South Staffs Water

Cost adjustment claim for topography

Submission 9th June 2023

EXECUTIVE SUMMARY:

South Staffs and Cambridge Water is an efficient company as shown in Ofwat's models both recent and historic. However our unique topography circumstances mean that we have increased pressure on our power and capital maintenance costs as a result of higher energy use and the use of larger capacity pumping assets in order to supply water to the elevations where many of our customers are located.

Ofwat's models are not appropriately funding the efficient costs of network topography for us or the sector. This is primarily because the choice of cost drivers to represent topography that Ofwat proposes to use in its PR24 model suite is not robust with regard to engineering and operational rationale. This creates a material funding gap going forward.

We have no choice but to fund our power cost and other asset related costs that result from our topography factors. If PR24 models do not fund these costs appropriately it means that other investments and obligations, which are important to customers, may suffer over the long term, as we have to trade off those additional investments to meet our topography cost obligations. On a like for like basis with other companies (which Ofwat uses econometric models to assess) this means that not using appropriate cost drivers puts us at a significant disadvantage compared to the sector.

In this claim we present detailed information on the impact of our physical topography in our SST supply area on our asset configuration and costs, demonstrating the link to where our customers are located.

We provide detailed and strong arguments showing the engineering and operational rationales for the average pumping head and boosters per length of mains cost drivers, looking at bottom up engineering evidence and top down, sector level, data correlations.

We show the wide range of modelled allowances that result from different model configurations, and derive a claim value of £45m over five years, taking into account implicit allowance and a fixed catch up efficiency challenge. This claim value is based on historic modelled data up to 2021/22 and does not include the impact of recent and future power price increases.

We also present evidence on the extensive activity we do to try and mitigate the impacts of topography on our costs, but fundamentally we cannot change the locations of our customers and so material impacts on cost are not possible.

1. Introduction

This claim is required because of uncertainty surrounding Ofwat's modelling choices to appropriately reflect our high network topography in our cost allowances for PR24.

We raised this issue in our response to Ofwat's April 2023 cost modelling consultation and we discussed the importance of this issue in our meeting on 11 May with Andrew McGeoghan of Ofwat.

In this claim we will demonstrate why the choice of cost driver for topography is so critical to the cost allowance process. To do this we will:

- Present detailed engineering rationale on the measurement of topography and why assumptions about how networks are configured matters to the selection of cost drivers.
- Demonstrate the high topography in our region and the locations of customers in relation to that.
- Demonstrate how our assets are configured in relation to our network and its topography.
- Demonstrate why our network configuration does not align with the rationale behind the boosters per length of main cost driver.
- Demonstrate how the boosters per length of main cost driver actually results in a negative adjustment to our cost allowance, and show how the choice of driver materially impacts modelled allowances and efficiency scores.

We demonstrate that the claim value is material, against Ofwat's threshold of 1% of totex in the wholesale price control.

We will examine whether there is any implicit allowance that should be considered in this claim.

We will present the impacts on the sector as a whole to demonstrate that the right modelling choices will lead to a robust symmetrical adjustment.

We will present information on what options we have considered to mitigate the impacts of topography, and the significant limitations that these options face.

There are a number of assumptions that we must make in order to derive a claim value. We wish to stress that we recognise that the claim value is nominal at this stage and that as the process progresses it will be necessary to update the claim to account for changes in modelling processes including efficiency challenge, or policies surrounding future power costs. We set out our current assumptions below.

2. Assumptions and uncertainty factors

The claim value presented at this stage is dependent on some factors that are likely to change between now and our business plan submission, and change further over the course of Ofwat's price preview process. We have set out the assumptions and uncertainties in this chapter. We intend to update these assumptions and resultant claim value (and other data) for our business plan submission in October, and expect that further updates will be required as the process continues.

<u>Modelling assumptions:</u>

- We are running Ofwat's given models as consulted on in the April 2023 modelling consultation.

- We have run all models in 2017/18 price base, as per the stata files provided. We manually inflate modelled costs to 2022/23 prices for the resultant claim value.
- As instructed by Ofwat, we triangulate the models in each group with equal weights, and we triangulate bottom up and top down model groups with equal weights.
- Ofwat has indicated that models should be run with catch up efficiency but without frontier shift efficiency. However, the degree of catch up efficiency has not been specified and we notice that some models have a 4th place or upper quartile catch up efficiency of above one, which is counter intuitive for a catch up efficiency challenge. We believe this situation is arising due to recent increases in industry costs, as catch up efficiency is assessed over the most recent five years of the data set. We do not expect the final catch up efficiency challenge at draft determination to be above one, so instead we have applied a fixed 5% catch up efficiency challenge to all models that we are using in this claim, as well as showing the modelling results with no efficiency applied. We fully recognise that final models will include an efficiency challenge based upon the latest models at that point and mirroring Ofwat's chosen policies on the level of challenge.

Power costs assumptions:

- Pumping costs are materially impacted by the uncertain power costs going forward. At the moment we have not included these forecasts in our claim value, i.e it is a claim based on the modelling differences only, which only incorporates historic actual data and future cost driver forecasts to run the models. The power costs issue creates a separate additional upwards cost pressure that will apply to all of our pumping, treatment and other power usage.
- We have assumed that a cost adjustment claim at this stage is not the appropriate mechanism to deal with the power cost issue, because it is a sector wide issue. We note however that other companies may be including cost adjustment claims at this stage for this issue.
- In our case, any adjustments for future power prices would need to incorporate the impact of topography on those costs, as per this claim, our costs are higher because of topography and future power price increases will impact this too.

We trust that Ofwat recognises that the assumptions above are valid due to the uncertainty remaining in the process. When the sector wide approach to power costs is clearer, we will need to ensure it also reflects our sector-highest topography level appropriately. We discuss power costs further in section 5 of this document.

3. Engineering rationale for the inclusion of topography

Before we address the Ofwat gateways and present the numerical aspects of the claim, we want to first set out some important context on what topography is, in the context of the pumped water network we operate, and how this can be measured effectively.

Why topography is important:

Ofwat and the sector have long since recognised that topography is a key cost driver.

Fundamentally, companies supply water to customers' properties. Those customers exist in a mixture of physical locations across our respective regions, and those locations have different elevations. The water we supply is derived from abstraction sources - rivers, reservoirs and boreholes; and those assets are located at different elevations too, dictated mainly by legacy factors in terms of where the sources of water are that we are licensed to utilise.

When customers are located at higher elevations, all else being equal the pressure we need to pump water to, to reach those customers, is higher. This uses more energy. As topography is entirely exogenous, in that we do not have any control over the location of customers in relation to our assets, and as it directly impacts energy use and therefore costs, it has long been accepted that Ofwat should account for topography within its cost allowance setting process.

Not appropriately controlling for topography in cost modelling would mean that efficiency scores and cost allowances generated are not taking account of a key cost driver, an issue known as omitted variable bias.

This has significant implications on companies, as it would mean companies with higher topography would be inadequately funded for this issue, and companies with lower topography would be over funded. Neither is good for customers, particularly in companies who are underfunded as the need to pay power costs from a cost allowance that does not reflect it, means trade-offs in other investment areas.

How topography can be measured:

There are several factors that matter for determining the costs of pumping into and within a treated water distribution network:

- The elevations of customers
- The elevations of source, re-pumping, and storage assets
- The intermediate topography on the pumping routes
- The volume of water pumped from and to those different elevations on the network
- The frictional losses on the pipe network

We have considered whether spacial approaches are possible, by using our GIS systems to merge together the locations of customers and our assets with topographical map layers. The difficulty with this approach is how to take account of the volume of water that is pumped from each asset to different elevations, and the intermediate topography that may influence the pumping pressure on the route of a pipe. It also would not implicitly include frictional pipework losses, so these would need to be calculated. An approach such as this would be a 'top down' method of measuring pumping topography, as an alternative to a 'bottom up' measure such as APH, but it is a complex exercise.

However APH is a very powerful 'bottom up' measure of pumping topography, mainly because it uses actual measured flow and pressure data from every relevant pumping asset on the network. It therefore implicitly includes the difference in elevations between the source assets and customers, and the volumes of water pumped from and to each location. It also implicitly includes the impact of any intermediate topography that may need to be overcome on a pumping route, and the frictional losses that are incurred across the pipe network. Because it uses measured data, the APH metric also implicitly includes any fluctuations in pumping pressure across the year, which occur due to demand fluctuations and the mix of assets that are in operation at any point to meet that demand.

The concept of average pumping head was rooted in fundamental engineering and water network science, a measure created specifically to represent exogenous topography, and has been used for this purpose over the past twenty years or more, from Ofwat's opex efficiency model prior to PR14, to the totex models used at PR14, and now in some of the proposed models for PR24.

At PR19 however, Ofwat chose to use the number of boosters per length of main to represent topography in its models. Ofwat maintain a view that boosters per length of main is a suitable replacement for APH to measure topography.

Boosters per length of main only measures the number (specifically the density of) booster pumping station sites for each company, taking no account of capacity, nor the actual volume and pressure that a site produces during its operation. Therefore the variable assumes that a company with higher topography to deal with will simply have a greater number of sites.

This assumption is fundamentally flawed. This is not the way in which UK water network assets are constructed. The vast majority of customers will be supplied by gravity flows from strategic storage assets located at higher points within an area. Only a relatively small number of customers will require additional pumping where they reside at locations higher than these assets, and whilst this does typically constitute an extra pumping site, these will be far smaller than assets located at source sites pumping bulk volume into supply areas.

The boosters per length of mains variable is simply not reflecting the topography of a whole network. It is not reflecting site capacity, and it is not reflecting the actual pumped flow and pressure delivered by all pumping assets into and within the treated water network. It does not implicitly reflect the elevations of customers, assets, nor intermediate topography.

In its report to Ofwat as part of the April 2023 cost modelling consultation, CEPA advised that Ofwat needs to further examine the rationale of the boosters per length of mains cost driver, and suggested that it could instead be measuring asset intensity. Ofwat's first principle for econometric cost models is to ensure the cost drivers are consistent with engineering, operational and economic rationale. Unfortunately we are concerned that in the case of boosters per length of mains, Ofwat is not following its own principles here.

Images above show Hampton Loade's high lift pump hall at 12 MW of installed pumping capacity, and a small distribution booster of 30 kW capacity. Both of these sites would be treated equally in the booster stations per length of main variable, counting as one site each, which is clearly not reflective of the power costs nor the capital maintenance requirements.

A further data set available to Ofwat is treated water distribution pumping capacity.

Pumping capacity data has been reported by companies for some time and so has good data history. Using capacity data, normalised (for example by property count or by length of main) to remove scale effects, would be expected to demonstrate strong links with topography, because it would reflect the engineering fact that pumping to higher pressure requires more pumping capacity. The capacity per length of mains would be independent of the number of sites that the capacity is spread over, and so would work equally well for companies that have a smaller number of larger capacity sites, and companies that have a larger number of smaller capacity sites. We demonstrate these correlations later in this document. The downside to pumping capacity is it includes standby capacity, and the degree that companies use standby capacity could be subject to some endogeneity. The data quality has also never been examined, although the variable has been reported for some time. These factors means that the variable may not be appropriate to use for modelling purposes at the moment, but nevertheless it is a useful data point to validate against given the robust engineering and operational rationale for its link to topography measurement.

<u>The choice of topography driver is material to our claim:</u>

We will demonstrate in this claim that our network is configured to utilise a smaller number of larger capacity pumping installations to overcome its inherent high topography and reach the higher elevations where many of our customers are located. Because of this configuration, Ofwat's boosters per length of main cost driver is not reflecting our topography at all within the models. Both APH and capacity per length of mains do correlate with our topography and we will demonstrate this by giving information about our specific asset configurations and their contributions to supplying water to those customers at higher elevations.

We continue to reject the premise that boosters per length of main is an appropriate topography driver for the sector, as its underlying assumption does not bear resemblance to how water networks are actually configured in practice. Ofwat's cost modelling consultant, CEPA, also advises

Ofwat in its latest report to do further work to understand the rationale of this cost driver, suggesting that the measure is actually measuring asset intensity.

We have also observed that boosters per length of main has some correlation to all three of the proposed density drivers. We observe a negative relationship that shows that a higher property density results in fewer boosters per length of main, and that this appears to be non-linear. This makes operational sense, as a denser population would likely allow a company to take account of economies of scale by minimising the number of sites but having sites of a larger capacity. A sparse network on the other hand may require a larger number of smaller sites which are more spread out. This finding means that there is the potential for duplication with the density drivers being used in the models.

We urge Ofwat to think again about the true engineering rationale of topography measurement and its choice of cost drivers. More could be done with the sector to generate a better picture of how water supply networks are configured to deal with topography issues, and to understand what metrics like boosters per length of main are actually measuring. Some additional data collections to support a sector-wide look at topography could be:

- Spacial approaches, as mentioned previously, to try and provide an alternative 'top down' measure of average customer elevation across each company's region.
- Ofwat could request site by site pump capacity data, along with information on site function, to try to build a picture of how pumping asset functions are distributed across each company's network.
- Ofwat could request specific data on sites which supply customers via boosted only zones above the elevation of the supplying service reservoir or water tower, i.e those numbers of customers that are fed by these types of asset, and the capacities of these sites.
- Ofwat could request more details of higher volume source station transfers, for example the volume and supply pressure of each site, so it can see where the bulk of APH is derived from for each company.

Whilst we include this claim at this stage because of modelling uncertainty, we are firmly of the view that the topography issue could be fully accounted for in cost models by making full use of the average pumping head cost driver. We set out our view on this in our response to Ofwat's modelling consultation in May 2023, and expand on this in this document. This claim could be made fully redundant if the appropriate modelling choices are made based on strong engineering rationale for the use of average pumping head as the sole topography driver. A fully modelled approach also has the advantage of automatically implementing a fully symmetrical adjustment across all companies.

We will now present the claim structured against Ofwat's designated cost adjustment claim criteria, and we present data and engineering evidence in this claim which reinforces the points we have made above in the context of our own network configuration.

4. Claim evidence

This section covers the evidence for this claim. It focusses on the configuration of our pumping network and shows where the topography within our areas primarily impacts us. It then goes on to show how our topography is reflected in reported data and within Ofwat's proposed cost drivers.

The sections below follow the criteria set out in Ofwat's guidance. For each criteria we provide a key points 'blue box' summary followed by a more detailed narrative. There is some overlap between sections, and so we have tried to keep any duplication to a minimum.

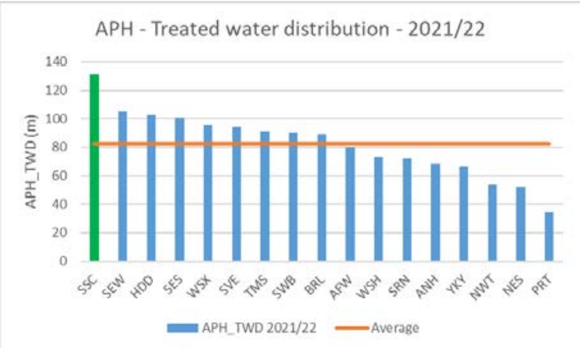
4.1: Is there compelling evidence that the company has unique circumstances that warrant a separate cost adjustment?

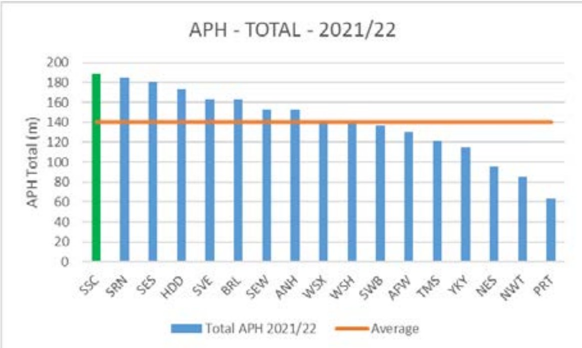
4.1 key points:

- We have the highest average pumping head in the sector for both total APH and in the treated water distribution component.
- This is due to the locations of our customers, and the assets that we use to supply them.
- We will show that our network configuration means that Ofwat's boosters per length of main cost driver is not reflecting our topography, because instead of large numbers of small capacity assets, we instead have significant reliance on small numbers of very large capacity assets for the bulk of our water supply.
- In this section we show the APH data, boosters per length of mains, and booster capacity data that demonstrates our position. We also show the bottom up engineering/network factors that substantiate what the data is showing.

<u>Average pumping head data</u>

The charts below show average pumping head data for treated water distribution and total APH for 2021/22, which is the latest year available at the point of this claim.





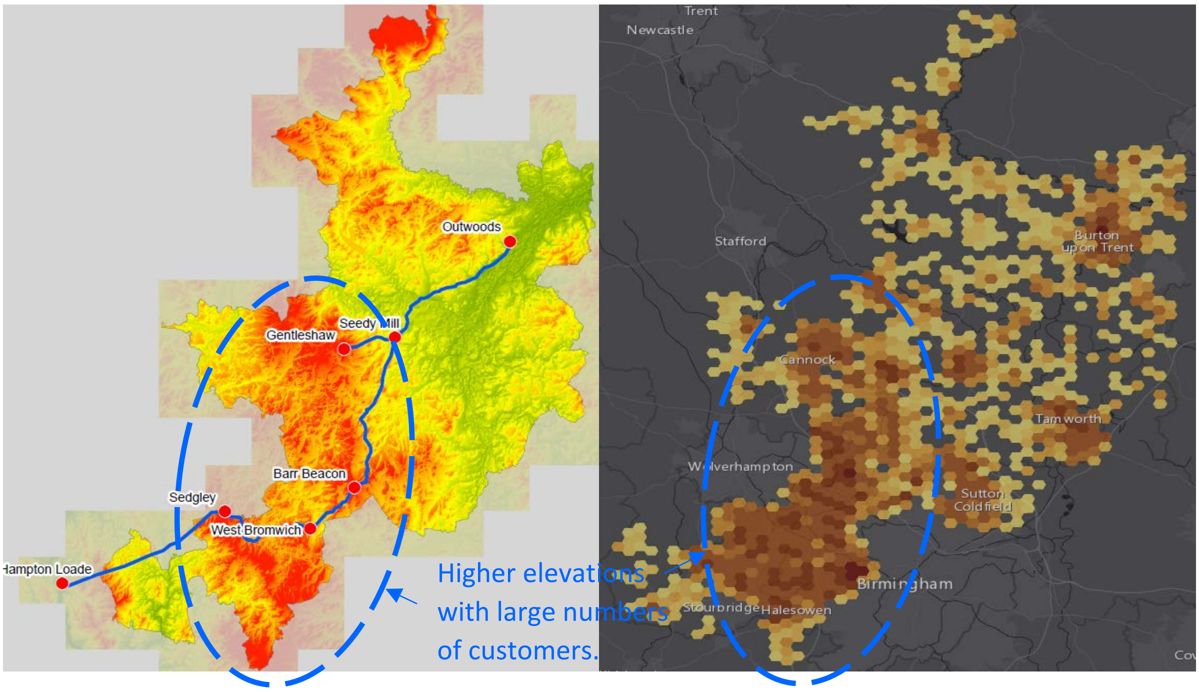
We have the highest total APH in the sector, largely driven by the highest treated water distribution APH. We have not shown the remaining three components, although for completeness we are also higher than the average level on water resources, average on raw water transport and below average on water treatment.

This situation arises from our SST region where the topography of the area, location of customers and configuration of the assets all combine to require a higher average pumping pressure in order to supply customers across the region. Our CAM region is relatively flat, and as we report our data on a combined basis, CAM does create a reduction effect on our combined figures. Despite this reduction effect, our combined APH is still sector-highest.

Our overall network and the locations of customers:

The images below are derived from our GIS system. The left image shows the variance of topography across the region, with red indicating higher topography and green indicating lower topography. The location of some key large capacity assets are also shown. The right image shows the population density, darker for high and lighter for low, against the same area.

The key observation here is the visual correlation of the higher topography areas with the areas of higher population density. This means that fundamentally, customers are densely located at many of the higher elevations within this supply region. For those readers familiar with the area, these are dense urban areas such as Dudley, Sedgley, Tividale, Oldbury, Rowley Regis, Warley, Cradley and Halesowen. Further north we have significant proportions of customers at higher elevations around Cannock, Hednesford, Burntwood, Walsall, Sutton, Streetly and Aldridge.



We recognise that our physical topography will not be as high, in absolute terms, as many other parts of the country (for example, areas with mountains). But what matters for pumping costs is the combination of elevation and customer distribution. A higher proportion of customers at higher elevations requires a higher volume of water to be pumped to greater pressures, using more energy.

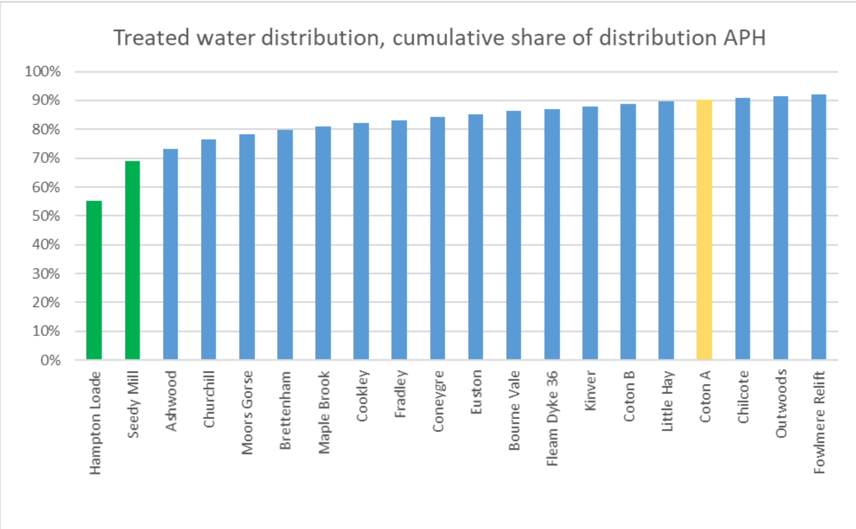
How our network is configured to supply customers at higher topographies:

A key factor in this claim is that our asset configuration is not represented appropriately by the boosters per length of main cost driver, but is represented fully by the average pumping head cost driver, and we believe this to be the case at the sector level as well given all companies will have networks configured using broadly similar engineering principles over a long period of time. We will demonstrate why our asset configuration is not reflected in the boosters per length of mains cost driver.

The maps above show the location of Hampton Loade and Seedy Mill surface water treatment works. Together these two sites provide around 60% of the total supply to the SST region. Both sites supply treated water to strategic storage assets located at high elevations, in order that customers in those areas can be supplied predominantly via gravitational flows from those service reservoir assets. This is the most resilient approach as it does not materially rely on a larger number of smaller distributed pumping assets that the boosters per length of mains driver assumes.

Of these two works, as can be seen from the chart below, our Hampton Loade works accounts for 55% of the APH value by itself, with Seedy Mill comprising a further 14% for a total combined value of 69% from only two sites.

This demonstrates why the choice of cost driver to reflect topography is so critical in determining the correct cost allowances. Taking Hampton Loade as the example, the site accounts for 55% of APH with the knock on impact to energy and maintenance costs, but would only count as 'one' site in the boosters per length of main cost driver.



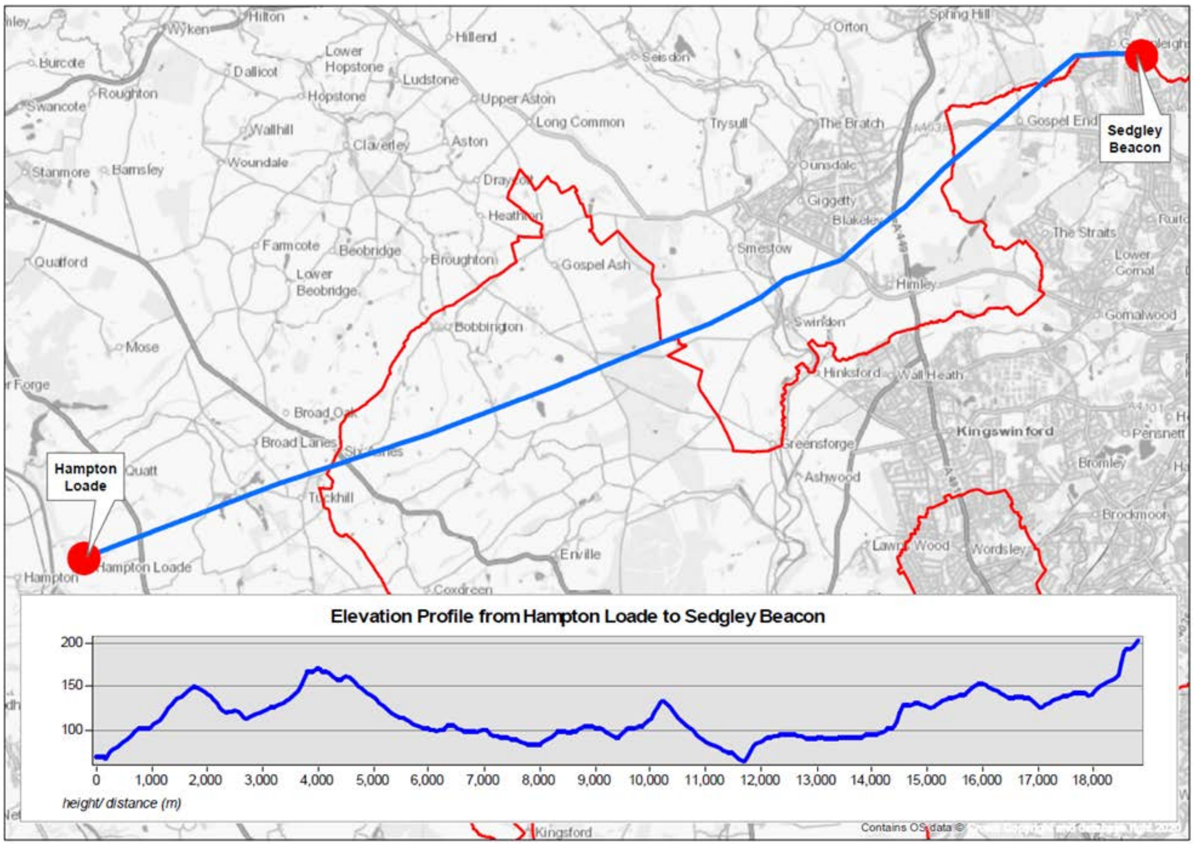
There are a total of 133 pumping sites that aggregate into our reported APH measure, across both regions. The chart above shows that out of all of these sites, 90% of the combined APH derives from only 17 sites (a threshold indicated by the site highlighted yellow in the chart above). This is a classic Pareto ('80/20 rule') relationship. Clearly this demonstrates that sites are not equal in their contribution to APH and topography, and hence a simple asset count, which implicitly assumes linearity, is not appropriate to represent the issue.

<u>Hampton Loade surface water treatment facility:</u>

Hampton Loade is located on the River Severn near Bridgnorth at an elevation of 64m above sea level and pumps an average of 117 Ml/d (in 2021/22, after deducting Severn Trent's bulk export) to a strategic service reservoir storage facility located at Sedgley at an elevation of 228m. This is a static height difference of 164m. Twin 45" diameter trunk mains, of a length of approximately 19km, are sufficiently sized to minimise dynamic losses along the route.

To deliver this volume of water to the required pressure, the final distribution 'high lift' pumping plant at the site comprises over 12 Megawatts of installed pumping capacity along with ancillary equipment such as high voltage electrical components (transformers, switchgear), and back-up generation capacity. This demonstrates that the topography issue does not only impact power costs, but also asset capacity and so capital maintenance and operational maintenance costs as well.

The image below shows the route of the trunk mains as a top down view and as a cross section.



Note that the route initially rises steeply out of the river basin to an elevation of over 160m within the first 4km of the route. In the final 2km of the route the mains again rise steeply on their final journey into the storage facility at Sedgley.

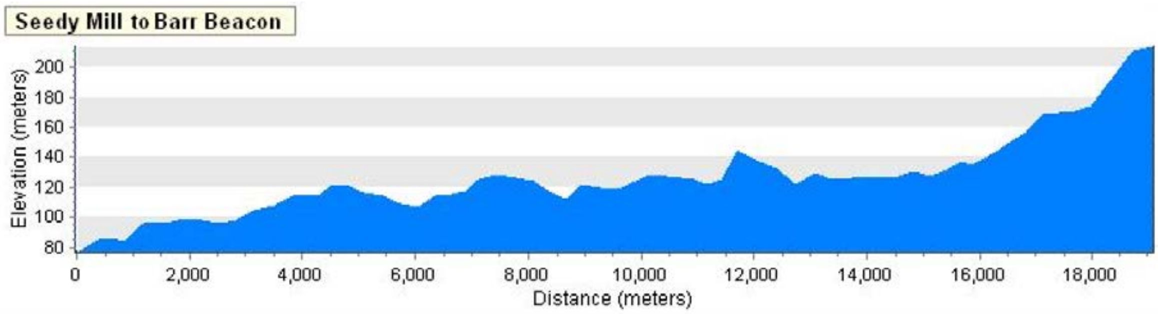
<u>Seedy Mill surface water treatment facility:</u>

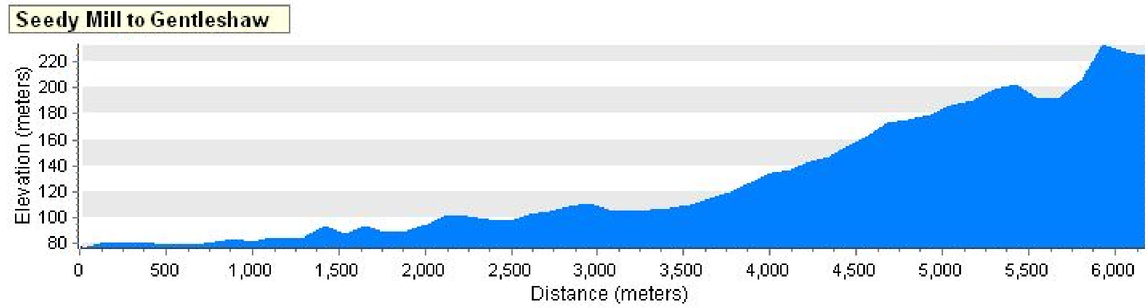
Seedy Mill is located near to Lichfield in Staffordshire. It is supplied from an impounding raw water reservoir, Blithfield, located around 10 miles away from the site. The elevation of Seedy Mill is approximately 81m above sea level. From its location, Seedy Mill pumps treated water in four different directions into strategic storage assets at Barr Beacon (226m elevation), Gentleshaw (227m elevation), Outwoods (97m elevation) and Hopwas (128m elevation).

To deliver this supply, Seedy Mill's final distribution 'high lift' pumping plant is of a total capacity of over 5 Megawatts, along with ancillary equipment such as high voltage electrical components (transformers, switchgear), and back-up generation capacity.

Over half of the site's output pumps to the significantly higher topography routes at Barr Beacon and Gentleshaw. However as the volume is far lower than Hampton Loade's average of 117 Ml/d (after deducting the Severn Trent export component), this explains why Seedy Mill contributes 14% of APH compared to Hampton Loade's 55%.

The routes and cross sections for the two high pressure areas (Barr Beacon and Gentleshaw) are shown below.





<u>Other sites:</u>

This document would be excessively long if we were to demonstrate the APH impact of each of our sites individually. However the same principles apply to all of our sites, in that the volume and pressure each site is required to deliver, driven by the topography along the pumping routes and the final destination, leads to a contribution to the total average pumping head we report.

APH includes all of our pumping sites, from large to small, and takes full account of the actual flow and pressure that each of those sites outputs to ultimately deliver water to wherever on our network that our customers are located.

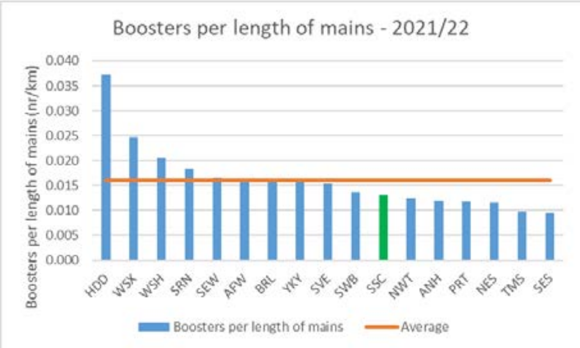
<u>Data relationships to boosters per length of mains and booster sites capacity per length of mains:</u>

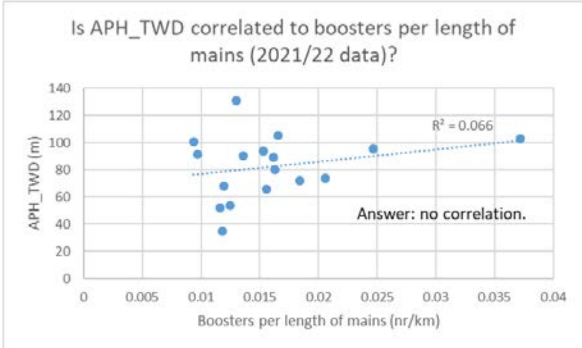
The above sections focus on the actual elevation profile of our region and explains how are assets are configured to operate to overcome that topography and supply water to where our customers are located. The APH_TWD cost driver is by far the best method to reflect the exogenous topography of our regions and its impact on pumping. Our APH data follows a classic Pareto relationship with a high proportion of APH being derived from only a small proportion of sites, and in our case we derive nearly 70% of our total APH from only two large surface water sites for the reasons given above.

Is this configuration reflected in the boosters per length of main cost driver?

The chart below left shows that it is not. We are below average in terms of boosters per length of main, clearly showing that a count of the number of sites bears no relationship to the whole topography of a region and the pumping plant needed to deliver water to customers across this topography. This finding makes sense, as despite the scale of Hampton Loade's 12 Megawatts of pumping plant and 55% contribution to sector-highest APH, and Seedy Mill's 5 Megawatts of pumping plant and 14% contribution to sector-highest APH, both of those sites still only count as 'one' site each in the number of booster pumping stations measure.

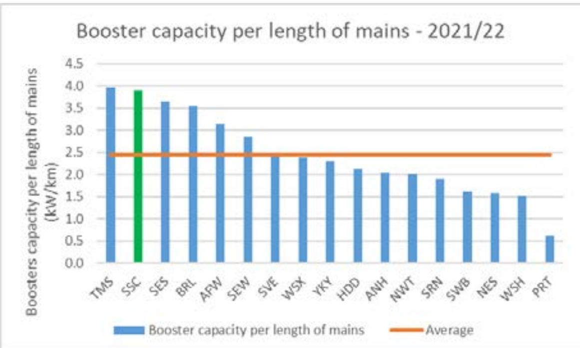
We have also found no correlation between boosters per length of main and average pumping head at the sector level, as we demonstrated in our response to Ofwat's cost modelling consultation in May 2023. The chart below right shows this lack of correlation for 2021/22 data only, using APH_TWD and boosters per length of main.

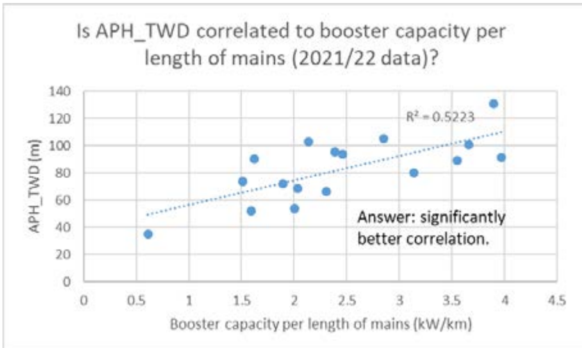




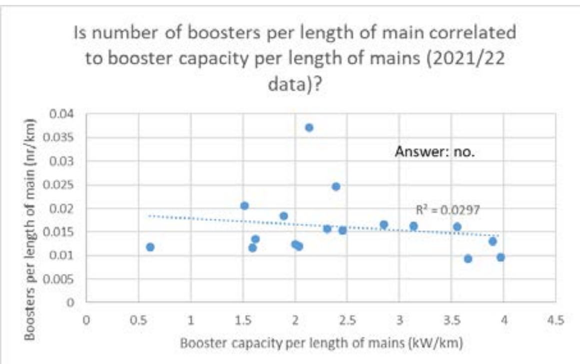
So if the number of sites is not reflecting topography, because it does not account for site capacity, what about the pumping station capacity data reported in the APR?

The chart below left shows that SSC has the second highest installed pump capacity normalised by length of mains, demonstrating that this variable is far better at reflecting our additional pumping capacity required to deliver against high network topography. The chart below right shows how this data is correlated to APH_TWD. This correlation is far stronger, as would be expected because the variable is measuring installed pumping capacity, which would be higher to deliver against a higher network topography.





For completeness, boosters per length of mains is also not at all correlated to booster capacity per length of mains, as shown below.

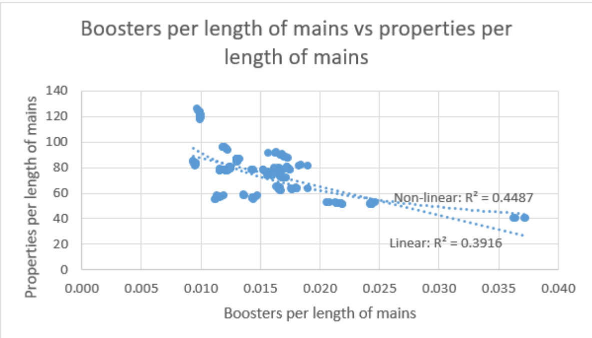


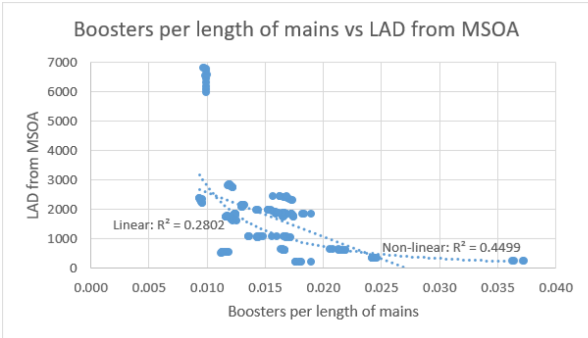
Ofwat's first and arguably most important gateway in the cost modelling process is that cost drivers should be "consistent with engineering, operational and economic rationale". It is clear from the evidence we have provided in the sections above that boosters per length of mains simply does not represent whole-network topography for us or for the sector as a whole.

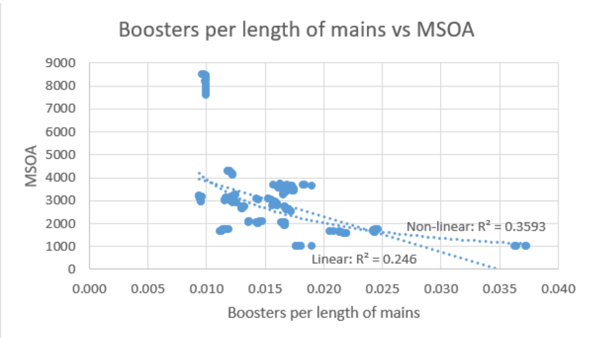
Our network configuration is the exact opposite scenario than Ofwat's boosters per length of mains variable assumes, as we do not have higher numbers of smaller capacity sites to overcome our topography factors. Our sites are small in number, high in capacity, and we only utilise small capacity boosters for specific localised supply issues, for example where a small number of customers are located at a higher elevation than the service reservoir or water tower.

We have seen no evidence from other companies or Ofwat that supports the rationale that a network-wide topography issue would be primarily overcome by having greater numbers of booster sites, and the fact that Ofwat's measure takes no account of site capacity reinforces this.

As indicated in section 3 (engineering rationale), we have further found that the boosters per length of mains cost driver has some correlations with all three proposed density drivers. We show these correlations below:







The correlations are consistently stronger if a non-linear relationship is fitted, indicating non-linearity in this relationship, as per the relationships used for density which include both a linear and a squared term of the relevant variable. Clearly at least some correlation exists here and therefore there is potential double counting of boosters per length of mains with density drivers.

4.2: Is there compelling evidence that the company faces higher efficient costs in the round compared to its peers (considering, where relevant, circumstances that drive higher costs for other companies that the company does not face)?

4.2 key points:

- A higher pumping pressure to overcome local topography means that we expend more energy to deliver each unit volume of water into our network.
- A higher pumping pressure for an equivalent volume also requires larger capacity pumping plant and associated ancillary assets, which increases replacement and maintenance costs.
- Both of these factors are included in the modelling process when the appropriate cost drivers are used, because both of these factors are present in all companies' historic data that is used to construct the models.
- We derive a claim value of £45m over five years, after implicit allowance, which represents the impact of our topography above Ofwat's proposed modelling combination.

Section 4.1 demonstrates that we have sector highest APH and how this is correctly reflecting the asset configuration that we have and the assets we operate to overcome the network topography within our area. We have also demonstrated that network topography can also be reflected in the reported booster capacity data, as would be expected since higher pumping pressures require larger capacity pumping plant. But the issue is not reflected in the number of boosters per length of main cost driver, as a simple asset count does not reflect the capacity and energy use required to operate against the topography we have to overcome with our assets in practice.

The engineering principles are simple in nature. For a pump unit, delivering a given volume of water to a higher pressure requires the pump, motor and ancillary assets all to be larger in capacity. This is an indisputable engineering principle.

Given our industry-highest APH, this means that:

- We have a higher energy use for a given volume and pump efficiency level; and
- We have higher capital and operational maintenance costs associated with the larger pumping plant and ancillary assets.

Impacts of topography on modelled allowance:

We have used the models Ofwat published at the April 2023 cost modelling consultation to project future cost allowances. As these models are still uncertain, this is done under a series of assumptions as set out in part 2 of this document and we recognise that models may change.

We run the following modelling combinations:

- Ofwat's models as provided, triangulating equally as instructed.
- Models using only the boosters per length of main cost driver.
- Models using only the APH_TWD cost driver.
- Models using no topography driver, i.e not using APH or boosters per length of main.

As we set out in assumptions (section 2), Ofwat required companies to include catch up efficiency challenge in models used for claim calculation. Ofwat did not specify the catch up challenge to be used. We have observed that for several models, the 4th place and upper quartile catch up efficiency scores can be above one in some instances. This is likely to be as a result of recently rising costs across the sector, as the efficiency scores are assessed based on the last five years cost data out of the full data set. We would not expect Ofwat to implement a catch up efficiency challenge of above one, so including it in this claim would not be meaningful. Instead, and in recognition that catch up challenge will change once an extra year of data is included and once the final model suite is agreed, we have implemented a fixed 5% catch up challenge across all models used for this claim. We also present models with no efficiency challenge applied for reference purposes.

To calculate future cost allowances, we have assumed property growth of 5,000 per annum, and mains length growth of 50km per annum. This is in line with our historic data and our draft business plan at this stage in the process. For other cost drivers, we have maintained stable forward projections at the 2021/22 level.

The results on future cost allowances are as follows, shown in ascending order of generated allowance:

Model group	**Modelled base allowance (£m over 5 years) with no catch up efficiency challenge**	**Modelled base allowance (£m over 5 years) with 5% catch up efficiency challenge**
Models with boosters per length of main only	£488m	£464m
Models with no topography driver	£503m	£478m
Ofwat's 50/50 suite of models using both boosters and APH_TWD	£536m	£509m
Models with APH_TWD only	£584m	£554m

This clearly shows that boosters per length of main is having a materially detrimental effect on the modelling process, as models using only that driver actually give us a lower cost allowance than not using any topography driver at all. This is completely counter intuitive to its stated rationale as a topography driver, and reflects the fact that despite having the highest APH in the sector, our boosters per length of main is below average. This supports our claim, that this driver is not representing our topography nor that of the wider sector.

Ofwat's preferred full suite of models, including both APH_TWD and boosters per length of main, is in practice an equal weights triangulation of the booster models and APH models, so as expected its projected cost allowance comes out exactly in the middle of those two separate model groups. This is because the downwards impact of the boosters per length of main driver, in half the models, is being offset by the upwards impact of the APH_TWD driver representing topography in the other half of the models. This means that for us, only half the models which include the relevant costs are correctly reflecting topography.

These different model combinations show that there is a gap of £45m against Ofwat's proposed models and this is our claim value including the implicit allowance from Ofwat's proposed set of models, as follows:

	No catch up efficiency challenge	With 5% catch up efficiency challenge
APH models (A)	£584m	£554m
No topography models (B)	£503m	£478m
Topography impact (A-B) (C)	£81m	£76m
Ofwat's preferred 50/50 approach (D)	£536m	£509m
Implicit allowance from Ofwat's approach (D-B) (E)	£33m	£31m
Remaining topography gap (C-E) – CLAIM VALUE	**£48m**	**£45m**

Note that this gap represents the historic gap, based on the data used to create the models from 2011/12 to 2021/22. It does not include the impact of future increases in power prices, which we address at the end of this claim as it is a material issue impacting not only this claim but the entirety of power costs.

We are using the modelling gap of £45m for this claim, which is the value after implicit allowance, when assuming a 5% catch up efficiency across all models.

Impacts of topography on efficiency rankings and other companies:

The differences in models also materialise, as would be expected, in the efficiency rankings, both for us and other companies.

It is important to recognise that correctly representing topography in models will cause changes to efficiency rankings and other companies' cost allowances, but that this is only ensuring that these values are corrected according to the robust engineering rationale of these cost drivers. To not include the appropriate cost drivers would result in incorrect efficiency rankings and cost allowances for the sector, and including the right drivers for the right costs is simply correcting this position appropriately.

We do not have enough information about other companies' cost driver movements to project future cost allowances appropriately, and to attempt this would therefore be speculative. We do not think this would add any value to this claim at this stage, and Ofwat will of course be looking at how this topography modelling issue impacts symmetrically across the sector as it evaluates claims and decides on final models.

However we are clear that this issue should be implemented fully symmetrically, as it is clear that there is a distribution of topography across the sector, measured by average pumping head which has demonstrable robust engineering and operational rationale. This is why we still believe the best approach is to fully incorporate APH into all models instead of boosters per length of main, which as we have demonstrated, does not have robust rationale as a topography measure for us or the sector, and may duplicate with density drivers. Adopting an approach outside of modelling would require a more complex symmetrical adjustment to be calculated and implemented, and we do not think this additional complexity is warranted when it could be fully implemented within the modelling process.

We can however demonstrate the impacts on historic efficiency rankings, to show the movements across the sector. The efficiency changes are clear from Ofwat's own provided modelling data set, as the efficiency scores for all individual models are provided. This enables us to see how the models using boosters per length of mains differ from those using APH_TWD.

As with our cost allowance, for us there is a clear and material improvement in our efficiency score when using APH_TWD models as opposed to boosters per length of main models. This is entirely correct and appropriate, as APH_TWD is the only driver which can correctly measure our topography issue as we have demonstrated using engineering/operational evidence.

Boosters models

Company	TWD1	TWD2	TWD3
South Staffs Water	1.22	1.42	1.15

APH_TWD models

TWD4	TWD5	TWD6
1.01	1.10	0.94

Company	WW1	WW2	WW3	WW4	WW5	WW6	WW7	WW8	WW9	WW10	WW11	WW12
South Staffs Water	0.90	0.86	0.92	0.88	0.87	0.84	0.74	0.72	0.72	0.70	0.75	0.73

For other companies, there are also material movements. Given the industry level correlations, or lack of, between boosters per length of main, average pumping head, and pumping capacity, these movements are correctly reflecting the topography issue more fully than has previously been the case and we therefore consider them genuine movements.

Efficiency changes for TWD models:

TWD models	**Average efficiency score boosters models**	**Average efficiency score APH models**	**Change nr**	**Change %**
Affinity Water	1.15	1.27	0.11	9.83%
Anglian Water	1.38	1.18	-0.20	-14.25%
Bristol Water	1.25	1.23	-0.01	-1.07%
Hafren Dyfrdwy	1.01	1.10	0.10	9.60%
Northumbrian Water	1.01	1.07	0.06	5.94%
United Utilities	0.89	0.99	0.10	11.28%
Portsmouth Water	0.77	0.97	0.20	26.52%
SES Water	1.29	0.97	-0.32	-24.81%
South East Water	1.19	1.05	-0.14	-11.48%
Southern Water	0.90	1.07	0.18	19.70%
South Staffs Water	1.26	1.02	-0.25	-19.53%
Severn Trent Water	1.05	1.02	-0.03	-3.17%
South West Water	0.83	0.73	-0.10	-12.10%
Thames Water	1.08	1.00	-0.08	-7.69%
Dŵr Cymru	1.13	1.25	0.12	10.65%
Wessex Water	1.08	1.11	0.03	2.79%
Yorkshire Water	1.14	1.24	0.11	9.38%

Efficiency changes for WW models:

WW models	Average efficiency score boosters models	Average efficiency score APH models	Change nr	Change %
Affinity Water	0.93	1.02	0.09	9.71%
Anglian Water	1.14	0.99	-0.15	-12.87%
Bristol Water	1.12	1.13	0.01	0.60%
Hafren Dyfrdwy	1.00	1.12	0.12	11.48%
Northumbrian Water	1.03	1.08	0.05	4.84%
United Utilities	1.02	1.11	0.10	9.36%
Portsmouth Water	0.74	0.89	0.15	20.36%
SES Water	1.48	1.15	-0.33	-22.07%
South East Water	1.06	0.96	-0.10	-9.58%
Southern Water	1.23	1.45	0.22	17.57%
South Staffs Water	0.88	0.73	-0.15	-17.27%
Severn Trent Water	1.04	1.01	-0.03	-2.73%
South West Water	0.97	0.88	-0.09	-9.43%
Thames Water	1.13	1.01	-0.11	-10.07%
Dŵr Cymru	1.09	1.21	0.13	11.66%
Wessex Water	1.27	1.30	0.03	2.37%
Yorkshire Water	1.05	1.14	0.09	8.77%

4.3: Is there compelling evidence of alternative options being considered, where relevant?

4.3 key points:

- The location of our supply assets in relation to the location of our customers, storage assets and intermediate topography is predominantly a legacy factor that cannot be economically altered.
- We mitigate the increased energy requirements of our topography through an extensive pump maintenance programme and by procuring energy at efficient market terms.
- Our efforts in reducing leakage and demand also seek to lower the volume of supplied water over time (although this is partially offset by growth).

In section 4.1 we showed the direct evidence of how key assets contribute to our sector-highest APH, and why these assets contribute in the way they do, for example by showing the route over which they pump and describing what capacity of pumping plant we have installed to achieve this.

There are significant legacy and current constraints that prevent us from any material changes to mitigate the impact of network topography:

- The location of source assets, which are at existing points of licenced abstraction that reflect legacy decisions.
- Similarly for the location of strategic storage reservoirs, which historically were located at the high points of a region to provide mainly gravity flows to the surrounding properties.
- The routes of our trunk and distribution mains networks to connect our sources to our customers.

- The location of our customers, which clearly the above factors were originally designed around, and many historically smaller settlements later grew to be major population centres which in our region, happen to be at relatively higher elevations.

We do focus on mitigation of energy costs extensively, including:

- A pump maintenance programme focussed on energy efficiency and pump optimisation.
- Securing competitive energy contracts with our supplier, including participating in 'triad' peak use avoidance schemes to generate energy cost savings, where possible.
- A major gas to electricity generation scheme at Hampton Loade which has reduced our costs from that site, and this is taken account of in historic reported costs.
- Small amounts of renewables installed to date, as there are significant constraints to overcome with renewables use, but we are looking more extensively at this option now and it will feature in more detail in our October business plan.
- Some local circumstances have allowed us to replace storage assets with boosted local areas, such as the conversion of the Morrilow Heath tower supply area to a permanently boosted zone. Schemes such as these save a little energy because we only pump the needed water to serve the pressure requirements of the customers in the area, rather than pumping all of the water to the same elevation for a storage tower. However these schemes are only viable where the area is small, because a boosted only zone for a large area would place significant risks on resilience as there is no strategic storage in a boosted only zone. It is also more difficult to design for peak demands, and a larger zone amplifies this problem. Currently there are no further opportunities for these types of scheme in our regions, but it is always kept under review.

Finally, the volume of water supplied into our network will be effected by long term delivery of leakage and water consumption targets. This is however offset by growth, which puts upwards pressure on water supply volume. Furthermore, without major network reconfiguration, the impact of this on APH is relatively small, because it primarily effects volume supplied rather than supply pressure. This is because the majority of pumping pressure is comprised of static height, which will not change if customers use less water as their locations in elevated areas have not moved. One benefit of customers using less water overall might be that we can reduce reliance on the source sites and reservoirs which have the largest contribution to APH. This is viable but will not produce any material impacts in the short term, and we do have to consider other operational supply factors as well when deciding how to use our sources, such as reservoir turnover which is important for water quality.

To conclude, there are no viable options for mass reduction of our topography burden. Major asset reconfiguration is not possible in most cases, or where it is possible is extremely expensive to undertake and not value for money when considered in the round against all other competing investment pressures within our network. We continue to seek smaller mitigation opportunities including continuing with our very effective pump efficiency programme, and in the future seeking self-generation as a possible cost mitigation – but note these schemes do not mean the underlying topography issue is reduced, as customers will still be located in the same places.

4.4: Is the investment driven by factors outside of management control?

4.4 key points:

- In both short and long term time horizons, the location of assets and demand centres in relation to the physical geography of our regions is almost entirely outside of company control.
- Even if relocation was physically possible, for example if an alternative resource capable of the abstraction level of Hampton Loade existed for us, then the cost to rebuild new assets, trunk mains and reservoirs in new locations would clearly not represent good value for money, and the scale of this investment would be simply unaffordable for customers and our business.
- Even if we could relocate assets, it would do nothing to mitigate the locations of customers, which as we have set out, are concentrated at particularly high elevations within our SST supply area.

The topography, or 'lie of the land' of our supply region is outside of management control. It is driven by the locations of assets and customers in relation to the physical geography of our region.

We have demonstrated extensively, in section 4.1, why our topography and asset configuration means we have sector-highest APH. And we have set out in section 4.3 above, why there are no practical options to significantly reduce this impact that are within management control.

4.5: Have steps been taken to control costs and have potential cost savings (eg spend to save) been accounted for?

4.5 key points:

- We have continually strived to reduce absolute pumping costs through our pump efficiency programme, network optimisation and effective energy contract negotiations and grid electricity mitigation options.
- Going forward, focus on leakage and demand management, as well as continuing to offset grid electricity use, for example via renewables, continues to try and offset the impact of APH on customers as much as possible.

As we have explained, we cannot change the physical topography of our regions or where customers are located, we can only try to minimise energy consumption of our assets within the constraints of that topography, through ensuring we are efficient and making optimal use of our network in relation to the location of customers. Our reliance on the large volumes of water supply from Hampton Loade and Seedy Mill works limits our options considerably, as no other sources are capable of replacing the volumes of water that these works supply.

Our pump efficiency programme helps to ensure that pump deterioration (all pumps deteriorate over time as their components wear) does not cause material impacts to energy consumption. Our programme is very proactive to ensure maintenance keeps pace with deterioration, and to adopt more efficient technologies where these are available. We have been running this programme for a very long period of time, and it is funded entirely from base maintenance. This is an example of where our topography issues create a different investment focus for us compared to other companies, because it becomes more cost effective to invest in new pumping solutions earlier than might otherwise be the case. Indeed, even between our own two regions, where SST region has the topography issue and our CAM region is very flat, we see very different cost benefit value from pump refurbishment.

4.6: Is there compelling evidence that the factor is a material driver of expenditure with a clear engineering/economic rationale?

4.6 key points:

- We have demonstrated that the impact of topography on energy usage and costs is material.
- We have demonstrated the engineering rationale behind our reported APH values, and how different cost drivers are not equally reflecting the issue that exists in practice.

We have examined the engineering rationale extensively in previous sections.

From section 4.2 we are calculating materiality based on a claim value of £45m over five years, after implicit allowance, based on modelling data and which does not include the impact of future higher power costs at this stage, because of crossover with any sector wide adjustments for increasing power prices.

At the time of writing our wholesale totex plan is in the order of £750m gross, excluding new development. This figure is not final as we work to refine our plan before submission.

Based on the above, the claim is material, at 6% of wholesale water totex.

4.7: Is there compelling quantitative evidence of how the factor impacts the company's expenditure?

4.7 key points:

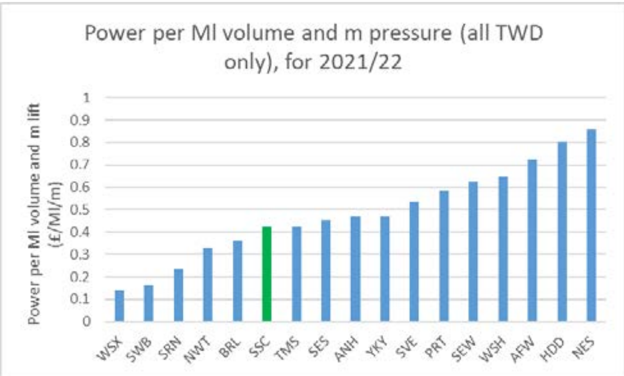
- We have demonstrated in section 4.2 how topography impacts our costs using extensive bottom up engineering and operational rationale.
- We have also shown how the different cost drivers available are or are not appropriately reflecting this topography issue.
- We will demonstrate in this section that we are relatively efficient in power costs when normalised.

We refer back to sections 4.1 and 4.2 primarily, where we have demonstrated clear engineering and operational rationale for this claim and derived the value of the impact directly from Ofwat’s modelling suite.

It is fundamentally clear that a requirement to pump to a higher average pressure will require more energy use and therefore costs more. As a proportion of total opex (excluding IRE), our expenditure on power within the treated water distribution price control was 18% for 2021/22, the second highest in the sector.

This high proportion is completely due to the topography issue, it is not a reflection of any embedded inefficiency either on asset operation or energy contract negotiation. We can show this simply by normalising power costs by volume and average pumping pressure:

$$Normalised\ power\ costs_{TWD} = \frac{Power_{TWD}}{Annual\ supplied\ volume\ \times APH\_TWD}$$



This shows that we are comparatively efficient in our power costs, when normalised, being below industry average.

4.8: Is there compelling evidence that the cost claim is not included in our modelled baseline (or, if the models are not known, would be unlikely to be included)? Is there compelling evidence that the factor is not covered by one or more cost drivers included in the cost models?

4.8 key points:

- We have demonstrated how APH is a whole-network measure of topography, and for a given volume of water results in larger pumping plant and ancillary assets to meet this increased pumping pressure, which is also reflected in the reported pumping capacity variable.
- We have further demonstrated that the number of booster pumping stations is not capable of detecting any of these factors, either for us or at sector level, and therefore does not meet Ofwat's own first gateway for selection of cost drivers.

The fundamental issue is that one of Ofwat's proposed cost drivers for topography, boosters per length of main, does not actually represent topography either for us or the sector as a whole. We have demonstrated this by presenting the engineering rationale and why the driver does not align to how our water network assets are actually configured, and how topography links to the location of our customers and assets. We then show that these asset configurations are not correlated to the boosters per length of main variable, and that expected sector wide correlations between this and other variables are also weak.

This means that the models which include boosters per length of main as the topography driver will significantly understate our costs, as we have demonstrated in section 4.2. The impact at sector level will be that topography is not fully represented in models and so efficiency rankings and future cost allowances will suffer from a material omitted variable bias. This will cause some companies to have more cost allowance than they need and some to have less.

Ofwat's proposed modelling approach, using an equal weights triangulation of average pumping head models and boosters per length of mains models, is only partially reflecting the topography issue and so is misrepresenting both ours and the sector's historic efficiency and future cost allowances.

4.9: Is the claim material after deduction of an implicit allowance? Has the company considered a range of estimates for the implicit allowance?

4.9 key points:

- We have examined the models to determine the implicit allowance for topography that is generated from the boosters per length of main cost driver, and we have found this to be negative.
- This is a counter intuitive result that reinforces our position that the boosters per length of main cost driver is not accounting for our circumstances, and is actually resulting in an opposite influence on costs than would be expected for our high topography.
- We have calculated the gross claim value using differences between the models which include APH and the models which include no topography driver. We then calculate an implicit allowance from Ofwat's proposed models which combine both drivers, which partially provides for some allowance but not fully.

In this section we demonstrate how we have considered implicit allowances.

An implicit allowance is a cost embedded in the models that is not specifically drawn out by a cost driver, or is impacted indirectly by another cost driver. Consideration of implicit allowances is important to avoid any double counting of costs.

We have considered the possible approaches to implicit allowance as per the Ofwat guidance which suggests three possible approaches:

1. Removal of relevant expenditure from the cost models
2. Removal of an explanatory variable from the model
3. Assessment of unit costs related to the claim

In this claim, which is focussed on the impact of topography on base costs, primarily power and capital maintenance, option 1 is not possible. This is because we cannot strip out the power and capital maintenance costs which are a direct result of each company's topography, from the modelled base costs.

Option 3 is also not appropriate, because this is not a claim that can be presented as a unit rate of cost per unit of activity, again this is primarily because it is not possible to strip out the impact of topography from actual reported data across all companies. We have however presented some benchmarking of power costs and our unit rate efficiency in section 4.7.

Therefore our approach focusses on option 2, which is to examine model combinations with inclusion and removal of various cost drivers in order to demonstrate the modelling variance that occurs in each scenario.

Any model which does not include an appropriate cost driver to represent the cost will be implicitly providing for industry average costs in that area. In the case of topography, we showed in section 4.2 that removing both average pumping head and boosters per length of main from the models entirely, so that there is no topography driver at all, results in an allowance of £478m (with 5% catch up challenge). This is therefore representing industry average topography, measured using APH_TWD, and industry average boosters per length of main, which is measuring asset intensity and correlating with density.

The modelled outputs from section 4.2:

Model group	**Modelled base allowance (£m over 5 years) with no catch up efficiency challenge**	**Modelled base allowance (£m over 5 years) with 5% catch up efficiency challenge**
Models with boosters per length of main only	£488m	£464m
Models with no topography driver	£503m	£478m
Ofwat's 50/50 suite of models using both boosters and APH_TWD	£536m	£509m
Models with APH_TWD only	£584m	£554m

The booster only models give a lower allowance than models without any topography driver. This is completely counter intuitive if Ofwat maintains that boosters per length of main is measuring topography. We have the highest average pumping head in the sector, yet the cost driver that Ofwat maintains is measuring this actually gives us a reduction in allowance, further demonstrating the fundamental flaws with this cost driver as a measure of topography.

Section 4.2 also shows how we use those models above to calculate implicit allowance, presented again here for completeness:

	No catch up efficiency challenge	**With 5% catch up efficiency challenge**
APH models (A)	£584m	£554m
No topography models (B)	£503m	£478m
Topography impact (A-B) (C)	£81m	£76m
Ofwat's preferred 50/50 approach (D)	£536m	£509m
Implicit allowance from Ofwat's approach (D-B) (E)	£33m	£31m
Remaining topography gap (C-E) – CLAIM VALUE	**£48m**	**£45m**

The gross value of the claim is the difference between the models containing APH_TWD as the topography driver, and the models containing no topography driver, £76m. Ofwat's proposed approach includes both APH_TWD and boosters per length of mains in alternating models, which partially increases the allowance but not fully. The remaining gap, after considering Ofwat's proposed models, is £45m. These figures include a 5% catch up efficiency challenge, but we also show figures above with no efficiency challenge recognising that the level of the challenge is not yet final.

We have completed the excel tables on the basis of these figures, in annual terms from 2025/26 to 2029/30.

We have considered the remaining cost drivers in the models and none of them have any engineering, operational or economic rationale for a relationship to network topography.

4.10: Has the company accounted for cost savings and/or benefits from offsetting circumstances, where relevant?

4.10 key points:

- We have demonstrated in section 4.3 what actions we take to try and mitigate the impacts of topography on customers.
- We have applied a fixed 5% catch up efficiency challenge to models to account for this, however we recognise the final catch up efficiency assumptions will be finalised as Ofwat finalises its model suite.

This claim is fundamentally about ensuring that the additional costs we face for power, due to our topography, are reflected appropriately in the models.

We continue to seek cost efficiencies on our procured energy and invest in pump efficiency and optimisation to mitigate the impacts of our topography, as we explained in section 4.3. These help ensure that we minimise the impacts of topography on energy use and ultimately customer bills, but as we have explained previously, the fundamental topography issue cannot be mitigated against as it is beyond management control.

Our efforts to minimise these impacts are embedded in our historic reported costs and we will continue to target these going forward. This challenge on us will automatically form part of the catch up and frontier shift efficiency challenges that Ofwat apply to the whole of our modelled costs.

4.11: Is it clear that the cost allowances would, in the round, be insufficient to accommodate the factor without a claim?

4.11 key points:

- Our PR24 cost allowance has to fund our power costs. If our power costs are higher than implicitly funded then other investment will suffer as a consequence. This is not good for customers in the long term.

If the models are not adjusted to fully account for topography appropriately at the sector level, or if this claim is not accepted for us, this means that our topography related power costs are underfunded at PR24.

We have no choice but to meet our power cost and capital maintenance obligations for the water that we supply, i.e we have to pay our power bills and we have to appropriately maintain our larger capacity pumping assets. Underfunding this means less funding available, compared to other companies, to meet our other investment needs and obligations.

This is not good for our customers, as like for like with other companies it means less funding for other key obligations. With obligations on the sector increasing, and many of these obligations being required from base expenditure and efficiency improvements (either direct, or by requiring performance improvement within the base funding envelope), underfunding for topography risks subjecting our company to material underfunding risks against our whole set of obligations.

4.12: Has the company taken a long-term view of the allowance and balanced expenditure requirements between multiple regulatory periods? Has the company considered whether our long-term allowance provides sufficient funding?

4.12 key points:

- Power costs are a continuous cost across all regulatory periods. We cannot choose to adjust timing to balance expenditure in this area.
- When we undertake capital maintenance, we have to install assets of the capacity required to deliver the required pressure into the network to overcome topography.

This section is not relevant, as power is a continuous operating cost, and we cannot choose to adjust timing of expenditure across regulatory periods to mitigate any immediate cost pressures. Similarly for capital maintenance costs that are higher as a result of needing to generally install larger capacity pumping plant due to topography, again this is not a cost we can avoid or postpone.

4.13: If an alternative explanatory variable is used to calculate the cost adjustment, why is it superior to the explanatory variables in our cost models?

We have set out in detail in sections 3, 4.1 and 4.2 why average pumping head is superior to boosters per length of main, and why boosters per length of main is not reflecting our circumstances nor those of the sector for network topography.

We do not class average pumping head as an alternative variable, rather, the issue is how the cost drivers are being used in the suite of cost models. The issue that arises for us is that Ofwat is using boosters per length of main in half of the models, which does not reflect topography, and therefore a valid topography driver is omitted from half of the models. This has a material negative impact on our efficiency and cost allowances, and also misrepresents the impact of topography across the sector.

4.14: Is there compelling evidence that the cost estimates are efficient (for example similar scheme outturn data, industry and/or external cost benchmarking, testing a range of cost models?

We have applied a fixed 0.95 catch up efficiency challenge to the models used in this claim, because of the models demonstrating a catch up efficiency factor of above one in some cases, which we do not believe Ofwat would be able to use. We recognise that the final models and Ofwat's policies on efficiency challenge will dictate the final efficiency challenges used and will likely alter our claim value.

We have tested a range of cost models as shown in section 4.2, by adding and removing the cost drivers representing topography and boosters per length of main to determine the impact on the modelling process, which is significant as we have demonstrated.

Other than our analysis of industry power costs in section 4.7, it is difficult to strip out the cost impacts of topography from industry data because the granularity does not exist. For example, it is difficult to strip out the element of power costs allocated to topography for the sector because we do not know each company's asset configurations. Furthermore, it is difficult to identify how capital maintenance (or indeed, enhancement) costs might change if pumping plant (and ancillaries) of a higher or lower pressure capacity are required in different companies. Finally, there are also likely to be impacts on trunk mains within the network that are embedded in costs and cannot be stripped out, for example the pressure rating of pipework being higher when requiring a higher pumping pressure, and possible greater impacts on trunk mains leakage.

To summarise, network topography has multiple cost impacts which cannot be separately identified in sector data. Ofwat's PR24 models would implicitly include these costs in its source data set, but need the right cost drivers to be used to correctly identify these patterns and correctly distribute these costs across the sector in future allowances.

4.15: Does the company clearly explain how it arrived at the cost estimate? Can the analysis be replicated? Is there supporting evidence for any key statements or assumptions?

In this claim document we have clearly explained the topography issue, from the engineering rationale, to the configuration of our assets and locations of customers, to the way in which different models and cost drivers appropriately accommodate the issue.

We have demonstrated the wide range of modelled allowances that result from different model configurations in this area, and we have presented a claim value that is net of an implicit allowance calculated from those same model configurations. We have used Ofwat's own Stata files to create these models, with only minimal changes required to remove the APH_TWD and boosters per length of mains costs drivers for our 'no topography' model.

Our analysis can be readily replicated, and we have supplied our modelling spreadsheets alongside this claim.

4.17: Does the company provide third party assurance for the robustness of the cost estimates?

We have worked with Oxera for cost model support and we asked them to review the robustness of the cost estimates and modelling approaches in our claim. The scope of this review covered: (i) the efficient cost estimates used to calculate the gross value of the claim; (ii) the implicit allowance calculations deducted from the gross value, to arrive at the net value of the claim; and (iii) the calculation of a symmetrical cost adjustment. Oxera's review concluded:

"In conducting this exercise, we took Ofwat's dataset as given but did not review the accuracy of the underlying forecast data. We reviewed the approach to quantify the gross value of the claim and the implicit allowance. In both cases the costs are estimated based on Ofwat's proposed top down econometric models and therefore provide cost estimates relative to other companies. We consider the choice of catch up efficiency more challenging than suggested by the data as the level of the upper quartile and the fourth ranked position was above one in some models. The mechanistic application of such an adjustment is counterintuitive since it would increase the value of the estimated costs which departs from the purpose of a catch-up efficiency challenge. Indeed, since the current modelling suite does not account for the recent upward cost pressures faced by the industry and would increase the estimated cost impact, until further detail is provided by Ofwat on its PR24 approach to this issue, we consider the net claim as being efficient." – Oxera, 7 June 2023.

4.18: Need for investment, best option for customers, and customer protection.

As this claim is modelling focussed, and is for the topography issue only, which is a continuous cost, we do not consider the final three sections relevant to the claim, as these sections are designed for use with scheme/project based claims.

Nevertheless, we do consider that ensuring topography is appropriately reflected in ours and the sector's cost allowances appropriately, ideally by sector wide modelling, or by allowing a claim and applying a symmetrical adjustment, is the best option for customers. This is because these increased costs have to be met, and underfunding this ultimately means trade-offs against other important areas of expenditure or investment.

5. Future power costs

This claim has been constructed using Ofwat's modelled costs, which represent ours and industry costs using data from 2011/12 to 2021/22 at present.

Historic costs do not include the impact of recent material increases in energy prices, and given many companies including ourselves have hedging arrangements on our power contracts, further power cost increases are forecast to occur as these hedging arrangements unwind and our exposure to market prices increases.

In our case, we are partially hedged to 2024/25 according to the below schedule.

	2021/22	**2022/23**	**2023/24**	**2024/25**	**2025/26 onwards**
Original contract fixed	90%	80%	70%	60%	-
Original contract floating	10%	20%	30%	40%	-
New arrangement additional fixed amount	-	20%	30%	20%	-
Remaining floating amount	-	-	-	20%	100%

We are currently monitoring the market carefully and in 2022/23 we entered into an additional fixed price arrangement to protect 20% of usage that was unhedged in the previous contractual arrangement. This new arrangement came at current market rates which of course are significantly higher than the original arrangement. We repeated this exercise for 2023/24, hedging a further 30% of our prices, and a further 20% for 2024/25. Going out further, we have to be very mindful of the forecasts that power prices may start to fall back from their current peaks, but not as far as levels previously seen.

We hedge prices to protect against financial risk, not to try and outperform the market. But nevertheless, we have to be extremely cautious about entering into fixed contracts now at current rates, which may then fall in future leaving us overpaying for energy, which is not good value for customers.

Power price increases will impact all of our power costs. But for us, because of the topography impact that we have as demonstrated in this claim, this means a greater exposure compared to other companies, because of our increased energy use deriving from the increased pumping pressure we have to operate in our network to overcome topography.

The numbers presented in this claim do not take future energy prices into account at this stage, because we recognise it is an industry wide issue that needs to be solved for all companies. If we include future power price increases in this claim at this stage, we would then need to be mindful of any duplication with power price mechanisms implemented sector wide, which would add complexity. It is for this reason that we decided to restrict this claim to historic modelled costs only at this stage.

----------------- END -----------------