAL INVESTIGATION

Error 3: Ofgem has placed disproportionate weight on unsubstantiated arguments to select a target from the upper end of the range, whilst failing to consider countervailing reasons to give weight to the lower end of the range.

4A Chapter structure

Ofgem ultimately justifies its choice of an OE target for RIIO-3 towards the top end of its "narrow" range by espousing the benefits that innovation and technology will have for the sector. In this chapter, we describe how, in order to do so, Ofgem has erroneously:

- Asserted that gas networks are one of the most innovative sectors of the economy, in Section 4B.
- Conflated productivity improvements delivered by companies (through the value they add themselves via innovation in the transformation of inputs, including intermediate inputs, into outputs) with productivity improvements companies benefit from (as the buyers of inputs, including intermediate inputs, where those inputs are subject to beneficial technological change). We address this in Section 4C.
- Asserted the power of AI to transform the sector, in Section 4D.

Finally, in Section 4E, we discuss how Ofgem has only made such incorrect and unevidenced claims to support a number at the top of its range. No consideration has been given to the numerous reasons to consider a more conservative target at RIIO-3. Thus, these claims are both 'incorrect', but also 'asymmetric'.

Through this error, in only considering (albeit not in a detailed and evidence-based capacity) the reasons for setting an OE target at the top end of the range, Ofgem are implicitly accepting a greater risk of underfunding networks at RIIO-3.

4B Asserting that gas utilities is one of the most innovative sectors of the economy

Ofgem, in part, justifies the upper bound of its OE range at RIIO-3 by suggesting gas networks will benefit from "*above average technological change*"[50]. Furthermore, its advisors state that a target at the top end of the range is consistent with a view that *"regulated companies are more akin, in terms of productivity growth potential, to the historically higher performing sectors of the economy (such as Manufacturing and Information & communication)"*[51].

We consider these arguments to be speculative and unsubstantiated, as no material evidence has been provided to support them. We acknowledge that it is inherently uncertain whether gas networks will benefit more or less from technological change than other industries, and that there is limited existing research or evidence on this topic. This makes it inherently challenging to form a definitive view on whether gas networks should be expected to benefit from above or below average technological change over RIIO-3. However, in the absence of evidence, we consider that it is regulatory best practice to take a cautious and balanced approach that does not assume the gas networks will outperform or underperform the wider economy in terms of their potential to benefit from technological change.

However, due to the previously limited evidence on this matter, we have conducted a survey of UK based experts in technology. We hope that this will assist Ofgem by providing a qualitative insight into whether the gas networks may be able to benefit from above average technological change. The

[50] *'RIIO-3 Draft Determinations Overview Document', Ofgem (July 2025); page 92.*

[51] *'Independent Report on Ongoing Efficiency – RIIO-3 Technical Annex', Grant Thornton (June 2025), page 8.*

survey was distributed to experts in academia, industry, and the public sector (across a wide range of disciplines). This approach ensures that the sample covers a diverse range of viewpoints and, once aggregated, reflects a knowledge base that includes a spread of technologies and industries (recognising that no one individual will be an expert in all industries, or all technologies). The survey asked the experts to rank UK industries according to which they consider will see the largest (net) positive productivity impact arising from all technological trends, in combination, over the next 5 years.[52]

Table 3 (overleaf) presents the results. We find that the experts expect the 'Regulated gas transmission and distribution networks' to see *lower* net positive productivity improvements from new technologies than *nearly every* other UK industry. On average, the experts rank the 'Regulated gas transmission and distribution networks' as 17th out of 18 industries in terms of those expected to benefit the most from productivity improvements due to new technologies. In contrast, the industries one would expect to be the most 'high-tech' are expected to benefit the most, such as 'Information & Communication'; 'Professional, Scientific & Technical Activities'; and 'Manufacturing'.

Contrary to Ofgem's claim that gas networks are expected to benefit from "*above average technological change"*, these results indicate that gas networks are actually expected to benefit less than nearly every other industry. This is consistent with the rationale presented in our May 2024 Report, which explained that gas networks have limited ability to benefit from technological change because they are characterised by long-lived assets that are not replaced frequently. This means that the introduction of new technologies is inherently slow.[53] In light of this, we consider that it is an error for Ofgem to rely on the unfounded expectation that gas networks will benefit from "*above average technological change"* to select an OE target towards the upper end of its range (particularly given that Ofgem has provided no robust evidence to support its claim).

It is also notable that the results show that the experts expect the regulated gas networks to see *lower* net positive productivity improvements from new technologies than the other regulated utilities. The experts rank the 'Regulated gas transmission and distribution networks' 17th out of 18 industries, which compares to 9th for the 'Regulated electricity transmission and distribution networks' and 15th for the 'Regulated water and wastewater companies'.

Overall, we conclude that Ofgem have erred because the views of leading academics on productivity contradict their unevidenced assertions that the networks will enjoy above average technological change.

[52] Further details on our survey methodology can be found in the Appendix.

[53] 'Ongoing Efficiency for Gas Networks at RIIO-3'. Economic Insight (May 2024), page 67-68.

Table 3: Ranking of industries expected to see the largest (net) positive productivity impacts arising from all technological trends in combination over the next 5 years

Industry	Overall rank	Average rank	Number of respondents that reported each rank																
			1st	2nd	3rd	4th	5th	6th	7th	8th	9th	10th	11th	12th	13th	14th	15th	16th	17th	18th
Information & communication	1	4.5	5	6	1	5	2	1	3	0	4	0	0	0	0	1	0	0	0	0
Professional, scientific & technical activities	2	4.6	6	2	5	2	6	2	2	0	0	0	0	0	3	0	0	0	0	0
Manufacturing	3	5.0	5	5	4	3	1	3	1	1	1	1	0	0	2	0	0	0	0	1
Financial & insurance activities	4	7.0	3	2	4	5	1	1	1	2	0	2	1	0	1	1	2	1	0	1
Administrative & support service activities	5	7.2	4	2	3	3	1	1	1	0	2	1	3	3	1	1	1	1	0	0
Transportation & storage (excluding airports)	6	7.6	0	2	2	2	4	2	3	3	4	1	1	0	1	1	0	1	1	0
Construction	7	7.6	0	3	0	1	4	6	4	1	1	1	2	1	1	1	0	2	0	0
Mining and quarrying	8	9.2	3	1	3	2	0	0	1	1	1	2	3	1	2	4	1	2	1	0
Regulated electricity transmission and distribution networks	9	9.9	0	3	0	1	1	1	1	4	2	4	0	2	3	2	0	2	1	1

Electricity, gas, steam & air conditioning supply (excluding regulated electricity and gas distribution and transmission networks)	10	10.2	2	0	1	0	0	1	5	0	4	2	2	2	1	2	2	2	2	0
Airports	11	10.4	0	1	3	0	2	3	0	2	1	1	2	2	1	1	4	2	3	0
Agriculture, forestry & fishing	12	11.0	0	0	1	1	3	2	1	2	0	0	1	4	4	3	1	2	2	1
Wholesale and retail trade; repair of motor vehicles & motorcycles	13	11.9	0	0	1	1	0	0	1	2	2	3	2	4	1	2	3	4	2	0
Water supply; sewerage, waste management & remediation Activities (excluding regulated water and wastewater companies)	14	12.0	0	0	0	0	1	0	2	2	2	4	3	5	0	0	0	4	3	2
Regulated water and wastewater companies	15	12.6	0	0	0	0	1	0	0	6	0	3	2	2	1	3	2	0	4	4
Real estate activities	16	12.7	0	0	0	1	0	2	1	2	1	2	1	1	2	1	6	2	5	1
Regulated gas transmission and distribution networks	17	13.8	0	0	0	0	0	1	0	0	2	1	3	1	3	4	5	2	3	3
Other services	18	13.9	0	1	0	1	1	2	1	0	1	0	2	0	1	1	1	1	1	14

Source: Economic Insight analysis of technology survey responses (N=30).

4C Conflating more productively produced intermediate inputs with productivity growth for the buyer of these inputs

Ofgem asserts that gas networks will enjoy greater productivity growth because they are increasing spending on intermediate inputs, which are enjoying high productivity growth in their production. Specifically, Ofgem states "*[g]rowth accounting analysis shows that the IT and communications sector has comparatively strong historical productivity growth rates compared to many other sectors. Therefore, the additional funding we have proposed for IT&T and data and digitalisation activities offers significant opportunity for network companies to drive efficiency improvements*"[emphasis added][54]. This is an error of logic; increased productivity in the production of gas network's inputs does not lead to an increase in the productivity of gas networks themselves.

If the IT sector starts producing new and innovative products, holding input factors constant, revenues (and subsequently Gross Value Added) can increase through the firm: (i) charging higher prices; and/or (ii) selling increased volumes. This will register as an increase in the productivity of this sector. If a downstream sector (such as gas distribution) starts to buy these products (to boost their own output), their consumption of inputs will increase through: (i) higher prices; and/or (ii) purchasing an increased volume. Plainly, the increased productivity of the IT sector does not translate one-to-one into higher productivity growth for the downstream sector. While the downstream sectors' outputs (prices and volumes, thus revenues and GVA) may increase as a result of utilising the new technology, critically their use of inputs (including what they have paid for them) has also increased. That is to say, in terms of productivity growth, the inventor of the technology gains more than the downstream buyer.

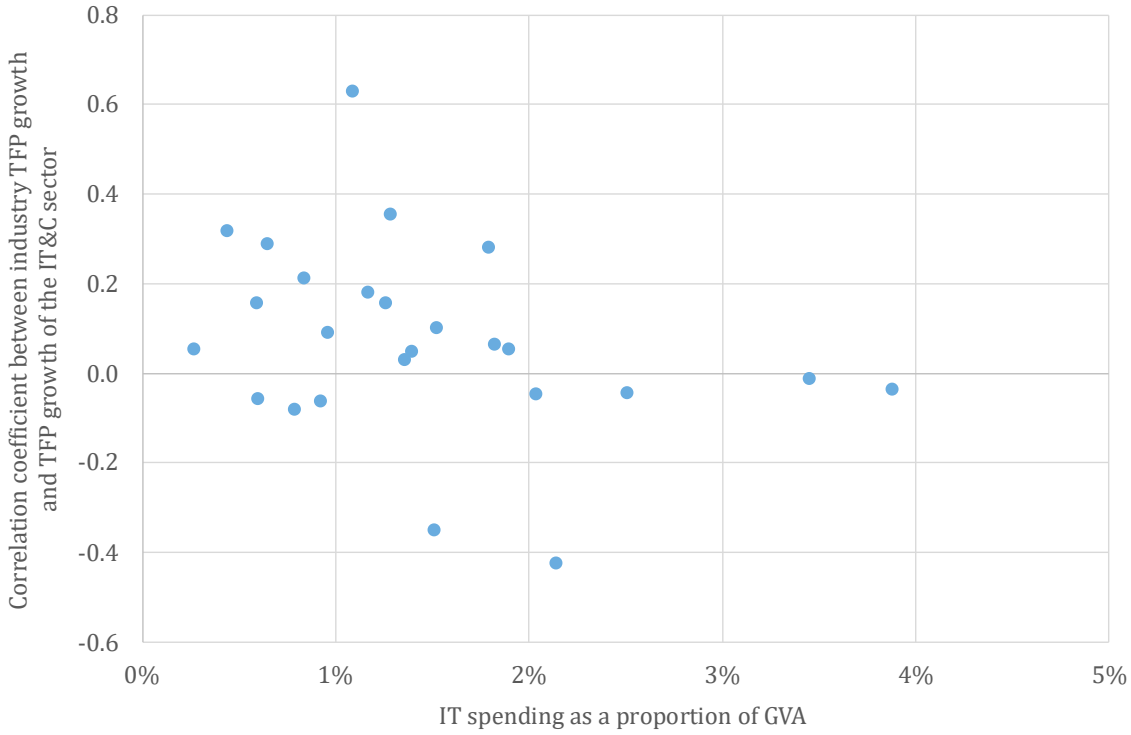
To the extent that increased productivity in the IT sector might translate by some amount (albeit less than one-to-one), we note that Ofgem proposes to cut the spending allowances that companies have requested for data and digitalisation by 11% (from £958.3m to £854.5m).[55] The OE targets proposed in company business plans (already materially below Ofgem's proposed 1%) are contingent on the originally proposed funding arrangements, not Ofgem's revised proposal. Should such a funding cut be made, companies may need to revise their original proposal OE targets downwards.

Beyond this matter of logic, we also note that the data does not lend credence to Ofgem's assertions that gas networks spending more on IT&T will yield higher productivity due to the IT sector becoming more productive. If high IT&T productivity growth was shared with companies that are spending heavily on IT&T, we would expect to see a positive correlation between the following variables:

- **Spending on IT as a % of GVA**.[56] This is the sum of industry spending on "Computer Software and Databases"[57] and "Purchases of computer and related services".[58]
- **The correlation coefficient between TFP growth for each SIC code and TFP growth of Information and Communication (IT&C)**.[59] Industries with a high correlation of TFP growth with the IT&C sector tend to experience high (or low) TFP growth at the same time as the IT&C sector.

[54] *'RIIO-3 Draft Determinations Overview Document'. Ofgem (July 2025); page 93.*
[55] *'RIIO-3 Draft Determinations Overview Document'. Ofgem (July 2025); page 117.*
[56] *'Regional gross value added (balanced) by industry: all ITL regions'. ONS (April 2025);*
[57] *'Investment in intangible assets in the UK'. ONS (November 2024).*
[58] *'ANNUAL BUSINESS SURVEY - 2019 Results'. ONS (January 2025). The ONS provided this in response to our request via email.*
[59] *'EU KLEMS growth accounts basic'. EU KLEMS (August 2025); UK growth accounts basic.*

Figure 4: High IT&T productivity growth is not shared with companies that are spending heavily on IT&T



Source: Economic Insight analysis of ONS and EU KLEMS data.

However, such a correlation is not observed in the data (as Figure 4 illustrates), in line with the logic described above.

We note that Ofgem also states that its chosen point estimate for OE (1.0%) "*also gives some weight to the expectation that companies should expect to see productivity benefits from their historical investments in RIIO-2 and planned investments in RIIO-3 in IT&T, data and digitalisation and innovation projects*"[60]. We consider that this claim is vague and raises a number of questions. Firstly, it is unclear how Ofgem have decided to apportion these productivity benefits of investment of IT spend at RIIO-2 between RIIO-2 itself and RIIO-3. Secondly, it is unclear how Ofgem will apportion these productivity benefits of investment in IT between RIIO-3 and RIIO-4. Without a clear method of appointing these effects, the regulator could easily mistakenly double count the effect of each investment (i.e. within the price control that it is made and in the subsequent price control).

4D Unevidenced claims about AI

Grant Thornton state that the upper end of its range is "*representative of the period 1997-2007, which saw significant productivity growth, driven by the improvement in information and communication technologies and their widespread adoption*" and further state that "*the 1997-2007 period benefitted from the development and spread (albeit fitful) of information and communication technologies, which*

[60] *'RIIO-3 Draft Determinations Overview Document', Ofgem (July 2025); page 94.*

may have some parallels with the current trends around AI and associated technologies"[61]. Any parallels that this "*may"* have with AI and its specific effects on the gas networks are not elaborated on. Nor does it explore or speculate on any of the avenues through which AI might benefit particular processes or workstreams undertaken by gas networks at RIIO-3. It nonetheless follows, in its report, that the growth in the use of AI will in large part replicate the productivity growth of the 1997-2007 period[62] in the coming price control.

We note that the period following the financial crisis also saw the adoption of new and innovative technologies, such as smart phones, cloud storage and computing, collaborative work software, and 3D printing but remained a period of low productivity growth. This introduction of new technology into the economy is an ongoing process, meaning that it is always reflected in the data. Furthermore, new technologies that were once expected to improve productivity growth have often not, as reflected in Solow's famous quote: "*You can see the computer age everywhere but in the productivity statistics*".[63]

Moreover, even when a new technology does have an increasing impact on productivity (for an economy or industry), this does not mean overall productivity growth will permanently increase. This is because there is a continual cycle whereby:

- new technologies are introduced, which may lead to temporary growth in productivity; and
- old technologies are phased out (reflecting the fact that their benefits have been exhausted, meaning they are no longer increasing productivity).[64]

Thus, an overall change in productivity growth for an economy or industry is only observed where the net impact of new technologies more than offsets the net impact of old technologies (as we explain using an illustrative example in **Figure 5** overleaf). Accordingly, speculation as to the impact of a single new technology, or subset of new technologies, is a poor basis on which to consider the setting of OE targets.

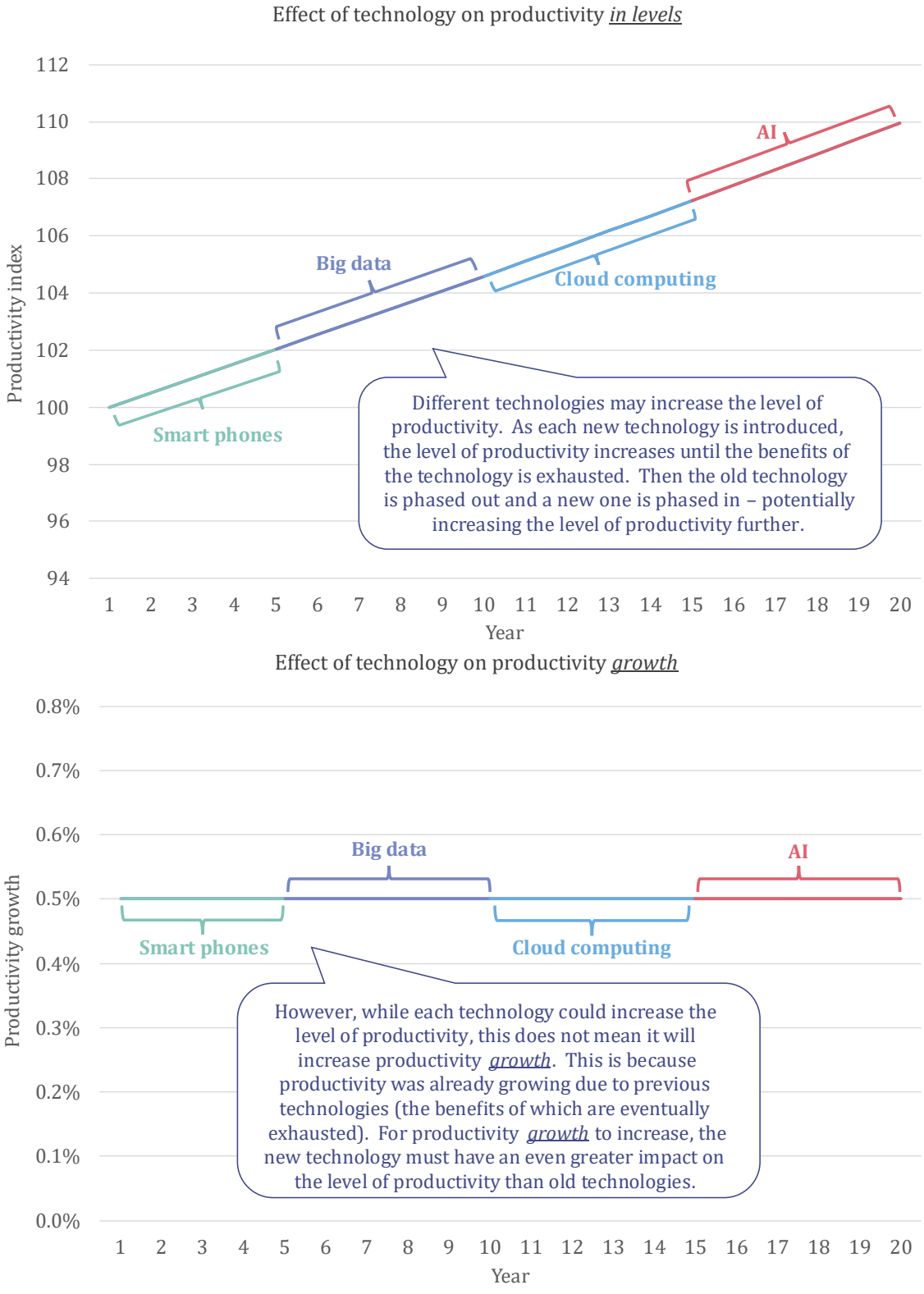
[61] *'Independent Report on Ongoing Efficiency – RIIO-3 Technical Annex'. Grant Thornton (June 2025), page 24.*

[62] *We explain in Chapter 3 that Ofgem's focus on this period upwards biases the top of their range.*

[63] *'We'd better watch out: New York Times book review'. Solow, R. (July 1987).*

[64] *Take, for example, the case of smart phones as a technology. Introduced around 2007, smartphones enabled people to work remotely, access information instantly, and communicate more flexibly, boosting productivity in the conveying of information around work sites and coordinating with head office. Smartphones replaced multiple devices (phones, cameras, GPS units) and streamlined tasks like emailing, scheduling, and data entry. However, once most people owned smartphones, around 2016, additional gains from new models were incremental (better cameras, faster processors) rather than transformative.*

Figure 5: Illustrative example of how new technology may increase the level of productivity but not growth



Source: Economic Insight analysis.

The above graphical example is, as stated, only illustrative. The reality is that AI, in particular its commercial application, is still in its infancy and therefore its impact on the path of productivity over the coming years and decades is unknown and open to debate.

4E Reasons to consider a more conservative target at RIIO-3

Ofgem has asserted that new technology will drive productivity growth for gas networks at an above-average rate at RIIO-3 (on the basis of incorrect claims, as discussed in the previous section). However, its approach to making these claims is asymmetrical, because Ofgem has not undertaken similar consideration of the reasons as to why one might need to be conservative when setting the target for OE (i.e. place weight on values towards the lower end of a range). We discussed such reasons at length, with detailed quantitative and qualitative evidence, in our May 2024 Report. We do not, therefore, repeat these in any detail here. However, in summary, we highlight the following:

- UK productivity growth has been low and stagnant since the **2008 financial crisis**.[65]
- **Academic survey evidence** shows most academic experts on UK productivity growth[66]:
  - expect UK productivity growth to be 0.5% pa or below over the next five years; and
  - do not expect the energy industry to outperform the UK, with regards to productivity growth.
- **The main factors causing the UK productivity growth slowdown are largely economy-wide and are unlikely to fully unwind over RIIO-3**. Evidence shows the key causal factors of the slowdown are insufficiency of: (i) investment; (ii) infrastructure quality; (iii) human capital quality; and (iv) management quality.[67]
- **Regulation is unlikely to mitigate the impact on gas networks of the factors causing the slowdown**.
  - In its DDs, Ofgem argued that: "*regulated network companies are not fully impacted by wider productivity slowdowns, given the predictability that the price control frameworks provide over future revenues and returns compared to the companies operating in competitive markets*."[68] However, it provided no evidence to support this view and did not engage with our evidence that (even in principle) regulation can at most mitigate one causal factor of the wider productivity slowdown (underinvestment) but it cannot shield the gas networks from the other factors. Thus, even if regulation mitigates the problem of underinvestment (which the data is not supportive of), it logically follows that gas network productivity growth must have been adversely affected by the remaining factors.[69]
  - Furthermore, while we agree that, *in principle*, regulation has the potential to mitigate underinvestment (e.g. due to greater predictability), *in practice*, this is contingent on regulators setting price controls that make investment attractive within the sectors they

[65] *'Ongoing Efficiency for Gas Networks at RIIO-3'. Economic Insight (May 2024), page 36.*
[66] *'Ongoing Efficiency for Gas Networks at RIIO-3'. Economic Insight (May 2024), page 13.*
[67] *'Ongoing Efficiency for Gas Networks at RIIO-3'. Economic Insight (May 2024), page 11.*
[68] *'RIIO-3 Draft Determinations Overview Document'. Ofgem (July 2025); paragraph 8.33.*
[69] *'Ongoing Efficiency for Gas Networks at RIIO-3'. Economic Insight (May 2024), page 11.*

> regulate. We find that the data indicates this has not been the case for gas networks.[70] Moreover, since the previous CMA appeals, there is now new evidence that indicates underinvestment is a challenge for regulated industries – including the conclusions of the recent Cunliffe review of the water sector which found that "*government and regulator pressure on bills played an important role in what can now be seen as underinvestment over this period*".[71]

In our May 2024 Report, we additionally argue that as a point of principle, best practice should be to derive any OE point estimate from towards the middle of any range derived directly from benchmarking. This reflects the inherent uncertainty as to the 'true' value of OE, as it cannot be observed. It would be appropriate to depart from this if there were compelling evidence to the contrary (on a case-by-case basis), but we do not observe such evidence in the present case. Again, this principle should help drive consistency over time and avoid accusations of cherry picking in either direction.

[70] We discuss this further in our May 2024 Report and our October 2024 report. See: 'Ongoing efficiency for gas networks at RIIO-3'. Economic Insight (May 2024); Chapter 3; and 'Further evidence on OE for gas networks at RIIO-3'. Economic Insight (October 2024); page 1 and Section 4.

[71] 'Independent Water Commission: Final Report'. Independent Water Commission (July 2025); page 204.

5

CORRECTIONS

When Ofgem's errors are corrected, Ofgem's chosen point estimate of 1% no longer lies within its "narrow" range.

5A Chapter structure

In this chapter, we summarise the impact of correcting Ofgem's errors on the range of OE figures that it should plausibly draw from in making its final determination.

5B Summary of corrections

When Ofgem's errors are corrected, we find that it has the following effect on the regulator's "narrow" range of OE estimates.

- **Apply a consistent regulatory method (correcting Error 1)**. When we modify Ofgem's approach, such that it is based on precedent of regulatory method, rather than of outcome, we find that its "narrow" range for OE becomes **-0.5% to 0.5%.**
- **Use complete business cycles (correcting Error 2)**. Assuming that Error 1 is not corrected, and Ofgem rely on its (limited) present analysis, but we correct Error 2, we find that its "narrow" range of OE becomes **0.1% to 0.9%**.
- **Not placing weight on unsubstantiated arguments to select an OE number from the upper end of the range, whilst also failing to consider countervailing reasons to place weight on the lower end of the range (correcting Error 3).** Correcting for this error points to the need to select a mid-point from any final range for OE.

We note that Ofgem's chosen point estimate of 1.0% does not lie in either of the ranges that result from correcting Error 1 or Error 2. To this extent, **Ofgem's OE target is wholly reliant on them making either one of these two errors**.

In our May 2024 Report we establish a method of estimating OE that can be applied over the long term, which is guided by clear principles (for example, a data driven approach to comparator selection) and can be updated simply with the addition of new data in future price controls. We maintain that **this is our preferred method** and preferable to even a corrected version of Ofgem's method**.** Following this method, we identify a plausible range for OE at RIIO-3 of **0.2% to 0.8%**.[72] Ofgem's adoption of this method would be consistent with the principles of applying and departing from regulatory precedent set out in Section 2B.

We note that the 0.5% OE target adopted by companies that rely on our suggested method (the midpoint of our suggested 0.2% to 0.8% range) falls within both of the ranges that result from correcting Ofgem's errors. Hence, it represents an appropriate target even if Ofgem chooses to retain its existing approach, once it has corrected for the above errors.

[72] *'Ongoing Efficiency for Gas Networks at RIIO-3'. Economic Insight (May 2024), page 5.*

6

APPENDIX

6A Chapter structure

In this appendix, we include further details on our analysis:

(i) **'Agree-disagree' table**. We outline the key areas in which Ofgem's approach to determining the OE target differs from our own.

(ii) **Replication of Grant Thornton's analysis.** We replicate the analysis that GTh has used to create its "narrow" range of 0.1%-1.3%. We find that, with the information on its approach available in its report, it is possible to replicate it closely, but not perfectly.

(iii) **Outlier analysis**. We include further details of the outlier analysis discussed in Chapter 3.

(iv) **Survey of technology experts**. We detail the survey methodology used to provide the results we refer to in Section 4B.

6B Agree-disagree table

The table overleaf provides a summary of where our views differ from Ofgem.

Table 4: Areas of agreement / disagreement between EI and Ofgem's advisors

Subtopic	Agreement Part agreement Disagreement	Ofgem view	EI view
Topic 1: Selection of OE target from the benchmarked range.			
1.1 Overall adjustment		**Ofgem selected a target (1.0%) towards the upper end of its range (0.1%-1.3%).** Ofgem first narrowed the range to 0.7%-1.0% because: • The lower half of the range was "*not sufficiently challenging*". • NGET's proposed target of 0.7% should represent the lower limit of what is plausible for companies. • Regulatory precedent. • The upper half of the range reflects the ability of gas networks to benefit from "*above average technological change*". Ofgem then selected a point estimate from the range (1.0%), stating it took the following into account: omission of embodied change in the gross output metric; placing some weight on the value added metric; significant increase in IT&T investment at RIIO-3; historical funding through the innovation fund; placing more weight on the pre-crisis/longer-term data; precedent for the target being 1.0%; and 1.0% is the mid-point of its narrowed range.[73]	**Post-estimation adjustments to the benchmarked range should be avoided.** Point estimates should be taken from towards the middle of the benchmarked range. This is a balanced approach that reflects the inherent uncertainty in OE estimation. The evidence is not strong enough to deviate from this when some factors imply an upward adjustment and some imply a downward adjustment, and when the magnitudes of the adjustments are unknown.[74] Ofgem's current approach is imbalanced. It points to several arbitrary factors to narrow the range (e.g. that the lower half is "*not sufficiently challenging*"). It also fails to consider any factors that would lead it to select a lower point estimate (e.g. the wider productivity slowdown, inclusion of catch-up efficiency in the TFP metric, the double count with its output incentives). Instead, Ofgem *only* focuses on factors that would lead it to select a higher point estimate. We discuss this further in Chapter 4.
1.2 Catch-up efficiency	No engagement	N/A	**TFP is likely to overstate OE, all else equal, as it captures both catch-up efficiency and ongoing efficiency.**[75]
1.3 Embodied technical change		**Ofgem implied that TFP will necessarily understate OE due to excluded embodied change**. It stated that: "[TFP] *growth rates calculated from the EU KLEMS database may underestimate the total potential for cost savings that can be achieved by network companies*	**It is not possible to conclusively determine whether TFP will overstate or understate OE due to excluded embodied change**. It depends on: (i) the extent to which embodied change is included in the TFP of the comparators used (which is

[73] *'RIIO-3 Draft Determinations Overview Document'. Ofgem (July 2025); page 92-94.*

[74] *We discuss this further in our May 2024 Report. See: 'Ongoing efficiency for gas networks at RIIO-3'. Economic Insight (May 2024); page 12 and Chapter 4.*

[75] *We discuss this further in our May 2024 Report. See: 'Ongoing efficiency for gas networks at RIIO-3'. Economic Insight (May 2024); page 62.*

		when quality improvements in the factor inputs [i.e. embodied change] *are considered".*[76]	unknown); and (ii) the scope for comparators to make gains from embodied change, relative to gas networks.[77]
1.4 Double count of quality improvements	No engagement	N/A	**Ofgem is double counting its efficiency challenge by also asking companies to make quality improvements out of base funding** (through output incentives), as well as reducing costs through an OE challenge. This is because the TFP of the comparators used already embeds quality improvements.[78]
1.5 RPEs and overlap with CPIH	No engagement	N/A	**Ofgem is double counting its efficiency challenge through its use of inflation measures at RIIO-3.** All else equal, productivity gains achieved by firms in the wider economy will put downward pressure on prices (and, therefore, inflation). This means that any measures of inflation used in RIIO-3 will implicitly reflect productivity gains and, therefore, including a separate productivity challenge on top of that could lead to a double count.[79]
1.6 Scope for gas networks to benefit from above average technological change		**Ofgem claimed that the gas networks have potential to achieve "*above average technological change*".**[80]	**Consistent with our survey of experts, we consider that gas networks have less potential to benefit from technological change than most industries**. Nonetheless, recognising this is inherently uncertain, we recommend a balanced approach that does not assume gas networks are more or less likely to benefit from technological change than other industries. The claim that gas networks will benefit from "*above average technological change*" is speculative and not based on a balanced view of the evidence. We discuss this further in Chapter 4.
1.7 Regulatory precedent		**Ofgem cited recent regulatory precedent to support its 1.0% target**: "*including RIIO-2, RIIO-ED2, and Ofwat's PR24, which all used EU*	**We consider that, if Ofgem is to rely on regulatory precedent, it is an error to rely on precedent of outcomes at previous regulatory decisions, rather than precedent of**

[76] *'RIIO-3 Draft Determinations Overview Document'. Ofgem (July 2025); paragraph 8.33.*

[77] *We discuss this further in our May 2024 Report. See: 'Ongoing efficiency for gas networks at RIIO-3'. Economic Insight (May 2024); page 65-68.*

[78] *We discuss this further in our May 2024 Report. See: 'Ongoing efficiency for gas networks at RIIO-3'. Economic Insight (May 2024); page 69-70.*

[79] *We discuss this further in our May 2024 Report. See: 'Ongoing efficiency for gas networks at RIIO-3'. Economic Insight (May 2024); page 70.*

[80] *'RIIO-3 Draft Determinations Overview Document'. Ofgem (July 2025); paragraph 8.32.*

		KLEMS-based growth accounting to set OE targets", noting that there is "*a notable alignment around OE targets at 1% per annum*".[81]	**method.** To rely on precedent of outcomes is illogical (and against the best interests of customers and investors) and inconsistent with its approach to other areas of the price control. If Ofgem were to instead rely on precedent of method, this would result in an OE range of -0.5%-0.5%. We discuss this further in Chapter 2.
Topic 2: Extent to which the productivity slowdown should be taken into account			
2.1 Overall effect of productivity slowdown on the gas networks		**Ofgem considered that "*regulated network companies are not fully impacted by wider productivity slowdowns*,** *given the predictability that the price control frameworks provide over future revenues and returns compared to the companies operating in competitive markets."*[82]	**The wider UK productivity slowdown should be reflected in the OE target, as the evidence indicates the gas networks are not immune to its underlying drivers.** We explain our rationale in the following rows.[83]
2.2 Factors explaining the productivity slowdown	No engagement	N/A	**To identify the main causal factors of the UK productivity slowdown, we conducted a literature review and surveyed independent, academic experts in productivity** – this research, has been published in a credible, peer-reviewed journal.[84]
2.3 Extent to which factors affect the gas networks	Minimal engagement	**Ofgem has not engaged significantly on this important issue**. As set out above, it just highlighted: "*the predictability that the price control frameworks provide over future revenues and returns compared to the companies operating in competitive markets*."[85]	**We find that, in *principle* regulation has the potential to mitigate just one of the causal factors** (underinvestment), but it cannot plausibly shield the gas networks from the impact of deficiencies in, for example, transport infrastructure; electricity networks; training; or vocational skills. Thus (even if regulation mitigates the risk of underinvestment for gas networks, which we do not consider to be the case to a material degree) **it logically follows that the productivity growth of gas networks must nonetheless have been adversely affected by the remaining factors driving the slowdown.**

[81] *'RIIO-3 Draft Determinations Overview Document', Ofgem (July 2025); paragraph 8.33.*

[82] *'RIIO-3 Draft Determinations Overview Document', Ofgem (July 2025); paragraph 8.33.*

[83] *We discuss this further in our May 2024 Report. See: 'Ongoing efficiency for gas networks at RIIO-3', Economic Insight (May 2024); Chapter 3.*

[84] *We discuss this further in our May 2024 Report. See: 'Ongoing efficiency for gas networks at RIIO-3', Economic Insight (May 2024); Chapter 3.*

[85] *'RIIO-3 Draft Determinations Overview Document', Ofgem (July 2025); paragraph 8.33.*

			While we agree that, in *principle*, regulation has the potential to mitigate underinvestment (due to greater predictability), in *practice,* this is contingent on regulators setting price controls that make investment attractive within the sectors they regulate. We find that the data indicates this has not been the case for gas networks.[86] Furthermore, since the previous CMA appeals (where it came to a similar conclusion to Ofgem), there is now additional evidence that indicates that underinvestment is a challenge for regulated industries – including the conclusions of the recent Cunliffe review of the water sector.
2.4 Historical TFP growth of gas networks	No engagement	N/A	**We observe that gas networks have delivered low productivity growth, reflective of the low productivity performance of the wider UK economy**, and significantly below Ofgem's recent OE targets. This appears consistent with the gas networks being affected by the wider slowdown.[87]
2.5 Expectations relied on in previous OE targets	No engagement	N/A	**Previous OE targets have been set partly based on expectations (by regulators and their advisers) that UK productivity growth would improve, but this improvement has not materialised**. Instead, UK productivity growth has remained near-zero for over 15 years. Therefore, even if productivity growth does eventually improve (which, at some point it must), this raises concerns that the gas networks may have already been materially underfunded.[88]
Topic 3: Benchmarking choices			

[86] *We discuss this further in our May 2024 Report and our October 2024 report. See: 'Ongoing efficiency for gas networks at RIIO-3'. Economic Insight (May 2024); Chapter 3; and 'Further evidence on OE for gas networks at RIIO-3'. Economic Insight (October 2024); page 1 and Section 4.*

[87] *We discuss this further in our October 2024 report. See: 'Further evidence on OE for gas networks at RIIO-3'. Economic Insight (October 2024); Section 2.*

[88] *We discuss this further in our October 2024 report. See: 'Further evidence on OE for gas networks at RIIO-3'. Economic Insight (October 2024); Section 3.*

3.1 Time period		**Ofgem relied on GTh's benchmarking analysis, which "*considered three, non-overlapping, time periods for the purpose of producing a plausible OE range: 1970-1996, 1997-2007 and 2010-2019*".** It also included the period 1970-2019 (excluding 2008 and 2009, which it considered to be outliers). It appears minimal rationale has been provided to support the choice of time periods.[89]	**We consider that Ofgem has erroneously**: (i) relied on incomplete business cycles, biasing its results; and (ii) removed three years from its analysis (2008, 2009, 2020), incorrectly referring to them as outliers. We discuss this further in Chapter 3. In our analysis, we recommended two time periods:[90] ● **2010-2019.** This is because we think that productivity growth is unlikely to deteriorate any further, so a continuation of the recent present provides a plausible lower bound. ● **1970-2019**. This provides a plausible upper bound, as it uses all of the data available at the time and includes some post-2010 years as it is unlikely the productivity slowdown will completely unwind.
3.1 Comparator selection method		**Ofgem relied on GTh's benchmarking analysis, which included: "*All sectors previously considered by CEPA or proposed by regulated companies (through external consultant reports)…with two exceptions*".** The exceptions related to the weighting of manufacturing subsectors (which GTh took the average of and included as a single sector) and inclusion of economy-wide productivity growth (which GTh excluded).[91]	**We consider that comparators should be selected based on data-driven criteria that capture the nuances of sector similarity.**[92]
3.3 Productivity measure		**Ofgem relied on GTh's benchmarking analysis, which used the GO metric, but Ofgem placed some weight on the VA metric when selecting an OE target from the benchmarked range.**[93]	**We agree that the GO metric is more appropriate for the purposes of deriving an OE range.** However, for the same reasons that make GO more appropriate, we consider that no weight should be placed on the VA measure.[95]

[89] *'RIIO-3 Draft Determinations Overview Document'. Ofgem (July 2025); paragraph 8.34; and 'Independent Report on Ongoing Efficiency – RIIO-3 Technical Annex'. Grant Thornton (June 2025), page 18.*

[90] *We discuss this further in our May 2024 Report. See: 'Ongoing efficiency for gas networks at RIIO-3'. Economic Insight (May 2024); Chapter 2. For the 2010-2019 period, given the available data at the time of writing our report, this time period included almost all of the most recent business cycle (which we find to be 2010-2020).*

[91] *'RIIO-3 Draft Determinations Overview Document'. Ofgem (July 2025); paragraph 8.34; and 'Independent Report on Ongoing Efficiency – RIIO-3 Technical Annex'. Grant Thornton (June 2025), page 17 & 20.*

[92] *We discuss this further in our May 2024 Report. See: 'Ongoing efficiency for gas networks at RIIO-3'. Economic Insight (May 2024); Chapter 2.*

[93] *'RIIO-3 Draft Determinations Overview Document'. Ofgem (July 2025); paragraph 8.33-8.34*

[95] *We discuss this further in our May 2024 Report. See: 'Ongoing efficiency for gas networks at RIIO-3'. Economic Insight (May 2024); Chapter 2.*

		GTh stated that "*on balance this report favours the more conservative GO metric*" and that "*GO is also more consistent with the wider regulatory regime (noting that the OE target is intended to be applied to totex) and more consistent with regulatory precedent*".[94]	

Source: Economic Insight analysis.

[94] '*Independent Report on Ongoing Efficiency – RIIO-3 Technical Annex*'. *Grant Thornton (June 2025), page 4 & 20.*

6C Replication of GTh's analysis

As part of our analysis in Chapter 3, we examine how Ofgem's OE range changes when its selection of time periods is adjusted to: (i) include the years it (incorrectly) identified as outliers; and (ii) reflect complete business cycles. In order to perform this analysis, we first replicated the analysis conducted by GTh in developing its recommended range for Ofgem.

While, we have not been able to reproduce GTh's results exactly, the resulting OE range from our replication is very similar. In the remainder of this section, we set out our approach to replicating GTh's analysis, and how the resulting OE range compares to GTh's reported results.

At a high-level, the approach to estimating an OE range is straightforward and relatively well-established. It involves selecting a set of sectors that can be considered comparable to the regulated industry and calculating the average annual productivity growth across them over certain time period(s).

However, it is challenging to replicate GTh's results perfectly because: (i) GTh has not provided its underlying calculations; (ii) there are a large number of analytical decisions that can materially influence the results; and (iii) GTh's report does not explain its approach to every analytical decision. The table below provides a summary of the analytical decisions GTh has and has not disclosed its approach for, alongside the analytical decisions we have assumed it has made in our replication of its analysis. We explored multiple permutations and selected the decisions that resulted in estimates closest to GTh's OE range.

Table 5: Key analytical decisions to replicate GTh's approach

Analytical decision	GTh approach	EI replication
Source of datasets	EU KLEMS	EU KLEMS
Year of dataset release	2025 2009	2025 2009
Month of dataset release[96]	Not disclosed	July November
Analytical or statistical module from dataset[97]	Not disclosed	Analytical
Sheet from dataset used to source VA TFP[98]	Not disclosed	VAConTFP
Time period(s)	1970-1996 1997-2007	1970-1996 1997-2007

[96] *In response to an SQ raised by the gas networks, we understand that Ofgem stated: "Each new edition of the EU KLEMS database reflects some information that was not available for the previous edition, hence resulting in different historical productivity estimates. The estimates within a given edition of the database are also updated every few months, which can result in small changes depending on when exactly the database was accessed".*

[97] *EU KLEMS report two different versions of its TFP data: a statistical module; and an analytical module. The difference between these is that the analytical module is extended to capture intangible capital assets not included in the statistical module, such as industrial design, brand, organisational capital, training, and new financial products.*

[98] *The EU KLEMS data reports VA TFP as both an index (in the tab 'VATFP_I') and as growth rates (in the tab 'VAConTFP'). As a result of rounding, these result in slightly different average annual TFP growth rates.*

	2010-2019 1970-2019 average (excluding 2008 and 2009)	2010-2019 1970-2019 average (excluding 2008 and 2009)
Approach to averaging over time[99]	Not disclosed	Geometric
Productivity measure	GO TFP	GO TFP
Approach to estimating GO TFP[100]	Not disclosed	$GO\ TFP\ growth = VA\ TFP\ growth \times \frac{VA}{GO}$
NACE II[101] comparator industries	1. Construction 2. Wholesale and retail trade; repair of motor vehicles and motorcycles 3. Transportation and storage 4. Financial and insurance activities 5. Manufacturing (simple average of the six selected subsectors)[102] 6. Information and communication 7. Professional, scientific and technical activities; administrative and support service activities	1. Construction 2. Wholesale and retail trade; repair of motor vehicles and motorcycles 3. Transportation and storage 4. Financial and insurance activities 5. Manufacturing (simple average of the six selected subsectors) 6. Information and communication 7. Professional, scientific and technical activities; administrative and support service activities
Corresponding NACE I[103] comparator industries	Not disclosed	1. Construction 2. Trade 3. Transport and storage 4. Financial intermediation 5. Manufacturing (simple average of the six selected subsectors)[104] 6. Post And telecommunications 7. Renting of m&eq and other business activities

Source: Economic Insight analysis of GTh report.

[99] The average productivity growth over time can be estimated using: (i) a geometric mean – this is calculated by taking the product of a series of numbers, raised to a power equal to the inverse of the length of that series (i.e. the number of numbers in the series); or (ii) an arithmetic mean – this is a simple average that is calculated by taking the sum of a series of numbers, and dividing this sum by the count of that series of numbers (i.e. the number of numbers in the series).

[100] GO TFP is not reported in the EU KLEMS raw data and, therefore, must be estimated from the value added (VA) TFP estimates that are reported in the data.

[101] NACE is a system used to categorise economic activities into different sectors. Newer EU KLEMS releases (like the 2025 release) use the updated NACE II system. Older EU KLEMS releases (like the 2009 release) use the old NACE I system.

[102] GTh reported these as: (i) Chemicals; basic pharmaceutical products; (ii) Manufacture of rubber and plastic products and other non-metallic mineral products; (iii) Computer, electronic, optical products; electrical equipment; (iv) Manufacture of machinery and equipment n.e.c.; (v) Manufacture of motor vehicles, trailers, semi-trailers and of other transport equipment; and (vi) Manufacture of furniture; jewellery, musical instruments, toys; repair and installation of machinery and equipment.

[103] NACE is a system used to categorise economic activities into different sectors. Newer EU KLEMS releases (like the 2025 release) use the updated NACE II system. Older EU KLEMS releases (like the 2009 release) use the old NACE I system. GTh reports the NACE II industries it uses for the EU KLEMS 2025 release, but it does not report how it has mapped these to NACE I for its results based on the 2009 release. We use the following paper to inform the mapping from NACE II to NACE II: 'Matching industry classifications. A method for converting NACE rev.2 to NACE rev.1', Guilio Perani and Valeria Cirillo (2015).

[104] These are: (i) Chemicals and chemical products; (ii) Rubber and plastics products; (iii) Electrical And Optical Equipment; (iv) Machinery, Nec; (v) Transport Equipment; (vi) Manufacturing Nec; Recycling.

Table 6 presents the results of our replication of GTh's analysis based on these analytical choices and compares them to the corresponding values reported by GTh. Our replication results in the same overall range as GTh (0.1%-1.3%), and similar overall results for each time period. The majority of the results for individual sectors and time periods are also very close to GTh's reported values (within 0.1 percentage points), with a small number of exceptions.

Table 6: Comparison of EI replication to GTh's reported values

	1970-1996		1997-2007		2010-2019		1970-2019 average	
	GTh	EI	GTh	EI	GTh	EI	GTh	EI
Simple average	**0.5%**	**0.4%**	**1.3%**	**1.3%**	**0.1%**	**0.1%**	**0.7%**	**0.5%**
1. Construction	0.4%	0.4%	-0.9%	-1.0%	-0.1%	-0.2%	0.1%	0.0%
2. Wholesale and retail trade; repair of motor vehicles and motorcycles	1.0%	-0.1%	0.0%	0.0%	-0.3%	-0.3%	0.5%	-0.1%
3. Transportation and storage	1.3%	1.3%	0.7%	0.3%	-0.6%	-0.6%	0.8%	0.7%
4. Financial and insurance services	-0.7%	-0.7%	1.2%	1.2%	-1.0%	-1.1%	-0.3%	-0.4%
5. Manufacturing (simple average of the six selected sub-sectors)	0.7%	0.7%	2.6%	2.8%	0.3%	0.3%	1.1%	1.1%
6. Information and communication	1.3%	1.3%	5.2%	5.9%	2.9%	3.1%	2.7%	2.7%
7. Professional, scientific and technical activities; administrative and support service activities	-0.4%	-0.4%	0.0%	0.0%	-0.3%	-0.3%	-0.2%	-0.3%

Source: Economic Insight analysis of EU KLEMS data and GTh OE report.

6D Outlier analysis

The table below reports the Z-scores, Mahalanobis distances and the outlier thresholds under each of the approaches discussed in Chapter 3.

Table 7: Z-scores, Mahalanobis distances and outlier thresholds

Year	Z-Score	Standard Z-Score threshold (3)	Implied Ofgem Z-Score threshold (0.60)	Mahalanobis distance	Standard M. D. threshold (14.06)	Implied Ofgem M. D. threshold (2.37)
NACE 1						
1971	-0.69			10.78		
1972	0.24			5.43		
1973	0.23			17.78		
1974	-3.03			13.19		
1975	-1.08			7.30		
1976	-0.46			2.04		
1977	-0.75			4.42		
1978	0.68			5.91		
1979	-0.14			4.16		
1980	-2.50			16.78		
1981	-0.39			4.88		
1982	1.48			14.55		
1983	1.49			6.00		
1984	0.36			2.22		
1985	-0.96			8.36		
1986	0.83			4.99		
1987	1.23			4.75		
1988	-0.54			4.88		
1989	-1.59			11.55		
1990	-1.00			7.86		
1991	-0.32			1.92		
1992	0.58			12.73		
1993	1.23			5.19		
1994	0.79			2.83		

Year	Z-Score	Standard Z-Score threshold (3)	Implied Ofgem Z-Score threshold (0.60)	Mahalanobis distance	Standard M. D. threshold (14.06)	Implied Ofgem M. D. threshold (2.37)
1995	0.14			5.61		
1996	0.83			6.47		
1997	0.41			10.79		
1998	0.21			6.27		
1999	0.36			6.18		
2000	0.19			3.10		
2001	-0.42			4.52		
2002	-0.22			7.87		
2003	0.39			2.71		
2004	0.96			5.91		
2005	0.29			4.84		
2006	0.92			5.45		
2007	0.27			1.76		
NACE 2						
1996	0.18			6.56		
1997	0.68			5.94		
1998	0.71			9.07		
1999	0.48			5.60		
2000	1.44			10.58		
2001	-0.40			3.63		
2002	-0.23			3.21		
2003	0.72			3.07		
2004	1.17			3.85		
2005	0.61			6.91		
2006	0.49			7.37		
2007	1.05			11.51		

Year	Z-Score	Standard Z-Score threshold (3)	Implied Ofgem Z-Score threshold (0.60)	Mahalanobis distance	Standard M. D. threshold (14.06)	Implied Ofgem M. D. threshold (2.37)
2008	-0.60			2.37		
2009	-2.94			12.88		
2010	1.61			9.66		
2011	-0.20			7.09		
2012	-0.70			1.78		
2013	-0.15			7.96		
2014	0.15			2.31		
2015	-0.54			11.35		
2016	-1.05			7.63		
2017	0.13			5.69		
2018	-0.45			3.07		
2019	-0.47			2.08		
2020	-1.68			16.83		

Source: Economic Insight analysis of EUKLEMS data.

Note: Outliers are marked in red.

6E Survey of experts in technology

This section is structured as follows:

- We first explain the purpose of the survey; how we selected the sample of technology; and how we distributed the survey.
- We then summarise the number of responses we received, including the organisatons to which the respondents belong.
- Finally, we present the results of the survey.

Survey purpose, sample selection and distribution

As we explain in Section 4B, there is limited existing evidence of the ability of gas networks to benefit from technological change, relative to other industries. In this context (and noting Ofgem's claim that it believes gas networks will benefit from "*above average technological change*"), we have conducted a survey of technology experts in the UK to better understand whether gas networks are likely to benefit more or less from new technologies than other industries.

The survey was distributed to experts across academia; industry; and the public sector. This approach ensures that the sample covers a diverse range of viewpoints and, once aggregated, reflects a knowledge base that includes a spread of technologies and industries (recognising that no one individual will be an expert in all industries, or all technologies).

Specifically, we sent the survey to:

- **Academics with expertise in technology.** We included academics that met at least one of the following criteria:
    - They were affiliated with one of the top 15 UK universities for research (according to the Complete University Guide 2025[105]) and belong to a technology-focused department or research centre (e.g. AI, robotics, data science, energy technology research, biotechnology, advanced/smart material research, nanotechnology etc). This captures leading technology researchers in their respective fields.
    - They were ranked among the top 10% of authors in the field of innovation, according to the RePEc rankings. This captures academics with expertise in the economics of innovation.[106]
- **Senior industry professionals with expertise in technology.** This included Chief Technology Officers and other senior figures specialising in technology (e.g. Chief Engineer, Director of AI, Technology Director) from companies that were part of at least one of the following:
    - The top 25 companies for R&D spending, as per the European Commission's 2024 ranking[107]. This captures senior industry professionals from the most innovative companies, such as major tech firms and pharmaceuticals.
    - The largest 25 companies in the FTSE[108]. This captures senior technology professionals at the UK's largest corporations.
- **Senior public sector professionals with expertise in technology.** This included individuals holding senior technology-related roles (e.g. Chief Technology Officer, Director of Science and Technology, etc) within relevant governmental and public sector organisations, such as: (i) The Department for Science, Innovation and Technology; (ii) The Department for Business and Trade; (iii) The Department for Transport; (iv) Innovate UK (part of UK Research and Innovation – UKRI – a non-departmental UK public body); (v) The Biotechnology and Biological Sciences Research Council (part of UKRI); (vi) The Science and Technology Facilities Council (part of UKRI); and (vii) The UKRI Board.

[105] These were: Imperial College London; University of Cambridge; London School of Economics and Political Science; University of Bristol; University College London; University of Oxford; University of Manchester; King's College London; University of York; University of Birmingham; University of Glasgow; University of Warwick; University of Edinburgh; University of Southampton; and the University of Sheffield. See: 'University League Tables research quality 2025'. Complete University Guide (2025).

[106] RePEc is one of the only publicly available rankings for academic authors in economics. The rankings are based on an aggregation of 33 different criteria including journal page counts, citation counts and number of works. We used it because the ranking system uses objective criteria, and the largest bibliographic database dedicated to economics. Its rankings are also important within the field of economics academia with evidence it is used for evaluation purposes such as promotion, tenure decisions and hiring. See: 'Academic Rankings with RePEc'. Zimmerman, C. (2009).

[107] 'The 2024 EU Industrial R&D Investment Scoreboard'. European Commission (2024); page 22.

[108] 'FTSE 100'. London Stock Exchange (February 2025). We used the largest 25 companies from this list on the 20/02/2025.

The survey was implemented via Omnisis,[109] a company specialising in the creation of online surveys and distributed via email.[110]

Responses

Overall, we received 30 responses to the survey, with 20 agreeing to disclose the organisation they were affiliated with, as Table 8 summarises. Most respondents that were willing to disclose their organisation were academics from universities, with one respondent each from Microsoft and Google.

Table 8: Organisations that respondents were affiliated with

Organisation	Number of respondents
University of Cambridge	4
University of Bristol	4
King's College London	3
University of Southampton	2
University of Manchester	1
Google	1
Microsoft	1
London School of Economics and Political Science	1
University of York	1
University of Sheffield	1
University of Birmingham	1

Source: Economic Insight analysis of technology survey responses.

Results

Participants were asked to: '*rank the following industries in terms of which you think will see the largest (net) positive productivity impacts arising from the various technological trends previously listed in combination over the next 5 years.*'

The participants were provided with a list of industries to rank (as Table 3 presents). The respondents were also given context on the meaning of productivity growth, which we defined as: '*equal to the change in output per change in unit of input i.e. how much more can be produced with a given set of resources, such as labour (workforce), capital (machinery, equipment, buildings), raw materials and energy.*'

Table 3 shows the number of participants that placed each industry in each position in the ranking, e.g. how many placed 'Information & Communication' as 1st, 2nd etc. It also includes the average rank

[109] *'Omnisis'. Omnisis.*

[110] *The email addresses of most academics are publicly available on university websites. For those in industry or the public sector, we used publicly available information, either finding the exact email address online or the reported organisation email structure for employees.*

for each industry by weighting the ranks according to the number of responses.[111] The table is sorted by these average ranks, with the 'Overall rank' column indicating the final position for each industry.

On average, the participating experts ranked 'Regulated gas transmission and distribution networks' 17th out of the 18 industries in terms of those expected to benefit from productivity improvements due to new technologies over the next 5 years. The vast majority of respondents (27/30) placed it in the lower half of the rankings.

In contrast, the industries that one would typically consider to be more 'high-tech' are expected to benefit more from productivity improvements due to new technologies in the next 5 years. For example, the three industries the experts expect to benefit the most are:

- **'Information and Communication'.** This was ranked 1st out of all 18 industries, with almost all experts (29 out of 30) placing it in the top half. A significant proportion (13 out of 30) included it as one of the three industries expected to benefit the most.

- **'Professional, Scientific & Technical Activities'.** This was ranked 2nd out of 18 industries, with nearly all experts (26 out of 30) placing it in the top half. A significant proportion (14 out of 30) included it as one of the three industries expected to benefit the most.

- **'Manufacturing'.** This was ranked 3rd out of 18 industries, with most experts (26 out of 30) placing it in the top half. Half of the experts (15 out of 30) included it as one of the three industries expected to benefit the most.

[111] *For example, suppose the only responses for a 'Industry X' were: 10 respondents ranking it 1st; 5 respondents ranking it 2nd; and 2 respondents ranking it 3rd. Then the average ranking of 'Industry X' would be calculated as:* $(10 \times 1 + 5 \times 2 + 2 \times 3)/(10 + 5 + 2) = 1.5$

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