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Price Effects for the RIIO-ED2 Price Control Review [REDACTED]

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Executive Summary

The Energy Networks Association (ENA) commissioned NERA Economic Consulting (NERA) to advise on real input price inflation, known widely as Real Price Effects (RPEs). This report contains our recommendation on the benchmark indices that Ofgem should use to index Distribution Network Operators' (DNOs') allowances over time to reflect changes in their input costs. It also sets out forecasts of the level of RPEs based on these benchmark indices.

For RIIO-ED2, Ofgem Intends to Set RPE Allowances by Indexing Costs to Benchmark Indices

Ofgem sets allowances for DNOs in constant prices (i.e. in "real terms") at the beginning of each price control. Ofgem indexes allowances to changes in general inflation, measured by the Consumer Price Index including owner occupiers' housing costs (CPIH), that occur over the applicable period. The prices of DNO inputs typically grow at a different rate to CPIH. For instance, wages tend to rise faster than general inflation. Differences between the growth rate of DNO input prices and general inflation are known as Real Price Effects (RPEs). Historically and at RIIO-2, Ofgem adjusts DNO allowances to take account of RPEs by relying on differences between the growth of benchmark indices intended to reflect the evolution of DNOs' underlying costs and general inflation. Ofgem's Business Plan Data Template for RIIO-ED2 allows DNOs to provide RPE assumptions for the following input cost categories: general labour, specialist labour, materials (capex), materials (opex), equipment/plant, and transport.[1]

At RIIO-ED1 and prior price controls, Ofgem set RPEs for input categories on an ex ante basis, using forecasts based on historical average growth in third-party benchmark indices. There was no true-up mechanism. Accordingly, in choosing benchmark indices to set RPEs at previous price controls, the primary criterion was whether the long-run average growth of an index reflected average growth in the relevant DNO unit costs. Ofgem and DNOs in their submissions have typically relied on the nominal relevance of an index to assess whether it was likely to track DNOs' unit costs. In other words, if an index included the world "plant and equipment" in its title and DNOs use plant and equipment in practice, Ofgem and its consultants would consider it a relevant index for setting RPEs.

At RIIO-ED2, Ofgem has decided to set RPEs using annual indexation to third-party benchmark indices. This change in methodology means it is important to consider the extent to which the indices reflect DNO cost pressures over the short term and the volatility of the indices. For instance, an index which has similar long-run average growth but is only weakly correlated with changes in DNOs' costs and is volatile may no longer be a suitable index for setting RPE allowances. A weakly-correlated and volatile index would expose DNOs to additional and unnecessary risk and reduce the likelihood that they would recover their efficient costs over the RIIO-2 price control period.

[1] General and specialist labour are also split into opex and capex, but we do not distinguish between them for the purpose of setting RPEs as there is no clear guidance on how labour unit costs should be classified as opex and capex.

We Select Benchmark Indices Following an Approach Adapted to Indexation

We select benchmark indices following an approach that explicitly considers whether indices reflect DNO cost pressures over the short term and whether the indices are volatile.

Our approach relies on historical data on benchmark indices and on DNO unit costs. We collected historical data on benchmark indices from three sources that Ofgem has used at previous price controls. These are the Office for National Statistics (ONS), the Building Cost Information Service (BCIS), and the British Electrotechnical and Allied Manufacturers' Association (BEAMA). We collected historical data on DNO unit costs from DNOs. We have unit cost data for general labour, specialist labour, and three subcategories of materials (capex) costs: wood poles, cables, and transformers.

Our index selection process incorporates two considerations:

- Whether there is evidence that an RPE is needed for a given input category, i.e. evidence that CPIH is a "poor proxy" for DNO input price growth.[2]
- Whether a particular index is relevant to DNO unit costs, i.e. moves in a similar way to DNO unit costs.

These considerations are interconnected: if RPEs are set by indexation, then in order to show that an RPE is needed we must be able to identify an index that is more relevant to DNO unit costs than is CPIH. We therefore address both considerations simultaneously in our selection process.

Our index selection process proceeds as follows. First, for each input cost category we identify a list of candidate benchmark indices based on nominal relevance and regulatory precedent. Then, we evaluate these indices against the two considerations identified above.

- **For input cost categories where we do not have DNO unit cost data**, i.e. materials (opex), equipment/plant, and transport, we apply a statistical test to determine whether the long-run average growth of that index is significantly different to the long-run average growth CPIH. We set an RPE based on the index if and only if the test confirms a significant difference, i.e. a "sustained and material deviation" from CPIH.[3] In other words, in line with Ofgem precedent, we rely on nominal relevance to identify suitable benchmark indices and recommend RPEs where those indices evolve significantly differently from CPIH.
- **For input cost categories where we do have DNO unit cost data**, i.e. general labour, specialist labour, and materials (capex), we estimate the Mean Squared Deviation (MSD). The MSD measures the average squared difference between the growth rate of the benchmark index (or CPIH) and the DNO cost data we had collected. Where the MSD is lower for a benchmark index than for CPIH, the benchmark index more closely tracks DNO unit cost growth than CPIH and is therefore more relevant for assessing DNO's cost growth than is CPIH. We set an

[2] Ofgem (22 April 2021), RIIO-ED2 Business Plan Guidance, para 5.43 p 50

[3] Ofgem (22 April 2021), RIIO-ED2 Business Plan Guidance, para 5.43 p 50

RPE based on the index if and only if the MSD shows that the index is more relevant to DNO unit costs than CPIH.[4]

Table 1 sets out our final selection of indices and the indices used at ED1. Our analysis shows that an RPE is needed for each input cost category.

For general labour, we find that two indices are more relevant to DNO unit costs than is CPIH, based on our MSD metric. However, both indices are *negatively* correlated with DNO unit costs, whereas CPIH is positively correlated. We conclude that CPIH better tracks the short term movements in DNO unit costs, but the two benchmark indices are closer to the long-run average. Therefore we propose to index to CPIH, but set a constant RPE based on the long-run averages of the two indices that are more relevant to DNO unit costs than is CPIH.

[4] For some input cost categories, many benchmark indices were more relevant to DNO unit costs than CPIH. In those cases, we restricted our index selection to the indices that were most relevant to DNO unit costs. This ensures that annual indexation remains a feasible exercise.

Table 1: Overview of Index Selection

Category	DNO unit cost	Index Name	NERA	ED1	Notes
Labour (general)		ONS Private Sector AWE (K54V)	C	C	These indices have a lower MSD than CPIH. However, since they are negatively correlated with DNO unit costs (whereas CPIH is positively correlated), we set a constant RPE rather than using indexation.
		ASHE Median Hourly Earnings for All Employees	C		
Labour (specialist)		BEAMA Electrical Engineering Labour (BEL)	I	C	All four indices have a lower MSD than CPIH.
		BCIS PAFI civil engineering (4/CE/01)	I	C	
		BCIS Electrical Installations – cost of labour (2/E1)	I		
		BCIS Electrical Engineering Labour (4/CE/EL/01)	I		
Materials (capex)	Poles	ONS Wood, Sawn and Planed (JU89)	I		This index has a lower MSD than CPIH.
	Cables	BCIS PAFI Pipes and Accessories: Aluminium (3/59)	I	C	Of all candidate cables indices that had a lower MSD than CPIH, we select the two with the lowest MSD.
		BCIS PAFI Pipes and Accessories: Copper (3/58)	I	C	
	Transformers	BCIS PAFI Pipes and Accessories: Copper (3/58)	I	C	Of all candidate transformers indices that had a lower MSD than CPIH, we select the two with the lowest MSD.
		BCIS Electrical – materials (3/E2)	I		
		BCIS PAFI Structural Steelwork - Materials: Civil Engineering Work (3/S3)		C	
	Other	BCIS RCI Infrastructure Materials (FOCOS)	I		For these categories, we do not have DNO unit cost data. We therefore select indices that (a) have regulatory precedent and (b) have long-run mean growth that is statistically significantly different from that of CPIH.
Materials (opex)		BCIS RCI Infrastructure Materials (FOCOS)	I	C	
Plant and Equipment		ONS Machinery and Equipment Output PPI (K389)		C	
		BCIS PAFI plant and road vehicles (90/2)	I	C	
Transport		BCIS PAFI plant and road vehicles (90/2)	I	C	

** Note: For columns "NERA" and "ED1", "C" indicates used to set a constant RPE and "I" indicates used for RPE indexation.*
Source: NERA analysis

We Use Mean-Adjusted Indices to Account for Persistent Differences Between DNO Unit Cost Growth and Benchmark Index Growth

Since Ofgem has decided to set RPEs using indexation, in the index selection process we attach weight to whether a benchmark index tracks the short term, year-on-year movements in DNO unit costs. By attaching more weight to this short term tracking, we necessarily attach less weight to whether the long-run average growth of the benchmark index aligns with the long-run average growth of DNO unit costs. The MSD metric that we use for index selection applies partial weight to both considerations.

As we attach more weight to short term tracking, there is a risk that the benchmark indices we select to set RPEs do not accurately reflect the long-run average growth in DNO unit costs. For example, the index "BCIS electrical - materials (3/E2)" tracks DNO transformer unit costs in the short term (correlation of 0.75), but its ten-year average growth is 3.24 percentage points below that of DNO unit costs. Such persistent differences in the long-run mean will cause RPEs based on the benchmark index to systematically over- or under-compensate DNOs for their unit cost growth.

In principle, the difference in the mean growth rate of DNOs' costs could result from (1) inefficiently high procurement costs of DNOs or (2) differences between the specific inputs used to calculate the benchmark index and the inputs used by DNOs. Of these two potential explanations, the latter is materially more likely. Differences in mean *growth rates* could only reflect the *rate* of efficiency improvement in DNOs' procurement relative to the inputs captured by the index, not the *level* of inefficiency. The assumption that a positive systematic difference in the mean growth rates of input costs results from DNO inefficiency would require that DNOs were becoming systematically less efficient in their procurement costs over time relative to the economy at large. If DNOs were inefficient historically and were catching-up to the economy at large, the mean historical growth in DNOs input costs would be below the benchmark index. By contrast, the precise products whose prices inform the calculation of the benchmark index are not fully known or described in available methodologies and will contain inputs not purchased by DNOs or weighted differently in DNOs' inputs from the index. The evolution of the any benchmark index may therefore systematically differ from DNOs' true inputs.

To correct the persistent difference in long-run means between indices and DNO unit costs, we apply a mean adjustment to our benchmark indices. The adjustment may be either positive or negative and brings the average growth of the index in line with the average growth of DNO unit costs. In the case of "BCIS electrical – materials (3/E2)", for example, it would reflect that the growth rate of transformer prices paid by DNOs is persistently above the growth rate of prices of electrical materials more broadly that are captured by the BCIS index.

We calculate the mean adjustment for each benchmark index using historical data on the index and historical data on DNO unit costs. We then construct a mean-adjusted index by adding or subtracting the mean adjustment to the index, as appropriate.

We Forecast RPEs for Each Input Cost Category Using Third-Party Forecasts and Historical Arithmetic Averages

We forecast RPEs from 2022 through 2028 for each of the input cost categories set out in Table 1. To produce these forecasts, we combine the forecast of CPIH inflation from Ofgem's Business Plan Data Template with forecasts of growth in the benchmark indices. We set the forecast of growth in each benchmark index equal to the historical arithmetic average growth of that index for most indices. For the specialist labour indices, we use forecasts of average earnings growth from the Office for Budget Responsibility (OBR). We take an unweighted average of the RPEs of the benchmark indices in each input cost category to get the RPE for the input cost category. Our forecasting approach follows that taken by Ofgem at previous RIIO-2 price controls.[5]

We set out forecast RPEs for each input cost category in Table 2.[6] We set out forecast RPEs for each input cost category, using mean-adjusted indices, in Table 3. We do not present mean-adjusted RPEs for Materials (opex), Plant and Equipment and Transport because we did not have access to sufficient DNO cost data for these categories of expenditure to calculate a mean-adjusted index. The forecasts are for financial years, so the forecast for 2022 is the forecast for the financial year ending March 2022.

For some sub-categories of costs and benchmark indices the mean-adjusted RPEs are lower than those without mean-adjustments. However, as can be seen from the Tables, the mean-adjusted RPEs are higher than the unadjusted RPEs for the three aggregated cost categories shown (general labour, specialist labour, and materials (capex)). These adjustments show that the historical evolution of DNOs' costs has, on average, exceeded the benchmark indices we have selected to estimate RPEs. If this pattern were to be repeated over RIIO-2, indexing DNOs' cost allowances by the unadjusted RPEs would systematically undercompensate DNOs for the evolution of their costs.

Table 2: RPEs by Input Cost Category

Category	2022	2023	2024	2025	2026	2027+
General labour	1.76%	1.46%	1.28%	1.12%	1.06%	1.06%
Specialist labour	1.40%	0.59%	0.98%	1.49%	0.88%	0.87%
Materials (capex)	1.89%	1.58%	1.40%	1.25%	1.19%	1.18%
Materials (opex)	2.85%	2.55%	2.37%	2.21%	2.15%	2.15%
Plant and Equipment	1.30%	1.00%	0.82%	0.67%	0.61%	0.61%
Transport	1.30%	1.00%	0.82%	0.67%	0.61%	0.61%

Source: NERA analysis

[5] See Appendix C.1 and Appendix C.2 for details.

[6] We apply the same RPE to both opex and capex within general and specialist labour. We do not distinguish between opex and capex within these labour cost categories for the purpose of setting RPEs as there is no clear guidance on how labour unit costs should be classified as opex and capex.

Table 3: Mean-Adjusted RPEs by Input Cost Category

Category	2022	2023	2024	2025	2026	2027+
General labour	2.80%	2.49%	2.31%	2.15%	2.09%	2.09%
Specialist labour	2.02%	1.21%	1.60%	2.11%	1.49%	1.49%
Materials (capex)	2.68%	2.37%	2.19%	2.04%	1.97%	1.97%

Source: NERA analysis

1. Introduction

In preparation for the RIIO-ED2 price control, the Energy Networks Association (ENA) commissioned NERA to provide independent expert advice and recommendations on real price effects (RPEs) for its members, the electricity distribution network operators (DNOs).

Ofgem sets allowances for DNOs in constant prices (i.e. in "real terms") at the beginning of each price control. Ofgem then indexes allowances to changes in general inflation, measured by the Consumer Price Index including owner occupiers' housing costs (CPIH), that occur over the applicable period. Changes in CPIH reflect, amongst other things, changes in factor input prices (materials, labour, etc.).

In reality, however, DNOs are subject to different cost pressures from those that show up in CPIH. The price of the mix of inputs that DNOs purchase rises or falls at a rate different from changes in CPIH. For instance, it is well-known that wages tend to rise faster than general inflation, at least over long periods of time. Materials prices may also rise and fall, such as with changes in supply and demand conditions in commodity markets. There are therefore a range of factors that lead the growth rate of input prices that DNOs face to differ from the rate of general inflation.

To account for this difference, Ofgem allows additional revenue to account for expected inflation in input prices over and above general inflation. Ofgem sets the additional revenue allowance in the form of RPEs for a number of DNO input cost categories. Ofgem calculates the RPE for each category based on forecasts of the growth in third-party benchmark price indices relevant to each category (e.g. indices tracking the growth in average earnings prepared by the Office of National Statistics).

For RIIO-ED1, Ofgem set RPEs for DNOs an ex ante basis, using forecasts based on historical average growth in the benchmark indices. There was no true-up mechanism.

For RIIO-ED2, Ofgem has decided to set RPEs using indexation to the benchmark indices.[7] This change in methodology means that certain factors are of increased importance when selecting benchmark indices to set RPEs for RIIO-ED2, in particular, the extent to which the indices reflect DNO cost pressures over the short term and the volatility of the indices.

This report sets out our recommended RPEs for RIIO-ED2, setting out both the methods we have employed and our results. Section 2 explains the background and regulatory precedent, including Ofgem's reasons for switching from ex ante RPEs to RPEs based on indexation. Section 3 sets out our selection of third-party indices. We produce forecasts of our selected indices in Section 4 and convert the index forecasts into RPE forecasts in Section 0. Section 6 presents a critical evaluation of the new methodology of RPE indexation, and Section 7 considers how RPEs set using this new methodology may be affected by economic shocks and structural shifts.

[7] Ofgem (17 December 2020), RIIO-ED2 Sector Methodology Decision: Annex 2 Keeping bills low for customers para 4.11 p 31

2. Background and Regulatory Precedent

Ofgem determines regulated network companies' price controls in constant prices and indexes them to changes in inflation. However, DNOs do not procure the same basket of goods that inflation indices such as the RPI or CPIH track. As a result, the input prices that DNOs face may be subject to price pressures that are not captured by general inflation indices. Ofgem allows companies to recover this difference through Real Price Effects (RPEs), defined as the differential between input price inflation and overall inflation as measured by the RPI or CPIH indices.

In the RIIO-ED1 determinations, Ofgem set an ex ante allowance for RPEs for the duration of the price control period by forecasting the input price pressure faced by DNOs based on a selection of indices. The selected indices were meant to reflect the external cost pressure for relevant inputs (labour, materials, equipment and plant, and others), relative to the economy, that are outside the DNOs' control. Ofgem set an ex ante allowance in order to ensure a stable regulatory environment and to avoid the challenges of designing an RPE index that would accurately track the companies' costs.[8]

Instead of setting an ex ante RPEs allowance for RIIO-T2/GD2, as it had done in previous price controls, Ofgem decided to index RPEs to the outturn values of selected indices, due to the perceived high risk of forecasting error. It has decided to also index RPEs for RIIO-ED2.[9]

RPEs are also used in other regulated industries. For example, at PR19 Ofwat decided to allow an RPE for labour costs. Ofwat set an ex ante RPE based on OBR forecasts but will apply a true-up at the end of the price control period based on outturn values of an input price index.

2.1. Ofgem Set Ex Ante RPE Allowances at RIIO-1

At the RIIO-1 controls, Ofgem set fixed, ex ante RPEs based on forecasts of RPEs for the entire eight-year price control period. Ofgem followed two different approaches for setting these RPEs depending on whether a company was fast-tracked or not. Ofgem allowed fast-tracked companies an ex ante RPE based on the forecasts included in the companies' Business Plans (i.e. it accepted companies' submissions), while Ofgem estimated its own RPEs forecasts for the slow-tracked companies.

To set RPEs for the slow-tracked companies, Ofgem calculated the forecast difference between a composite input price index for each category of inputs (labour, materials, equipment and plant, and transport and other) and RPI.[10] Ofgem constructed the composite input price index for each category based on a selection of independent input price indices Ofgem deemed representative of the types of inputs companies purchase. Table 2.1 summarizes the indices selected at RIIO-1.

[8] Ofgem (28 November 2014), – Reasons for our Decision on the Treatment of Real Price Effects for RIIO-ED1 Slow-Track Electricity Distribution Network Operators – Supplementary Annex, p. 6.

[9] Ofgem (17 December 2020), RIIO-ED2 Sector Methodology Decision: Annex 2 Keeping bills low for customers para 4.11 p 31

[10] Ofgem (27 July 2012), RIIO-T1/GD1 Real Price Effects and Ongoing Efficiency Appendix – Consultation, p. 6.

Table 2.1: Indices Selected in RIIO-1 for RPEs Allowances

Index	Source	Sector(s) applied in
RPI	ONS	ED, ET, GD, GT
Labour		
Average earnings index for private sector incl. bonus	ONS	ED, ET, GD, GT
Average weekly earnings (AWE) Private sector incl. bonus	ONS	ED, ET, GD, GT
AWE construction incl. bonus	ONS	ET, GD, GT
AWE transport and storage	ONS	ET, GD, GT
PAFI Labour and Supervision in Civil Engineering	BCIS	ED, ET, GD, GT
BEAMA labour cost index: electrical engineering	BEAMA	ED, ET
Materials – opex		
FOCOS Resource Cost Index of Infrastructure: Materials	BCIS	ED, ET, GD, GT
Materials – capex / repex		
PAFI Plastic Pipes and Fittings	BCIS	GD
PAFI Pipes and Accessories: Copper	BCIS	ED, ET, GD
PAFI Pipes and Accessories: Aluminium	BCIS	ED
PAFI Structural Steelwork - Materials: Civil Engineering Work	BCIS	ED, GD, GT
Equipment and plant		
PAFI Plant and road vehicles	BCIS	ET, GD, GT
Machinery & equipment (Output PPI)	ONS	ED, ET, GD, GT
Manufacture of machinery & equipment (Input PPI)	ONS	ET, GD, GT
Plant and road vehicles: providing and maintaining	BCIS	ED

Source: Ofgem (18 December 2018), RIIO-2 Sector Specific Methodology, p. 137, Table 11.
Note: ED, ET, GD, and GT stand for electricity distribution, electricity transmission, gas distribution, and gas transmission, respectively.

Ofgem noted that its selection of indices was influenced by the following considerations:[11]

- Ofgem did not differentiate between contractor and directly employed labour because it did not want to set differential real wage allowances based on the companies' preferred operational or contractual decisions;

[11] Ofgem (18 December 2018), RIIO-2 Sector Specific Methodology - Consultation, p. 138.

- Ofgem did not use company specific pay settlement data or energy sector real wage data to set RPEs. Rather it sought indices that it believed reflect external pressures on the costs of network companies, but which are outside their control;
- Ofgem did not use commodity prices as network companies purchase final manufactured goods, as opposed to raw materials;
- Ofgem did not provide RPEs for costs that represented a small proportion of total costs, as they were assumed to move in line with general inflation; and
- Ofgem did not apply regional RPE assumptions.

Ofgem calculated annual historical real input price index growth based on historical RPI and nominal price indices.[12] It then calculated the long-term average growth in the real input price index, using the shorter of: the maximum time horizon available, or data back to 1987.

To forecast real input price index growth for RIIO-1, Ofgem's primary approach was to set the forecast equal to the long-term trend. Where independent forecasts of input prices were available, Ofgem used these to forecast near-horizon real input price growth. For example, at RIIO-T1/GD1 Ofgem used Treasury (HMT) forecasts for the whole economy wage growth to set labour RPEs for 2012-13 and 2013-14, and the long-term historical average from 2014-15 onwards.

Where independent forecasts were not available, Ofgem extrapolated recent trends to forecast near-horizon real input price growth. For example, at RIIO-T1/GD1 for non-labour RPE assumptions, Ofgem calculated allowances for the second half of 2012-2013 based on the outturn data for the first half of 2012-13, and long-term historical averages from 2013-14 onwards.[13]

Ofgem took a simple average of the input price indices to create a composite index for each input category.

Ofgem then constructed a composite totex RPE by taking a weighted average of the composite indices for each input cost category. Ofgem set the weight on a cost category equal to the share of totex spent on a cost category (e.g. labour and materials). For T1, Ofgem constructed the weights using the companies' actual cost structures. For GD1 and ED1, Ofgem constructed the weights using a notional cost structure based on the average cost structures reported by companies in their Business Plans. For example, Table 2.2 shows the notional cost structure Ofgem used at ED1. In justifying its decision to use a notional cost

[12] More specifically, Ofgem made the following adjustment: $RPE_{C,t}(\%) = \frac{1+IPI_{C,t}(\%)}{1+RPI_t(\%)} - 1$, where:

$RPE_{C,t}(\%)$ is the real change in an input price index

$IPI_{C,t}(\%)$ is the percentage change in an input price index

$RPI_t(\%)$ is RPI, which is expressed in percentage change terms.

See: Ofgem (2018), RIIO-T1 Electricity Transmission Price Control – Regulatory Instructions and Guidance, p. 27

[13] Ofgem (17 December 2012), RIIO-T1/GD1 Real Price Effects and Ongoing Efficiency Appendix – Decision, pp. 8-13.

structure, Ofgem stated that it wanted to avoid rewarding potentially inefficient cost structures.[14]

Table 2.2: Ofgem's Notional Cost Structure for ED1 Slow Track Companies

	General labour	Specialist labour	Materials (capex)	Materials (opex)	Plant and equipment	Other
Totex	36%	31%	16%	4%	6%	8%

Source: ED1 Cost Assessment Files
Note: Ofgem calculated the weights on input categories within the composite totex RPE by multiplying together weights on input categories in each of six expenditure categories, and weights on the six expenditure categories in totex. The weights on input categories within expenditure categories are an average of the cost structure across Slow-Track companies only (i.e. excluding WMID, EMID, SWEST, SWALES which are WPD licensees). The weights on expenditure categories within totex are an average of the cost structure across all companies.

Ofgem used the resulting totex index to set ex ante allowances for the entire price control period (as opposed to indexing RPEs). At RIIO-1, Ofgem found that RPE indices generally exceeded RPI, and therefore allowed an RPE adjustment to increase companies' allowances. Table 2.3 shows Ofgem's RPE assumptions for each year. Ofgem increased or decreased the companies' allowed revenues for each year based on the RPEs shown in Table 2.3.

Table 2.3: Ofgem's RPE Assumptions for ED1 Slow Track Companies (%)

	2013-14	2014-15	2015-16	2016- 23
Totex	-	-1.4%	-0.3%	0.6%

Source: Ofgem (28 November 2014), RIIO-ED1: Final determinations for the slow-track electricity distribution companies, p.30.

2.2. Ofgem Has Decided to Index RPEs at the RIIO-2 Controls

For the RIIO-2 price controls, Ofgem has decided to index RPEs, i.e. to true-up RPEs allowance to the outturn value of selected indices. The Final Determinations for RIIO-T2/GD2 include RPE indexation. Ofgem has decided that it will index RPEs for the RIIO-ED2 price control in its Sector Specific Methodology Decision.[15]

Ofgem previously considered, but decided against, RPE indexation at RIIO-1. At the time of the RIIO-1 Final Determinations, Ofgem's primary concern was the risk of "unintended consequences" arising from the complexity of indexation, as discussed in Section 2.2.1 below.

Ofgem has decided in favour of RPE indexation at RIIO-2. Its primary reason for indexing RPEs is the risk of forecasting error with setting ex ante allowances, and the associated risks for consumers. Specifically, as we discuss in Section 2.2.2, Ofgem found that ex ante RPE allowances significantly overestimated outturn RPEs for RIIO-GD1 and TI price controls.

[14] Ofgem (18 December 2018), RIIO-2 Sector Specific Methodology - Consultation, p. 138.

[15] Ofgem (17 December 2020), RIIO-ED2 Sector Methodology Decision: Annex 2 Keeping bills low for consumers, p. 29

2.2.1. Ofgem considered, but decided against, RPE indexation at RIIO-1

At RIIO-1, Ofgem identified four factors as the basis for its decision to set a fixed ex ante allowance for RPEs, rather than to use RPE indexation:[16]

- *Differences in Risk*: Ofgem mainly considered the risk of forecasting error when setting an ex ante allowance and whether RPE indexation would mitigate it. It determined that although indexation would likely reduce forecast error, the size of the reduction depends on its ability to choose input price indices that appropriately reflect changes in DNOS' costs.
- *Impact on Incentives*: Ofgem stated that indexation could reduce companies' incentives to be efficient if the index is inappropriately affected by the actions DNOs take (i.e. if it reflects only the movement in the DNO's input costs). It noted that the indices chosen for an ex ante allowance would not be subject to these movements if used for indexation, but that an ex ante allowance provides greater certainty for DNOs to plan and optimise their procurement and contracting strategies.
- *Predictability*: Ofgem considered that indexation would lead to charges being more volatile and less predictable. Ofgem opted for an approach that would minimise the number of changes to revenues and charges. Furthermore, indexation would introduce a lag between the change in the input's price and its impact on RPE allowances.
- *Complexity and Unintended Consequences*: Ofgem noted that indexation would increase the complexity of the price control framework. This complexity could be reduced by using a lower number of indices at the cost that more indices diversify risk. Ofgem believed that without substantive testing of the RPE index, the added complexity from this approach could increase the risk of unintended consequences.

Ofgem did not explicitly weigh the factors mentioned above. It did, however, note that it decided to retain an ex ante allowance due to a significant risk of unintended consequences from designing an RPE indexation mechanism and the importance of stable regulation.

2.2.2. Ofgem's evaluation of forecast risk during RIIO-1

For the RIIO-2 price controls, Ofgem proposed RPE indexation "to mitigate the impact of uncertainty at the level of input price inflation in RIIO-2".[17] This follows Ofgem's assessment that "input price inflation has been lower than forecast [for RIIO-1] and this has had a material impact on companies' costs and returns".[18] Cambridge Economic Policy Associates (CEPA) has estimated the effect on RIIO-1 outperformance due to RPEs.[19] Figure 2.1 from CEPA's report shows the difference between the outturn indices used to set RPE allowances at RIIO-GD1, RIIO-T1, and RIIO-ED1, as compared to the forecasts Ofgem made when setting allowances.

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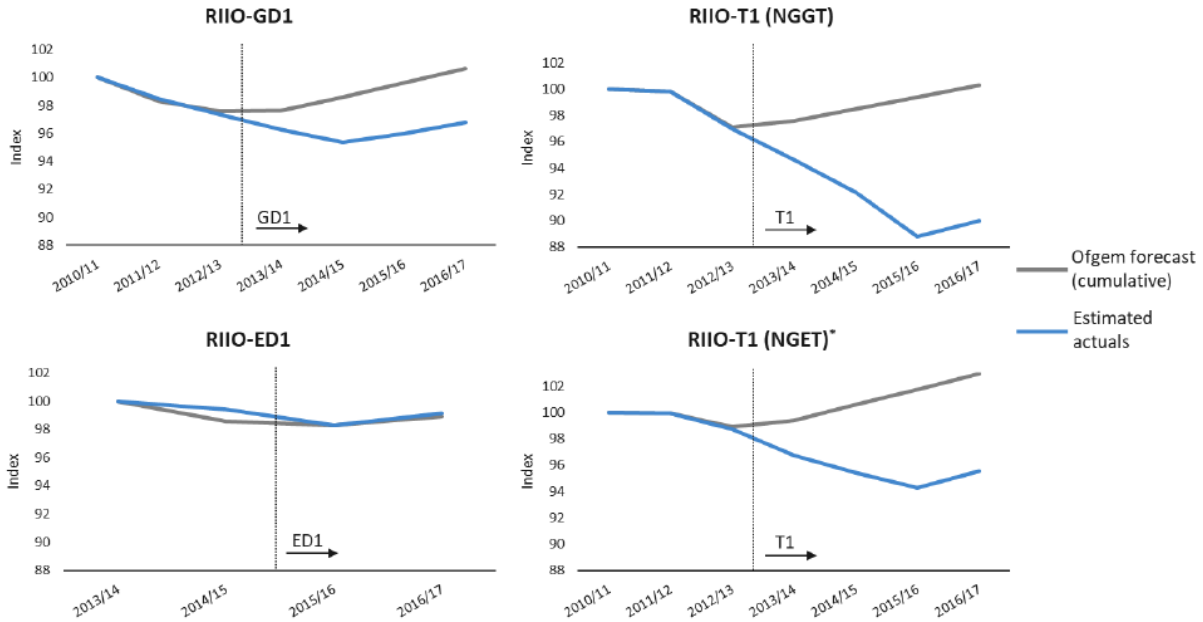
16 Ofgem (28 November 2014), – Reasons for our Decision on the Treatment of Real Price Effects for RIIO-ED1 Slow-Track Electricity Distribution Network Operators – Supplementary Annex, pp. 6-9.

17 Ofgem (8 December 2018), RIIO-2 Sector Specific Methodology, p. 58

18 Ofgem (28 September 2018), RIIO-2 Business Plans Initial Guidance Document, p. 10

19 CEPA (March 2018), Review of the RIIO Framework and RIIO-1 Performance.

Figure 2.1: Difference Between Ofgem's Forecast and Outturn RPE Indices



Source: CEPA (March 2018), Review of the RIIO Framework and RIIO-1 Performance, p. 27
Note: We understand that Figure 2.1 uses the average of the indices used to set allowed RPEs in each price determination, but we cannot confirm this from the CEPA report.

Ofgem employed a similar methodology to forecast RPEs and set RPE allowances at RIIO-ED1, RIIO-T1, and RIIO-GD1, but these price control determinations took place at different times, as indicated by the dotted grey vertical lines in Figure 2.1. Ofgem selected different indices in each determination, leading to the different comparisons of outturn and forecast RPEs in Figure 2.1.

Figure 2.1 shows that outturn RPEs have been predominantly below Ofgem's forecasts for GD1 and T1 but have been close to Ofgem's forecasts for ED1. In fact, CEPA's estimated actuals were slightly higher than Ofgem's forecast for ED1, as can be seen in the downward left part of Figure 2.1. CEPA further estimates the impact of this difference on companies' out/under performance:

- "RIIO-T1 (electricity) – RPEs account for around 80 basis points of additional RoRE [Return on Regulatory Equity] for NGET [National Grid Electricity Transmission] over the first four years of the price control period.
- RIIO-T1 (gas) – RPEs account for around 40 basis points of additional RoRE for NGGT [National Grid Gas Transmission] (TO only) over the first four years of the price control period.
- RIIO-GD1 – RPEs account for around 70 basis points of additional RoRE across the GDNs [Gas Distribution Networks] (on a weighted average basis) over the first four years of the price control period.

- RIIO-ED1 – RPEs broadly had a neutral impact on RoRE over the first two years of the price control period."[20]

This analysis by CEPA compares outturn values of the input price indices with Ofgem's forecast values of the price indices. It does not consider data on companies' actual input price pressures. Therefore, the analysis only tests the accuracy of the index forecasts; the analysis does not test whether the selected indices reflect companies' input cost pressures. CEPA recognises this and caveats its analysis accordingly, describing RPEs as a "regulatory construct" that do not necessarily reflect companies' input costs, which may vary independently from RPEs depending on factors such as companies' approach to contracting for labour, materials, and equipment.[21]

2.2.3. Ofgem's approach to RPEs at RIIO-T2/GD2

In its Final Determination Document, Ofgem set out the details of RPE indexation in the RIIO-T2/GD2 price controls.[22] Ofgem decided to forecast RPEs, but to update allowances annually to reflect the outturn values of the selected indices, and to replace its RPI inflation index with the CPIH. Hence, it set upfront RPE allowances at the RIIO-T2/GD2 price control that will be updated annually.

Ofgem cites four reasons for its decision to update RPE allowances annually:

- "It will provide a better balance of charges between existing and future consumers by enabling a more frequent recalibration of allowances, within-period.
- It will reduce risk and volatility compared to an ex ante approach and reduce any final true-up.
- It will provide us with the opportunity to update forecasts for RPEs annually using the latest available RPE price indices.
- It will better facilitate other aspects of our framework, such as reporting a more up to date RoRE, reflecting allowances updated for RPEs."[23]

Ofgem also introduced a materiality threshold based on its consultant's, CEPA's, cost assessment analysis. CEPA followed a two-step test, which Ofgem adopted on its Final Determination:[24]

- Identifying cost categories that represent a relatively large share of totex; and
- Identifying cost categories that would likely face relatively large movements over time.

In its February 2021 Final Determination Ofgem set a materiality threshold of 10 per cent of totex for RPE allowances. That is, cost categories that represent more than 10% of totex merit an RPEs allowance. In addition, Ofgem also applied an RPE allowance when the cost

[20] CEPA (March 2018), Review of the RIIO Framework and RIIO-1 Performance, p. 27.

[21] CEPA (March 2018), Review of the RIIO Framework and RIIO-1 Performance, p. 27.

[22] Ofgem (03 February 2021), RIIO-2 Final Determinations – Core Document (REVISED), p. 66

[23] Ofgem (24 May 2019), RIIO-2 Sector Specific Methodology – Core document, p. 70

[24] Ofgem (30 July 2020), RIIO-ED2 Sector Methodology Consultation, p. 42.

category makes up at least 5 per cent of totex *and* the expected impact of real price movements in the category represents at least 0.5 per cent of totex.[25]

As in RIIO-1, Ofgem used the "notional" company to set weights for each cost category when estimating its composite RPE index. In its February 2021 Final Determination, it set a list of indices to be used for RIIO-T2/GD2, and the weights placed on each index (for the specific input category). Table 2.4 shows the selected indices and weights for each category of input. As can be seen in Table 2.4, Ofgem used an unweighted average of the indices selected for each input cost category.[26]

Table 2.4: RPE Input Price Indices and Weightings for RIIO-T2/GD2

Index	GD	NGGT	NGET	SHET	SPT
Labour	**100%**	**100%**	**100%**	**100%**	**100%**
AWE: private sector (K54V)	33.3%	33.3%	25%	25%	25%
AWE: construction (K553)	33.3%	33.3%	25%	25%	25%
BCIS PAFI civil engineering (4/CE/01)	33.3%	33.3%	25%	25%	25%
BEAMA: electrical engineering	NA	NA	25%	25%	25%
Materials	**100%**	**100%**	**100%**	**100%**	**100%**
BCIS 4/CE/24 Plastic Products (including pipes)	33.3%	NA	NA	NA	NA
BCIS 3/S3 Structural steelwork – Materials: Civil Engineering Work	33.3%	50%	NA	NA	NA
BCIS 4/CE/EL/02 Electrical engineering materials	NA	NA	50%	50%	50%
BCIS FOCOS: Resource Cost Index of Infrastructure: Materials (7467)	33.3%	50%	50%	50%	50%
Equipment and plant	**NA**	**NA**	**NA**	**100%**	**NA**
PAFI Plant and road vehicles (1702)	NA	NA	NA	50%	NA
ONS Machinery & equipment output PPI (K389)	NA	NA	NA	50%	NA

Source: Ofgem (03 February 2021), RIIO-2 Final Determinations, p.67.

Nine companies have appealed the RIIO-2 Final Determinations.[27] None of these companies have appealed on RPEs specifically, but RPEs are mentioned in all but two of the appeals.[28]

The only appeal which could result in changes to Ofgem's approach to RPEs is the appeal by Wales and West Utilities Ltd (WWU). WWU mentions RPEs in the context of an argument

[25] Ofgem (03 February 2021), RIIO-2 Final Determinations, p. 67.

[26] While the approach is technically unweighted, it does provide implicit weights for certain cost categories. For example, for GDNs Ofgem places equal weights across two generalist and one specialist labour indices, meaning that Ofgem is assuming that the generalist labour force forms 66.6% of total labour and specialists form 33.3%. Likewise, Ofgem is assuming that specialists form a 25% of TO's total labour force.

[27] CMA (5 March 2021), Energy Licence Modification Appeals, https://www.gov.uk/cma-cases/energy-licence-modification-appeals-2021 (last accessed 22 March 2021)

[28] There is no mention of RPEs in either Scottish Hydro Electric Transmission's appeal or SP Transmission's appeal.

that the Ongoing Efficiency (OE) challenge is set too high. It argues that Ofgem's approach of setting the OE challenge ex ante based on historical labour productivity is inconsistent with the indexation of RPEs to outturn wage data, due to the economic link between labour productivity and real wage growth.[29] If the CMA accepts this argument, Ofgem may be required to align its treatment of both, either by indexing OE to outturn labour productivity or by setting RPEs ex ante.

The remaining six appeals that mention RPEs do so in the context of arguments relating to other aspects of the price control. These arguments are unlikely to result in changes to Ofgem's approach to RPEs.[30]

2.3. Ofwat Applied Labour RPEs at PR19 with a True-Up at the End of the Price Control

In its Final Determination for the PR19 price control, Ofwat indexed base cost allowances to CPIH, and set an RPE adjustment for labour costs only. Ofwat set the RPE adjustment ex ante based on the Office for Budget Responsibility's (OBR's) forecasts but will apply a true-up at the end of the price control period to reflect outturn labour cost growth. The Competition and Markets Authority (CMA) reviewed Ofwat's approach to RPE adjustments at PR19, following appeals, but did not make any changes to Ofwat's approach.[31, 32]

When developing RPEs for the PR19 price control, Ofwat and its consultants Europe Economics (EE) considered four candidate input cost categories for the application of RPE adjustments: labour, energy, chemicals, and "Materials, Plant, and Equipment" (MP&E). EE used three criteria to determine whether an RPE adjustment was appropriate for a given cost category and assessed each criterion on a pass/fail basis. If a cost category failed any one criterion, EE determined that an RPE adjustment was not appropriate.[33] The criteria are:[34]

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29 Gowling WLG (5 March 2021), In the matter of an appeal under section 23B of the Gas Act 1986 between Wales & West Utilities Limited and The Gas and Electricity Markets Authority: Notice of Appeal (non-confidential version), Article E9.5

30 National Grid Electricity Transmission and National Grid Gas Transmission (NGET and NGGT respectively, together National Grid) mention RPEs in the context of an appeal on Ofgem's decision to not "aim up" when choosing a point estimate for the Cost of Equity (COE). National Grid states that one reason given by Ofgem against aiming up is that RPE indexation protects licensees against changes in input prices; National Grid argues that RPEs "help mitigate specific risks related to input price variations" and cannot address "the harm aiming up seeks to avoid". Southern Gas Networks and Scotland Gas Networks (together SGN) mention RPEs in the context of an appeal on Ofgem's decision to set the efficiency benchmark higher than the upper quartile. They note that one reason given by Ofgem for setting a high efficiency benchmark is outperformance at GD1. They argue that 57 per cent of totex outperformance at GD1 was driven by RPE allowances, and that since Ofgem has already proposed a solution to this in the form of RPE indexation, it is inappropriate for Ofgem to expect that high levels of outperformance could be repeated at GD2. Northern Gas Networks mentions RPEs in the context of an appeal on the outperformance wedge, making similar arguments to SGN. Cadent mentions RPEs in passing, as background to the discussion in their appeal on Ongoing Efficiency.

31 CMA (29 September 2020), Anglian Water Services Ltd., Bristol Water plc., Northumbrian Water Ltd. and Yorkshire Water Services Ltd. price determinations: Provisional Findings. Section 4.452

32 CMA (17 March 2021), Anglian Water Services Ltd., Bristol Water plc., Northumbrian Water Ltd. and Yorkshire Water Services Ltd. price determinations: Summary of Final Determinations. Section 37(b)

33 For criterion 1, which has two sub-criteria 1A and 1B, Europe Economics determined that the cost category failed criterion 1 if it failed on both 1A and 1B.

34 Ofwat (December 2019), PR19 final determinations: Securing cost efficiency technical appendix, p. 200

1. Is there a significant likelihood that the value of the wedge between the input price and CPIH will differ substantially from zero over the period of the price control?

   A. Is the expected value of the wedge between the input price and CPIH materially different from zero?

   B. Does the wedge between the input price and CPIH exhibit high volatility over time?

2. Are there sufficient and convincing reasons to think that CPIH does not adequately capture the input price?

3. Is the input price and exposure to that input price outside management control during the duration of the price control?

All four cost categories passed criteria 2 and 3. Energy, chemicals, and MP&E failed on both 1A and 1B, while labour passed 1A.[35] Therefore, Ofwat only set an RPEs adjustment for the labour cost input category. Specifically, Ofwat set an ex ante RPE adjustment for the price control period based on the OBR's real hourly wage growth forecasts. Ofwat will true up the labour RPE adjustment at the end of the period, using the Office for National Statistics' (ONS's) Annual Survey of Hours and Earnings (ASHE Median Hourly Earnings for All Employees).[36]

Ofwat determined that such a true-up for labour costs is necessary because "the OBR has systematically overestimated average earnings growth and therefore reliance on these forecasts could lead to an upward bias" in RPE adjustments.[37] Ofwat determined that the ASHE Median Hourly Earnings for All Employees manufacturing wage index is the appropriate index for the true-up for three reasons:

- "manufacturing and water sector labour markets are similar and often involve similar skills and expertise";
- "manufacturing wages also show a close correlation to water sector wage growth";
- "the ASHE Median Hourly Earnings for All Employees…provides wages on an hourly basis which allows for the real price effect to be isolated", whereas the Average Weekly Earnings (AWE) index used by Ofgem to set RPE adjustments is also affected by changes in hours worked.[38]

Ofwat has used a notional cost structure in its PR19 determination, in the sense that it applied the labour RPE to 38.6 per cent of costs, which is representative of the average share of

[35] The appeals to the CMA argued first, that Europe Economics' criteria were not appropriate to determine whether an RPE adjustment was necessary, and second, that other cost categories (particularly energy) met the criteria. The CMA dismissed both arguments. See CMA (29 September 2020), Anglian Water Services Ltd., Bristol Water plc., Northumbrian Water Ltd. and Yorkshire Water Services Ltd. price determinations: Provisional Findings, p. 187-204

[36] Specifically, Ofwat will use the following index for the true-up: ASHE Median Hourly Earnings for All Employees all employees, mean manufacturing hourly wages, including overtime. See Ofwat (December 2019), PR19 final determinations: Securing cost efficiency technical appendix, p. 210

[37] Ofwat (December 2019), PR19 final determinations: Securing cost efficiency technical appendix, p. 196

[38] Ofwat (December 2019), PR19 final determinations: Securing cost efficiency technical appendix, p. 196

labour costs in base expenditure across the industry, based on company submissions.[39] The choice to use a notional cost structure is not discussed by either Ofwat or the CMA.

The CMA determined that Ofwat's use of criteria to decide which cost categories required an RPE was appropriate, as it "provides a reasonable balance between using RPEs when the evidence clearly demonstrates that it is necessary without overcomplicating the assessment".[40] The CMA determined that the three criteria used by EE captured the cost items where an RPE adjustment would be necessary. The CMA considered adding a materiality criterion, but decided against it because "it would not change our decisions".[41] The CMA reviewed the application of EE's criteria to each of the four cost categories, and also found that an RPE was warranted for the labour cost category only.

[39] Ofwat (December 2019), PR19 final determinations: Securing cost efficiency technical appendix, p. 197

[40] CMA (29 September 2020), Anglian Water Services Ltd., Bristol Water plc., Northumbrian Water Ltd. and Yorkshire Water Services Ltd. price determinations: Provisional Findings. Section 4.411

[41] CMA (29 September 2020), Anglian Water Services Ltd., Bristol Water plc., Northumbrian Water Ltd. and Yorkshire Water Services Ltd. price determinations: Provisional Findings. Section 4.415

3. Selection of Benchmark Indices

In this section we describe the procedure by which we select indices for our RPE analysis. This procedure has two stages.

1. First, we develop a list of candidate indices for consideration based on regulatory precedent, relevance to DNO unit costs, and data quality.

2. We then select a subset of indices from this list based on a set of pre-defined criteria. This selection process includes a quantitative assessment of the extent to which a given index tracks DNO unit costs, based on unit cost data provided to us by DNOs. It also considers regulatory precedent, index volatility, and relevance to the cost category for which the index is used.

Our final index selection includes indices that have historically been used by Ofgem to set RPEs, and additional indices identified through the selection process described above.

3.1. Data Sources for Benchmark Indices and Forecasts

To get data on benchmark indices, we use three sources that Ofgem and other regulatory bodies (e.g. Ofwat, the CMA) have previously used to set RPE allowances. These three sources are:

- the Office for National Statistics (ONS),
- the Building Cost Information Service (BCIS) provided by the Royal Institute for Chartered Surveyors (RICS), and
- the British Electrotechnical and Allied Manufacturers' Association (BEAMA).[42]

We collect short-term forecasts of some indices from external sources. We use forecasts for CPIH as set out by Ofgem in the Business Plan Data Template (BPDT) for RIIO-ED2.[43] We also rely on short-term forecasts of average, economy-wide earnings growth from the Office of Budget Responsibility (OBR). Ofgem used OBR forecasts of economy-wide earnings growth at RIIO-GD2 to forecast labour indices used to set RPE allowances. We also use the OBR forecasts for this purpose.

3.2. Criteria for Setting an RPE

We recognise that Ofgem has set a "high evidential bar" for the use of RPEs, requesting DNOs to "produce robust evidence of why general consumer price inflation is not an adequate proxy" for their unit costs.[44] In particular, Ofgem has instructed DNOs to provide

[42] In previous price controls, Ofgem also relied on data from BIS (the Department for Business Innovation and Skills, superseded by BEIS). BIS data has largely been transferred to the ONS and BCIS.

[43] Ofgem (2021), Business Plan Data Template version 4.2. Tab "I1 – Universal Data". These financial year forecasts are calculated from calendar year forecasts produced by the Office for Budget Responsibility (OBR) in November 2020.

[44] Ofgem (17 December 2020), RIIO-ED2 Sector Methodology Decision: Annex 2 Keeping bills low for consumers, para. 4.2 p 30

"clear evidence of a sustained and material deviation" between input costs and CPIH.[45] We explicitly address this requirement in our index selection procedure as follows:

- For input cost categories where DNO unit cost data is available, we only set an RPE where analysis of historical data shows that the benchmark index consistently outperforms CPIH in tracking DNO unit costs.
- For input cost categories where DNO unit cost data is not available, we only set an RPE where analysis of historical data shows a statistically significant difference between the long-run mean of the proposed benchmark index and CPIH.

3.3. Criteria for Index Selection

We evaluate a range of candidate price indices against the following criteria:

1. *Relevance to electricity distribution costs:* are the inputs covered by the price series wholly or substantially used by DNOs, or do they provide proxies for the inputs they use? To what extent does the movement of the index reflect the movement of DNO input costs?
2. *Data quality:*
   A. *Length of historical time series*: A longer time series means we have more data to evaluate the relevance of a benchmark index to DNO unit costs. As a broad rule of thumb, we consider we require at least 10 years of data to identify relevance.
   B. *Sample size*: All price indices are based on sampling of prices charged for goods or services. If indices are constructed based on a large sample size, i.e. a large number of goods and services are used, it means the growth rate of the price index may better reflect the underlying growth rate in the input cost category rather than a growth rate specific to an individual goods/service provider. Although data providers do not publish the sample size for many series, in general, price indices for broad sectors of the economy (e.g. average earnings in the private sector) will be based on larger sample sizes than more narrowly defined sub-sectors (e.g. highly specialised materials cost indices).
3. *Volatility of the time-series*: We also consider the volatility of the benchmark indices. In the context of indexation, a volatile index would result in a volatile RPE and thus volatile allowances. This would increase the difficulty of financial planning for DNOs and expose them to greater risk, which would ultimately be passed on to consumers. Hence, we measure the standard deviation of each series' annual RPE growth (relative to CPIH), and typically we would not recommend any which are especially volatile.
4. *Regulatory precedent:* We consider whether indices have been used to set RPEs in any of the following recent price controls: Ofgem's RIIO-T2/GD2 and RIIO-ED1, and the CMA's decision on Ofwat's PR19 price control.
5. *Feasibility:* It is not feasible to provide an RPE for each unit cost item that DNOs purchase. Therefore, we only consider RPEs for cost categories that constitute a material (i.e. large) portion of DNO costs. We consider that each of input cost categories in Ofgem's Business Plan Data Template is sufficiently material to warrant an RPE, but we

[45] Ofgem (22 April 2021), RIIO-ED2 Business Plan Guidance, para 5.43 p 50

do not attempt to set an RPE for the "Other" costs category. We also recognise that Ofgem needs to be able to evaluate the RPE in every year. We therefore limit the number of benchmark indices selected per category, and only consider benchmark indices from sources that we know Ofgem has access to.

Based on our analysis of each index against the above criteria, we then select the most relevant indices for each cost category.

Ofgem has imposed an independence criterion in the past, excluding indices such as BEAMA's CPA for Large Power Transformers (BLT) on the basis that since DNOs are the primary purchasers of such items, they have the ability to influence the index.[46] We do not use independence as a criterion for index selection. This criterion is unnecessary, because the DNOs consist of six separate groups and transmission companies may also purchase similar inputs. Therefore, even if energy networks in Great Britain were the sole purchasers of a given input, no single DNO has the ability to influence the price index. While the DNOs do not directly compete with each other for customers, Ofgem's benchmarking of costs means that they do effectively compete to source inputs at the lowest cost. This means that individual DNOs do not have an incentive to pay more for, for example, large power transformers in order to increase the index that sets a portion of their RPE allowances. (In any case, Ofgem sets ex ante allowances by benchmarking DNOs against one another and does not suggest that benchmarking discourages cost reduction by the industry as a whole. It is unclear why the same argument would not apply to RPE allowances).

We apply the criteria described in Section 3.3 to select indices that we propose Ofgem should use to set RPE allowances. We use the criteria according to the following procedure.

First, we identify a set of indices for closer consideration in each input cost category on the basis of regulatory precedent, relevance, sample size, and data length. For each cost category, we consider all indices that were used at RIIO-ED1 or RIIO-T2/GD2. We identify a number of additional indices that have either been used in other regulatory contexts, or that we deem potentially relevant to the input cost category based on the name of the index and the description of the sample used to construct the index. We exclude any index that has been, or will in the near future be, discontinued; or for which less than ten years of data are available.

Second, having identified the set of indices for consideration we formally evaluate them on the basis of relevance. Our formal evaluation also explicitly considers whether there is a need for an RPE, based on the criteria established by Ofgem and set out in Section 3.2.

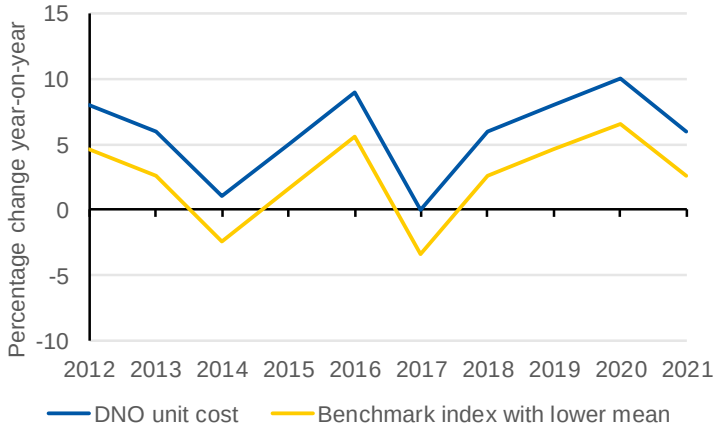
We evaluate relevance by comparing the price index data series to a series of DNO average unit costs, based on data provided to us by the DNOs. We use two metrics in the evaluation. The first is statistical, while the second is nominal and corrects for any risk of coincidental statistical relationships between data series.

The first metric we use is the Mean Squared Deviation (MSD) of the index growth relative to the growth DNO unit costs. This measure penalises a benchmark index if any of the following are true:

[46] CEPA (27 November 2020), RIIO-GD2 and T2: Cost Assessment – Advice on Frontier Shift policy for Final Determinations prepared for Ofgem, p. 68

- **It has a long-run mean growth that differs from the long-run mean growth of DNO unit costs.** An index that is relevant to the DNO unit cost should have a mean RPE that is close to the mean RPE of the DNO unit cost. If the mean RPE of the benchmark index is lower, then it will systematically under-compensate DNOs for the price pressures they face for those inputs. For example, in Figure 3.1 the hypothetical benchmark index has lower mean growth than the hypothetical DNO unit cost series, so an RPE based on the this index would under-compensate DNOs for unit cost growth.

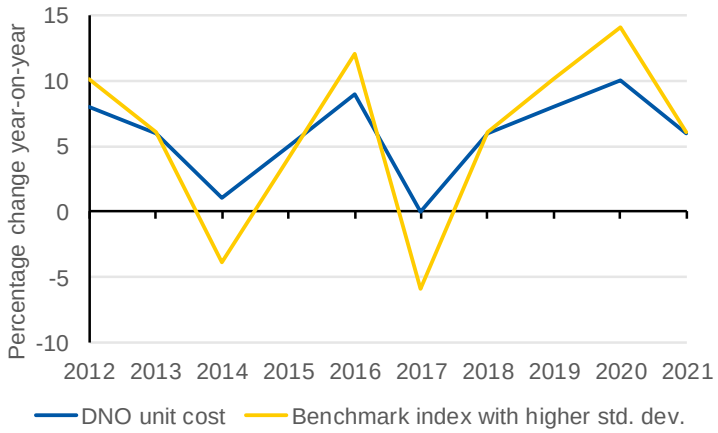
Figure 3.1: Stylised Illustration of Difference in Long-run Mean Growth



Source: NERA analysis.

- **The index growth is more volatile than that of DNO unit costs, i.e. it has a higher standard deviation.** An index that is relevant to the DNO unit cost should have an RPE with standard deviation that is close to the standard deviation of the RPE of the DNO unit cost. For example, in Figure 3.2 the standard deviation of the hypothetical benchmark index exceeds the standard deviation of the hypothetical DNO unit cost series, so an RPE based on this benchmark would be inaccurate. An RPE based on this benchmark would be too low in 2014 and 2017, but too high in 2016 and 2020.

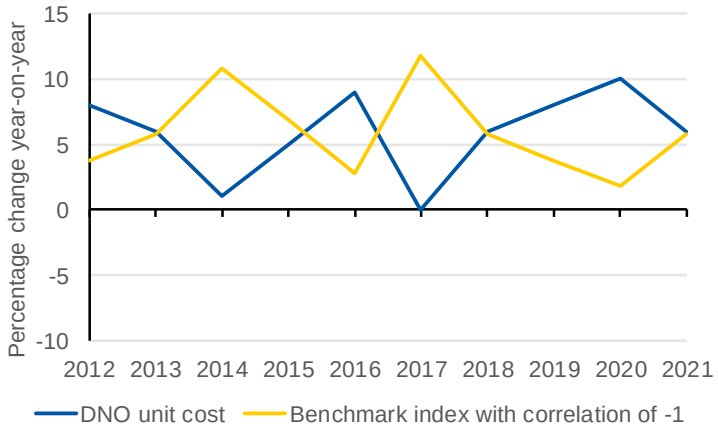
Figure 3.2: Stylised Illustration of Difference in Standard Deviation



Source: NERA analysis.

- **The year-on-year movements of index growth differ from the year-on-year movements of DNO unit cost growth (i.e. weak correlation).** Correlation is a measure of similarity of the movements of two price series, relative to their own means. Correlation can be thought of as measuring the *direction* of movements away from the mean, whereas volatility measures the *size* of those movements. A high, positive correlation (close to the maximum of 1) means that two series are likely to move up or down together. For example, Figure 3.1 and Figure 3.2 show positively correlated series. A negative correlation (between 0 and the minimum of -1) means that series move in opposite directions more often than not. For example, Figure 3.3 shows two negatively correlated series. A correlation of zero means that there is no discernible relationship between the two series. An index that is relevant to the DNO unit cost should have growth that is positively correlated with the growth of the DNO unit cost.

Figure 3.3: Stylised Illustration of Weak Correlation



Source: NERA analysis.

We calculate the MSD using growth data from 2012-2021 inclusive, i.e. ten observations on growth.[47] In general, a lower MSD means that the index is more relevant to DNO unit costs. We compare the MSD for each index with the MSD for CPIH, each calculated with respect to a particular DNO unit cost. An MSD for the index below the MSD for CPIH indicates that the index is more relevant to DNO unit costs than is CPIH, and is therefore a better proxy for DNO unit cost growth than CPIH.

We also consider nominal relevance. That is whether the sample used to construct the index would plausibly be related to the DNO unit cost series in question. For example, if looking at a DNO unit cost for wood poles, the price index "ONS Wood, Sawn and Planed (JU89)" has higher nominal relevance than the price index "BEAMA CPA Large Power Transformer (BLT)". This is because wood poles are more similar in terms of raw materials and processing to sawn and planed wood than they are to large power transformers, so it is more plausible that in general the prices of wood poles behave in a similar way to "ONS Wood, Sawn and Planed (JU89)" even if, over the ten year sample we use, this index does not

[47] The formula for the MSD is: $MSD_{ic} = \frac{1}{T}\sum_t (IPI_{it} - DNO_{ct})$. Here T is the number of years of growth data considered, i.e. 10. IPI_{it} is the growth rate of benchmark index i in year t, and DNO_{ct} is the growth rate of DNO unit cost item c in year t. MSD_{ic} is then the MSD of index i with respect to DNO unit cost category c.

perform as well in terms of MSD as "BEAMA CPA Large Power Transformer (BLT)". Given that we are relying on a time series of only ten years to construct our statistical metric, it is important to also consider this nominal metric, to avoid selecting price indices that are coincidentally statistically similar to the unit cost of interest. Even with a large dataset, given enough benchmark indices, a failure to consider nominal relevant would risk identifying indices that were spuriously correlated with costs.

The relevance metrics described above are our primary means of selecting indices.

Where we cannot construct the MSD due to lack of DNO unit cost data, we rely on nominal relevance and regulatory precedent to select indices. Where a series has already been used to set RPEs for DNOs, this provides continuity which may be valuable if, for example, supplier contracts are linked to indices that had previously been used to set RPEs.

3.4. Index Selection for Each Input Category

3.4.1. Whole economy price growth

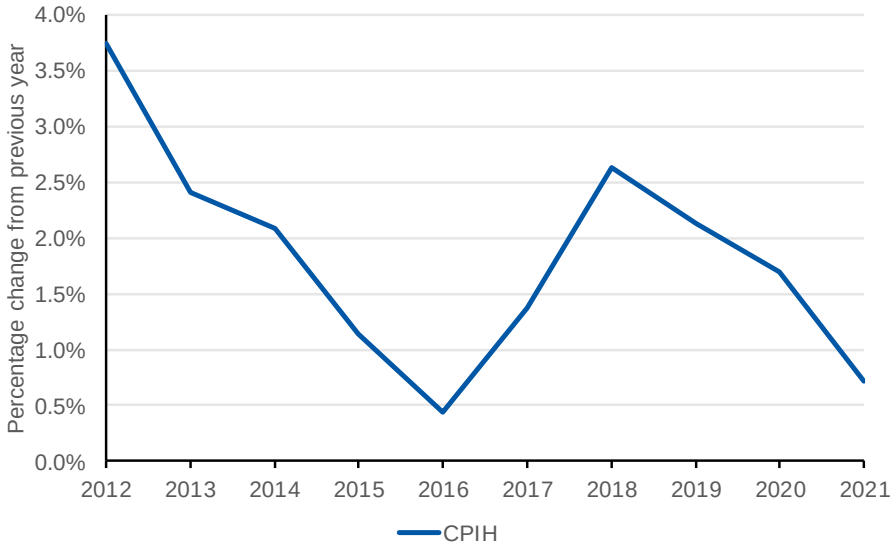
RPEs capture the additional price growth for a particular unit cost, over and above the price growth in the economy as a whole. It is therefore necessary to have a measure of price growth in the economy as a whole in order to construct RPEs.

At previous price controls, Ofgem has used RPI to measure price growth in the broader economy. For RIIO-2, Ofgem intends to use CPIH to measure price growth in the broader economy.[48] This is consistent with a general movement away from RPI and towards CPIH for regulation of the energy sector.

We therefore use CPIH as our measure of price growth in the broader economy. We construct all historical RPEs relative to CPIH, as it is the RPE relative to CPIH that will be of interest for forecasting purposes.

[48] Ofgem (17 December 2020), RIIO-ED2 Methodology Decision: Overview, p. 103

Figure 3.4: Historical Year-on-Year Growth in CPIH



3.4.2. Materials index selection

Based on the first stage of the selection process described at the beginning of this section, we identify nineteen indices that could be used to set RPEs for the materials (opex) and materials (capex) input cost categories. All nineteen indices are listed in Table 3.1 and Table 3.2.[49]

[49] We use two tables for ease of presentation, given the relatively large number of indices.

Table 3.1: Materials Indices Considered (part 1)

Data Provider	Series Name	Series ID	Reason for consideration
BCIS	RCI Infrastructure Materials	FOCOS RCI	Used at ED1
BCIS	Pipes and Accessories: Copper	3/58	Used at ED1
BCIS	Pipes and Accessories: Aluminium	3/59	Used at ED1
BCIS	Structural Steelwork Materials: Civil Engineering Work	3/S3	Used at ED1
BEAMA	CPA Basic Electrical Equipment Index	BEE	Name/sample suggest relevant to electricity distribution costs
BCIS	Electrical Installations – Cost of Materials	2/E2	Name/sample suggest relevant to electricity distribution costs
BCIS	Electrical – Materials	3/E2	Name/sample suggest relevant to electricity distribution costs
BCIS	Electrical Engineering Materials	4/CE/EL/02	Used at ET2 to replace BCIS 3/58, which CEPA/Ofgem deemed not relevant to transmission costs based on company submissions

Source: NERA analysis

To evaluate these indices against the relevance criterion, we collect data on unit materials costs from DNOs. We only use data where we have a series of sufficient length (i.e. at least ten years of data), and where we have data from at least three DNO groups. To assess the relevance of the price indices listed above to materials costs, we identify three unit cost series.

- The first unit cost series reflects the cost of 12m stout wood poles. We take the growth of costs of these wood poles as indicative of the growth of costs of wood poles and structural elements of the electricity network more generally.
- The second unit cost series for materials reflects the cost on a per-metre basis of 185mm^2, 11kV cables with a triplex structure. We take the growth of costs of these cables as indicative of the growth of costs of cables more generally.
- The third unit cost series reflects the cost of an 11kV 500 kVA ground transformer. We take the growth of costs of this transformer as indicative of the growth of costs of transformers and switchgear more generally.

For each of these unit cost series, for each DNO we calculate annual unit cost growth rates for financial years 2012-2021. We then construct a final series that is an unweighted average of those growth rates across the DNOs.

Table 3.2: Materials Indices Considered (part 2)

Data Provider	Series Name	Series ID	Reason for consideration
BEAMA	CPA Large Power Transformer Materials	BLT	Name/sample suggest relevant to electricity distribution costs
BCIS	Electrical Cables	4/CE/EL/03	Name/sample suggest relevant to electricity distribution costs
ONS	Electricity Distribution and Control Apparatus	JV72	Name/sample suggest relevant to electricity distribution costs
ONS	Electric Motors, Generators and Transformers	JV6R	Name/sample suggest relevant to electricity distribution costs
ONS	Other Electronics and Electric Wires	K325	Name/sample suggest relevant to electricity distribution costs
BCIS	Plastic Products (including pipes)	4/CE/24	Used at GD2
BCIS	Structural Steelwork Materials	4/CE/ST/02	Name/sample suggest relevant to electricity distribution costs
BCIS	Aluminium Products	4/CE/25	Name/sample suggest relevant to electricity distribution costs
ONS	Wood, Sawn and Planed	JU89	Name/sample suggest relevant to DNO unit costs (wood poles)
BCIS	Timber	90/12	Name/sample suggest relevant to DNO unit costs (wood poles)
BCIS	Timber	4/CE/25	Name/sample suggest relevant to DNO unit costs (wood poles)

Source: NERA analysis

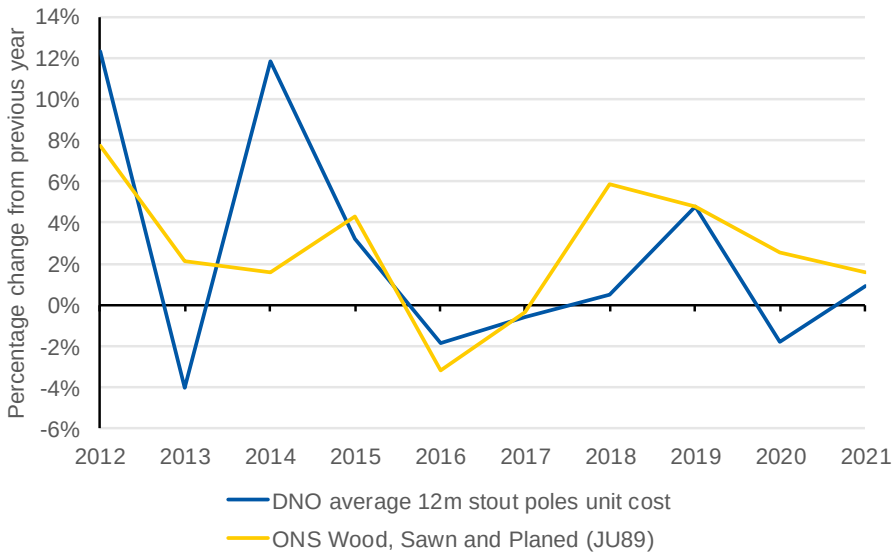
For each of the DNO unit cost series, we assign a set of benchmark price indices that we deem likely to reflect those DNO unit costs. Some series are easily assigned; for example, the BCIS Timber series are clearly most likely to be related to wood poles. Others are not easily assigned and so we evaluate them against more than one DNO unit cost series; for example, we evaluate "BCIS PAFI Pipes and Accessories: Copper (3/58)" against both cables and transformers.

We also recognize that while cables, transformers, and wood poles constitute the three largest cost items within materials for DNOs, there is a significant portion of total costs remaining that is composed of a host of other items. These other items include both specialized electrical equipment (fault detection, meters and accessories, fuses) and more general equipment (resin, personal protective equipment, clamps).

For **wood poles**, we select a single index: "ONS Wood, Sawn and Planed (JU89)". The MSD of this index is 6.81 percentage points, which is below the MSD for CPIH of 7.98 percentage points. The other two indices considered for wood poles had a higher MSD than CPIH and so were rejected. The exact MSD values are reported in Table A.2 of Appendix A. "ONS Wood, Sawn and Planed (JU89)" has high nominal relevance, as wood poles are made from the same materials as sawn and planed wood and undergoes a similar level of processing.

We present a time-series plot of "ONS Wood, Sawn and Planed (JU89)" against the DNO unit cost series in Figure 3.5.

Figure 3.5: We Select One Benchmark Index to set the RPE for Poles



Source: NERA analysis

For **cables**, thirteen indices have a lower MSD relative to DNO unit cables cost than CPIH. An RPE based on thirteen indices would violate our "feasibility" criterion, so we select only the two indices with the lowest MSDs. These are "BCIS PAFI Pipes and Accessories: Aluminium (3/59)" (MSD 5.50 percentage points) and "BCIS PAFI Pipes and Accessories: Copper (3/58)" (MSD 3.76 percentage points). For reference, the MSD of CPIH is 10.16 percentage points. Since aluminium and copper are components of cables, and indeed several DNOs index their cable supply contracts to aluminium and copper prices, these series also meet the nominal relevance criterion. Both indices also have regulatory precedent. We present a time-series plot of these indices against the DNO unit cost series in Figure 3.6. Further detail on our evaluation of the cables indices is set out in Table A.2 of Appendix A.

Figure 3.6: We Select Two Benchmark Indices to set the RPE for Cables

[REDACTED]

Source: NERA analysis

For **transformers**, five indices have a lower MSD relative to DNO unit costs than CPIH. Since transformers are only one component of materials (capex), we determine that five indices violates the feasibility criterion and select the two indices with the lowest MSD, as we did for cables. These indices are "BCIS PAFI Pipes and Accessories: Copper (3/58)" (MSD 7.60 percentage points) and "BCIS electrical – materials (3/E2)" (MSD 7.41 percentage points). For reference, the MSD of CPIH is 7.99 percentage points. These have nominal relevance, as they reflect the costs of inputs to transformers. "BCIS PAFI Pipes and Accessories: Copper (3/58)" also has regulatory precedent. We present a time-series plot of these indices against the DNO unit cost series in Figure 3.7. The detail of our evaluation of the transformers indices is set out in Table A.1 of Appendix A.

Figure 3.7: We Select Two Benchmark Indices to Set the RPE for Transformers

[REDACTED]

Source: NERA analysis

For **other materials (capex) costs, and for materials opex**, we do not have data on DNO unit costs to inform our analysis. We therefore select one index based on regulatory precedent. This index is "BCIS RCI Infrastructure Materials (FOCOS)", which was used to set the RPE for materials (opex) at ED1.[50] To verify that an RPE is needed, we test whether there is a statistically significant difference in mean growth between the index and CPIH. Our test has a p-value of 0.014, indicating that there is a statistically significant difference and therefore the RPE is needed.[51] We present a plot of the index against time in Figure 3.8.

Figure 3.8: We Select One Benchmark Index to set the RPE for Materials (opex) and Other Materials (capex) Costs

[REDACTED]

Source: NERA analysis

3.4.3. Plant and Equipment (P&E) index selection

Based on the first stage of the selection process described at the beginning of this section, we identify four indices that could be used to set RPEs for the plant and equipment (P&E) input cost category. These are listed in Table 3.3.

Table 3.3: Plant & Equipment Indices Considered

Data Provider	Series Name	Series ID	Reason for consideration
ONS	Machinery and Equipment Output PPI	K389	Used at ED1
BCIS	Plant and Road Vehicles: Providing and Maintaining	70/2	Used at ED1 (to be discontinued)
BCIS	PAFI Plant and Road Vehicles	90/2	Name/sample suggest relevant to electricity distribution costs
BCIS	Purchased Plant Including depreciation and maintenance	4/CE/04	Name/sample suggest relevant to electricity distribution costs

Source: NERA analysis

We do not have a unit cost data series for plant and equipment (P&E). We therefore select one index, based on regulatory precedent. The index we select is "BCIS PAFI Plant and

[50] "BCIS RCI Infrastructure Materials (FOCOS)" is a Resource Cost Index that reflects the notional trend of input costs to a infrastructure contractor. See BIS (2012), Construction Resource Cost Indices Notes and Definitions. Link: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/16474/resource-cost-indices-methodology-and-revision-policy.pdf

[51] We perform a paired test for the difference of means between two samples using data from 2000-2021, excluding 2010 and 2011 to avoid the impact of the financial crisis, and excluding 2021 to avoid the impact of COVID-19. The finding of significance is unchanged if we include these years.

Road Vehicles (90/2)". This index replaces "BCIS Plant and road vehicles: providing and maintaining (70/2)", which Ofgem used to set the RPE for P&E at ED1 but which is scheduled to be discontinued by BCIS. The mean growth of this series is statistically significantly different from that of CPIH, indicating that an RPE is needed.[52] We present a time series plot of this index in Figure 3.9.

We considered a second index, "ONS Machinery and Equipment Output PPI (K389)", which was also used by Ofgem to set an RPE for P&E at ED1. However, the difference in mean growth between that index and CPIH was not significant, indicating that an RPE based on this index is unnecessary.[53]

Figure 3.9: We Select One Benchmark Index to Set the RPE for P&E

[REDACTED]

Source: NERA analysis

3.4.4. Labour index selection

The labour input cost category includes both general and specialist labour. There is no commonly agreed definition of these two terms, and indeed at RIIO-T2 Ofgem combined the two into a single category and equally-weighted all associated price indices.[54] In both cases, the category reflects the costs of both internal labour and outsourced, contracted labour.

We identify eight candidate indices in the general and specialist labour categories. These are listed in Table 3.4.

[52] We perform a paired test for the difference of means between two samples using data from 2000-2021, excluding 2010 and 2011 to avoid the impact of the financial crisis, and excluding 2021 to avoid the impact of COVID-19. The p-value is 0.031, indicating significance at the conventional 5 per cent level. The finding of significance is unchanged if we include the excluded years.

[53] We perform a paired test for the difference of means between two samples using data from 2000-2021, excluding 2010 and 2011 to avoid the impact of the financial crisis, and excluding 2021 to avoid the impact of COVID-19. The p-value is 0.125, which is insignificant at all conventional significance levels. If we include the excluded years, the difference becomes significant (p-value 0.041).

[54] Ofgem (3 Feb 2021), RIIO-2 Final Determinations – Core Document (REVISED), p.66

Table 3.4: Labour Indices Considered

Input Category	Data Provider	Series Name	Series ID	Reason for consideration
General Labour	ONS	AWE: Private Sector Index: Seasonally Adjusted Total Pay Excluding Arrears	K54V	Used at ED1
	ONS	ASHE Median Hourly Earnings for All Employees		Used by Ofwat at PR19
	ONS	AWE: Construction Index: Seasonally Adjusted Total Pay Excluding Arrears	K553	Used at ET2
Specialist Labour	BCIS	PAFI Labour and Supervision in Civil Engineering	70/1	Used at ED1 (but to be discontinued)
	BEAMA	Electrical Engineering Labour	BEL	Used at ED1
	BCIS	PAFI Civil Engineering	4/CE/01	Used at ET2 (and GD2, GT2) to replace BCIS PAFI Labour and Supervision in Civil Engineering 70/1.
	BCIS	Electrical Installations - Cost of Labour	2/E1	Name/sample suggest relevant to electricity distribution costs
	BCIS	Electrical Engineering Labour	4/CE/EL/01	Name/sample suggest relevant to electricity distribution costs

Source: NERA analysis

To evaluate these indices against the relevance criterion, we collect data on unit labour costs from DNOs. We only use data where we have a series of sufficient length (i.e. at least ten years of data), and where we have data from at least three DNOs.

To assess the relevance of the price indices listed above to general labour costs, we identify a unit cost series reflecting labour costs for an average employee of the DNO. These numbers are calculated based on totals within each DNO and so reflect the average cost across all employees.

To assess the relevance of the price indices listed above to specialist labour costs, we identify a unit cost series reflecting labour costs for a skilled operative. This includes roles such as craftspersons, technicians, overhead linespersons, cable joiners, HGV drivers, field staff supervisors, etc.

For each of these unit cost series, we calculate annual unit cost growth rates for financial years 2010-2021 for each DNO. For each of general and specialist labour, we construct a final series that is an unweighted average of the growth rates across the DNOs. We refer to these as our DNO average general labour and DNO average specialist labour growth series.

For **general labour**, we identify two indices that have a lower MSD than CPIH. These are "ONS AWE Private Sector (K54V)" and "ASHE Median Hourly Earnings for All Employees". However, both series are also negatively correlated with DNO unit costs, whereas CPIH is positively correlated with DNO unit costs.

Series that are negatively correlated tend to move in opposite directions. This means that indexation to these indices is likely to be an unsuitable approach to setting RPE allowances for DNOs as it will result in allowances moving in the opposite direction to costs in most years.

One possible reason for the negative correlation between DNO general labour costs and economy-wide general labour indices is that electricity distribution is less vulnerable to economic downturns than other sectors. General labour indices experienced lower growth in the first half of the 2010s than did DNO unit costs, suggesting that the general labour indices suffered from lingering effects of the 2008 financial crisis. General labour indices also fell in 2021 in response to furlough associated with the COVID-19 pandemic; but since electricity distribution was deemed essential, DNO labour costs were largely unaffected.

However, the MSD result also indicates that these two indices are a better match to DNO unit costs than is CPIH. The reason is that the long-run mean of CPIH is much lower than the long-run mean of DNO unit labour cost growth, whereas the long-run mean of the two benchmark indices is closer to that of DNO unit costs.

We therefore recommend indexing to CPIH, but with a constant uplift based on the mean RPEs of "ONS AWE Private Sector (K54V)" and "ASHE Median Hourly Earnings for All Employees". This is consistent with Ofgem's previous treatment of RPEs for general labour costs, where Ofgem set a constant ex ante RPE based on long-run historical average growth in "ONS AWE Private Sector (K54V)" and "Average Earnings Index (AEI)" (another ONS index that has now been discontinued).[55]

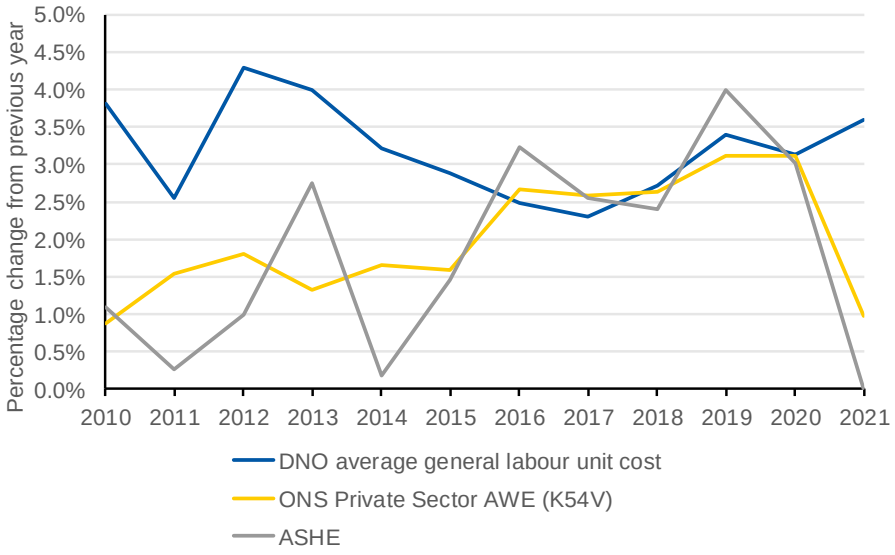
The reason that Ofgem decided to replace constant ex ante RPEs with indexation at RIIO-2 is because of concerns about the difference between outturn and ex ante RPEs meaning that DNO allowances may be either too high or too low. To mitigate this concern, we propose a true-up at the end of the RIIO-2 period based on outturn average long-term growth in the index. This is the approach taken by Ofwat at PR19. Due to the lack of correlation between price indices and the annual unit cost data we suggest a true-up using a twenty-year historical average.[56] Using a sufficiently long time horizon, such as twenty years, will mitigate any distortions arising from the negative year-on-year correlation.

The full detail of our evaluation of the general labour indices is set out in Table A.3 of Appendix A. We plot the two series selected along with DNO average unit costs against time in Figure 3.10.

[55] See Section 2.1.

[56] We recommend excluding unusual periods from the construction of this average, as they may have distortionary effects. For example, we exclude 2010, 2011, and 2021 due to the financial crisis of 2008 and the COVID-19 pandemic, following CEPA's approach on behalf of Ofgem for RIIO-ET2.

Figure 3.10: We Select Two Benchmark Indices to Set the RPE for General Labour



Source: NERA analysis

For **specialist labour**, we identify four indices that have a lower MSD than CPIH. These are "BEAMA Electrical Engineering Labour (BEL)", "BCIS PAFI civil engineering (4/CE/01)", "BCIS Electrical Installations – cost of labour (2/E1)", and "BCIS Electrical Engineering Labour (4/CE/EL/01)". The full details of our evaluation of these indices are set out in Table A.3 of Appendix A. We plot the series as well as the DNO unit specialist labour cost in Figure 3.11.

Figure 3.11: We Select Four Benchmark Indices to Set the RPE for Specialist Labour

[REDACTED]

[REDACTED]

Source: NERA analysis

3.4.5. Transport Index Selection

We do not have a unit cost data series for transport. However, the index "BCIS PAFI Plant and Road Vehicles (90/2)" clearly has nominal relevance for this cost category, as the cost evolution of "Road Vehicles" is likely to track that of DNO transport costs. This index has regulatory precedent, as it was used by Ofgem at ED1 (although for P&E rather than for Transport). As outlined in Section 3.4.3, there is a statistically significant difference between the mean growth of this index and that of CPIH, indicating a need to set an RPE for the Transport category.

3.4.6. Other Index Selection

Aside from materials (capex), materials (opex), P&E, specialist labour, general labour, and transport, any remaining DNO costs are categorized as "Other". In the absence of any indicative DNO unit cost data, regulatory precedent, or way to assess an index for nominal relevance, we are unable to assess whether CPIH is an appropriate proxy for DNO unit cost

growth in this category. We therefore take the conservative approach of assuming that CPIH is an appropriate proxy for DNO unit cost growth in this category and do not set an RPE.

3.5. Final Index Selection

We set out our final index selection in Table 3.5. We report both the selection of indices resulting from the process described in Section 3.4 above, and a selection that is based more heavily on regulatory precedent. Our selection is in the column "NERA", while the selection based on regulatory precedent is in the column "Precedent". The Precedent selection is the same set of indices that were used at ED1 with two replacements. The replacements are for two series from the BCIS 1970 series, which is to be discontinued.[57] Specifically, we replace "BCIS PAFI Labour and Supervision in Civil Engineering (70/1)" with "BCIS PAFI civil engineering (4/CE/01)" as was done at ET2; and we replace "BCIS Plant and road vehicles: providing and maintaining (70/2)" with "BCIS PAFI plant and road vehicles (90/2)", which is very similar in its construction.

[57] BCIS (6 Jan 2021), Guide to PAFI Series 4 – Civil Engineering and Related Specialist Engineering – Calculation, Section 1.7. Available from the BCIS website at https://service.bcis.co.uk/BCISOnline/Help/Documentation/2830?returnUrl=%2FBCISOnline%2FHelp%2FDocumentationIndex&returnText=Go%20back%20to%20documentation%20summary&sourcePage=Documentation (last accessed 23 April 2021).

Table 3.5: Final Index Selection

Category	DNO unit cost	Index Name	NERA	ED1	Notes
Labour (general)		ONS Private Sector AWE (K54V)	C	C	These indices have a lower MSD than CPIH. However, since they are negatively correlated with DNO unit costs (whereas CPIH is positively correlated), we set a constant RPE rather than using indexation.
		ASHE Median Hourly Earnings for All Employees	C		
Labour (specialist)		BEAMA Electrical Engineering Labour (BEL)	I	C	All four indices have a lower MSD than CPIH.
		BCIS PAFI civil engineering (4/CE/01)	I	C	
		BCIS Electrical Installations – cost of labour (2/E1)	I		
		BCIS Electrical Engineering Labour (4/CE/EL/01)	I		
Materials (capex)	Poles	ONS Wood, Sawn and Planed (JU89)	I		This index has a lower MSD than CPIH.
	Cables	BCIS PAFI Pipes and Accessories: Aluminium (3/59)	I	C	Of all candidate cables indices that had a lower MSD than CPIH, we select the two with the lowest MSD.
		BCIS PAFI Pipes and Accessories: Copper (3/58)	I	C	
	Transformers	BCIS PAFI Pipes and Accessories: Copper (3/58)	I	C	Of all candidate transformers indices that had a lower MSD than CPIH, we select the two with the lowest MSD.
		BCIS Electrical – materials (3/E2)	I		
		BCIS PAFI Structural Steelwork - Materials: Civil Engineering Work (3/S3)		C	
	Other	BCIS RCI Infrastructure Materials (FOCOS)	I		For these categories, we do not have DNO unit cost data. We therefore select indices that (a) have regulatory precedent and (b) have long-run mean growth that is statistically significantly different from that of CPIH.
Materials (opex)		BCIS RCI Infrastructure Materials (FOCOS)	I	C	
Plant and Equipment		ONS Machinery and Equipment Output PPI (K389)		C	
		BCIS PAFI plant and road vehicles (90/2)	I	C	
Transport		BCIS PAFI plant and road vehicles (90/2)	I	C	

** Note: For columns "NERA" and "ED1", "C" indicates used to set a constant RPE and "I" indicates used for RPE indexation.*
Source: NERA analysis

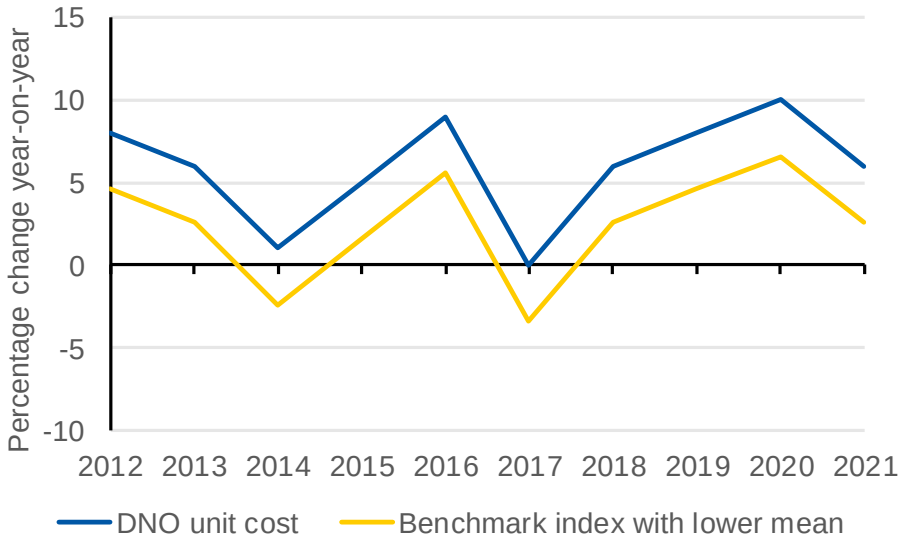
3.6. Mean-Adjusted Indices Account for Persistent Differences in Growth Rates Between Benchmark Indices and DNO Unit Costs

Our analysis of DNO unit costs shows that there are persistent differences between the rate of growth in our selected benchmark indices and the rate of growth in the DNO unit costs. These arise in part because our selection process does not only consider long-run average growth, but also short-term movements in growth.

For example, our index selection process identified the index "BCIS electrical - materials (3/E2)" as a good proxy for DNO transformer unit costs. This index has a low MSD, driven by its high correlation with DNO transformer unit costs (correlation of 0.75). The high correlation means that it tracks short-term price movements in DNO transformer unit costs and therefore makes sense to use in the context of indexation. However, its ten-year average growth is three percentage points lower than that of DNO transformer unit costs. [58]

Where the average growth rate of a benchmark index is different to the growth rate of DNO unit costs, RPE allowances based on the benchmark index alone will systematically over- or under-compensate DNOs. To illustrate, Figure 3.12 shows the growth in a hypothetical DNO unit cost, and a perfectly correlated hypothetical benchmark index. An RPE based on this index would perfectly track the short-term, year-on-year movements in DNO unit cost growth but would systematically undercompensate the DNO for unit cost growth due to the difference in average growth rates.

Figure 3.12: Stylistic Illustration of Need for Mean Adjustment



Source: NERA analysis

To correct for this difference in average growth rates, we apply a mean adjustment to each index where DNO unit cost information is available. We calculate the adjustment according to the formula:

[58] We consider ten-year averages (2012-2021) here rather than long-run averages (2000-2021) due to the limited availability of historical DNO unit cost data.

$$A_{ic} = \frac{1 + DNO_c}{1 + TYA_i} - 1$$

Here DNO_c is the ten-year (2012-2021) average of the annual percentage change in the DNO unit cost c; TYA_i is the ten-year (2012-2021) average of the annual percentage change in the benchmark index i and A_{ic} is the resulting adjustment for the price index i and unit cost c.[59]

The mean adjustment corrects for persistent differences in the *growth rate*, rather than the *level*, between DNO unit costs and benchmark indices. Therefore, it does not correct for any pre-existing differences between DNO unit costs and the prices underlying the benchmark index, for example due to legacy differences in efficiency. It only corrects for persistent differences in the growth rate of DNO unit costs and costs in the wider economy. In the case of "BCIS electrical – materials (3/E2)", for example, it would reflect that the growth rate of transformer prices is persistently above the growth rate of electrical materials more broadly.

The mean adjustments are set out inTable 3.6. The adjustments for the labour indices are similar to one another, but there is substantial variation in the adjustments for materials (capex). This partly reflects the fact that different indices are associated with different materials unit costs (poles, cables, and transformers).

Table 3.6: Mean Adjustments to Align Benchmark Index Growth and DNO Unit Cost Growth

Category	DNO unit cost	Index name	Adjustment
Labour (general)		ONS Private Sector AWE (K54V)	1.03%
Labour (general)		ASHE	1.01%
Labour (specialist)		BEAMA Electrical Engineering Labour (BEL)	0.69%
Labour (specialist)		BCIS PAFI civil engineering (4/CE/01)	0.53%
Labour (specialist)		BCIS Electrical Installations - cost of labour (2/E1)	0.62%
Labour (specialist)		BCIS Electrical Engineering Labour (4/CE/EL/01)	0.61%
Materials (capex)	Poles	ONS Wood, Sawn and Planed (JU89)	-0.17%
Materials (capex)	Cables	BCIS PAFI Pipes and Accessories: Aluminium (3/59)	-0.17%
Materials (capex)	Cables	BCIS PAFI Pipes and Accessories: Copper (3/58)	0.19%
Materials (capex)	Transformers	BCIS PAFI Pipes and Accessories: Copper (3/58)	1.60%
Materials (capex)	Transformers	BCIS electrical - materials (3/E2)	3.24%
Materials (capex)	Other	BCIS RCI Infrastructure Materials (FOCOS)	n/a
Materials (opex)		BCIS RCI Infrastructure Materials (FOCOS)	n/a
Plant and Equipment		BCIS PAFI plant and road vehicles (90/2)	n/a
Transport		BCIS PAFI plant and road vehicles (90/2)	n/a

Source: NERA analysis

[59] The formula to calculate mean adjustments is based on the Fisher formula, which is used to combine different growth series. We also use the Fisher formula to adjust the final RPE to incorporate the mean adjustment (see Section 5.1).

4. Forecasts of Benchmark Indices

We forecast growth in the indices selected in Section 3 in order to derive RPE forecasts. We prepare separate forecasts of the price indices and of CPIH, which we subsequently combine to calculate RPEs. We use both third-party forecasts and our own forecasts based on extrapolating long-term trends in historical data.

We forecast the price indices and CPIH separately, and then combine these separate forecasts to get RPE forecasts.[60] This approach of treating the price indices and CPIH separately allows us to make use of third-party forecasts of the indices and of CPIH. It is also more appropriate to forecast the indices and CPIH separately where the indices are not correlated with CPIH, as it allows for the possibility that the relationship between the price index and CPIH may change over time. The volatility of the historical RPEs for some of the price indices (e.g. "BCIS PAFI Pipes and Accessories: Copper (3/58)", for which the historical RPE has a mean of 0.35 per cent but a standard deviation of 5.02 percentage points) suggests that they are not correlated with CPIH, which lends support to our decision to forecast the indices and CPIH separately.

When a short-term forecast is available from a reputable government agency, our approach is to use those third-party forecasts in place of extrapolating historical data. Usually, this is only possible for labour indices.

For those indices where third-party forecasts are not available, we extrapolate long-term trends. We calculate the long-run historical average of the annual growth rate, using growth rates from 2000 through 2021.[61] We exclude data from 2010, 2011, and 2021 in order to avoid unusual impacts arising from the Financial Crisis of 2008 and from COVID-19. This is the same as the approach used by CEPA at ET2.

Extrapolating benchmark indices based on long-term trends is an objective approach to forecasting RPEs where reliable third party forecasts of indices are not available, and where there is no reason to believe that the long-term trend line does not systematically over- or under-estimate future cost inflation forecasts.

4.1. Short-term Third-party Forecasts

For CPIH we use the forecasts provided by Ofgem in its Business Plan Data Template.[62] These forecasts are based on November 2020 forecasts of CPI prepared by the OBR.

For the specialist labour benchmark indices, we use OBR forecasts of annual earnings growth from March 2021 as the latest available at the time of writing.[63] The March 2021 forecasts

[60] Ofgem followed this approach for RIIO-ET2. For RIIO-ED1 Ofgem followed an alternative approach, combining historical price indices and CPIH to get a single historical RPE series and then directly forecasting that single series. See Appendix C.1.

[61] The price indices in their raw form are either monthly or quarterly. To get an annual series, we take the average of monthly or quarterly observations within a financial year. We then calculate the growth rate of this annual series.

[62] Ofgem (2021), Business Plan Data Template version 4.2. Tab "I1 – Universal Data".

[63] Office of Budgetary Responsibility (3 March 2021), March 2021 Economic and Fiscal Outlook: Charts and Tables, Chapter 2 – Economic Outlook. Chart 2.16: Average earnings growth.

report price growth relative to the previous March; therefore we can use them directly as forecasts for financial year growth. There are forecasts for 2022-2025.

We do not use OBR forecasts of annual earnings growth for the general labour benchmark indices. The OBR forecasts provide guidance on the trajectory of economy-wide labour costs, as reflected in historical indices such as "ONS AWE Private Sector (K54V)" and "ASHE Median Hourly Earnings for All Employees". However, our analysis in Section 3.4.4 shows that DNO general labour costs do not track economy-wide labour costs in the short term. In fact, DNO general labour costs move in the opposite direction to economy-wide labour costs more often than not. The economy-wide labour indices are only similar to DNO general labour costs in terms of their long-run means. This is likely because DNO labour costs are less affected by short-term economic shocks than economy-wide labour costs, since electricity distribution is an essential service and therefore somewhat "recession-proof".[64] Therefore, we use the long-run mean of the indices rather than the short-term OBR forecast to forecast general labour costs.

4.2. Forecasts Using Long-run Arithmetic Average

We calculate the long-run arithmetic average of each of the benchmark indices. We use annual growth rates from financial years ending 2000-2021, but exclude the growth rates in 2010, 2011, and 2021 in order to avoid unusual impacts arising from the Financial Crisis of 2008 and from COVID-19. This is the same approach as that used by CEPA at ET2.

For the materials, plant/equipment, and general labour indices, we set the forecast for each year equal to the long-run arithmetic average. For the specialist labour indices we use OBR forecasts until 2025, and the long-run arithmetic average from 2026 onwards.

Ofgem used the long-run arithmetic average for forecasting at both RIIO-1 and RIIO-2. It is a simple and transparent approach. Over a long horizon it may be inaccurate because it does not account for the compounding effects of growth rates, but our forecast horizon is relatively short and therefore this is not a major concern.[65]

In extrapolating long-term trends, we rely on the past twenty years of data. Some regulators have adopted this approach of using all available data when extrapolating long-term trends (e.g. Ofgem stated in the RIIO-ED1 Final Determinations[66] that it had followed this approach), while others have restricted the window of data they select in order to capture a single, complete economic cycle (e.g. the CMA's approach for NIE[67]).

There is little merit to trying to capture a single economic cycle as there is no single, universally agreed definition of an economic cycle. However, using the full length of a series also bears risks if the series covers several decades, as it would fail to account for any

64 See Section 7 for further discussion of the response of DNO labour costs to short-term shocks.

65 For example, an index starting at 100 in year 0 and growing 7.5% for each of the two years would reach a level of 115.56, while an index starting at 100 in year 0 and growing by 15% in the first year and by 0% in the second year (or vice versa) would reach a level of 115.0. These two series would both yield an arithmetic average growth rate of 7.5% per annum, even though the former is growing more quickly than the latter.

66 Ofgem (28 November 2014): RIIO-ED1 Final Determinations: Expenditure Assessment, para. 12.37.

67 CMA (26 March 2014), Northern Ireland Electricity Limited price determination, para. 11.41.

structural breaks in the series. A compromise solution, in the absence of modelling such structural breaks appropriately, is to use a limited time horizon (e.g. 20 years).

We set out the forecasts in Table 4.1 and Table 4.2. The difference between using short-term third-party forecasts and long-run arithmetic averages can be seen by comparing the rows of Table 4.1 for CPIH and specialist labour indices with the rows for general labour indices. For CPIH and specialist labour we use third-party forecasts; notice that the forecasts vary over 2022-2027 but do not vary across the specialist labour indices. The rows for general labour contain forecasts of the general labour indices based on their long-run arithmetic averages. These forecasts do not vary across years but do vary across indices.

Almost all indices are projected to grow at a rate that exceeds inflation, with the exception of "BCIS electrical – materials (3/E2)". The implication is that the constituent elements of the index are becoming cheaper in real terms over time, perhaps due to efficiency improvements.

Table 4.1: Forecasts of CPIH and Labour Benchmark Indices

Category	Index Name	2022	2023	2024	2025	2026	2027+
Economy inflation	CPIH	1.30%	1.60%	1.78%	1.93%	2.00%	2.00%
Labour (general)	ONS Private Sector AWE (K54V)	3.13%	3.13%	3.13%	3.13%	3.13%	3.13%
	ASHE Median Hourly Earnings for All Employees	3.03%	3.03%	3.03%	3.03%	3.03%	3.03%
Labour (specialist)	BEAMA Electrical Engineering Labour (BEL)	2.71%	2.20%	2.78%	3.45%	2.60%	2.60%
	BCIS PAFI civil engineering (4/CE/01)	2.71%	2.20%	2.78%	3.45%	2.59%	2.59%
	BCIS Electrical Installations - cost of labour (2/E1)	2.71%	2.20%	2.78%	3.45%	4.05%	4.05%
	BCIS Electrical Engineering Labour (4/CE/EL/01)	2.71%	2.20%	2.78%	3.45%	2.32%	2.32%

Source: NERA analysis

Table 4.2: Forecasts of Materials (capex), Materials (opex), P&E, and Transport Benchmark Indices

Category	DNO Unit Cost	Index Name	2022+
Materials (capex)	Poles	ONS Wood, Sawn and Planed (JU89)	2.70%
	Cables	BCIS PAFI Pipes and Accessories: Aluminium (3/59)	2.99%
		BCIS PAFI Pipes and Accessories: Copper (3/58)	3.88%
	Transformers	BCIS PAFI Pipes and Accessories: Copper (3/58)	3.88%
		BCIS electrical - materials (3/E2)	1.61%
	Other	BCIS RCI Infrastructure Materials (FOCOS)	4.19%
Materials (opex)		BCIS RCI Infrastructure Materials (FOCOS)	4.19%
Plant and Equipment		BCIS PAFI plant and road vehicles (90/2)	2.62%
Transport		BCIS PAFI plant and road vehicles (90/2)	2.62%

Source: NERA analysis

5. Forecasts of RPEs

RPEs reflect the difference between economy-wide price growth as measured by CPIH, and the price growth in DNO inputs. In that sense they are a measure of the real-terms inflation in input costs for DNOs. We calculate RPEs at three levels.

1. First, we calculate the RPE for each of the price indices forecasted in Section 4.
2. Second, we combine these index RPEs to get an RPE for each input cost category, using unweighted averages.
3. Third, we combine the RPEs for each input cost category to get an RPE for totex, using a notional cost structure.

5.1. Forecasts of RPEs for Each Benchmark Index

To get the forecast of the RPE for each price index, we combine the forecast of CPIH with the forecast of the index, using the Fisher formula:

$$RPE_{it} = \frac{1 + IPI_{it}}{1 + CPIH_t} - 1$$

Here RPE_{it} is the RPE for benchmark index i in year t, IPI_{it} is the nominal growth of the benchmark index i in year t, and $CPIH_t$ is the percentage change in CPIH. Ofgem also used this Fisher formula at RIIO-ET2.[68]

We apply mean adjustments to the RPEs, described in Section 3.5. We do this using the following formula:

$$RPEA_{ict} = (1 + RPE_{it}) \times (1 + A_{ic}) - 1$$

Here A_{ic} is the mean adjustment reflecting the difference between the ten-year growth of the input price index and the ten-year growth of DNO unit costs, and $RPEA_{ict}$ is the RPE that should be allowed for DNO unit costs, accounting for the mean adjustment.

We present the RPE forecasts for each index, calculated using short-term third party forecasts or long-run arithmetic average forecasts and applying mean adjustments, in Table 5.1 through Table 5.3, below. The forecasts without mean adjustments are presented in Appendix B.1. Note that the RPEs vary across years for each index, unlike the index forecasts in Section 4.2. This is because the RPE accounts for the forecast of CPIH, which varies year-on-year.

For most indices, the forecast RPE declines across the horizon. This is because the forecast of CPIH increases across the horizon, as can be seen from the first row of Table 4.1, whereas for most indices the forecast is constant at the long-run arithmetic average. The exception is the specialist labour indices. These rely on short-term OBR forecasts of labour cost growth, which are rising over time. This counteracts the downward pressure on the RPE coming from the rising forecasts of CPIH.

[68] Ofgem (17 December 2020), RIIO-ET2 Price Control Financial Handbook, section 5.5. p. 40

Table 5.1: Mean-adjusted RPEs for Labour Indices

Category	Index Name	2022	2023	2024	2025	2026	2027+
Labour (general)	ONS Private Sector AWE (K54V)	2.85%	2.55%	2.36%	2.21%	2.15%	2.15%
	ASHE	2.74%	2.43%	2.25%	2.10%	2.03%	2.03%
Labour (specialist)	BEAMA Electrical Engineering Labour (BEL)	2.09%	1.28%	1.67%	2.19%	1.28%	1.28%
	BCIS PAFI civil engineering (4/CE/01)	1.93%	1.12%	1.51%	2.03%	1.12%	1.11%
	BCIS Electrical Installations - cost of labour (2/E1)	2.03%	1.22%	1.61%	2.13%	2.65%	2.65%
	BCIS Electrical Engineering Labour (4/CE/EL/01)	2.01%	1.20%	1.59%	2.11%	0.93%	0.92%

Source: NERA analysis

Table 5.2: Mean-adjusted RPEs for Materials (capex) Indices

Category	Index Name	2022	2023	2024	2025	2026	2027+
Materials (capex)	ONS Wood, Sawn and Planed (JU89)	1.22%	0.92%	0.74%	0.58%	0.52%	0.52%
	BCIS PAFI Pipes and Accessories: Aluminium (3/59)	1.49%	1.19%	1.01%	0.86%	0.79%	0.79%
	BCIS PAFI Pipes and Accessories: Copper (3/58)	2.74%	2.44%	2.26%	2.10%	2.04%	2.04%
	BCIS PAFI Pipes and Accessories: Copper (3/58)	4.19%	3.89%	3.70%	3.54%	3.48%	3.48%
	BCIS electrical - materials (3/E2)	3.56%	3.25%	3.07%	2.91%	2.85%	2.85%
	BCIS RCI Infrastructure Materials (FOCOS)	2.85%	2.55%	2.37%	2.21%	2.15%	2.15%

Source: NERA analysis

Table 5.3: Mean-adjusted RPEs for Materials (opex), P&E, and Transport Indices

Category	Index Name	2022	2023	2024	2025	2026	2027+
Materials (opex)	BCIS RCI Infrastructure Materials (FOCOS)	2.85%	2.55%	2.37%	2.21%	2.15%	2.15%
Plant and Equipment	BCIS PAFI plant and road vehicles (90/2)	1.30%	1.00%	0.82%	0.67%	0.61%	0.61%
Transport	BCIS PAFI plant and road vehicles (90/2)	1.30%	1.00%	0.82%	0.67%	0.61%	0.61%

Source: NERA analysis

5.2. Forecasts for each Input Category RPE

Each index is associated with one of six input categories. The input categories are: general labour, specialist labour, materials (capex), materials (opex), P&E, and transport. There is also an other cost category, for which we do not set an RPE (see Section 3.4.6). We use weights to combine the indices within each input category to get an RPE for that input category.

To get the RPE for a given input category we take an unweighted average of the RPEs for the indices within that category. Note that within materials (capex), "BCIS PAFI Pipes and Accessories: Copper (3/58)" appears twice and so gets double weight.

We use unweighted averages as there is no clear, data-driven alternative to determine the appropriate relative weights on, for instance, the four specialist labour indices. Any alternative to equal weighting would therefore be subjective and risk introducing bias.

It would in principle be possible to set weights on the poles, transformers, cables, and other sub-categories within materials (capex) based on the share of each of those items in total DNO costs. However, we did not have sufficient data to construct such shares.

We report the forecast RPEs for each input category in Table 5.4.

Table 5.4: Input Cost Category RPEs Using NERA Index Selection Based on Long-run Arithmetic Average Forecasts with Mean Adjustments

Category	Sub-category	2022	2023	2024	2025	2026	2027+
General labour		2.80%	2.49%	2.31%	2.15%	2.09%	2.09%
Specialist labour		2.02%	1.21%	1.60%	2.11%	1.49%	1.49%
Materials (opex)		2.85%	2.55%	2.37%	2.21%	2.15%	2.15%
Materials (capex)		2.68%	2.37%	2.19%	2.04%	1.97%	1.97%
	Poles	1.22%	0.92%	0.74%	0.58%	0.52%	0.52%
	Cables	2.12%	1.82%	1.63%	1.48%	1.42%	1.41%
	Transformers	3.88%	3.57%	3.38%	3.23%	3.16%	3.16%
	Other	2.85%	2.55%	2.37%	2.21%	2.15%	2.15%
Plant and Equipment		1.30%	1.00%	0.82%	0.67%	0.61%	0.61%
Transport		1.30%	1.00%	0.82%	0.67%	0.61%	0.61%

Source: NERA analysis

Table 5.5: Input Cost Category RPEs Using NERA Index Selection Based on Long-run Arithmetic Average Forecasts no Mean Adjustments

Category	Sub-category	2022	2023	2024	2025	2026	2027+
General labour		1.76%	1.46%	1.28%	1.12%	1.06%	1.06%
Specialist labour		1.40%	0.59%	0.98%	1.49%	0.88%	0.87%
Materials (opex)		2.85%	2.55%	2.37%	2.21%	2.15%	2.15%
Materials (capex)		1.89%	1.58%	1.40%	1.25%	1.19%	1.18%
	Poles	1.39%	1.09%	0.90%	0.75%	0.69%	0.69%
	Cables	2.11%	1.81%	1.62%	1.47%	1.41%	1.40%
	Transformers	1.43%	1.13%	0.94%	0.79%	0.73%	0.73%
	Other	2.85%	2.55%	2.37%	2.21%	2.15%	2.15%
Plant and Equipment		1.30%	1.00%	0.82%	0.67%	0.61%	0.61%
Transport		1.30%	1.00%	0.82%	0.67%	0.61%	0.61%

Source: NERA analysis

5.3. Forecasts for Totex RPE

We calculate an RPE for totex by combining the RPEs for each of the input categories, using the weights on input categories implied by a notional cost structure. The notional cost structure is constructed as an average of DNO cost structures and so represents the structure of a hypothetical "average" DNO.

5.3.1. Notional Cost Structure

We report the notional cost structure in Table 5.6. We report both the notional cost structure we use in this report as "Share of Totex (NERA)", and the notional cost structure used by Ofgem at ED1 as "Share of Totex (Ofgem ED1)".

Table 5.6: Notional Cost Structure for DNOs

Input Category	Share of Totex (NERA)	Share of Totex (Ofgem ED1)
General Labour (capex and opex)	30.19%	35.57%
Specialist Labour (capex and opex)	36.47%	30.52%
Materials (capex)	18.10%	16.27%
Materials (opex)	3.31%	4.04%
Equipment/Plant	4.31%	5.67%
Transport	2.78%	-
Other	4.84%	-
Other (incl. Transport)	-	7.93%

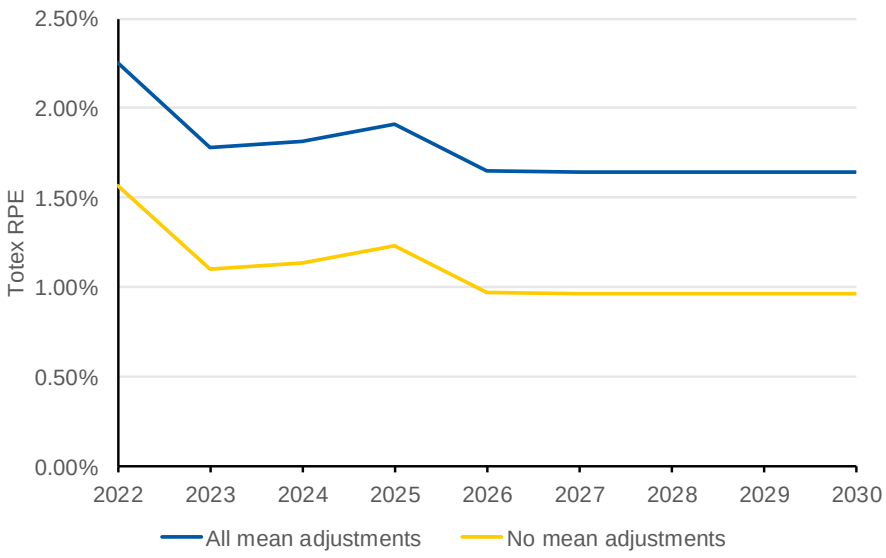
Source: NERA analysis of data provided by DNOs

We derive the notional cost structure as an average of DNO cost structures, following a two-step procedure that is described in Appendix C.2.2. For WPD, we use outturn data on its cost structure over the ED1 period, so 2016-2021. For all other DNOs, we use the projected cost structure for the full ED1 period (2016-2023) at the ED1 final determinations.[69] This was the best available data at the time of writing.

5.3.2. Calculation of Totex RPE

To get the totex RPE, we calculate a weighted average of the RPEs for each input category, using the weights implied by the notional cost structure in Table 5.6.

Figure 5.1: Totex RPE Forecasts



Source: NERA analysis

Table 5.7: Totex RPE Forecasts

	2022	2023	2024	2025	2026	2027+
With mean adjustments	2.25%	1.78%	1.81%	1.91%	1.65%	1.64%
Without mean adjustments	1.57%	1.10%	1.13%	1.23%	0.97%	0.97%

Source: NERA analysis

The near-term variation in the totex RPE is driven by variation in the forecast of CPIH. The eventual long-run RPE for our selection is in the region of 1.7 per cent, applying mean adjustments to all indices. With no mean adjustments, the long-run RPE is in the region of 1 per cent. It would also be possible to apply mean adjustments to a subset of indices only; we discuss this further in Appendix B.2.

[69] Since we are using percentage weights rather than absolute cost values it does not matter that the calculation is based on a different time period for different DNOs.

6. Critical Evaluation of RPE Indexation

6.1. Indexation Introduces Costs and Risks into the Regulatory System Since Indices do not Align with DNO Unit Costs

Our analysis of DNO unit cost data clearly shows that RPEs are necessary: for all input cost categories considered, benchmark indices are a better proxy for DNO unit cost growth than is CPIH. As Ofgem has committed to setting RPE allowances using indexation, our analysis identifies the set of benchmark indices that have historically most accurately tracked DNO unit costs for indexation purposes.

While our index selection procedure ensures that we have identified the set of indices that most closely reflects DNO unit costs of all indices available, many of the real price pressures that DNOs face are not well reflected by benchmark indices. This means that allowances based on indexation will typically not reflect DNO costs. DNOs may need to hedge these risk or engage in otherwise-inefficient cost management in order to bring actual costs into line with these non-reflective allowances.

At least over the last decade, the available price indices have not closely tracked short-run DNO cost pressures for labour costs, even though they typically perform better than CPIH. The evidence is more variable regarding short-run DNO cost pressures for materials costs. For certain materials, in particular for cables and to a lesser extent for transformers, the price indices are reasonably able to capture the directional movement of DNO cost pressures (although a mean adjustment is typically required to bring them up to the same average level of growth as DNO cost pressures). For other materials, e.g. wood poles, the indices are not particularly effective at tracking DNO unit cost pressures, although they more closely reflect DNO unit cost pressures than CPIH.[70]

Ofgem's intention in introducing RPE indexation was to protect consumers from forecasting risk.[71] However, if the selected indices do not accurately reflect companies' external cost pressures, then the indexation approach introduces additional revenue risk to companies and does not effectively protect consumers. The potential for non-cost reflective changes in allowances may increase financing costs and lead to insufficient investment in the network, to the detriment of services and outcomes. Companies can hedge general inflation risk (e.g. using financial instruments like inflation swaps and including indexation in contractor contracts), but this may not be possible for the more obscure indices used for RPE indexation. Introducing indexation to indices unrelated to companies' costs may distort decision-making for financeability reasons and result in inefficient outcomes.

By contrast, Ofgem's previous approach of setting allowances ex ante insulates companies and consumers from uncertainty and is therefore preferable where the RPE indices do not track year-to-year variation in regulated companies' costs (such as for labour costs). Indices that are inadequate for RPE-indexation, because they do not track DNO short-run cost pressures, may still be capture the long-term tendency for some input costs to rise faster or

[70] For further details on the correlations between RPE indices and DNO costs, see data presented in Chapter 3 and Appendix A.

[71] Ofgem (March 2018), RIIO-2 Framework Consultation, para. 6.28.

slower than general inflation and therefore provide a reasonable benchmark for the likely evolution of DNOs' costs over the price control period.

6.2. Indexation Introduces Undesirable Year-on-Year Volatility in Allowances

If all of the indices used for indexation closely track DNO unit costs, then indexation does not pose any challenges for DNO financial planning. DNOs could be confident that any input price pressures they face will be reflected in the indices and so in their allowances, provided they have accurately projected the volumes of each input they require.

However, if the indices do not closely track DNO unit costs and the indices are volatile, then financial planning becomes difficult for DNOs. DNOs cannot be confident that the input price pressures they face will be reflected in the indices or in their allowances. Further, DNOs cannot easily forecast five years of outturn values for volatile indices. This introduces unpredictable instability in revenues received by companies and therefore bills paid by consumers, with no offsetting benefit for consumers.

The inability to forecast allowances may increase the costs of DNOs contracting with suppliers. Regulated companies typically run tenders for contractors shortly after price control settlements are agreed, with either fixed prices or prices indexed to general inflation. Hence, companies would not necessarily benefit from lower-than-expected outturn RPEs (or suffer from higher than expected RPEs) for much of their contracted work, because contractors' rates would have reflected economic conditions (and inflation expectations) at the time of the price control determination.

6.3. RPE Indexation is Inconsistent with Ofgem's Approach of Setting Ex Ante Ongoing Efficiency Targets

Ofgem's indexation of RPEs must be considered as part of its broader frontier shift methodology, which also includes the ex ante ongoing efficiency adjustment. In past decisions, both RPEs and ongoing efficiency have been fixed percentages ex ante, which are then netted off of each other to form a single fixed percentage frontier shift term (i.e. the "X" in an RPI-X methodology).

By deviating from this approach, Ofgem removes the stability of revenues which comes from setting the whole frontier shift term on an ex ante basis. Companies and customers alike benefit from greater stability in revenue allowances.

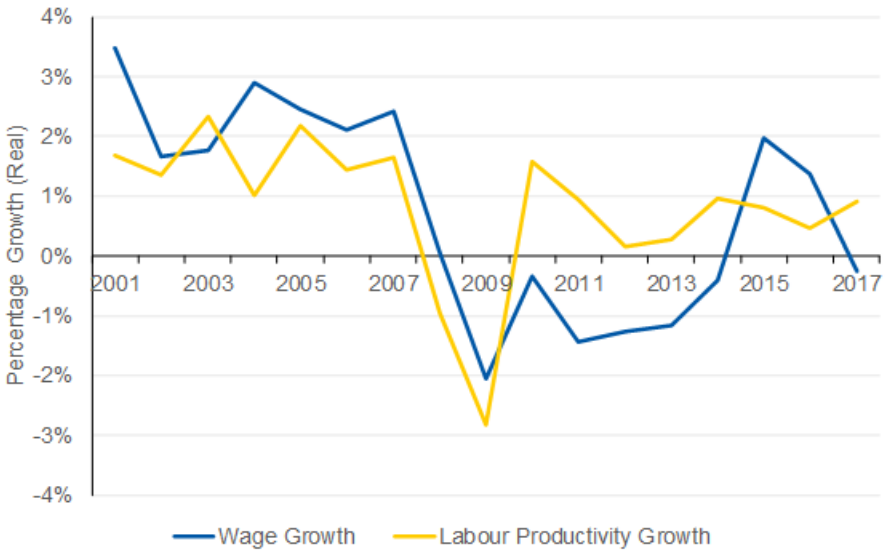
Furthermore, Ofgem's approach to indexing the RPE component of frontier shift but not the productivity component ignores the theoretical relationship between productivity and input prices. In a perfectly competitive labour market, for example, equilibrium wages equal labour productivity (i.e. output per worker). If one employer wished to pay its employees less than the level of labour productivity, then another employer would happily hire them at a higher wage. So long as that wage does not exceed the output the employer receives from the employees, the new employer is happy to increase the size of its workforce, and the employees are happy to accept the higher wage. It follows, therefore, that as labour productivity increases, so too do wages.

Additionally, economy-wide productivity (i.e. TFP) is driven in large part by aggregate demand. If aggregate demand falls, say due to a recession, then TFP will decline because

some inputs are fixed or partially fixed (e.g. capital inputs). Recessions will also tend to reduce labour costs (high unemployment rates mean there is an excess supply of labour), as well as possibly in materials costs.

We can see evidence of this relationship by comparing growth in UK labour productivity per person, as measured by the EU KLEMS dataset, with average private sector wages, as measured by the ONS Average Weekly Earnings (AWE) all employees series, as shown in Figure 6.1.

Figure 6.1: Wage Growth and Labour Productivity Growth[72]



Source: NERA analysis on data from EU KLEMS and ONS

The figure shows a clear, albeit imperfect, relationship between wage growth and labour productivity growth, especially during shocks to the economy

If a recession similar in magnitude to that following the 2007-08 financial crisis were to happen again (e.g. as a result of the COVID-19 pandemic or the effects of Brexit), we might expect another similar drop to both wages and labour productivity. Ofgem's plan to index only RPEs but not ongoing efficiency would mean companies would be expected to pay employees less while still expecting ever-increasing levels of labour productivity. As described above, this is inconsistent with both economic theory and empirical evidence.

By contrast, if Ofgem indexed both RPEs and ongoing efficiency to external indices, its reduced RPE uplift would be largely offset by its reduced ongoing efficiency challenge. However, this is challenging in practice due to the potential for productivity indices to be volatile from year-to-year.

[72] This report and our companion report on Ongoing Efficiency have demonstrated that the ONS AWE private sector series should not be used to set RPEs, and the EU KLEMS labour productivity per person series should not be used to set ongoing efficiency targets. Therefore, this figure is purely to illustrate the existence of a relationship between productivity and wages at an economy level. Economic theory suggests that a similar relationship will exist between labour productivity and labour costs at a DNO level, although the trajectories of the series will differ from those shown in this figure.

Alternatively, Ofgem could set *both* terms on an ex ante basis (as it has in the past). If such a downward shock occurred to both wages and labour productivity, customers would suffer the downside of forecasting risk on RPEs, largely offset by the upside of forecasting risk on labour productivity, and vice versa for network companies.

7. Impact of Shocks and Structural Shifts on RPEs

7.1. RPE Indexation Will Only Reflect DNOs' Underlying Costs Where Indices Respond Similarly to Economic Shocks and Shifts

An economic shock is a temporary economic phenomenon which causes a short-term distortion in typical economic patterns. A structural shift causes a permanent change to typical economic patterns.

In the context of RPE allowances, we are only interested in shocks and structural shifts to the extent that they affect either the price indices used to set allowances or the DNO unit costs. The impact of shocks and structural shifts on the accuracy of RPE allowances depends on whether price indices and DNO unit costs respond in similar or different ways to those shocks and shifts.

Where price indices and DNO unit costs respond in similar ways to shocks and shifts, RPE allowances set by indexation will accurately reflect DNO costs. However, RPE allowances set ex ante will not. With indexation, when a shock or shift occurs the response of the DNO unit costs is mirrored by the benchmark indices and therefore by the RPE allowances. In contrast, if RPEs are set ex ante, then if both DNO unit costs and the indices respond to a shock the allowance does not reflect the response. This is the argument CEPA makes when it writes "the impact of COVID-19 actually supports the case for RPE indexation, as it reduces the likelihood that companies benefit from windfall gains or losses brought about by 'forecast error'. For example, a deeper and longer recession might result in falling input prices that would not be captured in an ex-ante forecast used to set an RPE allowance, allowing the companies to make a windfall gain."[73]

Ofgem's view is that the discrepancy between forecast and outturn indices at RIIO-GD1/T1 shows that ex ante RPEs are inaccurate in the event of shocks or structural shifts. During RIIO-GD1/T1, the benchmark indices used to set RPE allowances grew at a slower rate than they historically had done due to a structural shift associated with the financial crisis, which the ex ante allowances based on historical data did not reflect.[74] However, Ofgem's view rests on the implicit assumption that price indices and DNO input costs respond similarly to shocks and structural shifts.

Where price indices and DNO unit costs do not respond in similar ways to shocks and structural shifts, RPE allowances may become more inaccurate as a result of the shocks or shifts. This risk is present regardless of the methodology used to set RPE allowances: it affects both allowances set by indexation, and allowances set ex ante based on historical data.

The response of DNO unit labour costs and the response of labour price indices to the shock associated with the financial crisis provides an instructive example. While the labour price indices exhibited low growth in the early 2010s, due to low economy-wide productivity growth, DNO unit labour cost growth continued. Eventually, DNO unit labour cost growth

[73] CEPA (27 November 2020), RIIO-GD2 and T2: Cost Assessment – Advice on Frontier Shift policy for Final Determinations, p. 63.

[74] See Section 2.2.2.

declined in the late 2010s. By the late 2010s, labour price indices that Ofgem intends to use to index RPEs were beginning to experience faster growth.

RPEs set based on indexation would have resulted in accurate RPE allowances in this example. Under indexation, the allowances would have been too low in the first half of the 2010s and too high in the second half. The overall impact across the full decade averages out, somewhat mitigating the damage associated with the year-on-year inaccuracies. However, had the financial crisis been a structural shift rather than shock, the price indices would have remained low in the second half of the 2010s and so this averaging-out would not have occurred. In any case, the year on year indexation of cost allowances would have resulted in unnecessary and excessive divergences between the allowances that DNOs were able to recover and their underlying costs.

RPEs set using ex ante allowances based on historical data would have resulted in less inaccuracy in this scenario. This is because they respond more slowly to shocks, and so would have better tracked the actual DNO unit costs. However, in the context of a structural shift the slow adjustment of RPEs set ex ante would mean that allowances are likely to be either too high or too low for some period of time, until the historical data reflects the new reality.

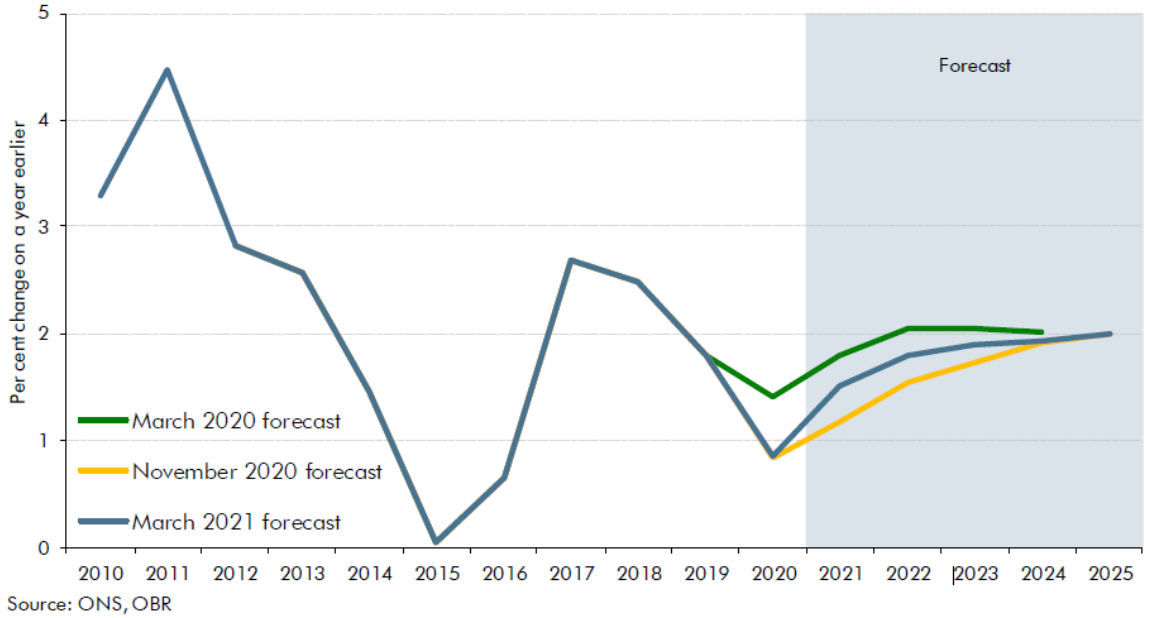
In general, DNO actual costs are likely to be less susceptible to shocks than economy-wide price indices, because electricity distribution is an essential service and experiences a smaller drop in activity than other sectors during economic downturns. DNOs are also unable in practice to immediately benefit from changes in wages outside the sector given the need for recruitment, training and specialist skills. In this context, RPEs set using ex ante allowances based on historical data, which smooth the effects of shocks in either direction, are likely to more accurately reflect DNO actual costs than RPEs set by indexation.

7.2. The COVID-19 Pandemic is Unlikely to Affect RPEs for RIIO-ED2

Economic forecasting agencies suggest that the COVID-19 pandemic is likely to be a short-term economic shock, with no persistent effect on growth rates. The consensus forecast for real GDP reported in the OBR's March 2021 Economic and Fiscal Outlook anticipates that real GDP will have recovered to its pre-pandemic growth rate by 2022.[75] The OBR's own forecast of CPI inflation anticipates that economy-wide price growth will have reached the Bank of England target of 2 per cent growth by 2023.

[75] OBR (3 March 2021), Economic and Fiscal Outlook, p. 78

Figure 7.1: The OBR Anticipates that CPI Inflation Will Recover By 2023



Source: OBR (3 March 2021), Economic and Fiscal Outlook, p. 71

Of the benchmark indices used to set RPEs, the impact of the COVID-19 pandemic to date is primarily visible in the price indices for labour. Figure 3.10 and Figure 3.11 show that the benchmark indices for both general and specialist labour fell in financial year 2021, whereas the benchmark indices for other input cost categories did not see significant declines in financial year 2021.

However, the OBR does not anticipate that the COVID-19 pandemic will introduce a permanent change to the rate of growth of economy-wide labour prices. It anticipates rapid earnings growth in 2021 and 2022 as the economy recovers from the pandemic, with a slight unwinding in 2023 and "earnings growth broadly recovering thereafter to 3.5 per cent at the forecast horizon".[76] While there may be persistent effects of COVID-19 on labour productivity due to economic scarring,[77] the OBR does not expect an associated reduction in wage growth. The wage response to low productivity may be masked by countervailing factors, such as a drop in labour supply due to lower net immigration.[78]

The RIIO-ED2 price control is due to begin in 2023. By then, the consensus among third-party forecasters is that the effects of COVID-19 on economic growth will largely be unwound. The OBR anticipates that prices, both economy-wide and for labour specifically, will have returned to their pre-pandemic long-term growth rates.

Based on these forecasts, we expect that RPEs set by indexation during the RIIO-ED2 price control will not be impacted by COVID-19.

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76 OBR (3 March 2021), Economic and Fiscal Outlook, p. 69

77 NERA (30 April 2021), Ongoing Efficiency Improvement at RIIO-ED2, p. 60

78 OBR (3 March 2021), Economic and Fiscal Outlook, p. 52

7.3. Brexit May Affect Labour RPEs for RIIO-ED2

The impact of Brexit on RPEs is likely to differ between RPEs for "goods" cost categories – i.e. materials, plant/equipment, and transport – and labour cost categories.

7.3.1. Brexit is likely to have little impact on RIIO-ED2 RPEs for goods cost categories in the absence of further changes to trading arrangements

For the goods cost categories, the most immediate impact of Brexit is likely to be an increase in non-tariff barriers to trade. There will be direct effects on the prices of imports, and indirect effects on the prices of domestically produced goods if it becomes more difficult to export them.

The extent to which this results in inaccuracies in RPE allowances will depend on whether the response of DNO unit costs for goods cost categories to non-tariff barriers to trade is similar to the response of the selected benchmark indices for those categories. The Institute for Fiscal Studies (IFS) found that the network sector has similar exposure to non-tariff barriers as a result of Brexit to the rest of the economy.[79] This suggests that the response of DNO unit costs is likely to be similar to the response of benchmark indices on average, over the longer term.

If the existing non-tariff barriers implied by the UK-EU Trade and Cooperation Agreement of 24 December 2020 remain unchanged, then it is likely that any changes to prices will have occurred prior to the beginning of RPE indexation for RIIO-ED2. Therefore, Brexit is likely to only impact price growth and thus RPEs for goods input cost categories if there are further changes to UK-EU trading arrangements.

7.3.2. Brexit may result in higher RIIO-ED2 RPEs for labour cost categories, depending on government policy

For the labour cost categories, Brexit may have longer-term impacts, but these will also depend on the policies adopted by the UK government. It is likely that Brexit will result in a reduction in the number of EU citizens living and working in the UK. The OBR estimates that the population may already be up to 2 per cent smaller than official statistics suggest, due to "foreign-born nationals returning home during the pandemic and lower levels of immigration".[80]

The impact of a reduction in the number of EU nationals in the UK on the price of labour will depend on the UK government policy response. If there is no policy response to counteract the loss of EU citizens, it is likely that the price of labour will rise over the next several years, including the beginning of the ED2 price control. This will increase the growth rate of benchmark indices and thus DNO labour RPEs under indexation. However, if the UK government implements policies to counteract the loss, e.g. by facilitating access to the UK labour market for other non-UK nationals, then the price of labour is not likely to rise.

[79] IFS (October 2020), IFS Green Budget 2020: Chapter 3 – The cost of adjustment: emerging challenges for the UK economy, p. 141

[80] OBR (3 March 2021), Economic and Fiscal Outlook, p. 52

7.4. DSO Transition

The transition from DNOs to DSOs is not an economy-wide structural shift, but it is a structural shift in the electricity distribution sector. It is unlikely to affect the relationship between DNO unit costs and price indices that are used to set RPEs. However, it is likely to alter the cost structure of DNOs/DSOs. A change to the cost structure may mean that certain DNO unit costs become more or less material, and therefore additional RPEs may be required.

In particular, the DSO transition is likely to require companies to employ more specialist labour and make more investments associated with data management and cyber-security. Ofgem has set out a number of specific obligations for DNOs as part of the DSO transition:

- Improve operational data management
- Share more market reporting data on procurement and utilisation of flexibility services
- Develop robust cyber-resilience plans
- Create a standardised public register of DER greater than 1 MW connected to networks.[81]

These obligations are likely to increase DNO costs for IT equipment, software, and associated labour. It may therefore be appropriate to add an index for IT equipment to the materials (capex) RPE, or to increase the weight on specialist labour in the totex RPE, prior to the change in licence from DNO to DSO, currently scheduled for Q2 2023.[82]

[81] Ofgem (28 August 2020), Next steps on our reforms to the Long Term Development Statement (LTDS) and the Key Enablers for DSO Programme of Work, Annex 1

[82] Ofgem (28 August 2020), Next steps on our reforms to the Long Term Development Statement (LTDS) and the Key Enablers for DSO Programme of Work, p. 21

8. Conclusion

There are outstanding concerns with the use of indexation to set RPEs for DNO unit costs, as outlined in Section 6. In particular, where benchmark indices are not closely correlated with DNO unit costs, indexation introduces inefficiencies as DNOs must manage uncertainty around year-on-year changes in allowances that do not track year-on-year changes in costs. This inefficiency affects both the general labour and specialist labour input cost categories, where even those indices that are more relevant to DNO unit costs than CPIH are still poorly correlated with DNO unit costs. Indexation of RPEs is also inconsistent with setting ex ante ongoing efficiency targets, since productivity and price growth are closely connected.

Despite these concerns, Ofgem has decided to use indexation to set RPEs at ED2. Therefore, in this report we work within the constraints of the indexation approach to select benchmark indices for DNO input costs.

Indexation raises new considerations for the selection of benchmark indices. At previous price controls, where RPEs were set ex ante, the primary consideration was whether the long-run average of the index reflected the long-run average of DNO unit costs. Now that Ofgem has decided to set RPEs using indexation, it is also important to consider whether the short term movements of the index reflect the short term movements in DNO unit costs and to consider the volatility of the index.

We apply an approach to index selection that accounts for these new considerations of short term movements and volatility. The approach is described in detail in Section 3. Our approach also explicitly addresses Ofgem's requirement that there should be "a high evidential bar" for the use of RPEs, in that we only apply an RPE where there is clear evidence that the benchmark index is a better proxy for DNO unit costs than is CPIH.

Our index selection approach shows that an RPE is necessary for each of seven DNO input cost categories and identifies the set of benchmark indices that should be used to set the RPE for each cost category.

Our evaluation of DNO unit cost data also reveals that there are persistent differences between the long-run average growth of the selected benchmark indices and DNO unit costs. These differences are present even for the indices that perform best on our metrics of relevance to DNO unit costs. They are in part a consequence of the need, under indexation, to select indices that track short term movements in DNO unit costs.

To correct for these differences, we apply mean adjustments to the growth of our selected benchmark indices, to bring them in line with DNO unit cost growth as described in Section 3.6. Mean adjustments account for differences in *growth rates*, and so do not correct for differences in price *levels* due to legacy differences in efficiency between DNOs and the wider economy. Rather, they reflect the fact that prices for specialised DNO inputs, e.g. transformers, typically grow at a faster rate than the prices of electrical equipment in general.

Under indexation, mean adjustments to benchmark indices are necessary to allow DNOs to fully recover their costs. If mean adjustments are omitted when setting RPE allowances, the RPE allowances will effectively impose an additional efficiency challenge to DNOs beyond that already set as part of the ongoing efficiency target.

Appendix A. Index Selection Tables

Table A.1: Materials Index Selection for Transformers

		Relevance/Volatility					Regulatory Precedent		
Input Cost Category	**Index Name**	**Mean of RPE**	**Standard deviation of RPE**	**Correlation with DNO unit transformers cost**	**MSD relative to DNO unit transformers cost**	**Nominal relevance**	**ED1**	**ET2 (FD)**	**NERA**
Economy inflation	CPIH	n/a	n/a	0.19	7.99%				
DNO average 11kV 500kVA ground transformer unit cost		**1.96%**	**5.22%**						
Materials (capex): Transformers	BCIS Structural Steelwork Materials (4/CE/ST/02)	1.37%	8.49%	0.67	9.62%	Mid	n	n	n
	BCIS Aluminium Products (4/CE/25)	-1.14%	6.83%	0.83	8.46%	Mid	n	n	n
	BCIS PAFI Pipes and Accessories: Copper (3/58)	0.35%	5.02%	0.65	7.60%	Mid	Y	n	Y
	BCIS electrical - materials (3/E2)	-1.24%	1.82%	0.75	7.41%	Mid	n	n	Y
	BCIS PAFI Structural Steelwork - Materials: Civil Engineering Work (3/S3)	-1.94%	6.70%	0.79	10.22%	Mid	Y	n	n
	BEAMA CPA Large Power Transformer (BLT)	-0.39%	1.13%	0.33	7.95%	High	n	n	n
	ONS electricity distribution and control apparatus (JV72)	-0.59%	1.31%	-0.02	8.38%	High	n	n	n
	ONS electric motors, generators, and transformers (JV6R)	-1.66%	1.70%	-0.43	9.89%	High	n	n	n

Notes: all statistical metrics calculated on annual data for financial years 2012-2021. All RPEs calculated with respect to CPIH. All indices selected for the "narrow" RPE are selected for the "mid" RPE, and all indices selected for the "mid" RPE are selected for the "broad" RPE.

Table A.2: Materials Index Selection for Wood poles and Cables

		Relevance/Volatility							Regulatory Precedent		
Input Cost Category	**Index Name**	**Mean of RPE**	**Standard deviation of RPE**	**Correlation with DNO unit wood poles cost**	**Correlation with DNO unit cables cost**	**MSD relative to DNO unit wood poles cost**	**MSD relative to DNO unit cables cost**	**Nominal relevance**	**ED1**	**ET2 (FD)**	**NERA**
Economy inflation	CPIH	n/a	n/a	0.52	0.73	7.98%	10.16%				
DNO average 12m stout poles unit cost		**0.66%**	**5.06%**								
Materials (capex): Wood poles	ONS Wood, Sawn and Planed (JU89)	0.83%	2.41%	0.5	0.66	6.81%	9.14%	High	n	n	Y
	BCIS Timber (4/CE/21)	0.03%	6.13%	0.33	0.42	12.47%	10.28%	Mid	n	n	n
	BCIS Timber (90/12)	-0.14%	5.44%	0.23	0.37	11.91%	9.64%	Mid	n	n	n
DNO average 11kV 185mm cable unit cost		**0.54%**	**6.26%**								
Materials (capex): Cables	BCIS PAFI Pipes and Accessories: Aluminium (3/59)	0.72%	3.71%	0.53	0.93	7.13%	5.50%	Mid	Y	n	Y
	BCIS PAFI Pipes and Accessories: Copper (3/58)	0.35%	5.02%	0.13	0.88	11.71%	3.76%	Mid	Y	n	Y
	BCIS Electrical Installations - cost of materials (2/E2)	0.46%	1.62%	-0.32	-0.58	9.12%	11.56%	Mid	n	n	n
	BCIS Plastic Products (including pipes) (4/CE/24)	0.13%	2.32%	0.35	0.8	8.64%	7.55%	Mid	n	n	n
	BCIS electrical cables (4/CE/EL/03)	-2.09%	3.84%	0.17	0.56	11.49%	9.58%	High	n	n	n
	ONS other electronics and electric wires (K32F)	-2.01%	3.84%	0.17	0.57	11.32%	9.39%	High	n	n	n
	BEAMA CPA Basic Electrical Equipment (BEE)	-0.43%	5.33%	0.36	0.81	11.14%	6.99%	Mid	n	n	n

Notes: all statistical metrics calculated on annual data for financial years 2012-2021. All RPEs calculated with respect to CPIH. All indices selected for the "narrow" RPE are selected for the "mid" RPE, and all indices selected for the "mid" RPE are selected for the "broad" RPE.

Table A.3: Labour Index Selection

		Relevance/Volatility							Regulatory Precedent		
Input Cost Category	**Index Name**	**Mean of RPE**	**Standard deviation of RPE**	**Correlation with DNO general labour cost**	**Correlation with DNO specialist labour cost**	**MSD relative to DNO general labour cost**	**MSD relative to DNO specialist labour cost**	**Nominal relevance**	**ED1**	**ET2 (FD)**	**NERA**
Economy inflation	CPIH			0.43	-0.07	2.72%	2.49%				
DNO average general labour unit cost		**1.35%**	**0.78%**								
Labour (general)	ASHE Median Hourly Earnings for All Employees	0.33%	1.73%	-0.13	0.18	2.29%	2.45%	High	n	n	Y
	ONS Private Sector AWE (K54V)	0.31%	1.21%	-0.46	-0.28	2.45%	2.43%	High	Y	Y	Y
	AWE: Construction index (K553)	-0.04%	2.55%	-0.32	-0.32	4.85%	5.09%	Mid	n	Y	n
DNO average specialist labour unit cost		**1.09%**	**1.20%**								
Labour (specialist)	BCIS PAFI civil engineering (4/CE/01)	0.56%	1.34%	-0.19	0.12	2.67%	2.73%	Mid	n	Y	Y
	BCIS Electrical Engineering Labour (4/CE/EL/01)	0.48%	1.63%	-0.25	0.3	2.19%	2.33%	High	n	n	Y
	BCIS PAFI Labour and Supervision in Civil Engineering (70/1)	0.61%	1.51%	-0.32	-0.06	2.35%	2.41%	Mid	Y	n	n
	BEAMA Electrical Engineering Labour (BEL)	0.40%	1.28%	-0.34	-0.38	2.24%	2.43%	High	Y	Y	Y
	BCIS Electrical Installations - cost of labour (2/E1)	0.46%	1.62%	-0.19	0.12	2.67%	2.73%	Mid	n	Y	Y

Notes: all statistical metrics calculated on annual data for financial years 2012-2021. All RPEs calculated with respect to CPIH. All indices selected for the "narrow" RPE are selected for the "mid" RPE, and all indices selected for the "mid" RPE are selected for the "broad" RPE.

Appendix B. Additional RPE Forecasts

B.1. Benchmark Index RPE Forecasts Without Mean Adjustment

Table B.1: RPEs for Labour Indices Without Mean Adjustment

Category	Index Name	2022	2023	2024	2025	2026	2027+
Labour (general)	ONS Private Sector AWE (K54V)	1.81%	1.50%	1.32%	1.17%	1.11%	1.10%
	ASHE	1.71%	1.41%	1.23%	1.08%	1.02%	1.01%
Labour (specialist)	BEAMA Electrical Engineering Labour (BEL)	1.40%	0.59%	0.98%	1.49%	0.59%	0.59%
	BCIS PAFI civil engineering (4/CE/01)	1.40%	0.59%	0.98%	1.49%	0.59%	0.58%
	BCIS Electrical Installations - cost of labour (2/E1)	1.40%	0.59%	0.98%	1.49%	2.01%	2.01%
	BCIS Electrical Engineering Labour (4/CE/EL/01)	1.40%	0.59%	0.98%	1.49%	0.32%	0.32%

Source: NERA analysis

Table B.2: RPEs for Materials (capex) Indices Without Mean Adjustment

Category	Index Name	2022	2023	2024	2025	2026	2027+
Materials (capex)	ONS Wood, Sawn and Planed (JU89)	1.39%	1.09%	0.90%	0.75%	0.69%	0.69%
	BCIS PAFI Pipes and Accessories: Aluminium (3/59)	1.67%	1.37%	1.18%	1.03%	0.97%	0.97%
	BCIS PAFI Pipes and Accessories: Copper (3/58)	2.55%	2.24%	2.06%	1.91%	1.84%	1.84%
	BCIS PAFI Pipes and Accessories: Copper (3/58)	2.55%	2.24%	2.06%	1.91%	1.84%	1.84%
	BCIS electrical - materials (3/E2)	0.31%	0.01%	-0.17%	-0.32%	-0.38%	-0.39%
	BCIS RCI Infrastructure Materials (FOCOS)	2.85%	2.55%	2.37%	2.21%	2.15%	2.15%

Source: NERA analysis

Table B.3: RPEs for Materials (opex), P&E, and Transport Indices Without Mean Adjustment

Category	Index Name	2022	2023	2024	2025	2026	2027+
Materials (opex)	BCIS RCI Infrastructure Materials (FOCOS)	2.85%	2.55%	2.37%	2.21%	2.15%	2.15%
Plant and Equipment	BCIS PAFI plant and road vehicles (90/2)	1.30%	1.00%	0.82%	0.67%	0.61%	0.61%
Transport	BCIS PAFI plant and road vehicles (90/2)	1.30%	1.00%	0.82%	0.67%	0.61%	0.61%

Source: NERA analysis

B.2. Totex RPE Forecasts With Mean Adjustments for a Subset of Indices

Our analysis in Section 3.6 demonstrated the need to apply mean adjustments to benchmark indices in all input cost categories. However, in principle it would be possible to apply mean adjustments to only a subset of these cost categories. For example, applying mean adjustments to one input cost category at a time makes the impact of the mean adjustment in each cost category easier to visualise.

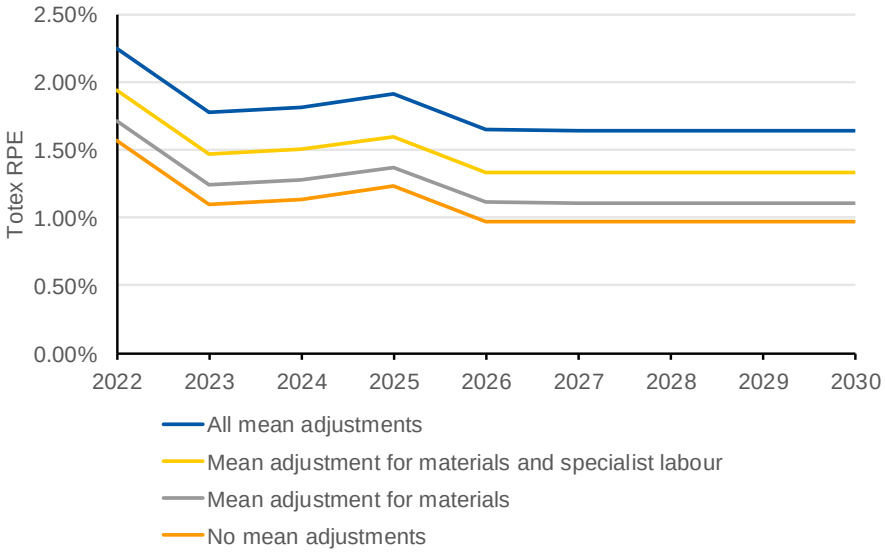
In Table B.4 and Figure B.1 we show the impact of applying a mean adjustment for each input cost category. The bottom row of the table and the lowest line in the figure show the totex RPE where no mean adjustments are applied. Working from the bottom up, we introduce mean adjustments sequentially, starting with the materials (capex) input cost category, followed by the specialist labour cost category, and finally the general labour cost category.

Table B.4: Totex RPE With Mean Adjustments for Some Input Cost Categories

	2022	2023	2024	2025	2026	2027+
All mean adjustments	2.25%	1.78%	1.81%	1.91%	1.65%	1.64%
Mean adjustments for materials (capex) and specialist labour	1.94%	1.47%	1.50%	1.60%	1.34%	1.33%
Mean adjustments for materials (capex)	1.71%	1.24%	1.28%	1.37%	1.11%	1.11%
Without mean adjustments	1.57%	1.10%	1.13%	1.23%	0.97%	0.97%

Source: NERA analysis

Figure B.1: Totex RPE with Mean Adjustments for Some Input Cost Categories



Source: NERA analysis

Appendix C. Methodology

C.1. Index Forecasting Methods Used at Previous Price Controls

C.1.1. Ofgem's approach to index forecasting at ED1

At RIIO-ED1, Ofgem chose to prepare forecasts of the RPEs directly, i.e. the annual real-terms growth of the price indices, rather than to prepare separate forecasts of the price indices and of economy-wide inflation. Ofgem prepared annual forecasts for financial years 2015-2023. To prepare these forecasts, Ofgem relied on third party forecasts where available, and long-run historical averages otherwise.

In order to forecast annual RPEs, Ofgem first needed to produce an annual version of each price series. The price series are published on either a monthly or a quarterly basis. To convert this to an annual series, Ofgem took the simple average of the monthly (or quarterly) values of the input price index within a financial year. Ofgem did this for data up to and including September 2014.

For financial year ending 2015, Ofgem assumed that the RPE of each index for the full financial year would be equal to the average actual RPE over the first half of the financial year, April-September 2014. Outturn data for that period was available at the time Ofgem prepared the forecast.

For financial year 2016, for labour price indices only, Ofgem used a third-party short-term forecast. Ofgem used the "consensus" forecast from HM Treasury (HMT) for economy-wide earnings growth.[83] It combined the consensus forecast for economy-wide earnings growth with the consensus forecast for RPI to produce a forecast of the labour RPE.[84] The consensus forecast aggregates forecasts from a range of City and non-City sources and presents the median of the forecasts.[85]

A downside of using either the OBR or HMT short-term forecasts is that they both measure whole-economy earnings, rather than private sector earnings. At RIIO-ED1, the DNOs submitted evidence showing that in the near-term, private sector wages are likely to grow faster than public sector wages, and that a whole-economy forecast will therefore underestimate private sector earnings growth.[86] To account for this, Ofgem subsequently provided a 0.15% private sector uplift to the HMT forecast, stating that "using an economy-wide forecast for 2015-16 may under-compensate DNOs for the labour cost pressures they will face".[87]

[83] Specifically, Ofgem used the consensus forecasts published in the October 2014 edition of the HM Treasury Forecasts for the UK Economy.

[84] Ofgem used the same approach for both general and specialist labour, with no adjustment to allow a higher RPE for specialist labour.

[85] HM Treasury (June 2015), Forecasts for the UK Economy, Table 2.

[86] NERA (2015), Review of Ofgem's Draft Determination of Real Price Effects for RIIO-ED1.

[87] Ofgem (28 November 2014), RIIO-ED1 Final Determinations: Expenditure Assessment, para. 12.28.

For financial year 2016 for non-labour price indices, Ofgem produced RPE forecasts using the long-run historical average RPE of the index (i.e. its real annual growth).[88] To calculate the long-run historical average, Ofgem used data up to and including 2013-14, and back to 1987-88 (so growth rates from 1988-89).

Ofgem calculated the long-run historical average RPE by taking the average over all annual historical RPEs. Ofgem calculated the annual RPE by subtracting the annual growth of RPI from the annual growth in the price index (i.e. the nominal growth).[89] Ofgem applied an adjustment for the step change in RPI from 2010-2011 through 2015-16. Ofgem subtracted 0.4 percentage points from RPI growth. This ensured comparability between post-2010 and pre-2010 RPI.

For financial years 2017-2023, for both labour and non-labour price indices, Ofgem produced forecasts using the long-run historical average RPE of each index in the same manner described above.

C.1.2. Ofgem's approach to index forecasting at ET2

In the RIIO-ET2 Final Determinations, Ofgem and its consultants CEPA chose to prepare separate forecasts of the price indices and of economy-wide inflation.[90] CEPA prepared forecasts for the full ET2 period, i.e. 2021-2026. To prepare these forecasts, CEPA used "independent forecasts of annual growth rates for a given index, where they exist".[91] Where independent forecasts did not exist, CEPA used the long-run historical average.

To produce short-term forecasts for financial years 2020-2022, CEPA used independent, third-party forecasts where available and long-run historical averages otherwise.

The independent, third-party forecasts used by CEPA are those prepared by the Office for Budget Responsibility (OBR). CEPA set its forecast for CPIH equal to OBR's forecast for CPI.[92] CEPA set its forecast for each labour price index equal to OBR's forecast of economy-wide earnings growth.[93] CEPA used the same third-party forecasts for both general and specialist labour indices.

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88 CMA (29 September 2015), Northern PowerGrid (Northeast) Ltd and Northern PowerGrid (Yorkshire) plc v the Gas and Electricity Markets Authority: Final Determination, p. 77

89 This simple subtraction is an approximation to the Fisher formula that should more properly be used to calculate real growth rates.

90 CEPA (27 November 2020), RIIO-GD2 and T2: Cost Assessment – Advice on Frontier Shift policy for Final Determinations prepared for Ofgem, p. 48

91 CEPA (27 November 2020), RIIO-GD2 and T2: Cost Assessment – Advice on Frontier Shift policy for Final Determinations prepared for Ofgem, p. 48

92 In the draft determinations, CEPA used HMT Consensus forecasts of CPI for 2020-21 and 2021-22 but reduced the annual growth rate by 0.1 per cent "based on the average difference between CPI and CPIH in the most recent three years". In the final determinations, they did not make any adjustment to the CPI forecast to account for differences from CPIH. See CEPA (27 November 2020), RIIO-GD2 and T2: Cost Assessment – Advice on Frontier Shift policy for Final Determinations prepared for Ofgem, p. 45, 48

93 CEPA (27 November 2020), RIIO-GD2 and T2: Cost Assessment – Advice on Frontier Shift policy for Final Determinations prepared for Ofgem, p. 49

CEPA did not identify any suitable third-party forecasts for non-labour price indices. To produce short-term forecasts for financial years 2020-2022 for these indices, CEPA used the long-term average annual growth.

CEPA calculated the long-term annual average growth using data from 2000 onwards but excluding data from financial years 2010 and 2011 in light of concerns around the impact of the financial crisis.[94]

To produce long-term forecasts for financial years from 2023 onwards, CEPA used the long-term average annual growth for all indices and for CPIH.

C.2. RPE Forecasting Methods Used at Previous Price Controls

C.2.1. Ofgem's approach to RPE forecasting at ED1

At ED1, Ofgem first constructed historical RPEs, and then used this series to produce direct forecasts of RPEs over the price control period. Ofgem constructed forecasts using long-run historical averages for most years, except for the labour indices for which it constructed an RPE for the first year of ED1 using HMT consensus forecasts of average earnings growth and RPI.

At ED1, Ofgem used a linear approximation to the Fisher formula to construct RPEs:[95]

$$RPE_{it} = IPI_{it} - (RPI_t - 0.4\%)$$

In the formula above the terms have the following meanings:

RPE_{it} is the real percentage change in an input price index

IPI_{it} is the nominal percentage change in an input price index

RPI_t is the percentage change in RPI

This linear approximation slightly overstates real growth.

Ofgem applied an adjustment for the step change in RPI from 2010-2011 through 2015-16. First, Ofgem subtracted 0.4 percentage points from RPI growth. This ensured comparability between post-2010 and pre-2010 RPI. Second, after combining historical and forecast growth for each input price index into historical and forecast growth for a single input category cost index (by taking an unweighted average), Ofgem subtracted 0.4 percentage points from growth for years 2012-13 onwards. This was to "remove the additional 0.4% per year growth in RPI DNOs will receive through RPI indexation".[96]

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94 In the draft determinations, CEPA constructed the long-term annual average growth rate from 2000 onwards but excluded data from 2009-10 and 2010-11 in light of concerns around the impact of the financial crisis. See CEPA (27 November 2020), RIIO-GD2 and T2: Cost Assessment – Advice on Frontier Shift policy for Final Determinations prepared for Ofgem, p. 45. CEPA does not state whether it continued this approach at the final determinations; we assume that it did.

95 "ST RPE analysis FOR FD-20141120-1_7.xlsx", received from client

96 Ofgem (28 November 2014), RIIO-ED1: Final determinations for the slow-track electricity distribution companies – Business plan expenditure assessment, p. 151. The numbers in this document are consistent with the numbers in the ED1 cost assessment files provided to us by the DNOs.

C.2.2. Ofgem's approach to RPE forecasting at ET2

At ET2, CEPA/Ofgem used forecasts of the priced indices and CPIH to construct forecasts of RPEs. CEPA states that "the real effects… are calculated relative to forecast CPIH".[97] This is a difference between the ET2 approach and the ED1 approach. At ED1, Ofgem calculated the historical indices in real terms, and then produced forecasts in real terms. At ET2, CEPA produced forecasts of both the nominal indices and CPIH, and then used these forecasts to calculate RPEs. After CEPA produces forecasts of the RPEs for each index, it weights them to form a composite RPE index for the cost category in question.

At ET2, Ofgem constructed RPEs using the Fisher formula:[98]

$$RPE_{it} = \frac{1 + IPI_{it}}{1 + CPIH_t} - 1$$

Here $CPIH_t$ is the percentage change in CPIH. Ofgem also used this Fisher formula at RIIO-T1 in 2018.[99]

C.3. Forecasting Based on Ordinary Least Squares

An OLS regression can be used to estimate the relationship between the natural logarithm of an index and a time trend, according to the model shown below. The β coefficient in the equation below represents the long-term average growth rate in the index, which issued to define the long-term RPE.

$$Ln(Index_t) = \alpha + \beta \times Time + \varepsilon_t$$

This approach has some advantages relative to the arithmetic average approach. It is based on index levels (more precisely, the natural logarithm of index levels) rather than annual growth rates, so it implicitly accounts for the compounding effects of growth rates, unlike the arithmetic average approach.

However, the OLS approach also has disadvantages relative to the arithmetic average approach. It is more sensitive to outliers in the data than the arithmetic average approach. In particular, negative outliers towards the end of the sample or positive outliers towards the beginning of the sample will reduce the annual estimated growth by more when using OLS than when using arithmetic averages.

We set out our forecasts of CPIH and the various price indices in Table C.1 and Table C.2.[100] Note that we continue to use third-party short-term forecasts for CPIH and specialist labour,

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97 CEPA (27 November 2020), RIIO-GD2 and T2: Cost Assessment – Advice on Frontier Shift policy for Final Determinations prepared for Ofgem, p. 47

98 Ofgem (17 December 2020), RIIO-ET2 Price Control Financial Handbook, section 5.5. p. 40

99 Ofgem (2018), RIIO-T1 Electricity Transmission Price Control – Regulatory Instructions and Guidance, p. 27

100 We calculate OLS forecasts using monthly data when available, as compared to the long-run arithmetic average which we calculate using annualised data. There is no need to use monthly data to calculate the long-run arithmetic average because one would get the same result whether calculating using monthly data and converting to an annual growth rate or calculating using annual data. However, this is not the case when using OLS. To convert the OLS coefficient from monthly data to an annual-equivalent coefficient, we use the formula $\beta_{ann} = (1 + \beta_{month})^{12} - 1$.

so the numbers for 2022-2026 in those sections of Table C.1 are identical to those in Table 4.1.

There is no consistent pattern in the relationship between OLS forecasts and long-run average forecasts. For CPIH, the OLS coefficient is higher than the long-run arithmetic average, so the OLS forecast is higher. For the two general labour indices, the OLS coefficient is lower than the long-run average, so the OLS forecast is lower.

A closer inspection of the monthly data suggested that several of the benchmark index series did contain outliers. Therefore, we deem the long-run average forecasts to be more reliable and focus on those in the report.

C.3.1. Index Forecasts

Table C.1: Forecasts of CPIH and Labour Benchmark Indices Based on Short-term Third-party Forecasts and OLS Coefficients

Category	Index Name	2022	2023	2024	2025	2026	2027+
Economy inflation	CPIH	1.30%	1.60%	1.78%	1.93%	2.00%	2.00%
Labour (general)	ONS Private Sector AWE (K54V)	2.65%	2.65%	2.65%	2.65%	2.65%	2.65%
	ASHE Median Hourly Earnings for All Employees	2.46%	2.46%	2.46%	2.46%	2.46%	2.46%
Labour (specialist)	BEAMA Electrical Engineering Labour (BEL)	2.71%	2.20%	2.78%	3.45%	2.73%	2.73%
	BCIS PAFI civil engineering (4/CE/01)	2.71%	2.20%	2.78%	3.45%	2.71%	2.71%
	BCIS Electrical Installations - cost of labour (2/E1)	2.71%	2.20%	2.78%	3.45%	3.44%	3.44%
	BCIS Electrical Engineering Labour (4/CE/EL/01)	2.71%	2.20%	2.78%	3.45%	2.51%	2.51%

Source: NERA analysis

Table C.2: Forecasts of Materials (capex), Materials (opex), P&E, and Transport Benchmark Indices Based on OLS Coefficients

Category	DNO Unit Cost	Index Name	2022+
Materials (capex)	Poles	ONS Wood, Sawn and Planed (JU89)	3.18%
	Cables	BCIS PAFI Pipes and Accessories: Aluminium (3/59)	3.41%
		BCIS PAFI Pipes and Accessories: Copper (3/58)	4.49%
	Transformers	BCIS PAFI Pipes and Accessories: Copper (3/58)	4.49%
		BCIS electrical - materials (3/E2)	2.46%
	Other	BCIS RCI Infrastructure Materials (FOCOS)	4.38%
Materials (opex)		BCIS RCI Infrastructure Materials (FOCOS)	4.38%
Plant and Equipment		BCIS PAFI plant and road vehicles (90/2)	2.63%
Transport		BCIS PAFI plant and road vehicles (90/2)	2.63%

Source: NERA analysis

C.4. Derivation of Notional Cost Structure Used to Calculate Totex RPE

We derive the notional cost structure used in Section 5.3 as an average of DNO cost structures, following a two-step procedure. For WPD, we use outturn data on its cost structure over the ED1 period, so 2016-2021. For all other DNOs, we use the projected cost structure for the full ED1 period (2016-2023) at the ED1 final determinations.[101]

In the first step, we calculate a notional expenditure structure using six expenditure categories: load-related expenditure, non-load-related expenditure (asset replacement), non-load-related expenditure (other), faults, tree-cutting, and controllable opex. For each DNO, we calculate expenditure per category over the ED1 period as a share of total expenditure over the ED1 period (i.e. the period for which we have data from that DNO). We then calculate an unweighted average of each of these shares across each of the 14 DNOs. This gives us the notional expenditure structure, which is presented inTable C.3

[101] Since we are using percentage weights rather than absolute cost values it does not matter that the calculation is based on a different time period for different DNOs.

Table C.3: Notional Expenditure Structure for DNOs

Load related capex	Non-load related capex - asset replacement	Non-load related capex - other	Faults	Tree cutting	Controllable opex
10.44%	32.12%	6.12%	11.73%	3.83%	35.77%

Source: NERA analysis of data provided by DNOs

In the second step, we calculate a notional cost structure within each expenditure category. For each DNO in each year of ED1, we calculate the share of each input in each of the expenditure categories. For example, for DNO X we may find that 50 per cent of the tree-cutting expenditure is attributed to labour as an input in 2019. For each DNO we then take the average of these numbers across years. For example, for DNO X we may find that on average across ED1 only 45 per cent of tree-cutting expenditure is attributed to labour as an input (so in 2019 labour costs were relatively high). We then take the averages over the 14 DNOs. This leaves us with a six-by-six matrix of the shares of each of six inputs in each of six expenditure categories, as seen in Table C.4.

Table C.4: Notional Cost Structure of Each Expenditure Category

	Load related capex	Non load related capex – asset replacement	Non load related capex – other	Faults	Tree cutting	Controllable opex
General labour	18.25%	18.01%	16.25%	32.24%	67.26%	42.36%
Specialist labour	33.90%	39.01%	26.80%	45.24%	24.87%	34.96%
Materials (capex)	39.75%	32.87%	37.19%	8.45%	0.00%	0.35%
Materials (opex)	0.00%	0.00%	0.00%	5.59%	2.92%	7.11%
Plant and equipment	4.18%	4.66%	10.54%	4.38%	1.48%	3.26%
Transport	1.52%	1.65%	7.24%	2.05%	2.08%	3.70%
Other	2.39%	3.80%	1.96%	2.05%	1.39%	8.26%

Source: NERA analysis

We calculate the final notional cost structure from Table 5.6 by taking a weighted average of the numbers in each row of Table C.4, using the numbers in Table C.3 as the weights.

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