May 2020

Reference of the PR19 final determinations: Cost efficiency – response to common issues in companies' statements of case

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Cost efficiency – response to common issues in companies' statements of case

This document provides our response to common issues raised by the disputing companies in relation to cost efficiency. Cost efficiency issues which are unique to a specific company are set out in the respective company specific 'Response to statement of case' documents.

Contents

1. Executive summary

Cost efficiency

1.1 Our aim at final determination was to set stretching but achievable level of efficient costs for the companies. As part of this, it is important that we set totex allowances which: incentivises companies to realise efficient costs and drive innovation; gives them the revenues they need to deliver valued outcomes for customers and the environment; while keeping bills affordable for all.

1.2 A number of the issues raised by the disputing companies in their statements of case in relation to cost efficiency are common across companies. This document sets out our final determination approach on these common issues, and our response to the concerns raised by the companies. The issues discussed here largely relate to base costs and the efficiency challenge applied to them. We also discuss our approach to leakage, which cuts across base and enhancement costs and our outcomes framework.

1.3 Throughout PR19 we implemented an inclusive process through the use of consultations and an iterative assessment of business plans, to enable us to build a robust and pragmatic set of models, and a cost assessment process which incorporated engineering, economic and statistical justification, and ultimately set a challenging yet achievable cost allowance.

1.4 We developed an independent view of efficient costs which consists of econometric modelling of historical data, independent view of the forecast of cost drivers and an efficiency challenge that includes a catch-up and a frontier shift component.

1.5 This includes making the appropriate decisions on choice of cost drivers, triangulation approach and aggregation level of the models. Where appropriate we also tested alternative model specifications and thoroughly assessed company evidence to ensure our overall allowance is appropriate.

1.6 Our final determination decision on cost allowances shows that we have evolved from the approach we set out in the initial assessment of business plans to incorporate evidence from company representations on the initial assessment of business plans and draft determinations.

1.7 We have also assessed cost allowances with recognition that they need to be considered with the outcomes package that we have set. In particular, we have

set the performance commitment level and cost allowance for leakage reduction in such a way which incentivises companies to deliver in an innovative and efficient way. That said, we do not consider there is necessarily a trade-off between the two elements.

1.8 In light of changes that followed our draft determinations, we reviewed again the appropriateness of our catch up challenge on base costs. We decided to modestly increase the catch up challenge for final determination. On the other hand, at final determination, our frontier shift assumption moved from 1.5% to 1.1% per year after careful review of a body of evidence from two consultant reports, which analysed in depth the appropriate magnitude and application of frontier shift.[1] We take an integrated assessment of this evidence alongside the totex and outcomes areas to reach our view.

1.9 Cost efficiency issues which are unique to a specific company, for example relating to a cost adjustment claim, are set out in the respective company specific 'Response to statement of case' documents.

Structure of the document

1.10 In the remainder of this document we set out our response to the arguments made by the disputing companies on cost efficiency that we set in our final determinations. Below is a summary of the contents in each chapter of this document.

2. Introduction to our assessment costs: Water sector productivity has stagnated in recent years, while water companies have tended to outperform their cost allowances. Some companies have stepped up and proposed significant reductions in costs over PR19. Overall our cost allowances are similar to company business plan proposals and for three of the disputing companies the stretch is lower than the average for the sector. We consider our level of stretch reasonable in light of a wide body of evidence.

3. Our base econometric models: Over the course of PR19 we have engaged extensively with stakeholders to develop a robust set of econometric models to use in our cost efficiency assessment. Overall, we consider we have achieved a balanced and pragmatic set of models that incorporates engineering, economic and statistical evidence. We use these models alongside other

[1] Europe Economics, 'Real price effects and frontier shift', December 2019.
KMPG and Aqua consultants, 'Innovation and efficiency gains from the totex and outcomes framework', June 2018.

mechanisms and elements of the PR19 framework to exercise appropriate regulatory judgement in the round.

4. Assessment of growth related expenditure: Growth expenditure relates to the additional costs companies incur to accommodate new connections on their network. We consider it appropriate to take an integrated approach to assessing growth related costs, which includes modelling growth expenditure in our base econometric models, supplemented by appropriate post-modelling adjustments and deep dive analysis. We have also introduced the developer services reconciliation adjustment (DSRA) mechanism to protect companies and customers against outturn growth rates that are different to those forecasted for the period.

5. Our approach to leakage: Reducing leakage is important for enabling resilient future supplies as we are face with challenges such as climate change and population growth. Despite this priority being recognised by customers, companies, regulators and other key stakeholders, the sector has failed to significantly reduce leakage over the last 20 years. We have therefore set companies a stretching leakage performance commitment which we expect to be funded through our base allowances in order to incentivise companies to be ambitious, innovative and cost efficient.

6. Our catch-up challenge for base costs: The catch-up efficiency challenge provides a challenge to relatively low performing companies to catch-up with the high performing companies in the sector. Following changes to our data and models, we well as further new information on cost efficiency revealed by companies, we decided to increase the catch up challenge by a small amount. Contrary to representation from some disputing companies, we consider that our decision to strengthen the catch-up challenge between draft determination and final determination is fully justified and the challenge is still relatively conservative.

7. Frontier shift: Our frontier shift estimate of 1.1% is applied on top of our catch-up efficiency challenge as a productivity assumption that all companies can and should improve productivity in 2020-25. The approach we have taken is supported by evidence from historical trends, case studies and experience of other regulatory sectors. Our decision also takes into account other aspects of the regulatory totex and outcomes framework.

8. Real price effects: We make real price effects adjustments to protect companies against the risk of change in the general inflation rate across the economy and this risk being passed onto customers. This benefit is in addition

to other mechanisms, such as the cost sharing, and so we consider there needs to be convincing and sufficient evidence to make an allowance for real price effects. Based on a wide range of evidence, we consider that only labour costs require a real price effect adjustment.

2. Introduction to our assessment of costs

Introduction

2.1 In Delivering W2020: Our final methodology for the 2019 price review,[2] we set out our expectation that water companies make a step-change in efficiency by 2025, allowing them to deliver better services for customers, and to protect and improve the environment, while keeping bills affordable for all. We have set a framework which enables water and wastewater services to be resilient to both short-term shocks and long-term challenges, such as population growth and climate change, and help to deliver this step change.

2.2 We set cost allowances on the basis of the forward-looking efficient cost of providing the required level of service to customers. For wholesale expenditure we set our cost allowances on the basis of the historical efficiency of the better performing monopoly water companies and the frontier shift (or the expected productivity improvement) based on comparator sectors. For retail expenditure we use a combination of historical and forward-looking costs of water companies to set an efficient cost benchmark.[3] We consider it important that poorer performing companies should be expected to face a catch-up efficiency challenge as well as a frontier shift challenge. To encourage efficiency and innovation, we reward companies with high quality, innovative and ambitious plans. We assess investment proposals to ensure customers pay for efficient investment and that they are protected if the investment is not delivered. We expect water companies to provide sufficient and convincing evidence for their proposals.

Background - company performance on costs

Water sector productivity growth has stagnated in recent years

2.3 Despite substantial improvements in water sector productivity post privatisation, productivity growth has stagnated in recent years. The Frontier Economics study for Water UK found that water sector total factor productivity, a measure of productivity growth, grew by 3-4% per year post privatisation, as shown in

[2] Ofwat, 'Delivering Water 2020: Our final methodology for the 2019 price review', December 2017.
[3] Our assessment of historical retail costs found that the water sector was behind other utilities and competitive benchmarks, see PwC, 'Retail services efficiency', September 2017.

Table 2.1.[4] However, since 2011, productivity growth has effectively been zero, even after allowing for quality improvements. This compares to productivity improvements of 0.6% per year in comparator sectors similar to the water sector (see Table 2.1) in the post crisis period.

2.4 In our view it is essential that the sector improves productivity. This is consistent with the Competition and Markets Authority's (CMA) 2019-20 annual plan, in which it has prioritised helping to "address the UK's longstanding problem with low productivity".[5]

Table 2.1: Annual water and sewerage sector total factor productivity growth estimates over price review periods

Period	Total factor productivity average growth per year (no quality adjustment)	Total factor productivity average growth per year (quality adjustment)
1994-1995	2.9%	3.5%
1996-2000	2.2%	4.5%
2001-2005	0.7%	2.0%
2006-2010	1.4%	2.2%
2011-2015	-0.5%	-0.2%
2016-2017	-0.2%	0.0%
1994-2008 Business Cycle 1	1.6%	3.2%
2009-2017 Business Cycle 2 (ongoing)	-0.1%	0.1%
1994-2017	1.0%	2.1%

Source: Frontier Economics[6]

Companies have historically outperformed their expenditure allowances

2.5 We have analysed company historical performance of actual total expenditure versus their allowance in our final determinations and consider that companies have generally outperformed their cost allowances.

[4] Frontier Economics, 'Productivity Improvement in the Water and Sewerage Industry in England since Privatisation – Final Report for Water UK', September 2017, p.3, Figure 2.
[5] CMA, 'Competition and Markets Authority Annual Plan 2019/20', February 2019, p.11.
[6] Frontier Economics, 'Productivity Improvement in the Water and Sewerage Industry in England since Privatisation – Final Report for Water UK', September 2017, p.3, Figure 2.

2.6 Table 2.2 shows that Anglian Water and Yorkshire Water have outperformed their totex allowance in each of the previous four price control periods, Northumbrian Water has outperformed its totex allowance in three of the previous price controls and Bristol Water has outperformed its totex allowance in two of the previous four price control periods.

2.7 Anglian Water, Northumbrian Water and Yorkshire Water have very material totex outperformances over these control periods. In one control period Yorkshire Water has an outperformance of greater than 10%.

Table 2.2: Historical total expenditure performance versus allowances

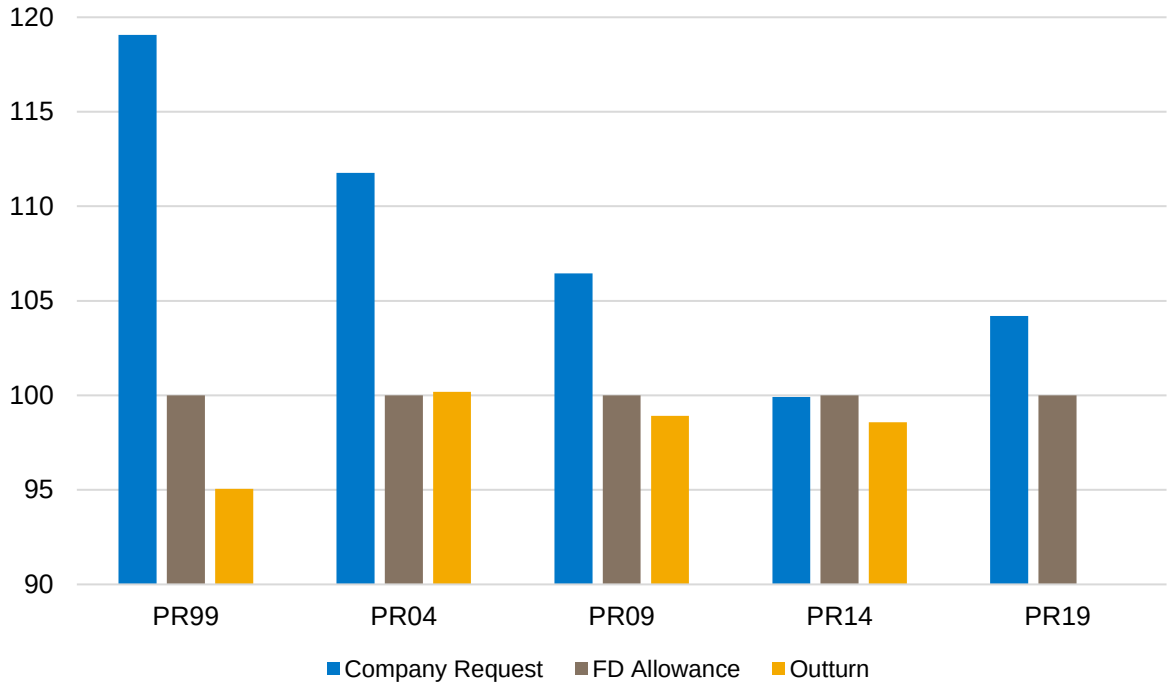
Company	2000-05	2005-10	2010-15	2015-19	Average
Anglian Water	3.5%	1.7%	8.3%	9.2%	5.7%
Northumbrian Water	2.9%	-8.9%	4.4%	9.0%	1.9%
Yorkshire Water	11.9%	0.8%	6.4%	1.9%	5.3%
Bristol Water	3.7%	-0.6%	-5.2%	4.2%	0.5%
Industry	**4.9%**	**-0.2%**	**1.1%**	**1.4%**	**1.8%**

Source: Ofwat analysis of published data. Note 2015-19 figures differ to those in the service delivery report as they are based on figures used in the totex reconciliation process. This includes some updates to actual expenditure and the removal of disallowables from Yorkshire Water's actual totex expenditure for comparison to allowances.

Company business plans are not a good guide to outturn expenditure

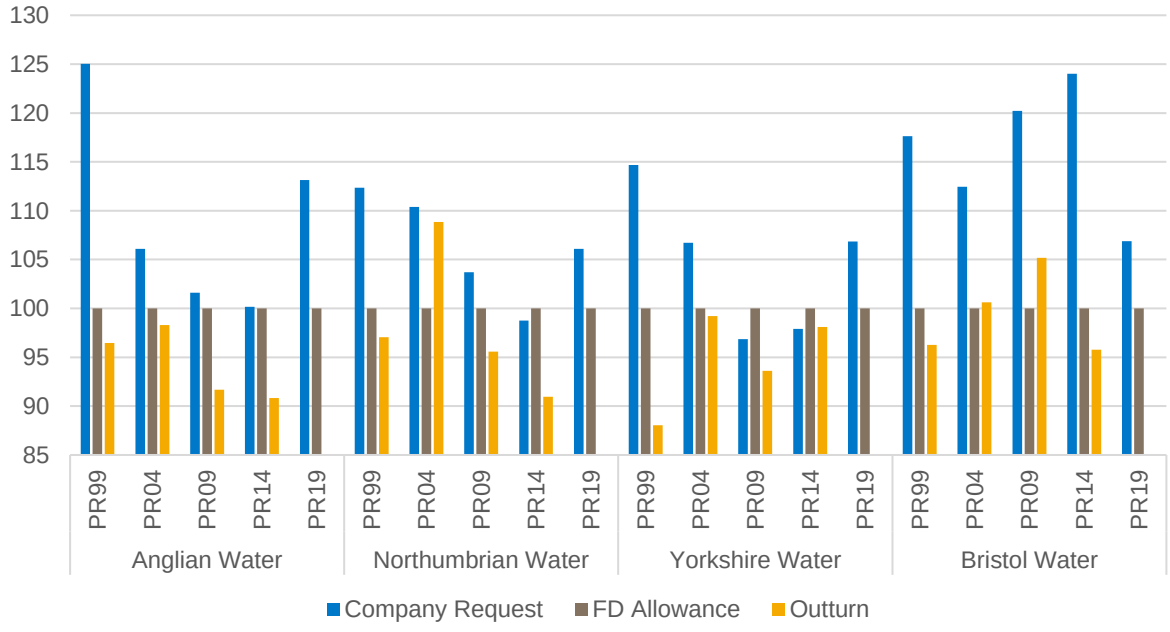
2.8 We have compared company business plans expenditure forecasts to our expenditure allowance and outturn total expenditure. Figure 2.1 and Figure 2.2 show that company business plans have consistently proved to be poor guides to outturn base total expenditure for the past four price review periods. Apart from Yorkshire Water in PR14, each of the four disputing companies business plans have consistently overestimated total expenditure requirements as evidenced in Figure 2.2. While there may be many reasons for this such as scope changes or improvements in efficiency over the period, our expenditure allowances tend to be a better guide to outturn expenditure than company forecasts. All figures are shown relative to our expenditure allowance (which is set equal to 100). Figures are for total expenditure including base and enhancement expenditure.

Figure 2.1: Historical totex comparison of industry expenditure request, final determination expenditure allowance and outturn expenditure



Source: Ofwat analysis

Figure 2.2: Historical totex comparison of company expenditure request, final determination expenditure allowance and outturn



Source: Ofwat analysis

The challenge on base costs for the disputing companies is appropriate

2.9 In our final determinations we set base, or ongoing, cost allowances on the basis of a 1.1% per year improvement in frontier efficiency. We set a catch-up efficiency challenge of 4.6% for wholesale water, 2.0% for wholesale wastewater and 15.4% for retail. This was a lower catch-up efficiency challenge than we set at PR14.[7]

2.10 In comparison to historical base costs, our final determinations reflected a 3.0% efficiency challenge over five years (after allowing for inflation) compared to historical expenditure (see Table 2.3). Overall across the sector our base cost allowances were just 0.4% below company business plans. We consider that our overall level of challenge to company business plans is modest, in particular given previous company outperformance and that company business plans have tended to overstate outturn expenditure. It is also clear that some companies responded to our challenge for a step change in efficiency and proposed base expenditure that was lower than their own historical spend by as much as 15% (see Table 2.3). Six water and wastewater companies had business plan base costs below our efficient level of base costs (i.e. they were more efficient than our baseline). Six companies were given a base allowance in our final determinations that were higher than their historical spend.

2.11 Across the industry, the stretch compared to historical base costs is on average a 3% reduction. The stretch on three out of the four disputing companies (**bolded** in Table 2.3 below) is less than the average stretch of 3%.

[7] See Chapter 6: Our catch-up challenge for base costs.

Table 2.3: Stretch on base costs (total and wholesale only)

Company	Stretch between company view (August 2019) and our final determination for total base costs (wholesale and retail)	Stretch between our final determination and historical wholesale base costs	Stretch between company view (August 2019) and historical wholesale base costs
Anglian Water	**-11.0%**	**-2.7%**	**15.7%**
Dŵr Cymru	-0.6%	-14.5%	-15.1%
Northumbrian Water	**-3.4%**	**-0.7%**	**1.4%**
Severn Trent/ Hafren Dyfrdwy	5.2%	2.0%	-0.5%
South West Water	1.9%	1.5%	-0.2%
Southern Water	-2.2%	-1.6%	7.5%
Thames Water	4.8%	-1.2%	-5.1%
United Utilities	-1.2%	-11.8%	-9.9%
Wessex Water	-1.6%	2.2%	5.0%
Yorkshire Water	**-2.5%**	**-2.9%**	**2.2%**
Affinity Water	-1.0%	-3.1%	3.1%
Bristol Water	**-5.9%**	**-8.7%**	**-2.3%**
Portsmouth Water	11.2%	18.6%	4.3%
South East Water	-0.1%	6.8%	10.5%
South Staffs Water	1.9%	6.4%	6.4%
SES Water	-2.8%	-0.8%	2.0%
Industry	**-0.4%**	**-3.0%**	**-0.6%**

Note: We include enhancement opex in modelled base costs in column 3 and 4, to allow for comparison between historical and PR19 costs. We exclude enhancement opex when comparing companies' view and our final determinations of forecast base costs (column 2). Historical refers to last five years of actual performance (2014-15 to 2018-19). We merge SVT/DVW and SVE/HDD to allow for historical comparison given the reconfiguration of customer base within these companies. Source: Ofwat analysis.

3. Our base econometric models

Our final determination

3.1 An important element of our approach to cost assessment is the use of comparative assessment, to identify companies that are relatively efficient within the sector. Our main tool to carry out the comparative assessment of base costs is econometric modelling. At final determination we used a set of five models to assess wholesale water costs and eight models to assess wholesale wastewater costs.

3.2 Our suite of econometric base cost models at final determination have been developed following an extensive consultative development process, which began in 2016. We have worked closely with stakeholders through our cost assessment working groups and have proactively taken on board stakeholder feedback to improve and select our set of models. We have also consciously taken on board lessons learnt from our 2014 price review and the issues raised as part of the CMA's decision on Bristol Water's PR14 redetermination.

3.3 As set out in our consultation on econometric modelling for PR19 as well as in our PR19 methodology,[8] the assessment criteria and selection of our models was based on the following principles:

- **Specification validity:** use engineering, operational and economic understanding to form expectations of cost drivers, and, assess whether the estimated coefficients are of the right sign and of plausible magnitude.
- **Statistical validity:** consider if the estimated coefficients are statistically significant, and stable and consistent across different specifications; consider the statistical validity of the model more widely using statistical tests and diagnostics.
- Avoid cost drivers which are under reasonable **management control**.

3.4 We supplemented our econometric modelling results with an adjustment process. Companies were able to raise cost adjustment claims and representations throughout the process. We considered those claims and representations and made an adjustment where the claims are well evidenced and appropriate.

[8] Ofwat, 'Cost assessment for PR19: a consultation on econometric cost modelling', March 2018.

3.5 For final determination, we tested a suite of alternative models and used these to assess whether our set of models provided an appropriate and balanced view of company allowances.[9] Overall we found that our models provided an appropriate and balanced view of costs for companies, with the exception of Anglian Water, for which we made an adjustment of £50.2 million to address the issue at final determination.

3.6 Overall, we consider we have achieved a balanced and pragmatic set of models.[10] Indeed, a number of companies acknowledged that we have produced a robust set of models with sensible results, and most companies did not raise significant representations on our econometric models when responding to our draft determinations.

3.7 Our approach has been supported by companies at multiple stages of the model development process:

Table 3.1: Supportive company views on base cost modelling

Company	Source	Quote on cost modelling approach
Northumbrian Water	Northumbrian Water, 'Statement of case', April 2020, p.85, paragraph 407.	"Ofwat's econometric models are robust and appear to be a good predictor of Northumbrian Water's allowance in AMP7"
Dŵr Cymru	Dŵr Cymru, 'Draft Determination Representations WSH.DD.CE.1 Wholesale base expenditure', August 2019, p.3[11]	"Whilst cost modelling is necessarily imperfect as a means of establishing an efficient cost baseline for a complex industry with a small number of companies (resulting in a small sample size), we believe that Ofwat have produced cost models that function as intended and produce meaningful results. The approach to the botex modelling at the IAP was based on consultation with the industry through the cost assessment working group; a process that we consider to be best practice."
Affinity Water	Affinity Water, 'AFW Company response:9 reference AFW-CE', August 2019, p.4[12]	"The methodology used by Ofwat has been subject to extensive consultation over a long period of time and has enabled the selection of a robust model."
Severn Trent Water	Severn Trent Water, 'Cost assessment for PR19 – a consultation on econometric cost	"Ofwat's modelling approach, as presented in its consultation, represents a major improvement on that used for PR14. Ofwat has addressed the majority of the concerns raised by the CMA,

[9] Ofwat, PR19 final determinations: Securing cost efficiency technical appendix, December 2019, pp. 34-35.
[10] Professor Andrew Smith, 'Appendix 2. Statement from our academic reviewers', January 2019, p.39.
[11] Dŵr Cymru, 'Draft Determination Representations: Wholesale base expenditure', August 2019.
[12] Affinity Water, 'AFW Company response: Securing cost efficiency', August 2019.

Company	Source	Quote on cost modelling approach
	modelling', May 2018, p.2[13]	following the Bristol appeal and also applied a much more transparent process."
Wessex Water	Wessex Water, 'Wessex Water response to PR19 Cost Assessment consultation', May 2018, p.3[14]	"We wholeheartedly agree with the principles in your proposed approach, and are pleased to see the outcomes of our discussions with you over the last year at the cost assessment working group (CAWG) reflected in your proposals."

Issues raised by disputing companies

3.8 Northumbrian Water is supportive of our base cost econometric models. In its statement of case, the company notes:

> "Based on our assessment we are supportive of Ofwat's base costs models and we do not currently see any rationale for the CMA to revisit the models in its redetermination of our price control. Ofwat has followed an extensive process in its development, there is a strong rationale behind the estimated models in terms of engineering and economics, and the models have robust statistical performance".[15]

3.9 The other three disputing companies have raised a number of issues. Those issues relate to:

- our choice of models, cost drivers and model accuracy;
- the absence of service quality cost drivers in our selected models; and
- the inclusion of 'growth expenditure' in our base models.

3.10 We discuss those issues below. We discuss separately our assessment of growth expenditure in Chapter 4: Assessment of growth-related expenditure.

Issues relating to our choice of models, cost drivers and model accuracy

3.11 Anglian Water argues that our drivers to account for water treatment complexity are not appropriate. Water treatment complexity reflects both the quality of raw water supplying the treatment works and the processes involved to comply with output quality requirements before being distributed to the network. Water

[13] Affinity Water, 'Cost Assessment for PR19 consultation response, Affinity Water', May 2018.
[14] Wessex Water, 'Wessex Water response to PR19 Cost Assessment consultation', May 2018.
[15] Northumbrian Water, 'PR19 CMA Redetermination Statement of Case', April 2020, p. 64, paragraph 291.

companies report the volume of water treated at treatment works of different complexity levels ranging from 0 to 6 (desalinisation). Higher complexity levels are associated with higher treatment costs.

3.12 In our final determination models, we selected two measures of water treatment complexity as cost drivers: the percentage of water treated at complexity levels 3-6 and the weighted average treatment complexity (where the complexity levels are weighted by the proportion of water treated at each level).

3.13 Anglian Water considers that the percentage of water treated at complexity levels 3-6 is not suitable because there is little surface water treated below level 3. It suggests using the share of water subject to low treatment complexity (2 and below) and the share of water subject to high complexity (level 5 and above).[16]

3.14 We note that using that the percentage of water treated at complexity levels 2 and below is complementary to the percentage of water treated at levels 3 and above. Therefore, both variables would be statistically equivalent. Regarding the company's other proposal to consider the percentage of water treated at levels 5 and above, we found this driver had no effect in our water resources plus models, where we would expect a potential effect. As an alternative measure to account for variation in treatment complexity across companies, we use the weighted average treatment complexity to better capture the full range of treatment complexity levels. This variable is an index ranging from 1 to 7 weighted by the proportion of water treated by each company at each of the seven levels of complexity. With the two measures above, we consider that our models appropriately account for treatment complexity.

3.15 Geographical characteristics and the distribution of demand centres across the region can influence a company's distribution costs through greater requirements to pump and transport water to customers. We use the number of booster pumping stations per length of mains to measure these requirements. Anglian Water considers that we should use average pumping head instead.[17] Average pumping head measures how much water on average is pumped from treatment centres to the network accounting for exogenous factors such as elevation and distance.

3.16 We recognise that average pumping head may offer some advantages over other factors to control for variation in energy requirements across companies.

[16] Anglian Water, 'PR19 CMA Redetermination Statement of Case', April 2020, p.134 paragraph 563.
[17] Anglian Water, 'PR19 CMA Redetermination Statement of Case', April 2020, p.134 paragraph 563.

We tested the average pumping head at different stages of the price review. While the variable worked in some model specifications, it was not robust across other specifications.[18] This may be explained by the fact that **companies reported low confidence grades for this driver's data quality** when compared with the number of booster pumping stations in their data submissions, as shown in Table 3.2. The low quality of average pumping head data was noted also when we quality assured the data and identified large unexplained annual variations for some companies.

Table 3.2: Cost driver confidence grades

	Confidence grades (mode for historical period)		
Company	Number of booster pumping stations	Capacity of booster pumping stations	Average pumping head (distribution)
Anglian Water	B2	B3	C3
Dŵr Cymru	B3	C4	B3
Northumbrian Water	B2	B3	A2
Severn Trent Water	A2	B4	C3
South West Water	B2	B3	B3
Southern Water	B2	C4	B4
Thames Water	A4	C5	B2
United Utilities	B2	B2	B2
Wessex Water	A1	A3	C2
Yorkshire Water	A1	A2	B3
Affinity Water	A2	B2	B2
Bournemouth Water	A2	A2	B3
Bristol Water	B4	B4	C3
Dee Valley Water	A1	A1	B3
Portsmouth Water	A1	B2	A2
South East Water	A2	B3	B2
South Staffs Water	A1	B2	A2
SES Water	A1	A1	B2

Notes: The confidence grade is an alphanumeric code that companies assign to data in their annual performance review submissions. The letter refers to reliability and the number to accuracy.

3.17 We recognise that using average pumping head is an alternative, theoretically valid measure, for a company's energy requirements. For the reasons set out above we did not include this variable in our models to determine an allowance for all companies. However, we considered the impact of this variable through the adjustment process:

[18] We also explain the reason for not using average pumping head in Ofwat, 'PR19 draft determinations: Securing cost efficiency technical appendix', July 2019, p.25.

- The first, SES Water provided a well evidenced representation on energy requirements, supported by evidence on its high average pumping head, which resulted in a cost adjustment for the company. In this opportunity we also considered if the adjustment to SES Water suggested that an adjustment to any other company but concluded that SES Water's circumstance were unique and its cost adjustment claim did not apply to other companies.
- The second, we considered the impact of using average pumping head as a cost driver on companies allowance, albeit as part of a set of five alternative modelling specifications. This resulted in a cost adjustment for Anglian Water only.

3.18 Anglian Water suggests using alternative drivers to determine efficient costs and suggests that, in addition to the number of connected properties, other scale drivers should have been considered such as distribution input.[19] Our scale drivers were selected based on responses to our econometric consultation (March 2017), statistical performance and engineering rationale. Following responses to our consultation, we decided not to use the volume of water as a cost driver in our models.[20] The volume of water (whether abstracted, treated or distributed) is to some extent under management control. Management can reduce leakage, promote demand side efficiency etc. Indeed, a model that uses the volume of water as a scale variable could undermine the same behaviours and performances that we are expecting the sector to critically achieve.

3.19 Anglian Water claims that we adopted models that do not follow economic and engineering rationale.[21] In particular, Anglian Water claims that one of our sewage collection models provides a counter-intuitive elasticity for the variable 'length of sewers'.[22] Specifically, in the model:

$$\ln(\text{costs}) = \alpha + \delta \ln(\text{length}) + \beta \ln\left(\frac{\text{capacity}}{\text{length}}\right) + \gamma \ln\left(\frac{\text{properties}}{\text{length}}\right) + e$$

3.20 Applying log properties, the model can be written as follows:

[19] Anglian Water, 'PR19 CMA Redetermination Statement of Case', April 2020, p.134, paragraph 563.
[20] For example, Northumbrian Water response to our consultation, March 2018, p.6.
[21] Anglian Water, 'PR19 CMA Redetermination Statement of Case', April 2020, pp.137-138, paragraphs 580-587.
[22] Anglian Water, 'PR19 CMA Redetermination Statement of Case', April 2020, p.137, paragraph 582.

$$\ln(\text{costs}) = \alpha + \delta \ln(\text{length}) + \beta(\ln(\text{capacity}) - \ln(\text{length})) + \gamma(\ln(\text{properties}) - \ln(\text{length})) + e$$

3.21 Based on this specification, Anglian Water suggests that the effect of sewer length on costs is given by: δ - β - γ. Results based on the parameters of the sewage collection model presented in our final determinations would, therefore, suggest that sewer length has a negative effect on costs, which contradicts engineering and economic rationale.

3.22 We consider that Anglian Water's argument disregards the proper interpretation of the model. In our model, properties/length is a measure of density and capacity/length is a measure of energy intensity per kilometre. The purpose of the model is that is that δ is the elasticity of length, that is, it captures what happens to costs as a water company becomes bigger, holding the other variables, density and energy intensity per kilometre, constant. This is a reasonable question to ask of our model given that as the length of sewers changes across companies, so does the pumping capacity and the number of properties. To ask the question, what happens to costs when length only increases, means that we are asking the question what happens if we increase length and at the same time decrease the density variable and energy intensity. We do not consider that this is an appropriate question to ask of the model.

3.23 For this reason we consider that it is appropriate to interpret δ as the elasticity of length, β as the elasticity of energy intensity and γ is the elasticity of density. All these parameters have the expected sign.

3.24 The company also states that there is inadequate triangulation between aggregation levels, in particular due to the absence of an integrated wastewater econometric model from our suite of models.[23] An integrated wholesale wastewater model would aim to explain all parts of the value chain which may have fundamentally different cost drivers.

3.25 We explored this level of aggregation but considered that the model results were **not sufficiently robust to make our final selection**.[24] We found a number of issues with wholesale level models. For example, factors that capture economies of scale in treatment often lack statistical significance and/or fluctuate in sign and size between different possible specifications. This could be due to scale having different effects in different parts of the value chain. The effect of density was also ambiguous across different parts of the value chain

[23] Anglian Water, 'PR19 CMA Redetermination Statement of Case', April 2020, p.138, paragraphs 588-590.
[24] Ofwat, 'Supplementary technical appendix: Econometric approach', February 2019, p.19.

(for example, between sewage collection and sewage treatment) and may also contribute to the statistical performance of these models.

3.26 Yorkshire Water raises a new concern on the overall accuracy and performance of the water and wastewater econometric models.[25] The company claims that our econometric models contain a significant amount of statistical noise which leads to inaccurate company efficiency scores and cost allowances. The company provides a report by Oxera,[26] where it aims to quantify the degree of uncertainty and level of confidence in our base econometric models.

3.27 Any statistical model has a degree of error. The report by Oxera does not present alternative model specifications for the water sector which could provide a better approach with higher levels of accuracy. We have taken an open and transparent approach to consult widely with the industry and offered many opportunities for companies to raise concerns and put forward potential solutions. Our approach has allowed us to reach a set of pragmatic and robust models which take into consideration a wide range of issues raised by companies from choice of cost drivers to aggregation levels. Our models are triangulated and complemented with a thorough adjustment process, where we consider cost adjustment claim and company representations.

3.28 The report presents analysis on the confidence intervals around each of our econometric models, and uses stochastic frontier analysis (SFA) to assess whether the estimated inefficiency component is statistically significant. In doing so the analysis ignores that we triangulate different models at different levels of aggregation to form our view of efficient costs. It is also unclear Oxera chose to use a pooled SFA approach, which ignores the panel structure of the data, rather than more suitable stochastic frontier models. Ultimately, what Oxera's analysis demonstrates is that the SFA model cannot easily distinguish statistical noise from inefficiency with the sample size that we have. For this reason SFA is not widely used in regulation in the UK. The stochastic frontier approach also relies on distributional assumptions which can be arbitrary and therefore faces the same challenge as deciding where to set the catch-up benchmark. We provide further discussion on the limitations of using SFA in Chapter 6: Our catch-up challenge for base costs.

[25] Yorkshire Water, 'PR19 Redetermination Statement of Case', April 2020, pp. 61-62, paragraphs 190-193.
[26] Yorkshire Water, 'Annex 10 – Oxera report: Issues with Ofwat's approach to determining the cost benchmark', March 2020.

3.29 Anglian Water claims that our modelling principles lack transparency and have been applied inconsistently.[27] For instance, the company questions our acceptance of our wholesale water models presenting multicollinearity, suggested by a high variance inflation factor (VIF) in the wholesale water models.[28] The VIF is one of a number of statistical diagnostics we considered in our model selection process.

3.30 We discuss standard interpretations of the VIF in appendix 1 to our March 2018 consultation on econometric modelling for PR19.[29] We also explain that when a model includes a variable and its quadratic term the VIF will exceed the standard threshold due to the high correlation between these two related terms. While the high collinearity may impair our ability to accurately estimate the impact of the individual terms on the dependent variable, it should not impair our ability to accurately estimate their collective impact. Since these two terms always move together, the collective impact, measured by the elasticity of the variable, is what is important. The high VIF values identified by Anglian Water are driven by the inclusion of density and its squared term in our models. Table 3.3 shows the VIF tests results when not adding the squared term of density which suggests that the drivers used in our models are not collinear:

Table 3.3: Variance inflation factors for water models

Model	VIF test value (highest)
Water resources plus 1	1.12
Water resources plus 2	1.17
Treated water distribution	1.81
Wholesale water 1	1.04
Wholesale water 2	1.10

Source: Ofwat analysis

The absence of a service quality cost driver in our econometric models

3.31 Yorkshire Water, Bristol Water and Anglian Water raise concerns that our base cost econometric models do not control for service quality as a driver of cost.

[27] Anglian Water, 'PR19 CMA Redetermination Statement of Case', April 2020, p.136, paragraph 570.
[28] As a rule of thumb VIFs above 10 would suggest the model presents multicollinearity. See Introductory Econometrics: A Modern. Approach, Fifth Edition. Jeffrey M. Wooldridge, page 98.
[29] Ofwat, 'Appendix 1 – Modelling results', March 2018, p.4.

3.32 Yorkshire Water sets out this argument in a report by Oxera.[30] The company argues that controlling for service quality allows for better estimates of historical efficiency, and allows to account for the higher costs associated with improving service quality. The company presents a set of alternative models which include two service quality cost drivers, namely, leakage volumes measured by deviations from the sustainable economic leakage level (SELL) per property, and water quality contacts per 1,000 people, which is a measure of the volume of customer complaints relating to specific characteristics of water, such as taste, odour and discoloration. Bristol Water argues that lack of a service quality driver leads to the company appearing inefficient historically. It claims that its base costs were higher in the historical period because it targeted a higher level of service to be delivered from its base allowances, while other companies were delivering a lower level of service in the historical period and are now proposing enhancement expenditure for the same service improvements that Bristol Water has already achieved. It claims that remedying this would increase its allowance by a further £14-£15 million ('service level error').[31]

3.33 To control for service level, Bristol Water reviewed the enhancement proposals from other companies for the 2020-25 period, and identified which proposals it considers relate to achieving the same level of service Bristol Water has already achieved from its base expenditure. The company reallocated around £1.5 billion of other companies' forecast enhancement costs for the period 2020-25 to historical base costs, and re-ran our final determination cost models with the inclusion of the additional enhancement expenditure in the sample period. [32] We discuss this evidence in our response to Bristol Water's statement of case.

Our response

3.34 We do not include service quality variables in our models for a number of reasons. We will discuss each in turn.

- We have tested and **failed to find statistical robustness** of service quality variables;
- The relationship between costs and service quality is **ambiguous** and;

[30] Yorkshire Water, 'Annex 10 – Oxera report: Issues with Ofwat's approach to determining the cost benchmark', March 2020.
[31] Bristol Water, 'Statement of Case', April 2020, p. 85, paragraphs 341-346.
[32] Bristol Water, 'Statement of Case', April 2020, pp. 90-91, paragraphs 360-362 and table C4.

- We are mindful of **statistical concerns** and potential **perverse incentives** related to service quality variables in the context of econometric modelling.

We have failed to find statistical robustness of service quality variables

3.35 In 2017-18, ahead of our consultation on econometric modelling, we engaged CEPA to support us in the development of econometric models for the wholesale water and wastewater controls. As part of this project, CEPA tested a range of service quality variables:

- Leakage
- Total number of sewer blockages
- Total number of gravity sewer blockages
- Total number of sewer rising main bursts / collapses
- Designated bathing waters
- Intermittent discharge sites
- Number of odour related complaints

3.36 None of these variables made the final model selection either because it led to a perverse incentive (e.g. higher allowances for poorer service quality) or did not produce sensible and/or statistically significant results.[33]

3.37 For our March 2018 consultation on econometric modelling for PR19, we invited companies to submit their views. Thirteen water companies submitted their preferred models for our consultation, including the four disputing companies. Overall the companies submitted over 220 models in wholesale water and wastewater activities. None of the models submitted by the companies included a service quality variable. We think that this is quite revealing, in particular given that at that early stage of the process, in contrast to the current stage, companies were much more likely to propose their objective view of models, rather than be motivated to search a model that would close their final determination cost gap.

The relationship between costs and service quality is ambiguous

3.38 Service quality variables have an ambiguous relationship with costs. Low performing companies often have to incur high costs related to reactive repairs and dealing with a large volume of customer contacts. While a company will initially incur costs to improve its performance, it will subsequently reduce costs

[33] CEPA, 'PR19 Econometric Benchmarking Models', March 2018.

associated with reactive repairs (in favour of cheaper, proactive repair) and multiple contacts. It is also the case that poor management can lead to both inefficient costs and poor service performance, or that underinvestment can lead to poor quality of service. When all these effects are considered, the impact on totex is unclear. In principle it is reasonable to assume that an inefficient and low performing company can have a net gain from improving performance while an efficient and high performing company will incur net costs.

3.39 In its report, CEPA assessed the expected sign of the coefficient for the quality of service variables that it had considered. For all of these variables it concluded that the sign may be negative or positive i.e. it is ambiguous.

3.40 We also provide evidence in Chapter 7 of the 'Introduction and overall stretch' document on the ambiguity of the correlation between cost inefficiency and performance levels. In practice, there does not appear to be an inverse relationship between cost efficiency and service quality. Evidence suggests there is a positive correlation albeit relatively weak.

3.41 In this context it is relevant to consider the evidence presented by Yorkshire Water to show that when including certain service quality variables in our models – leakage above SELL per property and quality contacts per person – the company would receive an additional £139 million allowance.[34] We make three observations in relation to these findings:

1. The elasticity of the leakage variable is positive, providing a perverse incentive in relation to leakage – higher levels of leakage provide higher allowances. We do not consider that we can use a model with a positive relationship between leakage volumes and costs. It is in contrast to the behaviours and targets that the sector critically needs to achieve (see Chapter 5: Our approach to leakage, for a discussion on the importance of reducing leakage). We also note that this result is in contrast to claims by high performing companies, such as Anglian Water and Bristol Water, that low levels of leakage require higher costs.

2. The models presented by Yorkshire Water may be quite selective. Yorkshire Water is one of the poorest performers on leakage in the sector. A model that has a positive relation between leakage volumes and costs is therefore bound to provide material additional costs for the company. On the other hand, we have considered five alternative models for final determination,

[34] Yorkshire Water, 'Annex 10 – Oxera report: Integrating cost and outcome', March 2020, p.8, Table 3.2.

based on plausible cost drivers that companies represented on. Our set of alternative models included two models with a leakage variable, but with a negative relation to cost. Our alternative models provide a different result for Yorkshire Water. If we used results from our alternative models together with our original set of models, the company would receive £10 million less in cost.[35] We have not made this adjustment.

3. As we said above, the model presented by Yorkshire Water has a positive relationship between higher leakage volumes and costs whereas the alternative leakage models we have developed have a negative relation with cost. The difference in results may be due to the different approach in which we measure leakage performance. Yorkshire Water measures leakage as the distance from the sustainable economic level of leakage (SELL). We do not consider that it is appropriate to measure leakage relative to SELL, as SELL is a measure influenced by companies' own determinations of costs and benefits and does not represent an objective and consistent approach across the industry.[36] Instead, we measure leakage relative to a normalised upper quartile performance level. Such variable is a more appropriate and consistent measure of leakage performance and is less within management control.

We are mindful of statistical concerns and potential perverse incentives related to service quality variables in the context of econometric modelling

3.42 Service quality is under management control, both in the short and in the long run. Including an explanatory factor that is under management control in an econometric model presents a couple of issues. The first is that the service quality may be correlated with the residual, an issue termed technically as 'endogeneity'. Endogeneity, in turn, means that the estimated coefficients are biased (i.e. their estimation is systematically distorted).

3.43 The second is that inclusion of a factor under management control may provide a perverse incentive for the company. For example, if higher costs are associated with lower performance levels, then companies will be rewarded, and incentivised to continue underperforming, through the model's cost allowance.

[35] Ofwat, Base adjustment model, Sheet 'Analysis', Table 1.
[36] Further discussion on inappropriateness of using SELL is discussed in Chapter 5: Our approach to leakage

3.44 We recognise that, despite the issues raised here, it may be appropriate to include a service quality variable in a model, if such variable were to be found robust, as its exclusion would similarly risk an 'omitted variable bias'. There may be ways to address the endogeneity and perverse incentives issues, although none of the proposed remedies is straightforward. At any rate, as we set out above, we have not found a robust relationship between service quality variables and cost in our econometric models.

3.45 The reasons for not including service quality cost drivers in econometric models was also highlighted and endorsed by the CMA in its 2015 redetermination for Bristol Water.[37] The CMA made the decision not to include service quality variables such as number of properties below reference pressure level, leakage, and number of properties affected by unplanned and planned interruptions more than 3 hours, for the reasons outlined above. The CMA state, "given these issues, it seemed safer to exclude this variable altogether than to include it in the econometric analysis."[38]

3.46 Finally, we note that where appropriate, and in customer interest, we provided additional expenditure for companies to provide service improvements. For example, we provided an additional allowance to reduce leakage for high performing companies. We also provided an allowance for Thames Water to improve its performance on unplanned interruptions and for Welsh Water to improve network water quality. Where companies improve service beyond their performance commitment level they can receive outperformance payments under our outcomes framework. In Chapter 2 of our document 'Outcomes – common issues' we explain why we consider that our base allowance is sufficient for companies to deliver remaining improvements in service.

[37] CMA, 'Appendix 4.2: Supporting information on alternative econometric models', March 2015, pp.27-29.
[38] CMA, 'Appendix 4.2: Supporting information on alternative econometric models', March 2015, p.27, paragraph 131.

4. Assessment of growth-related expenditure

Our final determination

4.1 Growth expenditure relates to the additional costs companies incur that are driven by population growth. This includes, for example, costs related to connecting newly constructed houses or reinforcement work to build additional capacity in the network. We benchmarked growth-related expenditure with base expenditure (which includes operational and capital maintenance expenditure). We summarise growth-related expenditure included within our modelled base costs in Table 4.1 and Table 4.2 below, which was guided by the business plan data tables.[39]

Table 4.1: Wholesale water growth-related expenditure

Activity	Description
New developments	Expenditure for local distribution infrastructure and non-infrastructure assets to provide a water service to new customers.
New connections element of new developments	Expenditure on local network assets associated with new developments in water services (including the cost of a meter, communication pipe and boundary stop tap valve).

Table 4.2: Wholesale wastewater growth-related expenditure

Activity	Description
New development and growth	Expenditure for the provision of new development and growth in sewerage services.
Growth at sewage treatment works[40]	Expenditure to meet or offset changes in demand from new and existing customers at sewage treatment works.
Reduce flooding risk for properties	Expenditure for enhancing the sewerage system to reduce the risk to properties and external areas of flooding from sewers.

[39] Expenditure to reduce the number of properties with low pressure ('addressing low pressure') and expenditure on assets falling within the scope of the statutory transfer of private sewers ('transferred private sewers') were also added to modelled base costs as we consider these costs are related to base costs rather than enhancement, as detailed in our final determinations. See Ofwat, 'PR19 final determinations: Securing cost efficiency technical appendix', December 2019, pp. 15-16.

[40] We include expenditure to enhance growth at treatment works in wastewater, but not in water. In water companies do not separately report costs related to enhancing treatment works. These costs would typically be reported as costs related to balancing supply and demand and are identified as part of the long term water resources management plans.

4.2 This allowed an integrated approach to modelling operational, capital maintenance and growth-related expenditure, which we consider is appropriate for several reasons:

- **Water and wastewater companies have incurred growth-related expenditure in the past** and will continue to incur growth-related expenditure going forward. Dealing with population growth is a routine part of water companies' businesses, as it is in many other sectors.
- **Growth related expenditure can be explained by similar cost drivers to operational and capital maintenance.** Namely, company scale and population density. For example, all else being equal, a large company would be expected to have a greater number of new connections in any given year than a small company. Similarly, some companies have argued that the remoteness of growth from existing assets and the type of property being connected are also drivers of growth costs,[41] which we consider are captured by our density explanatory variables.
- **Our integrated approach mitigates for known company reporting inconsistencies between operating, capital maintenance and growth-related expenditure.** For example, some companies reported zero costs under historical new connections capex because they reported the costs as opex instead, and we are not able to distinguish between 'base opex' and 'growth opex' in the historical cost data (up to 2016-17). Regulatory Accounting Guidelines (RAGs) also allow companies to apply a level of discretion when proportioning costs between growth-related expenditure and capital maintenance. These reporting inconsistencies between companies could therefore make standalone growth and base model results misleading.

4.3 We note that we flagged all these categories of growth costs as suitable for inclusion in our base econometric models already in our March 2017 consultation on econometric models.

4.4 We recognised, however, that our base econometric models may not capture all growth cost drivers, and may lead to the models only funding the average historical growth rate across the industry. We therefore complemented our model outputs with the following:

- **Growth unit cost adjustment** – we made an adjustment to our base allowance depending on whether the company operates in an area with relatively high or low forecast population growth relative to the historical average growth rate for the sector.

[41] For example, Anglian Water, 'PR19 CMA Redetermination Statement of Case', April 2020, p.87, paragraph 372.

- **Deep dive assessment** – we considered if companies presented strong evidence or arguments of material factors that are not captured in our models or by any other adjustments we have made. The assessment was conducted against the cost adjustment claim gateway process and scrutinised through internal governance to ensure that that each company was appropriately and fairly funded for growth related activities given the evidence available.

4.5 A key component of our final determinations in relation to growth related expenditure is our forecast of the number of connected properties, which was based on household growth rate projections produced by the Office for National Statistics (ONS).

4.6 ONS is an independent and widely recognised source of population forecasts. We considered that ONS projections of household growth rates were appropriate to set efficient cost allowances in a manner that protects customers from the risk of over-forecasting growth rates and does not expose companies to undue risk over a five-year regulatory period.[42]

4.7 It is also important to note that for this price review we introduced an additional mechanism, the developer services reconciliation adjustment (DSRA). The DSRA is a true-up mechanism that will be applied at the end of the 2020-25 period. It will reconcile the difference between our forecast and outturn new connections, providing companies with additional revenue for any outturn new connection in excess of our forecast. This substantially protects companies if outturn growth is higher than forecast.

Issues raised by disputing companies

4.8 Northumbrian Water and Yorkshire Water have made limited comments on our approach to modelling growth expenditure. The former challenges the application of the growth negative adjustment;[43] the latter the use of ONS forecasts[44]. We note that Northumbrian Water states that our models forecast its growth expenditure requirements accurately.[45]

[42] Ofwat, 'PR19 final determinations: Securing cost efficiency technical appendix', December 2019, pp. 23-24.
[43] Northumbrian Water, 'NWL PR19 Statement of Case', April 2020, pp.83-86, section 5.6.
[44] Yorkshire Water, 'PR19 Redetermination Statement of Case', April 2020, p.65, paragraph 198.
[45] Northumbrian Water, 'NWL PR19 Statement of Case', April 2020, p.85, paragraph 404.

4.9 Conversely, Anglian Water and Bristol Water raise a number of issues.[46] We summarize all issues below and respond to each in turn:

- the inclusion of growth expenditure in base models;
- the use of ONS household projections to forecast growth rates;
- the growth adjustment; and
- the inadequacy of the DSRA to protect against the risk of higher growth costs.

Issues relating to the inclusion of growth expenditure in base models and the implied unit rates

4.10 Anglian Water and Bristol Water argue that it is inappropriate to model growth expenditure within base models. Anglian Water claims that this approach fails to recognize the lumpy nature of some components of growth costs, and the indirect off-site costs that are related to increases in population growth (such as treatment work upgrades).[47] It also argues that drivers of growth expenditure are not similar to those of base costs, and that the lack of growth scale drivers attenuates the coefficient of the scale drivers. The company submits an additional report by Vivid Economic to explore alternative approaches to modelling, which account for additional cost drivers.[48]

4.11 Bristol Water argues that it was inappropriate to model growth costs together with base because the implied unit rates for growth (i.e. cost per new connection) which result from the modelling approach are lower than the unit rates proposed by the companies.[49]

Issues relating to the use of ONS household projections

4.12 Anglian Water, Bristol Water and Yorkshire Water challenge our use of ONS household projections to forecast connected properties in each company's region. They argue that the ONS methodology states that the data should not

[46] Anglian Water, 'PR19 CMA Redetermination Statement of Case', April 2020, Chapter E.2; and Bristol Water, 'Statement of Case', April 2020, Section 15.
[47] Anglian Water, 'PR19 CMA Redetermination Statement of Case', April 2020, pp.160-162, paragraphs 672-678.
[48] Anglian Water, 'SOC369 Vivid Economics Growth Report', March 2020.
[49] Bristol Water, 'Statement of Case', April 2020, pp.119-120, paragraphs 484-486.

be used as a reliable forecast of growth rates, but rather as a starting point for analysis.[50]

4.13 Anglian Water also points out that Ofwat used the version released in 2018 of the ONS dataset (based on 2016 data), while the only version sanctioned for use by the Government is the 2016 version (based on 2014 data). It claims that the dataset Ofwat used forecasts a lower number of connections than the previous version, because it is based on historical trends which do not reflect step changes in future growth.

4.14 Companies argue that Ofwat should have adopted their proposed forecasts of new connections, which are based on Local Authority planning data and are used in their water resources management plans (WRMPs).

Issues relating to the growth adjustment

4.15 Anglian Water, Bristol Water and Northumbrian Water challenge the growth unit rate adjustment Ofwat made at final determination.

4.16 Anglian Water and Bristol Water, both of which received upward adjustments due to their expected higher growth, argue that this volume-driven adjustment does still not adequately fund their expenditure requirements. Anglian Water says that the adjustment does not account for other cost drivers of growth, is too low and uses a volume of new connections that is too low (because it is based on ONS forecasts).[51] Bristol Water claims that the unit rate used in the adjustment is based on companies' forecasts of cost and connections, resulting in a unit rate which is higher than that implied in our econometric models. The company argues this illustrates the under-allowance made by our econometric models for growth at final determination. It also assumes that this adjustment works in the same way as the DSRA and will be payable at the end of the period 2020-25.[52]

4.17 Northumbrian Water, which received a downward adjustment due to its expected lower growth, argues that the adjustment is arbitrary because there is no evidence that the models overfund companies with slower growth.[53] It

[50] Anglian Water, 'PR19 CMA Redetermination Statement of Case', April 2020, pp.158-160, paragraphs 657-667. Bristol Water, 'Statement of Case', April 2020, pp.117-119, paragraphs 474-483. Yorkshire Water, 'PR19 Redetermination Statement of Case', April 2020, p.65, paragraph 198.
[51] Anglian Water, PR19 CMA Redetermination Statement of Case Corrected, April 2020, pp. 163-164, paragraphs 687-695.
[52] Bristol Water, 'Statement of Case', April 2020, pp.120-121, paragraphs 489-494.
[53] Northumbrian Water, 'NWL PR19 Statement of Case', April 2020, p.85, paragraph 405.

proposes that the negative adjustment is not applied, because Ofwat's models forecast its growth expenditure accurately.

Issues relating to the inadequacy of the DSRA to protect against risk of high growth

4.18 Anglian Water considers the DSRA to be an inadequate protection against the risk of higher growth. It challenges several aspects of the DSRA, namely the scope (which it considers to be too narrow), the unit rate adopted (which it considers to be too low even in comparison with the unit rate implied in Ofwat's models) and the base efficiency challenge applied on the unit rate (which it considers not to be based on any sound evidence or reasoning).[54]

4.19 It proposes that the efficiency challenge on the unit rate is removed, and that the CMA adopts the uncertainty mechanism Anglian Water proposed on water recycling treatment costs in its August 2019 representation to our draft determinations.

Our response

4.20 To allow for easier navigation of this section, our responses follow the same order in which we summarised issues above. Where possible, we group similar arguments by topic within each sub-section.

We complemented our modelling approach to growth costs with deep dive assessments and appropriate post-modelling adjustments, which Anglian Water and Bristol Water disregard in their statements of case

4.21 Anglian Water and Bristol Water argue that the inclusion of growth expenditure in our base models fails to recognise the lumpy nature of these costs and results in low implied unit rates.

4.22 The way these companies have presented their arguments has disregarded the full scope of our assessment of growth-related expenditure in our final determinations: as described above, for our final determinations we adopted an integrated approach to assess base and growth-related costs, which we

[54] Anglian Water, 'PR19 CMA Redetermination Statement of Case', April 2020, pp.167-169, paragraphs 712-727.

complemented with a **growth unit cost adjustment** and **deep dive assessments** of company evidence.

4.23 At the initial assessment of plans stage we assessed growth costs using stand-alone econometric models. Companies challenged these models, arguing, among other things, that they were weak and led to a wide range of unit costs across companies.

4.24 Following this feedback we carefully reconsidered our approach to assessing growth costs. We considered assessing growth costs using bottom up assessments, revised stand-alone models or integrating growth costs into our base econometric models.

4.25 We considered carefully undertaking deep dive assessment of growth costs instead of benchmarking analysis. However, a deep dive assessment, based mainly on the information provided by each company, risks being subjective as company specific data is difficult to assess on its own. Also, it does not incentivise companies to reveal their true efficient costs because their proposed cost is the starting point of our assessment.

4.26 Given that growth costs are inherently comparable we strongly consider that it is preferable to assess them with comparative analysis. Through benchmarking analysis we can obtain an independent benchmark of costs, which incentivises companies to submit efficient costs.

4.27 We concluded that integrating growth costs into our base econometric models was the best option. Growth related expenditure is part of companies' routine expenditure and our explanatory drivers should be appropriate to explain these costs.

4.28 Further, the inclusion of growth costs in our base models better addressed data concerns than stand-alone models (e.g. inconsistencies in company reporting between operating, capital maintenance and growth expenditure; differences in self-lay penetration between companies).[55] Importantly, our base econometric models remained robust to the inclusion of growth costs, which was supported by several companies including Northumbrian Water.

4.29 We consider that the companies have simplified our full approach to assessing growth related costs in our final determinations. **Our final determinations approach combined an integrated approach of modelling base and growth-**

[55] Ofwat, 'PR19 draft determinations: Securing cost efficiency technical appendix', July 2019, pp.16-18.

related costs, together with a growth unit cost adjustment and deep-dive assessments. This aimed to mitigate potential limitations of the integrated modelling approach and ensure that each company received an appropriate and efficient growth allowance. **The DSRA will also retrospectively adjust allowed revenue** in PR24 if outturn growth is more or less than our forecast growth for each company (see below for more details).

4.30 We adopted a **growth unit cost adjustment** at final determination in response to companies' concerns that our base models would not **capture step changes in population growth rates** (we discuss this in more detail in the following sections).

4.31 Our **deep-dive assessments** added a final layer to our growth cost assessment and aimed to ensure that each company received an appropriate base cost allowance to fund growth in their region. Through this step we **systematically reviewed the evidence presented by companies** to decide whether any additional adjustments were necessary.

4.32 We undertook a deep dive assessment for companies that provided sufficient level of detailed evidence: Anglian Water, Northumbrian Water, Yorkshire Water, South East Water, Southern Water, Wessex Water and South West Water.[56] From these deep dives, we made additional adjustments for Yorkshire Water (Hull and Haltemprice investment) and South East Water (intra-zonal schemes).

Our assessment of Anglian Water's additional evidence on modelling growth costs

4.33 Anglian Water in particular provided a large amount of evidence within its draft determination response with regards to growth in their region and the corresponding impact on costs.[57] The company provided further evidence in October 2019, which included a revision of its growth forecasts (which we discuss in the following sections).[58]

4.34 The lack of cost drivers to capture variations in onsite and offsite connection costs was at the heart of Anglian Water's submissions and remains a key part

[56] We did not conduct a deep dive for Bristol Water as the evidence provided was not detailed enough to allow a deep dive assessment to take place. The main issue raised in its draft determination response was in relation to the base models disadvantaging companies experiencing high growth, which we consider we rectified through the growth adjustment in our final determinations.
[57] Anglian Water, 'SOC171 AW DD Growth Expenditure Deep Dive', August 2019.
[58] Anglian Water, 'SOC215 AW Growth Submission', October 2019.

of its statement of case. The company considers there are two key 'complexity' drivers of growth costs that are not captured in our base cost models:[59]

- **Growth intensity** - a company operating in a region with a relatively high growth rate (i.e. intense growth) may incur higher costs associated with reinforcement due to headroom in the network being used up more quickly than a relatively low growth company.
- **Remoteness of growth** - a company operating in a region where new developments are being built in remote areas, away from existing infrastructure, may incur higher costs to connect such properties to the network.

4.35 Following publication of our final determination, Anglian Water's advisors, Vivid Economics, have developed an alternative set of stand-alone growth models.[60] Having considered these models carefully, **we remain of the view that Anglian Water has failed to provide convincing evidence that our base cost models, deep dives and growth unit cost adjustment in combination do not provide a sufficient allowance.**

4.36 Vivid Economics' preferred stand-alone wholesale water and wastewater models contain a measure of scale (e.g. number of new connections), sparsity and growth-intensity (wastewater only), which we assess below:

- **Their preferred wholesale water growth model** includes the number of new connections and growth intensity as explanatory variables. Sparsity / density was excluded as it was not found to be statistically significant and switched signs between different model specifications.[61] The model has an adjusted R-squared of around 86%, which is driven mainly by the new connections explanatory variable given the **growth intensity explanatory variable is not statistically significant.** This is demonstrated by an alternative model presented by Vivid Economics that only includes the number of new connections as an explanatory variable but has an adjusted R-squared of 85%. Overall, this result implies that the main driver of wholesale water growth costs is the number of new connections, which is captured within our base cost models, growth unit rate adjustment and DSRA mechanism. In addition, **the model produces a wide range of efficiency scores**, ranging from 0.49 to 1.75.

[59] Vivid Economics find that the type of property does not have a significant impact on on-site growth costs. Source: Anglian Water, 'SOC369 Vivid Economics Growth Report', March 2020.
[60] Anglian Water, 'SOC369 Vivid Economics Growth Report', March 2020.
[61] Anglian Water, 'SOC369 Vivid Economics Growth Report', March 2020, pp.28-29.

- **Their preferred wholesale wastewater growth model** includes the change in total population served, sparsity (as a proxy for remoteness) and growth intensity as explanatory variables.[62] The model has an adjusted R-squared of around 74% and all explanatory variables are statistically significant at a 5% level. However, **the model produces a wide range of efficiency scores**, ranging from 0.67 to 1.22, and Anglian Water itself acknowledges that it thinks the model produces an efficiency score range that is wider than the plausible range of relative company efficiency.[63]

4.37 Based on the evidence provided, wholesale water growth costs appear to be largely driven by the number of new connections given that the growth intensity variable is not statistically significant. This result may suggest our hybrid approach to assessing wholesale water growth costs is generous given that we take differences in growth intensity into account through our growth unit cost adjustment.

4.38 In addition, the Vivid Economics standalone growth models present a wide range of efficiency scores, which was one of the main reasons why we moved to an integrated base and growth modelling approach. The reporting inconsistencies between operating, capital maintenance and growth expenditure mean that stand-alone growth model results are likely to be misleading. Anglian Water itself admits that the stand-alone models developed by Vivid Economics could be used to inform cost assessment but not necessarily to set cost allowances directly. For these reasons, we remain convinced that our hybrid approach to assessing growth costs is the best approach available and ensures that all companies receive an appropriate allowance to fund growth in their operating region.

4.39 It is also important to reiterate that we consider that **our hybrid approach does take into account growth intensity and remoteness**.

4.40 The growth adjustment was put in place to recognise that our base models may undercompensate companies with relatively high forecasts of population growth (i.e. intense growth). Similarly, we consider the cost drivers in our base cost models capture differences in remoteness between companies:

- Our wholesale water base cost models include population density / sparsity and number of booster pumping stations, which are both related to remoteness.

[62] Anglian Water, 'SOC369 Vivid Economics Growth Report', March 2020, pp.33-34.
[63] Anglian Water, 'PR19 CMA Redetermination Statement of Case Corrected', April 2020, p.170, paragraph 731.

- Our wholesale wastewater base cost models include population density / sparsity, sewer length, pumping capacity per sewer length, load treated in different size treatment works and number of sewage treatment works per property, which are all related to remoteness.

A note on the estimation of implied growth unit rates

4.41 Both Anglian Water and Bristol Water comment on the **implied growth unit rate** (i.e. cost per new connection) resulting from the base cost models.

4.42 It is important to acknowledge that our models do not identify separate allowances for growth expenditure, which is modelled altogether with base costs. It is possible to estimate an 'implied' allowance for growth expenditure, however there are **different approaches**. Therefore, every estimate of an 'implied' allowance for growth expenditure and 'implied' unit rates **is likely to be imprecise and highly sensitive to the approach adopted.** Every estimate is also likely to be imprecise due to historical differences in reporting growth costs between companies (which is one of the reasons we model base and growth expenditure together).

4.43 This point was highlighted by Northumbrian Water in its statement of case who acknowledged that our base models are designed to capture the overall level of efficiency in aggregate and are not designed to capture the implicit allowances for individual cost items.[64]

4.44 Given the variety of different estimation methods, the sensitivity of unit costs estimates, and the wide range of historical and forecast unit costs between companies (which was among the reasons we moved away from stand-alone growth models), **a comparison of implicit allowances and implied unit costs should not be taken as reliable indicator of the appropriateness of the growth allowance**.

4.45 Notwithstanding these limitations, we note that our estimated implied unit costs in both water and wastewater are considerably above the historical unit cost for most companies and may be considered to have favoured the companies.

4.46 We note that Bristol Water argues that our implied unit rate for the company is considerably below the company's own estimate of the cost per new connection (£1,014 per connection).[65] However, Bristol Water fails to consider the additional £3.6 million growth adjustment we allowed to the company. Once

[64] Northumbrian Water, 'NWL PR19 Statement of Case', April 2020, p.129, paragraph 638.
[65] Bristol Water, 'Statement of Case', April 2020, p.120, paragraph 486.

that is taken into account, our estimate of the implied unit cost per connection is £1,014, in line with the company's requested unit cost.

ONS forecasts are appropriate to protect customers from undue risk of over-forecasting

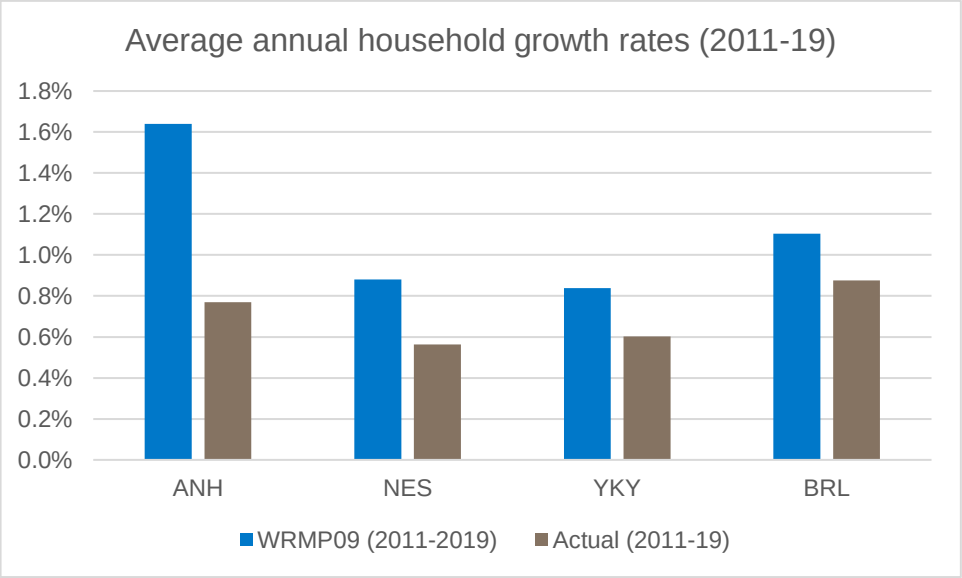
4.47 Developing independent cost drivers is a fundamental step of our approach to setting efficient allowances. It is important that we protect customers from the risk that potentially inflated forecasts of cost drivers will feed into our cost estimates and customer bills. Like any other cost driver, population growth estimates are subject to this risk.

4.48 In their statements of case, Anglian Water, Yorkshire Water and Bristol Water argue that we should have adopted their forecast of population growth, which are based on Local Authority data and follow the same guidance companies adopted to forecast population growth for their water resources management plans (WRMPs).[66]

4.49 **WRMP forecasts have historically over-estimated households' growth.** Figure 4.1 presents a comparison of household forecast growth rates for the period 2011-19 from the disputing companies' WRMP09 plans, and the effective growth rates that took place in same period. **All disputing companies over-forecasted households' growth. This is particularly true for Anglian Water,** whose average forecast rate was over twice the actual growth rate.[67]

[66] Anglian Water, 'PR19 CMA Redetermination Statement of Case', April 2020, pp.158-160, paragraphs 657-667; Bristol Water, 'Statement of Case', April 2020, pp.117-119, paragraphs 474-483; Yorkshire Water, 'PR19 Redetermination Statement of Case', April 2020, p.65, paragraph 198.
[67] We note that the 2007 guidance from the Environment Agency for estimating household growth indicated ONS forecasts as a starting point of household forecast figures. In its WRMP09, Anglian Water indicates that it applied a series of adjustments to these forecasts, namely it combined ONS household forecasts with property targets published by regional and Local Planning Authorities; it revised the draft WRMP to take into account a higher growth rate than experienced historically; and it considered that ONS might underestimate migration, and therefore allowed for headroom for this. See Ofwat, 'C006 AW_WRMP_2010_main_Report', February 2010, p. 26, paragraphs 3.16 to 3.18.

Figure 4.1: Comparison of forecast (WRMPs) and actual household growth rates

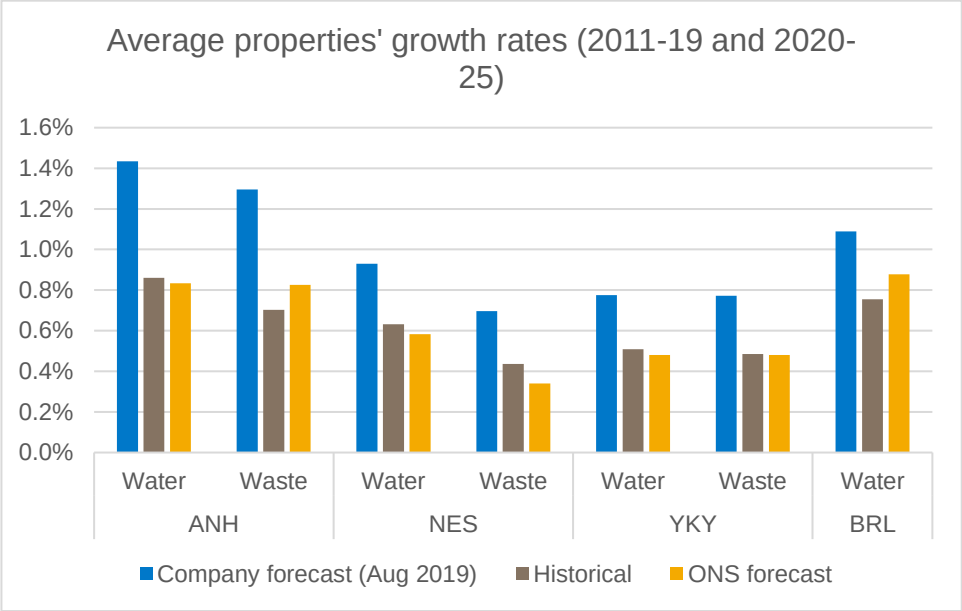


Source: Environment Agency, Ofwat analysis [68]

4.50 Similarly, we note that all companies have forecasted growth rates for the period 2020-25 which are significantly higher than the historical period (Figure 4.2). In particular, Anglian Water's forecast growth rate is almost twice as high as the historical growth rate. This is because projections based on WRMPs guidance tend to be on the upper quartile range of possible growth estimates, where they are used to identify long-term capacity requirements. While this may be appropriate for long-term plans such as WRMPs, over a shorter-term five-year period t**he use of companies' forecasts would expose customers to a risk of over-forecasting population growth**.

[68] WRMP09 data not published online but available on request from the Environment Agency. Historical household growth rates calculated from Ofwat, final determination models, Feeder model 1 wholesale water.

Figure 4.2: Comparison of forecast company view (August 2019) and actual properties' growth rates



Source: ONS, Ofwat analysis [69]

4.51 It is important to adopt independent forecasts of population growth. ONS is a recognised and widely used source to forecast population growth. We reviewed these forecasts at both the draft determination and the final determination stages, and found them to be generally higher than time trends and lower than companies' projections.[70] In the case of Anglian Water, Yorkshire Water and Bristol Water, the forecasted growth rates are similar to or higher than historical rates (Figure 4.2).

A note on Anglian Water's forecast of new connections

4.52 We discuss here in more detail the forecast of connected properties for Anglian Water, who significantly challenged our use of ONS projections.

4.53 There is uncertainty around population growth. We note that **Anglian Water revised its household growth estimates twice in the span of six months**. In its October 2019 late submission, the company reduced the forecast to roughly 75% compared to the forecast included in its August 2019 representation to our draft determination.[71] In its statement of case, Anglian Water states to have

[69] Ofwat, final determination models, Feeder model 3 wholesale water.
[70] This was the case for Dŵr Cymru, Southern Water, Thames Water, Wessex Water, Affinity Water, Bristol Water, SES Water and South East Water, and Anglian Water on wastewater growth rates.
[71] Anglian Water, 'SOC215 AW Growth Submission', p.5, paragraph 11.

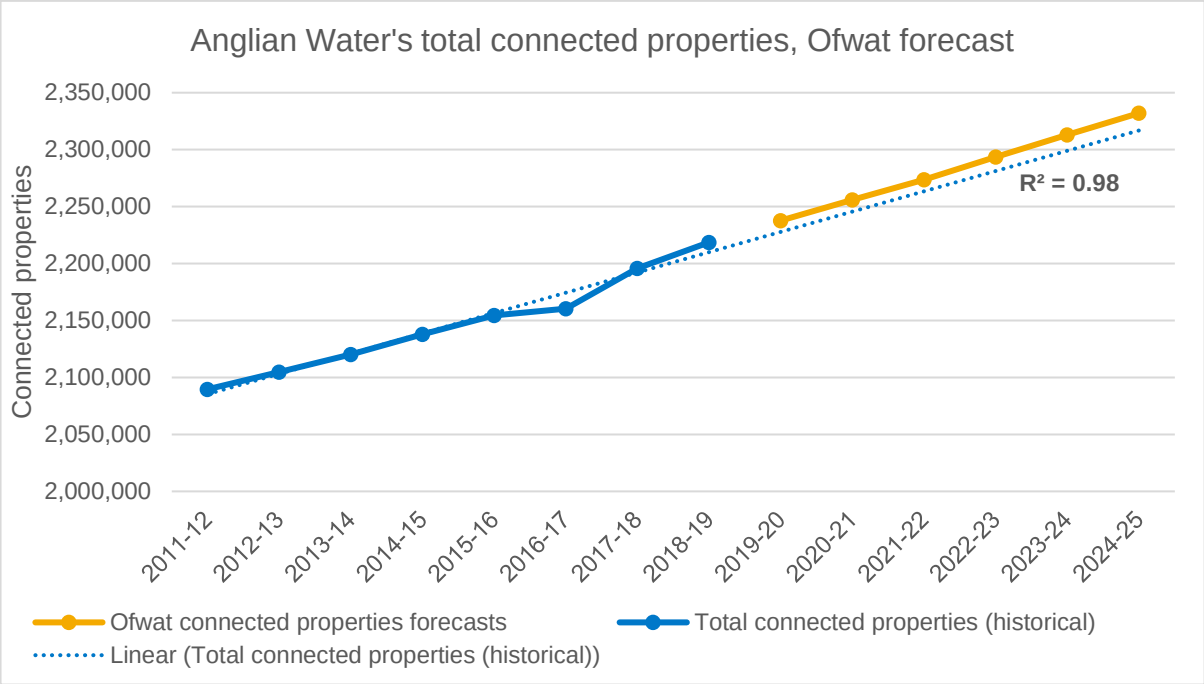
revised its forecast again. The latest forecasts are lower than the August 2019 company view forecasts but higher than to the October 2019 company view forecast (roughly 81% (water) and 84% (wastewater) of the August 2019 forecast).[72]. It is also surprising to see that Anglian Water's latest forecasts represent an increase compared to their October 2019 forecasts given the potential negative impact Covid-19 may have on housing demand and supply across the UK.

4.54 More notably, although Anglian Water revised its new connection forecasts downward by 19% compared to the August 2019 company view forecast, **the company did not revise the requested growth expenditure for the period 2020-25**. This casts doubt over the credibility of the significantly high forecast expenditure the company put forward in its plan, and over the credibility of the suggestion that the expenditure forecast is really affected by growth forecasts.

4.55 **We strongly refute Anglian Water's claim that our forecast of new connections for the company is implausibly low.** Figure 4.3 presents our forecast of total connected properties for the company, which clearly shows that our forecast is in line with, if not slightly higher than, the historical trend. In addition, the statistical relationship between total connected properties and the historical time trend is very strong, with an R-squared (explanatory power) of 98%. We consider this figure clearly demonstrates the reasonableness of our connected property forecasts, which are higher than the forecast trend.

[72] Anglian Water, 'PR19 CMA Redetermination Statement of Case', April 2020, p.159, footnote 370.

Figure 4.3: Ofwat forecast of total connected properties for Anglian Water

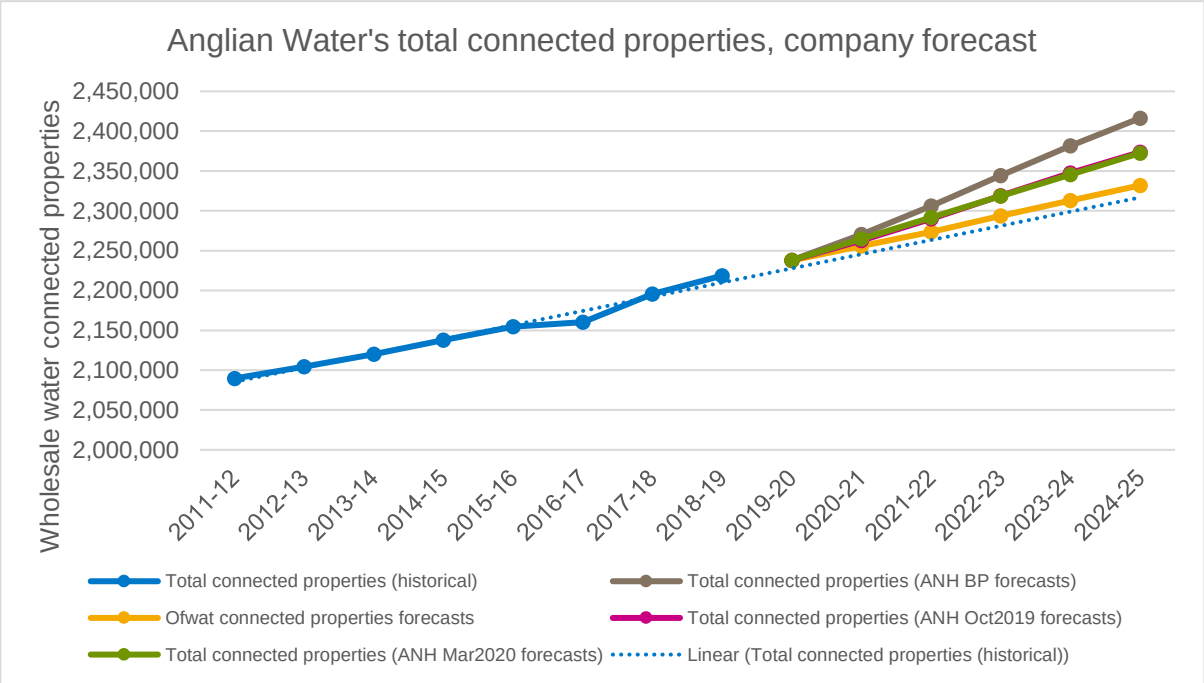


Source: Ofwat analysis [73]

4.56 In its statement of case, Anglian Water argues that there is close alignment between its forecast and the historical linear rate of growth.[74] However, the company's linear time trend is calculated on new connections, rather than total connections. **We consider that this way of presenting the information is misleading**. If we plotted Anglian Water's forecast on a total connection basis, rather than new connection basis, this would clearly show that **Anglian Water's connected properties forecast is significantly above the historical trend and appears overly optimistic** (Figure 4.4). We therefore consider that adopting the company's forecast would expose customers to a considerable risk of over forecasting the number of new connected properties.

[73] Ofwat, final determination models, Feeder model 3 wholesale water.
[74] Anglian Water, 'PR19 CMA Redetermination Statement of Case', April 2020, pp.159-160, paragraphs 666, Figure 48.

Figure 4.4: Anglian Water's forecast of total connected properties



Source: Ofwat analysis [75]

4.57 In addition, total connected properties are reported based on well-known and understood definitions, which minimises the risk of reporting inconsistencies between companies and over time. In contrast, reporting of 'new connected properties' has been found to suffer from reporting inconsistencies between companies for a number of reasons:

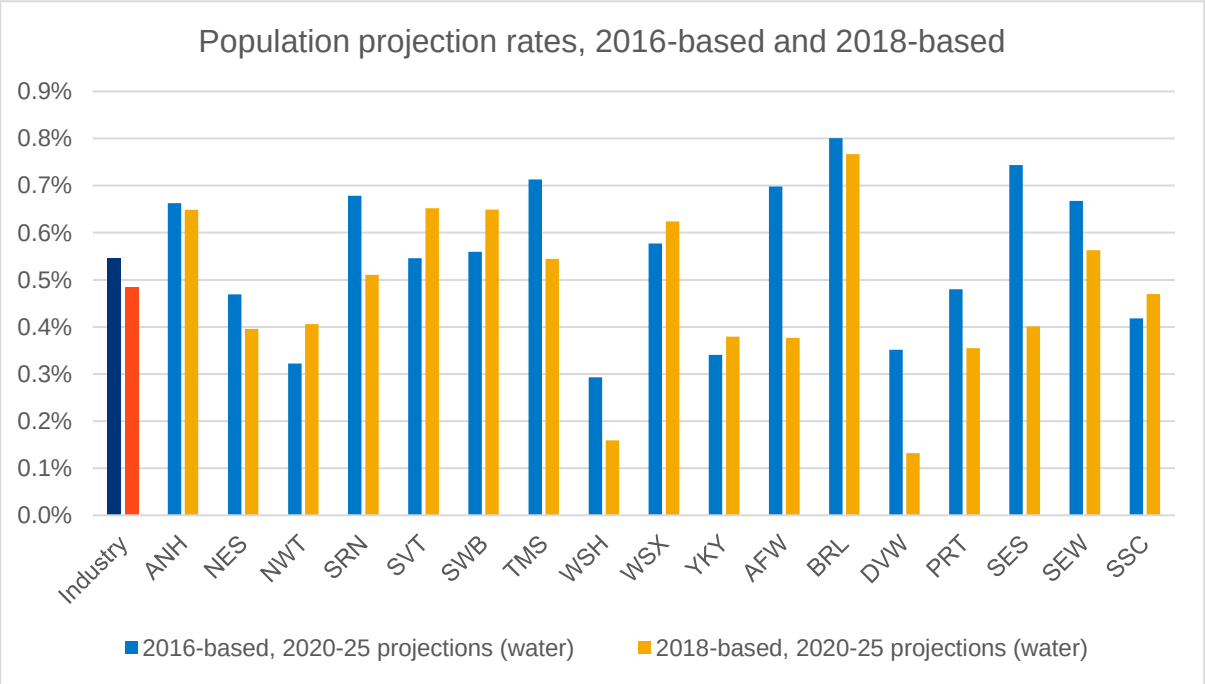
- Some companies reported number of 'new connected properties' whereas other companies reported the number of 'new connections'. All else being equal, we would expect the number of new connected properties to be greater than the number of new connections as there could be instances where multiple properties connected to a single connection.
- Some companies included an estimate of new properties supplied on New Appointments and Variations (NAVs) sites while others did not.

4.58 **The latest ONS population projections predict lower growth rates in the UK, with Anglian Water's population growth not being the highest in the sector.** In March

[75] The historical and company business plan forecasts are calculated from Ofwat, final determination models, Feeder model 3 wholesale water. The revised October 2019 forecast is from Anglian Water, 'SOC215 AW Growth Submission', October 2019, p.5, paragraph 11. The March 2020 forecast is from Anglian Water, 'PR19 CMA Redetermination Statement of Case', April 2020, pp.159-160, paragraphs 666, Figure 48.

2020 the ONS released updated population growth forecasts, based on 2018 data.[76] While our forecasts of growth rates are based on ONS household projections rather than population projections, the latest evidence on population projections can still provide useful insight.[77] Compared with the previous projections (based on 2016 data), the latest figures predict lower population growth in most company regions (Figure 4.5). In the next regulatory period, growth in the Anglian Water region is predicted to be in line with that of the Severn Trent and South West Water regions, and it is not the highest in the sector (Bristol Water). Although population projections do not perfectly align with household projections, it is clear that there is no evidence in support of Anglian Water's own projections, which are significantly higher than any other company's prediction.

Figure 4.5: Comparison of 2016-based and 2018-based ONS population projections (water)



Source: ONS, Ofwat analysis [78]

4.59 **Companies are largely protected against the risk that our forecasts might be understated**. Firstly, the price control is re-set every five years, which means that our projections will be updated multiple times over a 25-year period.

[76] ONS, Subnational population projections for England: 2018-based.
[77] For example, Anglian Water states population is a more important driver of off-site and treatment growth costs than the volume of connections. Anglian Water, 'PR19 CMA Redetermination Statement of Case', April 2020, p.83, paragraph 359.
[78] Data for English companies from ONS, Population projections for local authorities: Table 2. Data for Welsh companies from Welsh Government, Local Authority projections, 2018-based and 2014-based.

Secondly, this price review introduced a new mechanism to reconcile forecast with outturn new connections (i.e. the DSRA), meaning that companies will be refunded for the cost of every outturn connection in excess of our forecasts. This is a considerable additional protection which companies did not have in previous price reviews. The cost sharing mechanism also protects companies' investment, by sharing the risk of under-forecasting with customers.

4.60 Anglian Water argues that the Government did not sanction the 2016-based ONS dataset for use in planning and that the Government considered the 2014-based dataset to better reflect the objective of significantly boosting the supply of homes. We adopted the 2016-based dataset because it reflects the most updated view of population forecasts, and although it may forecast lower growth rates than the 2014-based dataset, it would have been inappropriate to discard the latest and most updated evidence. In addition, the ONS went through an extensive consultation process on the methodology for the 2016-based projections, to make improvements from the 2014-based methodology.[79] Therefore, the latest 2016-based dataset reflects the most updated and accurate position on households' projections. In fact, the latest projections on population growth predict even lower growth rates (as discussed above).

4.61 Overall, we maintain our position that it would not be appropriate to adopt companies' forecasts based on Local Authority data from their WRMPs. These forecasts have historically proven to be high. Latest evidence highlights a downward trend in population growth, and confirms that Anglian Water is not expected to be the region with the highest population growth.

4.62 **Finally, we note that the impacts of Brexit and more importantly of COVID-19 have not been taken into account in our forecasts of household growth** (nor in the latest Office for National Statistics (ONS) population projections). In the current weeks we are witnessing a halt in new developments due to the restriction measures adopted in the country. The possibility of a housebuilding recession increases the likelihood that outturn new connections in the next five years might be well below ONS forecasts.

The growth unit rate adjustment is a sensible and pragmatic approach to refine our assessment of growth expenditure

4.63 While our econometric models provide a sound basis for assessment of efficiency, it is appropriate to consider any limitations of the modelling and make relevant adjustments. At final determination, we applied a growth unit rate

[79] ONS, Methodology used to produce household projections for England: 2016-based.

adjustment in response to companies' representations that the base models would not adequately fund any step changes in population growth, which is a largely exogenous factor.

4.64 The principle behind our adjustment for growth is **intuitive.** It provides an upward or downward adjustment to the company's allowance depending on whether the company operates in an area with relatively high or low forecast population growth, relative to the historical average growth rate for the sector. For each company, we calculate the forecast number of new connected properties above or below the historical average growth rate, and multiply it by the efficient historical unit cost.[80]

4.65 Our adjustment for growth has **sound rationale** for its application. Northumbrian Water argues that there is no evidence that the models overfund companies with lower growth.[81] However, as we explained in our final determinations,[82] our models may suffer from missing variables to capture growth, due to data quality challenges in this area. This means that our models may fund the historical average growth rate across the industry. This would not capture step changes in population growth and would result in the overfunding of companies with expected growth rates that are lower than the historical average, and underfunding of companies with expected growth rates that are higher. Therefore it is appropriate to make an adjustment which reallocates expenditure from companies with expected lower growth to companies with expected higher growth. We also note that we took a **conservative approach to the negative adjustment**, by halving it.

4.66 Anglian Water considers that the unit rate applied is too low.[83] The unit rate we applied is the efficient historical cost per new connection, in line with our expectation that our models should fund the efficient cost. Anglian Water also argues that the adjustment is too low and that Ofwat did not sense check the validity of its growth allowances against any other evidence. However, at both draft determination and final determination we carried out separate deep dive assessment for several companies, evaluating the additional evidence provided in support of their higher requested expenditure to determine whether there were any material factors not accounted for in our approach.

[80] See Ofwat, 'PR19 final determinations: Securing cost efficiency technical appendix', December 2019, p.22 for a detailed description of the calculation of the growth adjustment.
[81] Northumbrian Water, 'NWL PR19 Statement of Case', April 2020, p.85, paragraph 405.
[82] Ofwat, 'PR19 final determinations: Securing cost efficiency technical appendix', December 2019, pp.20-21
[83] Anglian Water, 'PR19 CMA Redetermination Statement of Case', April 2020, p.164, paragraph 694.

4.67 **Bristol Water appears to have fundamentally misunderstood how we calculated and applied the growth adjustment.** The company states that Ofwat made an off-model adjustment for growth using the DSRA.[84] The growth adjustment we applied at final determination is very different in nature and application from the DSRA.

4.68 The DSRA is a true-up mechanism that will be applied at the end of the 2020-25 period to protect companies against the risk of higher outturn growth, and the reconciliation will be based on the difference between our forecast of new connections and outturn new connections.

4.69 The growth adjustment is not a true-up mechanism but forms part of a company's allowance for the period 2020-25, and was applied to correct for the fact that our models may fund companies based on the average historical growth rate. Moreover, the growth adjustment does not use Bristol Water's forecast new connections and costs, contrary to what is stated by the company. Given Bristol Water's misunderstanding of the growth adjustment, we consider that the company's claim that our growth adjustment is flawed is not credible.

4.70 Overall, the growth adjustment is a balanced and robust solution adopted in response to companies' representations, with a clear rationale and intuitive calculation. It forms part of a bigger picture on how we assess growth expenditure, which includes additional deep dives and the application of DSRA true-up mechanism at the end of the period.

4.71 We note that, while Anglian Water and Bristol Water are arguing the adjustment is not sufficient and uses a unit cost and volume driver that are too low, Northumbrian Water argues that the adjustment should be removed altogether. The **opposite arguments companies are presenting** are a reflection of the symmetrical nature of the adjustment. If the CMA were to disagree with our approach, we suggest that the CMA looks at arguments across all disputing companies, and forms a consistent view of the issue.

Our overall framework offers considerable protection against the risk of higher growth, and we do not consider there is a need for an additional uncertainty mechanism

4.72 PR19 offers companies protection against higher than expected growth through three main mechanisms:

[84] Bristol Water, 'Statement of Case', April 2020, p.120, paragraph 489.

- The developer services reconciliation adjustment (**DSRA**) mechanism provides a volume driver revenue adjustment for new development costs.
- The **cost sharing mechanism**.
- The **resetting price control determinations every five years**, which provides the opportunity to adjust for high growth rates.

Our response to issues raised in relation to the DSRA

4.73 In its statement of case, Anglian Water raises some challenges in relation to the scope (arguing it is too narrow), unit cost (arguing it is too low) and efficient challenge applied to the unit cost of the DSRA (arguing it is too high).[85] We provided a detailed response to each of these issues at final determination.[86] In summary:

- The objective of the DSRA was to encourage timely and high quality new connections. Broadening the scope of the DSRA to include broader-related growth costs, as Anglian Water suggested in its response to our draft determination, would not better achieve this. Wider growth-related costs are covered by cost sharing arrangements.
- The unit cost adopted is based on companies' forecasts. This would implicitly reflect the unique characteristics of each company, such as the degree of self-lay penetration, the mix of brown and greenfield development, etc.
- We consider it is appropriate to apply the base cost efficiency challenge to the DSRA unit costs given that developer services are a key component of base costs. In turn, this ensures alignment between the DSRA mechanism and cost assessment.

4.74 No other company has argued for a different approach and companies in general appear to support the proposed DSRA based on the feedback we have received.

4.75 In combination, we consider that our final determinations provide water and wastewater companies with sufficient protection against high growth. In fact, the introduction of the DSRA provides an **additional level of protection that was not provided in PR14**.

[85] Anglian Water, 'PR19 CMA Redetermination Statement of Case', April 2020, pp.167-169, paragraphs 712-727.
[86] Ofwat, 'PR19 final determinations: Our approach to regulating developer services', December 2019, pp.6-17.

4.76 However, in its representations on the draft determinations Anglian Water put forward the proposal for three additional uncertainty mechanisms on growth costs. In our final determination, we rejected all three mechanisms.[87]

4.77 Anglian Water is now requesting that the CMA consider the adoption of the third of these mechanisms, i.e. a mechanism for costs related to enhancements to sewage treatment works.[88] **We maintain the position that there is no need for additional special protection for Anglian Water.** The adoption of this mechanism would lead to distortive incentives for the company, and lead to decisions that are not in the best interest of customers. [89] [90]

4.78 Our cost assessment approach at price controls is to set a fixed totex allowance, in advance, for a period of five years. This approach has provides incentives for companies to seek efficiencies during the price control period, and provides stability for customers and investors.

4.79 Making an exception to this approach may be appropriate in certain cases. For example, introducing a volume adjustment can protect customer and companies from forecasting error of future volumes. For this reason we introduced a volume driver to our retail control, where the majority of costs are "marginal costs" that vary one-to-one with customers. And we introduced a volume adjustment for new development costs, that is for onsite and closely related offsite costs that vary one-to-one with housing growth.

4.80 However, unlike the cases above, costs related to enhancing sewage treatment works are not 'marginal' costs and do not vary one-to-one with population growth. The risk of incurring additional sewage treatment enhancement costs as a result of unexpected growth is lower than in retail or in new connections, and in any case can be mitigated by effective long term planning. On the same token, enhancements to water treatment works are identified in the long terms water resource management plans of companies, and are not subject to an uncertainty mechanism.

4.81 We are concerned that **the proposed mechanism could distort company decision-making** and lead to sewage treatment capacity increases taking place during PR19 that were not originally in its plans given the added certainty the

[87] Ofwat, 'PR19 final determinations: Anglian Water – Cost efficiency additional information appendix', December 2019, pp.22-24.
[88] Anglian Water, 'PR19 CMA Redetermination Statement of Case', April 2020, p.169, paragraph 727.
[89] We would like to clarify that we did not misunderstand the proposed measure as being related to the volume of wastewater treated. We understood that the mechanism was based on sewage treatment capacity created.
[90] Ofwat, 'PR19 final determinations: Anglian Water – Cost efficiency additional information appendix', December 2019, p.24.

mechanism would bring in terms of cost recovery. The mechanism may therefore lead the company to adopt short term decisions that are not optimal for the long term or in the best interest of consumers.

4.82 We also consider the mechanism could be **challenging to implement effectively and may lead to unintended consequences**. The mechanism would operate against a baseline level of capacity that is expected to be delivered with the ex-ante base cost allowance. Determining the baseline level of capacity may be difficult. Especially since Anglian Water have changed its growth forecasts on two separate occasions since its original PR19 business plan. This may mean that the mechanism is triggered at the incorrect level of capacity, which **could lead to consumers funding investments twice**.

4.83 **Finally, other wastewater companies also operate in relatively high-growth areas and have not requested an additional uncertainty mechanism for growth at sewage treatment works.** This suggests that other wastewater companies support our position that growth at sewage treatment works investments are best funded through an ex-ante allowance and do not require an uncertainty mechanism. It may also be considered unfair to give additional special protection to Anglian Water given that other wastewater companies also face similar circumstances.

Concluding remarks

4.84 Dealing with population growth is a routine part of a water company's business, as it is in many other sectors.

4.85 We have adopted a comprehensive approach to assessing growth-related expenditure. Through our combination of econometric modelling, growth adjustment and deep dives we are confident that all disputing companies have been suitably assessed and funded. The DSRA, cost sharing mechanism and overall regulatory framework will ensure that companies are protected from undue risk of higher outturn growth.

4.86 Anglian Water and Bristol Water are the two disputing companies which raise significant issues with our approach to assessing growth costs, claiming that our approach leaves them materially unfunded.

4.87 Our analysis for Bristol Water indicates that, if the company's forecast of new connection was to materialise, the additional revenue the company will receive

(£5.6 million) will fund the company for any remaining difference between our allowance and the company requested cost.[91]

4.88 Anglian Water revised its forecast of new connection twice in the last six months, forecasting a lower number of new connections, but did not revise its requested cost. This fundamentally undermines the credibility of the cost gap which the company claims has not been funded.

[91] We discuss this in more detail in Ofwat, 'Reference of the PR19 final determinations: Response to Bristol Water's statement of case', May 2020, Chapter 3.

5. Our approach to leakage

5.1 In this chapter we explain our approach to leakage at PR19. We explain the importance of leakage and long terms ambitions, the stagnation in the sector over the last 20 years and, against this backdrop, our policy at PR19.

5.2 We explain how we set performance commitments for leakage reductions and how we expect companies to achieve their commitments. We also explain the circumstances in which we have made an additional allowance for companies to reduce leakage to reach their performance commitment.

A focus on leakage

5.3 Leakage is a high profile and important issue for customers, companies and regulators. Reducing leakage levels is important for ensuring resilient future supplies as we are faced with challenges such as climate change and population growth. Many customers see reductions in leakage as a prerequisite to taking steps to reduce their own water consumption.

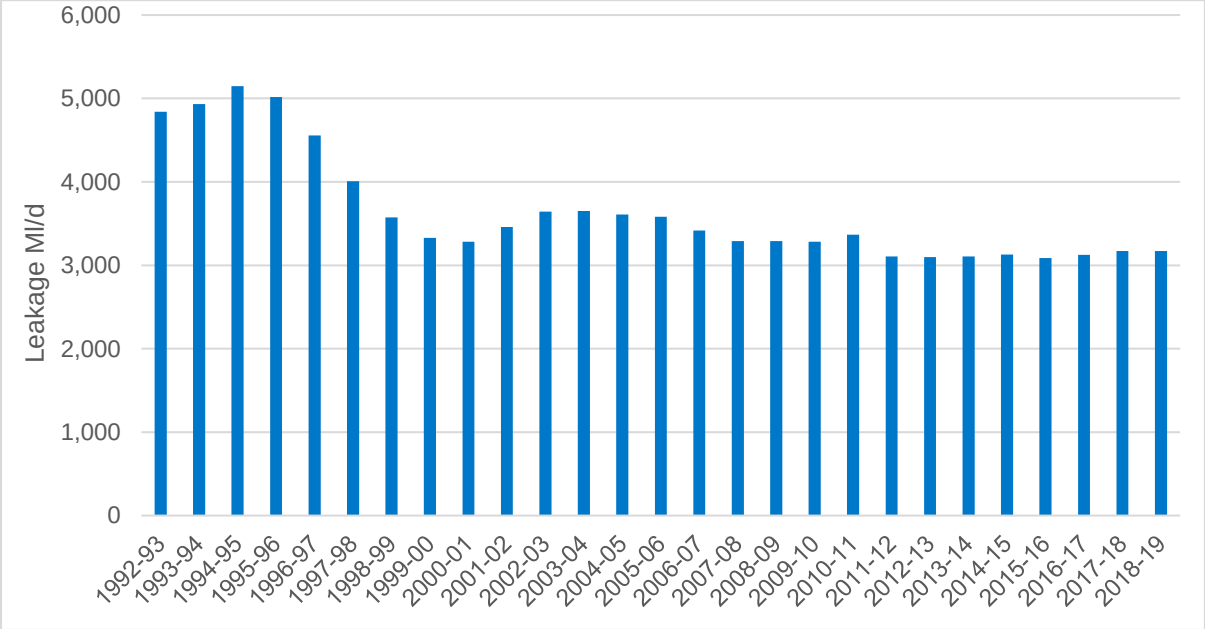
5.4 The need to make significant reductions in leakage is recognised by companies, regulators and other key stakeholders. The National Infrastructure Committee **recommended a 50% reduction by 2050** and companies have committed to this target.[92] A 50% reduction by 2050 was also included in the National Framework for Water Resources, which was published by the Environment Agency in March 2020.[93] The National Audit Office also recognised the importance of reductions in demand in its March 2020 report.[94]

5.5 Despite the importance of leakage in light of current challenges, the sector as a whole has failed to significantly reduce leakage since 2000. The current level of leakage is about 21% of total water supplied by the industry, equivalent to about 53 litres per person per day.[95] Since 2000-01 to 2018-19 the sector has achieved little overall reduction. Leakage levels have reduced by only 3.5%, an annual average of less than 0.2% reduction—almost a flat profile—despite

[92] Companies committed to the 50% reduction from 2017-18 levels in a letter from Water UK to the Secretary of State on 17/10/2018. The reduction was a recommendation from the National Infrastructure commission, 'Preparing for a drier future: England's water infrastructure needs', April 2018, p.13.
[93] Environment Agency, 'Meeting our future water needs: a national framework for water resources', March 2020, p.13.
[94] National Audit Office, 'Water supply and demand management', March 2020, p.6.
[95] Leakage, distribution input and population served data from company annual performance reports 2018-19. For context, in 2018-19 average per capita consumption was 143 litres per person per day.

large technological improvements over the same period. The modest reductions over the last 20 years contrast to the significant reductions achieved following the 1995-96 drought, where the sector achieved a greater than 30% reduction in leakage.

Figure 5.1: Industry leakage levels 1992-93 to 2018-19



Source: Ofwat analysis [96]

Our expectations for companies' leakage reduction at PR19

5.6 As the economic regulator of the water sector we aim to incentivise companies to efficiently deliver great outcomes for their customers and the environment. The stagnation in leakage reduction across the sector over the last 20 years is disappointing, particularly in the light of the long term challenges facing the sector from population growth and climate change. Making better use of water resources by reducing leakage is an important element of addressing these challenges. It is vital that companies turn around their performance on leakage. That turnaround needs to begin now and be sustained into the future.

[96] Following a query to Anglian Water the figures pre-2003-04 have been adjusted from previous published data to account for the impact of the 2001 census on the leakage performance of both Anglian Water and Northumbrian Water. Ofwat, 'Security of supply, leakage and the efficient use of water', December 2004, p.26. Anglian Water's leakage figure for 1996-97 has been adjusted to reflect an amendment recognised in 1997-98. Ofwat, '1997-98 Report on leakage and water efficiency', October 1998, p.11, note 3.

5.7 We believe that the scale of technological change over the last 20 years has been underexploited by the sector and that, if properly utilised, technology can enable companies to significantly step up leakage reduction at PR19. The National infrastructure Committee also considered that "an ambitious long-term strategy to reduce leakage would help encourage action by customers and incentivise technological innovation, which in turn should drive down the costs of managing leaks".[97] It is important that we build on the recommendations and ambition to halve leakage by 2050 and challenge the sector to make a strong start towards achieving this goal.

5.8 For this reason, we challenged companies in our PR19 methodology in 2017 to achieve a stretching leakage performance commitment of 15% leakage reduction (one percentage point more than the largest leakage reduction commitment at PR14). Our aim was to encourage companies to innovate, exploit existing and new technology and to revise business processes to reduce leakage, rather than just doing more of the same techniques used in the past. We wanted to see a step up in performance. We therefore set out that we expected the 15% challenge to meet from within base funding. We note that the 15% reduction was not a requirement: rather, it was one of three challenges on leakage that we set in the methodology to encourage companies to stretch themselves. We also have taken account of the increased stretch from the 15% reduction in leakage in our consideration of the level of frontier shift in cost efficiency.

5.9 Despite being explicit that companies can make the case for leakage reductions that do not meet our 15% challenge, we were pleased that **all companies accepted the challenge**. Companies' commitment to leakage reduction will support the message that we all need to use water more wisely. However, a number of companies sought additional funding to achieve this improvement.

Setting leakage performance commitment levels at PR19[98]

5.10 We defined the common leakage performance commitment as a percentage reduction in three-year average leakage value from the actual 2019-20 position to 2024-25. We adopted a three-year average to smooth variations due to weather. However, the 15% reduction in leakage by 2024-25 challenge set out

[97] National Infrastructure commission, 'Preparing for a drier future: England's water infrastructure needs', April 2018, p.11.
[98] The description of our approach was previously included in our day one submissions. Ofwat, 'Reference of the PR19 determinations: Key elements of the methodology appendix', March 2020, pp. 13-14.

in the PR19 methodology is measured on an annual average basis. In many cases, the leakage reduction measured over three years will differ from an annual average basis and this is taken into account in our setting of leakage performance commitment levels.

5.11 For Anglian Water, Bristol Water, SES Water and South East Water we allowed additional expenditure to reduce leakage to achieve their performance commitment level, recognising their sector leading performance. We discuss our funding approach in the next section.

5.12 For other companies we set the performance commitment at a level that reflects a 15% reduction in leakage by 2024-25 (on an annual average basis). This is consistent with the challenge proposed in the PR19 methodology and the level that those companies proposed in their business plan.[99] Where companies proposed leakage reductions greater than 15%, we considered whether these reductions were deliverable within our base allowance, and if not adjusted the performance commitment to a lower level of stretch. This means that these companies will receive outperformance payments for delivering the level of reduction beyond 15%, recognising that they are delivering beyond a stretching performance level.

5.13 For Anglian Water, Bristol Water and South East Water, we aligned their performance commitment with their leakage reduction strategy in their water resources management plans. This resulted in a performance commitment of 16.4%, 21.2% and 9.7% for these companies respectively (on a 3-year average basis). We note that this increase in performance commitment for these companies does not represent an additional stretch on cost efficiency, as for these companies we allowed additional costs to reduce leakage for volume reduction beyond the upper quartile level and up to their performance commitment level.

5.14 Further detail regarding our setting of company specific performance commitment levels is included in our final determinations.[100]

[99] The 15% leakage reduction was defined in comparison to 2019-20 performance commitment levels as specified in our PR14 final determinations. Further, it was considered on an annual average basis rather than three-year average basis because this was the most commonly adopted format for PR14 performance commitments.
[100] Ofwat, 'PR19 final determinations: Delivering outcomes for customers policy appendix', December 2019, pp.36-40.

The sustainable economic level of leakage

5.15 The sustainable economic level of leakage (SELL) is meant to represent the level of leakage that offers the best value for money for customers. Reducing leakage below SELL would be more expensive than the cost of abstracting, treating and distributing additional water, including the indirect social and environmental costs. Historically SELL was used to establish regulatory leakage targets.

5.16 As part of the development of our PR14 methodology, we commissioned a review of SELL.[101] The review found that SELL tends to reinforce the status quo and does not incentivise efficiency or innovation. The report highlights that there are many uncertainties in estimating SELL, particularly in incorporating the social and environmental costs of leakage. An increase in the value placed on water will reduce the SELL. Last, a company's SELL is evaluated based on the company's own costs of reducing leakage, such that companies that are inefficient in reducing leakage will have a softer level.

5.17 The National Infrastructure Committee report, which recommended halving leakage by 2050, has found that there was an economic case for reducing leakage further when compared against the costs of developing supply options, such as reservoirs. We do not consider that the continued use of SELL in setting performance commitment levels would drive the industry to deliver the recommended 50% reduction by 2050.

5.18 Based on these considerations we do not consider that SELL, as currently measured, is suitable to set performance levels at PR19.

Setting a cost allowance for leakage reduction at PR19

5.19 As we set out above we expect companies to innovate, and to leverage on process, technology and asset improvements made over the past 20 years, to reduce leakage levels during PR19.

5.20 Except for four high performing companies, discussed further below, we did not make an additional allowance for companies to reduce leakage to achieve their performance commitments (but they will earn outperformance payments if they reduce leakage beyond this level). **Most companies should fund leakage reduction from our base allowance**. This reflects that the 15% leakage

[101] Strategic Management Consultants, 'Review of the calculation of sustainable economic level of leakage and its integration within water resource management planning', October 2012.

reduction is a challenge to companies to improve their performance and not simply to do more using the same processes and techniques as used historically. We want to stimulate innovation and a step change in performance on leakage.

5.21 As noted above, the industry has in the past demonstrated an ability to successfully respond to challenge. In the decade after privatisation, when the industry was faced with significant public scrutiny following the 1995-96 drought, the sector achieved a greater than 30% reduction in leakage.

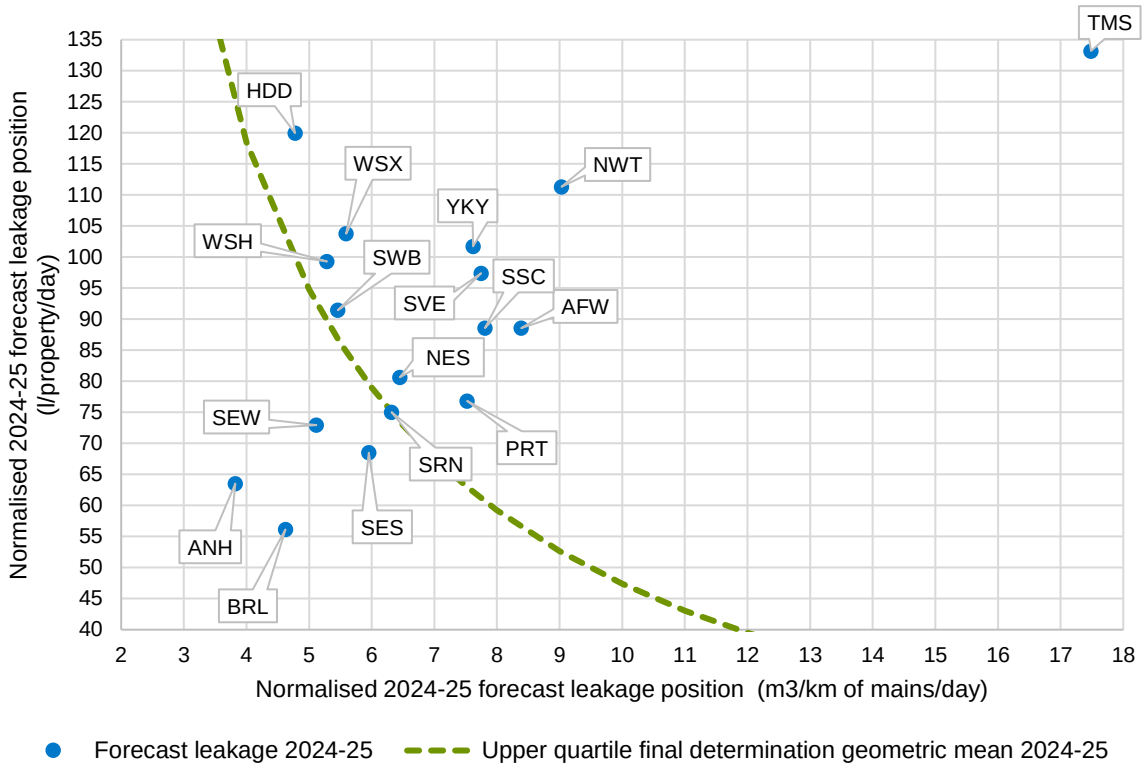
5.22 Our leakage policy may present an additional efficiency challenge for some companies. In our final determinations we amended the frontier shift efficiency challenge from 1.5% to 1.1% in part to account of the increased challenge on performance, in particular the reduction in leakage. If companies are unable to reduce leakage up to their performance commitment level within their cost allowances, then customers will contribute a share of the cost through the totex cost sharing mechanism. If they reduce leakage beyond their performance commitment level customers will pay outperformance payments.

5.23 In addition to our base allowance, we made an enhancement expenditure allowance for high performing companies to further reduce leakage beyond industry leading levels. We make an allowance for companies who propose leakage reductions beyond an upper quartile benchmark threshold. This threshold is derived from companies' forecast 2024-25 leakage positions.[102]

5.24 Four companies (Anglian Water, Bristol Water, South East Water and SES Water) demonstrated industry leading performance in their 2024-25 forecast leakage position and were granted the allowance (see Figure 5.2).

[102] Ofwat, PR19 final determinations: Securing cost efficiency technical appendix, December 2019, p. 71.

Figure 5.2: Company view (August 2019) forecast 2024-25 leakage position, relative to the enhancement allowance threshold



Source: Ofwat analysis [103]

5.25 Our allowance for the four companies was based on their proposed unit cost per leakage reduction.[104] Where the proposed unit cost was above the industry median, we challenged the company to justify its high unit cost. As a result, we applied a small challenge to Anglian Water's proposed unit cost, as it was third highest in the industry and significantly higher than similar high performing companies like South East Water and Bristol Water. We allowed Anglian Water £71.4 million of £77 million requested. Bristol Water's unit cost was below the industry median and we allowed the company the entire costs requested to reduce leakage, £4.8 million.

5.26 Yorkshire Water and Northumbrian Water did not meet our performance threshold. Both companies have had increasing leakage levels over the five-year period to 2018-19.[105] For such companies we do not consider it

[103] Ofwat, Wholesale Water Enhancement feeder model: Supply demand balance, December 2019.
[104] Unit costs for leakage reduction are calculated in Ofwat, Wholesale Water Enhancement feeder model: Supply demand balance, December 2019. Leakage benefits associated with metering expenditure are removed from our consideration of unit cost. Metering expenditure was assessed in Ofwat, Wholesale Water Enhancement feeder model: Metering, December 2019.
[105] Three-year average figures based on analysis of annual performance reports.

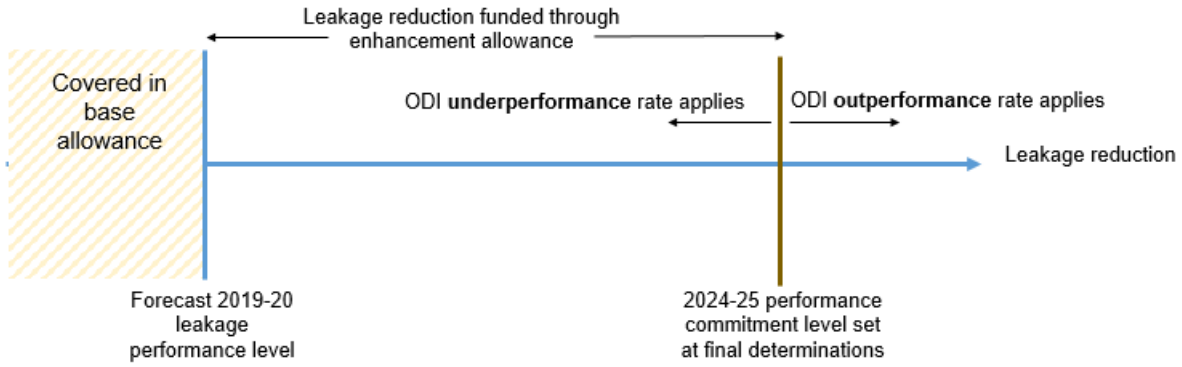
appropriate for customers to provide additional funding for them to reduce leakage to levels that have already been achieved by their peers.

5.27 Our leakage allowances are included in the individual company deep dive sheets of the supply demand balance enhancement model and summarised in the 'Securing cost efficiency technical appendix'.[106]

5.28 We expected all four companies to maintain their 2019-20 forecast leakage levels funded by their base model allowances. If the 2019-20 forecast was beyond our benchmark threshold, we made an allowance for any further leakage reduction beyond the 2019-20 forecast. This was the case for Anglian Water, South East Water and Bristol Water.

5.29 The performance levels that this funding covers for these companies is represented in Figure 5.3. The underperformance rate claws back the enhancement funding, such that if the company does not improve from the forecast 2019-20 level, all funding is returned to customers. A different rate is applied for degradations in performance beyond that point. Outperformance payments incentivise companies to go beyond the performance commitment level. Further detail of how we set the incentive rates is provided in our published documentation.[107] For Anglian Water, further details are provided in our day one submission.[108]

Figure 5.3: Representation of leakage performance commitment level setting at final determination for companies receiving enhancement expenditure



Source: Ofwat

[106] Ofwat, 'PR19 final determinations: Securing cost efficiency technical appendix', December 2019, p.73.
[107] Ofwat, 'PR19 final determinations: Delivering outcomes for customers policy appendix', December 2019, Section 4.5.1, pp.115-116.
[108] Ofwat, 'Reference of the PR19 final determinations - Explanation of our final determination for Anglian Water', April 2020, pp.31-33, paragraphs 2.63 to 2.69.

Issues raised by disputing companies

5.30 In the following section we respond to those issues on leakage raised by the disputing companies that are cross-cutting in nature. We respond to company-specific issues raised with respect to leakage in the respective company specific 'Response to statement of case' documents.

The use of 2019-20 outturn performance as the performance commitment level baseline

5.31 In its statement of case to the CMA, Northumbrian Water argues that Ofwat's approach of using 2019-20 outturn performance as a leakage reduction baseline disincentivises a proactive approach to leakage and sets too demanding a level, given the funding provided in base allowances. In particular the company argues that companies will be penalised for making an early start on leakage reduction as this will result in a more stretching level for the 2020-25 period. The company argues this provides poor incentives especially if this is expected to be repeated in future periods and risks setting a precedent.

Our response

5.32 We do not consider it is appropriate to baseline the leakage performance commitment levels so as to measure improvement from the PR14 target level in 2019-20. As we stated in our final determinations we consider that use of companies' actual 2019-20 position ensures that if performance exceeds their forecast they are not rewarded twice through the incentives from PR14 and PR19. This is a necessary mechanism to protect customers, and ensures we are not retroactively rewarding the same improvement twice.

5.33 The approach also ensures outcome delivery incentive out and underperformance payments relate only to genuine changes in performance rather than differences in reporting methodologies between the 2015-20 and 2020-25 periods. This is important because Northumbrian Water is not currently fully compliant with the new 2020-25 reporting methodology.

5.34 The change in the reporting of leakage performance commitments has led to large changes in the estimates of future leakage levels. In 2018-19 some companies were still working towards full compliance with the new reporting. We specified the performance commitment as a percentage reduction from the leakage figure which will be reported for 2019-20 using the new methodology

as the baseline for the 2020-25 performance commitment level, in line with the discussions with industry. This ensures that the performance commitment relates to actual performance achieved in the 2020-25 period and not to data or methodology changes.

5.35 In September 2019 we asked all companies to provide further information on leakage. Northumbrian Water's response on 16 September 2019 stated: [109]

> "We are committed to adopting the revised reporting definition and have been undertaking an extensive programme of work to comply with this. Therefore, over time, the estimates produced may not tally with previously supplied data as each new dataset represents the best and most compliant information available at that time. We intend to be fully compliant with the new definition by April 2020."

5.36 We note that the company does not set out in its statement of case what the 2019-20 PR14 performance commitment levels are on a comparable basis with the new leakage reporting definition. It is apparently therefore proposing that a % reduction in leakage on a 3 year annual average basis using the new reporting definition be applied to its PR14 performance commitment level for 2019-20 using an incomparable leakage definition. This would give rise to the possibility that out or underperformance payments are generated on the basis of changes in reporting methodology rather than underlying improvements or deteriorations in performance.

5.37 We also note that no other company has objected to the use of the actual 2019-20 position in their leakage common performance commitments.

5.38 The company also argues that our approach renders its performance commitment levels too stretching given additional funding has not been allowed. We consider that the approach we have taken to allocating base and enhancement funding should allow companies to adopt innovative and efficient techniques to deliver their leakage performance commitments. We also note that in normalised 2019-20 performance metrics Northumbrian Water rank 8th and 9th in terms of comparative performance. This does not support a case for an enhancement expenditure allowance under our PR19 assessment approach.[110]

[109] See reference document C001 – Northumbrian Water Leakage Query Response, p.3.
[110] Ofwat, 'Reference of the PR19 final determinations: Key elements of the methodology appendix', March 2020, pp.13-22, Chapter 5.

5.39 In its statement of case, Northumbrian Water states the target leakage levels have never been achieved before and that between 2014-15 and 2018-19 the largest leakage reduction was 7.55%.[111] Our methodology notes the lack of progress on leakage in recent years.[112] However, as we have explained above, the industry has in the past demonstrated an ability to successfully respond to scrutiny and challenge to deliver a sustained reduction in leakage (for example, following the 1995-6 drought). We therefore consider that the company's performance commitment levels are stretching but achievable, particularly in the context of the sector's public commitment to reduce leakage by 50% by 2050.

Issues relating to leakage reduction performance commitment levels

5.40 In its statement of case Yorkshire water argues that:

- Ofwat has made a significant change in policy in moving away from the SELL approach to leakage level target setting and that the additional costs to meet the new policy cannot be part of historical base costs and therefore go beyond the economic level previously set by Ofwat;[113] and,
- A 15% leakage reduction not is supported by sound evidence. There is no economic or engineering rationale for why this represents an economically efficient level.

Our response

5.41 Our policy direction with respect to leakage has been defined by the future challenges faced by the industry and the limited progress made in driving down leakage levels over the past 20 years. We set out our expectation for companies to deliver more for customers and the environment in our PR19 methodology. For the reasons set out above in this chapter we do not consider the use of SELL to be an appropriate tool for target setting. We note that in its statement of case the company states that it "supports Ofwat's policy of reducing leakage below the SELL in Yorkshire."[114] The company, however,

[111] Northumbrian Water, 'NWL Statement of case – PR19 CMA redetermination', April 2020, p.111, paragraph 539.
[112] Ofwat, Delivering Water 2020: Our final methodology for the 2019 price review. Appendix 2: Delivering outcomes for customers, pp.60-63.
[113] Yorkshire Water, 'PR19 redetermination Statement of Case', p.12, paragraphs 32-33.
[114] Yorkshire Water, 'PR19 redetermination Statement of Case', p.54, paragraph 162.

argues that the additional costs of going beyond SELL will not be reflected in historical base costs.

5.42 First we note that the company has not proposed an alternative assessment of the level of leakage that can be delivered within base costs, and itself proposed a 15% reduction in its response to our draft determination, which we accepted in our final determination.

5.43 Secondly we have been clear throughout PR19 that we expect leakage reductions to be delivered through the application of innovative approaches, given the scale of technological change over the past 20 years which has been as yet underexploited by the sector. This should enable companies to make a step change in leakage reduction, going beyond SELL, within base costs.

5.44 Notwithstanding the above, we nevertheless recognise that our leakage policy may present an additional efficiency challenge for some companies.

5.45 With respect to the company's argument that the 15% leakage reduction target lacks rationale, in our PR19 methodology we set companies a challenge to reduce their leakage by 15% within base funding cost allowance. The challenge is similar to the highest proposed reduction at PR14 for the period 2015-20. In their business plans, all companies accepted the challenge and proposed at least a 15% reduction on an annual average basis.

5.46 The need for significant reductions in leakage levels has been accepted by other regulators, stakeholders and the industry, explained above. Yorkshire Water proposed a reduction of 15% with its base cost allowance in its representation to our draft determination. The company has not presented an alternative proposal for what could be achieved at no additional expense to customers.

5.47 Based on our assessment of companies' proposals we have set a range of leakage reductions in our final determinations from 9.7 to 21.2%.[115] All companies that are not appealing have accepted the performance commitment levels set in our final determinations. We are aware that a number of companies are acting to innovate and develop new approaches to reducing leakage in response to PR19 challenge. For example Severn Trent Water and United Utilities have joined to create a World Water Innovation Fund with the aim developing and accelerating ground-breaking technologies in leakage

[115] Percentage reduction in three-year average leakage figures from 2019-20 to 2024-25.

reduction.[116] South West Water is working in collaboration with the University of Exeter to conduct research into developing innovative solutions to leakage detection and management.[117]

Issues relating to the base allowance providing insufficient expenditure to meet performance commitment levels

5.48 In its statement of case Yorkshire Water argues that it does not receive sufficient allowance to achieve its proposed leakage reductions. Yorkshire Water presents a consultant report which shows that adding a leakage cost driver to our econometric models results in a higher cost allowance for the company.

5.49 In their statements of case both Bristol Water and Anglian Water argue that the base allowance is insufficient to maintain their 2019-20 leakage performance. Both companies consider that their strong performance in this area in comparison to their peers results in a higher cost to maintain leakage due to increasing marginal cost as levels are reduced.

5.50 Bristol Water proposes a £13 million uplift to its allowance based on models that were considered by Ofwat and PwC, which include a leakage specific variable. The company also argues that an additional leakage allowance was made by the CMA as part of the redetermination following PR14 and that this recognises the need for increased investment to maintain performance levels.

5.51 Anglian Water argues that its cost adjustment claim of £137 million for maintaining leakage levels should be allowed in full.

Our response

5.52 **Our econometric models do not include service quality cost drivers for sound economic and statistical reasons.** We consider that our models provide an appropriate allowance for companies. We discuss the inclusion of service quality cost drivers Chapter 3: Our base econometric models.[118]

5.53 We clearly set expectations in our methodology that **all companies need to improve their leakage performance and to deliver more for customers through**

[116] Severn Trent Water, World Water Innovation Fund Press Release, April 2019.
[117] University of Exeter, Realising the potential for operational leak detection using landscape modelling and drone thermal imaging press release.
[118] For further information see Chapter 3 : Our base econometric models.

their base allowance. The need for Ofwat, as a responsible regulator, to take this challenging approach is well established based on:

- The long-term resilience challenge;
- The sectors commitment to reduce leakage levels by 50% by 2050;
- The very limited leakage reductions over the past 20 years in comparison to the period following the 1995-96 drought;
- The need to stimulate innovation, adoption of existing and new technology and new business processes to reduce leakage;
- The opportunities to exploit productivity gains from the technological advancements made over the past 20 years;
- Establishment of £200 million innovation fund to promote innovation within the water sector; and
- Customers' views that companies must reduce leakage as a prerequisite to customers taking individual steps to reduce their own water consumption.

5.54 We consider our approach to setting a base allowance in the context of the leakage policy is appropriate because we:

- Acknowledge that all companies voluntarily accepted the 15% reduction challenge in their business plans and that providing additional funding to meet the reduction would undermine the efficiency challenge set by Ofwat in PR19 and potentially undermine future efforts to challenge the sector to improve performance;
- Recognise the policy may present an additional efficiency challenge and consider this when setting the frontier shift efficiency challenge;
- Consider potential base adjustments through alternative model specifications, including leakage specific parameters; and
- Recognise that if companies incur additional costs to manage leakage, customers will contribute a share of the cost through the totex cost sharing mechanism.
- Note that eleven of the thirteen companies with a 15% reduction in leakage to be delivered from within base costs have accepted that final determination, which indicates that these companies accept the challenge in the round.

5.55 For Yorkshire Water we expect the company to deliver a level of performance already achieved by its peers through its base allowance. For Bristol Water and Anglian Water, we allowed expenditure to further drive down leakage levels but expect the companies to maintain their 2019-20 leakage position with their base allowance.

5.56 Anglian Water and Bristol Water were funded by customers within cost allowances and ODIs to achieve reductions made in the 2015-20 period. We do not accept that customers ought to pay again to make same reduction in leakage in the 2020-25 period. We discuss further company specific issues relating to the expenditure requested within the Anglian Water and Bristol Water cost adjustment claims in the respective company specific 'Response to statement of case' documents.

5.57 In summary, we would emphasise the importance of reducing leakage for a sustainable and resilient future. There is a need to challenge the industry including companies that are comparatively high performers to do more to deliver leakage levels required to ensure future resilience. It is important and appropriate to push the sector to innovate in order to achieve a step change in leakage reduction given company stagnation over the last 20 years.

6. Our catch-up challenge for base costs

The concept of catch-up efficiency

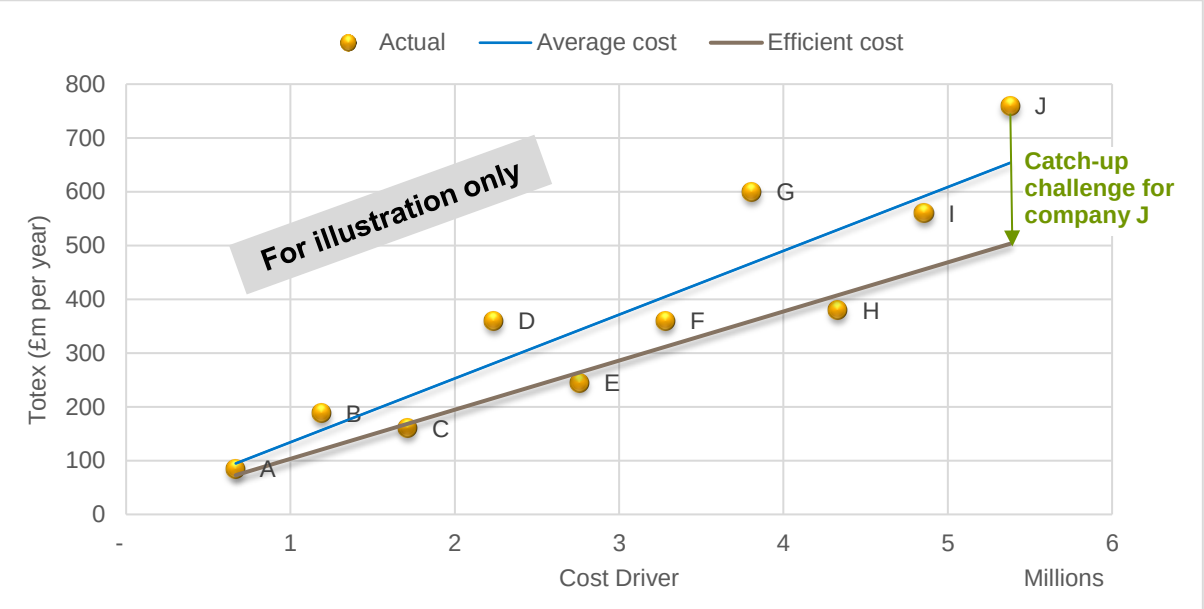
6.1 To protect the interest of customers, we aim to set cost allowances that are efficient. Benchmarking analysis allows us to identify relatively efficient companies within the sector, and we can use this information to set a catch-up challenge to the less efficient companies in the sector. This replicates a competitive market, where less efficient companies would be unable to charge a premium to customers to cover their inefficiency.

6.2 We do our benchmarking analysis using econometric modelling. We estimate an average cost line, which provides the formula to link an average cost to a given level of outputs (where the outputs is our set of cost drivers). This line is a benchmark against which we rank companies' performance from the most efficient company ("frontier" company) to the least efficient company.

6.3 To set efficient allowances for companies, we shift the benchmark line downwards, to reflect the performance achieved by more efficient companies. This will provide a modified formula to link efficient costs to a given level of outputs. We illustrate this in Figure 6.1.

6.4 In Figure 6.1, the yellow dots represent the data on cost and cost driver used to estimate the average costs curve (blue line). We then shift the line proportionally to a more efficient benchmark than the average (brown line).

Figure 6.1: An illustration of the catch-up challenge



Source: Ofwat

6.5 If the model was properly capturing all relevant cost drivers and there was no statistical noise, we could shift our benchmark to the frontier company. In practice, due to the fact that models are imperfect, we shift the line towards the frontier, but not quite all the way, to allow for modelling imperfections.

The catch-up efficiency in our final determinations

6.6 In our final determinations we set the catch-up efficiency challenge at the **fourth placed company** (out of seventeen companies) for wholesale water base costs. That is a level of base cost efficiency that four companies have achieved, and thirteen companies are lagging behind. For wholesale wastewater base costs, we set the catch-up efficiency challenge at the **third placed company** (out of ten wastewater companies)[119]. That is a level of base cost efficiency that three companies have achieved, and seven companies are lagging behind.

6.7 The level of catch-up challenge that we set at final determination is beyond that of the "upper quartile" company we applied at draft determinations.

6.8 We apply the catch-up challenge at the wholesale level rather than at the price-control level. We decided against applying the catch-up challenge at a price-control level following feedback from companies in their response to our draft

[119] Hafren Dyfrdwy is not identified as a separate company within the historical modelling data set.

determination. Applying the challenge at the price control level would be significantly more challenging for companies.

Our motivation for strengthening our catch-up efficiency challenge

6.9 The price review process allows companies to make representations and draw attention to areas where they contend that they deserve a higher allowance. Companies have less incentive, and other stakeholders less ability, to identify areas where we may have made an over-generous allowance. This situation gives rise to an asymmetry in the price review process.

6.10 Indeed, during the price review process we received numerous representations and cost adjustment claims from companies for additional costs. We would expect there to be numerous cases where a negative adjustment is warranted, however, we have not received any such representations from companies.

6.11 Against this backdrop, we said in our PR19 methodology that we would make the adjustment process more symmetrical, and, in addition to allowing companies to raise cost adjustment claims, we would consider downward adjustments to our cost baselines where appropriate.

6.12 At any point during the process, it is therefore our role to take a step back and reflect on whether our cost allowances are efficient and in the best interest of customers. In particular, in the light of new information that is revealed, or becomes available, during the process.

6.13 After our draft determinations, new information came to light:

- We received outturn data for the year 2018-19, which we incorporated to our econometric models, which significantly increased cost allowances.
- We removed non-section 185 diversions costs from our econometric models.[120]This removed some lumpy expenditure and slightly improved the accuracy of our models.
- Companies reduced their requested costs in their representations to our draft determinations.

[120] In consultation with companies and with their full support we decided to remove the costs of diverting mains where the request is not made under section 185 of the Water Industry Act 1991. This will include works requested under the New Roads and Street Works Act 1991 and works in connection with large infrastructure projects such as High Speed 2 (HS2). See p. 47 of our 'PR19 final determinations: Securing cost technical appendix', December 2019.

6.14 We acknowledge that there could have been different reasons for the reductions in companies' requested costs. However, these reductions may be a response to information revealed to the companies during the process, for example information on other companies' costs and our benchmarking assessment, which allowed them to better understand their efficient costs.

6.15 Further, at draft determinations we changed our approach to the calculation of cost sharing rates. We said that we would put 50% weight on companies' August 2019 representation cost forecasts to determine their cost sharing, so they were incentivised to disclose better information about their efficient costs.[121] It would be wrong for us not to act on information disclosed through our incentives, in particular given that it is in essence customers who pay for this improved information.

6.16 Following the new information that came to light after draft determinations, we reviewed whether our base allowances are efficient. We identified three issues.

6.17 The first is that **most companies (12 out of 17) forecast lower modelled base costs** for 2020-25 than the modelled base cost allowance under the historical upper quartile. This compares to six out of 17 companies before the above changes took place.

6.18 The second is that **2018-19 was a high cost year**, both relative to historical years and to forecast years. We examined companies' business plan forecasts of base costs for 2020-25 and found:

- In water, the sector forecasts annual base costs that are 16.2% lower than base costs in 2018-19.[122]
- In wastewater, the sector forecasts annual base costs that are 5.2% lower than base costs in 2018-19.

6.19 These results are not driven by one or two large companies, but by the majority of companies.

6.20 The third is that the level of the **historical upper quartile challenge has steadily decreased** from the initial assessment of plans to draft determinations, and again following the incorporation of the 2018-19 data after draft determinations. The upper quartile challenge is also significantly lower

[121] Ofwat, 'PR19 draft determinations: Securing cost efficiency technical appendix', July 2019, p.94.
[122] Ofwat, 'PR19 final determinations: Securing cost efficiency technical appendix', December 2020, p.33.

than the corresponding value at PR14, and relative to the efficiency challenge of the frontier companies (see Table 6.1).

Table 6.1: Comparison of the upper quartile challenge at different price controls and different stages at PR19

	Wholesale water	Wholesale wastewater
PR14 final determinations	6.5%	10.4%
PR19 initial assessment	4.8%	3.7%
PR19 draft determinations	4.2%	1.4%
PR19 final determinations	**3.9%**	**1.2%**

6.21 In light of the above, we considered that the historical upper quartile challenge no longer provided a suitable challenge to the companies' proposed base costs. We decided to make the challenge at final determination more appropriate.

6.22 We consider that this decision is not only appropriate, but also completely in line with our PR19 methodology. In our PR19 methodology we said that at PR19 we will look to strengthen the efficiency challenge of PR14 by using information both from historical and forward-looking cost performance to identify the most efficient companies in the sector, which will set the benchmark for the rest of the companies. By using all available information to set our cost baselines, we ensure that our baselines are appropriate, so that customers do not pay more than necessary for the services they receive. Finally, we said that we would determine the appropriate level of efficiency challenge for PR19 when we set draft and final determinations, based on evidence at that time.

Issues raised by disputing companies

6.23 The disputing companies have raised the following issues related to our catch-up challenge at final determination:

- The quality of the models does not justify moving from an upper quartile to a more stretching challenge
- The catch-up challenge at final determination is more challenging than previous regulatory decisions
- Ofwat could have used stochastic frontier analysis to ensure the catch-up challenge was appropriate

- Strengthening the catch-up challenge will dis-incentivise companies from revealing expected cost savings in the future
- Water and wastewater companies (WASCs) should not be compared to water only companies (WOCs)
- Portsmouth Water is not an appropriate benchmark company

Our response

The quality of the models does not justify moving from an upper quartile to a more stretching challenge

6.24 The disputing companies consider that the strengthening of the catch-up challenge could have been justified if our final determination models were an improvement on the draft determination models. But they do not consider our final determination models are superior to our draft determination models.

6.25 To support this view, Anglian Water and Yorkshire Water present evidence to suggest there is a large level of uncertainty in our forecasts, which manifests itself in a wide range of efficiency scores between companies that they consider cannot plausibly be due to inefficiency.

6.26 We note in response to our draft determination companies did not raise concerns with the application of the upper quartile as an efficiency benchmark based on our models (except Thames Water). This means that the main concern is the move from the upper quartile to a slightly more stringent benchmark.

6.27 While we strengthened the catch-up efficiency challenge at final determination, the change was only modest and the evidence suggests that our challenge is very much achievable. Eight out of 17 companies forecast modelled base costs that are more efficient than our efficient benchmark.

6.28 In water, the move from the upper quartile challenge (represented by the 5th company) to the fourth most efficient company in wholesale water increased the catch up challenge by 0.7% (from 3.9% to 4.6%). This is a modest change and the challenge also remains significantly lower than what was applied at PR14 where it was 6.5%, as shown in Table 6.1.

6.29 In wastewater, the move from the upper quartile to the third most efficient company increased the catch-up challenge by 0.8% (from 1.2% to 2.0%). The

challenge also remains low relative to the catch-up challenge that was applied at PR14 where it was 10.4%, as shown in Table 6.1.

6.30 This evidence suggests that the level of the catch-up challenge we applied at final determination is likely to be conservative. However, taking into account the overall stretch of our final determinations, we consider our catch-up challenge is appropriate and in the interest of customers.

6.31 The disputing companies claim that there is a large level of uncertainty in our analysis, which manifests itself in a wide range of efficiency scores between companies.

6.32 But our analysis indicates that the efficiency score range between companies that is used to determine the wholesale water and wastewater catch-up challenge has narrowed between draft and final determination, as demonstrated in Table 6.2 and Table 6.3 below.

Table 6.2: Wholesale water efficiency scores – final versus draft determination

Company	Final determination historical efficiency scores	Company	Draft determination historical efficiency scores
PRT	0.79	PRT	0.78
YKY	0.93	YKY	0.86
SSC	0.94	DVW	0.88
SWB	0.95	SRN	0.91
DVW	0.96	SSC	0.96
SEW	0.98	WSX	0.96
SRN	0.98	NES	0.97
NES	1.00	SEW	0.98
WSX	1.01	SWB	0.98
NWT	1.01	ANH	1.01
AFW	1.03	AFW	1.01
ANH	1.06	TMS	1.04
TMS	1.06	SVT	1.07
SVT	1.10	NWT	1.08
BRL	1.13	SES	1.13
SES	1.14	BRL	1.18
WSH	1.17	WSH	1.19

Source: Ofwat Wholesale Water Feeder Model 2 – Draft and Final Determinations

Table 6.3: Wholesale wastewater efficiency scores – final versus draft determination

Company	Final determination historical efficiency score	Company	Slow track draft determination historical efficiency score
SVT	0.85	WSX	0.87
WSX	0.91	SVT	0.87
NES	0.98	YKY	0.99
ANH	1.01	TMS	0.99
SWB	1.02	ANH	1.00
TMS	1.02	NES	1.03
YKY	1.03	SRN	1.05
SRN	1.04	SWB	1.05
WSH	1.09	WSH	1.07
NWT	1.22	NWT	1.27

Source: Ofwat Wholesale Wastewater Feeder Model 2 – Draft and Final Determinations

6.33 We reiterate that most companies considered that we had produced a robust set of econometric models with sensible results or did not raise significant representations on our econometric models when responding to our draft determination. In addition, the industry was generally supportive of our decision to apply a stretching catch-up challenge based on the econometric model results presented in our draft determination.

6.34 It would therefore seem appropriate to apply a stretching catch-up challenge based on our final determination econometric model results, which arguably perform better than our draft determination models given they produce a lower range of efficiency scores.

6.35 We strongly consider that the setting of the catch-up challenge is not only a function of model quality. The fact that 2018-19 was a high cost year, unrepresentative of historical and forecast costs, and as a consequence our base cost allowance was above that of most companies' forecasts is something that we need to take into account. Rather than not using the 2018-19 data, we accepted companies view that we ought to use the latest data but amended the catch-up challenge to address the issue.

6.36 We also have to consider that our benchmarking is done amongst long standing monopolies. Even the relatively efficient companies within this sector are unlikely to be as efficient as companies facing competitive pressure. Our comparative assessment is unlikely to identify maximum achievable efficiency.

This relates to the concept of x-inefficiency, which is that that in non-competitive sectors there is a level of inefficiency due to lack of competitive pressure.

The catch-up challenge at final determination is more challenging than previous regulatory decisions

6.37 The companies note that regulators rarely select a benchmark that is more challenging than the upper quartile. In particular, they mention that Ofgem applied an upper quartile benchmark at RIIO-1.

6.38 While previous regulatory decisions provide a point of reference, they do not contain what current or future regulatory decisions. Such constrains would stifle our ability to make appropriate decisions in the light of the relevant evidence and circumstances, and to push the sector when this is appropriate.

6.39 Other UK regulators have previously set more stretching benchmarks than the upper quartile. Postcomm, Ofcom and Monitor have previously employed an upper decile benchmark in their regulation of Royal Mail delivery offices, British Telecom and acute health care providers respectively.[123] More recently, and potentially closer in terms of comparability to the water sector, the Northern Ireland Utility Regulator used the fourth placed company out of fifteen companies to set the efficiency benchmark in the price control determination for NIE Networks for the period 2017-2024 (RP6).[124] In contrast, the upper quartile benchmark would have been between the fourth and fifth placed company.

Ofwat could have used stochastic frontier analysis to check whether the catch-up challenge was appropriate

6.40 Yorkshire Water considers that we could have used a different modelling approach, such as stochastic frontier analysis, to check whether the catch-up efficiency challenge was appropriate.

6.41 While in theory stochastic frontier analysis (SFA) is appealing for efficiency analysis, in practice, it has had limited use in regulatory applications. SFA models are complex and non-transparent for stakeholders who have to engage with our proposals. SFA models also require large amounts of data to produce

[123] Source: https://www.ofcom.org.uk/__data/assets/pdf_file/0019/69400/benchmarking-report.pdf
[124] Source: https://www.uregni.gov.uk/publications/nie-networks-td-6th-price-control-final-determination-rp6

high quality results and are sensitive to assumptions related to the distribution of inefficiency.

6.42 CEPA recommended that SFA models should only be used when other, simpler, models do not provide sufficiently robust estimates.[125] This view was shared by the CMA in Bristol Water's PR14 redetermination, who also found that SFA models provided limited additional value.[126]

6.43 Following CEPA's advice, we were able to develop robust, simpler, econometric models using random effects estimation. We therefore did not consider SFA as part of our PR19 modelling. This industry welcomed the simplicity and transparency of our PR19 models as they are easier to understand and assess compared with the PR14 models whilst also capturing a wide range of cost drivers.

Water and wastewater companies (WASCs) should not be compared to water only companies (WOCs)

6.44 Northumbrian Water considers that large and complex WASCs should not be compared to smaller WOCs due to fundamental structural differences in the cost base that lead to smaller WOCs having a cost advantage.

6.45 We disagree with this view. Our econometric cost models have been developed to capture factors such as 'company size' and 'complexity'. For instance, our econometric models capture a wide range of cost drivers including company scale, treatment complexity and network complexity. This is demonstrated by the fact that some WOCs are considered to be relatively efficient (e.g. South Staffs Water and South East Water) whilst others are considered to be relatively inefficient (e.g. SES Water and Bristol Water).

6.46 We note also that we compare companies' efficiency on the delivery of a specific common service. The cost separation between the water and wastewater services is robust and has been in place at PR14. We therefore do not consider there is a challenge in comparing water and wastewater companies with water only companies.

[125] CEPA, 'PR19 Econometric Benchmarking Models', 2018, p.38.
[126] CMA, 'Bristol Water plc – A reference under section 12(3)(a) of the Water Industry Act 1991 – Report', October 2015, pp.110, paragraph 4.193.

Strengthening the catch-up challenge will dis-incentivise companies from revealing expected cost savings in the future

6.47 Bristol Water expresses concern that Ofwat's decision to change the catch-up efficiency challenge after companies identified forecast efficiency savings may disincentivise companies from revealing expected cost savings in future price reviews.

6.48 We consider that the concern raised by Bristol Water is evidence on the asymmetry of information that we have to contend with. The concern also highlights the strength of benchmarking analysis to reveal information. Benchmarking analysis significantly mitigates a potential incentive for companies to withhold information.

6.49 Our regulatory framework provides incentives for companies to reveal information to reduce the asymmetry of information between Ofwat and the companies. It is customers that pay for these incentives and it would be inappropriate for us not to use information revealed through these incentives in order to protect them.

6.50 The fast-track process, for example, incentivises companies to submit efficient plans so that they can earn the rewards that come with being a fast track company. Similarly, at draft determinations we changed our approach to the calculation of cost sharing rates. We said that we would put 50% weight on companies' August 2019 representation cost forecasts to determine their cost sharing, so they were incentivised to disclose better information about their efficient costs. It would be wrong for us not to act on information disclosed through our incentives, in particular given that it is customers who pay for this improved information.

6.51 We will continue to use benchmarking analysis alongside incentivises on companies to reveal information. This approach significantly mitigates perverse incentives on companies to withhold information. It is incumbent on us to use the information that is revealed to us to set appropriate allowances to ensure that customers are not paying for inefficiency.

Portsmouth Water is not an appropriate benchmark company

6.52 Bristol Water does not consider Portsmouth Water should be used to determine the wholesale water catch-up efficiency challenge because it is not a good comparator to other companies.

6.53 We acknowledge that Portsmouth Water is some distance away from the next efficient company. Portsmouth Water's wholesale water historical efficiency score is 0.79, which compares with Yorkshire Water's historical efficiency score of 0.93. Yorkshire Water is ranked the second most efficient water company. This is one reason why we do not set the catch-up efficiency benchmark at the frontier company.

6.54 But we do not consider this limits our ability to set the benchmark at the fourth placed wholesale water company, which we consider is very much achievable (see discussion above).

6.55 As noted in our final determinations, our choice of wholesale water benchmark retains a credible set of smaller and larger companies to determine the catch-up efficiency challenge for the rest of the sector. For wholesale water, the set of companies include Portsmouth Water, Yorkshire Water, South West Water and South Staffs Water. These companies all represent a mix of outcomes performance, and also represent a mix of investment cycle positions. These companies were also identified as being relatively efficient in PR14.

7. Frontier shift

Our final determination

7.1 We consider that all companies can and should improve productivity in 2020-25. We reflect this expectation in setting cost allowances for the sector by the application of a frontier shift, which is applied on top of our catch up efficiency adjustment.

7.2 Our frontier shift estimate of 1.1% per year was based on independent advice from two external advisers:

- Europe Economics, who recommended a frontier shift efficiency number towards the upper end of the 0.6% to 1.2% per year range;[127] and
- KPMG, who recommended a range of 0.6% to 2.5% per year, taking into account both ongoing frontier shift as well as the impact of the introduction of the totex and outcomes regime.[128]

7.3 Europe Economics suggested two reasons why we should choose an ongoing productivity estimate towards the upper end of its range:

- **Some weight should be placed on productivity growth in value added terms**, which are, by definition, higher in magnitude than the corresponding gross output measure, and so move towards the upper end of the range for productivity growth which was estimated in gross output terms.
- **The productivity estimates exclude embodied technical change.** A true measure of frontier shift should take into account the potential cost savings from quality improvements 'embodied' in the inputs used by the sector (labour, capital and intermediate inputs), for example through investment in better equipment. However, the productivity estimates, which were made using EU KLEMS data, reflected primarily 'disembodied' technical change which allowed for increased output without additional investment, for example through better management processes. **Illustrative evidence**

[127] Europe Economics, 'Real Price Effects and Frontier Shift – Final Assessment and Response to Company Representations', December 2019, p.7.
[128] KPMG, 'Innovation and efficiency gains from the totex and outcomes framework', June 2018, p.24, Table 8.

suggested that productivity growth estimates might need to be uplifted by as much as 60% to account for embodied technical change.[129]

7.4 KPMG identified that introducing the totex and outcomes framework in the 2014 price review removed a regulatory barrier to companies achieving greater efficiency.[130] In particular it allowed companies to move away from capex-oriented decision making towards looking at total expenditure, and towards considering outcomes instead of outputs. **KPMG identified that companies could continue to make efficiency improvements from use of the totex and outcomes framework from 2020-25 of between 0.2% and 1.2% per year.** These were in addition to the ongoing frontier shift productivity gains.

7.5 A frontier estimate of 1.1% per year was also borne out by our own evidence that the sector responds to challenges, the scope for the sector to improve performance and took into account the latest evidence on totex outperformance in the sector. We significantly moderated our view of the frontier shift from 1.5% to 1.1% per year at final determination, taking account of representations and evidence.

7.6 We continue to consider that the final determination frontier shift estimate is realistic, attainable and in the interests of customers and in line with our duties in the round.

Issues raised by disputing companies

7.7 The disputing companies used a variety of frontier shift assumptions in their business plans and references to the CMA. These range from 1.5% per year for Northumbrian Water to 0.8%-0.75% per year for Yorkshire Water.

[129] Europe Economics, 'Real Price Effects and Frontier Shift – Final Assessment and Response to Company Representations', December 2019, p.85.
[130] KPMG, 'Innovation and efficiency gains from the totex and outcomes framework', June 2018, pp. 5 and 131.

Table 7.1: Company assumptions regarding frontier shift on totex

Company	Frontier shift
Anglian Water[131]	-1%
Bristol Water[132]	-1%
Northumbrian Water[133]	-1% (capex) to -1.5% (botex)
Yorkshire Water[134]	0.8% (water) and 0.75% (wastewater) based Oxera report

7.8 We note that Northumbrian Water forecast a slightly larger frontier shift than Ofwat, while Anglian Water and Bristol Water forecast a slightly lower forecast than Ofwat, with only Yorkshire Water being materially lower than Ofwat's proposed frontier shift.

7.9 Despite in most cases modest differences in the level of the frontier shift, the disputing companies raise a number issues in relation to our final determination frontier shift of 1.1% per year. These issues are summarised below and responded to in turn:

- the overall justification for our 1.1% frontier shift estimate;
- the time periods used;
- the use of gross output and value added measures of total factor productivity growth;
- the comparator sectors used;
- how the range for ongoing frontier shift efficiency was derived;
- taking account of embodied technological change;
- consistency with forecasts for productivity growth for the economy as a whole
- taking account of catch-up efficiency;
- taking account of historical water sector growth;
- the impact of the totex and outcomes regime;
- consistency with previous regulatory decisions;

[131] See 'All of our expenditure in botex and enhancement has been adjusted to take account of our continuing 1% productivity assumption' in Anglian Water, 'Draft Determination: Data Tables Commentary', August 2019, APP24a, p.17.
[132] Bristol Water, 'Statement of Case', April 2020, pp.6-7 and 110, paragraph 31 and 443. We note that their business plan assumptions were lower at 0.7% opex and 0.9% for capex: Bristol Water Business Plan: C5: Cost and efficiency, September 2018, pp.45 and 49.
[133] See 'All our totex projections in our plan (WS1, WWS1) are net of the adjustments in this table' in Northumbrian Water, 'Appendix 4.3 – Data Table Submission Commentary', March 2019, p.63.
[134] No proposal of a specific number is included in Yorkshire Water, 'Statement of Case', April 2020. These figures are included in a report prepared by Oxera for Yorkshire Water, 'Annex 09 – Oxera - Issues with Ofwat's frontier shift assessment in PR19', March 2020, p.1. These estimates are consistent with work originally prepared for South East Water.

- the application of the frontier shift to all base costs (including unmodelled costs) and some enhancement costs.

7.10 Many of these issues have been raised previously during the PR19 process and are discussed in more detail in the final determinations and associated Europe Economics report.[135] The main new issues raised are on embodied technological change and the application of frontier shift to all base costs and some enhancement expenditure.

7.11 The key reasons for the differences between our view and those of the disputing companies appear to be the fact that we have followed Europe Economics' advice and gone towards the upper end of their range for frontier shift to take account of embodied technological change and gross value added, as well as gross output measures of productivity, and the uplift to frontier shift to take account of the impact of the totex and outcomes regime.

7.12 We also set out below our initial assessment of the impact of Covid-19 on productivity estimates for the water sector.

Our response

Our frontier shift estimate is based on a wider variety of evidence

7.13 Bristol Water states that it is not clear how we have derived our estimate of frontier shift from the evidence, and in particular which portion of the 1.1% per year frontier shift is attributable to the impact of the totex and outcomes regime, although we note that they adopt a similar frontier shift of 1% per year.[136]

7.14 In our final determinations we summarised our extensive rationale for setting a frontier shift of 1.1%.[137] We consider that the combined effect of ongoing frontier shift efficiency and the impact of the totex and outcomes framework is an overall frontier shift of 1.1% per year based on a range of factors identified at the initial assessment, draft determination and final determination stages including:

[135] Europe Economics, 'Real Price Effects and Frontier Shift - Final Assessment and Response to Company Representations', December 2019, pp.54-85.
[136] Bristol Water, 'Statement of Case', April 2020, p.106, paragraphs 436-438.
[137] Ofwat, 'PR19 final determinations: Securing cost efficiency technical appendix', December 2019, pp.121-124.

- Europe Economics' frontier shift efficiency range of 0.6% to 1.2% per year for totex, before allowing for impacts of totex and outcomes.
- Europe Economics suggests we use a number towards the top end of the 0.6%to 1.2% per year range as some weight should be placed on value-added measures and to account for embodied technological change (input quality effects).
- We are including a real price effect adjustment for real wage growth to reflect improvements in labour productivity. Labour productivity improvements reflect the impact of improved labour quality (for example better skills) as well as a result of technological progress and better use of capital. As total factor productivity estimates remove the impact of improvements in labour quality, then we could be allowing for the additional costs of improved labour quality without allowing for the additional benefits in terms of increased productivity. We consider this an additional reason to use a total factor productivity estimate towards the upper end of the 0.6% to 1.2% per year range.
- The KPMG study indicates a range of 0.2% to 1.2% per year from the additional impact of the totex and outcomes framework.
- There are some factors that would indicate using a number towards the lower end of the range identified by KPMG for the additional improvement due to the totex and outcomes framework. For example, not all outperformance in this period can be attributed to the totex and outcomes framework.
- There are some factors that could indicate a figure towards the upper end of their range. For example, KPMG applies diminishing marginal returns to the totex and outcomes framework, however, evidence on diminishing returns from regulatory and structural changes in other sectors is mixed.
- The 48 case studies by KPMG indicate a 35% improvement from the impact of totex and outcomes and cover 3.8% of total expenditure. While some of these case studies are not easily replicable, even just considering these 48 case studies gives an efficiency improvement of 1.3% of totex over the price review period, equivalent to around a 0.5% efficiency improvement per year.
- Frontier Economics for Water UK (2017) found a quality adjusted total factor productivity of 2.1% between 1994 and 2017, showing the scope for efficiency gains in the water sector in the past, as well as the lack of recent productivity growth.
- An all-in efficiency figure of 1.1% per year is consistent with using a frontier shift efficiency number towards the upper end of Europe Economics' 0.6% to 1.2% per year range.
- An efficiency figure of 1.1% per year is towards the lower end of the range of 0.6% to 2.5% per year indicated by KPMG for the combined effect of frontier shift efficiency and the impact of the totex and outcomes framework.

7.15 In our final determinations we reduced the frontier shift efficiency challenge from 1.5% to 1.1% per year in part to account for the increased challenge on outcomes performance, in particular the reduction in leakage.

Both the pre and post-crisis time periods are relevant to forecast frontier shift for PR19

7.16 Anglian Water states that Europe Economics' analysis was misleading by selecting 2009 as a base year, when economic activity was at its most depressed following the global financial crisis.[138] Bristol Water, NERA (on behalf of Bristol Water), Yorkshire Water and Oxera (on behalf of Yorkshire Water) state that Europe Economics does not consider full business cycles and excludes 2008-09, which introduces an upward bias in productivity estimates.[139] [140] [141]

7.17 Europe Economics considers both the more recent growth in the post crisis period, and also growth over a number of past full business cycles. In assessing total factor productivity growth Europe Economics considered productivity growth from EU KLEMS for both the NACE 1 dataset which covers 1970 to 2007 and the NACE 2 dataset which covers 1999 to 2014.[142] [143] [144]

7.18 Productivity growth should, ideally, be measured over entire business cycles as it is procyclical. Europe Economics considered data for two complete business cycles from the NACE 1 dataset 1980-89 and 1990-2007. Europe Economics defined a business cycle as the period from just before one trough in GDP to just before the next trough in GDP, and therefore ensuring that each of the business cycles contained a full period of contraction and a full period of

[138] Anglian Water, 'Statement of Case', April 2020, p.207, paragraph 850.
[139] Bristol Water, 'Statement of Case', April 2020, p.111, paragraph 448.
[140] NERA, 'Expert Report on Ofwat's Approach to Water Wholesale Cost Assessment in the PR19 Final Determination', March 2020, pp.51-52. Provided to the CMA by Bristol Water as document 7.
[141] Yorkshire Water, 'Statement of Case', March 2020, p.66, paragraph 199.
[142] The EU KLEMS database provides data on measures of economic growth, productivity, employment, capital formation, and technological change at the industry level for all European Union member states, Japan, and the US. Productivity measures have been developed using growth accounting techniques.
[143] NACE is the acronym used to designate the various statistical classifications of economic activities developed since 1970 in the European Union. It provides the framework for collecting and presenting a large range of statistical data according to economic activity in the fields of economic statistics and in other statistical domains. Statistics produced on the basis of NACE are comparable at European and, in general, at world level. The use of NACE is mandatory within the European statistical system.
[144] Europe Economics, 'Real Price Effects and Frontier Shift – Final Assessment and Response to Company Representations', December 2019, p.7, Table 3.

expansion.[145] NERA does not provide details on why it considers this definition to be inappropriate and would ignore economic downturns.

7.19 The NACE 2 data set (1999-2014) does not cover a complete economic cycle,[146,147] and there may be a structural break, with the trend pre-crisis productivity growth being higher than trend post-crisis productivity growth.[148]

7.20 Europe Economics did not include 2008 and 2009 when productivity growth was strongly negative. First, if the crisis period were to be included in these figures, then they would not genuinely be "pre-crisis" and "post-crisis" figures. More importantly, inclusion of these crisis years would make the figures severely downward biased, since the figures would then include a full economic contraction but only an incomplete part of the period of economic expansion either side of the crisis.[149]

7.21 The Europe Economics range takes into account both the pre- and post-crisis period as well as data from complete business cycles from the NACE 1 dataset. We note that Oxera's choice of time period for its estimates of 1996 to 2014 and NERA time period 1970 to 2007 might not represent the entirety of complete business cycles.

7.22 Overall, Europe Economics' forecasts of frontier shift are based on an appropriate time period as they consider both growth over more recent years and a number of past full business cycles.

It is appropriate to consider value added as well as gross output measures of productivity improvement

7.23 NERA (for Bristol Water) states that Ofwat's decision to place some weight on the value-added total factor productivity measure is incorrect and contradicts

[145] Europe Economics, 'Real Price Effects and Frontier Shift – Final Assessment and Response to Company Representations', December 2019, p.141.
[146] Referring to the NACE 2 dataset, Economic Insight stated 'the EU KLEMS data does not contain a 'whole' business cycle'.
[147] Referring to the 1996-2014 period that it focuses on using the NACE 2 dataset, Oxera states that 'this might not necessarily represent a "full" business cycle'.
[148] This was recognised by water company consultants (Earwaker and Economic Insight).
[149] Europe Economics, 'Real Price Effects and Frontier Shift – Final Assessment and Response to Company Representations', December 2019, pp.118-119.

Europe Economics' preferred approach of using gross output total factor productivity measures.[150]

7.24 Gross output total factor productivity captures all production inputs in a sector, including intermediate inputs purchased from other sectors. Value added total factor productivity measures only consider capital and labour and exclude the impact of intermediate inputs.

7.25 Europe Economics considers that gross output is the more appropriate measure of total factor productivity growth as the frontier shift estimate will be applied to expenditure which includes expenditure on intermediate inputs. Europe Economics suggests that some lesser weight be placed on the figures for value added total factor productivity.[151] While the gross output measure is generally preferable it is not superior in all cases, and this is a reason for considering a point towards the upper end of the range suggested by the gross output-based measure.

7.26 Europe Economics' frontier shift estimate of 0.6% to 1.2% per year is based on gross output total factor productivity growth. Europe Economics suggests that a value towards the upper end of this range should be used to take account of value added measures which tend to be higher.

7.27 We note that Oxera (for Yorkshire Water) uses gross value added measures to estimate frontier shift and states that both gross output and value added measures are equally valid measures of frontier shift.[152]

7.28 We continue to consider that our use of the Europe Economics range is consistent with its advice to take account of both gross output and value added measures. We note that many of the water companies' consultants originally used value added measures to forecast productivity and other regulators such as Ofgem have used them in the past. We continue to consider that we should place some weight on value added measures.

[150] NERA, 'Expert Report on Ofwat's Approach to Water Wholesale Cost Assessment in the PR19 Final Determination – Prepared for Bristol Water', March 2020, pp.52-53. Provided to the CMA by Bristol Water as document 7.
[151] Europe Economics, 'Real Price Effects and Frontier Shift – Final Assessment and Response to Company Representations', December 2019, pp.76, 120-121.
[152] Yorkshire Water, 'Annex 09 – Oxera - Issues with Ofwat's frontier shift assessment in PR19', March 2020, p.1.

Our frontier shift range is based on appropriate comparator sectors which are similar to those used by companies and their consultants

7.29 Anglian Water states that Europe Economics was highly selective in its choice of comparator sectors, using evidence only from sectors where productivity improvements have been greater.[153]

7.30 The comparator sectors chosen by Europe Economics are similar to those put forward by companies (see Table 7.2), and comparators proposed by companies have only been rejected for good reason. For example, because they are sectors that are subject to regulation (such as the utility sector) or are not similar to water (such as the agricultural sector).[154]

Table 7.2: Comparator sectors used by other consultancies

Industry	Economic Insight[155]	NERA[156]	Oxera[157][158]	Europe Economics chosen comparators
Total industries	✓			
Total manufacturing	✓		✓	✓
Wholesale trade, except of motor vehicles and motorcycles	✓			
Construction	✓	✓	✓	✓
Financial intermediation		✓		
Agriculture, forestry and fishing	✓			
Real estate activities	✓			
Chemicals and chemical products		✓	✓	✓

[153] Anglian Water, 'Statement of Case', April 2020, Chapter E.4, p.207, paragraph 849.
[154] Further details on the choice of comparator sectors is set out in Europe Economics, 'Real Price Effects and Frontier Shift', December 2019, Section 3.8, pp.115-117 and 135-136.
[155] Economic Insight reports prepared for Yorkshire Water, Affinity Water, Bristol Water, Northumbrian Water, South West Water and Wessex Water. Provided to the CMA by Yorkshire Water: Economic Insight, Exhibit 66-051, 'Appendix 8n: The scope for frontier shift at PR19', February 2018. Provided to the CMA by Northumbrian Water: Economic Insight, SOC053, 'PR19 WHOLESALE REAL PRICE EFFECTS ANALYSIS AND EVIDENCE - A report for Northumbrian Water', February 2018.
[156] NERA, 'Forecasts of Real Price Effects and Ongoing Productivity Improvement During PR19 - Prepared for Bristol Water', December 2017. Provided to the CMA by Bristol Water as BW253.
[157] Oxera report prepared for Southern Water. Oxera, 'TA 14.6 Oxera Report: Estimate of RPE and frontier shift – Redacted', September 2018. We have requested permission from the company to share this report with the CMA and are awaiting confirmation.
[158] Oxera report prepared for South East Water. South East Water, 'Wholesale efficiency assessment – PR19 Supporting Appendix 13', September 2018, section 4.2.5.

Industry	Economic Insight[155]	NERA[156]	Oxera[157][158]	Europe Economics chosen comparators
Other manufacturing; repair and installation of machinery and equipment			✓	✓
Transport and storage	✓		✓	✓
Manufacture of electrical and optical equipment		✓		
Manufacture of transport equipment		✓		
Sale, maintenance and repair of motor vehicles; retail sale of fuel		✓		
Manufacturing n.e.c; recycling		✓		
Manufacture of rubber and plastics		✓		
Machinery and equipment n.e.c				✓
Electricity, gas and water supply[159]			✓	

Source: Europe Economics final report[160] based on company business plans and Europe Economics' own comparator selection.

An ongoing frontier shift efficiency range of 0.6% to 1.2% is supported by evidence from comparator sectors in both recent years and the longer term

7.31 Anglian Water, Yorkshire Water, NERA (for Bristol Water), and Oxera (for Yorkshire Water) raise concerns over the derivation of the Europe Economics frontier shift efficiency range of 0.6% to 1.2% per year.[161] [162] [163] [164] In particular they state that Europe Economics has effectively excluded the construction sector from the frontier shift estimates (Anglian Water, Yorkshire Water and Oxera), placed too much weight on growth in an upturn (Yorkshire Water) and only selected stronger performing sectors to derive the upper end of the range. Oxera suggest that a composite measure including data from multiple industries would provide a more robust estimate of the scope for frontier shift.

[159] Used as a sensitivity check only.
[160] Europe Economics, 'Real Price Effects and Frontier Shift – Final Assessment and Response to Company Representations', December 2019, p.69, Table 3.8.
[161] Anglian Water, 'Statement of Case', April 2020, Chapter E.4, p.202, Overview box, item (iii)(a).
[162] Yorkshire Water, 'Statement of Case', April 2020, p. 66, paragraph 199.
[163] NERA, 'Expert Report on Ofwat's Approach to Water Wholesale Cost Assessment in the PR19 Final Determination – Prepared for Bristol Water', March 2020, pp.50-51. Provided to the CMA by Bristol Water as document 7.
[164] Yorkshire Water, 'Annex 09 – Oxera - Issues with Ofwat's frontier shift assessment in PR19', March 2020, p.1.

7.32 The Europe Economics range of 0.6% to 1.2% per year for frontier shift on total expenditure is based on historical productivity growth of comparator sectors after the financial crisis and over the longer term.

7.33 The lower bound of 0.6% is based on average productivity growth of comparator sectors in the post-financial crisis period, which has been characterised by economy wide low productivity growth. Europe Economics considered that this was the lower bound as the economy may recover, or at least start to recover, to the pre-crisis long-run average over the course of the control period.[165]

7.34 The upper bound of 1.2% is based on stronger performing comparator sectors over both the pre- and post-crisis period.[166] Europe Economics considers that averages of comparator sectors would not provide an appropriate upper bound as historical performance indicates many sectors can perform more strongly than the average and by definition, an average provides a measure of the central value of a distribution rather than an upper value.[167] The upper end of the range also took into account the potential for additional productivity growth from embodied technological change and the higher productivity estimates from value added measures. We note that average growth under the value added measure of productivity was at least an average of 1.3% per year over the post crisis and full business cycle periods.

7.35 The range explicitly considers productivity growth from the construction sector, as can be seen in Table 7.3. We do not consider that the share of totex that companies spend on construction necessarily makes it a closer comparator than other sectors which have a similar nature of activity to the water sector.[168]

[165] Europe Economics, 'Real Price Effects and Frontier Shift – Final Assessment and Response to Company Representations', December 2019, p. 79.
[166] Europe Economics, 'Real Price Effects and Frontier Shift – Final Assessment and Response to Company Representations', December 2019, pp. 79-80.
[167] Europe Economics, 'Real Price Effects and Frontier Shift – Final Assessment and Response to Company Representations', December 2019, p.116.
[168] Europe Economics, 'Real Price Effects and Frontier Shift – Final Assessment and Response to Company Representations', December 2019, p.116.

Table 7.3: Total factor productivity pre and post financial crisis, based on gross output measure

Industry comparators	Average (1980-89)	Average (1990-2007)	Average (1999-2014)	Average pre-crisis (1999-2007)	Average post-crisis (2010-14)
Dataset (NACE)	**1**	**1**	**2**	**2**	**2**
Chemicals and chemical products	1.6%	1.2%	0.8%	1.3%	-0.7%
Construction	0.8%	0.3%	-0.1%	0.2%	0.7%
Machinery and equipment	0.5%	0.8%	0.9%	1.2%	1.0%
Other manufacturing; repair and installation of machinery and equipment	-	-	1.0%	1.2%	1.3%
Professional, scientific, technical, administrative and support service activities	-	-	0.9%	1.1%	1.5%
Total manufacturing	1.0%	0.6%	0.6%	0.9%	0.3%
Transport and storage	1.3%	0.7%	0.0%	0.2%	0.5%
Gross output average for comparators	**1.0%**	**0.7%**	**0.6%**	**0.9%**	**0.6%**
Market economy (for comparison)[169]	0.3%	0.3%	0.2%	0.7%	0.0%
Gross value add measure: average for comparators (for comparison)	2.6%	2.0%	1.3%	2.1%	1.3%

Note that the gross value added measure for comparators for both 1980-89 and 1990-2007 is 1.5% in NACE 2. Source: Europe Economics[170]

7.36 Oxera suggested to use a composite measure which implicitly weights data from different industries to provide a single estimate frontier shift. We consider a composite measure could lead to spurious accuracy and is better to consider productivity improvements of all comparator sectors in the round, as has been used by Europe Economics. This spurious accuracy is illustrated by Oxera's own estimates of productivity growth using this approach. Oxera's own composite measure of frontier shift significantly over-weights the construction sector, with construction accounting for around two thirds of the productivity growth for operating expenditure and half of capital expenditure. Since Oxera estimated a low total factor productivity growth rate for its time period of 0.2%

[169] Total industries (for purpose of comparison) used in NACE 1.
[170] Europe Economics, 'Real Price Effects and Frontier Shift – Final Assessment and Response to Company Representations', December 2019, p.77, Tables 3.13 and 3.14 for gross output average; p.78, Tables 3.15 and 3.16 and p.79, Table 3.17 for gross value added average.

per year for the construction sector, this over-weighting of construction significantly downward biases Oxera's estimates for frontier shift.[171]

It is appropriate to take into account embodied technological change in productivity growth estimates

7.37 Oxera (on behalf of Yorkshire Water) states that we should not consider embodied technological change when selecting our frontier shift from Europe Economics' range as:[172]

- considering embodied technological change when selecting a frontier shift is double counting potential productivity gains with catch-up efficiency; and
- Europe Economics has used isolated, limited research to suggest an uplift from embodied technical change.

7.38 Europe Economics recommended that we take into account embodied technological change when selecting our frontier shift to take account of the potential cost savings from quality improvements 'embodied' in the inputs used by the sector (labour, capital and intermediate inputs). Following Oxera's report for Yorkshire Water in March 2020, Europe Economics have set out a detailed response to Oxera's report.[173]

7.39 Oxera's suggestion that the frontier shift estimate should not take into account embodied technological change as it would constitute **double counting conflates the idea of catch up efficiency and embodied technological change.**

- Disembodied technological change, as measured by total factor productivity, is the increase in output after taking account of increases in the quantity and quality of inputs. For example, it captures increases in output due to improved management processes.
- Embodied technological change is the change in output from improvements in the quality of inputs (e.g. from technologically more advanced machines).

[171] South East Water, 'Wholesale efficiency assessment – PR19 Supporting Appendix 13', September 2018, p.75, Table 4.9; and Europe Economics, 'Real Price Effects and Frontier Shift – Final Assessment and Response to Company Representations', December 2019, p.117.
[172] Yorkshire Water, 'Annex 10 – Oxera - Issues with Ofwat's frontier shift assessment in PR19', March 2020, pp.6-7.
[173] See 'C002 - Europe Economics note responding to Oxera's arguments on embodied technical shift - 30 April', April 2020.

7.40 At a theoretical level, embodied technological change could represent frontier shift or catch-up efficiency. For example, the purchase of entirely new capital goods technology will represent a movement of the frontier rather than catch-up efficiency. The frontier shift analysis carried out by Europe Economics focused on competitive comparator sectors where we would not expect catch-up efficiency to be an issue, as inefficient firms will not survive in a competitive market (or if they can survive due to imperfections in competition, we would not expect the dispersion in efficiency levels to vary through time). Given that the reasoning in Europe Economics' report applies the percentage uplift for embodied technical change to total factor productivity estimates from competitive sectors, we would expect this uplift to represent frontier shift. Catch-up efficiency is dealt with below. **We therefore reject Oxera's argument that embodied technological change equates to catch-up efficiency and that there is double counting.**

7.41 Europe Economics states that Oxera's assertion that disembodied technical change equates to frontier shift and embodied technical change equates to catch-up efficiency is incorrect. Referring to the OECD's definition of embodied and disembodied technical change,[174] it notes that embodied technical change is not the same thing as movements towards the efficiency frontier and hence Oxera's argument is based on a false definition of embodied technical change. Europe Economics also notes that NERA, which continues to advise water companies through PR19, has conceded that total factor productivity data understates frontier shift due to embodied technological change.[175]

7.42 Europe Economics' recommendation to account for embodied technical change when selecting our frontier shift is based in part on evidence from peer reviewed academic research.[176] This research indicates that total factor productivity might need to be uplifted by as much as 60% to account for embodied technical change. While Europe Economics accepts that this research is limited, they note they "do not consider the fact that the articles [they] used by Uri and Hulten were published ten years apart represents a flaw in our approach. There is no reason why results from articles with different publication dates must necessarily be incompatible. Hence, in our view, this represents a wholly spurious criticism on the part of Oxera." Europe Economics also note they do not quantitatively apply an uplift for embodied technological

[174] OECD, 'Measuring Productivity; OECD Manual; Measurement of Aggregate and Industry-Level Productivity Growth', 2001.
[175] NERA, 'Review of Ofwat's Proposed Approach to Frontier Shift, Real Price Effects and Output Growth at PR19; Prepared for Bristol Water', March 2019. Provided to the CMA by Bristol Water as BW099.
[176] Europe Economics, 'Real Price Effects and Frontier Shift – Final Assessment and Response to Company Representations', December 2019, p.67.

change but simply state it should be accounted for by taking a value from towards the upper end of the range. Additionally, Oxera does not provide any alternative, better quantification of embodied technical shift.

7.43 Further details and response to Oxera's comments in relation to embodied technical change can be found in 'Europe Economics note responding to Oxera's arguments on embodied technical shift - 30 April'.

Our productivity growth estimate was consistent with productivity growth estimates at the time

7.44 Bristol Water states that independent estimates support a frontier shift efficiency range below 1% per year and quote recent economy wide productivity growth estimates from the Office of Budget Responsibility and the Bank of England (both before Covid-19).[177] Anglian Water states that a productivity growth rate of 1.1% is challenging in the light of low productivity growth over the last decade, which affects water companies as well as other companies.[178]

7.45 We fully accept that economy wide productivity growth has been low in recent years (as shown in Table 7.3). The Europe Economics productivity growth forecast is based on growth in comparator sectors, including manufacturing and construction, which has tended to outperform UK productivity in recent years (and also in the longer term). Growth in these comparator sectors has outstripped UK productivity by 0.5% to 0.6% per year. Assuming this relationship continues, the Office for Budget Responsibility's labour productivity forecasts of around 1% imply productivity growth in comparator sectors of 0.9% to 1.3% per year, towards the upper end of the range provided Europe Economics.[179] We therefore reject the company argument that water sector productivity should reflect recent low growth across the economy as a whole.

Our productivity growth estimate takes account of the potential for catch-up efficiency in productivity growth estimates

7.46 Oxera (on behalf of Yorkshire Water) states that our frontier shift estimates do not incorporate a downward reduction in estimates of total productivity growth

[177] Bristol Water, 'Statement of Case', April 2020, pp.106-110, Paragraphs 438-444.
[178] Anglian Water, 'Statement of Case', April 2020, Chapter E.4, p.207, paragraph 848.
[179] Ofwat, 'PR19 final determinations: Securing cost efficiency technical appendix', December 2019, p.185.

to reflect catch-up efficiency in historical estimates.[180] Northumbrian Water states that we wrongly reflect total factor productivity estimates from other sectors as frontier shift only, rather than a combination of frontier shift and catch-up efficiency, and that together these challenges are unachievable.[181]

7.47 Our frontier shift range is based on productivity in competitive sectors only. This limits effect of catch-up on total factor productivity estimates.[182] We do not consider that we need to adjust productivity estimates for competitive sectors for three reasons:

- In a reasonably competitive industry, inefficient firms will not survive in the long run, meaning that surviving firms may only have small efficiency differentials.
- Alternatively, in a reasonably competitive industry, even if efficiency levels of individual producers vary, on average, they might tend to cancel out across the sector and over time. For example if a firm makes a step forward in terms of frontier shift efficiency and other firms catch up over time, the average efficiency across the sector will reflect the frontier shift improvement that is made across the sector.
- Even if there were variations in efficiency across companies there is no reason for expecting the degree of dispersion to change over time.

Historical data from the water sector provides an illustration of the potential for productivity growth in the future

7.48 Bristol Water and NERA (for Bristol Water) suggest we are incorrect to take account of estimates of productivity growth in the water sector as these reflect catch-up as well as frontier shift efficiency.[183] [184]

7.49 In our final determinations we referred to findings from a study undertaken by Frontier Economics for Water UK on productivity improvement in the water sector to illustrate how productivity had stagnated in recent years. The Water UK study of productivity improvement in the water sector shows average, quality adjusted, productivity growth of 2.1% per year between 1994 and 2017,

[180] Yorkshire Water, 'Annex 10 – Oxera - Issues with Ofwat's frontier shift assessment in PR19', March 2020, p.7.
[181] Northumbrian Water, 'Statement of Case', March 2020, p.71, paragraph 326.
[182] Europe Economics, 'Real Price Effects and Frontier Shift – Final Assessment and Response to Company Representations', December 2019, pp.62 and 122.
[183] Bristol Water, 'Statement of Case', April 2020, p.110, paragraph 447.
[184] NERA, 'Expert Report on Ofwat's Approach to Water Wholesale Cost Assessment in the PR19 Final Determination – Prepared for Bristol Water', March 2020, pp.48-49, paragraphs 195-197. Provided to the CMA by Bristol Water as document 7.

although recent growth has been much lower. This captures productivity growth reflecting both catch up efficiency and frontier shift efficiency, particularly in the post privatisation period. Our frontier shift estimate of 1.1% per year is well below this. We use this as an illustration of the scope for the scope for efficiency improvement in the sector.

There is evidence to support application of an uplift to productivity from the totex and outcomes framework

7.50 Anglian Water, Yorkshire Water, and Bristol Water, state that any uplift from the totex and outcomes framework was unjustified and not supported by sufficient evidence.[185] [186] [187]

7.51 Our price control framework is designed to reward and encourage efficiency and innovation. At PR14, we introduced a totex and outcomes framework which has given companies the flexibility to decide how best to deliver their services, and to come up with the most cost efficient and innovative solutions. In PR19, we expect that water companies, as well as the supply chain, will have better embedded the totex and outcomes frameworks in their business planning process.

7.52 In making our assessment of the potential for additional efficiency improvement from the totex and outcomes framework we analysed findings from KPMG and Aqua consultants that forecast there could be an additional 0.2% to 1.2% per year improvement in efficiency from the totex and outcomes framework over the next control period.[188] KPMG's range was based on three factors:

- **Outperformance:** KPMG examined outperformance from the totex and outcomes regime in the water and energy sectors, and based on experience from the electricity distribution control (which is in its second totex control) made assumptions on the degree to which this was likely to continue in future controls.
- **Case studies:** 48 case studies provided by the water companies give examples of how they have been able to use the totex framework to realise greater efficiencies. These case studies varied across companies, and on their own, represented 3.8% of totex. KPMG found an average of 35.4% of

[185] Anglian Water, 'Statement of Case', April 2020, Chapter E.4, p.207, paragraph 848.
[186] Yorkshire Water, 'Statement of Case', April 2020, p.66, paragraph 200.
[187] Bristol Water, 'Statement of Case', April 2020, p.110, paragraph 445-446.
[188] KPMG LLP and Aqua Consultants LTD, Report for Ofwat, 'Innovation and efficiency gains from the totex and outcomes framework', June 2018, p.95, Table 31.

efficiency savings, which by themselves translated to an overall efficiency improvement of 1.3% over 5 years.[189] These were drawn from a subset of over 180 examples provided by water companies and the supply chain.

- **Experience of regulatory sectors:** KPMG reviewed performance improvements associated with structural or regulatory changes in 21 settings, and found the upper bound of comparable performance gains to be 6.7% per year.[190]

7.53 In setting our final determinations, we examined how outperformance forecasts for the period had changed in the light of the latest data available. KPMG adjusts, where possible, for outperformance that are clearly outside of management control, or where efficiency is not driven by the totex and outcomes framework, although there remains a risk that the analysis does not identify or account for all the drivers of outperformance. We have not attempted to make adjustments to reported outperformance. As shown in Table 7.4, better performing water companies appear to have maintained their outperformance between 2017 and 2019, although median outperformance appears to have declined. In our final determinations we reduced our frontier shift estimate from 1.5% per year to 1.1% per year in part due to the decline in totex outperformance from the sector.

[189] KPMG LLP and Aqua Consultants LTD, Report for Ofwat, 'Innovation and efficiency gains from the totex and outcomes framework', June 2018, p.19.
[190] KPMG LLP and Aqua Consultants LTD, Report for Ofwat, 'Innovation and efficiency gains from the totex and outcomes framework', June 2018, p.17, Table 5.

Table 7.4: Totex outperformance in the water controls (equivalent % per year)

Sector	Lower quartile	Median	Upper quartile
KPMG estimate (up to 2017)	0.0%	1.2%	2.7%
Ofwat estimate (up to 2017)	-0.1%	0.6%	2.5%
Ofwat estimate (up to 2019)	-0.3%	0.3%	2.4%

7.54 Reported totex performance in the annual performance reports might understate true outperformance of the PR14 settlement. Companies state in their 2018-19 Annual Performance Reports that they have spent money on a number of initiatives that are not directly related to the delivery of the PR14 review, including:

- Anglian Water spending up to £165 million of outperformance reinvested to make an "early start" on resilience plans and drive forward enhanced digital capability and customer experience.[191][192]
- Bristol Water investing in major metering and water efficiency campaigns to target reducing per capita consumption toward their target for 2025.[193]
- Northumbrian Water spending up to £36 million to 2020 on transforming their customer facing operation.[194]
- Yorkshire Water investing £7 million in fitting new water meters and a further £1.8 million to replace old water meters. The company explicitly states this investment is to improve leakage performance into the 2020-25 period.[195] Yorkshire Water is also undertaking investment through their "Customer Minutes Lost" program to become an industry leader in terms of water supply interruption performance by 2025.[196]

7.55 We reject the assertion that we have not provided sufficient evidence to justify an uplift from the totex and outcomes framework. We provided a significant body of evidence to support an uplift, including case studies put forward by the companies themselves together with evidence from both water and energy controls. Our uplift is small in comparison to upper quartile company outperformance of 2.4% per year. The case studies themselves suggest that

[191] Anglian Water, 'Annual Performance Report 2019', July 2019, p.108, paragraph 8; and Anglian Water, 'Our plan 2020-2025', September 2018, p.4.
[192] See reference document C00xx – Anglian Water Query Response - ANH-APR-PD-002, pp.2-5.
[193] Bristol Water, 'Annual Report and Financial Statements for the year ended 31 March 2019', p.248.
[194] Northumbrian Water, 'Northumbrian Water Limited Annual Performance Report for the year ended 31 March 2019', p.36.
[195] Yorkshire Water, 'Delivering our commitments – Our Annual Performance Report 2018/2019', pp.77-78.
[196] Yorkshire Water, 'Delivering our commitments – Our Annual Performance Report 2018/2019', p.81.

there is substantial scope for all companies to learn best practice from their peers. KPMG's estimate was for the second control period for a totex and outcomes regime and therefore took into account that cost models were based on historical expenditure data.

7.56 The alternative that the companies appear to be suggesting is that no account should be taken of the totex and outcomes regime going forwards. We do not consider that this is a credible position and does not reflect the balance of evidence. Indeed we consider that our approach to the application of the totex and outcomes regime is conservative. While we reduced the uplift in the final determinations so that our overall uplift for frontier shift was 1.1% per year instead of 1.5%, we consider that there is significant evidence we could have used a higher uplift. In particular:

- the reduction in the uplift was based on the reduction in outperformance however at least some of this is due to companies additional expenditure in preparation of PR19;
- the upper quartile performers had retained their level of outperformance, potentially indicating substantial scope from outperformance from those which are making more extensive use of the totex and outcomes framework; and
- the case studies remain valid, and they on their own, indicated outperformance 1.3% per year (equivalent to 0.5% efficiency improvement per year), given the wide variety of these case studies, simple adoption of best practice by each company would lead to an efficiency improvement many times this.

Our final determination frontier shift, including its application, is in line with recent decisions by other regulators

7.57 Northumbrian Water and Bristol Water argue that our frontier shift is inconsistent with previous regulatory decisions.[197] [198]

7.58 Our frontier shift of 1.1% is within the range of frontier shifts applied by other UK regulators in recent years which tend to be around 1% per year and can be as high as 1.2% per year Table 7.5 also shows that other regulators have applied frontier shift to enhancement costs as well as base costs.

[197] Northumbrian Water, 'Statement of Case', April 2020, p.56, paragraph 255.
[198] Bristol Water, 'Statement of Case', April 2020, p.112, paragraph 453, Table C8.

Table 7.5: Recent frontier shift application by other regulators

Regulator (Price Control)	Sector	Years	Start date	Opex (%)	Capex (%)	Totex (%)	Notable inclusions / exclusions
ORR (PR13)[199]	Rail	2014-2019	2013-14	-	0.4	-	0.4% on enhancement expenditure only
Ofgem (RIIO-T1/GD1)[200]	Electricity and Gas Transmission	2013-2021	2011-12	1.0	0.7	0.8	Included 0.7% challenge on Repex
Ofgem (RIIO-ED1)[201]	Electricity Distribution	2015-2023	2013-14	1.0	0.7	0.8 – 1.1%	Included 0.7% challenge on Repex and UQ efficiency adjustments
CMA Bristol Water (PR14)[202]	Water	2015-2020	2012-13	-	-	1.0	Excluded business rates and pension deficit repair contributions
CC (RP5)[203]	Electricity	2013-2017	2011-12 (opex) 2009-10 (capex)	1.0	1.0	-	-
UR (GD14)[204]	Gas Distribution	2014-2016	2014 (opex) 2012 (capex)	1.0	1.0	-	Excludes license fees and connection incentives from opex; includes all capex (incl. TMA)
UR (PC15)[205]	Water and Sewerage	2015-2021	2013-14	0.9	-	-	-
UR (GD17)[206]	Gas distribution	2017-2022	2015-16	1.0	1.0	-	Both opex and capex include labour, materials, equipment/plant and other

[199] ORR, 'Final determination of Network Rail's outputs and funding for 2014-19 – Chapters 3-11', pp.142 and 159, paragraphs 4.79 and 5.15.
[200] Ofgem, 'RIIO-T1/GDI: Real price effects and ongoing efficiency appendix', Chapter 3, p.15, paragraph 3.3.
[201] Ofgem, 'RIIO-EDI: Final determinations for the slow-track electricity distribution companies', November 2014, p.30, paragraph 4.42; and Ofgem, 'RIIO-ED1: Draft determinations for the slow-track electricity distribution companies', July 2014, pp.123-124, paragraphs 12.59-12.64.
[202] CMA, 'Bristol Water plc – A reference under section 12(3)(a) of the Water Industry Act 1991 – Report', October 2015, p.119, p.263 and p.365, paragraph 4.233 (b), Table 7.1 and paragraph 12.3.
[203] Competition Commission, 'Northern Ireland Electricity Limited price determination – A reference under Article 15 of the Electricity (Northern Ireland) Order 1992', March 2014, p.11-6, paragraphs 11.27-11.28.
[204] Utility Regulator, 'GD14 Price Control for Northern Ireland's Gas Distribution Networks for 2014-2016 – Final Determination', December 2013, pp.170-171.
[205] Utility Regulator, 'Water & Sewerage Services Price Control 2015-21 – Final Determination – Annex S – Opex Frontier Shift Report', December 2014, p.22, Table 5.1.
[206] Utility Regulator, 'Annex 6 – Real Price Effects & Frontier Shift – GD17 Final Determination', September 2016, pp.16 and 20.

Regulator (Price Control)	Sector	Years	Start date	Opex (%)	Capex (%)	Totex (%)	Notable inclusions / exclusions
UR (RP6)[207]	Electricity	2017-2024	2015-16	1.0	1.0	-	Both opex and capex include labour, materials, equipment/plant and other
CAA (H7 - consultation phase)[208]	Aviation	2020-2024	2018	0.9	Proposed by CEPA	-	Includes materials and wages
PPP Arbiter (PR09)[209]	Underground Infracos	2010-2017	2008	0.9	1.2	-	Excludes raw materials

Source: Ofwat analysis of recent regulatory decisions

Commencement of application of frontier shift and real price effects

7.59 In our final determinations,[210] we applied the frontier shift and real price effects to costs from 2019-20, instead of from 2020-21 as in our draft determination. Base cost inputs, and cost forecasts, used in our cost modes and assessment only take into account data and therefore ongoing efficiency improvements and real price effects up until 2018-19. We therefore considered it appropriate to add in frontier shift and real price effects from the last year that data was included in our modelling.

7.60 In their statement of cases to the CMA, both Anglian Water and Bristol Water advised they supported this decision. Northumbrian Water noted that by changing the starting point of the frontier shift we have reduced its allowance, and that we made this change without consulting the industry.

7.61 Our decision to apply the frontier shift from one year before the price control begins is supported by evidence from a number of other recent regulatory decisions as shown in Table 7.5.

[207] Utility Regulator, 'Annex C – Frontier Shift: Real Price Effects & Productivity – RP6 Final Determination', June 2017, pp.24, 25 and 27, paragraphs 3.27, 3.30, 4.4.
[208] CEPA, 'Heathrow Interim H7 Price Control: Review of HAL's initial submission – CAA Phase One Report', February 2019, pp.7, 32-33, and 51.
[209] PPP Arbiter, 'Reference for directions and guidance from London Underground Ltd in respect of the Periodic Review of Tube Lines' PPP Agreement', December 2009, pp.69-74, paragraph 7.88, 7.92, 7.97 and Table 7.12 and Table 7.15.
[210] Ofwat, 'PR19 final determinations: Securing cost efficiency technical appendix', December 2019, p.122.

We have applied the frontier shift to all base costs

7.62 Anglian Water, Bristol Water, Northumbrian Water, and Yorkshire Water argue we have incorrectly applied frontier shift to unmodelled costs including business rates, abstraction charges and traffic management act costs. [211] [212] [213] [214]

7.63 The frontier shift estimates identified for comparator sectors are based on productivity growth across all costs, including both base and enhancement costs. Given that the frontier shift estimate was based on all costs in comparator industries (including costs that might be regarded as 'fixed'), we therefore applied frontier shift to all wholesale base expenditure. Water unmodelled base expenditure includes business rates, Traffic Management Act costs and abstraction rates which in combination accounted for 7.9% (£3,653 million) of allowed totex.[215] We consider that there is some scope for companies to reduce these costs, in particular Traffic Management Act costs for example through the use of innovative or non-invasive ways to make repairs. If the frontier shift estimate was not being applied to these costs, then either comparable costs should have been removed from other sectors before productivity estimates are made; or the frontier shift on other costs should be increased as it is only being applied to a smaller proportion of costs in the water sector.

We have applied the frontier shift to the appropriate enhancement costs

7.64 Anglian Water, Northumbrian Water, and Yorkshire Water state that applying frontier shift to enhancement costs such as WINEP is double counting the efficiency gain. [216] [217] [218] They state companies have included frontier shift assumptions on enhancement costs, and these are used to determine the forward-looking benchmark for WINEP. Northumbrian Water argues that the two upper quartile WINEP benchmark companies (South West Water and Severn Trent Water) have applied frontier shift challenges to their WINEP costs

[211] Anglian Water, 'Statement of Case', March 2020, Chapter E.4, pp.202 and 207-208, Overview box item (iii)(b), paragraphs 850-851.
[212] Bristol Water, 'Statement of Case', March 2020, pp.6-7, 105-106 and 111-112, paragraphs 31, 434 and 450-452.
[213] Northumbrian Water, 'Statement of Case', March 2020, p.94, paragraphs 457-462.
[214] Yorkshire Water, 'Statement of Case', March 2020, pp.38-39, paragraphs 120d-120e.
[215] In our 'Reference of the PR19 final determinations: Cross-cutting issues' submission to the CMA we erroneously stated this was £40 million over the price control period rather than £40 million per year. Across the 2020-25 period and net of real price effects allowances this is equivalent to £96 million, or 0.2% of totex.
[216] Anglian Water, 'Statement of Case', April 2020, Chapter E.4, paragraphs 790-793.
[217] Northumbrian Water, 'Statement of Case', April 2020, pp.92-93, paragraphs 443-449.
[218] Yorkshire Water, 'Statement of Case', April 2020, p.67, paragraph 201.

similar to our challenge of 1.1% per annum, and states that if we apply the frontier shift of 1.1% to companies' WINEP costs we are double counting the efficiency gain.

7.65 In our final determinations we considered that we should apply frontier shift (and real price effects) to elements of enhancement costs which are more common across companies including the wastewater water industry national environment programme (WINEP) and metering costs. This is because the potential gains from productivity improvements are likely to be more significant for large, relatively homogenous programmes of work that are more common across companies.

7.66 We accept that enhancement costs are based on company estimates of future costs. Therefore to the extent that enhancement costs are included in future efficiency improvements due to frontier shift then there could be scope for double counting. As noted in our final determinations and 'Reference of the PR19 final determinations: Cross-cutting issues',[219] we reviewed company forecasts of frontier shift on enhancement costs. In general, we found that frontier shift assumptions on enhancement expenditure tend to be limited and were often offset by real price effect adjustments (where these are explicit). We therefore considered there was a case to apply frontier shift (and real price effect) adjustments to specific areas of enhancement costs to WINEP and metering costs where costs were more common and/or are part of large programmes of work.

7.67 As WINEP allowances are estimated based on a forward-looking benchmark, we agree with Northumbrian Water that if the upper quartile companies have applied a frontier shift adjustment (without offsetting it with a real price effects allowance) then the WINEP allowances would already capture frontier shift productivity improvements. Northumbrian Water suggests that Severn Trent Water and South West Water are the upper quartile companies and that they have applied frontier shifts to their WINEP costs. For the reasons set out below, we consider that suggestion to be unfounded.

7.68 We note that, while in the upper quartile, Severn Trent Water and South West Water are **not** the companies that define the upper quartile for WINEP modelling. The third and fourth companies (United Utilities and Dŵr Cymru) define the upper quartile in the WINEP modelling and therefore their costs and use of frontier shift is the most relevant to defining the efficient cost benchmark used by other companies.[220] As we set out below there is no evidence that the

[219] Ofwat, 'Reference of the PR19 final determinations: Cross-cutting issues', March 2020.
[220] Ofwat, Feeder model: Enhancement aggregator, WINEP in-the-round tab.

upper quartile companies have applied a net frontier shift challenge to WINEP enhancement expenditure, i.e. a frontier shift estimate that is greater than the corresponding real price effect adjustment. We therefore consider our application of frontier shift does not double count efficiency gains.

7.69 There is no evidence that United Utilities applied a positive net frontier shift adjustment to capital expenditure/WINEP enhancement costs. In its September 2018 business plan, United Utilities notes a number of efficiency challenges it imposed on enhancement expenditure, none of which were frontier shift efficiency.[221] In its September 2018 business plan it also outlined why a net frontier shift (i.e. inclusive of real price effects) of -0.2% (i.e. 0.2% increase in cost allowance) for wholesale price controls was appropriate.[222] In the response to its draft determination, this was revised to a 0.5% frontier efficiency challenge on base costs only.[223] As such, we do not find evidence that United Utilities has applied a frontier shift efficiency challenge to their enhancement costs and consider that our application of the frontier shift does not double count efficiencies.

7.70 There is no evidence that Dŵr Cymru applied an explicit net frontier shift efficiency challenge to its WINEP enhancement costs. In its September 2018 and April 2019 business plan data table commentary, Dŵr Cymru sets out the efficiency challenges it imposed on enhancement expenditure, in particular a 10% reduction in construction costs from negotiations with its capital alliance partners.[224] In its response to our draft determination, Dŵr Cymru proposed a net increase in its cost allowance as a result of a 1% real price effects allowance less a frontier shift efficiency challenge of no more than 0.25%, for base costs only.[225] We find no evidence to suggest Dŵr Cymru has applied a frontier shift challenge to enhancement costs and consider our application of the frontier shift does not double count efficiencies.

7.71 There is no evidence that South West Water applied an explicit net frontier efficiency challenge to its WINEP costs. Northumbrian Water included quotes from South West Water's September 2018 business plan to suggest that it

[221] United Utilities, 'PR19 Business Plan Data Tables Commentary', August 2019, pp.72-75.
[222] United Utilities, Business Plan supplementary document S6002: 'Cost assessment proposal – Chapter 7: Supplementary document', September 2018, p.71.
[223] United Utilities, D003: 'Representations: Cost Assessment', p.51.
[224] Dŵr Cymru, 'PR19 Appointed business plan table commentaries', September 2018, pp.143-154; Dŵr Cymru, 'PR19 Appointed business plan table commentaries' April 2019, pp.181-192; and Dŵr Cymru, 'Ref 3.6 – PR19 Costs: Efficiency, benchmarking and recovery (Commercial in confidence)', September 2018, p.6.
[225] Dŵr Cymru, 'Draft Determination Representations - WSH.DD.CE.1 – Wholesale base expenditure', August 2019, p.20.

applied a frontier efficiency overlay of 1% per year. However this quote is taken out of context as South West Water states targeting a 1% efficiency per annum compounded for general operating expenditure. While the company applies a 5% efficiency challenge on enhancement costs, there is no evidence to suggest that this includes a frontier shift adjustment, rather than value engineering or other cost reduction techniques.[226]

7.72 Severn Trent Water did not apply a net frontier shift adjustment to its WINEP costs. While the company has included a 1% frontier shift efficiency assumption on its plan,[227] this is offset by an equivalent real price effects allowance. The App24a data table commentary states "we will look to achieve additional, smaller efficiencies through AMP7 to offset the impact of real price effects where possible."[228] This results in a net neutral impact on the company's costs.

7.73 We note that no company provided a reference to the CMA on our application of frontier shift to metering costs. We did not apply a frontier shift estimate to other enhancement costs.

7.74 Europe Economics' recommended range for frontier shift is 0.6% to 1.2% if applied to totex, and 0.6% to 1.4% if applied to botex to reflect the greater scope for productivity growth in base expenditure.[229] In our final determinations we selected our frontier shift from the totex range as we were applying the frontier shift to base as well as some enhancement costs. However, if the frontier shift was applied to only base costs, then we suggest that it would be appropriate to take account of the higher potential for efficiency gains for base expenditure.

The latest data indicates that effects from Covid-19 should not change our assessment

7.75 Covid-19 has been declared a pandemic by the World Health Organisation (WHO) since we published our final determinations. We commissioned Europe Economics to prepare an initial view of the impact of Covid-19 on our final determinations (given we are at the early stages of the impact of Covid-19). This report focused specifically on the impact of Covid-19 on our decisions

[226] South West Water, Business Plan: 'Securing Cost Efficiency', September 2018, p.33.
[227] Severn Trent Water, 'A8: Securing cost efficiency and enhancement spend', September 2018.
[228] See reference document 'C004 – Severn Trent, 'Business Plan Data Table Commentary', September 2018, p. 29.
[229] Europe Economics, 'Real Price Effects and Frontier Shift – Final Assessment and Response to Company Representations', December 2019, p.7, Table 4.

relating to real price effects and frontier shift.[230] They reviewed the potential impacts of Covid-19 on real price effects under three scenarios:

- **Shorter scenario** assuming that the Covid-19 health crisis ends after 3 months and after 6 months almost all restrictions are lifted. Under this scenario GDP is significantly reduced during the first 3 months of the period, however much of that is caught up once the restrictions are lifted after 6 months. There are no enduring economic impacts after 6 months.
- **Extended duration scenario** in which the restrictions associated with the health crisis last 18 months. 18 months is sufficiently long to create enduring economic impacts (i.e. economic "scarring") even after 18 months. This creates some economic "scarring" which is assumed to be gone by the end of 2025.
- **Medium scenario** is assumed to be a shorter and more moderate version of the Extended scenario in which case the health crisis lasts a year and any enduring economic impacts after one year fade away quicker than under the Extended scenario.

7.76 Taking into account of the potential impact of Covid-19, Europe Economics finds that there is **no strong evidence to change its proposed frontier shift range for wholesale totex of 0.6% to 1.2%:** its review of EU KLEMS and ONS multi-factor productivity data over 5 years, starting in the first year of the four past recessionary periods (1973-1974, 1980-1981, 1990-1991 and 2008-2009), found that productivity growth typically slows down in the recession years, followed by a bounce back in the years immediately following the recession. Europe Economics finds the average total factor productivity growth across recessions is 0.6% which aligns with the lower bound of their existing recommended range. it also does not find strong evidence to change its recommended upper bound of 1.2% as the stronger performing comparator sectors were able to achieve total factor productivity growth of 1.2% in 2 out of the 4 recessionary periods considered, and 1.1% in a third recessionary period.

7.77 Europe Economics also reviewed asset betas for the comparator and water sectors and found that the comparator sectors are much more exposed to business cycle than the water sector. This implies any reduction in productivity of comparators over recessionary periods is likely to overstate the impact on the frontier shift the water sector may be expected to achieve.

7.78 Productivity growth can fall in recessionary periods if there is spare capacity of both capital and labour. This is less likely to be true for the water sector in part

[230] C005 - Europe Economics, 'Impact of COVID-19 Crisis on Real Price Effects (RPEs) and Frontier Shift', April 2020.

as the regulatory settlement is intended to incentivise water companies to undertake efficient levels of investment throughout the business cycle. We note that Frontier Economics' study for Water UK also identified significant continued total factor productivity growth in the water sector in the last recession (2008-09) despite falling productivity across the economy at that time.[231] While Europe Economics suggests that there may be a case for temporarily reducing the frontier shift expected in the water industry during the period of the health crisis, it states that a better alternative approach would be to consider separately whether companies will incur any additional costs during this period.

7.79 Overall, based on the analysis undertaken by Europe Economics **we continue to consider that our frontier shift of 1.1% per year remains appropriate.** As set out in 'Introduction and overall stretch' we consider that it is important to have reasonable certainty around the impacts of Covid-19 before making associated adjustments as part of the redetermination process.[232] We therefore consider that any additional costs from Covid-19, net of any offsetting reductions should be taken into account across the sector as part of the PR19 reconciliation process once we have clearer sight of the overall impact on the industry.

[231] See **Error! Reference source not found.** in this document.
[232] Ofwat, 'Reference of the PR19 final determinations: Introduction, overall stretch on costs and outcomes – response to cross-cutting issues in companies' statements of case', May 2020.

8. Real price effects

Our real price effects allowance at final determination

8.1 Real price effects are a measure of how much we expect water company costs to change due to input price inflation, relative to the indexation we use in price controls. Key input prices for water are labour, energy and material costs. In PR19 we index wholesale controls to the Consumer Prices Index including owner occupiers' housing costs (CPIH) as a measure of inflation. Hence any real price effects for wholesale expenditure will be additional (or deducted from) to the change in CPIH and are based on a comparison of the growth of the relevant input price relative to CPIH.

8.2 Indexation of price controls provides protection to water companies against the risk of changes in the general inflation rate across the economy with this risk passed on to customers. In addition, companies also benefit from additional protections such as cost sharing where out and under performance against cost baselines is shared between customers and companies. Overall we consider that, given the protections available to companies and the information asymmetry between companies and Ofwat, there needs to be sufficient and convincing evidence for making an allowance for real price effects.

8.3 Based on the report prepared by Europe Economics and further analysis we conducted, in our final determinations we made a real price effect adjustment for labour costs. Due to uncertainty in real wage forecasts, we included a true-up for the difference between forecast and outturn real wages in the manufacturing sector (as an independent proxy for water sector wages).

8.4 We did not include additional real price effects allowances (beyond general inflation) for other costs due to a range of factors. Real price effects allowances have not been made for any other costs due to a range of factors. These include a lack of a significant historical wedge between the cost element and CPIH, the lack of a substantial wedge between the forecast costs and CPIH, the extent to which management can control the cost and the extent to which the cost is already captured in CPIH.

Issues raised by disputing companies

8.5 **Our approach to assessing real price effects:** Anglian Water and Northumbrian Water disagree with the real price effect assessment framework

used by Europe Economics. Anglian Water and Northumbrian Water state they do not understand the relevance of considering historical volatility of costs. Anglian Water states it does not understand why comparability between company and household spending on a particular input type is considered when making an assessment. Northumbrian Water argues it is not appropriate to consider management control.

8.6 **Allowance for energy real price effect:** Anglian Water, Bristol Water, Northumbrian Water and Yorkshire Water argued we have failed to account for energy real price effects. Reasons companies give as to why we should have provided for an energy real price effect include: previous regulatory decisions, a wedge between CPIH and energy prices in some periods; materiality of energy costs and lack of management control.

8.7 **Allowance for other real price effects:** Anglian Water and Yorkshire Water argue we should have included a real price effect for all input costs (chemical costs and materials, plant and equipment). Northumbrian Water argues we should have included a real price effect for chemical costs. Bristol Water and Anglian Water argue true-up mechanisms should have been provided for other real price effects.

8.8 Each of these issues has been raised previously during the price control process and is set out in more detail in our final determinations and the associated Europe Economics report. [233] [234]

Our response

Our assessment framework balances the needs of customers and investors

8.9 Companies raise six issues on our assessment framework, which are discussed in turn below:

- whether the overall assessment framework is valid;
- how we have taken into account CPIH;
- our consideration of input price volatility;
- our consideration of management control; and
- real price effects have been accurately forecast in the past; and

[233] Ofwat, 'PR19 final determinations: Securing cost efficiency technical appendix', December 2019, Chapter 5.
[234] Europe Economics, 'Real Price Effects and Frontier Shift – Final Assessment and Response to Company Representations', December 2019.

- whether our assessment framework appropriately balances risks between customers and companies.

Our overall assessment framework is valid

8.10 Anglian Water states that Ofwat should have made a thorough assessment of future real price effect adjustments using their three-step methodology.[235] Northumbrian Water states we have adopted a novel and complicated approach relative to the straight forward methodology we used in the past.[236]

8.11 Our independent consultants, Europe Economics, developed their framework for assessing the case for including real price effects in a transparent, consistent and robust manner. The framework received feedback at both the initial assessment and draft determinations stages and was updated as a result. The framework is designed so that a real price effect allowance is only recommended if there is a sufficient and convincing case for including such an allowance. Europe Economics' analysis of real price effects runs to over 60 pages including numerous charts and analysis. We therefore reject the assertion that it is not thorough. The approach is also not particularly new, as we have used a similar structured approach when considering whether to introduce uncertainty mechanisms for other risks to companies' costs.[237] Given the problems identified with real price effect forecasts in the past (see discussion on Ofgem RIIO1 controls below)[238] we consider it is critical that there is appropriate evidence for any adjustments. We therefore made some improvements to the approach proposed by Anglian Water which was used by Ofgem in the RIIO1 controls. We did not make any real price effect adjustments (or frontier shift changes) in PR14.

8.12 The real price effect assessment framework created by Europe Economics assesses the case for a real price effect adjustment for each key input cost component against the following criteria. Each criterion (1a/1b, 2 or 3) is scored as a pass or fail (or a partial pass). If a cost fails any of the criteria (1a/1b, or 2 or 3), a real price effect adjustment is not considered appropriate.

[235] Anglian Water, 'Statement of Case', April 2020, Chapter E.4, p.206, paragraph 845.
[236] Northumbrian Water, 'Statement of Case', April 2020, p.74, paragraph 347.
[237] Ofwat, 'Setting price controls for 2015-20 - Final price control determination notice: policy chapter A7 – risk and reward', December 2014, p. 19.
[238] RIIO stands for Revenue = Incentives + Innovation + Output, and was the price control framework used by Ofgem for the last energy and gas price controls.

Table 8.1: Real price effect assessment framework created by Europe Economics

Criteria	Basis
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?	This could occur because the cost exhibits sufficient variability such that over the course of a five-year control period the wedge may differ substantially from zero. This uses a wedge of 1% over a five year period as a threshold.
2. Are there sufficient and convincing reasons to think that CPIH does not adequately capture the input price?	This compares the share of a cost item in wholesale totex with the share of the most relatable cost item(s) in the CPIH basket. If the share is similar in both then CPIH indexation should already capture the evolution of the cost item.
3. Is the input price and exposure to that input price outside management control during the duration of the price control?	Europe Economics considers the scope of management strategies to either substitute to alternative inputs, investing in new technologies and/or signing long-term contracts to reduce exposure to future price movements.

8.13 We consider that it is important that the case for providing a real price effect allowance be sufficient and convincing for two main reasons:

- **Due to the information advantage of regulated companies, there is a danger that allowed costs may be set above expected efficient costs and that companies are only seek real price adjustments where it is in their interests to do so.** For the price control as a whole, revenues should be set to recover expected efficient costs. This is the result achieved by competitive markets. However, regulators face an inherent difficulty in establishing what these expected efficient costs should be given the information asymmetry between the regulator and the regulated companies. Companies have better information on their future costs than the regulator and are only likely to put forward the case where real prices may go up rather than down. This means that customers will be disadvantaged as firms will benefit from real adjustments where costs are likely to increase, but not have real price adjustments where prices are expected to decrease. **This has been compounded by overstated forecasts of key input prices in the past.**
- **There are existing protections against cost increases that companies benefit from.** If costs overrun, there is a cost sharing mechanism in place which specifies cost sharing rates, i.e. the proportion of any cost overrun that companies will have to bear, with the remainder being passed on to

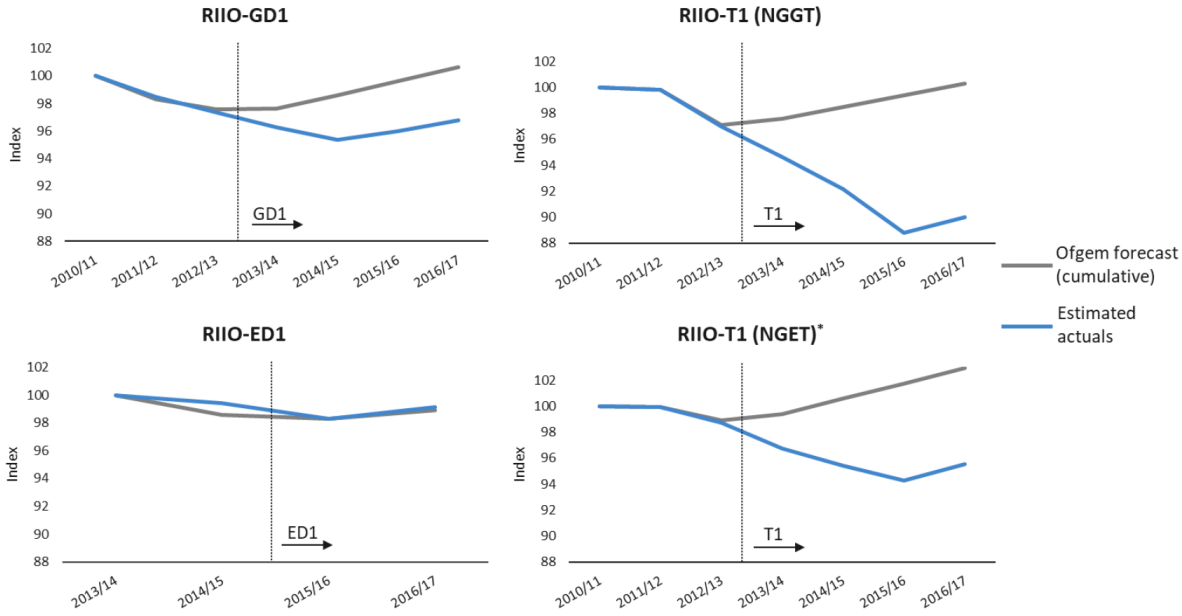
consumers. Interim determinations and the substantial effects clause provide other routes by which companies are to some extent shielded from significant cost increases.

8.14 The RIIO-1 price controls highlight the need for caution when forecasting real price effects. Ofgem used a mixture of independent short-term forecasts and historical averages of representative indices to set real input price adjustments for the RIIO-1 price controls. Citizens Advice estimated that out-turn values for real price effects for the RIIO-1 electricity transmission and gas distribution price controls would be £1.9 billion lower than Ofgem assumed, with companies keeping £0.9 billion of the savings as additional profit.[239] Separately CEPA repeated Ofgem's methodology with outturn values for the indices used by Ofgem.[240]

8.15 Figure 8.1 shows that across the gas distribution (GD1), Transmission (T1 (NGGT) and T1 (NGET)), Ofgem has over forecasted real price effects. This resulted in an additional 40 to 80 basis points of Return on Regulatory Equity (RoRE) over the first four years of the RIIO-1 price control period. This illustrates the difficulty in accurately forecasting real price effects and the potential significant impact on customers: it emphases the importance of caution before making real-term adjustments.

[239] Citizens Advice, 'Energy Consumers' Missing Billions', July 2017, p.20.
[240] Ofgem, 'Review of the RIIO Framework and RIIO-1 Performance – Prepared by CEPA', March 2018, p.27, Figure 2.4.

Figure 8.1: Indices used in Ofgem's real price effect forecasts - assumptions in RIIO-1 and outturn values



Source: CEPA analysis of Ofgem decision documents and publicly available indices. Note that for electricity transmission, Ofgem did not publish RPE assumptions for the fast-tracked TOs. Note that 2010/11 = 100 for RIIO-T1 and GD1; 2013/14 = 100 for RIIO-ED1.

We consider it is important to take into account how the CPIH basket is formed

8.16 Anglian Water states that it does not understand why no real price effect allowance should be made if water companies and households are spending comparable percentages on a particular input type, though the company does not explain this concern further.[241]

8.17 Our assessment framework considers whether CPIH indexation effectively captures the input price by examining the share of comparable items in CPIH (i.e., household spending). The logic is that if the share of a cost item in water company totex is similar to the share of that cost item in CPIH, then CPIH indexation should already capture the evolution of that cost item in company costs and no real price effects allowance is required.

8.18 For example, in looking at whether CPIH indexation adequately captures the potential for electricity price increases, we consider the percentage share in CPIH of domestic electricity prices and other energy prices that might be expected to move in line with electricity prices. Suppose the share of energy prices in the CPIH basket is about 5%and energy costs represent about 10% of water company wholesale totex. In this case, if energy prices rise by 5%, all

[241] Anglian Water, 'Statement of Case', April 2020, Chapter F, p.206, paragraph 844.

other things being equal, CPIH and water sector costs will increase respectively by 0.25%and 0.5%. Therefore the residual impact on water sector costs is only 0.25% after CPIH indexation has been applied (i.e. the difference between 0.25% and 0.5%), which is lower than the total percentage increase in energy prices.[242]

Input price volatility can indicate a need for a real price effect

8.19 Anglian Water and Northumbrian Water state that input price volatility is irrelevant to Europe Economics' real price effect assessment criteria and that real price effect allowances are still necessary for predictable input price changes.[243] [244]

8.20 The wedge between an input price and CPIH may differ substantially from zero over the course of a five-year control period for either of two reasons:

- it may be because in expectation the wedge is significantly different from zero; or
- it may be because, even if the long-run expectation is that the wedge is not significantly different from zero, the cost exhibits sufficient variability such that over the course of a five-year control period the wedge may differ substantially from zero.

8.21 The real price effect assessment takes into account both circumstances.

Management control is an important mitigant of real price effects

8.22 Northumbrian Water states that the criteria on management control is not appropriate.[245]

8.23 Management control is an important way to mitigate the impact of real input price inflation which is used in competitive markets, and can help to render a real price effect allowance (or at least a full real price effect allowance) as unnecessary.[246] Europe Economics outlines a clear typology of ways in which

[242] Europe Economics, 'Real Price Effects and Frontier Shift – Final Assessment and Response to Company Representations', December 2019, p.102.
[243] Anglian Water, 'Statement of Case', April 2020, p.206, paragraph 846.
[244] Northumbrian Water, 'Statement of Case', April 2020, p.74, paragraph 348.
[245] Northumbrian Water, 'Statement of Case', April 2020, p.74, paragraph 348.
[246] Ofwat, 'PR19 final determinations: Securing cost efficiency technical appendix', December 2019, pp.196-197.

companies may be able to limit their exposure to increases in input prices, for example: [247]

- reducing input prices by leveraging buyer power;
- reducing input prices through negotiation to a competitive market price;
- reducing input price volatility through long-term contracts with fixed input prices;
- reducing the volume of inputs used through greater input use efficiency; and
- reducing the volume of inputs used through input substitution.

8.24 Europe Economics provides a structured framework for the assessment of management control, recognizing that there may be instances of partial scope for management control. In its assessment of each input price, Europe Economics sets out how it would expect companies to be able to, not able to, exert management control. We note that a real price effect adjustment effectively transfers that risk on to customers, who have no ability to control that risk. If a real price effect adjustment is not made then the risk is shared between companies and their customers through cost sharing, and so companies are not fully bearing that risk.

It is difficult to accurately forecast RPEs and RPEs have been overstated in the past

8.25 Anglian Water states that it was accurate at forecasting real price effects in PR14 and their PR19 forecasts are equally robust, implying that we should simply adopt companies' forecasts.[248]

8.26 In hindsight, given the differences between the economic circumstances forecast at the time and what has transpired, it is perhaps surprising to what extent Anglian Water's real price effect forecasts at the time of PR14 have been accurate. Independent forecasts have tended to struggle to accurately forecast real price effects. For example the Office for Budget Responsibility and the Department for Business, Energy and Industrial Strategy forecasts of wages and energy costs have been very different to outturns.

8.27 Table 8.2 sets out the Office for Budget Responsibility's forecasts of average earnings growth. This shows that for 2014, the last year that would have been available for Anglian Water when forecasting real price effects during PR14, the

[247] Europe Economics, 'Real Price Effects and Frontier Shift – Final Assessment and Response to Company Representations', December 2019, pp.22-23.
[248] Anglian Water, 'Statement of Case', April 2020, Chapter F, p.206-207, paragraph 847 and Figure 58.

Office for Budget Responsibility's forecasts would have significantly overstated outturn wage growth. Over the period 2014-2018, the Office for Budget Responsibility has forecast an average annual growth rate of 3.4%, compared to an outturn average annual growth rate of 2.3%. This equates to an average overestimation of 1.1 percentage points per year.

Table 8.2: Average earnings: Office for Budget Responsibility forecasts vs actual outturns[249]

		Forecasted year											
		2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Forecast date	2010	1.9	2.3	3.8	4.4	4.4	-	-	-	-	-	-	-
	2011	2	2.2	3.8	4.3	4.5	-	-	-	-	-	-	-
	2012	-	2.8	3.1	4.3	4.5	4.5	-	-	-	-	-	-
	2013	-	-	1.4	2.7	3.6	4	4	-	-	-	-	-
	2014	**-**	**-**	**-**	**2.5**	**3.2**	**3.6**	**3.7**	**3.8**	**-**	**-**	**-**	**-**
	2015	-	-	-	-	2.3	3.1	3.7	4	4.4	-	-	-
	2016	-	-	-	-	-	2.6	3.6	3.5	3.4	3.6	-	-
	2017	-	-	-	-	-	-	2.6	2.7	3.0	3.4	3.6	-
	2018	-	-	-	-	-	-	-	2.7	2.4	2.5	2.8	3.0
Actual		**2.3**	**2.0**	**1.6**	**1.4**	**1.8**	**2.8**	**2.7**	**2.7**	**-**	**-**	**-**	**-**

Source: Europe Economics based on various Office for Budget Responsibility publications. For example, the 2018 forecast in the penultimate row came from Office for Budget Responsibility's "Economic and fiscal outlook" dated March 2018.

8.28 Table 8.3 sets out the latest available the Department for Business, Energy and Industrial Strategy's forecasts of industrial electricity prices at the time of company responses to the draft determination.[250] In 2013 the Department for Business, Energy and Industrial Strategy forecast a rise in industrial electricity prices of 9.3% in 2015 and 7.9% in 2016, while in practice prices only rose by 1.2% in 2015 and fell by almost 3% in 2016. On average, the Department for Business, Energy and Industrial Strategy's forecasts are nearly 2 percentage points higher per year than the outturn growth (6.8% versus 5.0%). This equates to an overestimation of growth by about 12 percentage points over the 2015-2019 period.

[249] Europe Economics, 'Real Price Effects and Frontier Shift – Final Assessment and Response to Company Representations', December 2019, table 2.7, pp.29.
[250] BEIS, 'Updated energy and emissions projections: 2013 – Annex F: price growth assumptions', September 2013, Reference scenario.

Table 8.3: Industrial electricity prices: Department for Business, Energy and Industrial Strategy (BEIS) forecasts vs actual outturns

Forecast Year	September 2013 BEIS Forecast	Outturn
2014	9.2%	1.2%
2015	9.3%	1.2%
2016	7.9%	-2.7%
2017	2.2%	4.1%
2018	5.9%	17.7%
2019	8.7%	4.7%
Average annual growth rate (2015-2019)	**6.8%**	**5.0%**
Compound annual growth rate (2015-2019)	**6.8%**	**4.8%**
Total growth (2015-2019)	**38.7%**	**26.4%**

Note that 2019 is based on data published in May 2019 from the 2018 update, so the 2019 data still represents a forecast.
Source: Ofwat calculations based on the Department for Business, Energy and Industrial Strategy's September 2013 forecasts and May 2019 outturn data[251]

8.29 Based on the evidence available to compare forecasts with outturn values, the Office for Budget Responsibility and Department for Business, Energy and Industrial Strategy's forecasts have repeatedly failed to be accurate and caution should be placed on relying on external forecasts of real price effects.

Our real price effect framework balances risks between customers and companies

8.30 Anglian Water states that we have inconsistently applied true-up mechanisms, which transfer the risk of labour input price changes to customers but leave the risk of other input price changes with water companies.

8.31 We have consistently considered true-up mechanisms within our real price effect framework and only applied true-ups on inputs which require a real price effect allowance. In our case labour costs.

8.32 A true-up reconciles for differences between the forecast real price effect and the outturn underlying input price change. Given that we found evidence that there could be a material wedge between wage rates and CPIH measured

[251] Forecasts taken from BEIS, 'Updated energy and emissions projections: 2013 – Annex F: price growth assumptions', September 2013, Reference scenario; and outturn growth taken from BEIS, 'Updated energy and emissions projects: 2018 – Annex M: Growth assumptions and prices', May 2019, Reference scenario.

inflation, the labour cost real price effect true-up protects customers and companies if underlying real wage inflation (as measured by manufacturing wages) is higher or lower than forecast (as customers will only be paying the costs of wages if they went up in line with underlying drivers). Companies (and customers through cost sharing) bear the risk between differences between water and manufacturing real wages. Given that wider movements in market wages are outside the control of companies, the absence of a true-up could allow companies to reap windfall gains (or losses) at the expense (or benefit) of customers, without any justification for allowing them to do so.

8.33 Europe Economics explain that without a true-up the totex cost sharing mechanism is insufficient to protect customers from potential harm if real price effects turn out to be too generous, as it allows companies to retain some of the benefit of over generous real price effect allowances. The impact of this can be substantial as illustrated by Ofgem's experience with RIIO-1 price controls.[252] We therefore consider that a true-up mechanism protects both customers from paying too much and companies from underlying movements in wage rates. A true-up was also supported by some water company consultants at the time.[253]

8.34 We consider that true-up mechanisms should be used with caution and should only be included where there is evidence that a risk needs to be passed on customers, as, for example, this could encourage companies to simply link costs to that input price measure and not to manage costs appropriately. As other input price categories do not pass our criteria (which include considering whether there is a likely to be a material wedge over five years due to volatility), we do not consider that a true-up is appropriate and risks should be managed within the context of the normal risk protections such as cost sharing, which share risks between companies and customers.[254]

Real price adjustment for energy prices

8.35 The disputing companies raise a number of detailed points on whether we have appropriately allowed for a real price adjustment for energy prices. Many of these arguments raise issues that were considered as part of the development of the final determinations and so more detail on our response to these issues is set out in our final determinations and the associated Europe Economics

[252] Europe Economics, 'Real Price Effects and Frontier Shift – Final Assessment and Response to Company Representations', December 2019, p.127 and 134.
[253] NERA, 'Response to Ofwat's Draft Determination on Real Price Effects and Frontier Shift', August 2019, p.31. Provided to the CMA by Bristol Water as BW127.
[254] Europe Economics, 'Real Price Effects and Frontier Shift – Final Assessment and Response to Company Representations', December 2019, p.134.

report. Overall we continue to consider that a real price adjustment for energy prices is not required. We set further detail on our position and our response to company arguments below.

We continue to consider that a real price adjustment for energy prices is not required

8.36 In our final determinations we stated that there while there was some evidence to suggest that we should allow a real price effect for energy, on balance, an adjustment was not required.[255]

8.37 Taking into account the detailed company responses, **we continue to consider that a real price adjustment is not required**, in particular as it would weaken company incentives to minimise energy prices. The case for not including an adjustment has if anything become stronger since final determination:

- There is mixed evidence of a historical wedge which depends on the period of analysis (see Figure 8.2), and energy prices have reduced since final determination.
- Energy costs are partially within management control, particularly the option to sign up to fixed energy tariffs to minimise exposure to price fluctuations. In our final determinations we noted that these contracts were usually for one to two years however we note that household and business contracts are currently available for up to five years. Other mechanisms such as payment arrangements, increased energy generation by the companies themselves, timing of energy use and improved energy efficiency can assist companies to reduce costs through reduced consumption and minimising exposure to price fluctuations.[256]
- While the latest Department for Business, Energy and Industrial Strategy electricity forecast a wedge of 0.7% per year between 2020 and 2024 – see Table 8.4, there is significant uncertainty about forecasts of energy price, particularly as the Department for Business, Energy and Industrial Strategy's forecasts have repeatedly failed to provide accurate forecasts of energy costs in the past. This reflects the volatility of energy prices and interactions with global markets.[257]

[255] Ofwat, 'PR19 final determinations: Securing cost efficiency technical appendix', December 2019, pp.196-198.
[256] Europe Economics, 'Real Price Effects and Frontier Shift – Final Assessment and Response to Company Representations', December 2019, pp.37-38.
[257] Europe Economics, 'Real Price Effects and Frontier Shift – Final Assessment and Response to Company Representations', December 2019, p.37.

- Some energy costs are reflected in CPIH. Europe Economics presents evidence that CPIH partially captures the impact of changes in energy costs as the total share of energy (including other fuels which tend to move in line with energy prices) in CPIH is 5.2%. Therefore CPIH indexation will in part reflect increases in electricity prices.[258]
- Water companies produce as well as consume energy, reducing the net impact of energy prices. They also produce biofuels whose value will be linked to energy prices.[259]
- Unlike labour costs, there is no clear theoretical link between energy costs and productivity growth.
- Some water companies do not assume a real price effect adjustment or assume that any adjustment would be very small.[260]
- There are a number of protections within the price control such as cost sharing which provide additional protections to water companies.
- Unlike labour costs, the potential wedge is much smaller, equivalent to less than 0.1% of costs over the period based on the Department for Business, Energy and Industrial Strategy's forecasts (which have proved inaccurate), not taking account of the impact of cost sharing.
- Companies are moving towards their target of net zero carbon emissions during the 2020 to 2025 period. For example, Yorkshire Water will increase the amount of renewable energy it generates from biogas by 15%, and South East Water will reduce its carbon emissions by 68%. To do this water companies are using a range of measures,[261] including greater water efficiency, buying green energy, generating renewable energy, planting trees and working with their supply chain. These measures could have a substantial impact on energy usage in the sector and therefore mitigate real price effects.

8.38 We do not consider an ex-ante adjustment is appropriate given the uncertainty over the historical wedge and energy price forecasts have proved unreliable.

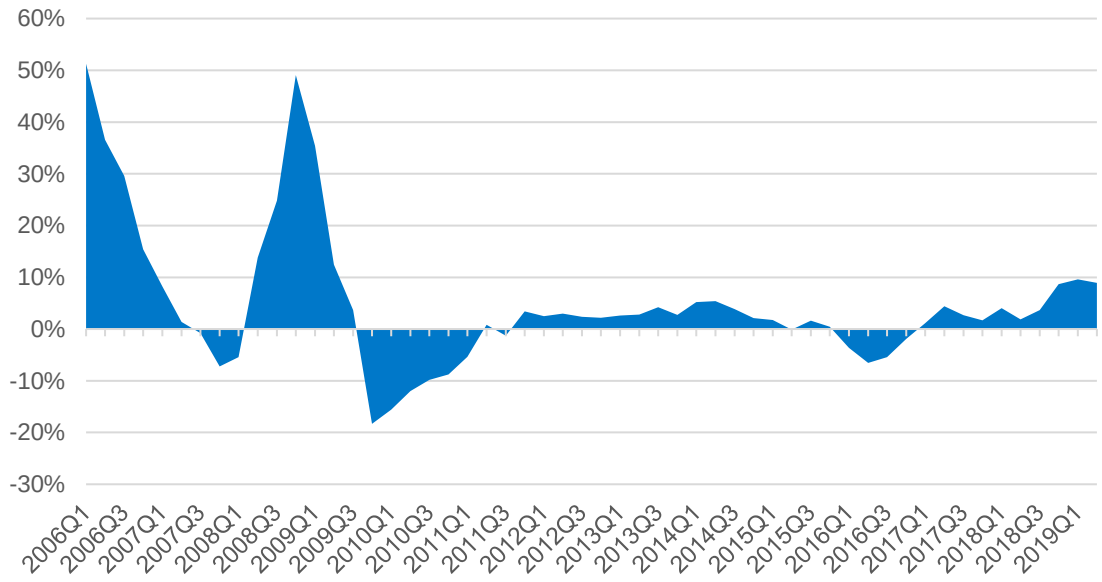
8.39 We do not consider an ex-post adjustment is appropriate as: an ex-post mechanism increases the risk that energy costs would be passed directly on to customers without management mitigation, energy costs can be partially mitigated by management, most company energy costs are already reflected in CPIH and even without an energy real price effect adjustment any changes in

[258] Europe Economics, 'Real Price Effects and Frontier Shift – Final Assessment and Response to Company Representations', December 2019, pp.37-38.
[259] Europe Economics, 'Real Price Effects and Frontier Shift – Final Assessment and Response to Company Representations', December 2019, pp.37-38.
[260] Europe Economics, 'Real Price Effects and Frontier Shift – Final Assessment and Response to Company Representations', December 2019, p.16.
[261] Water UK, 'Public Interest Commitment', April 2019.

energy costs would be shared with customers through cost sharing. In addition company net energy usage is likely to reduce over the period given the move towards net zero carbon emissions.

8.40 We note that uncertainty over energy prices has increased with Covid-19, with recent falls in oil prices putting significant downward pressure on energy prices. While the expected impacts for the 2020-25 period are still unclear, this may result in falling real energy costs over the period and further reduce the case for a positive real price adjustment for energy.

Figure 8.2: Annual wedge between the electricity price index and CPIH, 2006 Q1 – 2019 Q2



Source: Ofwat final determination based on Department for Business, Energy and Industrial Strategy data [262] [263]

[262] Ofwat, 'PR19 final determinations: Securing cost efficiency technical appendix', December 2019, p.207, Figure A3.1.
[263] BEIS, 'Quarterly Energy Prices', September 2019.

Table 8.4: Department for Business, Energy and Industrial Strategy electricity price forecasts

Scenario	Percentage change		
	Low	Reference	High
2020	0.6%	0.5%	3.0%
2021	0.8%	0.8%	-0.9%
2022	-1.4%	-0.2%	-0.8%
2023	0.6%	0.1%	-0.6%
2024	1.6%	2.4%	2.2%
Average % per year (2020-24)	0.4%	0.7%	0.6%

Source: Ofwat final determination based on Department for Business, Energy and Industrial Strategy data [264] [265]

Table 8.5: Analysis of wholesale real price effects for energy costs proposed by companies

Parameter	2020-21	2021-22	2022-23	2023-24	2024-25
Min	-1.2%	-2.2%	-2.0%	-3.5%	0.0%
Max	12.6%	9.0%	2.5%	3.0%	3.9%
Average	3.9%	1.5%	0.4%	0.7%	1.9%

Source: Europe Economics [266]

Detailed company arguments for a real price effect adjustment for energy

8.41 In Table 8.6, we summarise the detailed arguments made by companies and their consultants in their statement of case as well as our response. We note that Anglian Water and Yorkshire Water do not provide specific or additional evidence in support of a real price effect allowance for energy in their statements of case. [267] [268]

[264] Ofwat, 'PR19 final determinations: Securing cost efficiency technical appendix', December 2019, p.207, Table A3.8.
[265] BEIS, 'Quarterly Energy Prices', September 2019.
[266] Europe Economics, 'Real Price Effects and Frontier Shift – Final Assessment and Response to Company Representations', December 2019, p.16, Table 2.3.
[267] Anglian Water, 'Statement of Case', April 2020, Chapter A, p.16, paragraph 90.
[268] Yorkshire Water, 'Statement of Case', April 2020, p.67, paragraph 202.

Table 8.6: Detailed company arguments for an energy real price effect allowance and our response

Company statement	Our response
Anglian Water, Bristol Water, Northumbrian Water and Yorkshire Water state that we failed to account for energy real price effects.	At final determination we assessed all of the available evidence and found that a real price effect adjustment was not appropriate. Further details of our assessment of a real price effect adjustment for energy is set out in our final determinations[269] and the associated Europe Economics report.
Northumbrian Water states that we have gone against the advice of our consultants Europe Economics in deciding against an energy real price effect. [270]	This is incorrect. Europe Economics did not recommend that we include an energy price real price effect. Europe Economics stated: "Overall, our conclusion is that whether energy qualifies for an RPE mechanism depends on whether reliance is placed on BEIS forecasts for industrial electricity prices and on the weight that Ofwat attaches to the high wedge between growth in industrial electricity prices and CPIH prior to 2010." [271] In addition Europe Economics states that reliance should not be placed on Department for Business, Energy and Industrial Strategy (BEIS) forecasts "BEIS forecasts have also often failed to accurately predict electricity prices." [272] In discussing the historical wedge Europe Economics states that "[t]he lack of sufficient and convincing evidence is echoed by the submissions on energy RPEs in company business plans, with some companies proposing zero or negative RPEs while others propose positive RPEs." [273]
Northumbrian Water states there are historical examples for including real price effects for energy in price controls.[274]	The comparison table Northumbrian Water presents shows regulatory decisions from at least 5 years ago (2009, 2012 and 2014). The Department for Business, Energy and Industrial Strategy's historical data indicates that prior to 2010 there was a material wedge between industrial electricity prices and CPIH. [275] Evidence from more recent years is mixed and depends on the time period chosen.
Bristol Water and Northumbrian Water state that the historical data and forecasts indicate a wedge between CPIH and energy prices over most periods,	While we have acknowledged evidence of a statistically significant historical wedge for some time periods (as shown in Figure 8.2), but not for other periods. The Department for Business, Energy and Industrial Strategy electricity price

[269] Ofwat, 'PR19 final determinations: Securing cost efficiency technical appendix', December 2019, Chapter 5.
[270] Northumbrian Water, 'Statement of Case', April 2020, p.74, paragraphs 349-350.
[271] Europe Economics, 'Real Price Effects and Frontier Shift – Final Assessment and Response to Company Representations', December 2019, p.41.
[272] Europe Economics, 'Real Price Effects and Frontier Shift – Final Assessment and Response to Company Representations', December 2019, p.112.
[273] Europe Economics, 'Real Price Effects and Frontier Shift – Final Assessment and Response to Company Representations', December 2019, p.35.
[274] Northumbrian Water, 'Statement of Case', April 2020, pp.75-76, paragraphs 354 and Table 15.
[275] Europe Economics, 'Real Price Effects and Frontier Shift – Final Assessment and Response to Company Representations', December 2019, p.37.

Company statement	Our response
citing data published by the Department for Business, Energy and Industrial Strategy.[276] [277]	forecasts show significant differences compared with outturns, questioning the reliability of the forecasts.[278]
Bristol Water states that the energy component of totex is a small part of the CPIH basket.[279]	While the share of electricity in the CPIH basket is 1.3%, and the total share of energy (i.e., including other fuels) is 5.2% (based on 2018 weights).[280] Europe Economics consider that it is most appropriate to consider the total share of energy including fuels rather than simply energy as there is evidence of a long-run relationship between oil, gas and electricity prices. This relationship is likely to reflect the fact that some long-term gas contracts on the Continent are indexed to oil prices, and arbitrage across the UK-Continent interconnector in turn links UK wholesale gas prices to continental gas prices. Further, the important role played by gas-fired generation in the UK means that wholesale electricity prices will be influenced by wholesale gas prices.
Northumbrian Water states that energy costs make up approximately 6% of the company's totex and are a material component of totex.[281]	Northumbrian Water states that the impact of Department for Business, Energy and Industrial Strategy's forecast energy price forecasts if it were to be put forward in full would be between £1.3 million (low fossil fuel scenario) and £11.4 million (high fossil fuel scenario) increased expenditure. This compares to a total Northumbrian Water wholesale expenditure allowance of £2,683.3 million.[282] The impact of the energy price rise would therefore be between 0.05% and 0.4% of total expenditure if the Department for Business, Energy and Industrial Strategy's forecasts were accurate. We note that more than half of this would be covered by changes in CPIH given Northumbrian Water's low share of energy in total expenditure. We continue to consider there should not be a real price effect adjustment for energy prices.
Bristol Water and NERA (on behalf of Bristol Water) state that we have assessed energy RPEs inconsistently with labour RPEs.[283] [284]	There are a number of differences between energy and labour costs that affect our assessment.[285] These differences include (but are not limited to) the following: • there is a lack of consistent evidence of a wedge for energy;

[276] Bristol Water, 'Statement of Case', April 2020, pp.113-114, paragraph 460 and Table C9.
[277] Northumbrian Water, 'Statement of Case', April 2020, p.74, paragraph 349.
[278] Europe Economics, 'Real Price Effects and Frontier Shift – Final Assessment and Response to Company Representations', December 2019, p.36.
[279] Bristol Water, 'Statement of Case', April 2020, p.114, paragraph 463.
[280] Europe Economics, 'Real Price Effects and Frontier Shift – Final Assessment and Response to Company Representations', December 2019, p.37-38.
[281] Northumbrian Water, 'Statement of Case', April 2020, pp.77-78, paragraphs 364-368.
[282] Ofwat, 'Reference of the PR19 final determinations: Explanation of our final determination for Northumbrian Water', March 2020, p.11, Table 2.1.
[283] Bristol Water, 'Statement of Case', April 2020, p.114, paragraph 463.
[284] NERA, 'Expert Report on Ofwat's Approach to Water Wholesale Cost Assessment in the PR19 Final Determination', March 2020, pp. 58-59, paragraph 242. Provided to the CMA by Bristol Water as document 7.
[285] Ofwat, 'PR19 final determinations: Securing cost efficiency technical appendix', December 2019, pp. 196-198; and Europe Economics, 'Real Price Effects and Frontier Shift – Final Assessment and Response to Company Representations', December 2019, p.86.

Company statement	Our response
	• unlike wage costs, there is no clear theoretical link between input costs and productivity growth for energy costs; • the share of energy costs in totex is much smaller than labour; • forecasts of a wedge are smaller for energy than labour; and • energy costs are partially captured by CPIH.
Bristol Water and Northumbrian Water state that we have overestimated the ability for management to achieve efficiencies across their energy cost base. In particular, Bristol Water states that while management decisions can protect against short-term energy cost fluctuations (e.g. energy self-generation) companies are not protected against the long term tendency for electricity prices to rise.[286]	We do not consider that this is a fair or useful way of summarising our determinations on this point. As we explained at final determination, we recognise that energy costs are only partially within management control.[287] Europe Economics explained that while there are limitations to what it will be possible for companies to do to protect themselves against any increase in energy prices, there remains scope for management control. [288] We continue to consider this is the case. We also note the range of measures proposed by companies to reduce energy usage to help meet their net carbon zero commitment.
Bristol Water states that on average, companies proposed a positive real price effects allowance for energy costs of between 0.4% and 3.9% per year from 2020-25.[289]	This statement is misleading as while, on average, some companies did propose an increase, some companies suggested prices would decline, as shown in Table 8.5.[290]

We have appropriately accounted for other input costs

8.42 We consider that we have appropriately accounted for other input costs. In Table 8.7, we summarise arguments made by the disputing companies and their consultants in their statement of case along with our response. None of the disputing companies presented new evidence. Further details of our

[286] Bristol Water, 'Statement of Case', April 2020, p.114, paragraph 462.
[287] Ofwat, 'PR19 final determinations: Securing cost efficiency technical appendix', December 2019, p.196.
[288] Europe Economics, 'Real Price Effects and Frontier Shift – Final Assessment and Response to Company Representations', December 2019, p.39.
[289] Bristol Water, 'Statement of Cast', April 2020, p.115, paragraph 466.
[290] Europe Economics, 'Real Price Effects and Frontier Shift – Final Assessment and Response to Company Representations', December 2019, p.16.

assessment of real price effects for other inputs is set out in our final determinations and the associated Europe Economics report. [291] [292]

Table 8.7: Company arguments for RPE allowances for other input costs and our response

Company statement	Our response
Anglian Water, Northumbrian Water, and Yorkshire Water state that we should have allowed for a real price effects allowance for chemicals. [293] [294] [295]	In our final determination we stated that there was insufficient evidence for a real price effect adjustment for chemical costs.[296] Based on advice from Europe Economics there was no historical statistical significant wedge and wide variation in company forecasts and lack of robust independent forecasts.[297] In the PR19 process Yorkshire Water stated that the ONS PPI index used to assess chemical costs covered a wider range of chemicals than the ones actually used by companies and hence it may not be the most accurate index to use. At the time we stated that other water companies had used the same index ("Chemicals and Chemical Products" producer price index) and Yorkshire Water did not suggest an alternative. We also highlighted that another independent third party forecast on chemicals, the World Bank Commodities Price Forecast implied negative wedges ranging from 1.1% to 2.7% for the chemicals sector globally. However, as these were global estimates by the World Bank and only available for a few specific types of chemicals, we placed less weight on these forecasts than the historical wedge analysis. Anglian Water and Yorkshire Water do not provide specific evidence in support of a real price effect allowance for chemicals in their statements of case. Northumbrian Water states that based on an extrapolation of its own calculated composite index then a real price adjustment should be made for chemicals. This evidence was considered by Europe Economics as part of the development of their report. Europe Economics states that Northumbrian Water's own consultants acknowledge that a key drawback of this approach could be a significant rise in crude oil prices in 2017/18 which it identifies as one of the key drivers of chemical costs.[298] Given these concerns, the lack of independence of these forecasts, the lack of robust independent forecasts and the lack of a material wedge on the ONS indices used by a number of the water

[291] Ofwat, 'PR19 final determinations: Securing cost efficiency technical appendix', December 2019, Chapter 5.
[292] Europe Economics, 'Real Price Effects and Frontier Shift – Final Assessment and Response to Company Representations', December 2019, Chapter 2.
[293] Anglian Water, 'Statement of Case', April 2020, Chapter A, p.16, paragraph 90.
[294] Northumbrian Water, 'Statement of Case', April 2020, pp.73 and 75, paragraphs 341 and 352.
[295] Yorkshire Water, 'Statement of Case', April 2020, p.67, paragraph 202.
[296] Ofwat, 'PR19 final determinations: Securing cost efficiency technical appendix', December 2019, pp. 199-200.
[297] Ofwat, 'PR19 final determinations: Securing cost efficiency technical appendix', December 2019, p.192.
[298] Europe Economics, 'Real Price Effects and Frontier Shift – Final Assessment and Response to Company Representations', December 2019, p.18.

Company statement	Our response
	company consultants (including Oxera and NERA), [299] we continue to consider that we should not allow for a real price effect for chemicals. We note that oil prices have declined significantly since our final determinations.
Anglian Water and Yorkshire Water state that we should account for a real price effect for materials, plant and equipment prices although both companies do not provide specific supporting evidence of an adjustment as part of their statement of case. [300] [301]	In our final determinations,[302] we stated that there was insufficient evidence that a real price effects allowance for materials, plant and equipment was required. While there was mixed evidence across the relevant indices for materials, plant and equipment input costs,[303] half of the indices indicated a lack of a material wedge in water company forecasts. Additionally, some companies had proposed a zero or negative real price effect for this cost component, suggesting companies can limit input prices in this area to no more or less than CPIH. We continue to consider that a real price effect adjustment is not required for material, plant and equipment costs.

An initial view is that Covid-19 might make the case for real price effect adjustments weaker, or for negative adjustments to be more appropriate

8.43 Europe Economics provided an initial view on the impact of Covid-19 on our final determinations in relation to real price effects and frontier shift.[304] Europe Economics reviewed the potential impacts of Covid-19 on real price effects under three scenarios: shorter, medium and extended duration (as outlined in Chapter 7: Frontier Shift). This report was based on information up to the end of March 2020.

8.44 Europe Economics conducted a qualitative analysis to assess the case for a potential real price effect under each Covid-19 scenario, including whether there is a case for revisiting our final determinations. Key findings from their analysis include:

- **Labour:** Covid-19 is likely to lead to a significant increase in unemployment, putting downward pressure on wage growth. This means that there is a serious possibility of stagnant or negative real wage growth from 2020 to 2025 under Europe Economics' extended scenario. This implies that there is

[299] Europe Economics, 'Real Price Effects and Frontier Shift – Final Assessment and Response to Company Representations', December 2019, p.131.
[300] Anglian Water, 'Statement of Case', April 2020, Chapter A, p.16, paragraph 90.
[301] Yorkshire Water, 'Statement of Case', April 2020, p. 67, paragraph 202.
[302] Ofwat, 'PR19 final determinations: Securing cost efficiency technical appendix', December 2019, p.200.
[303] Europe Economics, 'Real Price Effects and Frontier Shift – Final Assessment and Response to Company Representations', December 2019, p.45.
[304] C003 - Europe Economics, 'Impact of COVID-19 Crisis on Real Price Effects (RPEs) and Frontier Shift', April 2020.

a case for revisiting our final determination real price effects allowance for labour in the context of Covid-19.

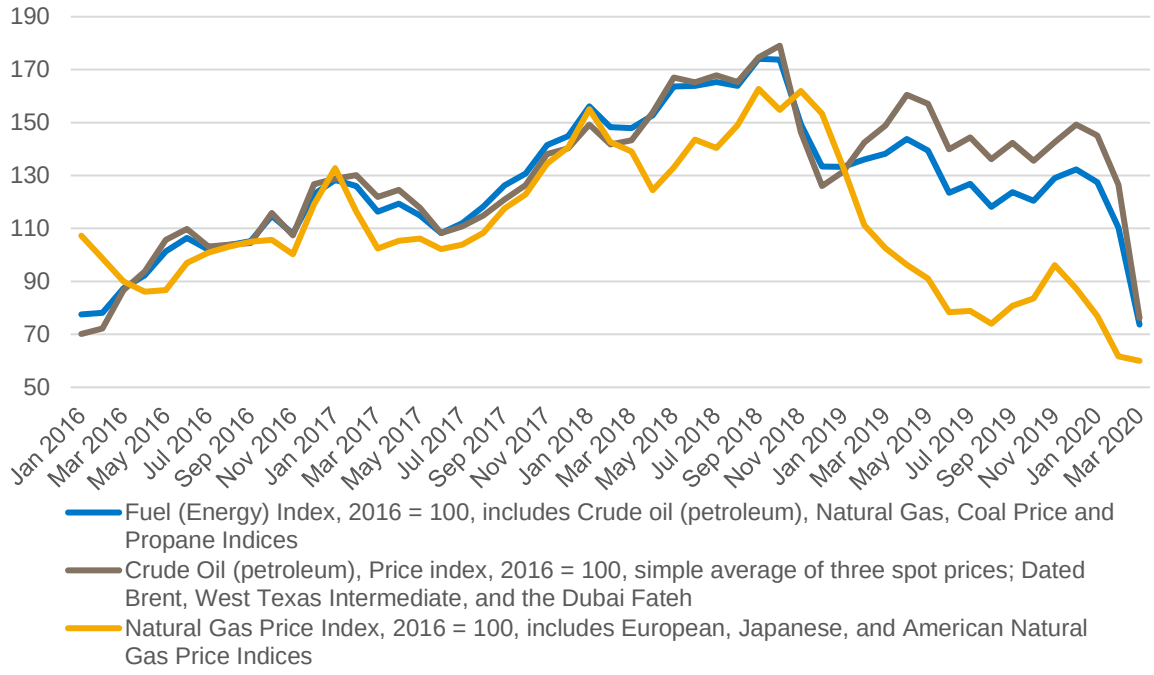
- **Energy:** Covid-19 has already led to a steep decline in oil prices which is likely to feed through into other energy prices as well. At the same time demand for electricity during the crisis is likely to fall due to industries shutting down. The supply of electricity is unlikely to be affected given that energy is a priority sector the UK government will want to ensure keeps running. These factors, along with lower input fuel costs (e.g., lower gas prices driven by lower oil prices), are likely to lead to industrial electricity prices falling during the crisis. Europe Economics suggest that this implies either a negative real price effects allowance should be made if combined with the existing assumption for base energy costs, or a reduced base energy cost. If addressed in the latter way, it is possible that energy prices could recover during the period, thus implying a potentially positive real price effects allowance be made from a lower base energy cost. However, given the uncertainty regarding future energy prices, Europe Economics suggest that the argument for indexation or a true-up mechanism may be stronger.
- **Chemicals and materials, plant and equipment:** the net effect of Covid-19 on these input prices is indeterminate under all three scenarios. This is because these sectors are likely to be facing both reduced demand and restrictions in supply from 2020-25.

8.45 The greater uncertainty over energy prices is reflected by the latest International Monetary Fund index prices and Brent Crude Oil daily spot price. As shown in Figure 8.3, fuel, oil and gas prices have declined significantly in the past three months. Further, Figure 8.4 shows that the Europe Brent Crude Oil spot rate had dropped as low as $9.12 recently.

8.46 We consider that it is appropriate to have reasonable certainty around the impacts of Covid-19 before making associated adjustments as part of the redetermination process. The above analysis suggests that the case for real price adjustments for energy is weaker than at final determination, with greater uncertainty over energy prices, and that there may be a case for a negative real price adjustment for labour costs. Changes to labour costs would to some extent by the true-up mechanism already in place for these costs. As we set out in our introduction to the CMA where appropriate,[305] we intend to take account of these impacts across the sector as part of the PR19 reconciliation process which takes place at PR24 once we have clearer sight of the overall impact on the industry.

[305] Ofwat, 'Reference of the PR19 final determinations: Cross-cutting issues', March 2020.

Figure 8.3: International Monetary Fund energy, oil and gas index prices



Source: IMF [306]

Figure 8.4: Europe Brent Crude Oil daily spot price (USD per barrel)

Source: Datastream from Refinitiv

[306] International Monetary Fund, 'Commodity Prices'. April 2020.

Ofwat (The Water Services Regulation Authority) is a non-ministerial government department. We regulate the water sector in England and Wales.

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