Ongoing efficiency and real price effects

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Executive summary

Ofgem reviews the expenditure and outputs included in transmission operators' (TOs) business plans to assess their efficient cost requirements and, ultimately, allowed revenues. As part of this assessment, the regulator seeks to account for forward-looking cost pressures and productivity improvements, including ongoing efficiency (OE) and real price effects (RPEs).

Scottish Power Energy Networks (SPEN) has commissioned Oxera to conduct a study on the appropriate scope and magnitude of OE targets and the approach to assessing RPEs for electricity TOs over 2026–31. As part of this study, we build on the methodology adopted at the last price control review (RIIO-2),[1] discussions at the ensuing Competition and Markets Authority (CMA) appeals,[2] and Ofgem's sector-specific methodology decision for RIIO-3 and the associated consultation responses.[3]

OE relates to the potential for efficient companies to improve their productivity in the future, via technological advancements, managerial improvements and 'learning by doing'. At a high level, Ofgem derived the OE target at RIIO-2 by examining the rate of productivity growth achieved in the wider UK economy and its chosen comparator sectors.

Meanwhile, RPEs relate to the fact that the price of several inputs that TOs face are largely determined by wider (exogenous) market forces, such that an exogenous increase or decrease in input prices results in an increase or decrease in a TO's efficient cost requirements. RPEs reflect changes in input prices (in real terms) that may not be appropriately captured by general inflation measures where revenues are indexed to (CPIH). At RIIO-2, Ofgem identified a set of input price indices relating to labour and materials, and indexed c. 70% of SPEN's revenues to these

[1] Ofgem (2021), 'RIIO-2 Final Determinations – Core Document (REVISED)', February, pp. 47–51.
[2] Competition and Markets Authority (2021), 'Cadent Gas Limited, National Grid Electricity Transmission plc, National Grid Gas plc, Northern Gas Networks Limited, Scottish Hydro Electric Transmission plc, Southern Gas Networks plc and Scotland Gas Networks plc, SP Transmission plc, Wales & West Utilities Limited vs the Gas and Electricity Markets Authority Final determination Volume 2B: Joined Grounds B, C and D', October, para. 7.867. (Hereafter 'CMA (2021) appeal'.)
[3] Ofgem (2024), 'RIIO-3 Sector Specific Methodology Decision – Overview Document', July, pp. 113–117.

input price indices (with the remaining c. 30% of revenues indexed to CPIH).[4]

We understand that TOs will face several challenges during the RIIO-3 price control period that will directly affect the scope and application of OE and RPEs. Principally, we understand that these challenges relate to the increased scale of new and uncertain investments that are required in order to facilitate the energy transition to meet consumer needs. The 'novelty' of these activities may limit TOs' ability to make OE improvements relative to more 'business as usual' expenditure. Moreover, the increased demand for highly specialised inputs that TOs use may generate supply chain challenges, which could translate into higher input prices (i.e. higher RPEs) and/or delayed investments.

Our approach to assessing OE and RPEs in light of the RIIO-3 context is outlined below.

Ongoing efficiency

At RIIO-2, CEPA used growth accounting (GA) analysis to inform Ofgem about a 'feasible range' of OE targets of c. 0.5–1.2% p.a. for the final determination.[5] Given that the application of the GA methodology led to a range of possible OE targets, Ofgem was required to provide some justification for selecting a point estimate from within that range. Ultimately, Ofgem selected a target of 1.15% p.a. for CAPEX and 1.25% for OPEX, based on a 'core' target of c. 1% p.a. (0.95% for CAPEX and 1.05% for OPEX, derived through GA analysis) plus an uplift of 0.2% p.a. for the additional productivity improvements that Ofgem expected companies to deliver as a result of innovation funding (the 'innovation uplift').[6] At the ensuing appeals, the CMA requested that Ofgem remove the innovation uplift and reduce the target to 0.95% p.a. for CAPEX and 1.05% p.a. for OPEX.[7]

In deriving an OE target, we follow Ofgem's high-level approach. Specifically, to inform the target, we examine the rate of productivity

[4] Ofgem (2023), 'RIIO-2 RPE Workbook - AIP 2023', January, available at https://www.ofgem.gov.uk/sites/default/files/2024-01/RIIO-2%20RPE%20Workbook%20-%20AIP%202023.xlsx, last accessed 2 December 2024.
[5] CEPA (2022), 'RIIO-ED2: Cost Assessment – Frontier Shift methodology paper', June, p. 7.
[6] Ofgem (2020), 'RIIO-2 Final Determinations – Core Document', December, pp. 48 and 213.
[7] CMA (2021) appeal, para. 7.867.
Ofgem's OE targets for OPEX and CAPEX at the final determination differed by 0.1% p.a., as did the CMA's. Hereafter, when referring to Ofgem's and the CMA's targets, for brevity we take the midpoint (i.e. c. 1.2% and c. 1% p.a. respectively).

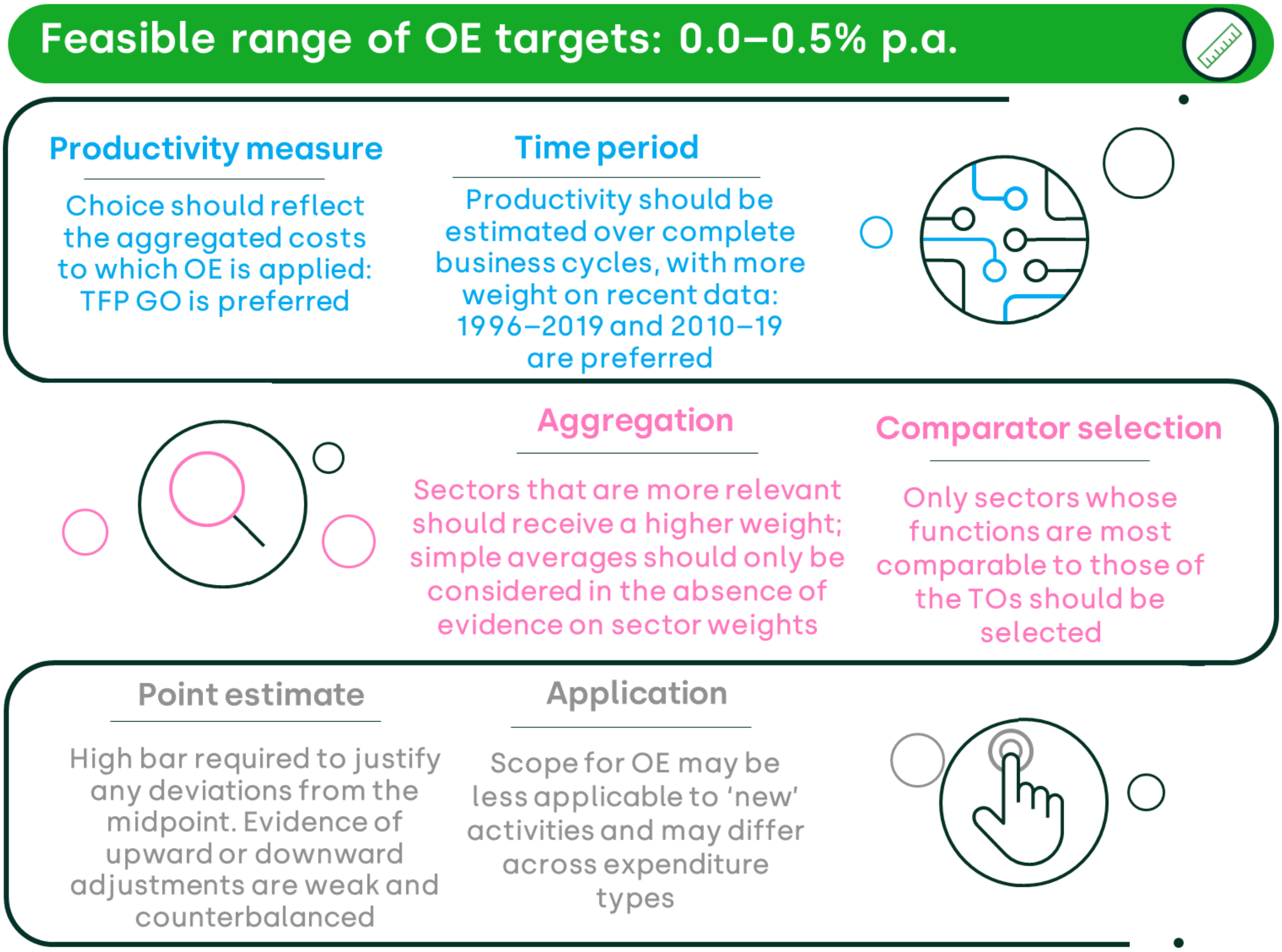
achieved by sectors of the UK economy using the data publicly available in the EU KLEMS.[8]

A robust application of the GA methodology requires a careful consideration of the following factors:

- the choice of productivity measure;
- the selection of comparator sectors;
- the time period of analysis;
- the aggregation of productivity across sectors;
- the selection of a point estimate;
- the application of the OE target to different cost bases.

Our modelling criteria and decisions in these areas are shown in the figure below.

[8] See Luiss (2023), 'EUKLEMS & INTANProd - Release 2023'.



Source: Oxera.

These modelling decisions are explained in more detail below.

Choice of productivity measure

Productivity growth is often estimated by comparing growth in outputs to growth in inputs. Typically, when estimating productivity growth, two choices of output are considered: gross output (GO) and value added (VA). GO represents the total output of a firm, industry or economy, while VA represents the incremental value that a firm, industry or economy has added in the production process (i.e. GO less any intermediate inputs that have been consumed in the production process). GO has the conceptual advantage over VA that it is the more natural measure of output in a competitive industry since it accounts for all inputs. Moreover, the GO measure is considered to be more reflective of the decisions made by company managers, as it assumes that all inputs are controllable. Indeed, the OECD notes that GO measures of productivity growth are the 'most appropriate tool[s] to measure technical change [i.e. OE] by an industry as the role of intermediate inputs in production is fully acknowledged'.[9]

Conversely, VA is seen as an incomplete measure of productivity growth at the firm or industry level since it does not take into account the role of intermediate inputs. This poses issues for manufacturing and energy-intensive industries, which often rely on a higher proportion of intermediate inputs in their production processes. The OECD notes that VA-based measures of productivity growth are 'not, in general, an accurate measure of technical change [i.e. OE]'.[10] We note that VA measures of productivity growth could be considered if the OE target were applicable to labour and capital only.

At RIIO-2, CEPA argued that both VA-and GO-based measures of productivity growth should be used to inform the OE target. Beyond regulatory precedent, CEPA argued that VA-based productivity measures are less prone to error than GO-based ones, given that measuring intra-sectors flows of intermediate inputs can be challenging. However, as the OECD notes, measuring VA requires data on intermediate inputs (as VA is defined as GO less intermediate inputs) such that any errors in the estimation of intermediate inputs will also affect VA.[11]

Productivity can be assessed either considering all inputs (total factor productivity, TFP) or limiting to individual inputs (partial factor productivity, PFP). As with the choice of VA or GO, the most appropriate measure of productivity depends on the context. In the current case, the OE challenge is applied to aggregated cost bases that include all inputs (labour, capital and intermediate inputs), such that TFP measures are most appropriate. If the OE target was applied to only one input (or a subset of inputs), then PFP measures would have some merit. At the RIIO-2 determination, CEPA argued that, when determining the OPEX target, some weight should be placed on PFP measures (specifically labour productivity, LP), given that OPEX is more labour-intensive than CAPEX. However, CEPA did not present any robust analysis to suggest whether OPEX was more labour-intensive for TOs than for the comparator sectors or the wider economy—if TOs' OPEX is roughly as labour-intensive as it is

[9] OECD (2001), 'Measuring Productivity: Measurement of Aggregate and Industry-level Productivity Growth – OECD Manual', July, p. 18.
[10] Ibid., p. 16.
[11] Ibid., p. 77.

for the comparator sectors or wider economy, then a TFP target would be more appropriate.[12]

For the reasons outlined above, we focus on GO-based TFP measures. If partial measures of productivity are to be used to inform the target, care must be taken to ensure that the resulting target is applicable to the cost bases on which the target is applied.[13] Similarly, if VA-based measures are to be used, they should be adjusted to reflect the contribution of intermediate inputs.

Selection of comparator sectors

The EU KLEMS dataset contains input and output data for 42 sectors or sector-aggregates. For the TFP estimates to reflect the OE level that is achievable for the TOs, the comparator sectors must fulfil the following criteria.

1. **Relevance**—the comparator sectors must undertake activities similar to those undertaken by the TOs. No sector (other than the TO sector itself) will be perfectly comparable, but there are sectors that undertake activities similar to in the TO sector. For example, a significant proportion of a TO's activity base relates to the building and maintenance of infrastructure, which can be represented by the Constructions and construction works sector (henceforth the 'Construction' sector).
2. **Competitiveness**—the comparator sector must be competitive in order to mitigate the risk that the estimated TFP is 'tainted' by sources of productivity growth that are unrelated to OE, such as catch-up efficiency and scale effects.[14]
3. **Exogeneity**—the comparator sector should not contain the companies being assessed (i.e. TOs), in order to provide an independent assessment of the scope for OE.[15]

[12] We understand from SPEN that the share of labour costs within OPEX is broadly aligned with the labour share of GO across our comparator sectors (ranging from c. 27% in Financial and Insurance activities to c. 48% in IT and other Information services). This is broadly aligned with an observation raised at the CMA appeal, where it was noted that labour accounted for less than half of one GDN's OPEX (see CMA (2021) appeal, para. 7.170).
[13] For example, if labour productivity is used to inform the OE target for OPEX (as at RIIO-2), labour productivity growth is c. 1% p.a. and labour constitutes c. 50% of OPEX, the OE target implied by the labour productivity analysis would suggest a target of c. 0.5% p.a. (=1%*50%).
[14] No sector is perfectly competitive such that the TFP estimates will always capture (to varying extents) other sources of productivity improvements. In the absence of a full breakdown of TFP into its components, this issue may need to be dealt with qualitatively.
[15] There are established regulatory applications that rely on the regulated companies' performance over time to inform OE. In such cases, appropriate methodology must be considered to isolate OE (i.e. frontier shift) from other sources of productivity developments.

4 **Data quality**—the comparator sectors' data relating to input and output volumes must be clear and robust. In this respect, sectors such as healthcare and education may not be appropriate as the output is not clearly defined.

If the comparator set contains sectors that are relevant to large sections of TOs' activities, it might be appropriate to take an unweighted average of the productivity growth achieved in the comparator sectors in the absence of additional evidence. However, if the sectors selected (or some of them) are relevant only to a subset of TOs' activities, the results from individual sectors should be weighted according to their relevance. Therefore, the appropriate comparator sector selection will depend on how the results from individual sectors are aggregated, or, conversely, the aggregation approach will depend on its selected comparators.

As the CMA noted in the RIIO-2 appeals, the selection of comparators and weighting approach involves a degree of value judgement.[16] To ensure that the OE target is not oversensitive to these value judgements, we consider three comparator sets to inform the target.

1 **A singular set**—here, we focus on the Construction sector only. This sector includes civil engineering and specialised construction activities, such as large-scale infrastructure projects. This sector is critical in capturing the costs associated with the building and maintenance of physical infrastructure required for transmission. It is also often seen as the key comparator for regulated utilities' CAPEX.[17] The Construction sector also captures some indirect OPEX-related activities explicitly (such as costs related to project management) and some implicitly (such as corporate functions, HR and regulatory teams, to the extent that companies in the Construction sector undertake these activities). The Construction sector is also marginally more IT-intensive than the TO sector, such that the productivity growth associated with digitisation is also captured by the Construction sector.[18]

2 **Broad set**—this set includes three operationally relevant sectors: i) Construction (as above), ii) Transportation and Storage

[16] Competition and Markets Authority (2021) appeal, paras 7.231 to 7.239.
[17] Ofgem used construction as its main comparator for capital and replacement expenditure at RIIO-1. See Ofgem (2012), 'RIIO-T1/GD1: Real price effects and ongoing efficiency appendix', December, p. 15.
[18] We understand that the TO sector may become more IT-intensive in RIIO-3 as a result of increased digitisation. However, the construction sector is currently 1.5 times more IT-intensive than the TO sector.

Services; and iii) Repair and Installation of Machinery and Equipment. Transport and Storage captures some of the activities associated with building and maintaining distribution networks (e.g. transport via pipelines), which are not dissimilar to TO functions. However, the sector may be too broad, given that it includes less relevant activities (e.g. air transport, water transport). Similarly, Repair and Installation of Machinery and Equipment may capture the maintenance, renewal and replacement activity undertaken by TOs, but this sector also serves as a 'catch-all' for 'other manufacturing', which would be less relevant for TO functions. As with the Construction sector, these sectors also capture activities relating to indirect expenditure (e.g. project management, finance) and the productivity growth associated with IT.

3 **A granular set**—here, we map TO activities to sectors that are directly comparable to those activities. For example, sectors like 'Financial and Insurance Activities' and 'Professional, Scientific and Technical Services' have little relevance to most TO functions, but are (both explicitly and implicitly) relevant to indirect OPEX. Therefore, these sectors may add more information about the scope for OE in these specific activities, even if they do not provide an accurate estimate of the scope for OE at the TOTEX level. When aggregating the results in the granular set, we apply a weighted average approach where the weight is calculated as the share of TOTEX related to the activity to which the sector is mapped.[19] This allows activities to be mapped according to their intensity and relevance within TOs' activities.

The weights attached to each sector are shown in the table below.

Comparator selection

Comparator industry	Singular set	Broad set	Granular set
Construction	100.0%	33.3%	30.4%
Transportation and Storage	-	33.3%	10.5%
Repair and Installation of Machinery and Equipment	-	33.3%	30.0%
Financial and Insurance Activities	-	-	9.9%

[19] Specifically, the weighting approach is based on the share of **baseline** TOTEX only i.e. excluding uncertain expenditure items, as defined by SPEN. Note that if all TOTEX is included in the analysis, the resulting OE targets are largely unchanged. That is, the OE estimates are insensitive to the inclusion of uncertain expenditure.

Comparator industry	Singular set	Broad set	Granular set
Professional, Scientific and Technical Services Administrative and Support Services	-	-	9.9%
IT and Other Information Services	-	-	9.3%

Source: Oxera analysis.

We note that, in the granular comparator set, comparator sectors are mapped to activities only for which they are **explicitly** relevant. For example, Construction is largely mapped to CAPEX-related activities and is not mapped to indirect functions, even though the Construction sector will capture these activities implicitly. This explains why the weight on the Construction sector naturally reduces in the granular comparator set relative to the singular and broad comparator sets.

The time period of analysis

Economic activity varies from one period to the next (from one 'business cycle' to another), and these fluctuations can affect the estimated productivity growth of a sector or economy over time. Specifically, productivity is often assumed to be 'pro-cyclical': productivity increases during times of economic expansion and decreases during times of economic contraction. As such, when determining the OE target, regulators typically assess productivity growth over complete business cycles.

In addition to analysis of business cycles, there may be a trade-off between using *more* data and placing greater weight on *more recent* data. In principle, assuming there are no structural breaks in the dataset, estimating productivity growth over a longer period (i.e. using multiple business cycles) can provide a more robust estimate of the long-term potential for OE. However, if there has been a structural break in the dataset, the older data may be less relevant for determining what is achievable; the recent past may be more representative of what is achievable in the near future. For example, the Global Financial Crash (GFC) of 2007/08 may have induced permanent changes to productivity and led to a structural break in the dataset. Such a structural break would necessitate greater weight being placed on the most recent business cycle.

Our analysis of the EU KLEMS dataset suggests that the time period 1996–2019 contains complete business cycles (according to multiple definitions of the business cycle), and uses the majority of the data available.[20] This period may provide a reasonable estimate of the long-run scope for OE if the economy were in a steady state. However, given that the economy experienced a structural break during this period, we also consider the most recent business cycle, 2010–2019, to account directly for the slower productivity growth experienced after the GFC.

We note that, at RIIO-2, Ofgem decided to place less weight on the most recent period, arguing that energy networks are less affected by the economy-wide slowdown in productivity. If such a hypothesis were correct, one would expect there to be no relationship between economy-wide productivity growth and the productivity growth achieved in the energy networks sector. However, a cross-country comparison of productivity estimates suggests that there is a strong and statistically significant relationship between economy-wide slowdowns in productivity and slowdowns in productivity in the energy networks sector—countries that saw a material reduction in economy-wide productivity growth after the GFC also saw a material reduction in productivity growth in the energy networks sector, and vice versa. Therefore, there is evidence that the energy networks sector is not immune from economy-wide slowdowns in productivity.

Qualitative arguments

The GA analysis outlined above can lead to a range of feasible OE targets. When selecting a point estimate from within this range, the midpoint may be a natural starting point in the absence of further evidence. A deviation from the midpoint might be justified if some sources of evidence used to inform the target were more robust than others, or if the GA analysis systematically over- or underestimated the scope for OE in the TO sector.

At RIIO-2, Ofgem largely used the innovation fund to justify an uplift to the core OE target (derived through GA's analysis). However, as noted above, the CMA asked Ofgem to remove this uplift subsequent to the appeals.

We have reviewed the evidence and arguments used to justify deviations from what is implied through the GA analysis. These factors include the following.

[20] Data for the year 2020 is omitted; in addition to not being included as part of a complete business cycle, the data in that year is 'tainted' by the impact of COVID-19.

- **Changes in the regulatory framework** may trigger an increase or decrease in the achievable rate of OE relative to historical data.
- TFP may underestimate the scope for OE as it does not account for **embodied technical change** (changes in the quality of capital inputs).
- The OE **targets submitted by companies** in their business plans could be used to inform the target.
- The increased **digitisation** and/or the use of artificial intelligence (AI) in the production process may imply that the TFP estimates (based on historical data) underestimate the scope for OE in future.
- The TFP estimates may overestimate the scope for OE as they capture all sources of efficiency, including both **catch-up and scale effects**.
- The **indexation to CPIH** and other output price indices may already capture the OE achieved by the wider economy, potentially resulting in a double-count.

On balance, we consider that none of these qualitative arguments is sufficiently strong to justify a material revision to the OE target derived through GA analysis. In most cases, these arguments are not supported by empirical evidence or are offset by other factors.

Deriving the OE estimate

The TFP estimates we have considered when informing the overall target are presented in the table below. For comparison, we also present the outcome using Ofgem's economy-wide and targeted comparator set at RIIO-2, estimated using the latest data.

Estimated TFP growth (% p.a.)

Time period	2010–2019	1996–2019
Singular comparator set	0.5%	-0.2%
Broad comparator set	0.2%	0.2%
Granular comparator set	0.1%	0.1%
RIIO-2 economy-wide[1]	0.2%	0.3%
RIIO-2 targeted comparators[2]	0.0%	-0.3%

Notes: [1] All industries excluding: i) Real Estate Services; ii) Public Administration and Defence Services; iii) Compulsory Social Security; iv) Education; v) Health and Social Work; vi) Services of Households as Employers; Undifferentiated Goods and Services—Producing Activities of Households for Own Use; and vii) Services Provided by

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Extraterritorial Organizations and Bodies.
[2] Includes i) Construction; ii) Transportation and Storage; iii) Financial and Insurance Activities; and iv) Wholesale and Retail Trade Services; Repair of Motor Vehicles and Motorcycles.
Source: Oxera analysis of EU KLEMS data.

The table shows that the estimated TFP growth in the identified comparator sets is between -0.2% p.a. (the singular comparator set, 1996–2019) and 0.5% p.a. (the singular comparator set, 2010–2019). Across the six estimates based on our comparator sets, the average productivity growth is c. 0.15% p.a.

We note that the latest release of the EU KLEMS dataset shows that productivity growth has been lower across comparator sectors relative to RIIO-2. Indeed, focusing on the targeted comparator set applied at RIIO-2, the average productivity growth is between -0.3% p.a. and 0% p.a. This is materially below what CEPA found at the time of the determination (c. 0.2% p.a.).

Scope of application

It may be appropriate to apply different OE targets to different cost bases depending on the scope for OE in those activities and how the costs are assessed and funded through the regulatory framework. Indeed, we note that Ofgem applied different targets to OPEX and CAPEX at RIIO-2 for this reason.

In this respect, we suggest that there are two important types of classification to consider when applying OE.

1. The first is the **type of activity** (e.g. OPEX versus CAPEX; indirect OPEX versus direct OPEX), in line with Ofgem's principles at RIIO-2. The observation that the scope for OE may differ across different activities is supported by the TFP analysis, which suggests that sectors that are directly relevant for indirect OPEX (e.g. Finance and insurance) experienced different productivity growth to more widely comparable sectors (e.g. Construction).

   The granular comparator set can be used to construct an activity-specific OE, given that the comparator sectors in this set have been purposefully chosen to represent the activities in individual cost lines. The table below shows the estimated OE for each activity, based on the mapping exercise.

OE by activity

Time period	2010–2019	1996–2019
CAPEX	0.2%	0.2%
OPEX	-0.2%	-0.2%
TOTEX	**0.1%**	**0.1%**

Source: Oxera analysis using EU KLEMS and SPEN data.

The analysis suggests that there may be less scope for OE in OPEX than in CAPEX. However, relying on this analysis exclusively to set the OE target at the granular level would place material weight on the granular comparator set. As noted above, both the 'broad' and the 'single' comparator sets implicitly capture several functions, not just the activities to which these sectors have been mapped. Therefore, it may be appropriate to apply a target at the TOTEX level.

2 The second type of classification relates to the **novelty of the activity**. OE is driven by 'learning by doing' (at least in part) and is therefore most applicable to activities that are repeated regularly. For example, as a company undertakes more maintenance and monitoring activity on its network, it may become better at identifying when maintenance activity is required and in delivering it. That is, such activity can become more targeted and delivered at a lower unit cost over time (assuming all else equal). However, there may be less scope for OE (and possibly the additional costs involved) when undertaking novel activities compared to business-as-usual activities, given that this learning-by-doing effect is not present.

We understand that SPEN is expecting to undertake several new activities in the upcoming regulatory period. For example, it is planning to invest in high-voltage direct-current lines—technology that is complex, and not only expensive to build but also to maintain and operate. Given that this activity is 'new', the scope for OE is more limited.

More generally, Ofgem typically ascertains the need for and efficiency of large, one-off investments using engineering assessments. In this way, the volume of activity (e.g. the number of assets installed) is assessed for efficiency at the start of the period, such that companies cannot make further efficiency savings by reducing the volume of activity.[21] Moreover, these activities are typically outsourced via competitive tendering exercises, such that SPEN pays the competitive (and exogenously set) market price. If both the volume and the price of the activity are largely exogenous to SPEN, the scope for further OE improvements is unclear. Indeed, the only area in which the TO has material control relates to the competitive tendering exercise itself. However, we understand that this represents an immaterial proportion of the total cost of an investment.

When setting ex ante TOTEX allowances, it may be appropriate to forecast an element of OE for these new projects, given that the competitive companies commissioned to construct the assets will be able to make OE improvements over the regulatory period. However, the OE that competitive companies are able to achieve is outside SPEN's control, such that the price that SPEN pays for the investment is exogenous. Therefore, the uncertainty mechanisms through which these new activities are funded should account for the market conditions prevailing at the time, which could necessitate material deviations (up- or downwards) from the ex ante allowance. The exact nature of this may vary depending on the type of uncertainty mechanism. For example, the unit rate for volume drivers could be calibrated based on developments in the market price (equivalent to our proposals on RPEs; see section below), while the engineering assessments undertaken via re-openers[22] could be based on the prevailing market conditions without recourse to the OE set at the start of the price control period.

Real price effects

At RIIO-2, Ofgem indexed c. 70% of revenues to input price indices that were intended to capture the prices that SPEN (and TOs more broadly) face. The overall RPE index was determined based on a weighted average of these input price indices, where the weights were determined ex ante and calculated as the expected share of TOTEX that each input represented. While, in principle, indexing revenues to input price indices can protect companies and consumers from unexpected changes in

[21] For example, a company may be able to make efficiency savings by improving its approach to asset health, such that it requires less maintenance and replacement activity. However, if a company is required to install a fixed number of transformers, then efficiency savings cannot be made by simply installing fewer transformers. If SPEN could make efficiency savings by reducing the need to install new assets throughout the period, its allowance may reduce where linked to an uncertainty mechanism such that this efficiency is automatically passed on to consumers.
[22] A form of uncertainty mechanism whereby the necessity and costs of a particular activity can be revisited through a consultation process during the price control period, when the activity is undertaken.

input prices, we consider that the approach at RIIO-2 inadequately accounted for the price pressures faced by TOs, thereby providing insufficient protection. The two key issues with Ofgem's approach are as follows.

1. **Basis risk** resulting from selecting indices and weights that do not accurately reflect the cost pressures that TOs face.
2. **Composition risk** resulting from the ex ante fixing of weights, whereby if a company spends more or less on a particular input (due to uncertainty or other developments), this is not reflected in the RPE.

These are discussed in more detail below.

Basis risk

If outturn prices due to input price inflation faced by TOs differ significantly from the forecast selected input price indices, then Ofgem's current annual true-up mechanism does not adjust for this differential, as it adjusts for differences in the forecasts for input price indices. In doing so, the current true-up mechanism assumes that input costs track perfectly to the selected input price indices. There is no mechanism that explicitly adjusts for the differences between the outturn prices faced by TOs and the selected input price indices used by Ofgem. This is exacerbated by the fact that the selection of input price indices used by Ofgem is not fully representative of how TOs incur costs. As a result, the discrepancy between the input price indices and the movement of actual input prices incurred results in 'tracking errors'. This in turn means that TOs are not appropriately compensated for exogenous shocks, such as supply chain issues.

These tracking errors are likely to occur under Ofgem's current approach because TOs use highly specialised inputs (labour, capital, materials) that, at best, form only a small segment of the input price indices used by Ofgem. These concerns were raised as part of the RIIO-2 consultations, and as a result Ofgem made some adjustments to the selection of RPE indices. However, these changes did not go far enough in addressing TO concerns and, as a result, basis risk has continued to be an issue during the RIIO-2 period.

This basis risk could be rectified by selecting more appropriate input price indices that better reflect the inputs that TOs actually use.

For labour costs, this could involve selecting indices that more accurately reflect the actual occupations undertaken by SPEN's

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workforce than those used currently. Ofgem's use of the Office for National Statistics' (ONS) Average Weekly Earnings indices for the private sector and construction, as well as the more specialised indices from the Building Cost Information Service (BCIS) and the UK trade association for energy infrastructure and systems does not appropriately reflect SPEN's three largest workforce categories. In addition, the weighting against each index should be dynamic and more reflective of the proportion of the workforce in each occupational category.[23]

Furthermore, to assess materials RPEs, Ofgem uses two industry indices with an equal weighting: the BCIS electrical engineering materials index and the BCIS FOCOS Resource Cost Index of Infrastructure—materials. These are too broad to accurately capture the inputs that TOs procure such as conductors, cables, circuit breakers, switchgears, and transformers.[24] The BCIS FOCOS, for instance, does not focus on these assets in particular and instead reflects a broad range of goods, many of which are not relevant to SPEN and other TOs (e.g. timber, bricks and clay products). As a result, the use of this index overlooks pressures, such as supply chain issues, faced by TOs when purchasing key assets. Therefore, a more granular assessment of inputs reflecting the actual assets that TOs procure would be more cost-reflective than the current approach.

To this end, we have considered a few approaches that represent improvements on Ofgem's current approach.

First, we looked at UK-specific indices that provide a more granular approach at the asset-specific level. The ONS publishes such granular input price indices on some specialised inputs that are either directly relevant for TOs or are likely to exhibit similar price developments (e.g. Electric Motors, Generators & Transformers; and Wiring Devices), and which could be used for a more cost-reflective assessment. However, the ONS' indices are at a four-digit industry classification level and incorporate data for many broader and irrelevant cost categories. To reflect more TO-specific prices, we looked at asset-based indices from

[23] An approach based on TO-specific composition could risk perpetuating an inefficient structure, by encouraging companies to change their input costs to align with the weighting. That said, Ofgem already uses TO-specific cost category weights in its RPE approach. Moreover, there is a question about substitutability between different unit costs—i.e. it may not be possible to 'game the system' by adjusting costs to match cost categories that have higher weights. Therefore, updating the approach to dynamically adjust to the actual composition of TO's input costs would not materially affect this incentive if it already existed in the current approach.
[24] Section 3.3.4 presents the biggest categories of assets purchased by SPEN by volume and weighted by the estimated cost of each asset.

the British Electrotechnical and Allied Manufacturers Association (BEAMA) which focus on large power transformer materials, switchgears, cables etc. These may not cover the full range of assets used by TOs but will broadly reflect the largest categories of a TO's expenditure.

Given the relatively limited availability and granularity of indices from the UK, we have also explored indices from other jurisdictions that offer even more targeted input price indices. For example, the Federal Reserve Bank of St Louis (FRED) in Missouri publishes more granular data on the prices of specific assets used by US companies. FRED published an input price index specifically for transformers, not including Electric Motors & Generators, as per the ONS's index outlined above. In addition, German producer price indices (PPIs) are available at a six-digit industry classification level (compared to the four-digit ONS indices), and cover cost categories such as other electric conductors, liquid dielectric transformers.

While an index from another country may be seen as less relevant if there are country-specific input price pressures, indices from other jurisdictions can provide valuable information on price developments, especially as many of the assets procured by TOs may be internationally traded. This is particularly the case since many countries globally are making significant levels of investment in the transmission grid to account for the energy transition, exacerbating the pressure on input prices given the use of highly specialised inputs in transmission from a relatively limited set of suppliers. Therefore, input price pressures may not be specific to any one jurisdiction. While currency-exchange risk must be considered in the use of indices from other jurisdictions, this risk may be mitigated by foreign exchange hedging arrangements in procurement contracts.

Regardless of which of the above approaches is chosen, we consider that a more granular tracking of input costs is appropriate to mitigate the basis risk and better reflect TOs' input prices. However, for both labour and materials cost categories, an assessment of inputs at a more disaggregated level could come into conflict with Ofgem's use of materiality thresholds. In other words, the more granular the assessment of input prices, the more likely it is that individual inputs will appear immaterial when measured against the current materiality thresholds. This is because Ofgem's current approach necessitates the aggregation of disparate types of inputs into one input category, encouraging the use of high-level indices. Therefore, to mitigate basis risk, disaggregated assessment could be considered which requires less stringent and less rigid materiality thresholds.

Composition risk

In addition to basis risk, composition risk is a concern resulting from Ofgem's current RPE approach. As discussed above, RPE allowances are weighted ex ante based on the specific input's expected percentage of a TO's TOTEX over the control period. The RPE allowance itself is provided on a composite basis. In other words, a single RPE allowance adjustment is made based on a weighted average of the outturn RPEs across the different cost categories.

There is currently no true-up mechanism for adjusting these weights based on the proportion of outturn costs that each category represents. In practice, this means that if outturn activity differs from expected proportions (due to uncertainty or other developments), there is a risk that the RPE mechanism under- or potentially over-compensates the TO for its input costs. This situation might arise, for example, if SPEN had to invest more in installing cables, and therefore had to require more cables to be procured than anticipated, resulting in a higher proportion of materials costs over the period.

Indeed, data from SPEN's annual reports from 2014 to 2023 shows that there was significant variance between CAPEX forecasts and outturns. For example, in 2017 and 2021, CAPEX outturns significantly exceeded allowances, and in recent years (2022 and 2023), outturns have been lower than allowances. If RPE weights are based on forecast levels of investment, the degree of variance between CAPEX forecasts and outturns could indicate that SPEN is exposed to this kind of composition risk. The RIIO-2 framework allows for 're-openers', a form of uncertainty mechanism whereby the necessity and costs of a particular activity can be revisited through a consultation process during the price control period, when the activity is undertaken. Given the magnitude of TOTEX that would be funded through uncertainty mechanisms at RIIO-3, we expect that similar (or indeed more) volatility will occur in future, and companies and consumers need to be protected from such volatility.

Ofgem could adopt one of two mechanisms to address this composition risk:

1 **revise the weights ex post** based on companies' outturn expenditure, as discussed above. This is a natural 'next step' to Ofgem's current approach, which currently updates the value of the index but not the weight on the index;

2 **update the unit rates attached to the uncertainty mechanisms** using an asset-specific (or activity-specific) RPE.[25] The asset-specific RPE could be taken directly from one of the price indices above (such as the ONS PPIs), or could be estimated as a composite of several asset or activity-specific indices.

Finally, the shift towards a more granular assessment of RPEs with a more dynamic weighting approach, in addition to uncertainty mechanisms, can go some way to protecting companies and consumers from unexpected changes in input prices. However, even granular price indices may not fully protect companies from supply chain issues, given that the inputs are often specialised. When determining the appropriate incentive framework, it will be important to consider the impact of supply chain issues, not only on the price, but also on the deliverability of projects. Indeed, we understand that there are few market participants with respect to some inputs such that shortages could drive up prices. Therefore, additional mechanisms may be required to protect companies and consumers specifically from supply chain issues, such as separate cost-sharing rates, or allowing pass-throughs for items expected to be affected by supply chain issues; allowing a re-opener specifically for supply chain issues; or constructing a GB index for certain inputs using data from GB TOs.

Oxera's assessment of RPEs for RIIO-T3

Oxera takes a two-step approach to assessing RPEs for RIIO-T3:

1 we re-weight the index weights within each cost category to reflect SPEN's input cost composition more accurately. The re-weighting for labour RPEs is based on SPEN's labour-force breakdown, while for materials this is based on the largest categories of assets procured by SPEN, weighted by the estimated cost of each asset;

2 based on these revised cost categories, we assign input indices that align more closely with each respective category.

For materials RPEs, our estimate uses the ONS PPIs because they are UK-based and more granular than the current approach. However, the above weightings could also be applied against foreign indices, such as the German PPIs and FRED discussed above, which provide an even more

[25] At present, the ex ante allowance is based on the unit rate multiplied by the volume and is adjusted based on the outturn volume. While the unit rate is adjusted for TO wide RPEs, it is not adjusted on an asset specific or activity specific basis.

accurate assignment between more specific categories and the assets that SPEN procures. Because the foreign indices require more consideration about their application in the UK context, including taking into account the foreign exchange rates, for the purposes of our current RPE assessment we use the ONS PPIs.

The re-weighting of the cost categories and allocation to revised input indices are presented in the table below.

Re-weighting of cost categories and allocation to revised input indices

Input category	Proposed index	Proposed weight
Labour		**100%**
Management; Business & Administration	Building Cost Information Service (BCIS) Management and Admin	27%
Engineering & Technical; Field-based; Specialist	BCIS PAFI Civil Engineering	36.5%
Engineering & Technical; Specialist	BCIS Electrical Engineering Labour Index	18.25%
Engineering & Technical; Specialist	BEAMA Electrical Engineering	18.25%
Materials		**100%**
Transformer	ONS Electric Motors, Generators & Transformers	35%
Reactors	ONS Electric Motors, Generators & Transformers	25%
Switchgears	ONS Electricity Distribution & Control Apparatus	15%
Circuit breakers	ONS Electricity Distribution & Control Apparatus	12.5%
Cables	ONS Other Electronic and Electric Wires and Cables	12.5%

Source: Oxera analysis of SPEN data and ONS PPIs.

Based on this re-weighting to more granular cost categories and assignment to more appropriate input indices, we estimate combined TOTEX RPEs as shown in the table below.

Oxera estimate of T3 Combined TOTEX RPEs

	2027	2028	2029	2030	2031	Average
Labour	0.4%	1.3%	0.2%	0.2%	0.2%	0.5%
Materials	1.6%	1.6%	1.6%	1.6%	1.6%	1.6%

	2027	2028	2029	2030	2031	Average
Total	**0.6%**	**1.0%**	**0.6%**	**0.6%**	**0.6%**	**0.7%**

Note: SPEN's notional weights for labour and materials RPEs are 41.4% and 28.9% respectively.
Source: Oxera analysis based on SPEN data and publicly available indices.

We find that, on average over the T3 period, Oxera's revised approach would compensate SPEN for inflationary pressures by 0.3 percentage points more than the current Ofgem approach, presented in the table below.

Estimate of T3 combined TOTEX RPEs under Ofgem's approach

	2027	2028	2029	2030	2031	Average
Labour	0.4%	1.3%	0.7%	0.7%	0.7%	0.8%
Materials	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%
Total	**0.2%**	**0.6%**	**0.4%**	**0.4%**	**0.4%**	**0.4%**

Note: SPEN's notional weights for labour and materials RPEs are 41.4% and 28.9% respectively.
Source: Oxera analysis based on SPEN data and publicly available indices.

This difference stems entirely from materials RPEs, where the Oxera approach leads to RPEs that are 1.4 percentage points higher than the current Ofgem approach over the T3 period. Conversely, labour RPEs under the Oxera approach are lower (by 0.3 percentage points) than under Ofgem's current approach.

Ofgem's current approach is likely to have underfunded SPEN for its input prices during RIIO-2, and maintaining this approach for RIIO-3 would likely result in under-compensation again. Oxera's approach leads to a more accurate representation of the input price pressures experienced by SPEN, and therefore leads to appropriate compensation. This ultimately protects companies and customers, especially in periods of high volatility.

1 Introduction

1.1 Scope and remit of the study

Scottish Power Energy Networks (SPEN) has commissioned Oxera to conduct a study on the appropriate magnitude of ongoing efficiency (OE) and real price effects (RPEs) targets for electricity transmission operators (TOs) ahead of Ofgem's next regulatory period (RIIO-3), expected to cover 2026–2031. As part of this study, we build on the methodology adopted at the last price control review (RIIO-2),[26] the ensuing Competition and Markets Authority (CMA) appeals,[27] and Ofgem's sector-specific methodology decision.[28]

1.2 Conceptual background

As part of the price control process, Ofgem undertakes an assessment of the expenditure and outputs (among other things) included in TOs' business plans, to determine the efficient cost requirements for each TO. This ultimately feeds into the revenues that TOs are allowed to recover from consumers.

When determining the efficient cost requirements, Ofgem seeks to account for the different sources of efficiency gains that are achievable by each TO. As is common in regulatory contexts, the focus is typically on two sources of efficiency gains:

- catch-up efficiency: the degree to which a TO's performance can improve relative to observed best practice;
- OE: the degree to which current best practice is expected to improve in future.

At RIIO-2, Ofgem assessed the catch-up efficiency using disaggregated modelling, whereby individual cost lines (or groups of cost lines) were assessed for need and efficiency. This is counter to Ofgem's approach to assessing costs for gas distribution networks (GDNs) at RIIO-2, where costs were assessed at the total expenditure (TOTEX) level. The exact

[26] CEPA (2020), 'RIIO-GD2 and T2: Cost Assessment – Advice on Frontier Shift Policy for Final Determinations', November.
[27] Competition and Markets Authority (2021), 'Cadent Gas Limited, National Grid Electricity Transmission plc, National Grid Gas plc, Northern Gas Networks Limited, Scottish Hydro Electric Transmission plc, Southern Gas Networks plc and Scotland Gas Networks plc, SP Transmission plc, Wales & West Utilities Limited vs the Gas and Electricity Markets Authority Final determination Volume 2B: Joined Grounds B, C and D', October (hereafter 'CMA (2021) appeal), section 7.
[28] Ofgem (2024), 'RIIO-3 Sector Specific Methodology Decision – Overview Document', July.

methodology for assessing TOs' expenditure differed across different cost items, but typically involved one or more of the following:

- run-rate analysis, where the cost requirements are assumed to be (relatively) constant over time and can be extrapolated into the future;
- unit cost modelling, where an efficient unit cost for an activity is determined by the regulator using outturn or forecast unit costs across the industry and are applied to expected volumes to derive an efficient cost requirement;
- econometric benchmarking, where the efficient cost requirement is determined through more sophisticated statistical analysis;
- engineering assessments, where the efficient cost is determined through a detailed investigation of the proposed expenditure from an operational perspective.[29]

In addition to these assessments, Ofgem imposes an incremental OE target. At RIIO-2, the regulator set the OE challenge at c. 1.2% p.a. This reflected a core challenge of c. 1.0% p.a., with an innovation uplift of 0.2% p.a.[30]

The other focus of this study is RPEs, which reflect input price pressures that deviate from the consumer price index (CPIH) applied to allowances over the price control period. At RIIO-2, Ofgem used a range of input price indices covering various input price pressures. Based on forecasts of these input price indices, TOs were provided with an ex ante allowance for RPEs that was adjusted ex post if outturn input price inflation differed from forecasts.[31] More detail on the RPE is provided in section 3.

1.3 Structure of this report

The report is structured as follows:

- section 2 sets out the methodology and approaches to estimating OE targets. This section also provides our assessment of an appropriate OE target for RIIO-3;

[29] See Ofgem (2021), 'RIIO-2 Final Determinations Electricity Transmission System Annex (REVISED)', February, section 3.
[30] Specifically, Ofgem set an OE challenge of 0.95% p.a. on CAPEX and REPEX, and a challenge of 1.05% p.a. on OPEX. Combining the 0.2% p.a. challenge on the innovation uplift results in a total OE challenge of 1.15% p.a. on CAPEX and REPEX, and 1.25% p.a. on OPEX.
[31] Ofgem (2020), 'RIIO-2 Final Determinations – Core Document', December, pp. 66–67.

- section 3 describes the methodology to estimating RPEs, and presents an assessment of our estimation of appropriate RPE estimates for RIIO-3.

Internal Use

2 Ongoing efficiency

When determining OE targets, regulators consider several approaches, and each approach requires a series of methodological decisions that can have a material impact on the resulting OE target. At RIIO-2, CEPA on behalf of Ofgem, used growth accounting (GA) analysis to inform a 'feasible range' of OE targets of c. 0.5–1.2% p.a.[32] Given that a single estimate of OE is needed to determine expenditure allowances, Ofgem was required to provide some justification for selecting a point estimate from within that range. Ultimately, Ofgem selected a target of 1.15% p.a. for CAPEX and 1.25% for OPEX, which was based on a 'core' target of c. 1% p.a. (0.95% for CAPEX and 1.05% for OPEX, derived through GA analysis). Ofgem added an uplift of 0.2% p.a. for the additional productivity improvements that it expected companies to deliver as a result of innovation funding (the 'innovation uplift').[33] At the ensuing appeals, the CMA requested that Ofgem remove the innovation uplift and reduce the target to 0.95% p.a. for CAPEX and 1.05% p.a. for OPEX.[34]

While the CMA ultimately reversed the uplift for innovation funding, the CMA afforded Ofgem a degree of regulatory discretion when determining the core OE target. We consider that this degree of discretion is inappropriate and is, in part, driven by a perceived subjectivity with respect to GA analysis; and the wide range of OE estimates resulting from said subjectivity.

In this section, we outline a more concrete methodology for estimating the OE target. Where appropriate, we comment on where there may be a reasonable degree of regulatory discretion. However, we note that this should never involve 'arbitrary' decision-making—as with any regulatory parameter, the OE targets should always be based on robust evidence.

[32] CEPA (2022), 'RIIO-ED2: Cost Assessment – Frontier Shift methodology paper', June.
[33] Ofgem (2020), 'RIIO-2 Final Determinations – Core Document', December, pp. 48 and 213. This is discussed in more detail in section 2.7.1.
[34] CMA (2021) appeal, para. 7.867.
Ofgem's OE targets for OPEX and CAPEX at the final determination differed by 0.1% p.a., as did the CMA's. Hereafter, when referring to Ofgem's and the CMA's targets, we take the midpoint for brevity (i.e. c. 1.2% p.a. and c. 1% p.a. respectively).

This section is structured as follows.

Section	Description
2.1	Outlines the high-level methodology used to construct the OE target.
2.2	Describes the dataset used to estimate the OE target.
2.3	Discusses the type of productivity measures that could be used to inform the target, and how such measures should be used.
2.4	Considers the time period within which productivity should be estimated.
2.5	Outlines the comparator sectors used to estimate the OE target.
2.6	Discusses the approach to aggregating the results from multiple sectors into a feasible point-estimate.
2.7	Evaluates the qualitative arguments that could be used to select a point estimate from within the range.
2.8	Presents the reasonable range of OE targets and a robust point estimate.
2.9	Outlines how the OE target should be applied to costs.

2.1 High-level methodology

Regulators typically assess the scope of OE using 'top-down' methods. That is, regulators do not examine the details of the production process and the scope for technological progress at each stage of that process; rather, they use high-level productivity metrics to assess the extent of long-run OE in the past, and extrapolate that performance into the future.

These top-down methods can be broadly split into two categories.

- Indirect comparisons examine the rate of productivity growth achieved by competitive sectors of the economy that undertake similar activities to those undertaken by the regulated company. If the past rate of productivity growth achieved by these sectors is a strong indication of the scope for productivity improvements in the future, this approach can provide useful evidence to set OE targets for the regulated company. Examples of regulators using indirect comparisons to set the OE target include Ofwat (England and Wales),[35] Ofgem,[36] and the ACM (Netherlands).[37]

- Direct comparisons examine the rate of OE achieved by the regulated sector itself. A robust application of direct comparisons involves breaking down the observed rate of productivity growth into its components (e.g. scale efficiency, catch-up efficiency and OE) in order to isolate the impact of OE. For example, the Bundesnetzagentur (in Germany) uses stochastic frontier analysis (SFA) and data envelopment analysis (DEA) to set the 'Xgen' (the OE net of input prices) for the energy networks,[38] and in the most recent international benchmarking exercise (TCB18), the Council of European Energy Regulators (CEER) used DEA to estimate the OE for European Transmission System Operators (TSOs).[39]

At RIIO-2, Ofgem used indirect evidence to determine the OE target for the GDNs and TOs. However, it also used a form of direct evidence as a 'cross-check' to the indirect analysis. Specifically, it examined the rate of productivity growth achieved by the frontier GDN (Northern Gas Networks, NGN) and stated that, as NGN had achieved a higher rate of productivity improvement than the OE target, the OE target was achievable.[40] However, the CMA concluded that Ofgem had made an error when calculating the productivity growth that NGN had achieved, and argued that limited weight should be placed on the productivity growth achieved by a single company.[41]

In this report, we focus on the use of indirect evidence to set the OE target, in line with the extensive precedent in the UK and the CMA's decision at the RIIO-2 appeal.

[35] Ofwat used indirect comparisons to form the OE target at PR19, and this approach was supported by the CMA in the PR19 redeterminations. More recently, Ofwat has used indirect comparisons to form the OE target in its PR24 draft determinations. See Ofwat (2019), 'PR19 final determinations: Securing cost efficiency technical appendix', December, section 5; Competition and Markets Authority (2021), 'Anglian Water Services Limited, Bristol Water plc, Northumbrian Water Limited and Yorkshire Water Services Limited price determinations Final report', March, pp. 233–272; and Ofwat (2024), 'PR24 draft determinations: Expenditure allowances', section 4.1.
[36] For example, in its most recent price control, RIIO-ED2, Ofgem used indirect comparisons to set the OE target for electricity distribution networks. See Ofgem (2022), 'RIIO-ED2 Final Determinations Core Methodology Document', November, pp. 351–357.
[37] See Economic Insights (2020), 'Frontier Shift for Dutch Gas and Electricity TSOs', May.
[38] Bundesnetzagentur (2018), 'BK4-18-056 Beschlusskammer 4', November.
[39] A similar study was conducted in 2019 but no frontier shift analysis was published. (See Sumicsid (2019), 'Pan-European cost-efficiency benchmark for electricity transmission system operators', July.) Oxera understands that frontier shift results were discussed with the TSOs participating in the project.
[40] See Ofgem (2020), 'RIIO-2 Final Determinations - Core Document', December, para. 5.27.
[41] See CMA (2021) appeal, paras 7.330–7.347.

2.2 The dataset

The EU KLEMS is a widely used dataset providing detailed information on productivity and economic growth across EU and some non-EU countries, including the UK. It identifies multiple industries and their aggregates, which can be used to set an OE target, and is used by various regulators including Ofgem and Ofwat in setting their targets. In line with Ofgem's RIIO-2 approach, we use the EU KLEMS dataset to estimate the OE targets.

In addition, we use internal cost data provided by SPEN to identify the materiality of different cost categories and to provide a weighting to each cost activity, as well as the inputs that the TO uses. This data is also used in our RPE analysis (see section 3).

2.3 Productivity measure

Several measures of productivity can be estimated using the EU KLEMS dataset, and each has its own uses in particular contexts. They can be broadly split into two categories.[42]

- **Partial factor productivity (PFP) measures**—these include high-level metrics such as output per worker or labour productivity (LP) at constant capital. Such measures are sometimes used to set efficiency targets, especially if these are set on relevant subsets of total expenditure. However, PFP measures are not comprehensive measures of productivity. In particular, the productivity of any one input depends on the utilisation of other inputs, which implies that partial measures are not likely to reflect comprehensively the productivity potential of an input set.
- **Total factor productivity (TFP) measures**—TFP estimates are calculated using data on all inputs, and therefore represent the productivity of the entire production process. TFP is therefore seen as a more relevant productivity measure for a broad cost base, such as TOTEX.

The exact method of calculating TFP differs depending on the measure of output used. Typically, practitioners consider either gross output (GO) or value added (VA) measures of output. GO represents the total output of a firm, industry or economy, and can be considered the 'end product'. VA, on the other hand, represents only the incremental value that a firm,

[42] For a detailed discussion of different productivity measures, see OECD (2001), 'Measuring productivity. OECD Manual. Measurement of aggregate and industry level productivity growth', July, section 2.

industry or economy has added in the production process. In other words, VA is GO less any intermediate input consumed in the production process (such as materials, services procured from external organisations, and energy consumed in the production process).

The GO-based TFP growth measure is estimated as the residual from subtracting the weighted average growth of labour (L), capital (K) and intermediate inputs (I) from the growth of gross output (GO) according to the equation below:

$$gTFP(GO) = gGO - w_L \times gL - w_K \times gK - w_I \times gI$$

where:

- gGO represents the growth in gross output volume;
- gL represents the growth in labour volume, weighted by the labour share of GO, w_L;
- gK represents the growth in capital volume, weighted by the capital share of GO, w_K;
- gI represents the growth in intermediate input volume, weighted by the intermediate input share of GO, w_I.[43]

VA-based productivity measures are calculated similarly, but with intermediate inputs removed from the equation and the weights calculated as the share of input in VA rather than in GO.

Under neoclassical assumptions regarding the production technology, VA- and GO-based TFP measures are related. In particular, it can be demonstrated that a scaling factor can be applied to TFP(GO) to derive TFP(VA). As this scaling factor is greater than 1 by construction,[44] TFP(VA) will be larger in absolute terms than TFP(GO) if the neoclassical assumptions are maintained.[45]

Both TFP(GO) and TFP(VA) have been used in regulatory contexts to set efficiency targets. GO has the advantage that it is the more natural measure of output in a competitive industry, as it accounts for the contribution of all inputs to outputs, including intermediate inputs. The inclusion of all inputs can avoid biases in the VA measure when the mix

[43] GA typically uses an endogenous capital share of output and, as such, $w_L + w_K + w_I = 1$ by construction.
[44] The scaling factor is the inverse of the share of VA in GO. As VA is equal to GO minus intermediate inputs, and intermediate inputs cannot be negative, GO is always greater than (or equal to) VA. The inverse of the share of VA in GO is therefore always greater than (or equal to) 1.
[45] See Balk, B.M. (2009), 'On the relation between Gross Output- and Value Added-based productivity measures: The importance of the Domar Factor', *Macroeconomic Dynamics*, **13**, pp. 241–67.

of inputs used in the production process changes. Furthermore, the GO measure is closely related to the decisions made by companies, as it assumes that all inputs in the production process are controllable.

2.3.1 The RIIO-2 approach

At RIIO-2, CEPA used a combination of productivity metrics to inform the OE target. These metrics included both VA- and GO-based measures of productivity. For OPEX, CEPA recommended using TFP and LP to inform the OE challenge.[46]

The primary limitation with Ofgem's and CEPA's use of these metrics is that they have applied partial or incomplete productivity metrics to aggregate cost bases, without any necessary adjustments. This applies to both the choice of VA versus GO and the choice of TFP versus LP, as follows.

VA-based estimates of productivity growth can provide some information about the extent to which companies can improve productivity (as outlined above). However, given that VA captures labour and capital only, and ignores intermediate inputs, it does not provide a complete picture of the extent to which companies have improved productivity at the aggregate level. We note that VA-based measures of productivity growth may have their uses in the study of macroeconomics, as they allow for an aggregation of productivity growth across different sectors to form 'sector aggregates'. According to the OECD, the purpose of VA-based measures of productivity growth is to analyse 'micro-macro links, such as the industry contribution to economy-wide MFP growth and living standards, analysis of structural change'.[47] Moreover, the OECD clearly states that VA-based measures of productivity are '[n]ot a good measure of technology shifts [i.e. OE] at the industry or firm level'.[48]

If VA-based measures of productivity growth are to be used to inform the OE target, they must be adjusted to reflect the intermediate inputs used by TOs.

Similarly, LP can be used to set productivity targets, but only if the OE target is applied specifically to labour costs. If LP metrics are used to set OE targets for aggregated cost bases like OPEX (which include multiple

[46] See CEPA (2020), 'RIIO-GD2 and T2: Cost Assessment – Advice on Frontier Shift policy for Final Determinations', November, section 2.3.
[47] OECD (2001), 'Measuring Productivity – OECD Manual: Measurement of Aggregate and Industry-level Productivity Growth', July, p. 16.
[48] Ibid., p. 16.

inputs, not just labour), then the LP metrics require adjustment. For example, if the LP target is identified to be 1.2%, and labour constitutes 50% of OPEX, then the OE target resulting from LP metrics should be 0.6% (=1.2%*50%). We note that the inability of LP to measure OE is also recognised by the OECD:[49]

Labour productivity is a partial productivity measure and reflects the joint influence of a host of factors. It is easily misinterpreted as technical change [i.e. OE]

At the RIIO-2 final determination, CEPA argued that some weight should be placed on PFP measures (specifically LP) when determining the OPEX target, given that OPEX is more labour-intensive than CAPEX.[50] However, CEPA did not conduct any analysis to suggest whether OPEX was more labour-intensive than the comparator sectors or the wider economy—if TOs' OPEX is roughly as labour-intensive as that of the comparator sectors or wider economy, then a TFP target would be more appropriate.[51]

2.3.2 Oxera's approach

Given that TFP(GO) captures the contribution of all factors of production to productivity growth, we consider that TFP(GO) should form the basis for the OE target. Nonetheless, TFP(VA) measures can provide some useful information regarding productivity growth, and we consider these as a sensitivity. However, as noted above, these measures do not account for all inputs into production and therefore cannot be applied to aggregated cost bases without some adjustment.

2.4 The time period of analysis

Economic activity varies from one time period to the next, and these fluctuations can have an impact on the estimated productivity growth. As such, the choice of the starting and end points of the analysis can have a significant impact on the resulting estimates. Given the sensitivity of the estimates to the time period of analysis, the chosen period must be robustly justified. In particular, the following need to be considered.

[49] OECD (2001), 'Measuring Productivity – OECD Manual: Measurement of Aggregate and Industry-level Productivity Growth', July, p. 15.
[50] CEPA (2020), 'RIIO-GD2 and T2: Cost Assessment – Advice on Frontier Shift Policy for Final Determinations', November, section 2.3.
[51] We understand from SPEN that the share of labour costs within OPEX is broadly aligned with the labour share of GO across our comparator sectors (ranging from c. 27% in Financial and Insurance activities to c. 48% in IT and other Information services). This is broadly aligned with an observation raised at the CMA appeal, where it was noted that labour accounted for less than half of one GDN's OPEX (see CMA (2021) appeal, para. 7.170).

- **The stability of TFP growth.** If productivity growth is relatively stable over the available data, the most robust estimate of TFP would simply use all the available data. If productivity growth is volatile over time, the selection of the most appropriate time period of analysis becomes more nuanced, as the full dataset may produce a biased estimate (up- or downwards) of the feasible rate of productivity growth in the next regulatory period.
- **The cyclicality of TFP growth.** If productivity growth fluctuates around its long-run average growth rate, it is said to be 'cyclical'. In such cases, the data on which productivity growth is estimated should include periods of both below- and above-average TFP growth. Productivity growth is said to be 'pro-cyclical' if these cycles are broadly in line with the economic cycles of the overall economy (i.e. the business cycle). If productivity growth is indeed pro-cyclical then the appropriate time period of analysis can be informed by business cycles in the overall economy.

In simplified models of production, there is no clear reason why productivity growth and output growth should be related. An increase or decrease in output should be matched by a proportionate increase or decrease in input, leaving productivity unchanged. However, micro- and macroeconomic evidence indicates that productivity growth is pro-cyclical in the real world. There are various hypotheses for why this is the case, including:

- **exogenous shocks**—the pro-cyclicality of productivity is a product of productivity growth and output growth being driven by the same exogenous shocks (such as war or technological innovations);
- **labour-hoarding**—labour market imperfections (such as labour regulations or trades union power) reduce firms' ability to downsize in an economic decline. As the demand for output falls, the same number of employees produce less output and the measured productivity falls. Similarly, as the demand for output rises, the same number of employees produce more output and measured productivity rises;
- **economies of scale**—the production technology available to firms may exhibit increasing returns to scale, at least in the short term. That is, a 1% increase in outputs requires an increase in inputs of less than 1%. Similarly, a 1% decrease in outputs requires a less than 1% decrease in inputs. By construction, the

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measured productivity growth of such technology would be pro-cyclical.[52]

Because of this pro-cyclicality, regulators typically assess productivity growth over complete business cycles when setting OE productivity targets.[53] The main area of contention is exactly how the business cycle should be defined and estimated.

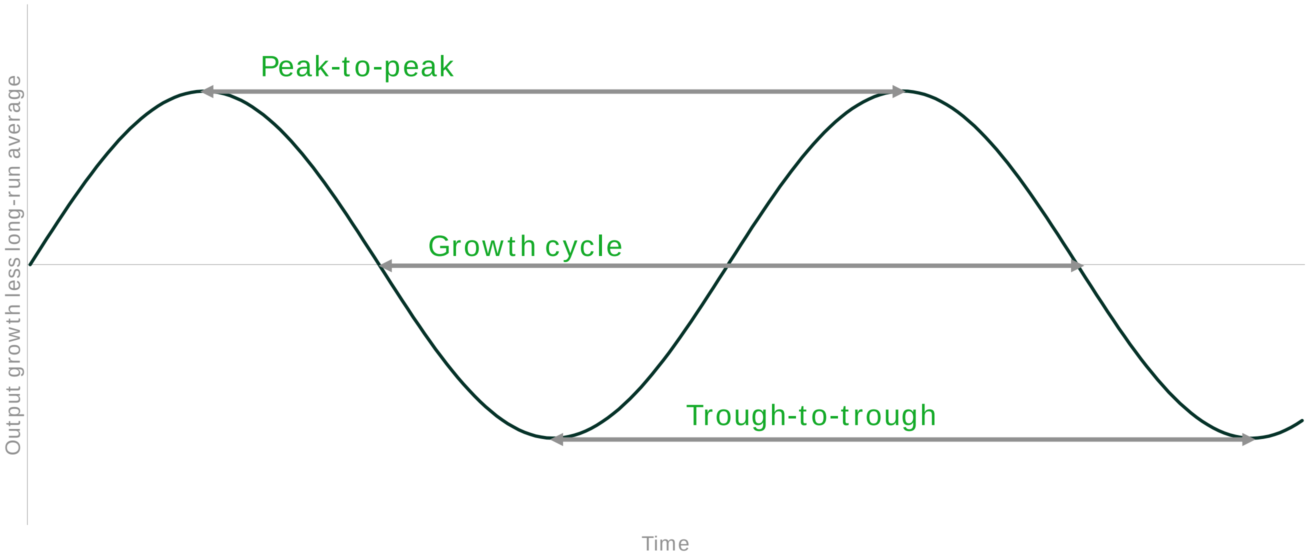
In principle, business cycles can be estimated in multiple ways, provided that they include one period of below-average growth and one period of above-average growth. For example, they can be defined as:

- ‘peak-to-peak’ business cycles: the business cycle starts at the highest point in a cycle and continues through one contraction before reaching the next peak;
- ‘trough-to-trough’ business cycles: the business cycle starts at the lowest point in a cycle, continues through one period of expansion, and ends at the following lowest point in the cycle;
- ‘growth cycle’ business cycles: the cycle begins at average output growth, and then cycles through one period of expansion and contraction before ending at average output growth.

These cycles are displayed graphically in the figure below.

[52] These hypotheses are discussed in BIS (2011), ‘Productivity and the Economic Cycle’, March, section 2.
[53] The main exception to this is Ofwat’s PR19 determination, where Europe Economics (Ofwat’s advisers) estimated productivity growth over incomplete business cycles. However, the CMA rejected this decision in the PR19 redetermination. See Competition and Markets Authority (2021), ‘Anglian Water Services Limited, Bristol Water plc, Northumbrian Water Limited and Yorkshire Water Services Limited price determinations: Final report’, March, pp. 233–272.

Figure 2.1 Business cycle definitions



Source: Oxera.

2.4.1 The RIIO-2 approach

At RIIO-2, Ofgem estimated productivity growth over complete business cycles. Specifically, CEPA used the time period 1997–2016, which it argued represented two complete business cycles according to the growth-cycle definition of a business cycle.

2.4.2 Oxera's approach

We have re-evaluated the business cycles in the UK economy based on the latest EU KLEMS dataset. The output growth (less the long-run average) of the UK economy in the period 1996–2019 is shown in Figure 2.2 below.[54]

[54] The latest EU KLEMS dataset contains data for 2020. However, 2020 is a clear outlier with respect to output growth due to the impact of COVID-19. We have assessed business cycles when including the data for 2020, and the conclusions do not change.

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Figure 2.2 Business cycle analysis

Note: The figure shows the growth in gross output minus the long-run average growth in gross output.
Source: Oxera analysis of EU KLEMS data.

The figure shows that there are multiple business cycles in this period, depending on the definition of the business cycle adopted, as follows.

- peak-to-peak: 2000–2010; 2010–2014.
- trough-to-trough: 1996–2009; 2009–2011; 2011–2019.
- growth cycle: 1996–2010; 2008–2011; 2010–2019.

Given this analysis, we consider that an appropriate time period would be 1996–2019. This would contain three complete business cycles under the 'trough-to-trough' definition and the growth cycle definition. This also uses the majority of the data included within the latest EU KLEMS release (the only omitted year is 2020) and, under certain conditions, using a larger sample may lead to a more robust estimate of the long-run potential for productivity growth.

However, we note that this period places significant weight on the productivity growth achieved by the comparator sectors over a decade ago. Such data may be outdated and unrepresentative of the scope for productivity growth in the near future. In this respect, there may be a trade-off between having *more* data (which would involve using multiple business cycles) and *more representative* data (which would typically

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involve using only recent business cycles). Therefore, we also consider the period 2010–2019 as a relevant time period for our analysis.[55]

2.5 Comparator selection

The EU KLEMS dataset contains input and output data for 42 sectors or sector-aggregates. For the TFP estimates to reflect the level of OE that is achievable for TOs, the comparator sectors must (to the extent possible) fulfil the following criteria.

1. **Relevance**—the comparator sectors must undertake activities similar to those undertaken by the TOs. No sector (other than the TO sector itself) will be perfectly comparable, but there are sectors that undertake activities similar to the undertaken by the TO sector. For example, a significant proportion of a TO's activity base relates to the building and maintenance of infrastructure, which can be represented by the Construction sector.
2. **Competitiveness**—the comparator sector must be competitive in order to mitigate the risk that the estimated TFP is 'tainted' by sources of productivity growth that are unrelated to OE, such as catch-up efficiency and scale effects.[56]
3. **Exogeneity**—the comparator sector should not contain the companies being assessed (i.e. TOs), in order to provide an independent assessment of the scope for OE.
4. **Data quality**—the comparator sectors' data relating to input and output volumes must be clear and robust. In this respect, sectors such as healthcare and education may not be appropriate as the output is not clearly defined.

We note that there may be a trade-off between different criteria. For example, the 'Electricity, gas, steam and air conditioning supply' sector may be directly comparable to the TO sector given that it contains the TO sector itself (thereby meeting criterion 1). However, this sector fails criteria 2 and 3, given that the sector is endogenous (for the same reason that it meets criterion 1) and insufficiently competitive.

2.5.1 The RIIO-2 approach

At RIIO-2, CEPA used two comparator sets to inform the OE target:[57]

[55] CEPA argued that less weight should be placed on recent data at RIIO-2. The errors associated with this are discussed in section 2.7.3.
[56] No sector is perfectly competitive such that the TFP estimates will always capture (to varying extents) other sources of productivity improvements. In the absence of a full breakdown of TFP into its components, this issue may need to be dealt with qualitatively.
[57] CEPA (2020), 'RIIO-GD2 and T2: Cost Assessment – Advice on Frontier Shift Policy for Final Determinations', November, p. 6.

1 a targeted comparator set: 'Construction'; 'Wholesale and Retail Trade; Repair of Motor Vehicles and Motorcycles'; 'Transportation and Storage'; and 'Financial and Insurance Activities';

2 an economy-wide comparator set: comprising all industries excluding: i) Real Estate Services; ii) Public Administration and Defence Services; iii) Compulsory Social Security; iv) Education; v) Health and Social Work; vi) Services of Households as Employers; Undifferentiated Goods and Services—Producing Activities of Households for Own Use; and vii) Services Provided by Extraterritorial Organizations and Bodies.

Given that the economy-wide comparator set led to the highest OE estimate in CEPA's range, and Ofgem used the top end of the range to set the OE target,[58] Ofgem implicitly placed sole weight on the economy-wide comparator set.

CEPA and Ofgem's approach at RIIO-ED2 was similar. However, CEPA added two sectors to the targeted comparator set at RIIO-ED2: 'Information and Communication' and 'Professional, Scientific, Technical, Administrative and Support Service Activities' .[59] Regarding the former sector, CEPA argued that this could capture some of the activities associated with digitisation. On the latter sector, CEPA leaned on precedent from the PR19 determination.

Ofgem's comparator selection at RIIO-2 (and RIIO-ED2) was inappropriate, particularly its focus on the economy-wide comparator set. This set contained industries that fail several of the criteria outlined above, such as:

- the manufacture of food products, beverages and tobacco sector (which fails the relevance criterion);
- the electricity, gas, steam and air conditioning supply sector (which fails the competitiveness and exogeneity criteria);
- the publishing, audio-visual and broadcasting activities sector (which fails the relevance criterion).

The CMA stated that there is no perfect targeted comparator set for TOs, nor is there a solid dividing line to draw between activities carried out by TOs and those in sectors that do not appear to be close

[58] Ofgem (2020), 'RIIO-2 Final Determinations – Core Document', December, p. 48
[59] CEPA (2022), 'RIIO-ED2: Cost Assessment – Frontier Shift methodology paper', June, p. 16.

comparators.[60] While it is indeed infeasible to identify a 'perfect' target comparator set, allowing sole weight to be placed on an economy-wide set implicitly allows sectors that are not relevant, with activities unrelated to TOs, to have an impact on the expected productivity of the TOs. If a sector is to be included in any comparator set, there must be a rationale to warrant its inclusion, which neither Ofgem nor the CMA provided.

We do not consider the inclusion of an economy-wide set to be warranted if its inclusion is based solely on the limitations of identifying a 'perfect' comparator set. Instead, identifying and triangulating across a range of suitable comparator sets may provide a more suitable estimate.

Moreover, CEPA's 'targeted' comparator set at RIIO-2 placed material weight on sectors that are only loosely relevant to TOs' activities. For example, the Financial and Insurance sector is not comparable to large swathes of the TOs' activities. It is unclear how the productivity achieved in banking (professional services, IT-intensive) should be replicable to constructing and maintaining physical infrastructure. At best, the Financial and Insurance sector may be relevant to some of the TOs' indirect activities (e.g. raising debt), although these represent a comparatively small proportion of the TOs' cost base. Therefore, if the Financial and Insurance sector is to be included at all, it should be given a lower weight in the analysis than more relevant sectors. Furthermore, companies in the Construction sector also undertake indirect activities (including raising debt) such that the productivity improvements associated with these indirect activities will already be captured in the estimated TFP in the Construction sector.

CEPA's decision to include additional sectors in the targeted comparator set at RIIO-ED2 exacerbates the errors in the RIIO-2 approach. The 'Professional, scientific, technical, administrative and support service activities' suffers from the same issues as the Financial and Insurance Activities sector. Moreover, the Information and Communication sector is not a relevant comparator sector for energy networks, for several reasons.

First, the Information and Communication sector-aggregate includes 'Publishing, motion picture, video, television programme production; sound recording, programming and broadcasting activities', which are

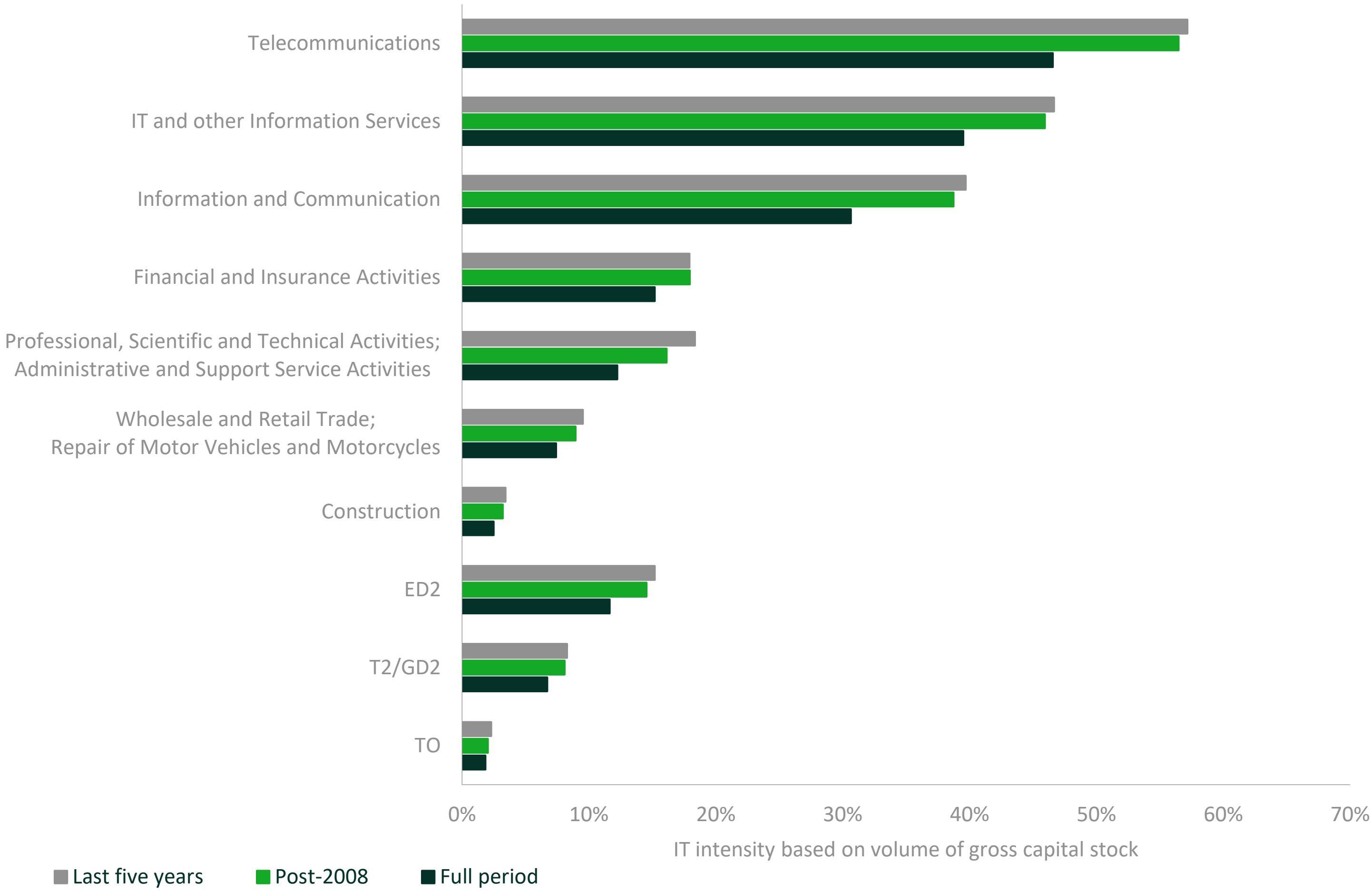
[60] CMA (2021) appeal, p. 134.

not relevant to the TOs' activities. Second, the sector contains telecommunications. Some aspects of the Telecommunications sector are relevant to the TOs' functions, such as wired communication, which requires a physical network that must be constructed and maintained, not dissimilar to a TO's network. However, the Telecommunications sector also contains the Wireless Communication sector, which is not likely to be relevant to the TOs' functions. Studies have shown that the wireless communications sector has achieved significantly higher rates of technological progress than the wired communications sector,[61] such that an examination of the total telecommunications sector is likely to overestimate the scope for OE.

Third, the Telecommunications sector is often characterised by natural monopolies and is highly regulated. Therefore, it fails the competitiveness criterion. Fourth, the stated purpose of including the IT and other Information Services sector—i.e. to capture the impact of digitisation—is not relevant. The impact of digitisation on productivity will already be implicitly captured by the estimated TFP in the other comparator sectors to some extent, depending on the sectors' IT intensity. If the TO sector is more IT-intensive than the rest of the comparator sectors, it may be appropriate to consider the inclusion of the IT and other information services sector to capture this, provided it is given a sufficiently low weight in the analysis (notwithstanding the above issues with the sector). Figure 2.3 below shows the IT intensity of the RIIO-ED2 comparators relative to the TO sector.

[61] See, for example, Modica, N.F. and Chansky, B. (2019), 'Productivity trends in the wired and wireless telecommunications industries', *Beyond the Numbers: Productivity (U.S. Bureau of Labor Statistics)*, May, **8:**8.

Figure 2.3 IT intensity of TOs relative to the RIIO-ED2 comparator sectors



Note: 'Telecommunications' and 'IT and other Information Services' are included as part of 'Information and Communication'. 'TO' is proxied by 'Electricity, Gas, Steam and Air Conditioning Supply'.
Source: Oxera analysis of EU KLEMS data.

Figure 2.3 shows that the TO sector is far less IT-intensive than the comparator sectors—indeed, it is less IT-intensive than any comparator sector, albeit close to the Construction sector. Therefore, far from requiring an uplift in the OE target to account for the impact of digitisation, a reduction in the target may be more appropriate, as TOs cannot benefit from productivity improvements in IT to the same degree as the comparator sectors can.

Fifth, the Information and Communication sector has undergone extensive growth during the modelling period. Between 1995 and 2019, the VA of the industry grew by 1,035% in real terms, compared to a

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growth of 39% in the TO sector and 60% in the wider economy.[62] If there is any economies of scale in the Information and Communication sector—which we would expect, given that part of the sector is characterised by natural monopolies—the estimated TFP growth would capture a combination of OE and scale effects.

2.5.2 Oxera's approach

The following section describes various sectors that may form part of our comparator sets, including the potential relevance of each sector to explain the costs that TOs face.

Construction

The Construction sector includes civil engineering and specialised construction activities, such as large-scale infrastructure projects. This sector is critical in capturing the costs associated with the building and maintenance of physical infrastructure required for transmission. It is also often seen as the key comparator for regulated utilities' CAPEX.[63] The construction sector also explicitly captures some indirect OPEX-related activities (such as costs related to project management) and implicitly some indirect OPEX-related costs (such as corporate functions, HR and regulatory teams, to the extent that companies in the construction sector undertake these activities).

As such, productivity improvements associated with construction will directly affect the productivity of TOs. We consider this sector to be the closest aligned to transmission, and therefore a core comparator.

Transportation and Storage

We consider certain aspects of the Transportation and Storage sector to be relevant when examining productivity improvements in transmission. In particular, the distribution network aspect of transportation and storage systems has relevant costs associated with the TOs, which can be captured by the sector 'Land transport and transport via pipelines'.

However, this comparator as a whole may be too broad since it includes sectors that are not relevant to the costs associated with the TOs, such as postal and courier services, and direct types of transport (e.g. air transport, water transport). Nonetheless, the relevant sector, Land

[62] The TO sector is proxied using the Electricity, gas, steam and air conditioning supply sector.
[63] Ofgem used construction as its main comparator for capital and replacement expenditure at RIIO-1. See Ofgem (2012), 'RIIO-T1/GD1: Real price effects and ongoing efficiency appendix', December, p. 15.

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transport and transport via pipelines, still forms a material proportion of the sector aggregate, at c. 39%, despite this meaning that a majority of the transportation and storage sector is still not relevant to the TOs.

Given that there are certain aspects of costs that can be directly captured by this sector, and a significant proportion of it is still relevant to the TOs, we consider that it may form part of a broader comparator set.

Repair and Installation of Machinery and Equipment

Maintenance, renewal and replacement expenditure faced by the TOs can be directly captured by this sector. However, this classification also incorporates 'other manufacturing'—that is, manufacturing activities that cannot be directly categorised into other manufacturing sectors. As such, this comparator may suffer from a 'catch-all' classification and include sectors that are not relevant.

Given that certain aspects of this classification are of direct relevance to a large proportion of the TOs' expenditure, we consider that this sector may form part of a broader comparator set.

Information and Communication

We consider that Information and Communication is too broad a sector to form part of the comparator set and suffers from several limitations, as outlined in the section above. However, it is possible that the more granular sector, 'IT and Other Information Services', could directly capture data management, processing and software design costs faced by the TOs. As such, we consider that IT and Other Information Services may form part of a broader comparator set, provided that it is given a weight commensurate with the IT intensity of TOs' functions.

Wholesale and Retail Trade; Repair of Motor Vehicles and Motorcycles

Given that the majority of repair activities can be captured by the repair and installation of machinery and equipment sector, we consider this sector not to be of relevance and that it should not form part of the comparator set.

Financial and Insurance Activities

The Financial and Insurance Activities sector can directly capture a TO's financing activities such as issuing debt. Furthermore, we consider that this sector overlaps with other areas of indirect costs associated with the TOs—in particular, professional, scientific and technical services. The Financial and Insurance Activities sector uses skilled labour and specialised IT equipment to produce technical outputs. In this respect, this sector may also indirectly capture other indirect activities that the TOs undertake, including some aspects of research and development (R&D).

However, since this sector does not directly capture the core functions of a TO, we consider that it should not be included in a comparator set unless it is assigned an appropriate weight.

Professional, Scientific, Technical, Administrative and Support Service Activities

This sector may capture direct technical, administrative and support service costs faced by the TOs. These can include consultant and advisory fees for engineering, operational and regulatory compliance, to administrative costs such as logistics and maintenance coordination. As discussed, this sector may overlap with other areas of indirect costs, in particular Financial and Insurance Activities.

However, since this sector does not directly capture the core functions of a TO, we consider that is should not be included in a comparator set unless it is assigned an appropriate weight.

Summary

Although our selection of comparators is based on our informed methodology, we acknowledge that there will always be an element of value judgement when developing a robust comparator set.[64] To ensure that the OE target is not over-sensitive to these value judgements, we consider a range of comparator sets to inform the target, as follows.

1 **A singular set**–here, we focus on the Construction sector only. This sector includes civil engineering and specialised construction activities, such as large-scale infrastructure projects. The sector is critical in capturing the costs associated with the building and maintenance of physical infrastructure required for transmission. It is also often seen as the key comparator for regulated utilities' CAPEX.[65] The construction

[64] CMA (2021) appeal, paras 7.231–7.239.
[65] Ofgem used construction as its main comparator for capital and replacement expenditure at RIIO-1. See Ofgem (2012), 'RIIO-T1/GD1: Real price effects and ongoing efficiency appendix', December, p. 15.

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sector also captures some indirect OPEX-related activities explicitly (such as costs related to project management) and some indirect OPEX-related costs implicitly (such as corporate functions, HR and regulatory teams, to the extent that companies in the construction sector undertake these activities). The Construction sector is also marginally more IT-intensive than the TO sector, such that the productivity growth associated with digitisation is also captured by the Construction sector.

2 **A broad set**—this set includes three operationally relevant sectors: 'Construction' (as above), 'Transportation and Storage', and 'Repair and Installation of Machinery and Equipment'. Transportation and Storage captures some of the activities associated with building and maintaining distribution networks (e.g. transport via pipelines), which are not dissimilar to the TO functions. However, the sector may be too broad, given that it includes less relevant activities (e.g. air transport, water transport). Similarly, Repair and Installation of Machinery and Equipment may capture the maintenance, renewal and replacement activity undertaken by the TOs, but this sector also serves as a catch-all for other manufacturing, which would be less relevant for the TO's functions. As with the Construction sector, these sectors also capture activities relating to indirect expenditure (e.g. project management, finance) and the productivity growth associated with IT.

3 **A granular set**–here, we map the TO's activities to sectors that are directly comparable to those activities. For example, sectors such as 'Finance and Insurance Services' and 'Professional Services' have little relevance to most TO functions; however, they are (both explicitly and implicitly) relevant to indirect OPEX. Therefore, these sectors may add more information about the scope for OE in these specific activities, even if they do not provide an accurate estimate of the scope for OE at the TOTEX level. When aggregating the results in the granular set, we apply a weighted average approach where the weight is calculated as the share of TOTEX related to the activity to which the sector is mapped. This allows activities to be mapped according to their intensity and presence within the TOs' activities.

Table 2.1 below summarises the comparator sectors we have used to estimate a suitable OE level that the TOs are likely to face at RIIO-3. For comparison purposes, we also present the sectors represented under the RIIO-2 and RIIO-ED2 comparator sets.

Table 2.1 Industries included in comparator sets

Comparator Industry	Singular set	Broad set	Granular set	T2/GD2	ED2
Construction	✓	✓	✓	✓	✓
Transportation and Storage		✓	✓	✓	✓
Repair and Installation of Machinery and Equipment		✓	✓		
IT and other Information Services			✓		
Financial and Insurance Activities			✓	✓	✓
Professional, Scientific, Technical, Administrative and Support Service Services			✓		✓
Wholesale and Retail Trade; Repair of Motor Vehicles and Motorcycles				✓	✓
Information and Communication					✓

Source: Oxera.

2.6 Aggregation approach

Each comparator sector may provide valuable (and different) information about the extent to which TOs can improve productivity. Given that the productivity growth achieved by the comparator sectors represents the full extent of achievable efficiency gains, some form of aggregation approach is required. Ideally, this aggregation approach would place more weight on comparator sectors that are most relevant to TOs' functions, and less weight on those that are less relevant or are relevant only for a subset of the TOs' functions.

2.6.1 The RIIO-2 approach

At RIIO-2, Ofgem used two aggregation approaches to determine the OE target, depending on the comparator set. For the targeted comparator set, Ofgem took a simple average. Meanwhile, for the economy-wide comparator set, it weighted each sector based on the contribution of that sector to the wider economy (in terms of GO or VA, depending on the measure of productivity used).[66]

A simple average of comparator sectors may be appropriate if each comparator captures broad swathes of the TOs' activities. In this case, and in the absence of further evidence, it may be difficult to argue that

[66] CEPA (2020), 'RIIO-GD2 and T2: Cost Assessment – Advice on Frontier Shift policy for Final Determinations', November, p. 21.

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one comparator sector should be assigned a higher weight than another. However, if the comparator set contains sectors that are relevant to only a subset of activities, then a simple average would be inappropriate. To take an extreme example, a comparator set may contain the Construction sector (which directly captures TOs' core functions and some indirect costs), the Financial and Insurance Activities sector (which directly captures financing costs and may partially capture some other indirect functions), and the Professional Services sector (which directly captures indirect functions). Clearly, the Construction sector is more directly relevant to the TO functions than the other two sectors, yet a simple average would assign a c. 33% weight to each sector. A 66% weight would be attached to sectors that are relevant to only a small proportion of the TOs' activities. Therefore, the choice of a simple average over a weighted average would depend on the sectors included within the comparator set.

Ofgem's approach to constructing the weighted average at RIIO-2 is not appropriate, regardless of the comparator set adopted. There is no reason to assume that a sector is more representative of the TOs' activities simply because the sector forms a larger proportion of the UK economy. Such an approach assumes that a TO undertakes the same activities as an 'average' British company, which we consider to be unlikely (at the very least, it is unevidenced). To see why this is unlikely, one can construct a hypothetical example whereby the agricultural sector saw an increase in output such that the weight attached to the agricultural sector increases, even though the core task of the TO has not changed.

2.6.2 Oxera's approach

As noted above, the aggregation approach may depend on the approach to comparator selection. If only comparators that are directly relevant to large swathes of the TOs' functions are used, then a simple average of comparator sectors may be appropriate (in the absence of further information). For example, if only the Construction and Transportation and Storage sectors are selected as comparators (the former being directly relevant to building and maintaining physical assets; the latter containing some information about the operation, monitoring and maintenance of physical assets), then a simple average of these comparator sectors may be appropriate. Therefore, we use a simple average of comparator sectors in the broad comparator set.

However, some of our chosen comparator sets contain sectors that are relevant only to a subset of the TOs' functions. For example, the Financial and Insurance Activities and the Professional Services sectors are relevant to indirect functions only, and it would be inappropriate to attach the same weight to these sectors as sectors that are directly relevant to a larger proportion of the cost base. As such, when aggregating the results from several comparators, we undertake the following weighting procedure.

- **Cost-allocation exercise**—this involves defining the key, distinct activities undertaken by the TOs and determining the contribution of each activity to providing transmission services. This could be undertaken using a cost-allocation exercise, whereby activity cost centres of a TO are created, and costs are allocated to the activities based on defined activity metrics (e.g. the intensity, importance or proportion of spend on each activity). The resulting estimate is a measure of the importance of each activity to the overall organisation and is typically referred to as the 'weight' of the activity.
- **Mapping exercise**–once activities have been identified, individual sectors can be mapped directly to the most relevant activities. For example, as noted above, the Construction sector may be relevant to maintenance and construction activities. Multiple sectors can be assigned to each activity without necessarily attaching specific weights within that activity—an industry's contribution to an activity is typically averaged equally with other relevant industries if multiple industries are deemed relevant to that activity.
- **Deriving weights**—the relative importance of each industry (i.e. the weight attached to each industry in the aggregation process) is derived by aggregating the weights of the activities to which they are mapped.

We note that the CMA argued that such a weighting approach may result in spurious accuracy and potentially underweight useful comparators.[67] However, neither the CMA nor Ofgem presented evidence to suggest that this is the case. A simple average across comparator sectors is not a passive, assumption-free decision; rather, it is an active decision to assume that all comparator sectors are equally representative of the TO functions, which is evidently not the case when the comparator set contains sectors that are relevant only to a small subset of the TOs' activities.

[67] Competition and Markets Authority (2021), 'Anglian Water Services Limited, Bristol Water plc, Northumbrian Water Limited and Yorkshire Water Services Limited price determinations', March, p. 240.

Table 2.2 shows the mapping exercise we used for each activity. The weight of each activity is also shown, based on its proportion of total costs as described in the cost-allocation exercise.

Table 2.2 Comparator mapping

	Load-related CAPEX	Non-load-related CAPEX	Non-operational CAPEX	Network operating costs	Indirect OPEX	Other costs
Proportion of total costs	**5%**	**39%**	**1%**	**28%**	**20%**	**7%**
Construction	✓	✓	✓	✓		✓
Transportation and Storage	✓			✓		✓
Repair and Installation of Machinery and Equipment	✓	✓		✓		✓
Financial and Insurance Activities					✓	
Professional, Scientific, [...] Services					✓	
IT and Other Information Services			✓	✓		✓

Source: Oxera analysis of data provided by SPEN.

Table 2.3 shows the implied weight for each comparator set under the granular set, based on aggregating the weights of the activities to which they are mapped. We have also listed the weights for the other comparator sets, for comparative purposes.

Table 2.3 Derived industry weights

Comparator industry	Singular set	Broad set	Granular set
Construction	100.0%	33.3%	30.4%
Transportation and Storage	-	33.3%	10.5%
Repair and Installation of Machinery and Equipment	-	33.3%	30.0%
Financial and Insurance Activities	-	-	9.9%
Professional, Scientific, [...] Services	-	-	9.9%
IT and Other Information Services	-	-	9.3%

Source: Oxera analysis of data provided by SPEN.

Under the granular set, Construction, which also forms the singular comparator set, has the highest weight, followed closely by Repair and Installation of Machinery and Equipment.[68] The other industries which subsequently form the granular set have a materially lower weight since they affect cost activities that are less material in the overall cost base.

We note that the comparator sectors are mapped to activities only for which they are **explicitly** relevant. For example, Construction is largely mapped to CAPEX-related activities and is not mapped to indirect functions, even though the Construction sector will capture these activities implicitly. This explains why the weight on the Construction sector naturally reduces in the granular comparator set relative to the singular and broad comparator sets.

2.7 Qualitative arguments

The GA analysis outlined above can be used to determine a range of feasible OE targets. However, the regulator is typically required to derive a point estimate for the OE target in order to set the challenge for the TOs. Selecting the midpoint of the range derived through TFP analysis may be a natural starting point, in the absence of further evidence. Nonetheless, some regulators have deviated from the mid-point of the range in recent decisions, depending on the quality of the evidence used to derive the upper and lower bounds of the range and additional (often qualitative) evidence about the TOs' ability to make OE improvements. At RIIO-2, Ofgem largely used the innovation fund to justify an uplift to the core OE target (derived through GA analysis). However, as previously noted, at the appeals the CMA subsequently requested Ofgem to remove this uplift.[69]

We have reviewed the regulatory precedent regarding the use of alternative evidence to justify more or less stringent targets than that implied by the midpoint of the range. We consider that the following issues require examination, given that they have either been explored in recent regulatory decisions or are otherwise relevant when determining the target:

[68] As part of this mapping exercise, we have generally assumed that the three sectors contained within the broad comparator set capture similar costs. However, as noted in section 2.5, the Construction sector may be more relevant than the other two sectors and suffers from fewer limitations. As a sensitivity, we explored an alternative mapping exercise where only Construction was used in these areas (i.e. omitting the other two sectors contained within the broad comparator set), but this did not materially affect our conclusions. An alternative would be to assign different weights to different sectors that are mapped to an individual activity. However, this would require more detailed information than is currently unavailable, and risks becoming an arbitrary value judgement.
[69] CMA (2021) appeal, para. 7.867.

- **changes in the regulatory framework** may trigger an increase in the achievable rate of OE relative to historical data;
- TFP may underestimate the scope for OE as it does not account for **embodied technical change**;
- TFP estimated using data after the GFC may underestimate the scope for OE, given that regulated networks are 'immune' or 'protected' from economy-wide shocks;
- the OE **targets submitted by companies** in their business plans;
- the increased **digitisation** and/or the use of AI in the production process may imply that the TFP estimates (based on historical data) underestimate the scope for OE in the future;
- the TFP estimates may overestimate the scope for OE as they capture all sources of efficiency, including both **catch-up and scale effects**;
- the **indexation to CPIH** and other output price indices may already capture the OE achieved by the wider economy, potentially resulting in a double-count.

These are discussed in turn below.

2.7.1 Changes in the regulatory framework

Both Ofgem and Ofwat sought to justify an uplift to the OE target at RIIO-2 and PR19 respectively, as a result of changes in the regulatory framework. Specifically, Ofgem argued that the presence of 'innovation funding' allowed companies to invest in more innovative projects that should result in improved productivity beyond the rate implied by the TFP analysis. Meanwhile, Ofwat argued that the 'TOTEX and outcomes' introduced at PR14 allowed companies to achieve a step change in productivity improvements at PR19.

At the RIIO-2 appeal, the CMA rejected Ofgem's innovation uplift, giving the following justifications for doing so.[70]

- Ofgem had assumed that all of the projects relating to the innovation fund improved efficiency via cost reductions, whereas the CMA argued that a significant proportion of the innovation funding was used to improve quality. The CMA noted that 'the impact of this error, by itself, is sufficient for us to conclude that GEMA erred.'
- Ofgem had incorrectly assumed that the impact of the innovation funding was entirely incremental to the TFP estimate,

[70] CMA (2021) appeal, paras 7.802–7.866.

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whereas the CMA noted that the comparator sectors also undertake R&D activities such that the impact of innovation funding is already captured within the TFP estimates to some extent.

- The impact of innovation funding was already captured within companies' business plans, to some extent.
- There is a realistic expectation that the introduction of an uplift for innovation funding would distort companies' incentives with respect to R&D activities, specifically in relation to whether companies invest in cost-reducing or output-enhancing activities.

We consider that, in principle, changes to the regulatory framework could be used to qualitatively inform the OE target. This could result in aiming towards the upper end of the range informed by the TFP estimate, or towards the lower end of the range, depending on the exact change in the regulatory framework. However, in line with the CMA's response to the innovation funding uplift at RIIO-2, we consider that any adjustment must be robustly justified (and, where possible, quantified) and that care must be taken to ensure that there is no double-count of efficiency improvements.

We are unaware of changes to the RIIO framework that would necessitate an adjustment to the targets derived through TFP analysis at RIIO-3.

2.7.2 Embodied technical change

Embodied technical change relates to the fact that the quality of inputs might improve over time, contributing to productivity improvements, yet this is not captured in the TFP estimates.[71] Usually this is framed in terms of the quality of capital inputs improving over time—e.g. a computer bought in 2020 is likely to be more productive (e.g. have faster processing power, greater storage) than a computer bought in 2000.

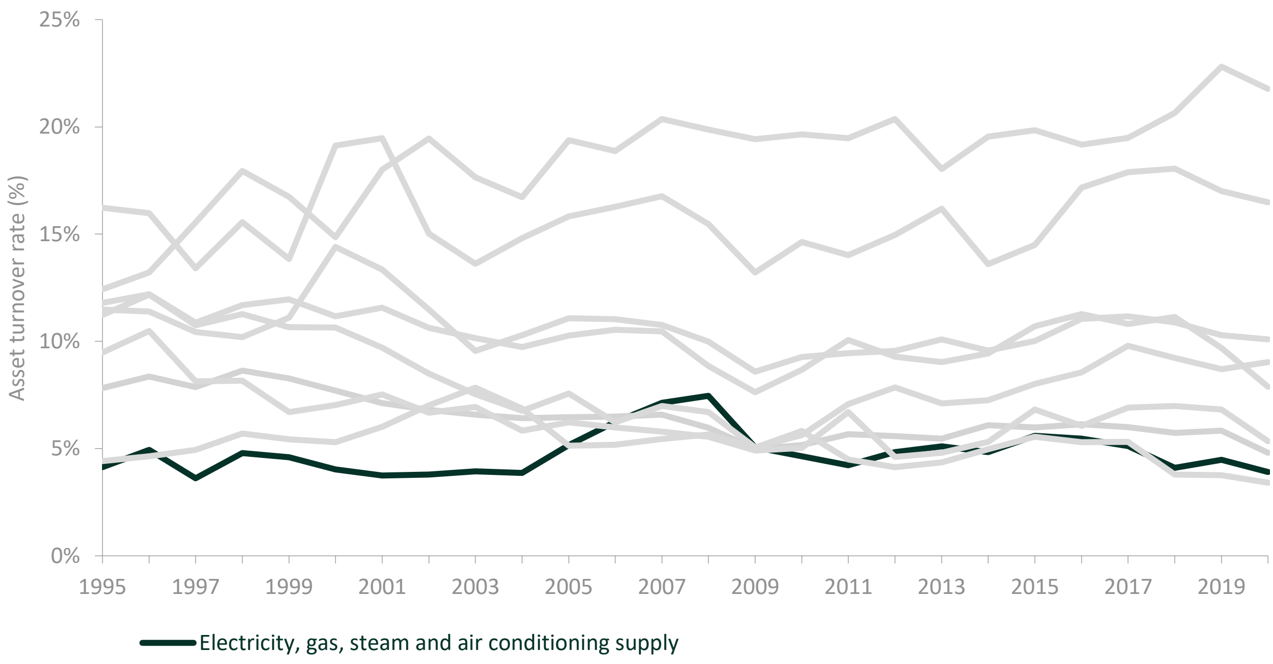
Both Ofgem and Ofwat have, to varying extents, used the hypothesised presence of embodied technical change to justify an uplift to the OE target. However, neither regulator has presented any evidence regarding the presence of embodied technical change in the comparator sectors or their respective regulated sectors. It is good practice, and indeed essential, to provide some evidence to support regulatory decisions. Indeed, the ACM examined embodied technical change when setting its

[71] The extent to which TFP captures embodied technical change is disputed among experts.

frontier shift target for Dutch TSOs, and found that an uplift was not required.[72]

Moreover, to the extent that embodied technical change may exist, it is unlikely to be material in the TO sector. For embodied technical change to be relevant, there must be a relatively high turnover of assets. This may be applicable to certain types of assets that are replaced or upgraded regularly, such as IT, but is unlikely to be relevant for vast swathes of the TOs' asset base that are only replaced every 20–50 years. The trends in capital volume between electricity transmission (ET) and the comparator sectors are shown in Figure 2.4.

Figure 2.4 Trends in asset turnover across the electricity transmission and comparable sectors, 1995–2020



Note: The asset turnover rate is defined as the gross fixed capital formation over the total gross capital stocks of the sector.

Source: Oxera analysis of EU KLEMS data and Office for National Statistics (ONS) data for total gross capital stocks of the sectors.[73]

[72] See College van Beroep voor het bedrijfsleven (2023), ECLI:NL:CBB:2023:321, para. 18.3.
[73] See Office for National Statistics (2023), 'Gross and net capital stocks for the total UK economy, by industry and asset', accessed 19 November 2024.

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As shown by Figure 2.4, the ET sector (proxied by the electricity, gas, steam, and air conditioning supply sector) had very low turnover of assets prior to the GFC. The sector experienced a higher rate of asset turnover during the GFC than comparator sectors, yet it has returned to comparatively low rates since 2009.

Furthermore, not only is the rate of replacement/installation a relevant driver of embodied technical change, but the actual advancements in technology for those assets is also relevant. For example, it is clear that there has been rapid progress in the computing power of IT assets over time such that embodied technical change may be relevant for the assets; but it is less clear that technological progress in other relevant assets (e.g. vehicles, transformers, cables) has been similarly rapid. That is, as the materiality of embodied technical change will be sector-specific, it is important to assess whether (rather than assert that) embodied technical change is relevant for the sector in question.

For these reasons, we do not consider that significant weight should be placed on the hypothesised presence of embodied technical change when deriving the OE target.

2.7.3 The post-GFC period

It is well-established that productivity growth has stagnated in the UK since the GFC. Both Ofwat and Ofgem have argued that network companies are less affected by economy-wide slowdowns, so the OE targets derived from the EU KLEMS dataset in recent years (post-GFC) will underestimate the true scope of OE.[74]

The arguments use to support this hypothesis primarily relate to: (i) the fact that network companies have protected revenue (determined by the regulator) that allows them to maintain innovation and investment activity during economic slowdowns, more so than the comparator sectors; and (ii) the hypothesised drivers of the economy-wide slowdown in productivity (such as declining demand) do not apply to network industries.[75] However, neither Ofwat nor Ofgem presents empirical evidence to support this hypothesis.

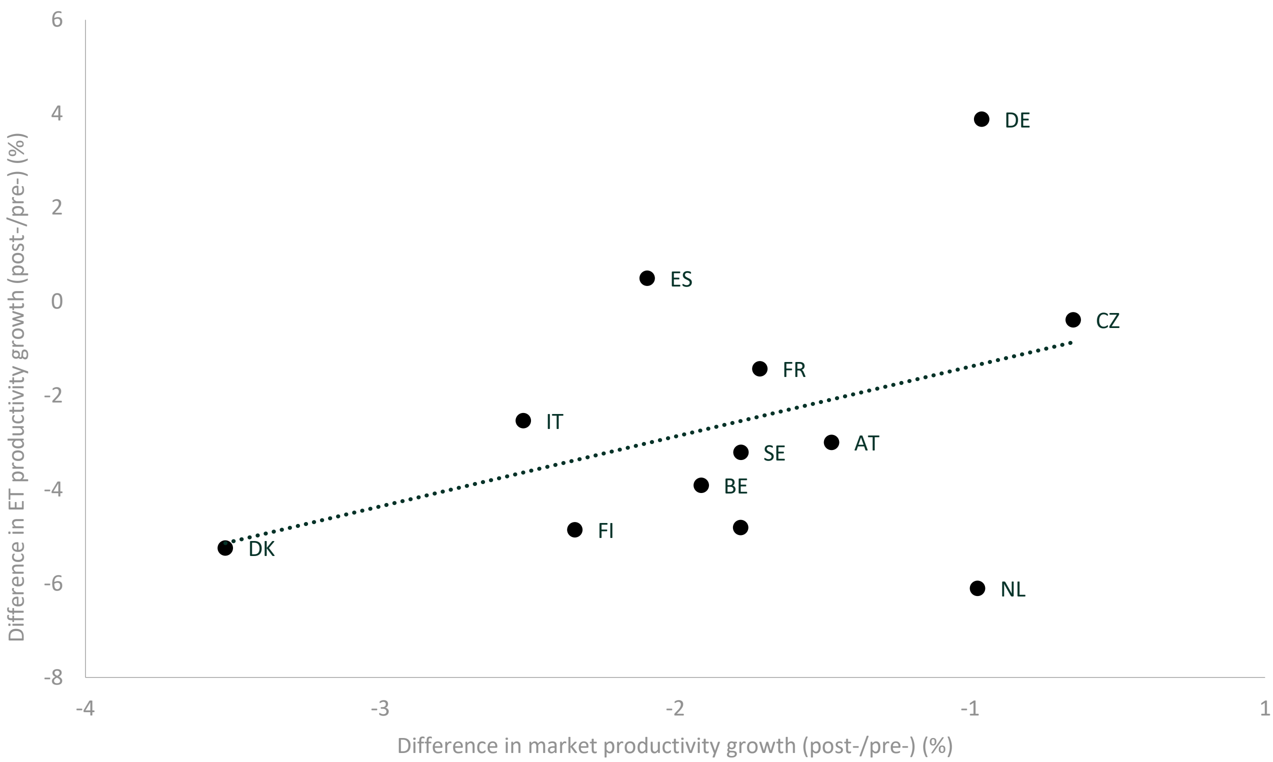
We note that, as a general point of principle, more *recent* years of data are to be given a larger weight in the assessment of OE, given that the recent past is usually more indicative of the near future. For example, the

[74] Europe Economics (2023), 'Frontier Shift and Outcomes Stretch at PR24', March, p. 3.
[75] CEPA (2020), 'RIIO-GD2 and T2: Cost Assessment – Advice on Fronter Shift policy for Final Determinations', November, p. 23.

Dutch Tribunal Court (CBb) noted that if there is a structural break in the productivity data (e.g. due to energy transition) then past data becomes inappropriate to consider. On this basis, it concluded that the measurement period for the Dutch Distribution System Operators (DSOs) should be 2017–21, ignoring data between 2005 and 2016 that the ACM had also considered. Given this point of principle, there is a high evidential bar for omitting or otherwise discounting recent data.

If Ofgem's hypothesis that network industries are less affected by economy-wide slowdowns were correct, one would expect that the productivity growth achieved in the TO sector would be uncorrelated with productivity growth achieved in the wider economy. Figure 2.5 shows the relationship between the productivity growth in the market economy and that in the TO sector for the European countries included in the EU KLEMS dataset.

Figure 2.5 Relationship between productivity growth changes post-GFC between TO sector and wider economy



Source: Oxera analysis of EU KLEMS data.

Figure 2.5 shows that countries that experienced larger economy-wide slowdowns in productivity following the GFC also experienced a larger

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slowdown in productivity in the TO sector after the GFC. For example, Denmark (DK) has seen a significant decline in economy-wide productivity growth since the GFC and has seen a similar decline in TO productivity. Meanwhile, Germany (DE) and Czechia (CZ) experienced a more modest decline in economy-wide productivity growth, and productivity growth has not declined in the TO sector. While there are outliers, the relationship between productivity growth in the TO sector and the wider economy is statistically significant. That is, there is strong evidence that productivity growth in the TO sector and the wider economy are related, such that it cannot be argued ex ante that the TO sector is fully insulated from economy-wide slowdowns in productivity. Therefore, we do not consider that less weight should be placed on the recent slowdown in productivity growth. Rather, the recent decline in productivity growth should be used to inform the OE target by placing more weight on more recent data.

2.7.4 Targets submitted by companies

Both Ofwat and Ofgem have historically used the OE targets presented by companies in their business plans to inform or validate the OE target that the regulator derived through its own analysis. Such use of business plan data to validate the regulator's OE target is subject to several limitations.

First, using the OE targets proposed by companies as some 'minimum' value for what the OE target should be creates perverse incentives. If companies know they will be penalised (through tougher efficiency challenges) by submitting more stretching targets, they may be less likely to propose ambitious and challenging business plans.

Second, the OE targets proposed by companies are 'headline figures' that may not accurately capture the level of OE embedded in their business plans. In this respect, a 1% p.a. OE target submitted by one company may not be comparable to a 1% p.a. OE target submitted by another. This was evident at RIIO-2 and the subsequent appeals, where the 'true' OE target submitted by companies was a contentious issue. In this context, the observation that a subset of companies has proposed a 'stretching' OE target may have little bearing on the level of OE that companies are actually planning to achieve.

Third, the evidence submitted by companies to support their OE targets is often very similar to the evidence explored by regulators—the companies often rely on industry-wide studies or reports from economic experts to determine the OE target. That is, the OE targets submitted by the companies often do not represent 'new' evidence regarding the potential scope for OE; rather, it is often a different interpretation of the same (or at least similar) evidence as that presented by the regulator.

Relatedly, companies have sometimes gone against the advice of their advisers when setting their own OE targets. For example, at PR24, a large proportion of the water industry commissioned a report by Economic Insight to derive an OE target. Economic Insight concluded that a feasible range for the OE target was 0.3–0.8% p.a.[76] However, several companies proposed more stretching targets than this range (up to 1.1% p.a.) without providing additional evidence on how such a stretching target could be supported.[77] Caution should be exercised when interpreting these figures—given that companies are incentivised to submit 'ambitious' business plans, it is feasible that at least some of them submit over-stretching OE targets in an effort to gain additional rewards or avoid penalties. This is particularly the case in the context of OE, which (as outlined above) is a headline figure that may not accurately capture the frontier shift productivity improvements that companies are proposing.

For these reasons, we do not consider that the OE targets submitted by companies should hold any material weight in the assessment of the OE target. If there are material deviations between what companies have proposed and what the regulator assesses, the cause of the discrepancy should be explored in some detail, particularly if companies have provided alternative evidence to support their OE assumptions (e.g. bottom-up evidence relating to the expected productivity improvements associated with a particular investment).

2.7.5 Digitisation

Technological advances and the increased decentralisation of the energy network have led (and are expected to continue to lead) to an increased digitisation of energy networks. For example, the installation of smart devices on the network can enable TOs to better monitor the network, thereby improving demand flows and mitigating faults and outages. Both Ofwat and Ofgem have used this increased digitisation of the network to set more stretching targets for water and energy networks respectively.

At RIIO-ED2, CEPA introduced the Information and Communication sector into the comparator set in order to account for the increased

[76] Economic Insight (2023), 'Productivity and Frontier Shift at PR24', April, p. 87.
[77] CEPA (2024), 'PR24 Draft Determinations: Frontier Shift, Real Price Effects and the energy crisis cost adjustment mechanism', June, p. 9.

productivity growth associated with digitisation.[78] However, as noted in section 2.5, the TO sector is significantly less IT-intensive than the rest of the comparator sectors, indicating that the impact of digitisation on productivity growth is already captured in the TFP estimates.

At the PR24 draft determination, Ofwat argued that the widespread adoption of AI may drive rapid improvements in productivity growth across the economy, including the water sector. It cited an example of one company already using AI to detect sewer defects and improve sewer maintenance efficiency.[79] While the potential advantages of AI are well-known, it is less clear how quickly companies will be able to adopt AI technologies, how widespread the usage of AI will be across TOs' activities, and whether the resulting productivity improvements will result in cost reductions or service improvements. Given this uncertainty and the paucity of evidence, caution should be exercised when applying any uplift resulting from AI.

2.7.6 Catch-up and scale effects

The TFP measured in a particular company, sector or economy is not a direct measure of OE; rather, it captures a combination of data and measurement errors and all sources of productivity improvements, including both catch-up efficiency and scale effects. The impact of catch-up and scale effects is somewhat mitigated by the comparator selection criteria (specifically the focus on 'competitive' sectors). However, 'perfect competition' is an ideal in the economic literature that never perfectly materialises in practice—there will always be some frictions in the market that, at least in the short term, mean that the ideal of perfect competition is never realised.

Given that no sector is perfectly competitive, it is possible that the TFP estimates include a combination of catch-up efficiency and scale effects. Regarding the former, the presence of inefficient firms in a sector may cause the TFP estimates to over- or underestimate the scope for OE, depending, respectively, on whether the inefficient firms are catching up to best practice or falling behind. Without additional evidence, it cannot be known ex ante whether the presence of inefficient firms in a sector will result in an over- or underestimation of the scope for improvement. Therefore, we do not consider at this stage that the hypothetical presence of catch-up efficiency should be used to qualitatively inform the OE target.

[78] CEPA (2022), 'RIIO-ED2: Cost Assessment – Frontier Shift methodology paper', June, p. 16.
[79] Europe Economics (2023), 'Frontier Shift and Outcomes Stretch at PR24', March, p. 26.

Meanwhile, if economies of scale exist within a sector and the sector experiences an increase in output, the TFP estimates will incorporate some scale effects and (assuming no other issues, such as catch-up efficiency) will overestimate the scope of OE. Therefore, caution must be exercised when interpreting the TFP estimates for industries that have experienced rapid growth in output. Table 2.4 shows the average annual change in VA volumes for each of the comparator sectors, relative to TFP growth.

Table 2.4 Average annual change in VA volumes relative to TFP growth

	2010–2019		1996–2019	
	VA volume	TFP	**VA volume**	TFP
Construction	**2.9%**	0.5%	**0.7%**	-0.2%
Transportation and Storage	**1.3%**	-0.3%	**1.4%**	-0.1%
Repair and Installation of Machinery and Equipment	**0.6%**	0.2%	**1.6%**	0.9%
Financial and Insurance Activities	**-0.5%**	-0.7%	**1.2%**	-0.4%
Professional, Scientific, […] Activities	**3.0%**	0.0%	**2.9%**	-0.3%
IT and other Information Services	**3.2%**	-0.2%	**5.0%**	0.0%
Information and Communication	**8.7%**	3.6%	**10.7%**	3.9%
Repair of Motor Vehicles and Motorcycles	**1.8%**	0.4%	**0.8%**	-0.3%

Source: Oxera analysis of EU KLEMS data.

Table 2.4 shows that several sectors have experienced a modest increase in output over the modelling period, such that scale effects are less likely to have a material effect on the TFP estimates. However, the Professional, Scientific […] Activities sector and the IT and Other Information Services sector have experienced material increases in output under both modelling periods. Therefore, the TFP estimates for these sectors may be tainted somewhat by scale effects. However, these sectors are given a comparatively low weight in the granular comparator set, such that the impact of scale effects on the resulting OE target is likely to be limited.

For these reasons, we do not consider that the presence of scale effects warrants a material adjustment to the TFP estimates when deriving an OE target, although it may need to be considered qualitatively in combination with other evidence.

2.7.7 Indexation

As a baseline, Ofgem indexes revenues to CPIH, which is an output price index for the prices of end products to consumers. As an output price index, CPIH captures the net effect of the input price pressure facing companies that produce consumer goods and the productivity growth that these companies have been able to achieve. Therefore, the indexation to CPIH already captures OE to some extent, and any additional OE target should capture only the productivity growth that TOs are expected to achieve above and beyond what is already captured.

In this respect, we note that the wider economy has achieved a productivity growth of c. 0.17% p.a.[80] To the extent that CPIH captures economy-wide productivity growth and that historical productivity growth is a reasonable estimate of future productivity growth, this indicates that the indexation to CPIH already imposes an implicit OE target of c. 0.17% if this rate of productivity growth continues.

However, Ofgem's RPE framework means that, in effect, only c. 30% of SPEN's revenues are indexed to CPIH, with the remainder indexed to other input price indices. Therefore, the indexation to CPIH is likely to impose a smaller OE challenge of c. 0.05% (0.17%*30%). If Ofgem continues to index a material proportion of revenues to CPIH, the implicit challenge this imposes should be accounted for when determining the target.

2.8 Deriving the OE target

Table 2.5 shows the estimated GO growth based on the methodology outlined in the preceding sections. For comparison, we also show the OE target based on the RIIO-2 and RIIO-ED2 comparator sets.

Table 2.5 Estimated TFP growth (% p.a.)

Time period	2010–2019	1996–2019
Construction	0.5%	-0.2%
Transportation and Storage	-0.3%	-0.1%
Repair and Installation of Machinery and Equipment	0.2%	0.9%
Financial and Insurance Activities	-0.7%	-0.4%
Professional, Scientific, […] Activities	0.0%	-0.3%

[80] This is based on the 'Total Economy' TFP GO growth across the full period (1996–2019).

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IT and other Information Services	-0.2%	0.0%
Singular comparator set	**0.5%**	**-0.2%**
Broad comparator set	**0.2%**	**0.2%**
Granular comparator set (weighted)	**0.1%**	**0.1%**
RIIO-2 (targeted comparators)[1]	0.0%	-0.3%
RIIO-2 (economy-wide)[2]	0.2%	0.3%

Notes: [1] All industries excluding: i) Real Estate Services; ii) Public Administration and Defence Services; iii) Compulsory Social Security; iv) Education; v) Health and Social Work; vi) Services of Households as Employers; Undifferentiated Goods and Services—Producing Activities of Households for Own Use; and vii) Services Provided by Extraterritorial Organizations and Bodies.
[2] Includes i) Construction; ii) Transportation and Storage; iii) Financial and Insurance Activities; and iv) Wholesale and Retail Trade Services; Repair of Motor Vehicles and Motorcycles.
Source: Oxera analysis of EU KLEMS data.

Table 2.5 shows that the estimated TFP growth in the identified comparator sets is between -0.2% p.a. (the singular comparator set, 1996–2019) and 0.5% p.a. (the singular comparator set, 2010–2019). Across the point estimates within the table (highlighted in bold), the average productivity growth is c. 0.1% p.a. While this is significantly below the c. 1% p.a. OE target applied at RIIO-2 (after the CMA appeal), we note that the latest release of the EU KLEMS dataset shows that productivity growth has been lower across comparator sectors. Indeed, focusing on the comparator sectors applied at RIIO-2, the average productivity growth is between -0.3% p.a. and 0% p.a., which is materially below what CEPA found at the time of the determination (c. 0.2% p.a.).

2.9 Application to costs

The section above provided a headline, TOTEX-level OE target. However, it may be appropriate to apply different OE targets to different cost bases, depending on the scope for OE in those activities and how the costs are assessed and funded through the regulatory framework. Indeed, we note that Ofgem applied different OE challenges to OPEX and CAPEX at RIIO-2 for this reason. In this respect, we consider that there are two important types of classification when applying OE, which are discussed in turn below:

1. **type of activity**—in line with Ofgem's approach at RIIO-2, different activities may have different scope for OE. Indeed, this is supported by the TFP analysis in the previous section, where comparator sectors directly relevant to 'core' TO functions experienced different productivity growth to those that are directly relevant to indirect functions;

2 **novelty of activity**—OE is driven, at least in part, by 'learning by doing'. In this respect, regularly repeated activities are more likely to benefit from OE. New activities, or activities that are undertaken infrequently, are less likely to benefit from OE improvements.

2.9.1 Ongoing efficiency by type of activity

Table 2.6 shows the estimated GO growth for each cost activity, based on the estimated GO growths in Table 2.5 combined with the comparator mapping in Table 2.2.

Table 2.6 TFP growth estimates by cost activity

Output measure	GO	GO
Time period	**BC1**	**BC2**
Load-related CAPEX	0.2%	0.2%
Non-load-related CAPEX	0.4%	0.4%
Non-operational CAPEX	0.2%	-0.1%
Network operating costs	0.1%	0.1%
Indirect OPEX	-0.4%	-0.4%
Other costs	0.1%	0.1%
CAPEX	**0.2%**	**0.2%**
OPEX	**-0.2%**	**-0.2%**
TOTEX	**0.1%**	**0.1%**

Source: Oxera analysis of EU KLEMS data and data provided by SPEN.

Table 2.6 shows that, based on the granular mapping exercise, the scope for OE is generally higher for CAPEX than for OPEX. This is to be expected, given that the Construction sector experienced stronger productivity growth than other sectors and receives a large weight when mapped to CAPEX.

We note that, when setting more granular targets, placing sole weight on the granular mapping may be inappropriate, given that the target set at the TOTEX level is not based solely on the granular comparator set. As noted in section 2.5, sectors such as Construction capture some indirect activities (e.g. corporate functions, project management costs) even though they are not mapped to these activities in the granular mapping exercise. Therefore, we consider that this analysis could be used to

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qualitatively inform the target if separate targets for different expenditure categories are to be considered.

2.9.2 Ongoing efficiency by novelty of activity

As noted above, OE is driven by learning-by-doing effects and is therefore most applicable to activities that are regularly repeated. For example, as a company undertakes more maintenance on and monitoring of its network, it may become better at identifying when maintenance activity is required and in delivering it. However, it is less clear how a company can be expected to make OE improvements to activities that are 'new' or not regularly repeated, given that this learning-by-doing effect is not present.

We understand that SPEN is expecting to undertake several new activities in the upcoming regulatory period. For example, it is planning to invest in high-voltage, direct-current lines, a complex technology that is not only expensive to build but also to maintain and operate.[81] Given that this activity is 'new', there is likely to be less scope for OE.

More generally, Ofgem typically assesses the need for and efficiency of large, one-off investments using engineering assessments. In this way, the volume of activity is assessed for efficiency at the start of the period, such that companies cannot make further efficiency savings by reducing the volume of activity. Moreover, these activities are typically outsourced via competitive tendering exercises, such that SPEN pays the competitive (and exogenously set) market price. If both the volume and the price of the activity are largely exogenous to the SPEN, it is unclear where SPEN would be able to make OE improvements. Indeed, the only area in which SPEN has material control relates to the competitive tendering exercise itself; however, we understand that this represents an immaterial proportion of the total cost of an investment and is, in any case, reviewed for effectiveness by Ofgem.

When setting ex ante TOTEX allowances, it may be appropriate to forecast an element of OE for these projects, given that the competitive companies that are commissioned to construct the assets will be able to make OE improvements over the regulatory period. However, the degree to which this OE is within SPEN's control is highly limited, such that the price SPEN pays for the investment is exogenous. Therefore, the uncertainty mechanisms through which these new activities are funded should account for the market conditions prevailing at the time, which

[81] For example, we understand that SPEN would be dependent on the original equipment manufacturer.

could necessitate material deviations (up- or downwards) from the ex ante allowance. The exact nature of this may vary depending on the type of uncertainty mechanism. For example, the unit rate for volume drivers could be adjusted based on developments in the market price (equivalent to our proposals on RPEs, see section 3.3), while the engineering assessments undertaken via re-openers should be based on the prevailing market conditions without recourse to the OE set at the start of the price control.

3 Real price effects

Regulated companies across all sectors face cost pressures with respect to their input prices. These pressures could be the result of various factors, including but not limited to, supply chain disruptions, lagged inflationary effects, bargaining power of the labour force, and macroeconomic factors. As a result, input prices are often seen as exogenous in the cost assessment framework. Moreover, transmission or distribution operators may face changes in input prices (in real terms) that may not be appropriately captured by general inflation measures such as CPI or CPIH. To this end, regulators including Ofgem, use mechanisms to account for these real price effects (RPEs) by calculating the differences between general price indices and actual input price inflation when setting TOTEX allowances.

This section explores the approach used by Ofgem in RIIO-1 and RIIO-2, its limitations, and proposed alternative frameworks for RIIO-3 that would serve to adequately compensate SPEN and, by extension its customers, for increases and decreases in input prices.

3.1 RPE frameworks in previous price control periods

3.1.1 RIIO-1

In RIIO-1, Ofgem indexed allowed revenues for transmission companies by RPI. RPEs were calculated for certain cost categories (labour, materials, equipment and plant) based on analysis of historical data and short-term independent forecasts of Ofgem-selected input price indices.[82] In particular, Ofgem used the following indices for labour:

- ONS AWE private sector;
- ONS AWE construction;
- ONS AWE transport and storage;
- the price adjustment formula index (PAFI) civil engineering index published by Building Cost Information Service (BCIS);
- the British Electrotechnical and Allied Manufacturers Association (BEAMA) electrical engineering index.[83]

[82] Ofgem (2012), 'RIIO-T1/GD1: Real price effects and ongoing efficiency appendix', 17 December, para. 2.2.
[83] BEAMA is the trade association for the UK electrotechnical sector, which includes energy networks.

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In addition, it used the following indices for non-labour inputs:

- BCIS FOCOS RCI infrastructure materials;
- BCIS PAFI steel works;
- BCIS PAFI plastic pipes;
- BCIS PAFI copper piping;
- BCIS PAFI plant and road vehicles;
- ONS Machinery and equipment output producer price index (PPI);
- ONS Machinery and equipment input PPI.

Ofgem's approach was to provide upfront RPE allowances based on fixed assumptions at the start of the price control period.[84]

3.1.2 RIIO-2

Going beyond the approach it used at RIIO-1, Ofgem added some layers at RIIO-2: (i) indexing uncertain costs; (ii) introducing a materiality threshold; and (iii) introducing indexation for RPEs resulting in annual updates to the RPE allowances.[85]

Ofgem explained that its revised approach for RIIO-2 was due largely to the fact that some of the assumptions made in RIIO-1 'did not reflect the actual costs that companies subsequently incurred [...including...] input price inflations (called Real Price Effects (RPEs)) running lower than the forecast used to inform allowances'[86] resulting in a 'material impact on companies' costs and returns'.[87]

Moreover, in RIIO-2 Ofgem discontinued or replaced some of the indices used at RIIO-1, as shown in Table 3.1 below.

[84] Ofgem (2019),'RIIO-2 Sector Specific Methodology – Core Document', 24 May, para. 9.15.
[85] RIIO-2 also saw Ofgem adopt the use of CPIH instead of the previously used RPI for general market-wide inflation. Ofgem (2021), 'RIIO-2 Final Determinations – Core Document', February, para. 11.26.
[86] Ofgem (2018), 'RIIO-2 Framework Consultation', March, para. 4.7.
[87] Ibid., para. 6.26.

Table 3.1 RPE indices selection—changes between RIIO-1 and RIIO-2

Index	Removed/replaced	Rationale
AWE Transport and storage	Removed	Consultation respondents indicated that transport and storage do not reflect a material portion of costs for network companies
BCIS 3/58 Copper pipes and accessories	Removed	Consultation respondents indicated that they do not reflect a material portion of costs for network companies
BCIS 3/58 Copper pipes and accessories (materials)	Replaced with BCIS 4/CE/EL/02 Electrical engineering materials	Consultation respondents considered BCIS Electrical engineering materials a more accurate measure of the costs of ET materials
ONS Machinery and equipment input PPI	Removed	The machinery and equipment costs that companies face are more likely to reflect output producer prices than input producer prices

Source: Ofgem (2021), 'RIIO-2 Final Determinations – Core Document', February, para. 7.57.

With respect to **indexing uncertain costs**, Ofgem noted that RPE indexation could be used 'where extraneous factors introduce risks that companies cannot manage themselves'.[88] Ofgem adopted an approach to set upfront allowances based on forecasts of input price indices and then to reconcile outturn differences between CPIH and input price indices as part of its Annual Iteration Process (AIP).[89] While a notional cost structure was adopted for GDNs, a company-specific structure was used for each TO based on the data submitted in its business plan.[90]

In addition, Ofgem used a **materiality threshold** whereby RPEs were applied only to cost categories representing over 10% of TOTEX, or where cost categories make up at least 5% of TOTEX but where real price movements are expected to be at least 0.5% of TOTEX.[91] As a result, for most transmission companies RPEs were applied to the cost categories for labour (general and specialist) and materials.[92]

RIIO-2 used the following **RPE indices weighted** for SPEN as shown in Table 3.3. The ex post RPE allowance is estimated based on the outturn

[88] Ofgem (2019), 'RIIO-2 Sector Specific Methodology – Core Document', 24 May, para. 6.67.
[89] Ofgem (2021), 'RIIO-2 Final Determinations – Core Document', 3 February, para. 7.45.
[90] Ibid., para 7.47.
[91] Ibid., paras 7.51–7.52.
[92] SSE (SHET) was also granted RPE allowances for plant and equipment as this cost category exceeded Ofgem's materiality threshold of 10% of TOTEX. Ofgem (2021), 'RIIO-2 Final Determinations – Core Document', February, table 8, paras 7.51 and 7.55.

movements in the total composite index, while the weighting across cost lines is set ex ante.

Table 3.2 RPE indices for SPEN in RIIO-2

Index	Weighting for SPEN
Labour	***100%***
AWE Private sector (K54V)	25%
AWE Construction (K553)	25%
BCIS PAFI civil engineering (4/CE/01)	25%
BEAMA Electrical engineering	25%
Materials	***100%***
BCIS 4/CE/EL/02 Electrical engineering materials	50%
BCIS FOCOS Resource cost index of infrastructure: materials (7467)	50%

Source: Ofgem (2021), 'RIIO-2 Final Determinations – Core Document', 3 February, Table 8: RPE input price indices and weightings.

As a result of the above weightings for SPEN, its RPE allowances for RIIO-T2 were as shown in Table 3.3.

Table 3.3 T2 RPEs

	2021	2022	2023	2024	2025	2026
Total annual values RPEs	-0.47%	2.24%	0.29%	-1.81%	-0.06%	0.41%
SPEN cumulative RPEs	0.996	1.018	1.021	1.003	1.002	1.006

Source: SPEN (2024), 'RIIO-2 RPE Workbook - AIP 2023'.

In its sector-specific methodology decision, Ofgem notes that it will follow a similar approach to assess RPEs at RIIO-3.[93] That is, it will continue to undertake an ex ante assessment of RPEs based on external

[93] See Ofgem (2024), 'RIIO-3 Sector Specific Methodology Decision – Overview Document', July, pp. 111–113.

price indices, and if the outturn development of these indices differs from ex ante expectations, it will index revenues to RPEs.

3.2 Overarching issues with the current approach

In principle, indexing revenues to an accurate, external measure of the input price inflation that TOs face can protect companies and consumers from unexpected or volatile changes in input prices. However, there are material issues with the RIIO-2 approach that inadequately account for the price pressures faced by TOs and limit the extent to which companies and consumers are protected.

We have grouped these issues into the following categories, and discuss them in turn in the sections below:

- **basis risk** resulting from selecting RPE indices and weights that do not accurately reflect the cost pressures that TOs face;
- an ex post RPE allowance estimated based on a composite index could create **composition risk** if out-turn volumes differ in proportion from expectations;
- the potential for **materiality thresholds** to prevent a disaggregated cost category allocation which may otherwise be more reflective of how TOs incur costs;
- the lack of accounting for regional cost differences in RPE allowances.

3.2.1 Basis risk

As discussed above, Ofgem's RPE approach involves using the forecasts of various input price indices to account for RPEs when setting an ex ante cost allowance. Each cost category is weighted differently according to the percentage of TOTEX it is expected to represent over the next price control period. There is a true-up mechanism in the form of annual ex post adjustments to RPE allowances based on the outturn differences between CPIH and input price indices.[94]

This approach creates a few important issues with respect to how accurately indices track the actual prices that TOs face.

First, if outturn prices due to input price inflation faced by the TOs differ significantly from the selected input price indices, there is no mechanism to adjust for this differential. Ofgem's current annual true-up mechanism adjusts for differences between the forecasts for input price indices and

[94] Ofgem (2024), 'Sector Specific Methodology Decision – Overview document', 18 July, para. 9.6.

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the outturn input price indices. In doing so, the current true-up mechanism assumes that the input prices that the TOs face track perfectly the selected input price indices. There is no mechanism that explicitly adjusts for the differences between the outturn prices faced by the TOs and the selected input price indices used by Ofgem.

As a result, the discrepancy between the input price indices and the movement of actual input prices incurred results in 'tracking errors'. Thus TOs are not appropriately compensated following shocks, such as supply chain issues, as discussed further in Box 3.1 below. These tracking errors are likely to occur under Ofgem's current approach because TOs use highly specialised inputs (labour, capital, materials) which, at best, form only a small segment of the input price indices used by Ofgem.

These concerns were raised as part of the RIIO-2 consultations, and as a result Ofgem made some adjustments to the selection of RPE indices.[95] However, these changes did not go far enough in addressing the TOs' concerns and, as a result, basis risk has continued to be an issue during the RIIO-2 period.

[95] Ofgem (2021), 'RIIO-2 Final Determinations – Core Document', 3 February, para. 7.57.

Box 3.1 Supply chain issues

Over RIIO-3, electricity networks in the UK are expected to deliver a significant level of investment in the transmission grid to account for the energy transition. This includes, but is not limited to, the electrification of key sectors, such as industrial production and transport, the transition to more intermittent renewable energy generation, and the related need for energy storage and flexibility services.

This trend is not limited to the UK but is evident in and outside of Europe, exacerbating the pressure on input prices for the TOs, particularly given the use of highly specialised inputs in ET from a relatively limited set of suppliers. This is resulting in longer lead times to procure these inputs and has the potential to create shortages and/or result in increased or more volatile prices, including exposure to increased supplier margins in response to this higher demand.

These challenges are being exacerbated by constraints in the labour market and a lack of labour with the specialised skillsets to deliver these kinds of major network expansions.

Source: Oxera; and Ofgem (2024), 'RIIO-3 Sector Specific Methodology Decision – Overview Document', July, pp. 64–66.

3.2.2 Composition risk

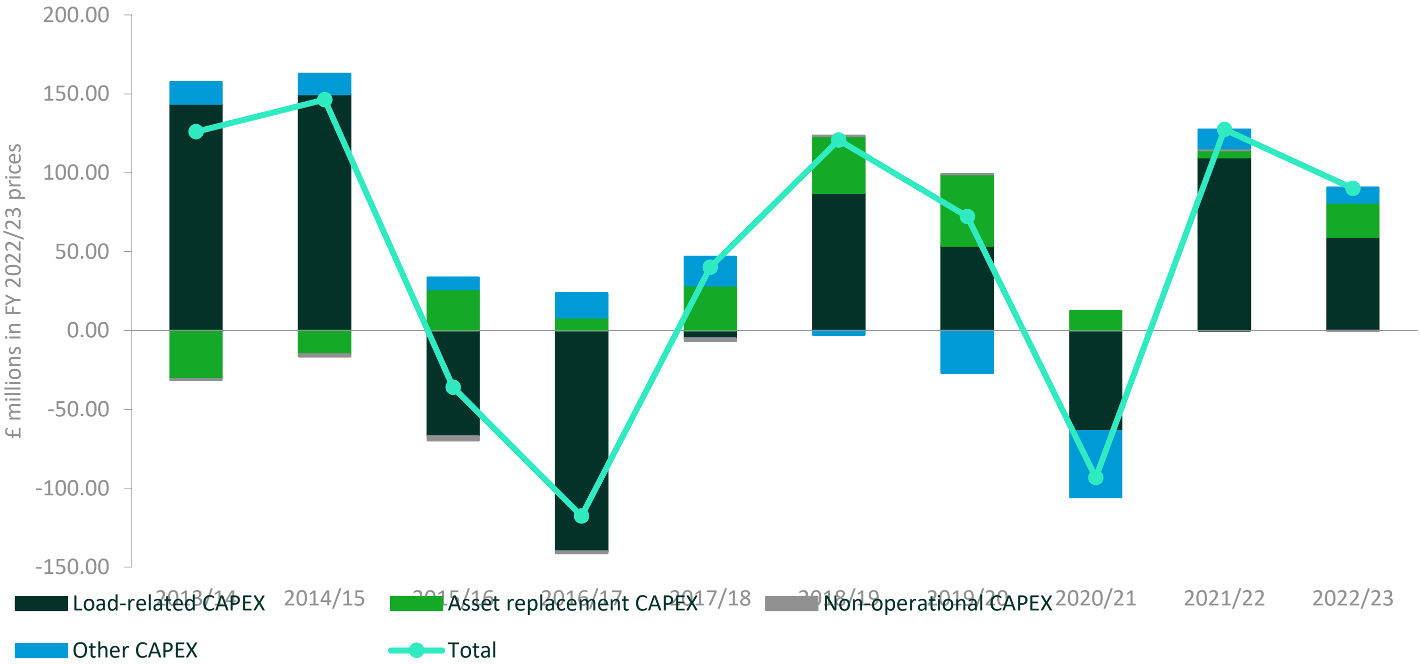
In addition to basis risk, composition risk is a concern resulting from Ofgem's current RPE approach. As discussed above, RPE allowances are weighted on an ex ante basis based on the expected percentage of a TO's TOTEX over the control period. The RPE allowance itself is provided on a composite basis. In other words, a single RPE allowance adjustment is made based on a weighted average of the outturn RPEs across the various cost categories.[96]

There is currently no true-up mechanism for adjusting these weights based on the proportion of outturn costs that each category represents.

[96] Ofgem (2021), 'RIIO-2 Final Determinations – Core Document', 3 February, para. 7.58, Table 9.

In practice, this means that if outturn volumes differ from expected proportions, there is a risk that the RPE mechanism under-compensates[97] the TO for its input costs. This situation might arise, for example, if SPEN had to invest more in installing cables, and therefore had to require more cables to be procured than anticipated, resulting in a higher proportion of materials costs over the period. Indeed, data from SPEN's annual reports from 2014 to 2023 shows that there was significant variance in between CAPEX forecasts and outturns, as indicated in Figure 3.1.

Figure 3.1 Variance between CAPEX forecasts and outturns, SPEN



Note: Negative values indicate where actuals exceeded allowances.
Source: SP Energy Networks, 2020/2021 Transmission Annual Report Published Totex, pp. 1–2; 2021/2022 Transmission Annual Report, p. 34; and 2022/2023 Transmission Annual Report, p. 29.

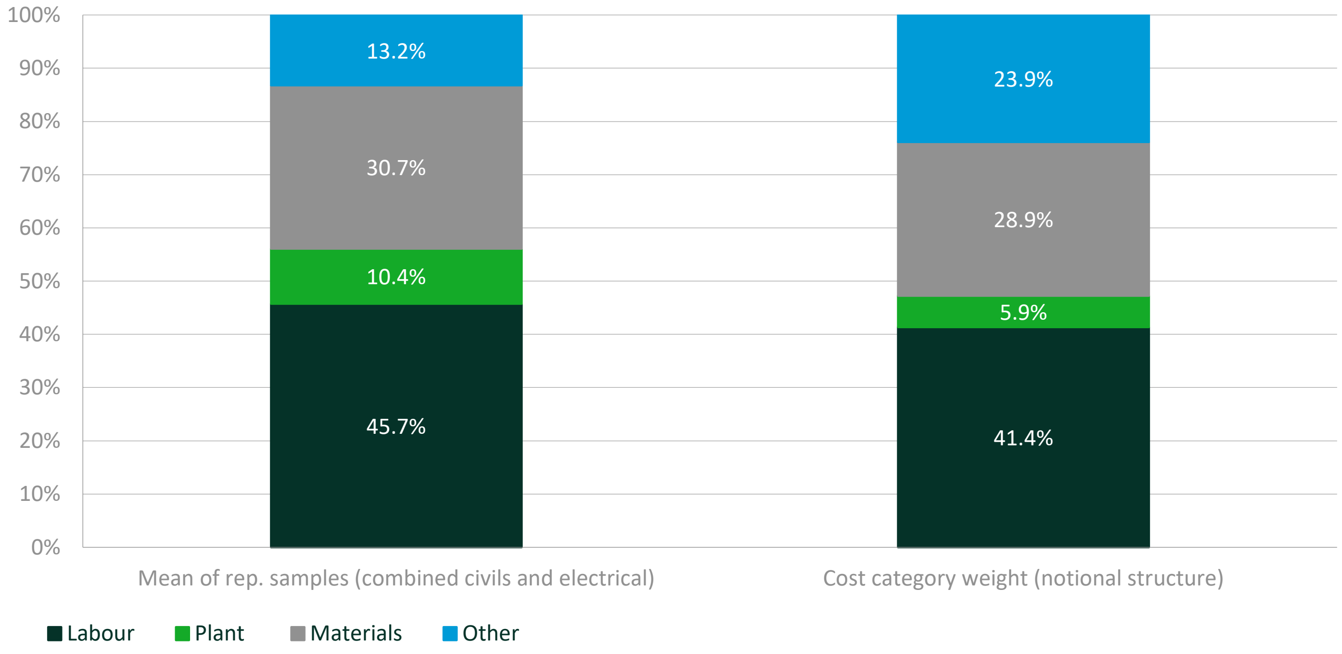
For example, in 2017 and 2021, CAPEX outturns significantly exceeded allowances, and in recent years (2022 and 2023) outturns have been lower than allowances. If RPE weights are based on forecast levels of investment, the degree of variance between CAPEX forecasts and

[97] In this example, the TO is under-compensated by the RPE mechanism because we assume that the prices of materials input increase at a faster rate than other input prices (namely labour). However, the RPE mechanism could in theory also over-compensate the TO in this situation if, for example, the prices of materials input did not increase as much as other input prices.

outturns could indicate that SPEN is exposed to this kind of composition risk.

Failing to compensate companies appropriately for the input price variation they face can result in them being disincentivised to make capital investments, leading to worse service provision for customers. Indeed, when considering a representative sample of load-related CAPEX undertaken by SPEN, we see that the composition (as measured by the normalised median and mean) differs from the composition of TOTEX considered by Ofgem (see Figure 3.2). This highlights that undertaking more CAPEX investment would exacerbate the potential for this kind of composition risk.

Figure 3.2 Composition of CAPEX—representative sample



Note: 'Other' includes subcontractors and preliminaries.
Source: SPEN (2024), 'Project Cost Allocation for RPEs – Overall Splits V2.1'; and SPEN (2024), 'RIIO-2 RPE Workbook - AIP 2023'

3.2.3 Materiality thresholds

As noted in section 3.1.2 above, Ofgem had materiality thresholds in RIIO-2. The thresholds allow for RPE adjustments for cost categories above 10% or TOTEX, or, alternatively, where cost categories make up at least 5% of TOTEX but where real price movements are expected to be at least 0.5% of TOTEX.

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The materiality thresholds in Ofgem's approach mean that, in practice, TOs must aggregate different types of input into one input category in order to be granted RPE allowances. This in turn means that Ofgem's approach necessitates the use of high-level indices to capture these disparate inputs in each category.

To be fair and effective, materiality thresholds should be appropriate to the context. For instance, we note that Ofwat uses a 1% materiality threshold for water and wastewater networks in its cost adjustment claims.[98] This may be particularly pertinent if cost categories are more disaggregated and reflect more granular levels of expenditure than the current high-level categories of 'labour', 'materials', 'plant', as we propose later in this report (in section 3.3).

Furthermore, it is not possible to know ex ante which input price pressures will end up being material over the control period. An illustrative example of this comes from the water sector, where Ofwat determined ex ante in PR19 that energy prices would not be material. The 2021 energy crisis then resulted in a significant spike in energy prices, which meant that water companies were materially underfunded during the PR19 period, resulting in many submitting energy cost adjustment claims.[99] This resulted in Ofwat accepting in its draft determinations for PR24 that a cost adjustment should be paid out to companies and proposing an ex post true-up to account for the uncertainty about future energy prices.[100]

3.2.4 Accounting for regional differences

Finally, we note that Ofgem's RPE approach does not account for regional differences, particularly when it comes to labour costs. The use of a general labour index such as ONS's AWE, or even the sector-specific specialist indices from BCIS and BEAMA shown in Table 3.2 can overlook important regional differences in cost structures. This was reflected in the responses by some of the GDNs to the sector-specific methodology decision consultation:

> Two GDNs asked Ofgem to consider methodological changes which consider regional differences on such matters as labour and contractor costs and reflect contractor RPEs separately considering the nuanced cost pressures faced compared to direct labour adjustments.[101]

[98] Ofwat (2022), 'PR24 Final Methodology Appendix 9 Setting Expenditure Allowances', December, p. 31.
[99] Ofwat (2024), 'PR24 Draft Determinations Expenditure allowances', July, pp. 44–45.
[100] Ibid., p. 45.
[101] Ofgem (2024), 'Sector Specific Methodology Decision – Overview document', 18 July, para. 9.15.

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Moreover, by not accounting for these regional differences—particularly where TOs are contracting for goods and services—supply chain issues may not be appropriately captured. For instance, labour costs may differ across the country, particularly for the kind of specialised workforce required by the TOs. Therefore, consideration within the RPE mechanism of how labour costs differ across the country can make a commensurate difference to how appropriately they reflect the input price pressures for the labour-related costs faced by the different TOs.

3.3 Oxera's approach to RPE methodology

The key issues identified in the previous section require a reassessment of Ofgem's current RPE methodology. This section addresses each of the risks discussed above, setting out Oxera's proposed approach to improving the RPE methodology by:

- identifying alternative indices and weighting for labour RPEs;
- considering regional adjustments for RPEs;
- proposing a more granular asset-based approach to material RPE indexation;
- setting lower materiality thresholds for more disaggregated cost categories.

Each of these proposed options is discussed in turn below.

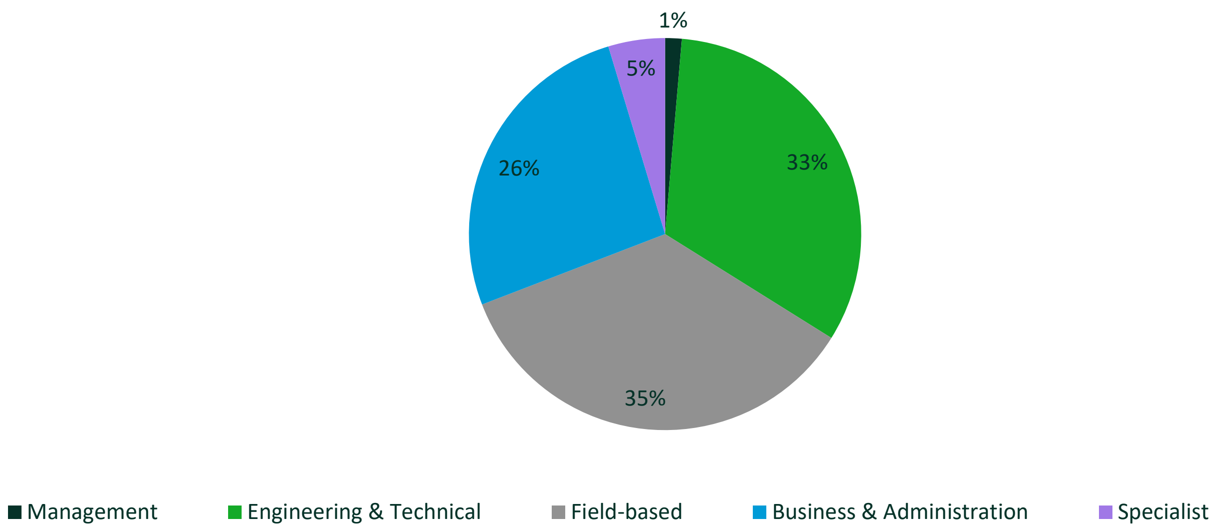
3.3.1 Alternative index selection and weighting for labour RPEs

To address the shortcomings of the indices used in the current approach, alternative index selection for some categories is appropriate. In particular, general ONS AWE indices for the private sector and construction are currently used for labour RPEs, as well as slightly more specialist indices from BCIS and BEAMA for engineering roles.

We note that SPEN's labour force breakdown is as shown in Figure 3.3 below.

Internal Use

Figure 3.3 SPEN workforce (proportion of FTEs)



Source: SPEN (2021), 'RIIO-ED2 Business Plan for 2023-2028', December, p. 124.

The three largest categories—Business & Administration, Field-based, and Engineering & Technical—are not appropriately reflected in the current index selection and weighting. First, the use of the AWE private sector and AWE construction raises some issues. The AWE is a general index reflecting earnings of approximately 9,000 businesses each month and covering 13.8m employees.[102] The AWE private sector index used by Ofgem in its RPE approach is not sector-specific and as a result covers many sectors that are not relevant to the labour categories of management or business and administration (e.g. retail, real estate, social work). In addition, CEPA, which was commissioned by Ofgem to estimate RPEs for RIIO-2, included the use of ONS's ASHE Median Hourly Pay Index in the general labour index to account for potential biases in the AWE (e.g. if the share of part-time workers in the wider economy changed relative to the electricity distribution sector).[103]

For these reasons, we consider that the use of the BCIS Management & Administration index, which is based on the ONS ASHE, would better reflect movements in the workforce categories of Management and Business & Administration, which together account for 27% of the SPEN workforce compared to the AWE private sector index. The BCIS index

[102] ONS (2017), 'Average weekly earnings QMI', 25 October, accessed 10 October 2024.
[103] Ofgem (2022), 'RIIO ED2 Final Determinations Core Methodology Document', 30 November, para. 7.614.

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uses the following compilation from the Standard Occupation Classification (SOC2010) from the ASHE survey, as shown in Table 3.4.

Table 3.4 Compilation: BCIS Management & Administration Index

Occupations	Weighting
Civil engineers	75%
Quantity surveyors	10%
Construction project managers and related professionals	15%

Source: BCIS (2024), 'Guide to PAFI Series 4 - Civil Engineering and Related Specialist Engineering – Calculation', 22 February, p. 12.

These categories are likely to be more reflective of the kind of specialised management and administration skillsets required by SPEN. The BCIS index uses weekly earnings and incorporates national insurance (NI) and pension contributions (based on annual ONS Occupational Pension Schemes Survey statistics). The incorporation of NI and pension contributions is particularly important in the current context following the Autumn Budget 2024 announcement to increase employer NI contributions and reduce the salary threshold where employers must start to make these contributions.[104] Required increases in employer NI contributions may have a dampening effect on labour supply, which may take time to feed through to indices that look only at earnings. As a result, the BCIS index which incorporates NI and pension contributions may be more reflective of any potential input price pressures on SPEN's labour force.

We note that the heavy weighting of this index towards the civil engineers occupation may be appropriate for specialist administrative occupations, like project managers, but may mean that this index is less relevant for general administrative functions. An alternative option is to use the ONS ASHE for specific occupations relating to the weighting of the occupations captured within SPEN's 'Business & Administration' and 'Management' workforce. Some occupation classifications at the three- and four-digit levels[105] that could be relevant include:

[104] HM Treasury (2024), Autumn Budget 2024, October, p. 4.
[105] Office for National Statistics (2023), Earnings and hours worked, occupation by four-digit SOC: ASHE Table 14, 1 November, accessed 22 October 2024.

- Administrative occupations: office managers and supervisors (414);
- Administrative occupations: finance (412);
- Engineering project managers and project engineers (2127);
- Human resources administrative occupations (4136);
- Human resource managers and directors (1136);
- Information technology professionals (213).

In addition, the AWE construction index currently used by Ofgem may not appropriately reflect the 'field-based' labour force employed by SPEN. One reason for this is that, as we understand from SPEN, labour in ET tends to be subject to less collective bargaining pressure than other sectors such as construction or transport, or even compared to other parts of the electricity sector, such as distribution. In part, this is because a lot of OPEX is subcontracted by TOs, which means that the labour force directly employed by SPEN tends to have less bargaining power. It is also worth noting that many of the field-based employees are in technical occupations that require specialised knowledge and/or some engineering knowledge. Therefore, it might be more appropriate for the weighting for this part of the workforce also to be reflected by the engineering indices used by Ofgem for specialist labour. For instance, the BCIS Electrical engineering labour index covers occupations such as electrician, electrical/site technician, mechanical technician, and cable foreman.[106]

Next, the indices used for specialist labour—in particular, the BEAMA Electrical engineering index and the BCIS PAFI civil engineering index—are more aligned with the labour force employed by the TOs. However, there is still potential for improvement in the use of these indices. For instance, in the context of RIIO-ED2, CEPA also found that the BCIS Electrical Engineering Labour Index diverged in trend from the BEAMA Electrical Engineering Labour Index. According to CEPA, this suggested that: 'the two indices may capture different elements of electrical engineering labour costs and may therefore not be duplicative of each other.' [107] Therefore, CEPA used both indices for RIIO-ED2.[108] Such an approach could be considered for RIIO-T3.

Finally, an overarching issue with the current approach is that the weighting is based on fixed percentages for each category which do not

[106] BCIS (2024), 'Guide to PAFI Series 4 - Civil Engineering and Related Specialist Engineering – Calculation', 22 February, p. 13.
[107] Ofgem (2022), 'RIIO ED2 Final Determinations Core Methodology Document', 30 November, para. 7.620.
[108] Ibid., para 7.620.

map well to the distribution of the labour force. This should be adjusted to become more dynamic so as to reflect more appropriately the proportion of TOTEX that each category represents.

We note that there may be a risk that an approach based on a TO-specific composition could perpetuate an inefficient structure, by encouraging companies to change their input costs to align with the weighting. However, we note that Ofgem already uses TO-specific cost category weights in its RPE approach. Moreover, it may not be possible for TOs to 'game the system' by adjusting the composition of their labour force such that more costs are assigned to categories with higher weights if different types of labour are not directly substitutable for each other. Therefore, updating the approach to dynamically adjust to the actual composition of TO's input costs would not materially affect this incentive if it already existed in the current approach.

For these reasons, we adopt the following indices and weights.

Table 3.5 Oxera's approach: labour index selection and weighting

Current index	Current weight	Labour category	Proposed index	Proposed weight
AWE: Private Sector	25%	Management; Business & Administration	BCIS Management & Administration	27%
AWE: Construction	25%		n/a	
BCIS PAFI Civil Engineering	25%	Engineering and Technical; Field-Based; Specialist	BCIS PAFI civil engineering	36.5%
BEAMA Electrical Engineering	25%	Engineering and Technical; Specialist	BCIS Electrical Engineering Labour Index	18.25%
			BEAMA Electrical Engineering	18.25%

Note: The proposed weights are based on the current breakdown of the labour force and are used to derive the labour RPE only (i.e. they are based on the proportion not of TOTEX but of labour costs).

It is worth noting that while this approach may address potential tracking errors for labour RPEs, it is unlikely to make significant changes in cost-reflectivity for materials categories that potentially face more complex input price pressures, such as supply chain issues. We return to this point in section 3.3.3 below.

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3.3.2 Regional adjustment for RPEs

We note that Ofgem has approaches for capturing regional differences—particularly for GDNs—when comparing company cost structures. For instance, at RIIO-GD2, regional adjustments were made in Ofgem's cost assessment models for GDNs with respect to:

- **regional wages**: adjustments were made for heterogeneity in wages across regions. A regional wage index also took into account differences in wages for occupations that may be considered 'indirect', such as administrative and managerial functions. In RIIO-GD2, regional wage adjustments made for labour costs in London and the South East of England accounted for the majority of regional adjustments;
- **sparsity:** adjustments made for sparsity account for the higher costs associated with local authorities in more sparsely populated areas than the GB average. In RIIO-GD2, the sparsity index was applied to emergency and repair costs only.
- **urban productivity**: pre-modelling adjustments to account for the additional costs associated with operating in urban areas. There was a high correlation between the regional wage adjustments and the urban productivity adjustments made.

We note that we were unable to find evidence of such regional adjustments in the context of RIIO-ET2. This is most because comparative benchmarking is usually done between SPEN and SHET which both operate in Scotland, and Scotland is considered to be one region from a cost assessment modelling perspective.

It would be relatively straightforward to extend the data that is already collected on these regional differences to construct an RPE. In the case of SPEN, we note that an RPE that accounts for regional wage input price pressures may be particularly relevant. This is because, while historically, regional wage pressures were primarily concentrated in London and the South East of England, this assumption needs to be reassessed in light of the changing macro environment in which the TOs are operating. It may be the case that labour has become more mobile in response to COVID-19 (e.g. through hybrid working environments) such that the heterogeneity in wages across regions has become less material and/or that cost pressures in wages are more dispersed outside of London and the South East. Indeed, the latest ONS ASHE release demonstrates that the three regions with the highest earners in the UK are London, Scotland

and the South East of England.[109] Changes in real median pay between 2010 and 2024 also demonstrate a narrowing gap between London and the South East (which have seen among the largest falls in median full-time earnings in real terms), and between Northern Ireland and Scotland, which have seen the largest increases in real-terms earnings.[110]

3.3.3 Granular, asset-based indexation for materials RPEs

To assess materials RPEs, Ofgem uses two industry indices with an equal weighting: the BCIS Electrical engineering materials index and the BCIS FOCOS Resource Cost Index of Infrastructure: materials. Both capture a range of goods that are not representative of the key assets used by TOs, such as timber, bricks and clay products, and asphalt for paving.[111]

As a result, these indices are likely to be too broad to accurately capture the inputs that TOs procure. In particular, the focus on general electrical engineering materials in these indices overlooks the pressures that TOs face when purchasing assets, such as supply chain issues. Therefore, a more granular assessment of inputs reflecting the actual assets that the TOs procure would be more cost-reflective than the current approach.

For materials RPEs, Oxera proposes indexing revenues to more granular input price indices, similar to those used in other jurisdictions.[112] If sufficiently granular indices are not available from the ONS, foreign price indices could be used. Indeed, this section explores the use of foreign indices from Germany and from Missouri in the US, as these indices may improve on ONS indices by accounting for supply chain issues such as the fact that: (i) some specialised inputs are internationally traded; and (ii) TOs in other jurisdictions are increasing investment such that they may face similar supply chain issues to those faced by the British TOs.[113]

To identify potential approaches used elsewhere that could be applied to the UK context, Oxera has explored international regulatory precedent in accounting for input price inflation in various countries. This is detailed in Annex 1. In contrast to RPE allowances, these regimes focus on calculating the correct costs for energy network companies by deciding

[109] Office for National Statistics (2024), 'Low and high pay in the UK: 2024', 29 October, accessed 19 November 2024.
[110] House of Commons Library (2024), 'Research Briefing: Average earnings by age and region', 15 November, accessed 19 November 2024.
[111] BCIS has confirmed that the model for the FOCOS is based on the resource indices in the PAFI for civil engineering. The above examples are based on this. See BCIS (2024), 'Guide to PAFI Series 4 – Civil Engineering and Related Specialist Engineering – Calculation', February, pp. 4–5.
[112] See Annex 1 for a summary of international regulatory precedent in accounting for input price pressures.
[113] For example, the European Commission's proposed action plan for electricity grids. See: European Union (2023), The Missing Link - An EU Action Plan for Grids, 28 November, accessed 1 October 2024.

on costs and/or inflationary pressures for different asset categories separately.

In light of the issues with the current approach to index selection, and the international precedent of using more granular 'cost catalogue'-type approaches, Oxera considers that an asset-based rather than input-based approach should be adopted. Examples of how such approaches could be applied are outlined in the remainder of this subsection.

We note that, as the assessment of RPEs becomes more granular, the risk of endogeneity issues becomes stronger. In the extreme case of exploring a price index that captures assets that only TOs (or energy networks more broadly) use, the price index may capture inefficiencies with respect to contract negotiation, for example. In other words, the ability of the TOs to influence unit prices may mean that the more specific an index is, the more likely it could be that the index is not reflecting *only* genuine input price pressures. However, we do not consider that this risk is material in practice, given that:

- even the most granular indices that we explore are still sufficiently broad to mitigate endogeneity issues;
- even in the stylised case of a TO-specific asset, the market price will still be determined via competition between the three GB TOs;
- several TO-specific assets are internationally traded, such that the price is influenced by more than just the negotiations of an individual British TO;
- the domestic indices can be cross-checked against international indices (e.g. from the EU or US) to mitigate this issue.

ONS PPI-based approach

The first option of such an asset-based approach is to use the ONS published PPIs by aggregate industry and product group levels at the four-digit classification level. Examples of relevant indices from the ONS PPI dataset are shown in Table 3.6 below.

Internal Use

Table 3.6 Select ONS PPIs

Dataset	Category
Price Indices of Products Manufactured in the United Kingdom (CPA 2.1)	Electric Motors, Generators, & Transformers
	Electricity Distribution & Control Apparatus
	Batteries & Accumulators
	Other Electronic & Electric Wired & Cables
	Wiring Devices
Price Indices of Selected Commodities Imported into the United Kingdom (CPA 2.1)	Imported Electric Motors, Generators & Transformers – EU
	Imported Other Electrical Equipment – EU
	Imported Other Electrical Equipment – NEU
	Imported Electrical Equipment
	Imported Electrical Equipment – EU
	Imported Electrical Equipment – NEU

Source: ONS (2024), 'Produce price inflation (MM22)', 18 September, accessed 3 October 2024.

The ONS PPI real growth rates for select categories and the RPE adjustments for TOs in RIIO-2 are shown in Table 3.7.

Table 3.7 ONS PPI and SPEN real price growth, 2015–24

<table>
<tr><th>ONS PPI categories (four digits)</th><th>UK PPI</th><th>SPEN's RPEs</th></tr>
<tr><td>Electric Motors, Generators & Transformers</td><td>0.04</td><td rowspan="4">-0.01</td></tr>
<tr><td>Electricity Distribution & Control Apparatus</td><td>-0.17</td></tr>
<tr><td>Other Electronic & Electric Wires & Cables</td><td>0.25</td></tr>
<tr><td>Wiring Devices</td><td>0.01</td></tr>
</table>

Note: SPEN's RPE is Scottish Power Transmission's RPE allowances using the RIIO-2 approach. While this table reflects SPENs' RPEs, we note that other TOs' RPEs overlap considerably with SPEN's.
SPEN's RPE allowance over this period has been estimated based on the approach set out in the RIIO-2 RPE Workbook – AIP 2023.
Source: ONS (2024), 'Producer price inflation (MM22)', accessed 15 October 2024, and SPEN (2024), 'RIIO-2 RPE Workbook - AIP 2023'.

It is clear that the inflationary pressures captured by the ONS PPIs are significantly higher than the RPE adjustments based on the input price

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indices currently used by Ofgem. For example, SPEN's RPE allowance growth has remained broadly flat (even slightly negative) since 2015 (i.e. with only marginal adjustments to allowances as a result of changes in real input prices), while the market prices for assets have increased by between c. -17% (electricity distribution & control apparatus) and 25% (other electronic & electric wires & cables).

However, one limitation with the ONS PPI indices at the four-digit level is that some of the sub-categories captured under the categories shown in Table 3.7 above are not as relevant for industrial consumption. For instance, the Electric Motors, Generators and Transformers category covers subcategories such as 'other transformers, having a power handling capacity of ≤ 16 kVA'.[114] Similarly, the 'Wiring Devices' category includes subcategories such as 'lamp-holders, for a voltage of ≤ 1000 V' and 'switches, for a voltage of ≤ 1000 V'. It may be reasonable to assume that SPEN and other TOs would not be procuring these components as part of their cables and wiring assets.

Nonetheless, these more granular indices are significantly more targeted than the indices adopted by Ofgem at RIIO-2. Even those assets that appear to be less related to the kinds of assets that SPEN procures (for example, low-capacity transformers) may be subject to cost pressures similar to those on the inputs that SPEN actually uses.

Furthermore, it is worth noting that there is a risk that the use of PPIs may be more likely to capture the prices at which these assets are produced rather than the prices at which TOs would procure the assets. However, we consider this risk to be limited as the prices at which TOs procure assets are directly determined by producer prices. If producer prices face supply chain shocks, this will be reflected in the prices paid by the TOs, albeit at an even higher rater given that output prices are a factor of input producer prices and are subject to mark-ups.

For these reasons, we consider that the use of PPIs is a valid approach to estimating the input price pressures that the TOs face.

PPIs from other jurisdictions

We note that ONS PPIs are not provided at a more granular level (i.e. they are at the four-digit level only) while other jurisdictions do provide PPIs at a lower level. For example, the German PPI indices are provided

[114] Eurostat (2024), ESTAT_Statistical_classification_of_products_by_activity,_2.1_(CPA_2.1), 8 January, accessed 11 October 2024.

at the six-digit level, allowing for a more accurate tracking of PPI subcategories that would be relevant for the TOs.

To confirm the relevance of these findings from international sources to the UK context, we compare the German PPIs to the UK ONS PPIs. Since the ONS PPIs are available at the four-digit level only, we compare these to the German PPI data at the four-digit level too. As shown in Table 3.8, we find that the ONS and German PPIs do broadly track over the period considered.

Table 3.8 Comparison of German PPI and UK PPI (four digits) nominal growth rates, 2020–23

	German PPI	UK PPI
Electric Motors, Generators & Transformers	0.24	0.27
Electricity Distribution & Control Apparatus	0.18	0.11
Batteries & Accumulators	0.16	0.21
Other Electronic & Electric Wires & Cables	0.29	0.23
Wiring Devices	0.23	0.28

Note: These growth rates (in nominal terms) are between 2020 and 2023 except for 'Other electronic & electric wires & cables' from the German PPI, where the growth rate is measured between 2021 and 2023 because the 2020 index value is missing.
Source: Statistisches Bundesamt (2024), '61241-0003:Erzeugerpreisindex gewerblicher Produkte: Deutschland, Jahre, Güterverzeichnis (GP2019 2-/3-/4-/5-/6-/9-Steller/ Sonderpositionen)'; and ONS (2024), 'Producer price inflation (MM22)', both accessed 15 October 2024.

Some categories diverge; namely, the wires and cables index is higher in the German PPI than the ONS PPI. This allows us to infer that input price pressures for these assets are likely to be not wholly specific to any one jurisdiction, at least between the UK and an EU comparator such as Germany. This indicates that it is reasonable to assume that there is an international market—or at least a European market—for the types of assets that TOs procure.

As ONS and German PPIs at the four-digit level are broadly comparable, it may be possible to use German PPIs at the more disaggregated six-digit level to index UK input price pressures. However, there may be reasons why the German and UK price levels diverge, such as trade frictions or other national price pressures. To confirm that the German PPIs are tracking international trends in electrical transmission asset procurement, and are therefore broadly applicable to the UK context, it is useful to further assess the German data against a non-EU example.

For a non-EU example, Oxera uses PPIs from the Federal Reserve Bank of St. Louis, Missouri's Federal Reserve Economic Data (FRED).[115] While the FRED categories differ from the ESTAT classification used by the German index and the ONS, some comparable categories are presented in Table 3.9.

Table 3.9 Comparison of the German PPI (six digits) and the St. Louis FRED PPI nominal growth rates, 2019–23

German PPI	Nominal growth rate	FRED PPI	Nominal growth rate
Other Electric Conductors, for a Voltage > 1000 V	0.31	Semiconductor and Other Electronic Component Manufacturing	0.03
Liquid Dielectric Transformers	0.76	Electric Power and Specialty Transformer Manufacturing	0.65
		Electric Power and Distribution Transformers	0.69
Electric Apparatus for Switching, for a Voltage > 1000 V	0.30	Switchgear and Switchboard Apparatus Manufacturing	0.42
Boards and Other Bases, for a Voltage > 1000 V	0.28		
AC Motors, Multi-Phase, of an Output > 75kW	0.16		

Note: The growth rates (in nominal terms) are between 2019 and 2023, except for 'AC Motors, Multi-Phase, of an Output >75kW' from the German PPI, which is measured between 2021 and 2023because the 2019 and 2020 index values are missing.
Source: Statistisches Bundesamt (2024), '61241-0003:Erzeugerpreisindex gewerblicher Produkte: Deutschland, Jahre, Güterverzeichnis (GP2019 2-/3-/4-/5-/6-/9-Steller/ Sonderpositionen)'; and St. Louis FRED (2024), 'Producer Price Indexes (PPI) > Industry Based > Manufacturing', both accessed 15 October 2024.

We find that generally the categories compared do track between the FRED PPIs and the German PPIs, albeit more closely for some assets than others. For example, switchgears and switchboard apparatus manufacturing from FRED tracks closely to 'electric apparatus for switching, for a voltage > 1000V' from the German PPI. Transformers also map relatively well from the German PPI to two corresponding FRED categories. Conversely, the indices diverge more with respect to semiconductors/other electric conductors. This is likely also to be a result of the differences in categorisation between the two PPIs.

[115] FRED is widely considered to be one of the 'world's most comprehensive online economic databases' with 'over 55,000 economic time series from 45 sources'. See University of Toronto Map and Data library, 'Federal Reserve economic data (FRED)', accessed 14 October 2024.

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Therefore, there is a strong argument in support of using the German PPIs at the six-digit level to index input price pressures for UK TOs. German PPIs provide more specificity than the ONS PPIs allowing for a better reflection of input price pressures. At the higher four-digit level, they track to the ONS PPIs, which provides some degree of comfort that they are broadly applicable to the UK context.

We note that there is inevitably a currency exchange risk present with the use of foreign indices for RPEs. For example, in a scenario where a key asset (e.g. a transformer) is imported from European manufacturers, and if there were a significant fall in the value of the British pound, British TOs would in effect be paying more for transformers. However, if RPEs were set using German PPIs, this would not capture the impact of the currency devaluation for British TOs and may suggest that no or limited RPE allowance is made.

However, this risk may be mitigated by the fact that some of these assets are procured from the international market outside of Europe (e.g. Asia) and therefore some foreign exchange hedging arrangements may already be in place in procurement contracts.

BEAMA indices

A final alternative approach is to use more specific asset-based indices from BEAMA, as these may be more reflective of the kinds of assets that TOs procure. These include:

- basic electrical equipment;
- switchgears >36kV;
- factory-built assemblies for low-voltage switchgear;
- factory-built assemblies for control equipment;
- large power transformer materials.

These indices are calculated using tender prices from a survey of industry participants, with weightings applied to account for the relevant labour and materials portions of each index. These indices have the added advantage of being based on UK datasets. They also broadly reflect the categories of TO expenditures—namely, transformers, switchgears, and cables.

3.3.4 Alternative index selection and weighting for materials RPEs

With respect to materials RPEs, SPEN's largest categories by volume of asset purchases are shown in Figure 3.4.

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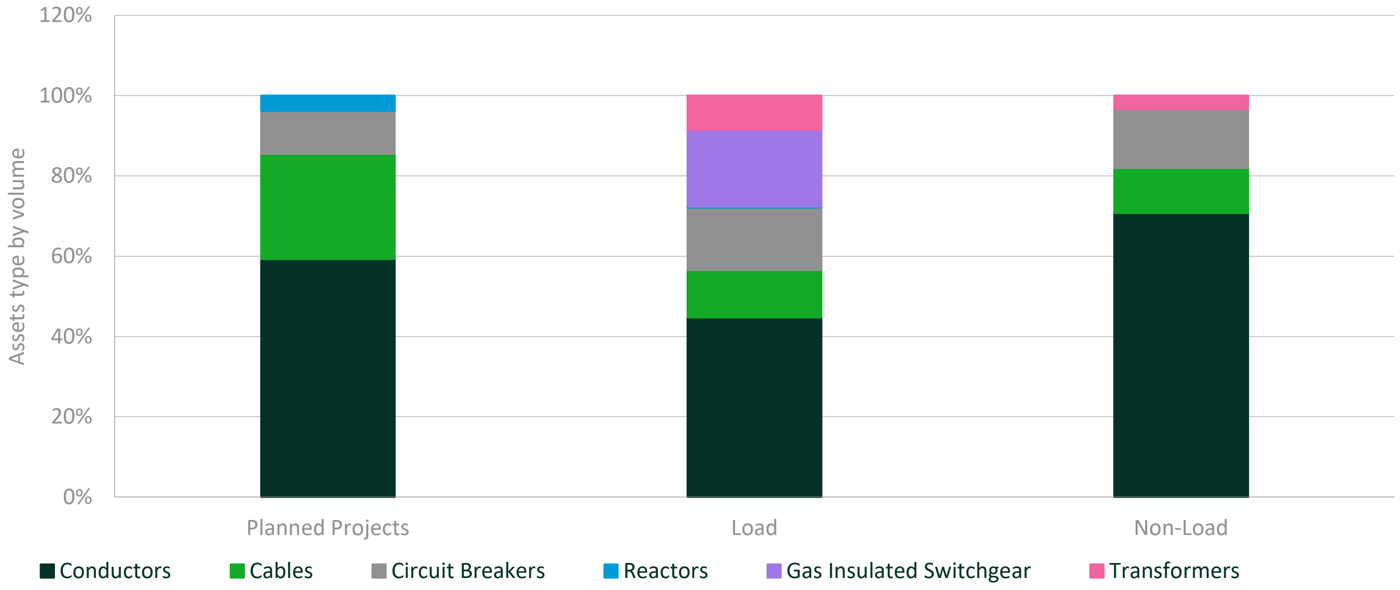
Figure 3.4 Percentage of asset volumes by project type



Source: Oxera analysis of SPEN data.

As shown above, conductors, cables, and circuit breakers account for the majority of all assets procured across all project types, with switchgears, transformers and reactors accounting for much smaller fractions of total asset volumes. However, when looking at the percentage of asset volumes weighted by the estimated cost of each asset, the distribution is different. In particular, conductors make up the majority of total asset volumes but, when weighted by the estimated cost per asset, they account for only 3% of total forecast costs, as shown in Figure 3.5 below.

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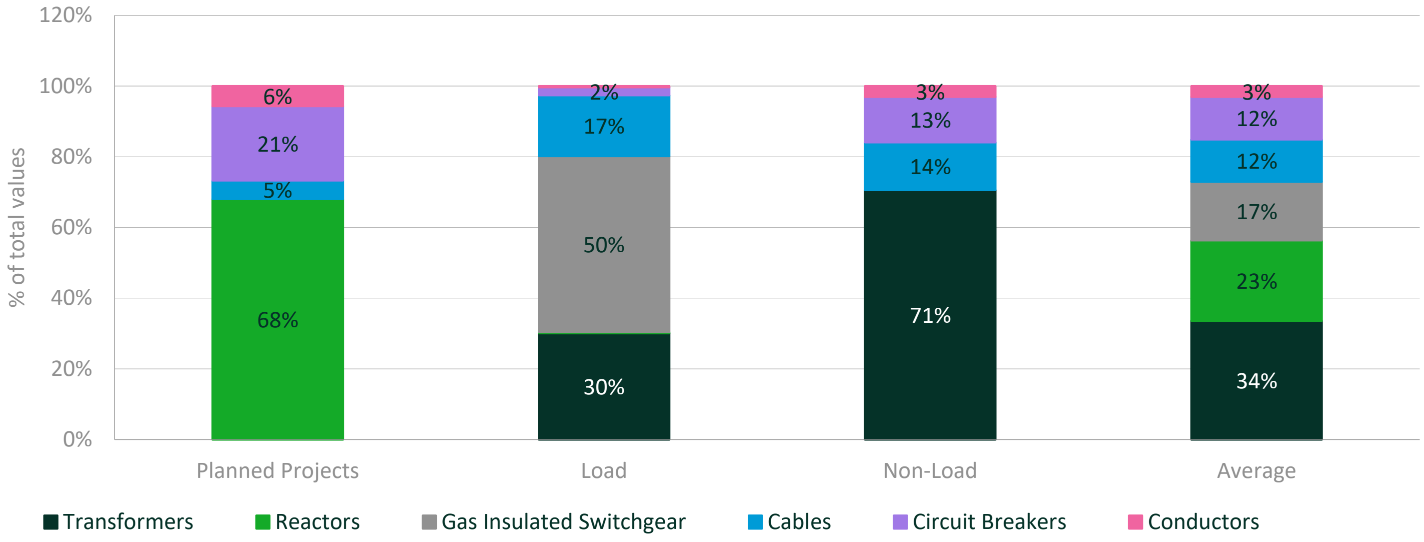
Figure 3.5 Asset volumes weighted by estimated asset cost



Note: As the estimated asset costs are on a historical basis, costs are presented as a percentage of the total estimated costs by asset (rather than a firm £m forecast value) in order to provide a general sense of the composition of total costs by asset type.
Source: Oxera analysis of SPEN data.

Given that inflation basis risk is measured according to the total asset costs incurred, rather than the asset volumes themselves, we consider that the weighted asset volumes' average presented in Figure 3.5 should be used to assign appropriate index weights for the RPE calculation.

We map the largest asset categories against the ONS PPIs identified in section 3.3.3 and then re-weight them to reflect the above volume breakdown, as shown in Table 3.10

Table 3.10 Proposed index weight within cost category—materials

Asset category	Proposed index	Proposed weight
Transformer	ONS Electric Motors, Generators & Transformers	35%
Reactors	ONS Electric Motors, Generators & Transformers	25%
Switchgears	ONS Electricity Distribution & Control Apparatus	15%
Circuit Breakers	ONS Electricity Distribution & Control Apparatus	12.5%
Cables	ONS Other Electronic & Electric Wires & Cables	12.5%

Source: Oxera analysis of ONS PPIs.

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3.3.5 True-up mechanisms to address composition and basis risk

The true-up mechanisms within Ofgem's approach do not address some areas of composition and basis risk, as discussed above in section 3.2. To address these risks, we propose annual true-up mechanisms that account for outturn costs differing:

- as a proportion of TOTEX from expectations;
- from input price indices.

To this end, we propose replacing the current true-up mechanism which adjusts for differences between outturn input price indices and forecasts with one that reflects the above effects. Each of these true-ups would account for composition risk and basis risk respectively, providing a more accurate reflection of the TOs' costs in RPE allowances.

In practice, this means that if outturn volumes differ from expected proportions—for example, because CAPEX was much higher than anticipated, resulting in a higher proportion of materials costs over the period—then there is a risk that the RPE mechanism under-compensates the TO for its input costs.

3.3.6 Lower materiality thresholds and disaggregation of cost categories

Oxera's approach would first entail dynamic weighting of RPEs in line with the cost categories used by Ofgem of 'labour', 'materials', and 'plant and equipment'. As discussed in section 3.3.1, instead of the current fixed weighting approach, different input price indices for 'labour' RPEs could be weighted based on the workforce breakdown of each TO.

Similarly, as discussed in section 3.3.3 above, the 'materials' category should be split by the key assets purchased by the TOs and the input price indices could be applied on this asset-specific basis, adjusted to the actual percentage of TOTEX that each asset represents.

More disaggregated cost categories may better reflect the cost pressures that SPEN and other TOs face. RPEs might be better assessed and applied at more disaggregated cost categories, especially for materials, potentially avoiding the risk of over- or under-compensating TOs for cost pressures. However, meeting the current materiality thresholds would be difficult at less aggregated levels of asset-based cost categories. This makes the current approach less flexible and dynamic than it could otherwise be.

For this reason, the second step would entail reducing the materiality thresholds from the current 10% to thresholds more in line with other regulated sectors and more appropriate for the level at which the granular assessment is done. This would allow for RPEs to be considered at the appropriate cost category level where TOs face the input price pressures, without over-compensating them for categories in which only small volumes are purchased.

3.4 Oxera's assessment of RPEs for RIIO-T3

Oxera's approach to assessing RPEs for RIIO-T3 is based on re-weighting the index weights within each cost category to align with our proposed indices. Our process for calculating the expected RPEs during RIIO-T3 is as follows.

For **labour RPEs**, SPEN's labour cost categories are weighted to reflect the workforce breakdown and indexed to the revised indices as presented in Table 3.5

Until 2028, we use the Office for Budget Responsibility (OBR) average earnings forecast, consistent with Ofgem's approach at RIIO-2. We use the forecast (real) earnings growth rate as a proxy for RPE growth in the years 2027 and 2028.[116] The expected RPEs are thus 0.4% and 1.3% for 2027 and 2028 respectively.

For the years 2029–31, we calculate RPEs by using the historical wedge between our selected input price indices for labour and CPIH. First, we calculate the real growth rate for these labour indices from 2014 to 2024 by subtracting the CPIH growth rate from the nominal index growth rate on a monthly basis. The total real growth rate from 2014 to 2024 is obtained by calculating the geometric mean of the individual monthly real growth rates.[117] We calculate this RPE for each index individually and then weight it according to the revised weighting presented above in Table 3.5. This results in labour RPEs equal to 0.2%.

For **material RPEs**, we have opted to use the ONS PPIs in this instance because they are UK-based and more granular than the current approach. However, the weightings set out in Table 3.10 could also be applied against foreign indices such as the German PPIs and FRED discussed in section 3.3.3 above, which may provide an even better assignment between more specific categories and the assets that SPEN

[116] The analysis is done on the basis of financial years rather than calendar years, so 2027 refers to the financial years 2026/27 to 2027/28.
[117] This is equal to the product of all individual monthly real growth rates to the power of one divided by the number of months. The yearly RPE is this total real growth rate to the power of 12, minus 1.

procures. Because the foreign indices may require more consideration about their application in the UK context, including the question of foreign exchange rates, for the purposes of our RPE assessment we have used the ONS PPIs.

To calculate expected materials RPEs for the RIIO-T3 period, we use the historical wedge forecast again. We find the real monthly growth rates of the three proposed indices from For **material RPEs**, we below and take the geometric mean to find the growth rate for the entire period.[118] We weight the individual RPEs according to Table 3.10, which results in an overall materials RPE of 1.6% based on the historical wedge. Therefore, we expect the materials RPEs to be 1.6% for each year during RIIO-T3.

Based on this approach, we estimate combined RPEs (labour and materials) for the T-3 period as shown in Table 3.11.

Table 3.11 Oxera estimate of T3 combined TOTEX RPEs

	2027	2028	2029	2030	2031	Average
Labour	0.4%	1.3%	0.2%	0.2%	0.2%	0.5%
Materials	1.6%	1.6%	1.6%	1.6%	1.6%	1.6%
Total	**0.6%**	**1.0%**	**0.6%**	**0.6%**	**0.6%**	**0.7%**

Note: SPEN's notional labour and materials weights are 41.4% and 28.9% respectively.
Source: Oxera analysis of SPEN data and publicly available indices.

Below we present what the RPEs would look like for T3 if the current Ofgem approach were maintained. We find that Oxera's revised approach would compensate SPEN for inflationary pressures more on average by 0.3 percentage points (as measured by the total annual values RPE estimates) over the T3 period. This difference stems entirely from materials RPEs, where the Oxera approach leads to RPEs that are 1.4 percentage points higher (as measured by the annual values RPE estimates) than the current Ofgem approach over the T3 period. Labour RPEs under the Oxera approach, conversely, are slightly lower (0.3 percentage points) compared to the current Ofgem approach.

[118] The individual RPEs are these total growth rates to the power of 12, minus 1.

Table 3.12 Estimate of T3 combined TOTEX RPEs under current Ofgem approach

	2027	2028	2029	2030	2031	Average
Labour	0.4%	1.3%	0.7%	0.7%	0.7%	0.8%
Materials	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%
Total	**0.2%**	**0.6%**	**0.4%**	**0.4%**	**0.4%**	**0.4%**

Note: These values were calculated using the same approach as in Table 3.11, but using the indices and weights that Ofgem suggested. SPEN's notional labour and materials weights are 41.4% and 28.9% respectively.
Source: Oxera analysis of SPEN data and publicly available indices.

In the current context, Ofgem's approach is likely to have underfunded SPEN for its input prices in RIIO-2 and maintaining this approach for RIIO-3 would be likely to result in under-compensation again. Our approach leads to a more accurate representation of the input price pressures faced by the TOs. In principle, this ultimately protects companies and customers from input price pressures, particularly in periods of high volatility. Oxera's approach leads to a more accurate representation of the input price pressures experienced by SPEN and therefore leads to appropriate compensation.

3.5 Other potential regulatory adjustments to address supply chain issues

The recommendations outlined above can go some way to protect companies and consumers from input price pressures. However, it is unclear whether these proposals can fully address the supply chain issues that companies face. Beyond adjusting the RPE approach as per the above suggestions, there are other regulatory mechanisms and levers that could be employed to fund companies for supply chain issues, as outlined below. When determining the appropriate incentive framework, it will be important to consider the impact of supply chain issues not only on the price, but also on the deliverability of projects.

3.5.1 Cost-sharing rates

At RIIO-2, Ofgem had different cost-sharing rates for 'high confidence' and 'low confidence' costs. A 50% cost-sharing rate was applied to high-confidence costs (e.g. if a company underspends by £10m, it retains £5m in additional returns and £5m goes towards reduced bills), while a 15% cost-sharing rate was applied to low-confidence costs (e.g. if a company underspends by £10m, it retains £1.5m in additional returns and £8.5m goes towards reduced bills). This approach of differing cost-sharing rates could be applied to cost categories that are known in advance to suffer from supply chain issues.

Such an approach would not fund companies for supply chain issues, but would protect them from the downside risk that supply chain issues are more material than anticipated. Similarly, if these issues do not materialise to the extent to which they are forecast in TOs' cost allowances, consumers are protected.

An extreme case of reduced cost-sharing rates would be to have full pass-through of costs that are known to be affected by supply chain issues (i.e. a cost-sharing rate of 0%). This would fully protect companies and consumers from supply chain risks, but may reduce the incentive for companies to invest efficiently. Ofgem would need to work with TOs to assess what costs should have a reduced cost-sharing rate and what that reduced cost-sharing rate should be.

3.5.2 Re-openers

The RIIO-2 framework allows for re-openers, which could be applied to projects known to be affected by supply chain issues such that the efficient costs of those projects can be assessed in light of the prevailing market conditions, rather than be based on some (highly uncertain) forecast of what will happen to input price pressure over time.

We note that the materiality threshold for re-openers can be excessive, particularly in the context that individual projects may have different supply chain issues and may be immaterial in isolation but material as a collective. Therefore, if Ofgem is to rely on re-openers to address supply chain issues, it should consider either reducing the materiality threshold or assessing projects collectively.

3.5.3 A GB index

The primary issue relating to RPEs is that some of the inputs used by TOs are highly specialised such that they are insufficiently captured by aggregated price indices. While more granular price indices are available (as outlined above), a robust input price index may not be available for all specialised inputs. However, it may be feasible to construct a GB-specific input price index for specialised inputs using contract data provided by the TOs. By construction, such an index would be able to capture input-specific supply chain issues, to the extent that these issues are common across GB.

The price of constructing or installing an asset (e.g. transformer) may differ across TOs for reasons other than inefficiency. For example, it may be more or less costly to install a transformer in an urban or sparsely populated region. Therefore, the GB price index would need to track the *change* in input prices over time rather than the difference in price *level* between TOs (to the extent that the differences in price levels are driven by inefficiency, this would already be captured by the cost assessment modelling). Table 3.13 show how such an index could be constructed for a stylised asset.

Table 3.13 GB-specific input price index—stylised example

	Year 1	Year 2	Year 3	Year 4	Year 5
Average unit cost: TO A	10	13	15	12	13
Average unit cost: TO B	12	14	17	15	14
Average unit cost: TO C	14	14	20	12	13
Average unit cost: GB	12.0	13.7	17.3	13.0	13.3
Index	100	114	144	108	111

Source: Oxera.

Table 3.13 shows that the price index would capture the change in the average unit cost of an investment over time. For example, between Year 1 and Year 2 of the regulatory period, the average unit cost of the investment increases by 14%. This would lead to an upward adjustment in the allowed revenues for this investment activity by 14%.

This mechanism could work well for activities that are relatively homogeneous across TOs and that are repeated regularly (such that a reliable unit cost can be estimated). However, the mechanism may be less robust for activities that are undertaken only once every few years.

A1 International precedent in accounting for input price pressures

A1.1 PPI and composite index approaches

Most European regulators adjust their revenue caps to inflation, commonly by indexing to inflation using the CPI.[119] Other countries, such as Czechia, use PPI to adjust for inflation.[120] A drawback of the CPI is that its focus is on consumer prices and end products. If the CPI and the PPI diverge, the PPI is likely to reflect more closely the costs incurred by energy network companies. The PPI is also a commonly used index that is straightforward to obtain from statistical agencies. Some countries even publish the PPI by industry, which would enable regulators to focus on very specific producer costs in the energy sector.

Some regulators use more than one index to create a composite index of inflation, often using separate inflation indices for material and labour prices. The advantage of using such a composite index is that diverging price developments in materials and labour costs can be captured more accurately. For example, Iceland adjusts its revenue cap using a wage index and the CPI.[121] Denmark and Austria both calculate their own inflation index, specific to regulated network companies. Denmark's 'regulation price index' is a simple average between the wage index and the net price index.[122] The Austrian index, the 'network company price index', is made up of 68% of agreed minimum wage index, 18% CPI and 14% construction output price index.[123] However, changes in the composition of the inputs are not accounted for in the Danish or Austrian approaches.

A1.2 Sweden's cost catalogue

The Swedish regulator 'Energimarknadsinspektionen' (Ei) uses a detailed breakdown of expenditures solely for calculating the current and expected costs for each firm. To this end, the regulator provides a list of standard costs in the industry for assets such as lines, transformers and cables. These standard costs are calculated based on the investment required to acquire the assets in a cost-effective manner, even taking

[119] Council of European Energy Regulators (2024), 'Report on Regulatory Frameworks for European Energy Networks 2023', Report, 21 February.
[120] Ibid., p. 38.
[121] Ibid., pp. 76–77.
[122] Forsyningstilsynet (2023), 'Prisindeks for Energinet', press release, 13 November, https://forsyningstilsynet.dk/vejledning-og-indberetning/udmeldinger/2023/prisindeks-for-energinet, accessed 30 September 2024.
[123] E-Control (2023), 'Regulierungssystematik für die fünfte Regulierungsperiode der Stromverteilernetzbetreiber 1. Jänner 2024 - 31. Dezember 2028', Decision, 31 October, p. 66.

into account conditions beyond the control of the network company.[124] The original sources of the standard costs are the cost catalogues of ElByggnadsRationalisering (EBR) from the industry organisation Energiföretagen Sverige, a service for planning, constructing and maintaining electricity distribution facilities.[125] For the 2024–27 regulatory period, Ei hired the architecture and engineering consultancy SWECO to propose changes to the cost catalogue, which it did by interviewing energy network firms, talking to its own experts, and conducting a quantitative analysis.[126]

Once the standard costs are determined, they are fixed for the entire regulatory period. Swedish electricity network companies then submit their current and expected costs based on these standard costs. Certain separate labour costs (not included in the standard costs) can also be submitted. Taking into account the costs submitted by each firm, Ei decides on a revenue cap for the regulatory period, which is adjusted to inflation ex post. We understand that this is done using the construction price index,[127] as this is the inflation measure used for all other inflation adjustments done by Ei. The construction price index is provided by Statistiska centralbyrån (Statistics Sweden) and includes prices for materials and labour.

The advantage of an approach based on more detailed expenditure is the focus on costs that affect the industry, instead of a more general cost measure. It captures more supply chain impacts than a system based on CAPEX or TOTEX, and as a result, it is more reflective of how companies incur costs in practice. The ex post indexing of the revenue cap using the construction price index adds a layer of flexibility to the revenue cap. However, this inflation adjustment is very broad and does not use an equally granular approach as the costs calculations does. This means that the basis risk still exists: the construction price index might not accurately track the costs pressures that TOs face. If one specialised input price increases significantly but this input receives little weight in the construction price index, then these cost pressures will not be adjusted for in the revenue allowance. Real price effects are therefore not taken into account in the Swedish approach.

[124] Energimarknadsinspektionen (2023), 'Handbok för inrapportering av uppgifter till grund för beslut om intäktsram 2024–2027, Intäktsramar elnät 2024–2027', Handbook, 25 October, Version 2.1, p. 43.
[125] SWECO (2022), 'FÖRSLAG NORMVÄRDESLISTA 2024–2027', report, 15 November, pp. 5–6.
[126] Ibid., p. 2
[127] Energimarknadsinspektionen (2023), op. cit., pp. 1–97.

A1.3 Luxembourg's asset-based weighted approach

In Luxembourg, the regulator, L'Institut Luxembourgeois de Régulation', (ILR) adjusts the historical costs of investment for inflation using a composite index similar to those used by Ofgem (UK), E-control (Austria) and Forsyningstilsynet (Denmark), but it employs a different weighting based on specific assets. While Sweden uses only the granular approach to calculate the costs, the ILR applies this approach to inflation adjustment by fixing the weights it gives to the price index for electrical work, wages and the harmonised index of construction prices. For example, low-voltage cables receive a 40% weight for electrical work prices, 40% for wages and 20% for construction prices. Medium-voltage cables have a 60% weight on the electrical work index and 20% on both wages and construction prices. The weight for electrical work prices increases to 80% for high-voltage cables, where the remaining 20% are entirely on construction prices and 0% on wages. The ILR lists 21 different expenditures with its respective weights (see Table A1.1).[128] The costs are set prior to each regulatory period of four years, adjusted by the weights. Each year, the network operator updates the ILR about ongoing investments and revised costs, as well as about the expected completion date. After completion of the investment, real costs and planned costs are compared and 30% of the difference goes to a regulatory account.[129] The balance on the regulatory account gives rise to interest. When the balance of the regulatory account for year t-1 is less than -5% or more than +5% of the revised Maximum Authorised Revenue, it is brought back to the nearest threshold by adjusting the Maximum Authorised Revenue in t+1.[130]

Table A1.1 Weighting for specific expenditures

TO (type of structure)	Price index for electrical work	Wages	Harmonised index of construction prices
Very-high-voltage building	50%	0%	50%
Very-high-voltage transformer	80%	0%	20%
Very-high-voltage switchgear	80%	0%	20%

[128] Institut Luxembourgeois de Régulation (2020), 'Règlement ILR/E20/22 du 26 mai 2020 fixant les méthodes de détermination des tarifs d'utilisation des réseaux de transport, de distribution et industriels et des services accessoires pour la période de régulation 2021 à 2024 - Secteur électricité.', Decision, 1 July, annex 1 p. 15
[129] Council of European Energy Regulators (2024), 'Report on Regulatory Frameworks for European Energy Networks 2023', Report, 21 February, pp. 94–95.
[130] Institut Luxembourgeois de Régulation (2020), op. cit., chapter 4, Art. 15, p. 9.

TO (type of structure)	Price index for electrical work	Wages	Harmonised index of construction prices
Very-high-voltage overhead line	80%	0%	20%
Very-high-voltage cable	80%	0%	20%
High-voltage building	50%	0%	50%
High-voltage transformer	80%	0%	20%
High-voltage switchgear	80%	0%	20%
High-voltage overhead line	80%	0%	20%
High-voltage cable	80%	0%	20%
Medium-voltage building	37.5%	12.5%	50%
Medium-voltage transformer	60%	20%	20%
Medium-voltage switchgear	60%	50%	20%
Medium-voltage overhead line	60%	20%	20%
Medium-voltage cable	60%	20%	20%
Low-voltage building	25%	25%	50%
Low-voltage transformer	40%	40%	20%
Low-voltage switchgear	40%	40%	20%
Low-voltage overhead line	40%	40%	20%
Low-voltage cable	40%	40%	20%
Low-voltage connection	40%	40%	20%

Source: Institut Luxembourgeois de Régulation (2020), op. cit., annex 1, pp. 15–16.

Similar to the Swedish regulator's approach, this approach allows focus on very specific costs that affect the industry. The ILR approach grants an even higher degree of flexibility, as it accounts for material (electric and construction) and labour costs separately, via a composite index. However, it is still dependent on the assumption that the indices and their weights correctly cover the underlying costs of the expenditures and that the composition of the inputs does not change during the regulatory period. Moreover, the complexity of implementing a solution that relies on bespoke weighting for different expenditures must also be considered in the context of the UK. It is possible that the weighting of each cost line would vary from company to company and would be subject to a high degree of discretion, given the size of the UK market and the number of companies operating within it.

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