



Assessing Ofwat's Funding and Incentive Targets for Leakage Reduction

Prepared for SES Water in collaboration with Affinity Water, Anglian Water, Dwr Cymru, South East Water, South Staff Water, Southern Water, Thames Water and Yorkshire Water

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Contents

Executive Summary	i
1. Introduction	1
2. Overview of Ofwat’s IAP Proposals on Leakage	2
2.1. Background on Ofwat’s Leakage Proposals.....	2
2.2. Ofwat’s Approach to Funding Leakage Reduction	3
2.3. Conclusion	4
3. Assessing the Funding of Leakage Reduction through Base Allowances.....	6
3.1. Econometric Models Used to Set Base Allowances	6
3.2. The Exclusion of Enhancement from the Definition of Botex.....	7
3.3. The Ability of Ofwat’s Models to Fund Current Levels of Leakage	8
3.4. The Ability of Ofwat’s Models to Fund PR19 Leakage Reduction Targets .	13
3.5. Empirical Assessment of the Impact of Leakage on Modelled Efficiency Gaps.....	18
3.6. Conclusion	21
4. The Need for Allowed Enhancement Expenditure to Fund Leakage Reduction.....	23
4.1. Ofwat’s Proposals to Partially Fund Leakage Reduction through Enhancement Expenditure	23
4.2. Regulatory Precedent on Funding New Performance Targets	24
4.3. Conclusion	26
5. Ofwat’s Allowed Unit Costs of Leakage Reduction.....	28
5.1. Ofwat’s Allowed Unit Costs of Leakage Reduction.....	28
5.2. Accounting for the Increasing Marginal Cost of Leakage Reduction	28
5.3. Impact on Companies Incentives for Efficient Leakage Reduction.....	29
5.4. Conclusion	30
6. Conclusions and Recommendations	32
Appendix A. Regression Analysis of Unit Costs and Leakage Reduction Targets.....	34

Executive Summary

NERA Economic Consulting (NERA) has been commissioned by SES Water, in collaboration with Affinity Water, Anglian Water, Dwr Cymru, South East Water, South Staffs Water, Southern Water, Thames Water and Yorkshire Water, to review the Office for Water Services' (Ofwat) PR19 Initial Assessment of Plans (IAP).¹

Specifically, SES Water has asked us to review the basis for Ofwat's proposed targets for leakage reduction over the next Asset Management Period (AMP), and the proposed funding arrangements for achieving leakage reduction.

Ofwat's Approach to Funding Leakage Reduction at PR19

Leakage reduction is a high-profile output provided by water companies, and has been given a great deal of prominence in Ofwat's "Delivering Outcomes for Customers" regime at PR19. Ofwat therefore expected companies "to propose stretching performance commitment levels for leakage".²

At PR19, Ofwat requires all companies to have a Performance Commitment (PC) and a financial Outcome Delivery Incentive (ODI) for leakage. Ofwat standardises the definition of leakage targets and prescribes a method for how companies should set their target at PR19, or justify why they have not adopted the prescribed method. Ofwat "expect[s] companies to propose forecast upper quartile performance levels" for four PCs, including leakage.³

As well as its expectation that companies propose UQ performance, it also sets out instructions on the minimum target for leakage improvement that companies are required to achieve,⁴ including that the target must be for at least 15 per cent reduction, "one percentage point more than the largest reduction commitment at PR14",⁵ and to "achieve the largest actual percentage reduction achieved by the company since PR14".⁶

Ofwat has not allowed the enhancement expenditure for leakage reduction requested by half of the companies for achieving the leakage reduction targets set out in their business plans. However, Ofwat partially allowed enhancement expenditure for leakage reduction by 10 companies forecasting leakage reduction beyond defined thresholds.

¹ Ofwat (January 2019), PR19 initial assessment of plans.

² Ofwat, Delivering Water 2020: Our methodology for the 2019 price review. Appendix 2: Delivering outcomes for customers, page. 65.

³ Ofwat, Delivering Water 2020: Our methodology for the 2019 price review. Appendix 2: Delivering outcomes for customers, page. 61 and page 65.

⁴ Ofwat namely states that "Companies should set stretching leakage performance commitment levels to: [...] achieve at least achieve at least a 15% reduction in leakage (one percentage point more than the largest reduction commitment at PR14) – or justify why this is not appropriate". Source: Ofwat, Delivering Water 2020: Our methodology for the 2019 price review. Appendix 2: Delivering outcomes for customers, page. 65.

⁵ Ofwat, Delivering Water 2020: Our methodology for the 2019 price review. Appendix 2: Delivering outcomes for customers, page. 65

⁶ Ofwat, Delivering Water 2020: Our methodology for the 2019 price review. Appendix 2: Delivering outcomes for customers, page. 65

By disallowing companies' enhancement expenditure below its target, Ofwat has proposed that companies should fund leakage reduction through their base cost allowances.⁷ Ofwat's stated rationale for this approach to funding leakage reduction is that: "[c]ustomers should not pay extra costs for companies to deliver stretching targets" for leakage reduction.⁸

As we set out in this report, there are several reasons why Ofwat's proposed funding for leakage reduction will not result in regulated revenues sufficient for companies to finance the efficient costs of meeting the "stretching" PCs on leakage reduction which Ofwat has itself asked companies to target.

Ofwat's Base Allowances Do Not Allow Funding of Leakage Reduction to Attain the More "Stretching" PR19 Targets

It may be intuitively appealing for Ofwat to argue that companies have been reducing leakage in recent years, so base allowances calibrated to historical levels of expenditure must necessarily fund ongoing leakage reduction. However, as we explain in this report, this statement rests on assumptions that do not hold in reality.

It is correct that some companies have reduced leakage during the historical period over which Ofwat calibrated its econometric models. Also, cost targets established through comparative benchmarking may (to some extent) identify the level of leakage expenditure required to minimise water companies' costs.

However, the econometric modelling performed to set base allowances has a number of limitations that mean it will not identify the level of expenditure required to achieve leakage targets set over the next AMP. They do not identify how the optimal level of leakage varies over companies, they may be distorted by variation in companies' historical investment cycles, and they do not capture the required increase in leakage reduction activity by the industry over the next AMP.

We have conducted empirical analysis that supports these arguments, demonstrating that controlling for differences between companies' actual leakage and SELL has a statistically significant impact on companies' costs.

We have also shown that the marginal cost of leakage reduction rises as companies reduce leakage to lower levels than observed historically, which is another factor not accounted for by Ofwat's base expenditure modelling.

We therefore conclude that base expenditure forecasts generated from Ofwat's models will systematically understate companies' investment requirements in a period in which companies are accelerating the rate of leakage reduction, as they will not capture the required step-change in companies' leakage reduction expenditure.

⁷ Ofwat rejected enhancement expenditure for reducing leakage for Bristol Water, SES, Severn Trent, South East Water, South West Water, Southern Water, Wessex Water, Yorkshire Water. Source: Ofwat (2019), Action summary tables for each affected company.

⁸ Ofwat (January 2019), PR19 initial assessment of plans, Technical appendix 2: Securing cost efficiency, page. 18.

Failure to Allow for Enhancement Expenditure to Fund Leakage Reduction Contradicts with Ofwat’s Approach at PR14 and Regulatory Precedent

Ofwat’s decision not to provide companies with allowances for enhancement to bridge the gap between SELL and its “stretched” leakage targets means that the funding package as a whole does not fund achievement of the leakage reduction targets. In essence, there is an inconsistency between Ofwat’s cost allowances (both base allowances and enhancement) and its targets.

By contrast, there was no such inconsistency in Ofwat’s approach at PR14, as PCs for leakage reduction were set to reflect local conditions affecting leakage/SELL, with funding for companies stretching their performance beyond the PCs coming through ODIs. Past regulatory determinations by Ofgem have also allowed companies to recover the costs of new regulatory requirements that trigger significant investment.

Ofwat’s Single Median Unit Cost Approach to Enhancement Funding is Flawed

Ofwat’s approach of allowing enhancement expenditure based on a single median unit cost across the industry is flawed on several grounds.

Ofwat’ single unit cost approach fails to capture any potential variation across companies’ marginal costs because of differences in the costs companies face to reduce leakage, and the level of leakage reduction efforts conducted historically. It also fails to capture the tendency of unit costs to be increasing for maintaining or attaining lower levels of leakage.

Ofwat’s approach may undermine companies’ incentives to reduce leakage at least-cost, as companies achieving the median do not benefit from doing so in terms of higher allowances.

Also, Ofwat’s allowed unit cost for leakage reduction is based in part on ODI out/underperformance rates proposed by companies, which tend to capture marginal benefits, which as Ofwat itself notes are likely to be less than marginal costs. ODI rates are also scaled by a 50 per cent sharing factor, so Ofwat’s calculation may understate the efficient unit costs of leakage reduction.

We Recommend Changing the Funding Package for Leakage Reduction to Allow Companies to Recover Efficiently Incurred Costs

Based on the above, change to Ofwat’s funding package for leakage reduction is therefore required to ensure companies can fund the efficient costs of meeting the industry’s leakage reduction targets. One option would be to develop its cost assessment modelling tools, so that companies’ base allowances better-reflect the growing need for work to reduce leakage. Alternatively, Ofwat could revise its “gated” approach to allowing companies’ claims for enhancement expenditure to reduce leakage in a way that provides funding for them to bridge the gap between their proposed PCs and the levels of leakage reduction activity conducted historically.

We have also shown that the marginal cost of leakage reduction rises as companies reduce leakage to lower levels than observed historically, which is another factor not accounted for by Ofwat’s base expenditure modelling, or its allowances for enhancement expenditure for companies exceeding the target.

A possible solution to this problem could lie in modelling more thoroughly the unit cost of leakage reduction, as a function of the levels of leakage reduction companies target and other factors influencing the cost of leakage reduction. Essentially, we recommend that Ofwat considers improving on its approach of basing allowances on proposed ODI rates (which are in any event inappropriate as a guide to the cost of leakage reduction) and industry median unit costs.

1. Introduction

NERA Economic Consulting (NERA) has been commissioned by SES Water, in collaboration with Affinity Water, Anglian Water, Dwr Cymru, South East Water, South Staffs Water, Southern Water, Thames Water and Yorkshire Water, to review the Office for Water Services' (Ofwat) PR19 Initial Assessment of Plans (IAP).⁹

Specifically, SES Water has asked us to review the basis for Ofwat's proposed targets for leakage reduction over the next Asset Management Period (AMP), and the proposed funding arrangements for achieving leakage reduction.

This report is structured as follows:

- Chapter 2 provides an overview of Ofwat's IAP proposals on how to set targets for leakage reduction and how to fund companies' leakage reduction efforts;
- Chapter 3 assesses the extent to which Ofwat's approach to setting base allowances funds companies' proposed leakage reduction targets;
- Chapter 4 assesses whether Ofwat's approach to appraising companies' requests for enhancement expenditure funds leakage reduction targets;
- Chapter 5 assesses Ofwat's approach to setting the allowed unit cost of leakage reduction; and
- Chapter 6 concludes and makes recommendations.

⁹ Ofwat (January 2019), PR19 Initial Assessment of Plans.

2. Overview of Ofwat's IAP Proposals on Leakage

2.1. Background on Ofwat's Leakage Proposals

Leakage reduction is a high-profile output provided by water companies, and has been given a great deal of prominence in Ofwat's "Delivering Outcomes for Customers" regime at PR19. Ofwat therefore expected companies "to propose stretching performance commitment levels for leakage".¹⁰

At PR19, Ofwat requires all companies to have a Performance Commitment (PC) and a financial Outcome Delivery Incentive (ODI) for leakage. Ofwat standardises the definition of leakage targets and prescribes a method for how companies should set their target at PR19, or justify why they have not adopted the prescribed method. Ofwat "expect[s] companies to propose forecast upper quartile performance levels" for four PCs, including leakage.¹¹

As well as its expectation that companies propose UQ performance, it also sets out instructions on the minimum target for leakage improvement that companies are required to achieve,¹² including that the target must be for at least 15 per cent reduction, "one percentage point more than the largest reduction commitment at PR14",¹³ and to "achieve the largest actual percentage reduction achieved by the company since PR14".¹⁴

At PR14, Ofwat also required all companies to set common targets on leakage.¹⁵ However, Ofwat did not intervene to standardise targets for all companies, or set targets to reflect an UQ level of performance. In response, most companies proposed caps and collars and deadbands on the incentive, to limit rewards and penalties if outturn leakage diverged materially from the PC.

By specifying a 15 per cent leakage reduction target at PR19, Ofwat has diverged from the approach it expected companies to use when setting leakage targets at PR14. Ofwat accepted lower leakage reduction targets at PR14 "because companies' proposals on leakage aligned with the sustainable economic level of leakage (SELL) and local issues (such as availability of water resources and statutory abstraction reductions) significantly influence the SELL".¹⁶ Under the SELL approach at PR14, companies set leakage targets such that the marginal cost

¹⁰ Ofwat, *Delivering Water 2020: Our methodology for the 2019 price review*. Appendix 2: Delivering outcomes for customers, page. 65.

¹¹ Ofwat, *Delivering Water 2020: Our methodology for the 2019 price review*. Appendix 2: Delivering outcomes for customers, page. 61 and page 65.

¹² Ofwat namely states that "Companies should set stretching leakage performance commitment levels to: [...] achieve at least achieve at least a 15% reduction in leakage (one percentage point more than the largest reduction commitment at PR14) – or justify why this is not appropriate". Source: Ofwat, *Delivering Water 2020: Our methodology for the 2019 price review*. Appendix 2: Delivering outcomes for customers, page. 65.

¹³ Ofwat, *Delivering Water 2020: Our methodology for the 2019 price review*. Appendix 2: Delivering outcomes for customers, page. 65

¹⁴ Ofwat, *Delivering Water 2020: Our methodology for the 2019 price review*. Appendix 2: Delivering outcomes for customers, page. 65

¹⁵ Ofwat, *Delivering Water 2020: Our methodology for the 2019 price review*. Appendix 2: Delivering outcomes for customers, page. 8.

¹⁶ Ofwat (December 2014), *Setting price controls for 2015-20, Final price control determination notice: policy chapter A2 - outcomes*, page. 21.

of water leakage would equal to the marginal cost of leakage control, reflecting both the private costs (i.e. the operating and capital costs of leakage control) and the external social and environmental costs of leakage.

By contrast, at PR19 Ofwat is now concerned that the SELL approach “has not driven sufficient efficiency improvements or innovation in leakage reduction”, and that it therefore is no-longer a sufficient leakage target.¹⁷

Reflecting this Ofwat policy, companies proposed leakage reductions broadly in accordance with Ofwat's 15 per cent target in their PR19 business plans: the proposed reductions ranged between -14.4 per cent and -25.4 per cent.¹⁸ Correspondingly, companies also requested additional enhancement expenditure to fund the leakage reduction targets, which “stretched” beyond the SELL that reflects local conditions.¹⁹

2.2. Ofwat's Approach to Funding Leakage Reduction

In its IAP, Ofwat does not grant enhancement expenditure allowances for reducing leakage to seven companies,²⁰ stating that “Customers should not pay extra costs for companies to deliver stretching targets. The delivery of stretching performance is to be funded from base costs”.²¹

During its webinar, Ofwat further clarified its position stating that companies' have been engaging in “network maintenance and leakage reduction” in the past and therefore the costs of these activities “are included in [...] base allowances”.²² To support its statement, Ofwat mentions that two companies have not requested enhancement funding to deliver the 15 per cent leakage reduction target, and that the 3 fast tracked companies “have accepted [Ofwat's] base allowance to achieve a 15% leakage reduction”.²³

Ofwat defines base costs as “routine, year on year costs, which companies incur in the normal running of their business” including operational and capital maintenance costs.²⁴ The base cost allowance consists of an unmodelled and a modelled cost component, with the modelled component determined by an econometric benchmarking exercise (see Section 3.1).

While Ofwat rejected many companies' requests for enhancement allowances to fund leakage reduction, Ofwat partially approved enhancement expenditure to support leakage reduction

¹⁷ Ofwat, Delivering Water 2020: Our methodology for the 2019 price review. Appendix 2: Delivering outcomes for customers, page. 63.

¹⁸ Ofwat (January 2019), Supply-demand balance enhancement: Feeder model summaries, page. 13.

¹⁹ Ofwat describes the leakage reduction targets at PR19 as “stretching performance commitment levels for leakage”. Source: Ofwat, Delivering Water 2020: Our methodology for the 2019 price review. Appendix 2: Delivering outcomes for customers, page. 65.

²⁰ This includes: Affinity Water, Hafren Dyfrdwy, SES Water, Southern Water, South West Water, United Utilities Water and Wessex Water. Ofwat (January 2019), Supply-demand balance enhancement: Feeder model summary, page 16.

²¹ Ofwat (January 2019), PR19 initial assessment of plans, Technical appendix 2: Securing cost efficiency, page. 18.

²² Ofwat (7 February 2019), Ofwat webinar: Securing cost efficiency, Q&A, p.3.

²³ Ofwat (7 February 2019), Ofwat webinar: Securing cost efficiency, Q&A, p.3.

²⁴ Ofwat (January 2019), PR19 initial assessment of plans, Technical appendix 2: Securing cost efficiency, page. 9.

for 10 companies.²⁵ The partial funding is set by multiplying an allowed unit cost of leakage reduction (£1.6m/MI/d) by an allowed volume of leakage reduction, conditional on passing one of two tests:

- If a company forecast leakage reduction in excess of the 15 per cent target, but does not achieve an upper quartile level of leakage, it receives funding for leakage reduction *beyond* 15 per cent.
- If a company achieves the upper quartile level of leakage by 2024-25, in both normalised measures (per km of main and per property), it receives funding for leakage reduction *beyond* the upper quartile level.
- If a company passes both the above tests, it receives the maximum of the funding under the two tests.

Ofwat has set the allowed unit cost of leakage reduction that applies to allowed enhancement expenditure through its Supply-Demand Balance (SDB) enhancement modelling that uses data from companies' business plans. The proposed allowed unit cost at PR19 is £1.6m/MI/d, and is the average of:²⁶

- median leakage unit costs derived from the PR19 SDB enhancement analysis;
- median incentive rate for underperformance reported in companies' business plans; and
- median incentive rate for outperformance reported in companies' business plans.

2.3. Conclusion

Ofwat has disallowed the enhancement expenditure for leakage reduction requested by half of the companies for achieving the leakage reduction targets set out in their business plans. However, Ofwat partially allowed enhancement expenditure for leakage reduction by 10 companies forecasting leakage reduction beyond defined thresholds, with allowances calculated at an allowed unit cost set by Ofwat, multiplied by the volume beyond the threshold.

By disallowing companies' enhancement expenditure below its target, Ofwat has proposed that companies should fund leakage reduction through their base cost allowances. Ofwat defines base cost as "routine, year on year cost, which companies incur in the normal running of their business", and estimates the efficient level of base costs through five econometric benchmarking models.²⁷

Ofwat's stated rationale for this approach to funding leakage reduction is that: "[c]ustomers should not pay extra costs for companies to deliver stretching targets" for leakage reduction.²⁸

²⁵ This includes: Anglian Water, Bristol Water, Northumbrian Water, Portsmouth Water, South East Water, South Staff Water, Severn Trent Water, Thames Water, Welsh Water, Yorkshire Water. Source: Ofwat (January 2019), Supply-demand balance enhancement: Feeder model summary, page 16.

²⁶ Ofwat (January 2019), Supply-demand balance enhancement: Feeder model summary, page. 15.

²⁷ Ofwat (January 2019), PR19 initial assessment of plans, Technical appendix 2: Securing cost efficiency, page. 9.

²⁸ Ofwat (January 2019), PR19 initial assessment of plans, Technical appendix 2: Securing cost efficiency, page. 18.

As we discuss in the sections below, there are several reasons why Ofwat's proposed funding for leakage reduction will not result in regulated revenues sufficient for companies to finance the efficient costs of meeting the "stretching" PCs on leakage reduction which Ofwat has itself asked companies to target.

3. Assessing the Funding of Leakage Reduction through Base Allowances

As explained above, Ofwat states that its base allowances are sufficient to fund companies' leakage reduction targets. In this section, we therefore review Ofwat's econometric methods and assess whether its approach to setting base allowances will produce revenues sufficient for efficiently operated companies to fund the leakage reduction targets Ofwat has set. As discussed below, in performing this assessment, we consider factors such as the ability of Ofwat's models to control for the determinants of companies' leakage performance, as well as the effects of different historical leakage reduction expenditure and investment cycles across companies.

3.1. Econometric Models Used to Set Base Allowances

Ofwat set total expenditure (totex) allowances for each company using four main building blocks:²⁹

- *modelled base cost*, including operating and capital maintenance expenditure;
- *unmodeled base costs*, including business rates, abstraction charges, Traffic Management Act costs, wastewater industrial emissions directive costs;
- *enhancement costs* reported in PR19 business plans; and
- *adjustments* based on claims submitted by companies.

As discussed in Section 2, Ofwat proposes that water companies should fund leakage reduction through their base costs allowance.³⁰ Ofwat sets modelled base cost allowances for water through the following stages:

- Ofwat's econometric benchmarking models use historical data on base costs and drivers over a seven-year period between 2011-12 to 2017-18. Ofwat constructs 5 econometric models with different cost and cost driver specifications. It regresses "botex" (operating expenditure excluding unmodeled opex, plus capital maintenance) on selected cost drivers, with cost drivers selected to reflect the scale, complexity, topography and density of a water network (see Table 3.1).
- Ofwat then calculates each company's efficiency score, the ratio of each company's actual botex in the modelling period to its modelled botex. It then ranks companies' efficiency score and selects the upper quartile value (95.2 per cent, set by South West Water) to be used as the efficiency challenge during AMP7. This efficiency target "triangulates" the results from Ofwat's 5 econometric models.
- Next, Ofwat forecasts levels of cost drivers for AMP7, generally by extrapolating trends from the historical period, and multiplying forecast drivers by the estimated model coefficients to generate modelled AMP7 botex for each company.

²⁹ Ofwat (January 2019), PR19 initial assessment of plans, Technical appendix 2: Securing cost efficiency, page. 7-8.

³⁰ Leakage reduction is not a component of unmodeled base costs, hence modelled base costs is the relevant building block for assessing whether the base cost allowance provides adequate funding for companies' leakage PCs.

- Ofwat then multiplies modelled AMP7 botex by (1) the efficiency challenge of 95.2 per cent; and (2) an ongoing productivity or frontier shift of 1.5 per cent cost reduction per annum. This calculation produces Ofwat’s view of efficient modelled WW botex.
- Finally, Ofwat adds any company-specific factors which are not adequately controlled for by the econometric models (known as “cost adjustment claims”) as well as allowances for unmodelled botex to arrive at a final view of efficient botex.

Table 3.1: Cost Drivers Included in Ofwat’s Econometric Models for WW

Category	Cost Driver
Scale	Number of properties (log); or length of main (log)
Complexity	% of water treated at treatment works with complexity level 3 or higher; or weighted average treatment complexity level
Topography	Number of booster pumping stations / length of main (log)
Density	Weighted average density (log); and squared term of log of weighted average density

Source: Ofwat³¹

3.2. The Exclusion of Enhancement from the Definition of Botex

Ofwat’s own definition of botex suggests that its base allowances do not allow funding of leakage to attain more “stretching” PR19 targets.

At PR14 Ofwat set companies’ total expenditure (totex) allowance by relying on modelled totex which included operating expenditure and capital expenditure, defined as including both capital maintenance and enhancement expenditure. Any expenditure to reduce leakage beyond base levels would have been captured by enhancement expenditure and therefore be included in baseline modelled costs.

At PR19, Ofwat has decided not to use totex benchmarking and as described above, opted to set companies’ modelled cost using “botex” as a dependent variable in the econometric models, i.e., operating costs plus capital maintenance.

According to the Regulatory Accounting Guidelines (RAGs), at PR19 capital expenditure is defined as “expenditure to maintain the long-term capability of the assets and to deliver base levels of service”.³² Any capital expenditure therefore deployed to deliver levels of service beyond the base, including expenditure to reduce the levels of leakage beyond the base, is classified as “enhancement expenditure”.³³ It follows that Ofwat’s botex models will not account for the any expenditure that is required to deliver enhancements in the level of

³¹ Ofwat (January 2019), PR19 initial assessment of plans, Supplementary technical appendix, Econometric approach, page. 12-14.

³² Ofwat (November 2017), RAG 4.07 – Guideline for the table definitions in the annual performance report, p.12.

³³ Ofwat’s RAG also note that “Where projects have drivers both of enhancement and capital maintenance, companies should apply a method of proportional allocation to allocate costs between enhancement and capital maintenance”. Source: Ofwat (November 2017), RAG 4.07 – Guideline for the table definitions in the annual performance report, p.12.

leakage of companies. This contradicts Ofwat’s own assertion that companies’ leakage reduction efforts “are included in [...] base allowances”.³⁴

3.3. The Ability of Ofwat’s Models to Fund Current Levels of Leakage

3.3.1. The levels of leakage achieved by each company will affect their performance in comparative benchmarking models

Leakage rates are (to some extent) within management control, and choices made about companies’ target levels of leakage reduction may affect their performance in comparative benchmarking models.

If companies minimise their own costs, and the models capture the drivers of leakage, then the base allowances emerging from the models will fund the levels of leakage consistent with minimising water companies’ own costs. However, as we explain below, this conclusion does not hold in practice and Ofwat’s models may fail to fund efficient leakage reduction.

3.3.2. In practice, companies do not target the least cost level of leakage

In practice, over Ofwat’s cost assessment period companies have not been targeting the least-cost level of leakage, but targeted levels of leakage that are consistent with the Sustainable Economic Level of Leakage (SELL) and other local issues.

As noted in Section 2.1, the concept of SELL identifies the point at which companies set leakage targets such that the marginal cost of water leakage equals to the marginal cost of leakage control. This definition captures both the operating and capital costs of the company to control leakage, and the *external* social and environmental costs of leakage. These include for instance the environmental impact of reduced leakage (e.g. the benefit of reduced abstraction), the environmental and social impact of leakage control (e.g. disruptions, low pressure) and the carbon impact of leakage and active leakage management (the cost of carbon due to electricity/fuels for power for abstraction, treatment and pumping).³⁵

A 2012 study by the Environment Agency, Ofwat and Defra acknowledges that “a key factor in determining SELL is believed to be costs which are external to the company”.³⁶ The study highlights that although these factors may “have a relatively small impact on the calculation of SELL”, they should be accounted for in setting leakage targets.³⁷ In line with Ofwat’s PR14 decision, companies included measures of external costs when setting SELL and their leakage targets.³⁸

³⁴ Ofwat (7 February 2019), Ofwat webinar: Securing cost efficiency, Q&A, p.3.

³⁵ Environmental Agency, Ofwat and Defra (October 2012), Review of the calculation of sustainable economic level of leakage and its integration with water resource management planning, page 14-15.

³⁶ Environmental Agency, Ofwat and Defra (October 2012), Review of the calculation of sustainable economic level of leakage and its integration with water resource management planning, page 5.

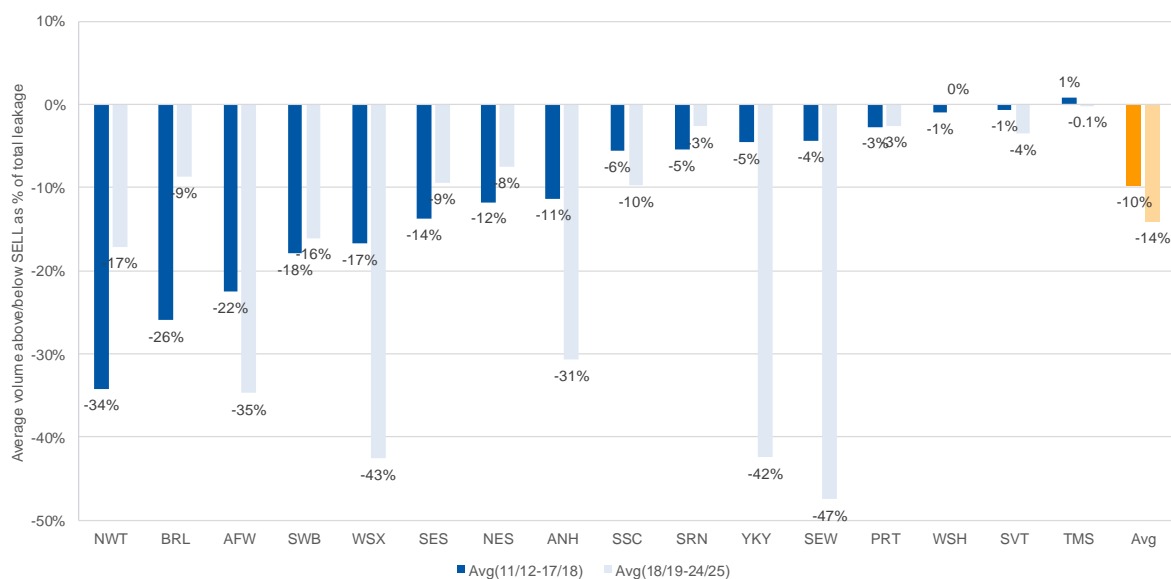
³⁷ Environmental Agency, Ofwat and Defra (October 2012), Review of the calculation of sustainable economic level of leakage and its integration with water resource management planning, page 7.

³⁸ Ofwat states: “The final methodology statement specifically required companies to include incentives in only two areas. These were: leakage, reflecting its importance to customers and the potential environmental and efficiency benefits of

Leakage targets set to achieve SELL are therefore calibrated to provide other benefits to society beyond minimising water companies’ costs, so achieving SELL implies companies will reduce leakage beyond the level that would optimise their performance in econometric benchmarking models.

In practice, as Figure 3.1 shows, over Ofwat’s cost assessment period (2011/12 – 2017/18) all companies have been operating on average below SELL, except for Thames Water which has been operating marginally above SELL.³⁹ Likewise, over the next AMP on average companies across the industry forecast that they will remain below SELL.⁴⁰

Figure 3.1: Collectively Companies Have Been Operating Below SELL Over the Cost Assessment Period (2011/12 – 2017/18)



Source: NERA analysis of Ofwat’s Stata Input file for water.

Therefore, because companies have been operating beyond the level of leakage that minimises companies’ own costs, companies achieving the lowest levels of leakage will tend to appear less efficient in Ofwat’s modelling as a result. Moreover, target levels of expenditure implied by Ofwat’s modelling are likely to be influenced by those companies which relatively high levels of leakage, closer to the levels that minimise water companies’ private costs.

As we explain in Section 3.4.4, Ofwat implicitly acknowledges this feature of its modelling to set base allowances by allowing Anglian Water a cost adjustment for achieving and maintaining lower levels of leakage.

its reduction”. Source: Ofwat (December 2014), Setting price controls for 2015-20, Final price control determination notice: policy chapter A2 – Outcomes, page10.

³⁹ Note the figure provides for each company the total volume of leakage above/below SELL as a percentage of total leakage over the 2011/12 – 2017/18 period.

⁴⁰ Note the figure provides for each company the total volume of leakage above/below SELL as a percentage of total leakage over the 2018/19 – 2024/25 period.

3.3.3. Ofwat's models also fail to capture the differences between companies that affect the least cost level of leakage

Ofwat's selection of cost drivers (see Table 3.1) has a material effect on what proportion of variation in companies' costs appear to be inefficient.

Some of the variables included in Ofwat's benchmarking models may be related to the amount of leakage companies experience. For instance, companies with longer mains or more customers may have higher underlying levels of leakage. However, none of the variables included in the botex models control directly for *normalised* leakage, i.e. a measure of leakage volumes that controls for differences in companies' scale.

None of the cost drivers included in Ofwat's models reflect companies' historical efforts to reduce leakage. Ofwat decided not to include cost drivers in its models which reflect leakage directly. Ofwat did not include the volume of water treated as cost driver, as companies can influence it "through leakage reduction and water efficiency schemes, which [Ofwat] wish[es] to incentivise".⁴¹ Instead, Ofwat selected length of mains and number of connections as the "scale" cost drivers, as discussed in Section 3.1.

In a similar vein, Ofwat's cost drivers fail to capture characteristics of water companies' assets like the age, condition and type of mains, which influence efficient levels of leakage and the costs of leakage reduction and are largely driven by asset inheritance. Also, for companies serving areas of the country with a relatively tight supply-demand balance, it might be economic to target lower levels of leakage as the value of the water lost through leakage is greater.

Ofwat argued against including the volume of water abstracted as a cost driver because it is under management control through leakage reduction, and hence "could send the wrong signal or create a perverse incentive for the regulated companies".⁴² Ofwat explains the perverse incentives as "the model will imply higher costs for the company that is less water efficient (and therefore abstracts more water)".

Failure to account for variation in leakage across companies was one of the reasons cited by the CMA in support of its conclusion that Ofwat's PR14 cost assessment "did not adequately reflect Bristol Water's costs".⁴³ One of CMA's recommendations was to define cost drivers in terms of distribution input per household. The CMA stated that one improvement of this decision that it "does not overlook the additional costs of achieving lower levels of leakage".⁴⁴

⁴¹ Ofwat (January 2019), PR19 initial assessment of plans, Supplementary technical appendix, Econometric approach, page 12.

⁴² Ofwat (March 2018), Cost assessment for PR19: a consultation on econometric cost modelling, page. 10.

⁴³ CMA (6 October 2015), Bristol Water plc, A reference under section 12(3)(a) of the Water Industry Act 1991, Report, para. 24.

⁴⁴ CMA (6 October 2015), Bristol Water plc, A reference under section 12(3)(a) of the Water Industry Act 1991, Report, para 4.135-4.136.

3.3.4. Ofwat's model cannot differentiate expenditure to reduce leakage from expenditure to maintain a relatively low level of leakage

Another reason why Ofwat's models may not fund efficient leakage reduction is the possibility of asynchronous investment cycles across companies.

Suppose two water companies that are otherwise identical have asynchronous investment cycles, the UQ target in Ofwat's base cost models will be set by those companies that happen to be conducting relatively little expenditure during the modelling period in question. Conversely, any company that is currently at a high-point in an investment cycle will appear relatively inefficient and be disadvantaged.

As described above, Ofwat's base allowance includes capital maintenance expenditure. The CMA noted at PR14 that, because capital maintenance includes "a greater proportion [...] of non-recurring costs from year-on-year", "one year's capital maintenance, or even one regulatory period's capital maintenance, will not necessarily be a good predictor of the future".⁴⁵

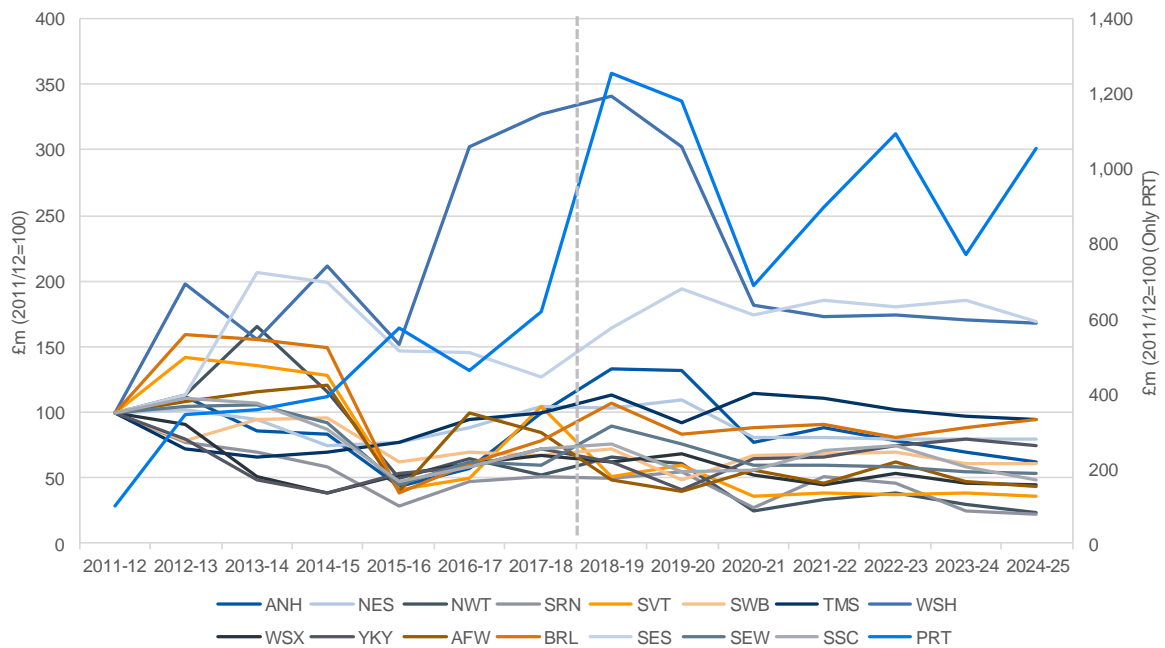
As Figure 3.2 shows, over Ofwat's relatively short assessment period capital maintenance is relatively lumpy and fluctuations in expenditure levels across companies do not appear to follow a synchronous pattern. Some companies such as Portsmouth Water, have increased capital maintenance expenditure over the modelling period, while other companies (e.g. Affinity Water) have reduced their capital maintenance expenditure.

A corollary of this feature of Ofwat's base cost models is that, if it is repeated over time and all companies have different investment cycles, the frontier will tend to be set by those companies that conduct relatively little capital expenditure at any point in time. Hence, if the benchmarking is conducted repeatedly, no company should expect to recover its efficient investment costs over the investment cycle as a whole.

Because companies' efforts to reduce leakage may entail lumpy expenditure (e.g. capital maintenance activities), differences in leakage reduction effort in a particular AMP could appear as inefficiency in Ofwat's models, and cost targets may be influenced by those companies performing relatively little leakage reduction work in a particular modelling period.

⁴⁵ CMA (6 October 2015), Bristol Water plc, A reference under section 12(3)(a) of the Water Industry Act 1991, Report, para. 124.

Figure 3.2: Capital Maintenance Expenditure Tends to be Lumpy and Asynchronous Across the Industry



*Note: Portsmouth Water (PRT)'s capital maintenance expenditure is reported on the secondary axis.
Source: NERA analysis of Ofwat data.*

3.3.5. Modelled allowances are probably determined by the companies spending least on leakage reduction during the modelling period

As we explain above, Figure 3.1 shows that companies have typically achieved a level of leakage close to, or beyond, SELL. Hence, most of the industry is probably achieving a level of leakage beyond the level that would minimise their own costs, which has historically been justified based on customers' preferences and the externalities associated with leakage. However, the benchmarking models do not capture differences in companies' leakage performance, or remunerate those choosing to go beyond SELL. Hence, those sustaining the lowest levels of leakage will tend not to be provided with base allowances to cover the costs of doing so.

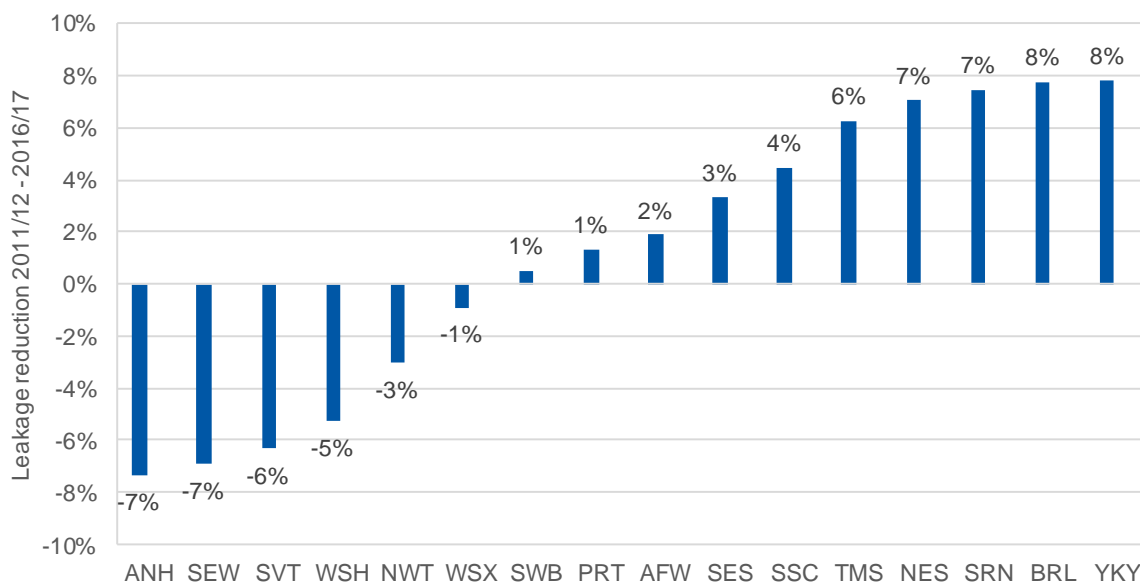
In addition to this evidence discussed in Section 3.3.1, the trajectory of leakage reduction also affects companies' expenditure. The expenditure targets emerging from Ofwat's models will tend to reflect the expenditure incurred during the historical modelling period to reduce leakage. If all companies had incurred similar levels of expenditure to reduce leakage during the historical modelling period, the allowances predicted for AMP7 would reflect a continued level of expenditure by company. However:

- Variation in companies' investment cycles, as we discuss in Section 3.3.4, means modelled costs will tend to be determined by the companies' spending relatively little to reduce leakage during the historical modelling period.

- Also, as Figure 3.3 below shows, half of all companies have increased or reduced leakage by less than 3 per cent over the 2011/12 – 2016/17 period.⁴⁶ As such, if the funding provided through the base allowances reflects the typical levels of leakage reduction achieved during the historical period, the base allowances for leakage reduction in AMP7 will continue to be minimal.

Therefore, Ofwat is wrong to argue that companies’ have been engaging in “network maintenance and leakage reduction” in the past and therefore the costs of these activities “are included in [...] base allowances”.⁴⁷ Ofwat’s base allowances will only tend to fund current levels of leakage and leakage reduction.

Figure 3.3: Leakage Reduction by Company Over the 2011/12 – 2016/17 Period



Source: NERA analysis of Ofwat’s Stata Input datafile for water.

3.4. The Ability of Ofwat’s Models to Fund PR19 Leakage Reduction Targets

While Section 3.3 explains that Ofwat’s base allowances will fund companies for achieving current levels of leakage and historical rates of leakage reduction, we also consider below whether its approach will fund the more stretching levels of leakage reduction targeted by the industry at PR19.

⁴⁶ 2017/18 leakage data for some companies (e.g., SVT) is substantially different from leakage volumes in the previous years. We therefore rely on 2016/17 as the latest available year for total leakage volumes. However, we cross-check our results with leakage reduction over Ofwat’s entire assessment period (2011/12 - 2017/18). Accordingly, we find that half of the companies experienced an increase in leakage volumes (in MI/d), with only four water companies reducing total leakage by no more than 8 percent. Source: NERA analysis of Ofwat’s Stata Input datafile for water.

⁴⁷ Ofwat (7 February 2019), Ofwat webinar: Securing cost efficiency, Q&A, p.3.

3.4.1. Ofwat’s approach to setting base allowances does not fund the more stretching PR19 leakage reduction targets

As explained in Section 3.2, Ofwat’s selected drivers do not reflect variation – either across time or companies – in leakage reduction expenditure. As such, the predicted values from the models that define water companies’ allowances will not change in a way that reflects changes in effort by the industry to reduce leakage.

Nonetheless, it would still be possible for Ofwat’s base allowances to include the costs of leakage reduction, to the extent the historical cost data used to calibrate the model includes the required level of leakage reduction expenditure over the next AMP. However, this is not the case.

In fact, Ofwat expects companies to stretch their leakage reduction targets beyond the most ambitious leakage reduction proposal at PR14. As discussed in Chapter 2, Ofwat recommended that companies set 15 per cent leakage reduction targets between 2019-20 – 2024-25. This target is “one percentage point more than the largest reduction commitment at PR14”.⁴⁸

Ofwat’s recommended target also represents a step change compared to recent historical leakage reduction performance. As Figure 3.3 above shows, none of the water companies in the sample have achieved a level of reduction of 15 per cent over Ofwat’s cost assessment period. The largest reduction over the 2011-12 – 2016-17 period is equal to 7 per cent by Anglian Water, almost half the target set by Ofwat.⁴⁹

It follows that models used by Ofwat to set base allowances will not produce predicted values that reflect the more stretching (unobserved) level of leakage reduction effort in the next AMP. Rather, they will reflect (at most) the historical efforts to reduce leakage during the modelling period.

3.4.2. Even if Ofwat’s models included leakage reduction variables, they would still not reliably estimate the costs of meeting PR19 targets

Even if Ofwat’s base cost models took leakage reduction into account, e.g. by including explanatory variables reflecting companies’ historical leakage reduction efforts, the base cost allowance could still be inadequate to fund the efficient costs of Ofwat’s proposed 15 per cent leakage target. The proposed leakage targets are higher than leakage reduction observed in the past, so the benchmarking method might not be able to capture the true cost of achieving the target because more rapid reductions in leakage could be costlier than leakage reduction efforts in the past. In essence, Ofwat’s modelled allowances are likely to be unrealistic if they are used for “out of sample” prediction when using models calibrated using historical data to predict how leakage reduction costs will change in the future.

⁴⁸ Ofwat, *Delivering Water 2020: Our methodology for the 2019 price review*. Appendix 2: Delivering outcomes for customers, page. 65

⁴⁹ 2017/18 leakage data for some companies (e.g., SVT) is substantially different from leakage volumes in the previous years. We therefore rely on 2016/17 as the latest available year for total leakage volumes. However, we cross-check our conclusions using 2017/18 data and find that largest reduction over the entire assessment period is equal to 8 percent, i.e., around half of the reduction target requested by Ofwat.

As shown above and further below, the level of leakage (in percentage terms) that Ofwat is targeting for the industry has not been observed in the historical data used to calibrate its model. Requiring companies to reduce leakage to new lows in relative terms could increase the marginal cost of achieving and sustaining its desired leakage reduction targets, as companies undertake more expensive measures to reduce leakage.

3.4.3. Ofwat’s base allowances fail to consider that more demanding PCs are associated with more expensive leakage reduction schemes

A further reason why Ofwat’s models may not provide a sound basis for predicting how the costs of leakage reduction efforts will change is that they fail to capture the tendency for the marginal cost of leakage reduction to rise as companies reduce leakage further beyond SELL.

As noted above, Ofwat’s cost models set base allowances that cover the costs associated with (at most) existing levels of effort in the industry to reduce leakage, which as Figure 3.3 shows, means its base allowances will only fund very low levels of leakage reduction.

However, in addition to this problem, Ofwat’s models fail i) to account for the incremental cost of achieving leakage reduction beyond SELL, and ii) to capture any potential variation across companies’ incremental costs because of differences in companies’ leakage control programmes. For instance, companies that have attained SELL may incur higher incremental costs for any additional unit of leakage reduction; compared to companies that have not achieved SELL.

In practice, there are a range of leakage reduction measures companies can undertake. First, at high levels of leakage, companies may implement “find and fix” processes and pressure management that have low marginal costs. Then, once all leakage reduction achievable through such measures has been achieved, companies may resort to more ambitious and innovative solutions (e.g. accelerating their mains replacement programmes) to achieve more ambitious leakage reduction targets. Hence, companies face an “upward sloping supply curve” of leakage reduction projects, with an increasing marginal cost of leakage reduction as they target lower levels of leakage.

The slope of each company’s “supply curve” of leakage reduction projects will also differ because of other factors, e.g. network configuration, geography, network age etc. For instance, companies with a larger proportion of older networks may have to resort more quickly, i.e. at lower leakage reduction targets, to expensive leakage reduction solutions like accelerated mains replacement.

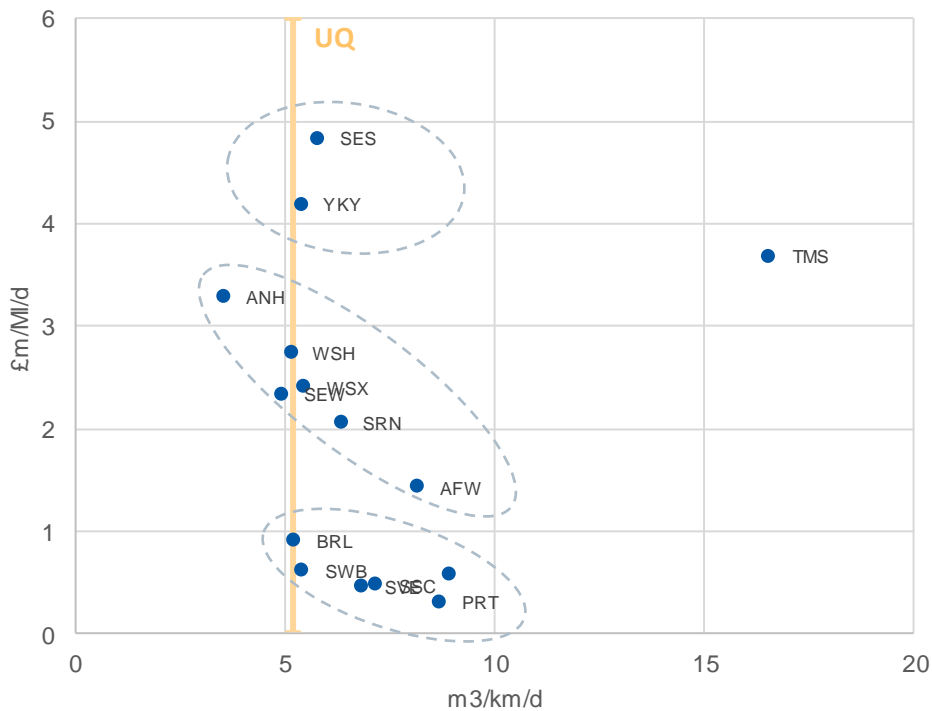
In its IAP, Ofwat defined the UQ performance by using two measures of leakage which control for scale: litres per property per day (l/prop/d) and cubic metre per kilometre per day (m³/km/d). Figure 3.4 and Figure 3.5 below show the relationship between companies’ planned leakage targets at the end of PR19 (2024-25), after controlling for scale, and the marginal cost they expect to incur to provide these levels of leakage reduction. As the figures show, companies closer to the upper quartile leakage performance target tend to expect higher unit costs of leakage reduction compared to companies that are further away the UQ target. At lower levels of leakage reduction, marginal costs appear to be lower.

Optically, the negative correlations shown in the figures between unit costs and leakage rates appear relatively weak, suggesting other factors are also affecting companies’ marginal costs of leakage reduction. However, this appearance of weak negative correlation may be

misleading. For instance, there appear to be some outliers (notably Thames Water, possibly due to the relatively high costs of serving a dense urban area in London). Also, the scatter diagrams in the figures suggest downward sloping relationships between leakage levels and unit costs may exist for “clusters” of companies, as indicated by the dashed lines around some of the data points in the figure. Such clustering of companies may reflect factors such as differences in their asset inheritance, availability of water resources and statutory abstraction reductions.

However, despite these potential differences, we have tested the significance and direction of this effect by running a number of regressions of the unit costs of leakage reduction in £m/MI/day on the level of leakage targeted at the end of the AMP,⁵⁰ measured in l/prop/day and m³/km/d and a cross-product term, using a simple cross-sectional Ordinary Least Squares regression across all companies, except Thames Water. We exclude Thames Water on grounds that it is an outlier based on a visual inspection of the scatterplots below. We find that there is a statistically significant negative relationship between companies’ unit cost and leakage reduction (see Appendix A). This confirms that across all companies, excluding Thames Water, marginal costs tend to increase as leakage reduction targets become more stretching.

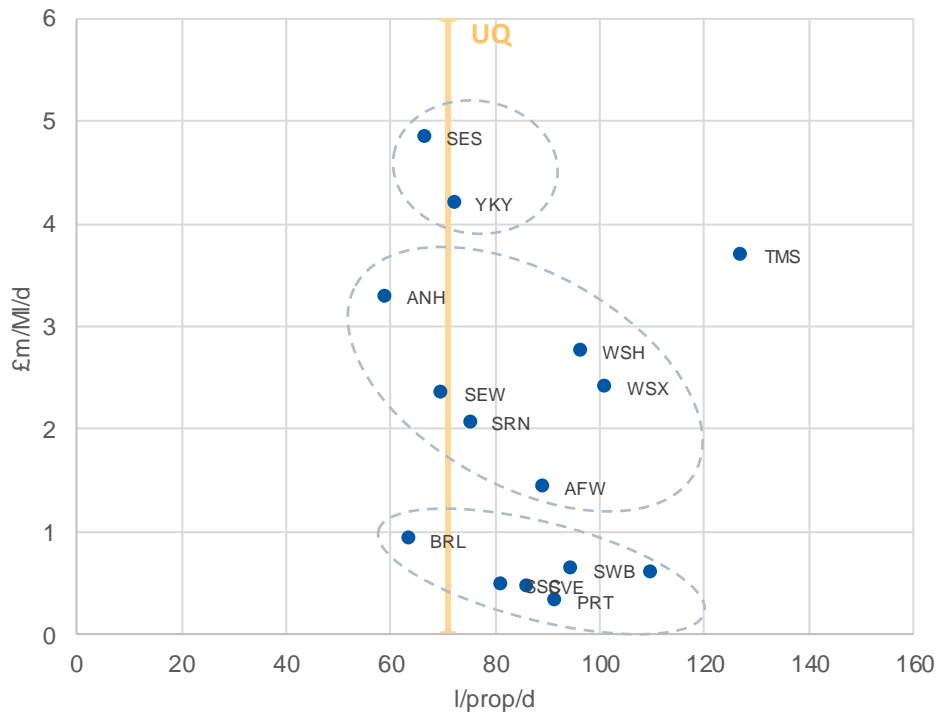
Figure 3.4: Correlation between Leakage Reduction Targets and Marginal Cost of Leakage Reduction Schemes



Source: NERA analysis of Ofwat data as reported in the Wholesale Water Supply-demand balance enhancement – feeder model.

⁵⁰ Ofwat’s test relies upon the forecast 3-year average leakage positions in 2024-25 that companies have provided as part of their common performance commitments. We have cross-checked our results using this measure of leakage instead of leakage at the end of AMP7 (i.e., 2024-25). As Appendix A shows, the results are consistent across all models.

Figure 3.5: Correlation between Leakage Reduction Targets and Marginal Cost of Leakage Reduction Schemes



Source: NERA analysis of Ofwat data as reported in the Wholesale Water Supply-demand balance enhancement – feeder model.

Failure to account for this systematic relationship between companies’ marginal cost of leakage reduction and the underlying level of leakage implies that Ofwat’s base allowance, set using historical costs and drivers, does not reflect the true economic costs of achieving more demanding leakage reduction targets beyond SELL.

3.4.4. Anglian Water’s special factor claim shows that Ofwat’s base allowances would not fund leakage performance

Ofwat’s IAP has already recognised the increasing marginal cost of achieving and sustaining lower levels of leakage in its assessment of a special factor claim submitted by Anglian Water. However, Ofwat has not recognised this feature of the cost pressures facing water companies in setting base allowances.

In its business plan submission, Anglian Water requested a special factor adjustment of £147.9 million over AMP7 to maintain frontier leakage performance.⁵¹ Ofwat partially accepted Anglian Water’s claim.⁵² Anglian Water argued that it is currently at the frontier of the sector in terms of leakage reduction and that maintaining frontier leakage performance therefore “requires greater expenditure compared to maintaining, for instance, the industry

⁵¹ Anglian Water, PR19 Water Data Tables Commentary, page 172.

⁵² Ofwat, Excel file “M_CAC_ANH_IAP.xlsx”.

average level of leakage”.⁵³ Anglian Water’s special factor claim therefore covers “the additional expenditure that will be required to maintain leakage at the current frontier level rather than at [SELL]”.⁵⁴

Anglian Water’s special factor adjustment reflects the inability of Ofwat’s base cost modelling to predict required expenditure levels to achieve more stretching (above-industry average) targets of leakage reduction at AMP7. By relying on historical costs and cost drivers, and not including leakage-specific cost drivers, Ofwat’s cost modelling will therefore penalise companies with above industry-average leakage reduction rates by allowing lower base costs than actually required to meet such target. Conversely, all else equal, Ofwat’s base allowance will be more generous for those companies that perform below industry average.

However, by accepting Anglian Water’s cost adjustment claim Ofwat is implicitly acknowledging increasing marginal costs of maintaining and/or achieving low levels of leakage and that base allowances not capture this feature of companies’ incremental leakage costs.⁵⁵

3.5. Empirical Assessment of the Impact of Leakage on Modelled Efficiency Gaps

As set out above, Ofwat’s models may conflate companies’ level of leakage performance (relative to SELL) and/or their leakage reduction efforts during the modelling period with variation in companies’ relative efficiency. Specifically, the omission of companies’ efforts to reduce leakage to a level beyond SELL means the predicted values generated from the modelling cannot reflect the costs companies will incur to further reduce leakage over the next AMP. As such, Ofwat’s models do not fund through base allowances the increased level of leakage reduction that companies and Ofwat are targeting.

While the theoretical basis for this argument is clear from examining Ofwat’s model specifications, we have also demonstrated this empirically by adding leakage reduction beyond SELL into Ofwat’s Treated Water Distribution (TWD) and Wholesale Water (WW) econometric models. To do this, we took data on companies’ historical SELL and leakage reduction from Ofwat’s PR19 input files, and tested whether this factor has a material effect on companies’ botex in a number of ways.

First, we regressed the residuals from Ofwat’s TWD model on the difference between companies’ SELL and leakage. We perform this calculation in MI/day (i.e. in levels) because for some companies this variable is negative, so cannot be logged (Model 1a in Table 3.2). We include the difference between SELL and leakage in both linear and squared form, to capture the possibility that, as leakage falls further from SELL, the marginal cost of reducing and maintaining lower levels of leakage could rise (see Section 5).

As the results below show, we find that the coefficients on the linear and quadratic terms of the difference between SELL and leakage are statistically significant at the 5 and 10 per cent significance levels respectively. They are also positive, suggesting companies with leakage

⁵³ Anglian Water, PR19 Water Data Tables Commentary, page 174.

⁵⁴ Anglian Water, PR19 Water Data Tables Commentary, page 172.

⁵⁵ Ofwat, Excel file “M_CAC_ANH_IAP.xlsx”.

performance beyond SELL have higher costs than companies with leakage closer to SELL, and the further beyond SELL companies reduce leakage, the more their costs tend to rise.

To test the effect of logging this variable, we also regressed residuals from Ofwat's TWD model on the natural logarithm of the difference between SELL and leakage, plus 200 MI/day (Model 1b in Table 3.2). The purpose of adding 200 MI/day was to ensure this variable was positive for all companies so we could run the model in logarithmic form.⁵⁶ As for Model 1a in which we include these variables without logging them, we find positive and statistically significant coefficients at the 10 per cent significance level.

We have also included these same variables directly within the Ofwat TWD and WW models, as shown in Table 3.2. In all cases, we find that including these variables gives statistically significant coefficients. The impact on the other modelled coefficients is relatively small, as the results below show. We also find no material changes in the statistical robustness tests applied by Ofwat. For instance, like Ofwat's base models, none of these adapted models violate the Ramsey RESET or normality of errors tests.

⁵⁶ We have added a value of 200MI/day to ensure positive values for this variable (necessary for a logarithmic transformation). However, any other larger number would achieve the same affect, and the choice of any adder is inherently arbitrary. The choice affects the estimated elasticities but not the underlying relationship, so we tested the effect of adding (arbitrarily) 1,000 instead of 200, and found it made little difference to our finding of statistically significant coefficients.

Table 3.2: Econometric Modelling of the Link Between (SELL-Leakage) on Companies' TWD and WW Botex

Model Description:	(1a) Residuals + Leakage1	(1b) Residuals + Leakage2	(2) Ofwat TWD Model	(2a) = (2) + Leakage1	(2b) = (2) + Leakage2	(3) Ofwat WW1 Model	(3a) = (3) + Leakage1	(3b) = (3) + Leakage2	(4) Ofwat WW2 Model	(4a) = (4) + Leakage1	(4b) = (4) + Leakage2
Dependent Variable:	Ofwat TWD Model Residuals	Ofwat TWD Model Residuals	TWD Botex (Log)	TWD Botex (Log)	TWD Botex (Log)	WW Botex (Log)	WW Botex (Log)	WW Botex (Log)	WW Botex (Log)	WW Botex (Log)	WW Botex (Log)
<i>Independent Variables:</i>											
Leakage above SELL	0.00133** (0.000666)			0.00149** (0.000706)			0.00141*** (0.000353)			0.00145*** (0.000338)	
Sq Leakage above SELL	5.97e-06* (3.49e-06)			7.27e-06** (3.31e-06)			1.08e-05*** (2.16e-06)			1.08e-05*** (2.14e-06)	
Leakage above SELL + 200 (Log)		-1.544* (0.926)			-1.794** (0.875)			-1.836*** (0.517)			-1.834*** (0.514)
Sq Leakage above SELL + 200 (Log)		0.175* (0.105)			0.202** (0.0998)			0.200*** (0.0581)			0.200*** (0.0573)
Lengths of Main (Log)			1.013*** (0.0277)	1.016*** (0.0280)	1.019*** (0.0278)						
Boosters per Length (Log)			0.465*** (0.150)	0.463*** (0.151)	0.460*** (0.151)	0.515*** (0.122)	0.534*** (0.127)	0.533*** (0.126)	0.517*** (0.0976)	0.531*** (0.0998)	0.529*** (0.0996)
Density (Log)			-3.068*** (0.412)	-2.857*** (0.482)	-2.860*** (0.484)	-1.711*** (0.378)	-1.541*** (0.390)	-1.565*** (0.386)	-1.473*** (0.287)	-1.337*** (0.306)	-1.371*** (0.306)
Sq Density (Log)			0.245*** (0.0287)	0.230*** (0.0342)	0.230*** (0.0343)	0.126*** (0.0250)	0.114*** (0.0258)	0.116*** (0.0256)	0.109*** (0.0191)	0.0994*** (0.0204)	0.102*** (0.0205)
Properties (Log)						0.993*** (0.0239)	0.987*** (0.0283)	0.991*** (0.0282)	0.984*** (0.0208)	0.980*** (0.0244)	0.983*** (0.0242)
% Treated 3-6						0.00311*** (0.00101)	0.00281*** (0.00102)	0.00275*** (0.00101)			
Average Treatment Comp.									0.371*** (0.0726)	0.351*** (0.0762)	0.351*** (0.0743)
Constant	0.0143 (0.0369)	3.289* (1.969)	5.777*** (1.274)	5.039*** (1.567)	8.842*** (1.972)	-1.273 (1.236)	-1.679 (1.328)	2.457 (1.890)	-2.267** (0.988)	-2.586** (1.099)	1.579 (1.755)
Observations	124	124	124	124	124	124	124	124	124	124	124
Overall R2	0.000287	1.92e-05	0.968	0.967	0.967	0.978	0.978	0.978	0.979	0.980	0.980

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

We have also considered the materiality of the effect on Ofwat's cost modelling that comes from omitting this factor. We have used the coefficients estimated in Table 3.2 (models 2a, 3a and 4a in place of 2, 3 and 4) to quantify the change in allowances over the next AMP due to all companies' reducing leakage by 15 per cent below current levels. When averaged across all companies, we estimate that botex allowances would increase by £647 million (around 4 per cent) over AMP7 if Ofwat were to control for cost increases resulting from 15 per cent leakage reduction.

The analysis shown above is not sufficient to prove that this particular variable (the difference between SELL and actual leakage) should be included in Ofwat's econometric models. For instance, the inclusion of this variable would ideally require Ofwat to re-examine other choices it made during its model selection process. There may also be other measures of leakage reduction that would yield more robust models. Before these results were used for setting allowances, it would also be important to cross check the coefficient estimates against other sources that have sought to estimate the marginal cost of leakage reduction.

Nonetheless, the calculations shown above demonstrate the importance of companies' level of leakage reduction in driving their efficient costs. Hence, the use of models that omit this factor to set base allowances cannot capture the expenditure required for companies to further reduce leakage over the next AMP. Addressing this limitation of Ofwat's existing base expenditure modelling could be achieved through adjustments to this modelling, or through other changes to the price control such as allowing enhancement expenditure to fund leakage reduction or through additional financial incentives to remunerate leakage reduction (see Section 6).

3.6. Conclusion

It may be intuitively appealing for Ofwat to argue that companies have been reducing leakage in recent years, so base allowances calibrated to historical levels of expenditure must necessarily fund ongoing leakage reduction. However, as explained in Section 3.3, this statement rests on assumptions that do not hold in reality.

It is correct that some companies have reduced leakage during the historical period over which Ofwat calibrated its econometric models. Also, cost targets established through comparative benchmarking may (to some extent) identify the level of leakage expenditure required to minimise water companies' costs.

However, the econometric modelling performed to set base allowances has a number of limitations that mean it will not identify the level of expenditure required to achieve leakage targets set over the next AMP. They do not identify how the optimal level of leakage varies over companies, they may be distorted by variation in companies' historical investment cycles, and they do not capture the required increase in leakage reduction activity by the industry over the next AMP.

We have conducted empirical analysis that supports these arguments, demonstrating that controlling for differences between companies' actual leakage and SELL has a statistically significant impact on companies' costs.

We have also shown that the marginal cost of leakage reduction rises as companies reduce leakage to lower levels than observed historically, which is another factor not accounted for by Ofwat's base expenditure modelling.

We therefore conclude that base expenditure forecasts generated from Ofwat's models will systematically understate companies' investment requirements in a period in which companies are accelerating the rate of leakage reduction, as they will not capture the required step-change in companies' leakage reduction expenditure.

A possible solution to this problem could lie in adjusting the modelling procedure used to set base allowances, though we do not necessarily advocate the particular changes in base expenditure models presented in Section 3.5. Alternatively, as discussed in the following chapters, Ofwat could adjust its assessment of companies' claims for enhancement expenditure related to leakage reduction.

4. The Need for Allowed Enhancement Expenditure to Fund Leakage Reduction

As demonstrated in Chapter 3, Ofwat’s base allowances do not provide adequate funding for companies to finance their efficient costs of delivering UQ leakage levels nor meeting the proposed leakage reduction target. Despite this, Ofwat has rejected 7 companies’ proposed enhancement expenditure for leakage reduction, while allowing some funding for 10 companies to reduce leakage at an allowed unit cost.⁵⁷

To ensure companies can fund the efficient costs of achieving Ofwat’s leakage reduction target, it will be necessary to allow them some enhancement expenditure. Indeed, it is common regulatory practice to allow for additional funding when regulated companies are asked to deliver investment programmes which would not be required to minimise costs and go beyond the levels of investment that have been required in the past.

4.1. Ofwat’s Proposals to Partially Fund Leakage Reduction through Enhancement Expenditure

4.1.1. Ofwat only allows part of companies’ requests for enhancement expenditure

As stated above, Ofwat approved partial enhancement expenditure for leakage reduction for 10 firms at PR19. The partial funding is conditional on passing one of two tests:

- Test A: Does the company forecast leakage reduction in excess of the 15 per cent recommended target, but not in the UQ of companies when ranked according to the leakage reduction targets in their business plans?
- Test B: Will the company be in the UQ by 2024-25 (again, when ranked according to the leakage reduction targets in their business plans), in both normalised measures of leakage: per km of main and per property?

Ofwat allows enhancement expenditure for companies passing Test A or B, with funding determined by an allowed unit cost multiplied by a funded volume of leakage reduction. The allowed unit cost is equal to the minimum of the industry forecast median unit cost (£1.6m/MI/d) or the company’s proposed unit cost. The funded volume of leakage reduction is set as:

1. All leakage reduction *beyond 15 per cent*, if the company passes Test A;
2. All leakage reduction *beyond the UQ level*, if the company passes Test B; or
3. The maximum of (1) and (2), if the company passes both tests.

4.1.2. Ofwat’s “gated” approach is inconsistent with its base allowances, which do not fund leakage reduction

As set out in Section 4.1.1, Ofwat applies a “gated” assessment of companies’ requests for additional leakage funding. Specifically, companies only receive funding for their enhancement required to reduce leakage beyond the 15 per cent target and/or the upper

⁵⁷ Ofwat (January 2019), Supply-demand balance enhancement: Feeder model summaries, page. 12.

quartile. This approach is inconsistent with the methods it has used to set base allowances. As demonstrated in Section 3, which shows that Ofwat’s models are only likely to provide companies with allowances for maintaining the rate of leakage reduction achieved over the modelling period, which as Figure 3.3 shows, has been close to zero.

As such, for companies to fund an accelerated rate of leakage reduction, some additional allowances above the those provided by Ofwat’s base expenditure modelling will be required. This need for additional funding is not recognised by Ofwat’s decision only to fund the leakage reduction above 15 per cent target and/or the upper quartile through allowed enhancement.

4.2. Regulatory Precedent on Funding New Performance Targets

In its IAP, Ofwat has allowed for additional “reasonable” funding requests by companies, both to base allowances and enhancement expenditure, to deliver levels of service beyond what was required in the past. This includes, for instance, additional allowances for some water companies to accommodate more demanding safety regulations (e.g. Dŵr Cymru and Hafren Dyfrdwy) or customer expectations (e.g. South Staff Water).⁵⁸ Failure to follow the same approach for leakage therefore appears inconsistent with Ofwat’s broader approach at PR19 and regulatory practice in the UK.

More broadly across the regulated industries, there are a number of precedents of regulated companies being asked to meet new requirements imposed on them by regulators, in a similar way to Ofwat’s requirement for faster leakage reduction, in areas that require investment that would not form part of an efficient (i.e. least-cost) solution in order to provide improved outcomes. In such cases, and in contrast to Ofwat’s proposed approach to leakage reduction, regulators have made specific allowances to fund the investments required to meet such new targets.

4.2.1. At PR14 Ofwat’s “cap and collar” system remunerated companies for reducing leakage beyond targets reflecting SELL

At PR14, Ofwat provided additional funding for leakage reduction beyond companies’ PCs (referred to as stretching performance improvements beyond commitments) through ODIs providing financial rewards for “delivering stretching performance improvements beyond commitments”.⁵⁹

The companies’ commitments themselves were set to reflect SELL. Ofwat stated that the threshold for receiving additional funding for leakage reduction was in line with companies’ SELL and regional conditions affecting leakage reduction. The PC on leakage reduction was not subject to UQ benchmarking at PR14. Instead, Ofwat accepted the leakage reduction targets “because companies’ proposals on leakage aligned with the sustainable economic

⁵⁸ NERA analysis of Ofwat’s Cost adjustment claim feeder models for each company.

⁵⁹ Ofwat (December 2014), Setting price controls for 2015-20, Final price control determination notice: policy chapter A2 - outcomes, page. 21.

level of leakage (SELL) and local issues (such as availability of water resources and statutory abstraction reductions) significantly influence the SELL”.⁶⁰

Specifically, companies committed to reduce leakage by 158 MI/d (a 5 per cent reduction in leakage) at PR14. In contrast, Ofwat’s new leakage reduction standard has led to companies to propose a 489 MI/d reduction in leakage during AMP7, a 16.3 per cent reduction over the period and a 209 per cent increase in the leakage reduction commitment compared to PR14.

Hence, at PR14 Ofwat provided funding for companies going beyond SELL, via payment for outperformance on ODIs. By contrast, Ofwat’s IAP has set more demanding targets than SELL, and provided no funding that allows companies to bridge the gap between SELL and the proposed targets.

4.2.2. Ofgem has allowed replacement expenditure at RIIO-GD1 to fund replacement of iron mains to achieve higher safety outcomes

Gas Distribution Networks (GDNs) are obliged to follow the Health and Safety Executive’s (HSE) iron mains replacement programme to reduce the risk of leakage, which require decommissioning of all iron mains within 30 metres of a building by 2032. In essence, this programme requires GDNs to provide a higher level of safety outcomes.

As part of its RIIO-GD1 determination, Ofgem has put in place a number of mechanisms to ensure GDNs can fund the efficient costs of iron mains replacement, which would not be required solely to minimise the costs of gas distribution. For instance, it included a cost driver reflecting repex workload, and made specific allowances for funding investment requirements over the control period estimated using unit costs differentiated by iron main type.⁶¹

Ofgem’s approach to funding GDNs’ repex programmes to meet the HSE’s targets is analogous to the challenge Ofwat faces when funding water companies’ leakage reduction beyond SELL. The HSE requirement was a regulatory mandate to achieve certain targets that were not least-cost for the GDNs. Similarly, Ofwat’s specific leakage reduction recommendations at PR19 require companies to be ambitious, setting leakage reduction targets beyond the most ambitious company at PR14. This requires companies to provide levels of investment beyond the least-cost option.

4.2.3. At RIIO-ED1, Ofgem also recognised the need to fund investments to provide improved outputs outside of base allowances

Ofgem has faced a similar challenge in the electricity distribution industry. Similar to the iron mains replacement in gas, Ofgem also recognised a mandate on Distribution Network Operators (DNOs) to conduct a large volume of safety-related work that would not have been

⁶⁰ Ofwat (December 2014), Setting price controls for 2015-20, Final price control determination notice: policy chapter A2 - outcomes, page. 21.

⁶¹ Ofwat included a “bottom-up” repex analysis which regressed repex workload on repex for all types of mains. Only repex, which did not have a sensible cost driver were excluded from the analysis.

Ofwat (17 December 2012), RIIO-GD1: Final Proposals – Supporting document - Cost efficiency, page 27, 52 and 91.

least-cost for the companies due to the Electricity Safety, Quality and Continuity Regulations (ESQCR) requirements.

These regulations required DNOs to incur maintenance and replacement expenditure to meet new standards. Ofgem required DNOs to submit costs for each maintenance activity category, accepted the volumes and remunerated DNOs by multiplying these volumes by an allowed unit cost.⁶² Ofgem remunerated efforts to comply with ESQCR using as unit cost the industry median (at each relevant voltage level) over 13 years (including therefore both historical and forecast unit costs).⁶³

Ofgem also sought to ensure consistency between its outcome targets and its cost assessment. For instance, for its “secondary deliverables targets”, which concerns the health, criticality and risks of network assets,⁶⁴ Ofgem cross-checked its cost assessment modelling results, and made qualitative adjustments to its targets where appropriate to ensure companies were only obliged to deliver the level of service for which they were remunerated under the price control.⁶⁵

4.3. Conclusion

From the discussion above in Chapter 3, we concluded that Ofwat’s methods for setting base allowances do not fund the expenditure required to achieve its stretching leakage reduction targets. As discussed in this chapter, Ofwat’s decision not to provide companies with allowances for enhancement to bridge the gap between SELL and its “stretched” leakage targets means that the funding package as a whole does not fund achievement of the leakage reduction targets. In essence, there is an inconsistency between Ofwat’s cost allowances (both base allowances and enhancement) and its targets.

By contrast, there was no such inconsistency in Ofwat’s approach at PR14, as PCs for leakage reduction were set to reflect local conditions affecting leakage/SELL, with funding for companies stretching their performance beyond the PCs coming through ODIs. As discussed above, past regulatory determinations by Ofgem have also allowed companies to recover the costs of new regulatory requirements that trigger significant investment.

Change to Ofwat’s funding package for leakage reduction is therefore required. One option would be to develop its cost assessment modelling tools, so that companies’ base allowances better-reflect the growing need for work to reduce leakage. Alternatively, Ofwat could revise its “gated” approach to allowing companies’ claims for enhancement expenditure to reduce

⁶² Ofgem (28 November 2014), RIIO-ED1: Final determinations for the slow track electricity distribution companies Business plan expenditure assessment, page. 86-87.

⁶³ Ofgem (28 November 2014), RIIO-ED1: Final determinations for the slow track electricity distribution companies Business plan expenditure assessment, page. 35.

⁶⁴ Secondary Deliverables targets relate to asset health, criticality and risk, and were defined for the RIIO-ED1 period in Standard Condition 51 (Network Asset Indices Methodology) of the electricity distribution licence. Ofgem (18 June 2015), RIIO-ED1 regulatory instructions and guidance: Annex A – Glossary, page 119.

⁶⁵ Ofgem cross-checked its modelling results using “against historical and forecast information, condition information contained in the secondary deliverables for asset health and criticality, scheme papers and other justification”.

Ofgem (28 November 2014), RIIO-ED1: Final determinations for the slow track electricity distribution companies Business plan expenditure assessment, page. 29.

leakage in a way that provides funding for them to bridge the gap between their proposed PCs and the levels of leakage reduction activity conducted historically.

5. Ofwat's Allowed Unit Costs of Leakage Reduction

As discussed in Chapter 2, Ofwat sets a constant unit cost for leakage reduction beyond either 15 per cent leakage reduction, or the UQ level of leakage reduction.

This chapter assesses whether Ofwat's method of setting unit cost is consistent with the need for efficiently operated companies to fund their leakage reduction targets. We also consider whether Ofwat's approach provides incentives for water companies to reduce leakage efficiently.

5.1. Ofwat's Allowed Unit Costs of Leakage Reduction

Ofwat has set the allowed unit cost of leakage reduction that applies to allowed enhancement expenditure using the marginal costs from its Supply-Demand Balance (SDB) enhancement modelling and companies' proposed ODI incentive rates. The proposed allowed unit cost is £1.6m/MI/d, and is the average of:⁶⁶

- median leakage unit costs derived from the PR19 SDB enhancement analysis;
- median incentive rate for underperformance reported in companies' business plans; and
- median incentive rate for outperformance reported in companies' business plans.

5.2. Accounting for the Increasing Marginal Cost of Leakage Reduction

5.2.1. Ofwat's approach fails to account for the increasing marginal cost of leakage reduction

Ofwat's approach fails to consider that the marginal cost of leakage reduction potentially increases, as companies reduce leakage. As mentioned in Section 3.4.3 above, historically, companies may have reduced their leakage by "picking the lowest-hanging fruit" to achieve their leakage reduction targets.

However, as evidence in Figure 3.4 above shows, more demanding leakage reduction targets are associated with higher marginal costs related to the more expensive leakage reduction solutions companies must deploy. Hence, requiring companies to meet more ambitious targets will increase the marginal cost of reducing leakage.

As we explain in Section 3.4.3, Ofwat's approach of allowing enhancement expenditure based on a single median unit cost across the industry fails to capture any potential variation across companies' marginal costs because of differences in the costs companies face to reduce leakage, and the level of leakage reduction efforts conducted historically.

5.2.2. A solution is to link allowed unit costs to a modelled estimate that controls for differences between companies

It is therefore important that, in order to fund the efficient costs of leakage reduction through enhancement, Ofwat sets unit costs in a way that addresses the factors causing unit costs to vary across companies. In particular, to address the tendency for the marginal cost of leakage

⁶⁶ Ofwat (January 2019), Supply-demand balance enhancement: Feeder model summaries, page. 15.

reduction to rise as leakage falls, and for the costs of leakage reduction to vary across companies for other reasons related to network characteristics, Ofwat could consider developing a targeted, disaggregated model of leakage reduction costs. Such a model would, for instance, link allowed unit costs of leakage reduction to an increasing function of companies' leakage reduction performance capturing both the rate and speed of change of companies' unit costs, and possibly control for other external factors.

5.3. Impact on Companies Incentives for Efficient Leakage Reduction

5.3.1. Ofwat's approach may undermine companies' incentives to reduce leakage at least-cost

Setting targets at the minimum of company's *proposed* unit costs and the industry median is likely to affect incentives for cost reduction detrimentally, as companies achieving the median do not benefit from doing so in terms of higher allowances. Firms with median or lower unit costs of leakage reduction do not benefit from being more efficient, beyond the totex sharing factor at the end of the relevant AMP. There is no additional benefit for a company to reduce its unit cost beyond the median (e.g. reducing a unit cost of £1.6m/MI/d to £1.4m/MI/d). Hence, under this structure companies do not have an incentive to improve their unit cost of leakage reduction to achieve industry median or lower unit costs.

This problem also could be addressed by setting all companies' allowed enhancement based on a unit cost predicted by a targeted leakage reduction unit cost model, as suggested in Section 5.2.2.

5.3.2. Ofwat's rationale for using out/under-performance unit rates is not justified

As explained above, Ofwat used leakage ODI outperformance and underperformance rates in setting the allowed unit costs for leakage reduction. For the reasons set out below, this approach is unlikely to produce an accurate estimate of the marginal cost companies face to reduce leakage.

In its final methodology, Ofwat presents companies with a series of options for how they should calculate their ODI incentive rates.⁶⁷ Ofwat states companies can use the incentive rate formulas used at PR14:⁶⁸

$$\text{ODI(underperformance)} = \text{Incremental benefit} - (\text{incremental cost} \times p)$$

$$\text{ODI(outperformance)} = \text{Incremental benefit} \times (1 - p)$$

Where 'p' is the customer share of totex outperformance (50%). Ofwat also stated that companies could use other customer evidence to propose changes to the ODI outperformance

⁶⁷ Ofwat, *Delivering Water 2020: Our methodology for the 2019 price review*. Appendix 2: Delivering outcomes for customers, p. 90-91.

⁶⁸ Ofwat, *Delivering Water 2020: Our methodology for the 2019 price review*. Appendix 2: Delivering outcomes for customers, p. 91.

and underperformance payment rates calculated according to the existing formulas, “provided the changes are well justified”.⁶⁹

From reviewing Ofwat’s IAP documents, we understand that most companies have based their incentive rates on Ofwat’s standard formula, meaning that underperformance incentive rates are based on a combination of marginal costs and marginal benefits, and outperformance incentives are based on marginal benefits.

The first problem with Ofwat’s use of these ODI rates is that both outperformance and underperformance incentive rates discount the proportion of out/underperformance which is shared with consumers (i.e. ‘p’ in the formulas above). It is not appropriate to discount the customer share when applying these rates to enhancement expenditure, since allowances for enhancement expenditure are subject to the totex outperformance sharing mechanism as a component of controllable totex.

Further, Ofwat incorrectly uses incentive rates which take account of marginal benefits as well as marginal costs, and, in the case of the outperformance formula, Ofwat takes account only of marginal benefits, such as marginal willingness to pay, and not marginal costs.

Ofwat does not explain its rationale for using the outperformance incentive rate as a proxy for the marginal cost of reducing leakage, although in its outcomes methodology, Ofwat explains that in its outperformance formula, it effectively assumes that incremental cost is equal to marginal benefit.⁷⁰ However, Ofwat goes on to explain that while this assumption is appropriate for setting an incentive rate for performance above a PC, it is not likely to hold in practice. Ofwat states that assuming marginal cost equals marginal benefit “allows for the fact that in reality a company is only likely to outperform its performance commitment if it reduces its marginal cost”, but that “typically you would expect beyond the performance commitment for marginal cost > marginal benefit”. In other words, since Ofwat explains that marginal benefits are likely to be less than marginal costs, it is inconsistent for Ofwat to use marginal benefits as an estimate of the efficient unit costs of leakage reduction.

Finally, while Ofwat states that it has taken incentive rates directly from companies’ business plan data tables, for some companies we have been unable to reconcile the “leakage under/out performance unit rates” which Ofwat has reported in its calculation of unit costs, with the data in companies’ business plan data tables. For instance, United Utilities and Yorkshire Water’s business plan Data Table reports different incentive rates for its leakage ODI to those which Ofwat reports in its “Supply demand balance enhancement feeder model”.

5.4. Conclusion

Ofwat has set the allowed unit cost of leakage reduction that applies to allowed enhancement expenditure through its SDB enhancement modelling that uses data from companies’ business plans. The allowed unit cost at PR19 is £1.6m/MI/d and reflects an average of

⁶⁹ Ofwat (January 2019), PR19 initial assessment of plans, Technical appendix 1: Delivering outcomes for Customers, p. 9.

⁷⁰ Ofwat, Delivering Water 2020: Our methodology for the 2019 price review. Appendix 2: Delivering outcomes for customers, p. 92.

median of unit costs submitted by companies and ODI incentive rates. Ofwat's approach is flawed for several reasons.

First, Ofwat's approach of allowing enhancement expenditure based on a single median unit cost across the industry fails to capture any potential variation across companies' marginal costs because of differences in the costs companies face to reduce leakage, and the level of leakage reduction efforts conducted historically. It also fails to capture the tendency of unit costs to be higher when companies maintain or attain lower levels of leakage.

Secondly, setting targets at the minimum of company's *proposed* unit costs and the industry median is likely to affect incentives for cost reduction detrimentally, as companies achieving the median do not benefit from doing so in terms of higher allowances. Hence, Ofwat's approach may undermine companies' incentives to reduce leakage at least-cost.

Also, Ofwat's rationale for using ODI out/under-performance rates to set allowed unit costs for leakage reduction is not well-justified and unlikely to produce an accurate estimate of the marginal cost companies face to reduce leakage. The ODI underperformance formula takes into account both marginal benefits as well as marginal costs, and the ODI outperformance formula only accounts for marginal benefits. However, Ofwat itself notes that beyond the performance commitments marginal benefits are likely to be less than marginal costs. It is therefore inconsistent for Ofwat to use marginal benefits as an estimate of the efficient unit costs of leakage reduction.

Finally, ODI outperformance and underperformance incentive rates discount the proportion of out/underperformance which is shared with consumers. It is however not appropriate to discount the customer share when applying these rates to enhancement expenditure, since allowances for enhancement expenditure are subject to the totex outperformance sharing mechanism as a component of controllable totex.

It is therefore important that, in order to fund the efficient costs of leakage reduction through enhancement, Ofwat sets unit costs in a way that addresses the factors causing unit costs to vary across companies.

To address the tendency for the marginal cost of leakage reduction to rise as leakage falls, and for the costs of leakage reduction to vary across companies for other reasons related to network characteristics, Ofwat could consider developing a targeted, disaggregated model of leakage reduction costs. Such a model would, for instance, link the allowed unit costs of leakage reduction to an increasing function of companies' leakage reduction performance capturing both the rate and speed of change of companies' unit costs, and possibly control for other external factors.

6. Conclusions and Recommendations

For PR19, Ofwat expects companies to target more stretching levels of leakage reduction than they have achieved historically, which targets a level of leakage reduction that requires additional expenditure by the industry to achieve.

Despite requiring companies to enhance their leakage reduction efforts, Ofwat has disallowed many companies' requests for enhancement expenditure, funding leakage reduction that does beyond a defined target. Ofwat has not allowed any enhancement expenditure to bridge the gap between current levels of leakage reduction and the target. By disallowing this enhancement expenditure, Ofwat relies on companies' ability to fund leakage reduction through their base cost allowances,⁷¹ stating that “[c]ustomers should not pay extra costs for companies to deliver stretching targets” for leakage reduction.⁷²

This aspiration, that companies should fund higher levels of service that require rising expenditure without funding for enhancement represents wishful thinking by Ofwat.

Leakage reduction is a material expense that companies need to fund. Indeed, our own empirical analysis supports these arguments, demonstrating that controlling for differences between companies' actual leakage and SELL has a statistically significant impact on companies' costs.

Ofwat's methods for setting base allowances do not fund the expenditure required to achieve its stretching leakage reduction targets. These will allow companies to fund a level of leakage reduction effort commensurate with the levels of leakage reduction achieved during the historical modeling period. Because average industry leakage reduction over this period was low on average, Ofwat's base allowances are unlikely to fund any material leakage reduction work at all.

As such, by only allowing enhancement expenditure for leakage reduction when companies exceed a target that itself exceeds the levels of leakage reduction achieved historically, Ofwat's funding package for leakage reduction is inconsistent with its targets.

By contrast, there was no such inconsistency in Ofwat's approach at PR14, as PCs for leakage reduction were set to reflect local conditions affecting leakage/SELL, with funding for companies stretching their performance beyond the PCs coming through ODIs. As discussed above, past regulatory determinations by Ofgem have also allowed companies to recover the costs of new regulatory requirements that trigger significant investment.

Change to Ofwat's funding package for leakage reduction is therefore required. One option would be to develop its cost assessment modelling tools, so that companies' base allowances better-reflect the growing need for work to reduce leakage. Alternatively, Ofwat could revise its “gated” approach to allowing companies' claims for enhancement expenditure to reduce leakage in a way that provides funding for them to bridge the gap between their proposed PCs and the levels of leakage reduction activity conducted historically.

⁷¹ Ofwat rejected enhancement expenditure for reducing leakage for Bristol Water, SES, Severn Trent, South East Water, South West Water, Southern Water, Wessex Water, Yorkshire Water. Source: Ofwat (2019), Action summary tables for each affected company.

⁷² Ofwat (January 2019), PR19 initial assessment of plans, Technical appendix 2: Securing cost efficiency, page. 18.

We have also shown that the marginal cost of leakage reduction rises as companies reduce leakage to lower levels than observed historically, which is another factor not accounted for by Ofwat's base expenditure modelling, or its allowances for enhancement expenditure for companies exceeding the target. We have also identified a number of other problems with the way Ofwat set its allowed unit costs, specifically related to the way it combined unit costs from its SDB modelling with information from companies' ODI incentive rates.

A possible solution to this problem could lie in modelling more thoroughly the unit cost of leakage reduction, as a function of the levels of leakage reduction companies target and other factors influencing the cost of leakage reduction. Essentially, we recommend that Ofwat considers improving on its approach of basing allowances on proposed ODI rates (which are in any event inappropriate as a guide to the cost of leakage reduction) and industry median unit costs.

Appendix A. Regression Analysis of Unit Costs and Leakage Reduction Targets

Table A.1 below set out the results of our regression analysis of the unit costs of leakage reduction in £m/MI/day on the level of leakage targeted at the end of the AMP across all companies, excluding Thames Water.⁷³ We used the following variables:

- Regression 1, 2 and 3 rely on forecast leakage at the end of the AMP7 (i.e., 2024-25), measured in l/prop/day (“F_leakage_prop_2425”) and m3/km/d (“F_leakage_km_2425”) and a cross-product term (“F_product_2425”).
- Regression 4, 5 and 6 rely on forecast 3-year average leakage positions in 2024-25 that companies have provided as part of their common performance commitments, measured in l/prop/day (“F_leakage_prop_avg”) and m3/km/d (“F_leakage_km_avg”) and a cross-product term (“F_product_avg”).
- All regression models use unit cost (£m/MI/day) as dependent variable.

Table A.1: Regression Analysis Results

Variables	(1)	(2)	(3)	(4)	(5)	(6)
F_leakage_km_2425	-0.549** (0.223)					
F_leakage_prop_2425		-0.0465* (0.0243)				
F_product_2425			-0.00436** (0.00167)			
F_leakage_km_avg				-0.519** (0.209)		
F_leakage_prop_avg					-0.0440* (0.0227)	
F_product_avg						- 0.00377** (0.00148)
Constant	5.317*** (1.417)	5.742** (2.032)	4.194*** (0.934)			
Observations	14	14	14	14	14	14
R-square	0.337	0.234	0.361	0.339	0.238	0.351

Note: Standard errors in parentheses: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Source: NERA analysis of Ofwat data.

⁷³ Data on unit costs for leakage reduction for HDD and NES is not available. We have therefore only included companies in the sample for which both unit cost and leakage data is available in the public domain.

Qualifications, assumptions and limiting conditions

NERA Economic Consulting (“NERA”) was commissioned by SES Water to analyse proposals published by Ofwat for the funding of leakage reduction as part of the PR19 price control review process. The primary audience for this report includes Ofwat and other parties with an interest in the water industry.

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