NERA
ECONOMIC CONSULTING

Reviewing the Current Household Metered Tariff Structure

Prepared for Southern Water

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Executive Summary

Overview of Our Assignment

Currently, the majority of Southern Water's household tariffs are structured with a standing charge, and a flat volumetric rate per cubic meter of water consumed. Following Southern Water's universal metering programme, the large majority of household customers pay this charge, rather than paying fixed charges per unit of rateable value, as would have been the case previously.

Switching to (near) universal metering brings a number of operational benefits, most notably through the incentives to avoid wasteful consumption that come from customers facing a volumetric tariff rather than a fixed price. However, while universal metering tends to facilitate bill collection, some customers may struggle to pay their water bills under this tariff structure. It may therefore deter less affluent customers from consuming water for all but essential purposes.

At the same time, recognising that the South East of England is a water-stressed region, the current tariff structure provides more affluent customers with very limited incentives to moderate their consumption for less essential applications like garden watering, swimming pools, and garden ponds.

These concerns are leading Southern Water to consider a more progressive charging structure, whereby the total water bill paid by customers could increase with the volume consumed to a greater extent than under the existing approach. A more progressive tariff structure could also help Southern Water to achieve its Target 100 programme of reducing average per capita consumption to 100 litres per person per day.

Southern Water has commissioned NERA Economic Consulting (NERA) to review its current household tariff methodology, and suggest improvements that could make it more progressive.

Tariff Design Criteria

Any change in tariff structure would need to be justified on grounds of cost-reflectivity, because Ofwat's Charges Scheme Rules require charges to reasonably reflect the costs imposed by different classes of customers. While this precludes a tariff structure that is expressly linked to customers' ability to pay for water, there are a range of tariff models identified in the economic literature and global experience of utility regulation that could be both feasible to implement and more progressive.

We have therefore considered in this review tariff design criteria that (a) adhere to Ofwat's Charges Scheme Rules, and (b) reflect economic literature on best practice in tariff design. These criteria include: ensuring that the tariff reflects costs, ensuring recovery of the revenue requirement, fairness, objectivity, and equity, stability and predictability, and practicality.

Assessment of the Current Tariff

Under Southern Water's current tariff structure, the company offers three different types of charge, applying to both water and wastewater customers and depending on whether the property in question has a meter or not. The majority of Southern Water's customers have

meters installed at their properties. They pay a measured charge, which includes a standing charge and a flat volumetric rate per cubic meter of water consumed.

Southern Water's current tariff methodology recovers the large majority of its costs – its wholesale water costs – through a tariff per cubic meter of consumption, reflecting the underlying assumption that wholesale water costs are entirely related to the volume of consumption. Southern Water collects its retail costs through a standing charge, on the basis that these costs are driven by the number of customers served, and are therefore invariant to consumption levels. In addition, Southern Water also recovers the cost of cross subsidising some vulnerable groups through the WaterSure and Essentials tariff schemes through its standing charge. The amount of cross-subsidy per customer is derived from Southern Water's willingness to pay research.

Ofwat's Charges Scheme Rules require charges to reasonably reflect the costs imposed by different classes of customers. Southern Water's existing tariff design appears to be (a) cost-reflective, since the underlying assumptions on cost structure reflected in the tariff are reasonable, and (b) fair, in the sense that all customers pay a tariff set in a similar way and face the same per unit charge. Hence, Southern Water's existing tariff design appears consistent with Ofwat's Charges Scheme Rules.

However, we believe there are potential improvements to Southern Water's tariff structure that would (a) meet Ofwat's criteria at least as well as the current methodology; and (b) make the tariff design more progressive.

Potential Improvements to the Current Tariff

The potential to improve efficiency of water use through better aligning the tariff structure with Southern Water's cost drivers

The current tariff structure assumes that the wholesale cost of serving customers' demands for water scale in proportion to the volume they consume; this is unlikely to reflect accurately the drivers of Southern Water's wholesale costs.

It is therefore likely that the current tariff design could be made more cost reflective if some of the wholesale price control were recovered through billing determinants other than volume of supply, such as per customer charges or billing determinants measuring customers' contributions to Southern Water's peak demand.

Considering the use of marginal cost pricing

As well as better aligning tariff structure with cost drivers, we consider there may also be benefits – in terms of encouraging Southern Water's customers to consume a more economically efficient amount of water than Southern Water's current approach – from introducing a long-run marginal cost (LRMC) pricing approach. A marginal cost based methodology could send signals to customers regarding the value that their efforts to save water generate, or their decisions to consume more water impose.

Using information from Southern Water's 2019 Water Resource Management Plan (WRMP19) on a list of preferred options for the company to meet expected water demand, including the costs of water abstraction, treatment, distribution costs as well as carbon costs

and assumed costs associated with other externalities, we have prepared an approximate estimate of Southern Water's LRMC.

The results shows that the LRMC is below Southern Water's current volumetric tariff of £1.55 per cubic metre. This result suggests on the face of it that restructuring tariffs to lower the volumetric tariff would improve the efficiency of consumption decisions, but whether this makes the tariff more progressive (or indeed more efficient overall) would depend on the methods used to recover the remaining "residual" costs not recovered through a lower volumetric tariff.

We have investigated different approaches that Southern Water could consider to recovering these residual costs (i.e. the difference between its revenue requirement and the revenue yielded by tariffs equal to LRMC) against relevant tariff design criteria, including the assessing whether these alternatives would make the tariff structure more progressive.

Recovering residual costs by applying mark-ups to summer tariffs best achieves cost-reflective and more progressive tariffs

We considered the following options for the recovery of residual costs: (a) an uplift of the standing charge, (b) a time-of-use tariff with a higher volumetric charge for the peak summer period, and (c) a rising block tariff structure.

Adopting LRMC pricing and recovering the residual costs through higher standing charges results in higher bills for customers with lower water consumption per year relative to the current tariff structure. As a result, this leads to a less progressive tariff structure. Given Southern Water is seeking to make its tariff structure more progressive to promote fairness, this option therefore appears to perform poorly against the fairness tariff design criterion.

We also consider it would also not be cost-reflective to apply our estimate of LRMC to set Southern Water's volumetric charge while recovering the remaining residual costs from a standing charge, principally because of limitations in how we have estimated Southern Water's LRMC in this case. In particular:

- Our estimated LRMC is potentially an understatement of the LRMC of serving higher water demand in the summer, as we have estimated it on the simplified assumption that supply volumes are flat throughout the year:
  - While water demand at any time of the year can affect the costs of maintaining the supply-demand balance, we also understand that some water resource costs are incurred to ensure the company can meet peak demand during the summer when Southern Water's daily Distribution Input (DI) tends to be highest. Hence, a tariff seeking to reflect the LRMC of water supply should ideally reflect this by being higher in the summer peak than in the rest of the year. A more detailed LRMC analysis would be needed to assess the appropriate seasonal spread in LRMC more accurately.
  - Therefore, the revenue recovered through an LRMC-based charge that peaks in the summer and is lower in the winter would likely yield more revenue than applying an LRMC-based charge (e.g. using our simplified estimate) that is flat all year.[1] Hence,

[1] This is simply because demand is higher in the summer than the winter, so the higher charge would be levied on higher demand.

applying our simplified estimate would result in residual costs that are exaggerated compared to a tariff design better reflected seasonal variation in Southern Water's LRMC.

- Our estimate of Southern Water's LRMC is based on its water resource scheme costs, which do not include the costs of the distribution network:
  - We understand that a high proportion of distribution network expansion costs are paid for directly by developers, and Southern Water is not currently planning significant investments to expand distribution network capacity. Nonetheless, it is possible that – in the long-term – rising demand would drive the need for more distribution network capacity, and lower demand would allow Southern Water to replace existing assets with smaller ones when they reach the end of their lives. Indeed, we understand Southern Water's water distribution network and treatment capacity have been sized historically to meet peak demand requirements.
  - Our existing estimate of LRMC does not reflect the fact that – in the long-term – changes in customers' summer peak demand might alter the distribution network costs Southern Water incurs to meet demand. A more cost-reflective tariff design would therefore likely levy some additional charge on summer demand (i.e. through time-of-use tariff) to reflect the LRMC of distribution network investment, and such distribution network costs are not captured in our existing estimate.

We therefore consider that a summer peaking tariff would be more reflective of Southern Water's LRMC of serving demand. We have therefore considered the effect of applying a tariff design that applies our estimate of LRMC all year round, plus a mark-up in the summer months to recover residual costs.

As well as being more cost reflective than either retaining the current charging approach or applying our estimated LRMC to consumption throughout the year, this tariff design would also be more progressive. By introducing a higher charger during peak months, this tariff is also progressive as it recovers more cost from those customers who use more water for less essential purposes such as garden watering or paddling pools.

However, the introduction of time-of-use tariff relies on the availability of smart meters to record when customers use water, which we understand is not feasible yet. Therefore, an alternative, interim option for Southern Water could be the use of rising block tariffs, where a higher volumetric tariff on consumption above a certain threshold is introduced.

This tariff would be progressive in the sense that it imposes higher tariff levels to recover residual costs only on customers consuming the largest amounts. It could also be more cost-reflective, in the sense that households consuming the highest volume may contribute more to the capital costs of the water system that households that consume less water. However, high occupancy homes could pay more, even if those households had relatively low per capita consumption and/or low incomes. We therefore do not recommend this as an optimal, long-term solution.

Next Steps

As set out above, we consider that the tariff design that best meets the relevant tariff design criteria and would make the tariff more progressive would be to introduce time-of-use

pricing, with a summer-peaking tariff. However, a phased implementation may be required to allow for the installation of smart meters.

For any tariff reform, Southern Water would need to engage with its customers to gather views on alternative tariff structures.

Southern Water would also need to consider the implication for NAVs when revising its tariff structure, as these licensees need to be able to replicate the company's retail tariffs because Ofwat caps NAV's end-user prices in-line with incumbents according to its "no worse off" principle.

1. Introduction

Currently, the majority of Southern Water's household tariffs are structured with a standing charge, and a flat volumetric rate per cubic meter of water consumed. Following Southern Water's universal metering programme, the large majority of household customers pay this charge, rather than paying fixed charges per unit of rateable value, as would have been the case previously.

Switching to (near) universal metering brings a number of operational benefits, most notably through the incentives to avoid wasteful consumption that come from customers facing a volumetric tariff rather than a fixed price. While universal metering tends to facilitate bill collection, some customers may struggle to pay their water bills under this tariff structure. It may therefore deter less affluent customers from consuming water for all but essential purposes.

At the same time, recognizing that the South East of England is a water-stressed region, the current tariff structure provides more affluent customers with very limited incentives to moderate their consumption for less essential applications like garden watering, swimming pools, garden ponds, etc.

These concerns are leading Southern Water to consider a more progressive charging structure, whereby the rate paid by customers could increase with the volume consumed to a greater extent than under the existing approach. A more progressive tariff structure could also help Southern Water to achieve its Target 100 programme of reducing average per capita consumption to 100 litres per person per day.

However, any change in tariff structure would need to be justified on grounds of cost-reflectivity, because Ofwat's Charges Scheme Rules require charges to reasonably reflect the costs imposed by different classes of customers. While this precludes a tariff structure that is expressly linked to customers' ability to pay for water, there are a range of tariff models identified in the economic literature and global experience of utility regulation that could be both feasible to implement and more progressive.

To help achieve this, we have investigated alternative options on the tariff structure in this report. The remainder of this report is structured as follows:

- Section 2 describes Southern Water's current household tariff structures and basis of setting household tariffs;
- Section 3 discusses economic principles defining good tariff design practice and Ofwat's tariff requirements; and
- Section 4 proposes various options for improving the tariff structure.

2. Southern Water's Current Household Tariff Structure

This chapter provides a summary of Southern Water's existing charging scheme for household customers, including the assistance provided to less affluent customers through the "WaterSure" scheme that provides a cap on water bills, as well as the "Essentials" tariff which offers various discounts to standard tariffs.

2.1. Household Water Tariffs

Southern Water provides three charging structures for household tariffs: measured charges that apply to households with water meters installed in their premise and any new water supply provided by Southern Water; assessed measured charges that apply to customers the company could not proactively meter via the universal metering programme; and unmeasured charges that apply to customers who do not have a meter and have not applied to install one. Charging structures for sewerage service charges also vary according to these same categories of customers paying the alternative charging structures for water supply (see Section 2.2).

Most Southern Water's customers pay "measured" charges, which requires the installation of a meter. Because Southern Water's universal metering programme, the measured charges apply for 83 per cent and 88 per cent of Southern Water's water only and dual service customers for the charging year 2022/23, respectively.[2] The charging structure for **measured charges** includes:

- A standing charge that is fixed per customer per year that covers the cost of billing and customer service costs, such as reading the meter, payment collection, and handling customer enquiries; and
- A volumetric charge to be applied to the recorded volume from the meter to recover Southern Water's water resources and water network plus expenditures. Based on Southern Water's tariff model, over 99.998 per cent of measured customers are charged by the standard volumetric charge in the charging year 2022/23. Three bands of variable charges are offered instead to large users based on their corresponding prescribed ranges of annual consumption. Southern Water sets three different bands for customers with annual consumption ranging between 5,000 and 19,999 cubic meters, 20,000 and 99,999, and above 99,999, respectively.[3] These volumetric charges are lower than the standard ones, as Southern Water applies a fixed discount to the three bands identified above, based on non-usage of elements of the local distribution network.[4] A large user also pays an additional fixed charge per year, that differs by consumption band. This is calculated by multiplying the difference between the standard volumetric charge and the variable

[2] Percentages calculated from Southern Water's Tariff Model.

[3] Large user tariff bands are specified in Southern Water's Tariff Model.

[4] Southern Water applies a 10 per cent discount on its standard volumetric charges to large users consuming between 5,000 and 19,999 cubic meters, 15 per cent to those consuming between 20,000 and 99,999 cubic meters, and 25 per cent to those using more than 99,999 cubic meters of water. See Southern Water's Tariff Model.

charge corresponding to the large user's band, i.e. the large user discount, by the volume associated to the lower bound of water consumption within its band.[5]

The **assessed measured charges** apply to customers that the company could not proactively meter via the universal metering programme. The assessed measured charges apply to 16 per cent and 12 per cent of Southern Water's respective water only and dual service customers in 2022/23.[6] The assessed water bills consist of:[7]

- A standing charge that is fixed per customer per year. This is lower than the standing charge for metered customers by a fixed amount set by Southern Water to reflect lower metering costs for the company; and
- An assessed volumetric charge, which is equivalent to the volumetric charge applied to metered customers. Southern Water then assumes different levels of yearly water consumption based on the number of bedrooms in the property, or calculated based on the assumption of single occupancy when the customer is the only resident. Southern Water provides lower assessed measured charges for customers who have access to shared/communal water facilities to reflect their lower expected usage where the payment for supply of water to such shared facilities is payable by a third party.

The **unmeasured charges** apply to customers who do not have a water meter in their properties and have not applied for one. The unmeasured charges apply to a very small number of Southern Water's customers: 0.4 per cent of water only and 0.3 per cent of dual services customers for the charging year 2022/23.[8]

- A standing charge that is fixed per customer per year, and it is equivalent to the one paid by customers paying the assessed measured charge described above; and
- A charge per pound of the rateable value of the property as set on 31 March 1990, or set at the minimum fixed charge when the rateable charge is less than a specified amount or when the property does not have a rateable value. In order to set the minimum fixed charge, Southern Water uses the measured volumetric charge and assumes a yearly household's consumption of 39 cubic meters.[9]

2.2. Sewerage Service Charges

Based on the applicable water supply charging structure to the property, the structure of sewerage service charges also varies. Indeed, there are also three charging structure for Southern Water's sewerage services: measured sewerage charges that apply to households with meters installed in their premise and any new wastewater service provided by Southern Water; assessed measured sewerage charges for those customers who could not be proactively metered by the company via the universal metering programme; unmeasured charges applying to households that do not have meters and have not applied for one.

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5 Therefore, for a large user that is consuming 10,000 cubic meters, Southern Water applies a standing charge, a discounted volumetric charge for users with consumption between 5,000 and 19,999 cubic meters, and an additional fixed charge that is calculated using 5,000 cubic meters of water consumed.

6 Percentages calculated from Southern Water's Tariff Model.

7 Southern Water Household Charges Scheme 2022-23, pp.19-20.

8 Percentages calculated from Southern Water's Tariff Model.

9 Southern Water's Tariff Model.

Most of Southern Water's customers have installed meters and are paying a **measured sewerage charge**, which accounts for 73 per cent of sewerage only and 88 per cent of dual service customers in 2022/23.[10] The measured sewerage charge for 2022/23 can be summarised as follows: [11]

- A standing charge of £21.11 that is fixed per customer per year;
- A fixed highway drainage charge of £10.40 per customer per year;
- A fixed surface water drainage charge where applicable, varying by meter and pipe size;[12] and
- A volumetric wastewater charge that is applied to 92.5 per cent of the water volume recorded by the water meter.[13]
- Southern Water also offer a large user tariff to customers with more than 99,000 cubic meters of foul water drainage per year. The volumetric charge is lower than the standard one, as Southern Water applies a fixed discount. A large user also pays an additional fixed charge per year. This is calculated by multiplying the difference between the standard volumetric charge and the large user variable charge, i.e. the large user discount, by a volume of 99,999 cubic meters.[14]

Approximately 4 per cent of sewerage only customers of Southern Water are paying **assessed measured charges**. The assessed measured charge in 2022/23 consists of: [15]

- A standing charge of £16.96 per customer per year, that is lower than the one paid by metered customers, to reflect lower metering costs;
- A fixed highway drainage charge per customer per year that is equivalent to the one paid by metered customers;
- A single fixed surface water drainage charge where applicable per customer per year;[16] and
- An assessed wastewater charge that is determined by 92.5 per cent of the estimated water volume supplied to the premise.[17] Southern Water provides estimated water consumption volumes based on the number of bedrooms in the property, or calculated based on the assumption of single occupancy when the customer is the only resident.

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10 Percentages calculated from Southern Water's Tariff Model.

11 Southern Water Household Charges Scheme 2022-23, p.17. Values of each charge are taken from Southern Water's tariff model.

12 The surface water charges are cancelled for consumer who established after 1 April 2000 or consumer that establishes to Southern Water's reasonable satisfaction that they are connected for the drainage of foul water only.

13 Adjustments of the volume will be applied if the customer presents evidence that the volume of wastewater discharged from his premises is consistently and significantly less than 92.5 per cent of the volume of water supplied.

14 Southern Water's Tariff Model.

15 Southern Water Household Charges Scheme 2022-23, p.21. Values of each charge are taken from Southern Water's tariff model.

16 The surface water charges are cancelled for consumer who established after 1 April 2000 or consumer that establishes to Southern Water's reasonable satisfaction that they are connected for the drainage of foul water only.

17 Adjustments of the volume will be applied if the customer presents evidence to Southern Water that the volume of wastewater discharged from his premises is consistently and significantly less than 92.5 per cent of the volume of water supplied.

Customers who are paying an **unmeasured sewerage charge** represent only 0.3 per cent of total sewerage only customers. Their sewerage service charges consist of:[18]

- A standing charge per customer per year, that is equivalent to the one paid by customers with assessed measured charges;
- A fixed highway drainage charge per customer per year that is equivalent to the one paid by metered customers;
- A single fixed surface water drainage charge where applicable per customer per year, equivalent to the one paid by customers paying assessed measured sewerage charges;[19] and
- A rateable value charge of £1.20 per rateable value of the property, or the minimum charge of £53.40 per property based on Southern Water's tariff model. The minimum charge is calculated by applying the volumetric charge for measured customers to an assumed yearly household's wastewater consumption of 27 cubic meters. When no rateable value is available, customers are charged a fixed charge per year equal to £228.80, which is calculated by multiplying the rateable value charge for wastewater by the average rateable value per property across the Southern Water region.[20]

2.3. Southern Water's Assistance to Vulnerable Groups

Apart from its general charging structure, Southern Water provides assistance to vulnerable customers that fall into a range of classes. The assistance includes the WaterSure scheme that offers a cap of water bills, as well as the Essentials tariff offering various levels of discounts to the standard tariffs described above.

2.3.1. WaterSure scheme for vulnerable groups

Southern Water provides the WaterSure scheme to its vulnerable customers, under the Water Industry (Charges) (Vulnerable Groups) (Consolidation) Regulations. Charges for eligible customers during their period of entitlement will be capped at the average household charge from Ofwat for water supplies and/or sewerage services. Total charges are reduced if the customer under this scheme consumes less than the average household, as the charges cannot exceed the amount the customer would have paid if she had not been included in the scheme.[21]

Eligible customers for support through the WaterSure scheme should be in receipt of the tax credits or benefits as specified in Southern Water's charges scheme, as well as satisfy one of the following requirements:[22]

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18 Southern Water Household Charges Scheme 2022-23, p.24. Values of each charge are taken from Southern Water's tariff model.

19 The surface water charges are cancelled for consumer established after 1 April 2000 or consumer that establishes to Southern Water's reasonable satisfaction that they are connected for the drainage of foul water only.

20 Southern Water's Tariff Model. The average rateable value per property is defined as the gross rateable value divided by number of rateable properties.

21 Southern Water Household Charges Scheme 2022-23, p.28.

22 Southern Water Household Charges Scheme 2022-23, pp.26-27. Detailed requirement regarding the qualified tax credits, benefits and medical conditions please refer to Southern Water's charges scheme.

- Households that are entitled to receive child benefit under Part IX of the Social Security Contributions and Benefits Act 1992, which have no less than three children under age 19 in full time education; or
- Households with a resident in the property who is diagnosed with medical conditions which leads to her being obliged to use a significant additional volume of water.

Other conditions that such eligible customers need to meet to be entitled to support through the WaterSure scheme include:[23]

- The property is the only home for the qualifying person; and
- Water is not used for watering a garden (other than by hand) or replenishing a pond or swimming pool exceeding a capacity of 10,000 litres.

2.3.2. Essentials Tariff scheme

Southern Water's Essentials Tariff is designed to help customers who are struggling to pay their water and wastewater services charges, providing a discount of at least 20 per cent on bills for entitled customers. This tariff is offered in different ways, depending on whether Southern Water is the wastewater provider only, or both the water and wastewater provider, and whether the customer receives assistance under Section 44 of the Flood and Water Management Act 2010 regarding the social tariffs.

When the customer receives only wastewater services from Southern Water and receives assistance on their water supply charges under Section 44 of the Flood and Water Management Act 2010 by the other water company, Southern Water provides the customer with assistance on the sewerage service charges, amounting to a 25 per cent discount on wastewater charges described in Section 2.2.[24]

Customers who receive their water from Southern Water, their wastewater services only by Southern Water with no assistance under Section 44 of the Flood and Water Management Act 2010 on their water supply from their water company, or when all the occupants of a property receive social pension credits assistance, are eligible for Essentials tariffs, if they:[25]

- Occupy the property as their only or principal home;
- Mainly use the property as a home (given the premise is not used solely as a home), and the principal use of the water supply is for domestic purpose;
- Hold total value of savings for the household below £16,000; and
- Do not use water for watering a garden (other than by hand) or replenishing a pond or swimming pool with a capacity 10,000 litres;
- Have established their entitlements to the assistance; and

[23] Southern Water Household Charges Scheme 2022-23, p.26.

[24] Southern Water Household Charges Scheme 2022-23, p.34.

[25] Southern Water Household Charges Scheme 2022-23, pp.31-40.

- For additional customers, the total amount of Essentials tariffs does not exceed the upper limit set by Southern Water, determined by a contribution from its current water and wastewater customers (see Section 2.4.1 below).[26]

For eligible customers who get water supply from Southern Water, there are different levels of tariff bands associated with different level of discounts on Southern Water's charges. The company provides a discount on charges based on an assessment of the household annual income, conducted either by the company or an independent agent. The discount levels and income thresholds are shown in Table 2.1 below.[27] The same bands and discounts apply also to sewerage service charges for the entitled consumer who gets water supply from another water company but does not receive assistance from a social tariff under Section 44 of the Flood and Water Management Act 2010.

Table 2.1: Southern Water Essentials Tariff Discounts

Tariff band	Annual income £	Discount from measured, assessed measured, and unmeasured charges in the Schedule
1	21,000 to 6,000	20%
2	5,999 to 4,000	30%
3	3,999 to 3,000	45%
4	2,999 to 2,500	65%
5	2,499 and lower	90%

Source: Southern Water Household Charges Scheme 2022-23

In the case where all occupants of a property receive state pension credit under the State Pension Credit Act 2002, Southern Water provides a 20 per cent reduction of the customer's water services charges.[28]

2.4. Southern Water's Approach to Setting Household Tariffs

The sections below set out Southern Water's current approaches to determining its household tariffs, taking as given the determination of allowed revenue set through Ofwat's price control decision.

2.4.1. Household standing charges

Southern Water sets its household standing charges to recover the total retail revenues allowed by Ofwat through the retail price control. The retail costs of Southern Water include activities such as metering, billing, customer service, etc. This is separate from the additional

[26] Note that when the total Essentials tariff exceed the upper limit set by Southern Water, no additional customers under the three scenarios will be entitled for assistance.

[27] Southern Water Household Charges Scheme 2022-23, pp.32-33.

[28] Southern Water Household Charges Scheme 2022-23, pp.40.

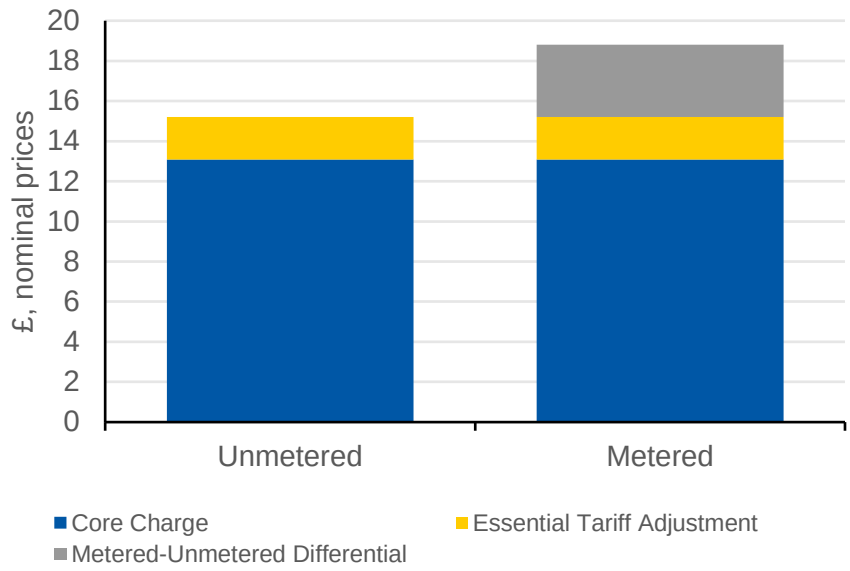
water and wastewater wholesale costs set through Ofwat's wholesale price control which cover activities like treated water distribution, water resource abstraction and treatment, wastewater collection and treatment, etc. Hence, under Southern Water's current methodology, all retail costs are recovered on a fixed "per customer per year" basis.

In its Tariff Model, Southern Water calculates a core charge element that serves as the foundation of different household standing charges. Indeed, other standing charges are underpinned by the core element plus certain adjustment components, and Southern Water determines the value of the core charge each year to minimise the difference between the allowed revenue and revenue to be collected through tariffs.

Based on the value of the core charge element, Southern Water derives the value of household tariffs under different charging schemes. The unmetered water standing charges, that apply to both unmeasured and assessed measured charges, is equal to the value of the calculated core charge plus the water essential tariffs adjustment. This adjustment is the value of a customer's willingness to pay (WTP) for the vulnerable groups based on Southern Water's Social tariff research. Therefore, this essential tariff adjustment is included in the standing charges for unmetered customers.

The standing tariffs for metered water customers use the unmetered standing charges as a starting point. Southern Water aims to ensure that the difference between metered and unmetered charges is reflective of the difference in costs associated with serving these two categories of customers. Therefore, it sums to the unmetered standing charge. i.e. the value of the core charge plus the water Essential Tariff adjustment and the cost per customer of meter reading. Using the core charge Southern Water calculates for 2022/23, the essential tariff adjustment and the differential between metered and unmetered standing charges, Figure 2.1 summarises the components of water standing charges. This cross-subsidy paid by both metered and unmetered customers is then used by Southern Water to determine the available resources to fund both the Essential Tariff and WaterSure schemes.

Figure 2.1: Components of Standing Charges for Unmetered and Metered Water Customers



Source: Southern Water's Tariff Model.

2.4.2. Household volumetric charges

Household volumetric charges are set to recover the costs attributable to serving them under Southern Water's wholesale water price control. For this part of the tariff, household and non-household tariffs are set as part of the same calculation. Essentially, Southern Water forecasts demand from all categories of customers, then sets tariffs for both household and non-household customers to ensure it recovers its wholesale price control.

Volumetric charges for non-household vary by usage band (0-1ML, 1-5 ML, 5-10 ML, etc.), and are generally lower than household charges. The non-household volumetric tariffs are determined by the household volumetric charges, using assumed relationships between the household variable charge and the variable charges for the different bands.

2.4.3. Wastewater tariffs

The standing charges for wastewater are determined in a similar fashion as the standing charges for water supply described above. Southern Water calculates the core charge element that minimise the difference between the allowed revenue and revenue to be collected through tariffs. The unmetered wastewater standing charge, that applies to both unmeasured and assessed measured charges, is determined by adding the value of the calculated core charge to the unmeasured wastewater essential tariffs adjustment, derived from Southern Water's Social Tariff research. The standing charge for measured wastewater customers is calculated by uplifting the unmetered standing charge by an amount per customer aimed at reflecting the relevant costs of providing metered services.

To derive the value of volumetric charges, Southern Water's tariff model forecasts the demand associated with each charge, setting their values to allow the company to recovery the allowed revenue through tariff collection. Surface water drainage charges are set to recover the wholesale wastewater network costs relating to the run-off from private land into the drainage and wastewater management network. Highway drainage charges relate to the cost of run-off from roads. Both charges are currently set as a fixed annual charge per year; the highway drainage charge is 50 per cent of the lowest surface water drainage charge.

2.4.4. Southern Water's social tariff scheme

Southern Water's social tariff design follows Defra's guidance on water companies' social tariffs, published in 2012. The guidance expects water undertakers, who choose to introduce the social tariffs, to provide a meaningful bill reduction for entitled households, and to communicate with their customers regarding the value of cross-subsidies and who will be responsible for cross subsidising the social tariffs.[29] Moreover, Defra proposed in the guidance that a reasonable overall quantum for the cross-subsidy should be around 1.5 per cent of the average household water and sewerage bills in England.[30]

[29] Defra (June 2012), Guidance to water and sewerage undertakers and the Water Services Regulation Authority under Section 44 of the Flood and Water Management Act 2010, para. 4.3 and 5.1.

[30] Defra (June 2012), Guidance to water and sewerage undertakers and the Water Services Regulation Authority under Section 44 of the Flood and Water Management Act 2010, para.6.4.

In compliance with Defra's 2012 guidance, the Essentials tariff offered by Southern Water is cross subsidised by the generality of Southern Water's household customers. The current level of the cross-subsidy provided through this scheme is determined through research conducted by the company in 2019 on customers' WTP for less affluent customers to pay lower bills. As described in Section 2.4.1 above, the final household tariffs are uplifted to cover the costs of the total Essentials tariff offerings set by Southern Water.[31]

Hence, the rationale for the social tariff scheme is that customer engagement research is used to identify the budget that the generality of customers is willing to offer to support less affluent customers through lower bills. The result is then used to define the available resources to finance the Essentials social tariff scheme.

2.4.5. The WaterSure scheme

The cost of the WaterSure scheme (described above) is funded by Southern Water's customers through the collection of standing charges above the level that would be required to recover Southern Water's retail price control revenue. Under the scheme, water bills for the eligible households are capped at the average bill, which is set by the total water supply revenue divided by the total number of water supply for measured and unmeasured customers.[32] This means customers consuming more than average will pay less than the share of costs that would normally be attributed to them under the tariff scheme; this shortfall is recovered through an uplift on standing charges.

2.5. Interaction of Household Tariffs and Developer Charges

The interaction between household tariffs and developer charges may also affect the structure of household tariffs. Developer services for connecting new development consists of both onsite and offsite work. Onsite work includes providing the infrastructure that needs to be laid out and connected to the local utility's existing water network. Many of these services are contestable, meaning they can be provided by the incumbent water company, the developers themselves, Self-Lay Providers (SLPs) or New Appointment and Variations (NAVs). On the other hand, offsite work includes any work needed on the incumbent utility's network due to the new development, such as upgrades to existing pipelines and pumping stations, that enables the provision of bulk water to the boundary of the new development. These services are non-contestable, i.e. only the incumbent can undertake this work.

Currently, Southern Water recovers the costs of onsite work through site-specific charges.[33] The site-specific charges recover all relevant costs of establishing a new connection for new homes to the nearest possible existing network. The charges vary depending on the size and location of the pipes, and Southern Water provides fixed charges that cover various options and charges for additional activities like working in areas of contaminated land.[34] The charges are set by assessing the average cost per water meter (property) with reference to the size of diameter connections, but also taking into considerations other aspects as the amount

[31] Southern Water Tariff Model.

[32] Southern Water Tariff Model.

[33] Southern Water (2021), New Connections Services Charging Arrangements 2022-23, p.5.

[34] Southern Water (2021), New Connections Services Charging Arrangements 2022-23, p.18.

of excavation and the surface type.[35] These charges are paid by the developers to Southern Water, if it is the entity providing the onsite work.[36]

As regards offsite work, water companies in England recover the costs of reinforcing the existing networks, needed to provide for new development-related growth, through the infrastructure charge. These charges are fixed fees calculated based on a five-year forecast of network reinforcement costs with annual adjustment for over/under recovery. They are set such that, over each five years period, the overall revenues from infrastructure charges will recover the costs of network reinforcement that the incumbent water company reasonably incurs. Once the infrastructure charge has been calculated, water companies in England can offer an income offset to developers, i.e. a discount to the charge funded by the local water and wastewater company, and ultimately by end customers. In 2022-23, the gross infrastructure charges Southern Water set for water and wastewater are £0 and £608 per new connection, respectively.[37] Then, Southern Water offers an income offset for water and wastewater of £213 and £193, respectively.

Under Rule 19 of the New Connection Rules (also referred as the balance of charges rule), Ofwat requires incumbent water companies to set charges that ensure a reasonable balance between developers' and other customers' contribution to network costs.[38] In practice, the costs of reinforcing the network are recovered through an infrastructure charge levied on developers and the remaining cost is funded by the incumbent water companies through an income offset mechanism, that offers a discount to the developers in recognition of the future revenues from new customers as a result of the development. Until 2018, the income offset was usually based on a Discounted Aggregated Deficits approach (DADs). The DADs approach consisted of offsite costs less the discounted present value of the first 12 years of revenues from the site as projected at the time of making the offer (see Figure 2.2 for a graphical representation).[39] We understand that currently Southern Water calculates an equivalent balance of contributions rather than the DAD. In both cases, the income offset is effectively recovered across all end-customers paying water and wastewater charges over time.

[35] Southern Water (2021), New Connections Services Charging Arrangements 2022-23, p.45.

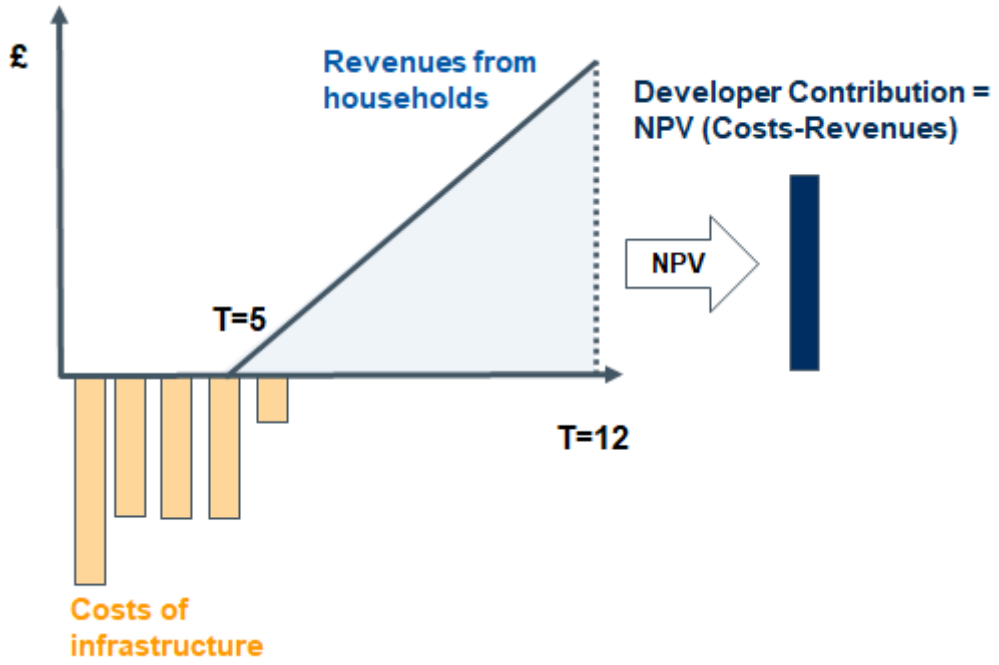
[36] It may have a limited impact on property prices, but this is outside the scope of this report.

[37] Southern Water (2021), New Connections Services Charging Arrangements 2022-23, p.15.

[38] Ofwat (October 2021), Charging Rules for New Connection Services (English Undertakers) issued by the Water Services Regulation Authority under sections 51CD, 105ZF, 143B and 144ZA of the Water Industry Act 1991, para.19.

[39] Before 2018, the income offset was applied to the requisition charge for contestable works. Since then, it has been applied to the infrastructure charge to not disadvantage NAVs.

Figure 2.2: A Graphical Representation of the DADs Approach for Calculating the Income Offset



Source: NERA illustration.

Recently, Ofwat has stated its intention to remove the income offset in England from April 2025, since, according to the regulator, there is no sound economic rationale for providing it in the first place.[40] According to Ofwat, costs should be recovered from the parties that are causing those costs to be incurred. As a result, an increase in developer charges is likely, and if developer charges are cost reflective, we should expect that the charges for wholesale water will include a lower share of the water distribution and wastewater collection costs associated with accommodating future changes in demand due to new developments.

Nonetheless, for the purpose of this report we consider it is reasonable to assume that infrastructure costs associated with upgrades to the network will continue to be recovered through a combination of yearly charges paid by customers through their bills, and one-off developer charges paid by developers.

2.6. Conclusions

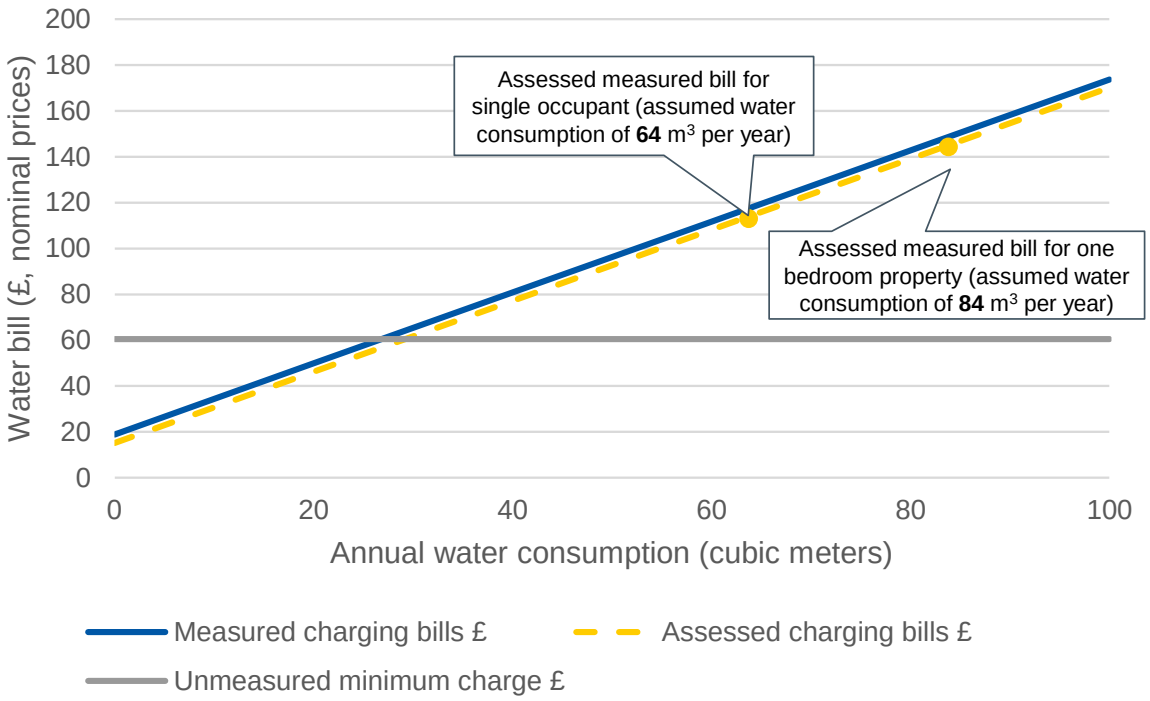
Southern Water offers different charges to its customers, depending on whether the property has a meter installed or not, and the customer has applied for the installation of a meter. Based on information from Southern Water's tariff model, over 80 per cent of Southern Water's dual customers are metered customers with water meters installed at their properties. These customers pay a measured charge, which includes a standing charge and a volumetric charge based on a flat rate and the volume of their water consumption. The assessed measured charges are offered to customers who could not be proactively metered by the company via the universal metering programme. They are charged with a lower standing

[40] Ofwat (October 2021), Scope and balance of developer charges and incentives – conclusions, p.12.

charge than the measured standing charge, to reflect the cost associated with meter reading, while the volumetric charge uses the same variable rate as the measured charge applied on the assumed consumption for a given property type. Finally, customers who do not have a water meter, and have not applied for one, pay the unmeasured charges. Their standing charges are the same as assessed measured customers, but they face a charge per pound of the rateable value of their properties, or a minimum charge per property set by Southern Water, based on a given assumed consumption level. There are equivalent arrangements in place for wastewater too.

Figure 2.3 shows these different charges, given the consumption level of the household.[41] The measured charge is parallel to the assessed one, with the difference given by the standing charge, to reflect the higher retail costs.

Figure 2.3: Comparison of Southern Water's Different Water Charges



Source: NERA analysis of Southern Water Tariff Model

Household tariffs are collected to recover Southern Water's costs. Specifically, the standing charges cover Southern Water's retail costs, while the volume charges are set to recover Southern Water's wholesale costs, with both highway drainage and surface water drainage also contributing to recovery of the wholesale wastewater costs.

In addition, through the collection of standing charges, Southern Water also fund the WaterSure and Essentials tariff schemes that provide different levels of discounts to its

[41] Note, for unmetered customers we only show the minimum charge.

vulnerable customers. Water and wastewater customers cross-subsidised these schemes, relying also on results based on Southern Water's Social Tariff research.

3. Economic Objectives for Efficient Tariff Design

3.1. Ofwat Tariff Requirements

In setting its water and wastewater tariffs, Southern Water needs to comply with the charging rules set by Ofwat. Ofwat's Charges Scheme Rules require that, in general, charges reasonably reflect the costs imposed by different classes of customers, using the following principles:[42]

- There should be consistency in principles and approaches across different customer classes in determining the charges;
- The tariffs should be reflective of the long-run costs associated with the provision of relevant services;
- Charges for services provided to domestic premises must be fixed so that the average difference between metered charges and unmetered charges only reflects any differences in the costs of, and the additional benefits of, the provision of one service relative to the other;
- Differences in service charges between larger and smaller users should be reflective only of the relevant cost differences associated with differential use of network assets, differential peaking characteristics, different service levels and/or different service measurement accuracy;
- When differences in charges between large and smaller users of water are driven by differential peaking characteristics, charges should be set on an appropriate peak demand basis; and
- Sewerage service charges must take into account the different pollutant loads associated with foul sewage, trade effluent, surface water draining from premises and surface water draining from highways.

Hence, while Ofwat sets out a range of relatively high-level principles, they are not prescriptive, leave leeway for companies to interpret them, including potentially how to make trade-offs between competing objectives. For instance, despite the clear requirement that "tariffs should be reflective of the long-run costs", the precise definitions of "cost" leave a wide range of potential interpretations, including on how to differentiate charges according to ensure tariff differences are "reflective only of the relevant cost differences associated with differential use of network assets, differential peaking characteristics, different service levels and/or different service measurement accuracy".

The tariff guidance does not explicitly define what protections should be offered to less affluent household customers.

3.2. Economic Principles Defining Good Practice in Tariff Design

We have therefore considered what guidance regulatory economics literature offers on the design of efficient tariff structures.

[42] Ofwat (October 2021), Charges Scheme Rules issued by the Water Services Regulation Authority under sections 143(6A) and 143B of the Water Industry Act 1991 – from April 2022, para.12-17.

In a seminal book, James Bonbright sets out widely used principles related to tariff design.[43] These principles cover a wide range of aspects that regulators and utilities commonly consider when designing tariffs, including the recovery of the total revenue requirement, the provision of appropriate price signals related to the costs of providing the service, fairness, objectivity, and equity aimed at avoiding undue discrimination and minimising inter-customer subsidies, as well as the stability and predictability of tariffs and revenues.

Regulators in other jurisdictions have used these principles to assess desirable rate structures. For example, the Queensland Competition Authority, the independent economic regulator in Queensland, considers Bonbright's principles when regulating utility tariffs.[44] Similarly, the Alberta Utilities Commission has relied upon similar principles for transmission tariff design since at least 2005.[45]

In the context of household water tariffs, we summarise these principles below:

- **Cost causation**: A well-designed water tariff provides appropriate price signals that reflect the costs of service associated with different patterns of water consumption. To promote economically efficient consumption decisions, the tariff should be structured to reflect the long-run link between how and when customers consume water and the costs of that water supply.[46] For instance, customers consuming different amounts of water from the network, having different amounts of contracted capacity, or using water at different times, may all impose different costs of water supply.

- **Recovery of the revenue requirement:** The tariff design should be set under any tariff design methodology such that companies expect to recover their revenue requirement each year.

- **Fairness, objectivity, and equity**: If a rate design sends price signals that reflect the costs of providing water, thereby meeting the cost causation criterion, then that rate design is likely to be both fair and objective. A tariff that reflects the costs of providing water would also be equitable, in the sense that differences in tariff costs across customers would reflect the costs caused by those users.

- **Stability and Predictability:** A well-designed tariff structure should be stable and predictable, in the sense that the tariffs should not change materially from year-to-year in conditions where water usage patterns and water supply costs are not similarly variable across years.

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43 Bonbright, James (1961), Principles of Public Utility Rates, New York: Columbia University Press.

44 Queensland Competition Authority (2013), Regulatory Objectives and the Design and Implementation of Pricing Principles.

45 EUB Decision 2005-096 (28 August 2005), Alberta Electric System Operator (AESO), 2005/2006 General Tariff Application, , available at https://www.auc.ab.ca/regulatory_documents/ProceedingDocuments/2005/2005-096.pdf.

46 Economists refer to a concept named "allocative efficiency" which describes when the costs of providing a service are aligned with consumers' value of a service and therefore the combination of production and consumption represents a desirable outcome for society. To achieve allocative efficiency in the context of water use, users of the water system rely on the price signal sent by the water charge to reflect the long-run cost of water companies. An inefficient price signal, in the context of water charges, arises when the charge does not reflect the long-run cost of providing a service, and therefore leads to too high or too low water consumption, resulting in a sub-optimal outcome for society. See for instance: Harvey Leibenstein. Allocative Efficiency vs. "X-Efficiency", June 1966, The American Economic Review, Vol. 56 (3), p. 392-415.

- **Practicality:** Any rate design needs to be administered by the water companies. Therefore, ease and practicality of implementation is an important consideration. Customers need to understand the structure of the tariff to be able to predict their water bills, and how changes in their consumption behaviour will result in them paying different charges. This is necessary both to adhere to the principle of fairness (discussed above), but also to ensure customers can respond to the efficient price signals sent in the tariff.

3.3. Conclusions

Tariffs need to be cost reflective to meet Ofwat's requirements, but these guidelines and wider guidance from economics literature on good practice in tariff design also identify other considerations like equity and fairness, which could support a more progressive design.

However, the definition of cost reflective tariffs could cover a wide spectrum of different designs. As discussed in the following chapter, an ideal solution to meeting Southern Water's objectives would involve making tariffs more cost reflective while also making them more progressive to improve performance of the tariff design against these other objectives.

4. Options for Improving the Tariff Structure

While Southern Water's current tariff structure has been designed to adhere to the relevant tariff design criteria set out in the previous chapter, a number of possible other tariff designs might be equally consistent with these criteria and achieve a more progressive tariff structure, which is the focus of this report.

In this section, we therefore describe different approaches for setting tariffs that (a) reflect the long-run costs associated with providing the relevant services and thereby promote more efficient consumption, and (b) may better promote tariff criteria regarding fairness and protection of vulnerable customers by creating a more progressive tariff structure.

4.1. Cost Reflectivity of the Current Southern Water Tariff

4.1.1. Southern Water's current tariff methodology uses an embedded cost methodology to set tariffs

As set out above, under Southern Water's current approach to setting household tariffs, the tariffs customers pay reflect the average cost of supply permitted under the prevailing Ofwat price control. In terminology widely used in the context of tariff design, it is therefore an "embedded cost" methodology (as distinct from a "marginal cost" methodology, discussed further below).

Specifically, Sothern Water's methodology identifies several functions performed by the company and the costs associated with each of them:

- The costs of the retail function are identified as equal to Ofwat's household retail price control. Southern Water recovers these costs through a standing charge set per customer, on the basis that these costs are driven by the number of customers served, and therefore invariant to consumption levels.
- Southern Water also identifies the costs of cross-subsidies for its vulnerable groups, which it also recovers through a standing charge set per customer, on the basis that these costs are driven by the number of customers served, and therefore invariant to consumption levels.
- The costs of abstraction, raw water transport, treatment, and treated water distribution are identified as equal to Ofwat's wholesale water price control. Southern Water's current methodology recovers these costs through a tariff per cubic metre of consumption. Southern Water's approach therefore assumes that its wholesale water price control costs are entirely related to the volume of consumption, by contrast to the retail costs associated with serving a customer which it assumes are fixed in nature and therefore unrelated to the amount of water supplied.
- The costs of wastewater collection, wastewater treatment, and sludge disposal are identified through Ofwat's wholesale wastewater price control. Southern Water's current methodology recovers these costs through both standing charges per customer per year and a volumetric charge per cubic metre of foul water drainage. In addition, both highway drainage and surface water drainage also contribute to recovering wholesale wastewater costs. This approach therefore assumes that wastewater costs are driven by both the number of customers served as well as the volume of consumption.

This existing tariff design is therefore consistent with the cost-reflectivity tariff design criterion discussed in the previous chapter, insofar as these assumptions on cost drivers reflected in the tariff are correct. This tariff design also appears to be fair, in the sense that all customers pay a tariff set in a similar way and face the same per unit charge.

4.1.2. Potential improvements to Southern Water's tariff structure

However, the assumptions made in the current tariff design about the drivers of Southern Water's costs are unlikely to be wholly accurate. For example, it is likely that – at least to a degree – the costs recovered through the wholesale price control do not vary with the volume of water consumed at all points throughout the year and include some elements that are unrelated to the volume of water Southern Water supplies. Hence, the current tariff design could arguably be made more cost reflective if some of the wholesale price control were recovered through billing determinants other than volume of supply, such as customers' contributions to peak demand. For instance:

- Southern Water's totex allowances set by Ofwat in the PR19 price control (2020/21-2024/25) amounted to £1,137 million for water distribution and treatment, and £161 million for water resources (stated in 2017/18 prices, deflated using CPI-H).[47] This cost breakdown is not a perfect reflection of Southern Water's costs to be recovered during the PR19 period, which are determined by the share of totex that Ofwat allows to be recovered through its pay as you go (PAYG) allowances, and remuneration for depreciation of and return on the Regulatory Capital Value (RCV). Nonetheless, it shows that the majority of Southern Water's wholesale costs are likely to be related to the water distribution activity, with water resources costs accounting for a much smaller share.

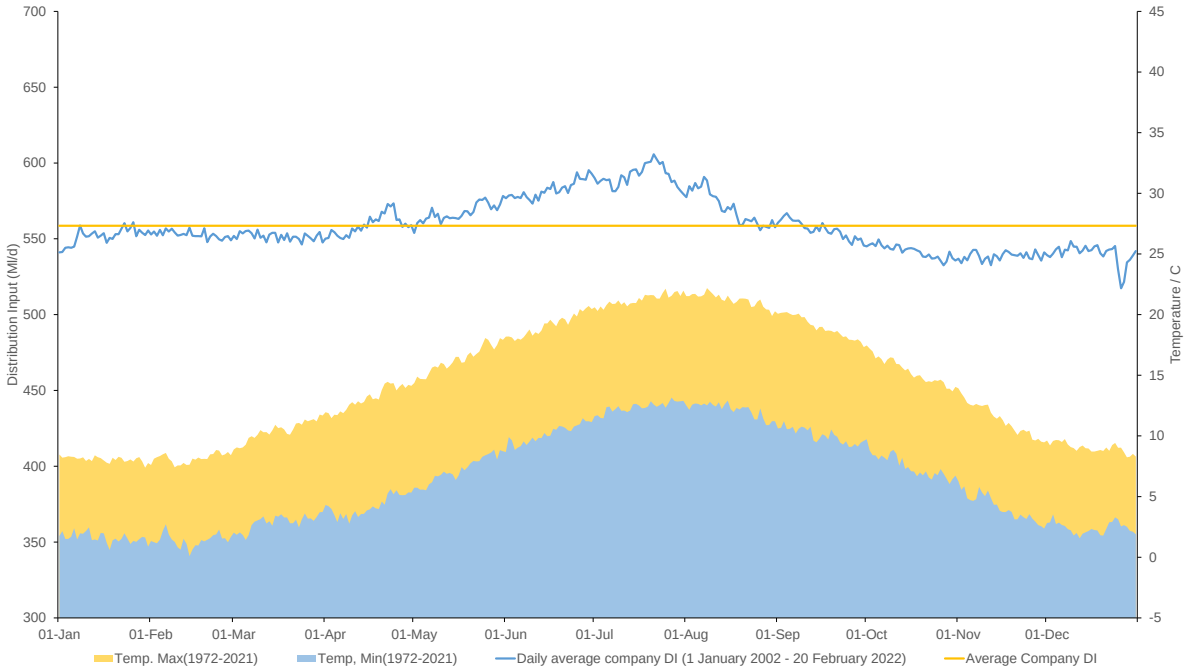
- We understand from the company that historically the water distribution network and treatment capacity have been sized to meet peak demand requirements, and the levels of usage in off-peak periods do not contribute materially to the required capacity. As such, recovering the costs associated with the historical capital expenditure incurred to provide distribution network and treatment capacity through a volumetric charge may not be cost reflective. Rather, a charge levied on customers' water use at peak times might be more appropriate.

- Similarly, we understand that water resources costs are to some extent driven by the need to ensure water supply all year, but some water resource costs are incurred to ensure the company can meet demand during the summer peak. As such, it could be appropriate to recover some water treatment, raw water transport and abstraction costs from a charge levied on peak usage.

Using data provided by Southern Water, Figure 4.1 shows the relationship between the average daily temperature in the period 1972-2021 and Southern Water's average daily water distribution input (DI) for the period 2002-2022. It shows that Southern Water's daily DI tends to be higher when the temperature increases. As such, a time-of-use tariff that recovers a portion of Southern Water's costs through a summer-peaking tariff could be more cost reflective than the current tariff design.

[47] Ofwat (December 2019), PR19 final determinations: Southern Water final determination, Table 3.1.

Figure 4.1: Southern Water's Water Distribution Input and Average Temperature



Source: Southern Water Data.

However, it would likely still be cost reflective to recover some elements of the wholesale water price control from charges levied on other demand determinants:

- Replacement costs could be attributed to serving peak demand, to the extent that the size of assets to be replaced is influenced by peak demand, but there are a number of reasons why it might be appropriate to use other billing determinants to recover some of these costs. For example, the costs of excavation to replace pipes are only partially linked to the size of demand the pipe is designed to serve.
- Maintenance costs and the capital costs associated with replacement are driven by the need to maintain reliable supply at all times of the year, and leakage reduction also offsets other types of supply and demand side interventions that would otherwise be needed.
- Some operating costs may be invariant to consumption at any time of the year, like the costs of corporate overheads and costs associated with emergency response capabilities. Some other operational costs are also more likely to be driven by volume of consumption, irrespective of the season, such as the power costs of pumping, and the chemical costs of treatment.

Hence, there are a series of reasons why Southern Water's current tariff methodology could be made more cost reflective. Apportioning its costs to appropriate cost drivers would require additional work that is beyond the scope of this report. However, it seems likely that this additional work would conclude that:

- Some of Southern Water's abstraction, treatment, and distribution network costs are driven by peak summer requirements, and should therefore be recovered through a charge that is levied on summer usage;
- It remains appropriate for some treatment and distribution network costs to be recovered through a volumetric charge that is invariant to time-of-use; and
- Some treatment and distribution network costs may be entirely invariant to consumption, so recovering them through a standing charge would be more appropriate.

As well as making the tariff more cost-reflective in the ways suggested above, these changes would allow Southern Water to better meet criteria around fairness, in the sense that customers are more likely to pay tariffs that reflect the share of costs associated with their water use. However, it is not clear-cut whether such a change in tariff structure would result in the tariff becoming more or less progressive:

- A reduction in the volumetric tariff would benefit all consumers, but higher consuming customers would benefit to a greater extent, thus making the tariff less progressive.
- To the extent that this reduction in the volumetric tariff is offset by the use of a summer-peaking tariff, this is likely to make the tariff more progressive, as customers using large amounts of water are more likely to be those using water for non-essential purposes, such as garden watering, paddling pools, etc. Customers using a similar amount of water all year round would be likely to see their bills reduce as a result of a summer-peaking tariff, so the tariff structure is likely to become more progressive as a result.
- To the extent that this reduction in the volumetric tariff is offset by a higher standing charge, the tariff structure would be less progressive, as all customers would pay the same amount, irrespective of consumption levels.

Therefore, the way the reduction in volumetric tariff is recovered will affect whether the tariff structure is made more or less progressive. As we discussed above, setting a higher standing charge is likely to be a less progressive option. However, introducing mark-ups to the tariff during the summer season would likely result in lower costs for customers who use water only for essential purposes and higher costs for customers consuming larger amounts of water for non-essential purposes in the summer.

4.2. Adopting a Long-run Marginal Cost Methodology

4.2.1. The theoretical advantages of marginal cost pricing

Another possible change in tariff design that Southern Water might consider is to implement a marginal cost-based methodology, as opposed to the embedded methodology it currently uses. In the context of Southern Water's activities, tariffs set to signal marginal cost could better reflect in the prices charged to customers regarding two (potentially countervailing) features of the costs it incurs to serve customers demands for water:

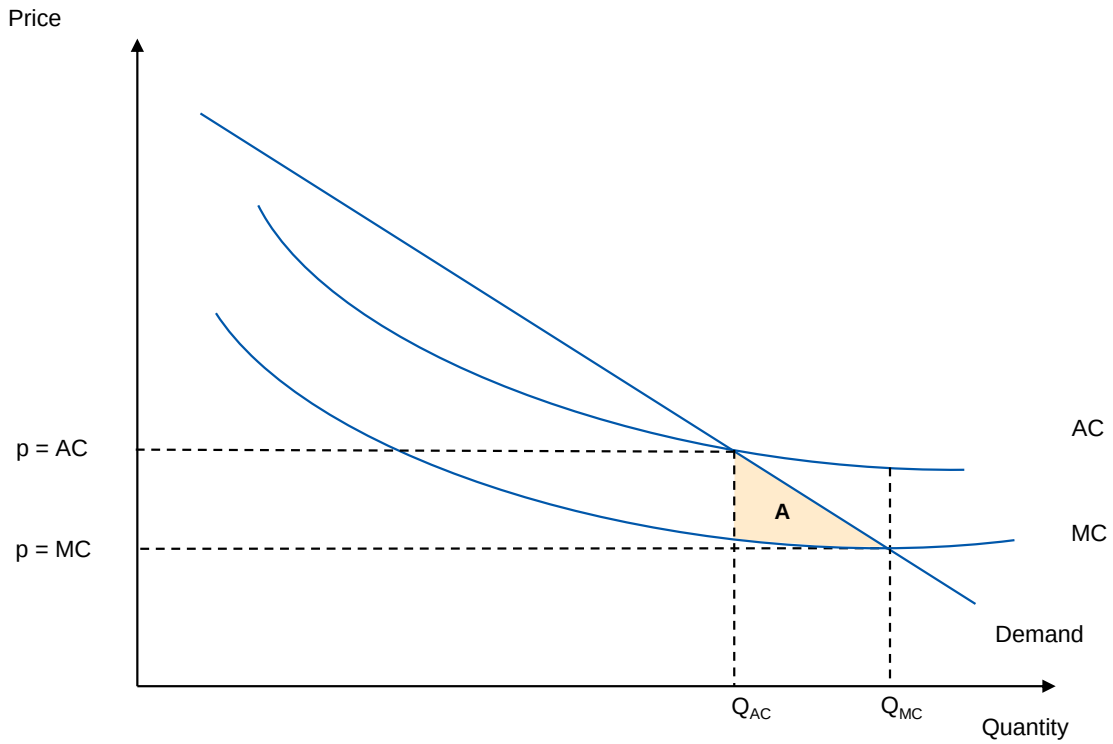
First, we understand from our discussions with the company that Southern Water serves a water scarce region, and it expects to invest heavily to maintain a demand-supply balance and improve resilience to drought. As such, the water resources costs it will incur in the future will likely be higher than the average of ongoing and historical costs of water abstraction and

treatment recovered through the existing price control and built into the current volumetric tariff. A marginal cost based methodology has the potential to send signals to customers regarding the value that their efforts to save water generate, or their decisions to consume more water impose, on demands for water in the region. This would likely lead to *higher volumetric tariffs*, and a more progressive tariff structure.

On the other hand, water distribution is widely considered to be an example of a natural monopoly activity, in which the Long-run Marginal Cost (LRMC) of serving an additional unit of demand may be below the average cost. As the theoretical diagram in Figure 4.2 shows, for low levels of output, a natural monopoly will face relatively high average costs because of its high initial infrastructure costs, where average costs are defined as total costs per unit of output. As output increases, the average costs tend to decrease because the marginal cost of serving each additional unit is relatively low. This generates significant economies of scale.

In this theoretical example, the marginal cost, i.e. the cost of an additional unit of output, is always below the average total cost over the whole range of output needed to serve market demand. When the price is set to recover average cost, as in the case of Southern Water's current tariff structure, it would be possible to marginally expand output at a cost which is below the price that customers would be willing to pay for that additional unit. As such, setting prices equal to average cost involves a "deadweight loss" in efficiency (area A), as it misses the potential for the utility to supply some customers' demands.

Figure 4.2: Deadweight Losses When Pricing to Average Cost



This loss in efficiency can be avoided when the price is set equal to the cost of producing an additional unit of output, i.e. the marginal cost. In contrast to the average cost approach

currently used by Southern Water, the marginal cost approach sets a price equal to the additional cost the water company incurs to serve an additional unit of demand, and therefore encourages efficiency in water use.

As the diagram above illustrates, setting a tariff to reflect marginal cost for the distribution network would likely lead to a *lower volumetric tariff* than the tariff charged at present, and therefore may result in a less progressive tariff structure.

Hence, whether a marginal cost tariff design would generate a more or less progressive tariff structure is not clear cut, and would require a detailed quantitative examination of Southern Water's costs.

In fact, the calculation of marginal costs is itself not straightforward. For example, the estimation of marginal costs depends on whether the time horizon over which the estimation is performed (i.e. the short-term or the long-term). This is because in the short-run, capital costs cannot easily adjust to small changes in output. However, in the long-run, the firm has the ability to determine the combination of capex and opex that achieves the lowest cost of production. As a result, for industries like the water sector where a significant level of upfront investment is required to serve demand, the short-run marginal cost (SRMC) tends to be lower than the LRMC.

Therefore, using a LRMC approach to set tariffs has the potential to improve the efficiency of water consumption decisions, but further work would be needed to implement it and it may make the tariff more or less progressive.

4.2.2. Approaches to estimating LRMC

There are some commonly used methods for estimating the LRMC for natural monopolies to provide marginal cost signals through tariffs.[48]

A commonly used method is the Turvey approach that estimates the cost of serving an additional increment in demand. The approach involves initially the estimation of the costs required to (under the assumption of optimal investment) meet demand before and after a permanent increase in demand. The LRMC is then estimated using the present value of the change in expenditure due to the new increment in demand, divided by the present value of the change in demand.[49]

$$Turvery\ LRMC = \frac{PV\ of\ cost\ difference\ in\ serving\ the\ change\ in\ demand}{PV\ of\ the\ change\ in\ demand}$$

Another commonly used approach is the Average Incremental Cost Approach (AIC). This approach estimates the average cost of optimal capital expansion needed to meet future demand. This approach involves first forecasting future demand growth and the optimal costs of meeting the demand over a certain period, similarly to the Turvey approach. Then, it forecasts costs under a counterfactual scenario where there is no demand growth over that

[48] See Anstey, G. and T. Graham, (2014), Incorporating Marginal Costs in Water Supply Tariffs: Prospects for Change, for an overview of different approaches for estimating the LRMC.

[49] Turvey (1976), What are marginal costs and how to estimate them, Analyzing the marginal cost of water supply, Land Economics, 71(4), 158 – 168.

period. Finally, the LRMC is calculated by taking the present value of the change in expenditure from the previous steps, and dividing by net present value of the additional demand served.[50]

4.2.3. LRMC approaches in practice

Some other jurisdictions use the LRMC approach to set water tariffs. For example, in New South Wales, the Independent Pricing and Regulatory Tribunal (IPART) sets water prices based on an estimated LRMC of providing water. After establishing the base water usage price with LRMC analysis, IPART also uses "dynamic water usage prices", to reflect the impact of water restrictions on demand in the event of drought. There are two alternative price caps based on normal and drought demand scenarios. The base usage price applies under normal conditions, and the drought scenario with a higher cap is triggered 31 days after the average dam levels fall below 60 per cent, and drought usage prices start applying, until dam levels have been restored for 31 more days. The higher price cap is set to enable water companies to recover the same total allowed revenue, despite the expected reduction in demand due to water usage restrictions.[51]

The Queensland Competition Authority (QCA) regulates utilities in Queensland. The QCA's 2021 regulatory pricing principles for the water sector require companies to set water prices that reflect the efficient cost of providing the relevant services. The QCA stresses the importance of marginal cost pricing in achieving allocative efficiency in water, but it also acknowledges that setting prices equal to the marginal cost is not always enough for recovering's water companies' costs. Therefore, QCA uses a two-part tariff, in which the variable component signals the marginal costs of water use, and a fixed charge recovers shortfalls in water companies' revenue.[52]

4.3. Southern Water's LRMC of Expanding Supply from its Water Resources

4.3.1. Estimating Southern Water's LRMC from data provided in its 2019 Water Resources Management Plan

As summarised in Section 4.2.2 above, the calculation of the LRMC requires a forecast of Southern Water's future demand and the cost of meeting it. Hence, in order to estimate the LRMC of Southern Water's water resources, we use data from Southern Water's 2019 Water Resource Management Plan (WRMP19), which provides information on the company's plans to meet expected water demand while planning for the target level of drought resilience over the period 2020-70.

The WRMP19 data we were supplied with – while it did consider a number of demand scenarios – did not contain a "clean" estimate of the additional costs associated with a change in demand. As such, it does not provide us with the basis for implementing the LRMC methods described in Section 4.2.2 above.

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50 Mann, P., R. Saunders, and J. Warford (1980), A Note on Capital Indivisibility and the Definition of Marginal Cost, Water Resources Research, Vol. 16, June 1980

51 IPART (June 2020), Review of Prices for Sydney Water from 1 July 2020, pp. 78-79.

52 QCA (23 April 2021), Statement of regulatory pricing principles for the water sector (2021), p.15.

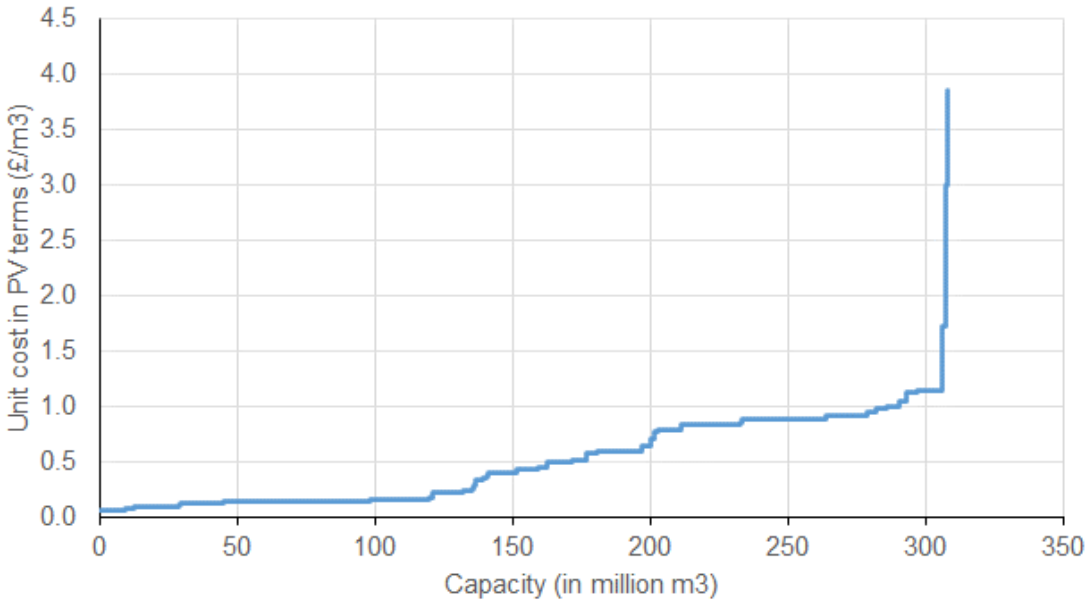
However, the data includes a list of 63 projects selected by the company in its preferred approach to meeting supply. For each of the project, we have information on capex, financing cost and opex for the aspects of the project including water abstraction, raw water pumping, treated water pumping, water treatment, network distribution, maintenance, and staffing costs. There is also information on the Deployable Output (DO) delivered by each option at full capacity in megalitres (ML) per day. Using the projects listed in the WRMP19 dataset, we estimate Southern Water's long run supply curve of projects it plans to deploy through the following steps:

- We first calculate the annuitised capex, financing costs and opex, thus calculating the annual total cost of each option in PV terms, using information provided in the WRMP19 data on schemes' lead time, asset life and discount rate;
- We divide this cost by the DO of each option, calculating the unit cost per cubic metre in PV terms; and
- We rank the different options according to their unit costs, starting from the smallest to the largest.
- We present this data as a supply curve, showing the cost and capacity of the option that has the lowest unit cost in PV terms on the bottom left, and the more expensive options to the right, as shown in Figure 4.3.

The supply curve slopes upwards by construction, showing the costs of the projects the company plans to deploy, ranked in order of their cost. It shows that the vast majority of water resource options (as measured by DI) cost up to £1 per cubic meter of DO. However, the dataset also includes three small options with a unit cost per cubic metre materially higher than the others: £1.72, £3.00, and £3.85 per cubic meter, respectively.[53]

[53] These projects are: Nitrate Option for Chilbolton (CM only), Steyning (CM only, no treatment plant), and Martin Mill (CM only, no treatment plant).

Figure 4.3: NERA Estimates of Southern Water's Water Resource Supply Curve



Source: NERA analysis of Southern Water WRMP19 data

Because of their small size, we assume that the costs of these projects are not reflective of Southern Water's LRMC of meeting growing demand for water. For example, these three small options may be used as short-term mitigants while other larger, cheaper schemes are developed. They may also be projects designed to enable other, larger projects.

Hence, especially given their small size, they are unlikely to be representative of Southern Water's LRMC of meeting demand changes in the future. Once we exclude these three options the highest point on the supply curve is £1.14 per cubic meter, and ranges between £0.85 to £1.14 per cubic meter for production between 250 to 300 million m^3. This is materially lower than the current household volumetric tariff of £1.55 per cubic meter under Southern Water's 2022/23 measured charges.

On the face of it, this would suggest that the company's existing volumetric tariff is around 50 per cent higher than an efficient price that reflects Southern Water's LRMC. However, this analysis may understate LRMC for the reasons discussed below in sections 4.3.2 to 4.3.5.

4.3.2. Accounting for the marginal cost of changes in demand on the distribution network

The supply curve shown above, which suggests the LRMC of meeting higher demand is around £1 per cubic metre, includes the costs of water abstraction, treatment and distribution costs identified in the WRMP. We assume the water distribution costs included in these WRMP projects are those which are directly attributable to individual projects, e.g. network investments to connect new resources to the distribution system.

If demand were to increase across the Southern Water network, it is also possible that distribution network costs would increase, as we understand the required capacity of the water distribution system is primarily driven by the size of peak demand (as discussed

above). The exclusion of the marginal costs associated with changes in distribution network costs due to changes in demand means the chart shown above would understate the LRMC of changes in peak demand.

However, we understand from discussions with the company that – in the next few years – changes in demand are unlikely to be a major driver of its future investment costs in the distribution network. We also understand, as discussed in Section 2.5, that most of the cost associated with expansions to the network will be paid for by developers.

As such, we have not at this stage in the analysis incorporated any element of network costs into these LRMC estimates shown above.

4.3.3. Identifying appropriate volume assumptions used in the unit cost calculations

As described above, the unit cost of each project included in our estimation of Southern Water's supply curve uses (in the denominator of the calculation) each project's potential to provide DI to the network. This may understate the LRMC of serving demand for the following reason:[54]

- Southern Water (like all water companies) needs to plan for a range of possible demand and supply scenarios, so in a "normal" year, it is unlikely that all of the selected projects would need to operate at full capacity. Hence, because we use DI capacity in the denominator of the unit cost calculation and not expected production, we may understate the LRMC of serving a unit of increased demand in a normal year. We could therefore uplift the unit costs shown above to reflect this, though we do not have the utilisation data that would be needed to allow us to perform this calculation.

4.3.4. Accounting for seasonality in the marginal cost calculation

As explained above, demand for water peaks in the summer, and we understand from the company that some water resources projects are needed to ensure it can meet peak demand. However, some other projects are needed to ensure a balance between demand and supply – including ensuring resilience to particular drought scenarios – on a year-round basis. The analysis we conduct above does not account for this, and instead divides all projects by the DI they are capable of producing all year.

It is likely, therefore, that the estimates shown above understate the LRMC of serving demand in the summer, and overstate the LRMC of serving demand in the winter, though more work would be needed to understand the extent of this effect.

As explained in Section 4.1.2, incorporating time-of-use elements into the tariff design would improve the extent to which the costs of meeting demand are targeted on those customers consuming most in the summer months and thus contributing most to Southern Water's costs. It would therefore improve cost-reflectivity and fairness to introduce such seasonal variation into the tariff. Also, by setting higher prices in the summer than the winter, the tariff structure becomes more progressive, by targeting more cost on those customers that use water for non-essential purposes like garden watering and paddling pools.

[54] We assume that the volume of leakage is invariant to the amount of demand on the system for simplicity.

4.3.5. Externalities in water supply

4.3.5.1. Externalities in water supply may cause us to understate the societal LRMC of meeting water demand

The LRMC estimates shown above represent the "private costs" Southern Water incurs to serve increased demand. As such, they may understate the full costs imposed on society from doing so, for example in instances where the environmental impacts caused by the company's operations are not charged to the company through policy interventions such as traded markets for pollution permits (like the Emissions Trading Scheme used to price carbon emissions) or taxes.

In the context of the water sector, there are many externalities associated with abstracting, treating and distributing water to customers. Several environmental impacts are considered by Ofwat in its historic performance monitoring for water companies, which include (amongst other things):[55]

- Greenhouse gas emissions: Many water company activities, like water pumping, could have significant impacts on carbon emission. According to a report from Water UK, the water sector's total gross greenhouse gas emission is around 1.7 - 2.5 MtCO2e, depending on the approach used for the assessment.[56]
- Protecting water bodies: Abstracting water from the environment reduces the amounts of water available in naturally occurring water bodies, like rivers and streams. This can in turn harm animal and plant life that live there.
- Impact of construction activities: Constructing new water resource solutions like desalination plants and reservoirs can – in addition to any greenhouse gas emissions associated with them – impact positively and negatively on the local environment. For instance, new reservoirs can create and destroy habitats. Construction activities can also cause noise and disruption, which imposes costs on society.
- Pollution of water bodies: Operations in water and wastewater sectors could have considerable impacts on the environment. Any pollution incidents incurred in these operations would be damaging to the environment and biodiversity in the local areas.
- Sludge: Sludge will also have impacts on the environment. While some sludge may contain useful organic matters and nutrients to plants and soil, some sludge could also contain chemicals and pathogens that are detrimental to the environment.

The company and/or regulators may take steps to moderate the company's impacts on the environment, such as through permitting regimes or taking steps to minimise environmental impacts where possible, but if the costs of environmental impacts are not charged to the company through taxes or other fees intended to "internalise" externalities, they would not necessarily show up in an estimate of the LRMC like those shown above, derived from the company's private operating, capital and financing costs. As such, the LRMC estimates we

[55] Ofwat Website, Environmental impact, Link: https://www.ofwat.gov.uk/regulated-companies/company-obligations/performance/companies-performance-2011-12/environmental-impact-2012-13/, visited on 9 February 2022.

[56] Water UK (2021), Annual Emissions Report 2021, p.6.

derived would tend to understate the full societal costs of serving increases in water demand in Southern Water's region.

4.3.5.2. Quantifying environmental externalities associated with water supply

Many of the externalities listed above are hard to quantify, both in terms of the volume of their effect (i.e. how much of the externality is created) and monetise (i.e. how much the bad effect costs to society in monetary terms). And, such a quantification is beyond the scope of this report, save that we have been able to quantify the effect of carbon emissions. To do this:

- We use Southern Water's WRMP19 data on the estimated total operational carbon emissions per year for each project included in the supply curves shown above. Using the annual operational carbon emission divided by the annual output for the corresponding option, we obtain the carbon emission per cubic metre of water produced for each option.
- We then multiply these costs by the carbon prices (traded sectors) published by the Department for Business, Energy and Industrial Strategy (BEIS) for 2030. BEIS estimates the Low and High carbon prices to be £45.29 and £135.89 per ton of CO_2 emissions, in 2022/23 prices.[57] These calculations allow us to work out by how much Southern Water's water resource supply curve (and hence LRMC) would increase, if we priced in the externalities associated with Southern Water's carbon emissions.

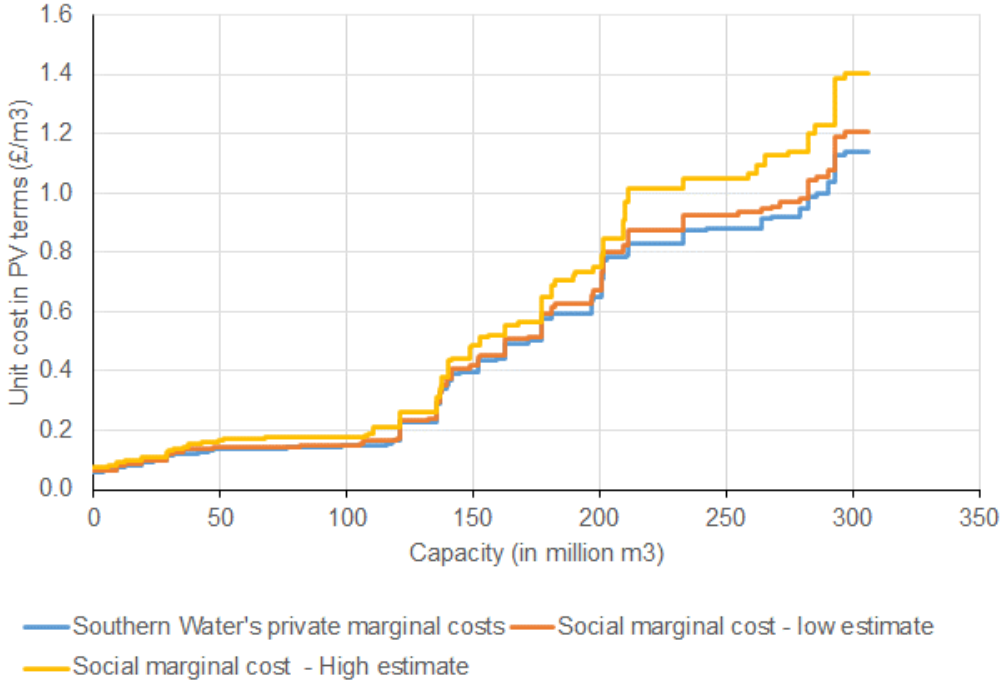
However, as noted above, other externalities associated with water supply such as the impact on biodiversity are more difficult to quantify. Hence, to provide an illustrative range, we assume these externalities range between 10 per cent of the value of the carbon impacts we estimate using the BEIS low case, and 50 per cent of the carbon emission costs we estimate in the high case. Hence, we apply the 10 per cent uplift to the low estimate of carbon emission costs, and 50 per cent uplift to the high estimate.

Using these scenarios, we uplift the unit costs of water production for each of the options depicted in Figure 4.3 by their corresponding carbon costs and assumed costs associated with other externalities. We then re-estimate the supply curve to take into account the costs associated with carbon and other externalities costs, as shown in Figure 4.4. This calculation shifts the supply curve upwards by up to around £0.3 per cubic metre.

However, the adjusted estimate of LRMC is implied by this graphic, up to around £1.40 per cubic meter, is still below the current volumetric tariff charged by Southern Water. While the illustrations in this graphic are driven by assumptions that could benefit from further investigation, in particular the assumption on how to value other non-carbon externalities, this suggests that the current volumetric price charged to customers is above the LRMC of Southern Water's water resources, though as noted above, there are a number of other reasons why these unit costs may understate Southern Water's LRMC.

[57] BEIS (April 2019), Updated Short-Term Traded Carbon Values used for UK Public Policy Appraisal, Table 1.

Figure 4.4: NERA Estimates of Southern Water's Water Resource Supply Curve, with Assumed Costs for Carbon and Other Externalities



Source: NERA analysis of Southern Water's WRMP19 data with BEIS's carbon values estimates.

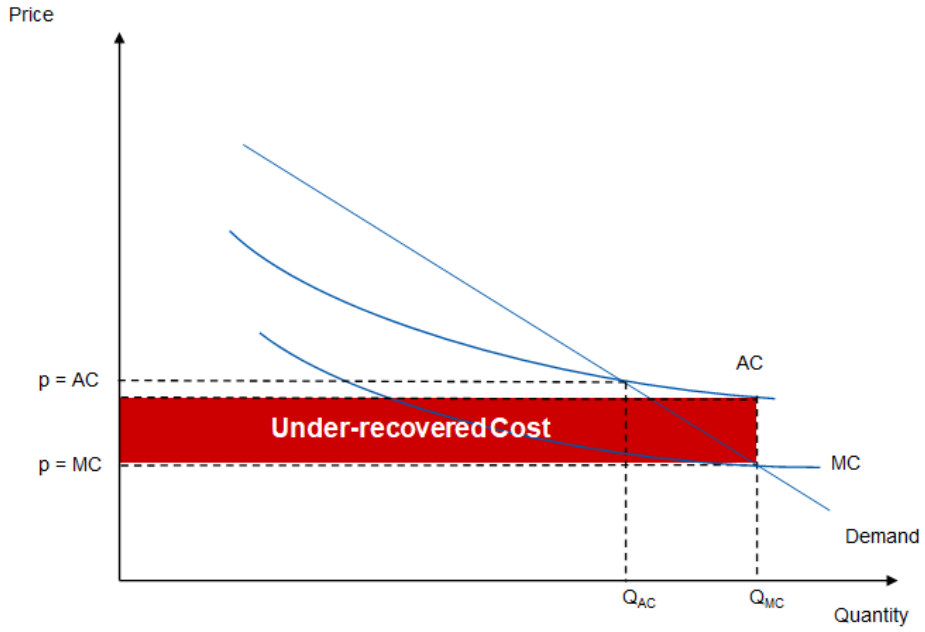
4.3.6. Recovery of residual costs under an LRMC methodology

4.3.6.1. Tariff design options

As explained above, a theoretical advantage of a marginal cost approach to tariff setting is the ability to send an efficient price signal that reflect the costs imposed by incremental changes in demand. This price signal should be sent through a charge which is "avoidable" or varies with customers' consumption behaviour. This allows customers to trade-off the benefits they derive from consuming water against the costs their consumption creates.

However, setting prices equal to an estimate of marginal cost will not usually (except by coincidence) generate enough revenue to recover the utility's revenue requirement. The difference between the revenue earned under marginal cost prices and the revenue requirement is often called "residual" costs (see Figure 4.5 for an illustration).

Figure 4.5: Under-recovery Under Marginal Cost Pricing



To recover the revenue requirement efficiently, the marginal cost methodology prescribes that the residual should be recovered in a way that avoids distorting the consumption decisions that customers would take in response to the price signals conveyed by marginal cost component of the tariff alone.

There are three commonly cited methods to recovering residual costs in a marginal cost-based tariff:

A. Ramsey pricing recovers residual costs based on the relative elasticities of demand for different classes of customers. Those classes with the highest price sensitivity will be charged the price closest to marginal cost (hence recovering less residual cost) while those that are least likely to respond to price will be charged the price that deviates the most from marginal costs (reflecting more residual costs).

B. However, recognising that it can be challenging to identify the price elasticity of demand for all customers, another option is to recover residual costs based on a charge levied on a billing determinant which is least likely to distort customer behaviour (and the price signal sent by the marginal cost component of the charge). In this context, this is likely to be a per customer fixed charge.

C. Another method to recoup residual costs is to apply a proportional mark-up to the marginal-cost component of the charge. This approach is relatively simple to administer, and can result in a similar outcome to Ramsey pricing if customer classes that impose the highest marginal costs also have the least price elastic demand. However, it distorts the marginal cost price signal, and so undermines the economic efficiency properties of marginal cost pricing.

4.3.6.2. Appraisal for Southern Water's context against relevant tariff design criteria

Of these methods, Ramsey pricing (A) would help achieve Southern Water's objective of making the tariff more progressive and protecting more vulnerable customers if their demand for water is more price sensitive because they face budget constraints. However, it comes with a number of challenges:

- First, it is hard to identify customers' price elasticity of demand, so this method is rarely used in practice.
- Also, because some water usage is essential, it may be the case that customers with the most price inelastic demand are the customers consuming least, while customers using water for less essential purposes like garden watering might have more price elastic demand, and could therefore end up paying less under this approach.
- Another challenge is that Ramsey pricing inherently involves pricing based on the value customers place on water, which departs from the Ofwat requirement for cost-reflective tariffs.

Option C, of applying proportional mark-ups to marginal costs, is unlikely to generate the efficiency improvements that a marginal cost methodology seeks to achieve as it would simply mark-up marginal cost estimates to the level required to achieve cost recovery (as under an embedded approach).

Option B may therefore be preferable if Southern Water were to implement a marginal cost based methodology, which involves identifying the billing determinants through which residual costs could be recovered in a way least likely to affect customer decisions on how much water to consume. However, this approach is likely to lead to a charge that recovers residual costs through a fixed per customer, which also raises two challenges.

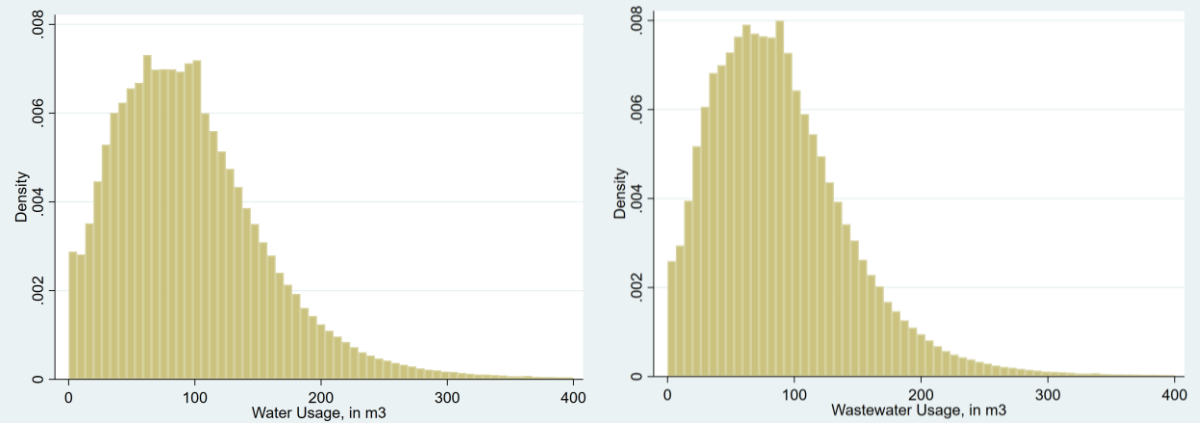
First, this approach would inherently result in a less progressive tariff, and may not perform well against a fairness criterion that could be interpreted as requiring that customers which consume more water or use more water for non-essential purposes bear a higher share of the costs. To illustrate this, we have considered two scenarios:

- Scenario 1: We assume a volumetric charge of £1.14 per m^3 based on the LRMC estimated in Figure 4.3 of Southern Water's costs only (i.e. excluding externalities and ignoring the small high-cost projects shown in the figure).
- Scenario 2: We assume a volumetric charge of £1.40 per m3, using the same LRMC as in Scenario 1, but adding the assumed high cost of carbon and other externalities, as shown in Figure 4.4.
- Both these scenarios involve a volumetric tariff lower than the current (2022/23) Southern Water tariff of £1.55 per m^3, so require that some of the company's revenue requirement be recovered through a residual charge. The 2022/23 standing charge is £18.81, which we estimate would need to increase to £58.73 in Scenario 1 and to £33.35 in Scenario 2.
- We estimate these changes in standing charge using household billing data provided by Southern Water. We construct the distribution of Southern Water customers' annual

consumption (see Figure 4.6),[58] and exclude customers with extremely high annual consumption above 400 m^3 per year which we assume arises from anomalous data, obtaining average household water consumption of 97.32 and wastewater volume of 89.59 m^3 per year. As expected, the distribution is skewed to the right, i.e. there are some customers with very large demands relative to average such that median consumption is lower than the mean.

- We assume no change in demand or costs as a result of this tariff change for simplicity. For the sake of this illustration, we consider this assumption is reasonable. Because volumetric tariffs are set equal to LRMC, any change in costs caused by a change in demand would result (in the long-run) in a change in tariff revenue roughly associated with the change in costs.

Figure 4.6: Distribution of Water and Wastewater Consumption by Southern Water's Customers



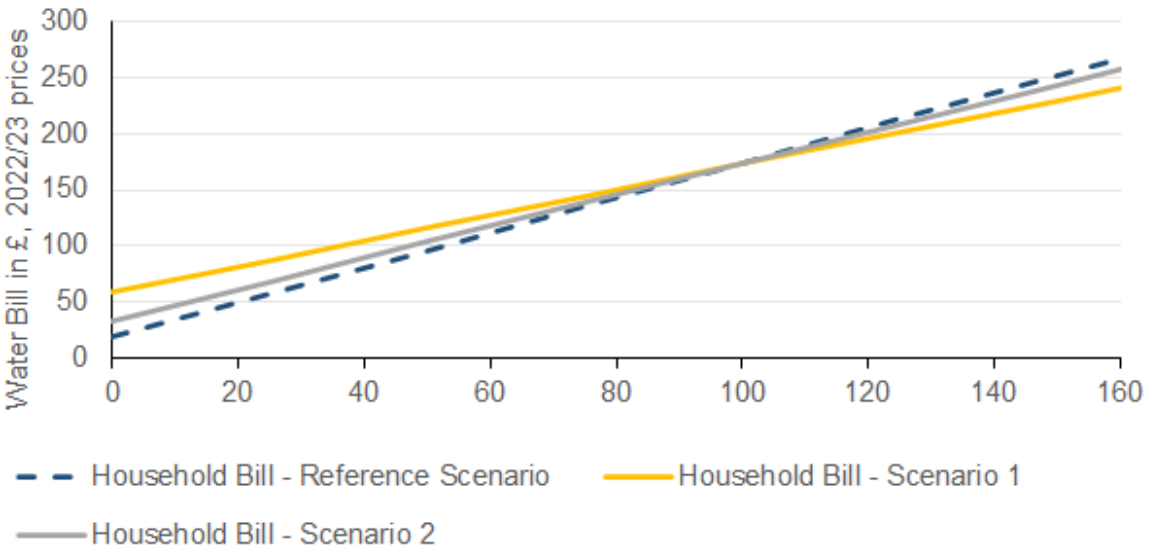
Source: NERA analysis of Southern Water household billing data

Note: On the y-axis we use density, as the figure represents an approximation to a probability density function. The density scales the height of the bars so that the sum of their areas equals one, where the height of the bars reflects the frequency of consumption that falls within each consumption range (e.g. 0-5m3).

Following this approach, if Southern Water set the volumetric tariff equal to the LRMCs assumed in scenarios 1 and 2, it would result in higher bills for all customers consuming up to around 100 m^3 per year, as illustrated in Figure 4.7. Hence, using the LRMC approach to send efficient price signals while also recovering residual costs through a higher standing charge would result in a less progressive tariff structure than the current one, therefore failing on the fairness criteria identified in Section 3 above.

[58] We construct a measure of annual consumptions for around 1.4 million individual households using readings collected between January 2019 and December 2021.

Figure 4.7: Bill Impact under LRMC Pricing with Residual Costs Recovered through a Change in the Standing Charge



Source: NERA Analysis with Southern Water data

Second, the recovery of residual costs through a standing charge would have no basis in cost-reflectivity. While this is an inherent feature of the marginal cost methodology, i.e. the marginal cost-based tariff signals the costs imposed by changes in demand while the residual costs are recovered in a way designed not to affect consumption decisions, it means a substantial portion of Southern Water's costs could be recovered through a per customer charge. In theory this promotes efficiency, but it may raise customer acceptance challenges if customers (or their representatives, such as Customer Challenge Groups) object to paying higher tariffs before customers have consumed any water. For these reasons, some negative publicity has surrounded the recent increases in the standing charge component of Ofgem's retail energy price cap.[59]

Recovering residual costs through the standing charge may also – because of the way we have estimated LRMCs above – understate the long-run costs associated with serving changes in demand. Specifically, as explained above in Section 4.1, we understand from the company that the long-run historical costs of the network – and likely the future costs of replacing network assets – are driven by the need to meet peak demand, and some ongoing costs in network operations and maintenance are driven by the need to avoid leakage and therefore implicitly avoid Southern Water having to provide alternative supplies from other sources. As such, even if the marginal costs associated with demand growth in the network are low, some ongoing and historical costs are intended to reduce the costs of providing water and would likely be avoided if consumption fell.

Hence, a residual cost recovery charge used to recover the share of the revenue requirement not recovered through the LRMC tariffs shown above that is entirely invariant to

[59] The Guardian (6 March 2022), Why is my standing charge up by 80%? Energy firms pile on the agony, Link: https://www.theguardian.com/money/2022/mar/06/why-is-my-standing-charge-up-by-80-energy-firms-pile-on-the-agony. Visited on 8 March 2022.

consumption would certainly not be cost-reflective. In fact, as set out in Section 4.1, it is likely that a cost-reflective tariff design would involve some share of distribution network costs being linked to customers' peak demand during the summer period. Moreover, as explained in Section 4.3.4, the LRMCs we have estimated likely understate the LRMC of water resource costs of serving demand in the summer.

Further study could identify the extent to which these effects justify a summer-peaking tariff based on cost-reflectivity grounds. However, these reasons could provide a justification – even without further work – for considering an approach that recovers residual costs from a summer tariff as an improvement on the current design.

This approach also has advantages in terms of its ability to generate a more progressive tariff structure. First, it means customers who are using water for less essential purposes, like garden watering, bear a higher share of the costs than customers who use water only for essential purposes. This may have advantages in terms of equity and protecting vulnerable customers, by recovering higher shares of cost from customers who are likely to be more affluent, i.e. it is reasonable to hypothesise that customers using more water for non-essential purposes, such as watering a large garden or filling a swimming pool, will tend to be more affluent, and this consumption primarily takes place in the summer (see Figure 4.1).

Time-of-use tariffs may be difficult to implement in the short-run, as charges based on different time of usage would require the installation of smart meters to allow water companies to record not only the water usage but also the timing of consumption. Therefore, the implementation of a time-of-use tariff may become feasible in the future following the rollout of smart meters.

In addition, Southern Water would need to consider the implication for New Appointment and Variations (NAVs) when setting a tariff structure. NAVs are 'inset' licensees for small areas of the country, which compete with the incumbents to the right to supply last-mile infrastructure and retail services to new development sites. Ofwat caps NAVs' end-user prices in-line with incumbents according to its "no worse off" principle. As NAVs charge the same as incumbents, or slightly less, Southern Water would need to make sure that its time-of-use charges are replicable.

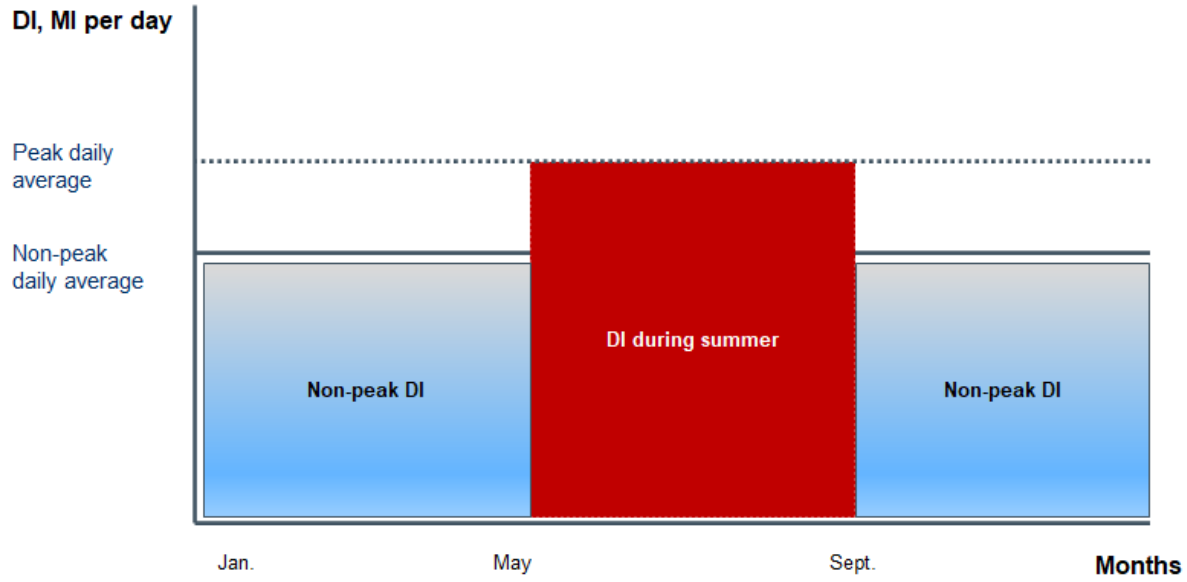
4.3.7. Calculating a higher volumetric charge for the peak summer period

As described above, designing a time-of-use tariff requires a detailed analysis of consumers' usage patterns and setting charges for peak and non-peak times accordingly to ensure the company can recover its relevant costs. We illustrate this process below.

As a first step for calculating a volumetric charge that differentiates between peak and non-peak periods, we need to quantify the amount of consumption observed in the summer months. We calculate the summer (May to September) and year-round daily DI for the period 2002-2022 using Southern Water's data. This is shown in Figure 4.8 below, where the area shaded in red represents the water consumption occurring in the summer. We calculate that this extra peak consumption accounts for 34 per cent of total water consumed in a given year, for both household and non-household.

We then subtract from these quantities the average daily leakage that occurred in 2020-21 using Southern Water's most recent Annual Performance Report.[60] We do this to obtain a measure of consumption rather than DI.

Figure 4.8: Graphical Representation of our Approach to ToU Tariffs



We assume that Southern Water charges for consumption outside this peak period using an LRMC of £1.14 per cubic meter, such that Southern Water will under-recover its revenues. Hence, under this potential tariff structure, the tariff would be marked-up during the summer period to recover total costs. Therefore, the volumetric tariff, in £ per cubic meter that applies during the summer would be higher by £1.19 per m3, as Table 4.1 shows.

[60] Southern Water reports leakage equal to 98.4 Ml/d in 2020/21. See Southern Water (July 2021), Annual Performance Report 2020-21, 3F – Underlying calculations for common performance commitments – water and retail .

Table 4.1: Calculation of Volumetric Charge for Non-Essential Consumption in the Summer, 2022/23 prices

	Data	Calculation	Source
Average consumption, in m3	97.32	A	HH water consumption data
Number of households	1,418,545	B	HH water consumption data
Overall consumption, in m3	138,052,799	C = A x B	
Share of summer consumption over total consumption	34%	D	NERA's assumption based on data on DI
Total summer consumption, in m3	47,606,298	E= D x C	
Residual costs if using LRMC, and SW standing charge, £	56,623,351	F	Under-recovered costs based on HH water consumption data
Additional charge to be applied to consumption in summer, £ per m3	1.19	G = F / E	

Source: NERA analysis of Southern Water data.

In Table 4.2 we provide examples for households that consume up to 100 per cent more during the summer relative to the rest of the year, for different levels of annual water consumption. We apply the uplift of volumetric charge calculated in Table 4.1, to summer consumption, while the lower £1.14 per cubic meter charge will apply in the other months.

As we show in Table 4.2 below, once we apply these two different volumetric charges, the bill of a given household could be smaller or larger than under the current tariff structure. Customers with flat consumption all year round or consume more in the winter would see a reduction, while consumers consuming more in the summer would pay more.

However, the increase shown below for customers that consume more in the summer months likely represents a conservative estimate as we expect some categories of customers to consume even more during the summer months than the scenarios shown in the columns of Table 4.2 suggest. For example, customers with second homes who spend only a limited amount of time in their properties outside of the summer months could face a material increase.

In addition, as we discuss above, the results depicted in Table 4.2 are likely to be an understatement of the summer-winter spread because the LRMC we have estimated is flat throughout the year. We expect the marginal cost of maintaining the water supply demand balance to be lower in the winter than in the summer. A more detailed LRMC analysis would be needed to assess the appropriate seasonal spread more accurately.

Table 4.2: The Effect of Households' Bills of Introducing a Peak Tariff, 2022/23 Prices

		Percentage difference between daily summer and winter consumption				
Total annual water consumption, in m3	**Total water bill under current SW tariffs £**	**-10%** £	**0%** £	**10%** £	**50%** £	**100%** £
50	96.30	-2.04	-0.67	0.61	4.99	9.24
75	135.04	-3.06	-1.01	0.91	7.49	13.86
100	173.78	-4.08	-1.34	1.22	9.99	18.48
125	212.53	-5.09	-1.68	1.52	12.48	23.10
150	251.27	-6.11	-2.01	1.83	14.98	27.72

Source: NERA analysis of Southern Water's data.

4.3.8. Rising block tariff structures as an interim solution

As set out above, it is likely that improvements to the cost-reflectivity of Southern Water's current tariff design would both (a) better meet the tariff design objective of cost reflectivity, and (b) result in a more progressive tariff design. However, the more progressive tariff structure comes about mainly from implementing time-of-use charges that set higher tariffs in the summer period. This change in tariff design would be challenging to implement before Southern Water has deployed smart meters across its network that are capable of recording time-of-use. In the absence of smart meters, it would require all meters to be read at the start and end of the summer charging period, which is likely to be impractical.

Given the difficulty of implementing a time-of-use tariff structure before the rollout of smart meters, an alternative, interim option for Southern Water could be the use of higher tariffs on consumption above a certain threshold.

This could involve setting a lower volumetric charge than at present (e.g. we assume at the level of the estimated LRMC of £1.14 per m^3 in Scenario 1 and £1.40 per m^3 in Scenario 2 for the sake of illustration). The remainder of the revenue requirement not recovered from these lower volumetric charges or through the existing standing charge would be charged through a mark-up on the tariff for all consumption above a pre-defined threshold.

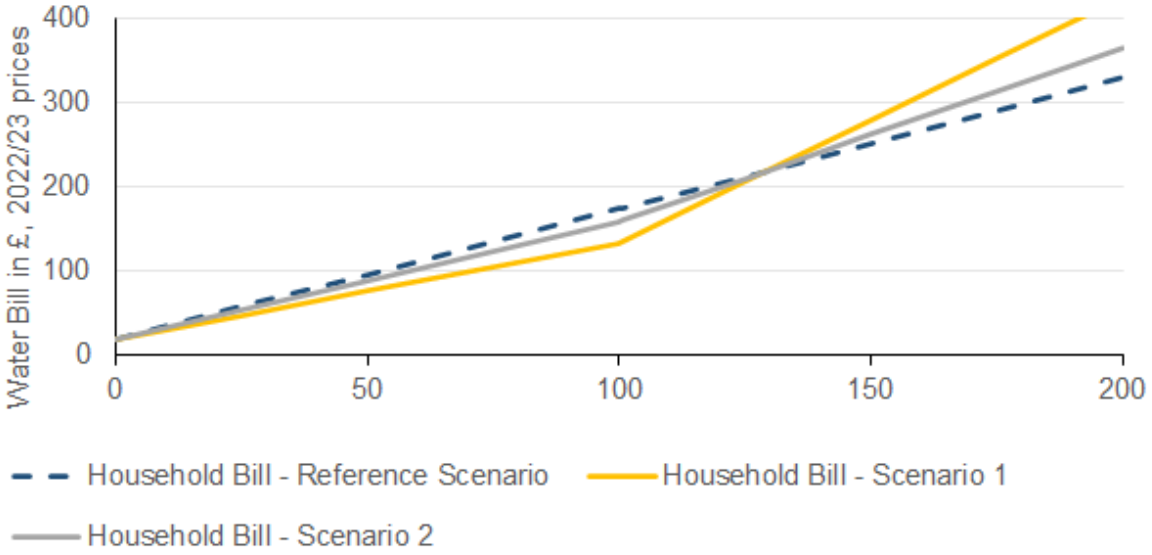
For illustration purposes, we use a threshold for high consuming households of 100 m^3 of water per year. This threshold is inherently arbitrary, but it means that the top 40 per cent of households by consumption would face this higher tariff "on the margin". That is, all households would pay £1.14 or £1.40 per m^3 for the first 100 m^3 of consumption, though for each m^3 above this level they would pay a higher fee.

Figure 4.9 shows the effect of this increasing block tariff structure on customers' bills, compared to the reference scenario where the customer is charged according to Southern Water's current tariffs. As customers pay the same standing charges as currently, and the volumetric charge is set at the LRMC, customers who consume below the threshold will pay less than under Southern Water's current tariff structure. After consumption hits the threshold, the new volumetric charge, made up of the initial LRMC and the additional component designed to recover the remaining revenue requirement applies. Therefore,

customers consuming up to around 130 m^3 per year pay less, while customers using more than this amount pay more.

Therefore, in contrast to the case where residual costs are recovered through a standing charge, introducing an uplift to the volumetric charge for households who consume more leads to a more progressive charge. This approach does not rely on the rollout of smart meters so may be implementable more quickly.

Figure 4.9: Illustrative Bill Impact under a Rising Block Tariff



Source: NERA analysis of Southern Water data

The rationale for this type of progressive tariff structure would be grounded in cost reflectivity less directly than some of the methods set out above:

- The rationale underpinning it would be an equity objective that all customers should have an entitlement to access a defined volume of water per household at a particular rate, with the burden for paying the higher tariff levels needed to fund the full costs of the system only falling on customers consuming the largest amounts.
- It could arguably have some grounding in cost-reflectivity because: (a) if all customers were to consume their deemed, necessary entitlement and no more, then Southern Water's costs may be lower; (b) hence any additional costs of consuming above this level could be targeted only on those customers consuming more than their entitlement. Identifying the costs associated with serving this minimum requirement could be done by constructing cost allocation rules that estimate the change in costs that would be associated with customers taking only their entitlement, e.g:
  - Estimating the average costs of the system that would be incurred in a scenario in which Southern Water's customers all took no more than 100m^3 of water, which would give a volumetric tariff charged on all consumption volumes, then any deficit compared to Southern Water's actual revenue requirement would be charged through a mark-up on the tariff payable on volumes over 100m^3 per household per year.

- However, it is likely this tariff would perform less well at charging the higher rates necessary to recover total cost from those customers using most water for non-essential purposes, such as garden watering. This approach would charge all customers more when their consumption rises above defined thresholds, irrespective of the reason. Hence, high occupancy homes could pay more, even if those households had relatively low per capita consumption and/or low incomes.
  - This could be addressed to some extent if the entitlement were defined in per capita terms instead of per household, but this would be challenging in practice, as Southern Water would need accurate information on the occupancy of each household it supplies, which would be challenging to achieve.

4.3.9. A minimum charge for metered customers as an interim solution

As an alternative interim solution, we have also considered the possibility of a minimum charge for metered customers. Such a charge would ensure that all customers contribute at least some pre-defined share of Southern Water's costs. This tariff option might have some benefits in terms of becoming more progressive, as customers with holiday homes consuming very little water could potentially pay more. However, it would also have the effect of charging more to customers consuming the least amount of water for other reasons (such as people living alone in small properties), so it would likely not achieve Southern Water's objective of making the tariff more progressive.

It would likely also perform poorly in terms of its ability to send signals to customers that reflect the cost of supplying them. For instance, the marginal cost of an additional unit of water would be zero for customers likely to be within the cap, which would discourage efficient water conservation.

We have therefore not considered this tariff option further in this report.

4.4. Evaluations of Alternative Tariff Structures

The table below provides a high-level summary of the alternative tariff structures, evaluated against the criteria defined in Section 3.1. We have colour-coded each option against the evaluation criteria:

- Red: the tariff performs poorly relative to the evaluation criterion;
- Amber: the performance is mixed relative to the evaluation criterion; and
- Green: the option performs very well relative to the evaluation criterion.

As discussed above, the introduction of time-of-use tariffs would make Southern Water's tariff structure more cost reflective and more progrssive, but it would be more demanding to implement as it requires the rollout of smart meters.

Table 4.3: Summary Evaluation of Tariff Design Options Against Relevant Criteria

	Cost Reflectivity	Recovery of the Revenue Requirement	Fairness	Stability and Predictability	Practicality
Current Tariff Structure	• Reflects average costs • Simplistic assumption that wholesale costs scale with volume	• All options perform similarly well in allowing recovery of the revenue requirement	• All customers pay a tariff set in a similar way and face the same per unit charge	• Simple tariff structure helps customers to predict their water bills	• Easy to implement • Easy for NAVs to replicate
LRMC with High Standing Charges	• Higher standing charge not designed to affect consumption decisions. • Potentially understates the long-run costs associated with serving changes in demand	• All options perform similarly well in allowing recovery of the revenue requirement	• Customers consuming less pay a higher standing charge so the tariff becomes less progressive, contrary to Southern Water's objective	• Simple tariff structure helps customers to predict their water bills	• Easy to implement • Easy for NAVs to replicate
LRMC with Time of Use Tariff	• Summer peaking tariff improves on annual average LRMC by reflecting higher network and water resource costs in summer months	• All options perform similarly well in allowing recovery of the revenue requirement	• Higher tariffs to recover residual costs and signal LRMC targets those customers who use more water for less essential purposes	• More difficult for customers to understand how their consumption behaviour affects final bills, though could be mitigated through customer communications strategy	• It relies on the availability of smart meters to record customers' time-of-use. • Requires coordination with NAVs to ensure it is replicable
LRMC with Rising Block Charges	• Limited justification in cost-reflectivity, as threshold is arbitrary • But, tariffs for most customers could be calibrated to equal LRMC	• All options perform similarly well in allowing recovery of the revenue requirement	• Higher tariff for customers consuming the largest amounts • High occupancy homes could pay more	• More difficult for customers to understand how their consumption behaviour affects final bills, though could be mitigated through customer communications strategy	• Easy to implement, after choosing threshold for increased volumetric charge • Requires coordination with NAVs to ensure it is replicable

4.5. Impact on the Social Tariff Scheme

As explained in Section 2, Southern Water's existing social tariff scheme offers a cross-subsidy from the generality of customers through a mark-up on the standing charge, allowing some customers to obtain a discount when they meet defined eligibility criteria. The evidence used to justify this cross-subsidy is the finding from Southern Water's willingness to pay research, showing that customers were – on average – willing to pay this additional charge to fund a cross-subsidy. This approach reflects Defra's social tariffs guidance, that requires water undertakers to communicate with their customers regarding the value of cross-subsidies and who will be responsible for cross subsidising these social schemes.

Therefore, any effort by Southern Water to make the tariff structure more progressive without a grounding for the changes in cost causation or other tariff design objectives would likely require further evidence from engagement with the generality of customers that they are willing to pay for it. Such evidence could potentially increase the total amount of cross-subsidies available for vulnerable groups.

For instance, to support its efforts to make the tariff design more progressive, Southern Water could conduct willingness to pay research to test the possibility of expanding the coverage of social tariffs.

However, it is also important to note that customers' willingness to pay higher tariffs that enable cross-subsidies may change over time:

- First, a more progressive tariff structure, like the time-of-use or rising block tariffs, may lead to an increase in water bills for customers with higher water consumption or lower price elasticity of demand. This, in turn, could reduce their willingness to cross-subsidise less affluent groups. Therefore, new willingness to pay research would ideally be needed to assess how customers' willingness to cross-subsidise changes as water bills rise anyway for more affluent households due to other changes in tariff design.
- Also, customers' willingness to pay higher tariffs to cross-subsidise those paid by poorer households may depend on economic conditions that change over time. Notably, the ongoing "cost of living crisis" due to inflation in energy and food prices may significantly reduce customers' willingness to pay higher water bills (though may also create some urgency in tariff reforms that protect less affluent customers).
- Willingness to pay research outcomes may also be sensitive to the method deployed to perform the research, resulting in instability over time in the amount of money available to support social tariff schemes.

While WTP studies are an important tool for understanding customer preferences, and are also required by Government guidance, the outcome from this research may result in some uncertainty and possible instability in tariffs over time as customers' WTP changes. If Southern Water is seeking to make its tariff structure more progressive, we would suggest that improvements that both make the tariff more cost reflective and improve cost-reflectivity would better meet the tariff design criteria in Section 3. However, all such changes in tariff would need to be subject to engagement with customers.

5. Conclusions

5.1. Assessment of the Current Tariff

Under Southern Water's current tariff structure, the company offers three different types of charge, applying to both water and wastewater customers and depending on whether the property has a meter or not. The majority of Southern Water's customers have meters installed at their properties. They pay a measured charge, which includes a standing charge and a flat volumetric rate per cubic meter of water consumed.

Southern Water's current tariff methodology recovers the large majority of its costs – its wholesale water costs – through a tariff per cubic meter of consumption, reflecting the underlying assumption that wholesale water costs are entirely related to the volume of water supplied. Southern Water also collects standing charges to recover its retail costs, on the basis that these costs are driven by the number of customers served, and are therefore invariant to consumption levels. In addition, Southern Water also recovers the cost of cross subsidising some vulnerable groups through the WaterSure and Essentials tariff schemes through its standing charge. The amount of cross-subsidy per customer is derived from Southern Water's willingness to pay research.

Southern Water's existing tariff design is consistent with Ofwat's Charges Scheme Rules. Ofwat's Charges Scheme Rules require charges to reasonably reflect the costs imposed by different classes of customers. Southern Water's existing tariff design appears to be (a) cost-reflective, since the underlying assumptions on cost structure reflected in the tariff are reasonable, and (b) fair, in the sense that all customers pay a tariff set in a similar way and face the same per unit charge.

5.2. Potential Improvements to the Current Tariff

5.2.1. Better aligning the structure of Southern Water's tariff with its cost drivers

While the current tariff design can reasonably be said to meet the relevant objectives, we believe there are potential improvements to Southern Water's tariff structure that would (a) meet Ofwat's criteria at least as well as the current methodology; and (b) make the tariff design more progressive.

For example, the assumption built into the current tariff structure – that the cost of serving customers scales linearly with the volume they consume – is unlikely to be accurate. Currently, Southern Water's tariff approach assumes the costs recovered through the wholesale price control vary linearly with the level of water consumption. The current tariff design could be made more cost reflective if some of the wholesale price control were recovered through billing determinants other than volume of supply, such as fixed charges or customers' contributions to peak demand. Such changes have the potential to make the tariff design more cost reflective, though could make the tariff either more or less progressive.

5.2.2. The potential to improve efficiency through marginal cost pricing

There may also be potential to improve efficiency by reflecting the LRMC of supplying changes in demand in Southern Water's tariff. This approach may better reflect the costs

Southern Water incurs to serve changes in demand than Southern Water's current average cost approach. For instance:

- To the extent significant scale economies in water distribution mean LRMC is permanently lower than average distribution costs, a reduction in the tariff customers face "on the margin" to reflect LRMC could avoid deterring efficient water use.
- However, probably more significantly, the LRMC of water resources (abstraction, treatment, etc) needed to meet demand in a water scarce region could be substantially higher than the average costs of these activities reflected in the current tariff. Hence, a tariff set to reflect LRMC could reflect the scarcity value of water in the region, and encourage efficient conservation.

A marginal cost based methodology could send signals to customers regarding the value that their efforts to save water generate, or their decisions to consume more water impose, on demands for water in the region. By charging the additional cost the water company incurs to serve an additional unit of demand, it therefore encourages efficiency in water use.

5.2.3. An indicative estimate of LRMC

Using information from Southern Water's WRMP19 on a list of preferred options for the company to meet expected water demand, including the costs of water abstraction, treatment, distribution costs as well as carbon costs and assumed costs associated with other externalities, we have prepared an approximate estimate of Southern Water's LRMC.

The results shows that the LRMC is below Southern Water's current volumetric tariff of £1.55. This result suggests on the face of it that restructuring tariffs to lower the volumetric tariff would improve the efficiency of consumption decisions, but whether this makes the tariff more progressive would depend on the methods used to recover residual costs, as this lower tariff equal to an estimate of LRMC would not generate enough revenue to recover the revenue requirement.

We have considered different approaches that Southern Water could consider to recovering these "residual" costs (i.e. the difference between its revenue requirement and the revenue yielded by tariffs equal to LRMC) against relevant tariff design criteria, including the questions of whether these alternatives would make the tariff structure more cost reflective and/or more progressive.

5.2.4. Options considered for residual cost recovery

We considered the following options for the recovery of residual costs: (a) an uplift of the standing charge, (b) a time-of-use tariff with a higher volumetric charge for the peak summer period, and (c) a rising block tariff structure.

We find that adopting LRMC pricing and recovering the residual costs through higher standing charges results in higher bills for customers with lower water consumption per year relative to the current tariff structure. As a result, this leads to a less progressive tariff structure, failing on the fairness criterion identified in Section 3. We find it would also not be

cost-reflective and could also understate the long-run costs associated with serving changes in demand, given the way we estimate Southern Water's LRMC.[61]

By contrast, we find that the use of LRMC pricing alongside a mechanism to recover residual costs through a summer-peaking, time-of-use tariff would make the tariff more cost reflective and more progressive.

- Historically we understand that Southern Water's water distribution network and treatment capacity have been sized to meet peak demand requirements. Therefore, the levels of usage in off-peak periods do not contribute materially to the required capacity costs, so a summer-peaking tariff would reflect this feature of Southern Water's cost structure.
- While water resources costs are to some extent driven by the need to ensure water supply all year (as we have assumed in our LRMC estimate), we also understand that some water resource costs are incurred to ensure the company can meet demand during the summer peak. A time-of-use tariff that recovers a portion of Southern Water's costs through a summer tariff could therefore be more cost reflective than the current tariff design.
- In addition, by introducing a higher charger during peak months, this tariff is also more progressive than the current methodology, as it targets those customers who use more water for less essential purposes, or households with second homes within the Southern Water's region whose water consumption in the summer is likely to be higher than in the winter.

However, the introduction of time-of-use tariff relies on the availability of smart meters to record when customers use water. Therefore, an alternative, interim option for Southern Water could be the use of rising block tariffs, where a higher volumetric tariff on consumption above a certain threshold is introduced. This tariff would be progressive in the sense that it imposes higher tariff levels to recover residual costs only on customers consuming the largest amounts. It could also be more cost-reflective, in the sense that households consuming the highest volume may contribute more to the capital costs of the water system that households that consume less water. However, high occupancy homes could pay more, even if those households had relatively low per capital consumption and/or low incomes. It therefore performs less well at making the tariff more progressive than the alternative option to use time-of-use pricing.

5.3. Next Steps

As set out above, we consider that the tariff design that best meets the relevant tariff design criteria of improve cost reflectivity and making the tariff more progressive would be to introduce time-of-use pricing, which would introduce a summer-peaking tariff. However, a phased implementation may be required to allow time for the installation of smart meters.

[61] Our result is potentially an understatement of the summer-winter spread because the LRMC we estimated is flat throughout the year. We expect the marginal cost of maintaining the water supply demand balance to be lower in the winter than in the summer. A more detailed LRMC analysis would be needed to assess the appropriate seasonal spread more accurately.

For any tariff reform, Southern Water would need to engage with its customers to gather views on alternative tariff structures.

Southern Water would also need to consider the implication for NAVs when revising its tariff structure, as these licensees need to be able to replicate the company's retail tariffs to adhere to Ofwat "no worse off" principle.

Qualifications, assumptions and limiting conditions

NERA Economic Consulting ("NERA") was commissioned by Southern Water to advise on potential improvements to its current tariff structure. The primary audience for this report includes regulators of the English and Welsh water industry, notably Ofwat.

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