UUW67

Cross Price Control Enhancement Case

October 2023

Chapter 8 supplementary document

This document sets out the service enhancement expenditure and activity that we will undertake, through our 2025-2030 business plan.

This case includes:

- Case 25: Carbon net zero
- Case 26: Power resilience

United Utilities

Water for the North West

1. Cross Price Control Enhancements

1.1 Structure

1.1.1 This document contains our Cross Price control enhancement cases and is structured as below:

- Case 25: Carbon net zero
- Case 26: Power resilience

UUW67

Carbon Net Zero

October 2023

Enhancement Case 25

United Utilities

Water for the North West

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1. Enhancement claim submission

<table>
<tr><th colspan="2">Enhancement submission</th></tr>
<tr><td>Title:</td><td>Net zero enhancement programme</td></tr>
<tr><td>Price Control:</td><td>Water Resources, Water Network Plus, Wastewater Network Plus and Bioresources</td></tr>
<tr><td>Enhancement headline:</td><td>With support from Ofwat, our net zero enhancement programme aims to enable well over 200,000 tonnes of operational greenhouse gas (GHG) emissions benefit in the period 2025 to 2030, and over 2 million tonnes of carbon dioxide equivalent (tCO_2e) by 2055.</td></tr>
<tr><td>Enhancement expenditure
(FY23 prices)</td><td>
<table>
<tr><th></th><th>AMP8 Capex inc TI (£m)</th><th>AMP8 Opex (£m)</th><th>AMP8 Totex (£m)</th></tr>
<tr><td>Pre RPE and Frontier Shift</td><td>199.732</td><td>0.573</td><td>200.305</td></tr>
<tr><td>Post RPE and Frontier Shift</td><td>195.700</td><td>0.645</td><td>196.345</td></tr>
</table>

The table above shows the total expenditure, inclusive of accelerated programme and transitional investment, on both a pre-efficiency (i.e. pre frontier shift and real price effects basis, consistent with the cost data tables), and a post efficiency and RPE basis (i.e. consistent with the value we propose to be recovered from price controls). All numbers referenced hereafter in this enhancement case are on a post efficiency and RPE basis.
</td></tr>
<tr><td>This case aligns to :</td><td>The two common performance commitments for operational GHG emissions (water and wastewater), a price control deliverable (PCD) document and delivery of our UUW37 – Our strategy to net zero 2050 Plan.

Data associated with this net zero enhancement programme is summarised in data tables CW21 and CWW22.

For full reconciliation between enhancement costs and data table lines, see enhancement mapping tabs in UUW117 – Project allocations CW3 and CWW3.</td></tr>
<tr><td>PCD</td><td>Yes</td></tr>
</table>

2. Enhancement claim summary

Ofwat assessment gates	Summary
Need for enhancement investment	• Working towards net zero is a priority to us and our customers as the affordability and resilience of our operations and services fundamentally rely on a stable climate and a healthy natural environment. We have produced an ambitious plan to reach net zero in scopes 1, 2 and 3 greenhouse gas (GHG) emissions by 2050, supporting the national legal requirements in the Climate Act 2008. Our net zero enhancement programme is central to our plan and crucial in AMP8 to achieve further GHG emissions reduction and work towards a science-based trajectory as part of our adaptive plan to net zero by 2050. • Customers have confirmed that achieving net zero is important and action needs to be taken in line with UK government ambitions. Our social value research in 2022 showed climate change is a top three concern among the public and a concern for all customer types. Our latest customer research specifically included net zero, confirming support for action in AMP8. More broadly, numerous pieces of national research over recent years have found that a clear majority of the public consider it a priority to take action now and over the long-term towards net zero. • Defra[1], Ofwat[2] and Environment Agency[3] guidance to the water sector for this price review confirmed that water companies should support the Climate Change Act and prioritise action on net zero in AMP8 as part of long-term plans. Ofwat has requested that companies put forward interventions with a primary driver of GHG emissions reduction as net zero enhancements. Appendix 9, page 92 in the Final Methodology states "*Ofwat has created a net zero enhancement challenge where companies that are stretching themselves and have efficient proposals will be priorities for additional enhancement funding to tackle operational GHG emissions.*" • Our net zero enhancement programme includes an innovative suite of projects, which all have a primary driver of emissions reduction, some of which we have put forward into Ofwat's net zero challenge. Through our assessments and optimisation we have included only the best possible projects in this programme and ensured multiple benefits and low regrets in securing the required levels of emissions reductions in AMP8 and essential enablers for our long-term adaptive plan. • Our net zero enhancement programme builds on our strength as an early leader in GHG emissions reductions, including large reductions in operational emissions. For example, through our investment in new renewable energy and our move to 100% certified green electricity. Our journey ahead is now much harder, having made this bold progress by deploying the most cost-beneficial interventions, and with the substantial growth in GHG emissions resulting from the new requirements in the Environment Act. • We will continue to make as much progress as possible from base allowances, for example driving efficiency, considering cost-effective innovations when maintaining or replacing existing assets, and funding roles that lead on expanding GHG analysis and reporting

[1] Defra (2022) The governments strategic priorities for Ofwat https://www.gov.uk/government/publications/strategic-policy-statement-to-ofwat-incorporating-social-and-environmental-guidance/february-2022-the-governments-strategic-priorities-for-ofwat

[2] Ofwat (2022) Our final methodology for PR24: https://www.ofwat.gov.uk/wpcontent/uploads/2022/12/PR24_final_methodology_main_document.pdf

[3] Water industry national environment programme (WINEP) methodology (2022): https://www.gov.uk/government/publications/developing-the-environmental-resilience-and-flood-risk-actions-for-the-price-review-2024/water-industry-national-environment-programme-winep-methodology

	requirements. However, to date there has been no implicit allowance with GHG emissions reduction as the primary driver. The net zero enhancement programme represents costs over and above historic base, and the base and enhancement proposals put forward as part of our AMP8 plan. Enhancement investment is required in AMP8 and beyond to further reduce emissions and retain a science-based trajectory towards the national legal requirements for five-yearly carbon budgets and net zero by 2050. • Our progress to date has been achieved through low cost and commercially attractive options, for example investing in renewable energy with a viable financial return and moving to a certified green electricity tariff at almost no extra cost up to 2025. In addition, we have so far absorbed relatively small and targeted additional costs for experimental trials or where interventions have aligned with business priorities but were more expensive, for example introducing our first fully electric vehicles. Maintaining this performance and delivering further emissions reductions at the required pace and scale will require transformation and substantial investment beyond our stretch of historic base allowances which have never included implicit costs for the emerging priority of net zero. • Having already taken early action to deliver the most commercially attractive interventions, further options require investment with the primary driver for emissions reduction. Maintaining green electricity purchase is also becoming increasingly costly with rising prices in the market as more organisations ramp up focus on moving to net zero. We need to go much further than previously expected to counter substantial new growth in emissions from the latest legal and regulatory requirements. • Business activities funded within base are often the source of operational emissions we are working to decarbonise, for example fleet and energy management. However, decarbonisation of these activities typically costs more than traditional approaches and many of our net zero enhancement proposals seek the uplift in funds to bridge the gap, for example for more expensive fuels and vehicles. Other schemes within our programme allow us to expand our innovative approaches and fund entirely new activities such as a focus on process emissions.
Best option for customers	• We have developed a net zero programme for AMP8 that, if supported by Ofwat, will ensure low regrets and high value to best serve customers short, and long-term, interests in meeting legal net zero targets. This enhancement programme is essential to ensure sufficient progress in AMP8 to maintain a science-based trajectory to net zero by 2050, which essential to protect customer's long-term interests in affordable and resilient water and wastewater services. • As summarised in the 'need for enhancement investment' assessment gate above, acting for net zero is a confirmed customer priority, and costs in the net zero enhancement are over and above a stretch on base allowances. • To ensure a high value and low regrets approach, the projects were optimised based on their cost per tonne of GHG emissions reduction (£/tCO_2e) and feasibility for delivery. The projects in phase 1 of our net zero enhancement programme were prioritised from a total of 26 potential projects. All projects in this programme offer multiple other benefits that customers confirm are priorities, including: financial and resource efficiency, water quality and storage, nature, recreation and public health. • We have collaborated with expert third parties to assess and value GHG emissions throughout our AMP8 business plan and net zero plan, including the development of our net zero enhancement programme. In addition, third party assurance has been undertaken across our net zero plan to challenge and validate the robustness of our approach. • The woodland and peatland projects represent 50% of the capex required for scheme delivery. Using past experience in delivering similar projects for water quality drivers, we

	will pursue partnership grant funding for the remaining 50%, reducing the impact to customer bills. • We understand from Ofwat's final methodology documents that the tCO_2e benefit approved for net zero enhancement funding will amend the performance commitment level (PCL) for common operational GHG PCs. Appendix 9, page 96 in the draft methodology states *"the reduction funded through the bidding competition would be factored into performance commitment levels"*. And Appendix 9, page 91 in the final methodology states Ofwat *"will benchmark the proposed GHG emissions impact of common enhancement activities between companies to ensure an efficient impact is represented in adjusted performance levels"*. Later in this document we set out the GHG benefits of each project, when these are expected and the most appropriate reporting methodology. These factors determine how each project supports the common GHG performance commitment (PC) methodology and PCL, or wider ambitions for progress towards net zero 2050. We have set out the many wider benefits of each project in the programme that ensure great value for customers. • Please also refer to the 'customer protection' assessment gate section in this table.
Cost efficiency	• We have ensured lowest possible costs by driving efficiency throughout and proposing a prioritised selection of the best opportunities identified. All of the final projects included in the programme offer wider benefits beyond GHG emissions to demonstrate greater value, including resource and potential long-term financial efficiencies in several cases. Further details are provided in each case set out in this document. • Costs have been estimated using best available information from a range of sources including site assessments, quotes from suppliers, and quotes from our estimating department using cost curves from a database of costs. As referenced in the best value for customer gate, this includes significant partnership funding which we expect to source for peatland and woodland projects. • For additional details, see the PR24 data table supporting commentary documents for CW21 and CWW22. • We commissioned two specific pieces of third party work to assure the cost efficiency of our enhancement cases: • A bottom-up benchmarking exercise (Faithful and Gould); and • Assurance on top-down benchmarking carried out by UUW (Deloitte). • We consider that the complementary and independent output of these pieces of work demonstrates that our cost estimates are efficient and represent excellent value for money for our customers
Customer protection	• Ofwat proposes that if companies fail to deliver improvements to customers, then price control deliverables (PCDs) should be used to return to customers the allowed cost of the enhancement. We recognise the need for PCDs to ensure that customers are appropriately protected. • For the eight projects in our net zero enhancement programme, we propose that customers are protected by a PCD that covers the full cost and tCO_2e benefit delivered by those projects. This means that there will be a refund and a financial and reputational penalty for under performance in either late or non-delivery. • Measurement of the PCD will be assured by an experienced third party. This provides independent verification to demonstrate that the outputs have been delivered. Section 5.5 summarises the PCD delivery expectations.

	• A second layer of customer protection is provided for the six projects which align to the delivery of the two common operational GHG emissions PCs for water and wastewater, therefore adding a financial and reputational penalty for under performance. The company takes the risk on cost increases beyond the funds identified in this programme to deliver the forecast benefit. • For the three projects entered into the net zero challenge, we do not propose a PCD, or a PCL reduction, at this time. By definition, these are more challenging and uncertain projects that involve innovation and can only proceed if successful in the national challenge competition. Protections will be provided by Ofwat's approach to the challenge. We propose customer protections similar to those in the innovation fund, where project milestones are agreed at the project outset which are then reported against. • For all projects in the net zero enhancement programme, we will publish progress in our Annual Performance Report to aid transparency. • All net zero enhancements put forward meet the scope definition of operational emissions as defined in the common PCs.

3. Key terms

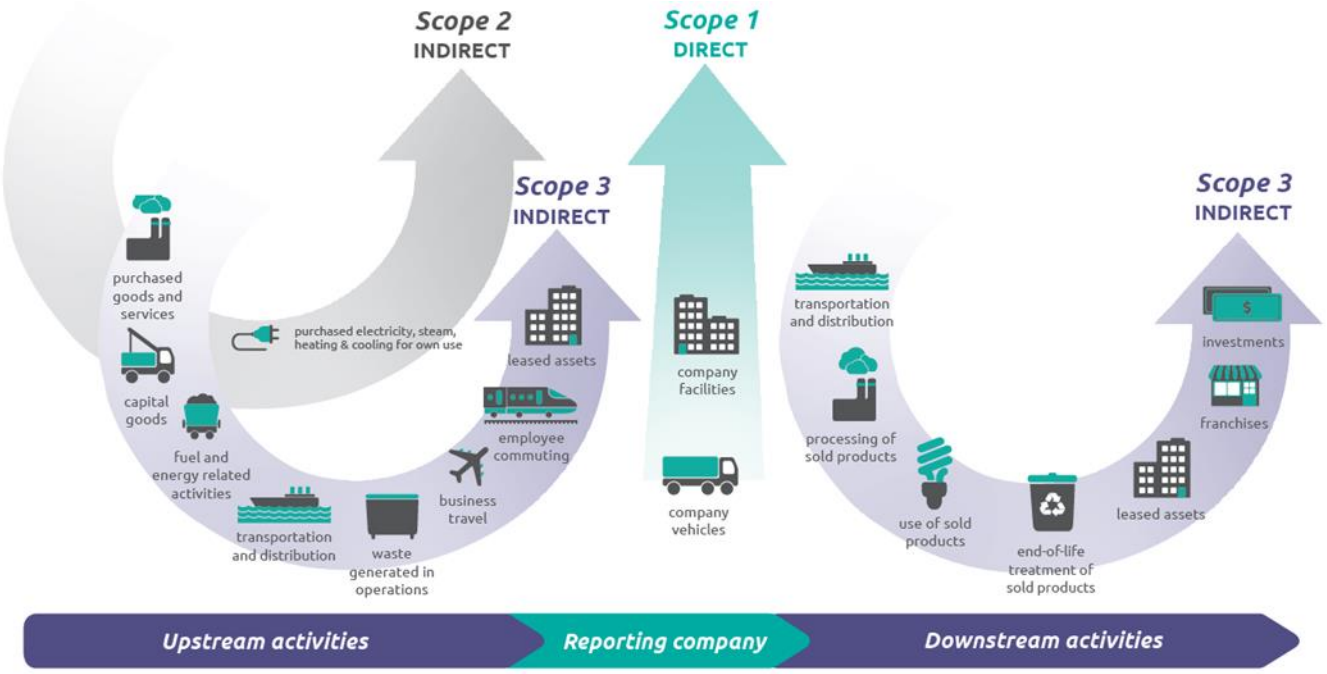
3.1.1 This section describes essential terms used in this document. A technical glossary is in Appendix A.

3.1.2 **Greenhouse gas (GHG) emissions** are those that contribute to climate change. Often referred to as a '**carbon footprint**'.

3.1.3 **The GHG Protocol** is the global best practice framework for the quantification and reporting of GHG emissions, including the definition of scopes (see Figure 1) and two methods for emissions from purchased electricity:

- **Scope 1 emissions** are those resulting directly from activities the organisation owns or controls;
- **Scope 2 emissions** are those from electricity and heat purchased by the organisation;
- **Scope 3 emissions** are those that occur elsewhere in the organisation's value chain;
- **Market-based method** quantifies scope 2 emissions based on the organisation's electricity procurement choices, such as green tariffs; and
- **Location-based method** quantifies scope 2 emissions based on the average intensity of the local grid, in Great Britain this is the National Grid and thereby recognises the organisation's electricity efficiency.

Figure 1: GHG emissions scopes defined in the GHG Protocol: Corporate Accounting and Reporting Standard



3.1.4 **Operational emissions** are those that result from our core service delivery, including all of scope 1 and 2, and specified scope 3 emissions (see Appendix A). The water sector's traditional boundary for operational emissions has been expanded in Ofwat's definition for the proposed new GHG common performance commitments (PCs), e.g. adding chemicals and sewage sludge recycling.

3.1.5 **Capital emissions** are those that result from the creation, refurbishment and end of life treatment of an asset. We define these emissions using GHG Protocol scope 3, category 2, capital goods.

3.1.6 **Embodied or embedded emissions** are those that result from all activities involved in creating or maintaining a built asset, including extraction and transport of materials and capital emissions.

3.1.7 **Science-based targets (SBTs)** are the global best practice method for an organisation to provide a clearly defined pathway to the global goal of the Paris Agreement, helping to prevent the worst impacts of climate change.

4. Summary of our net zero enhancement programme

Figure 2: The projects and emissions benefits of our net zero enhancement programme

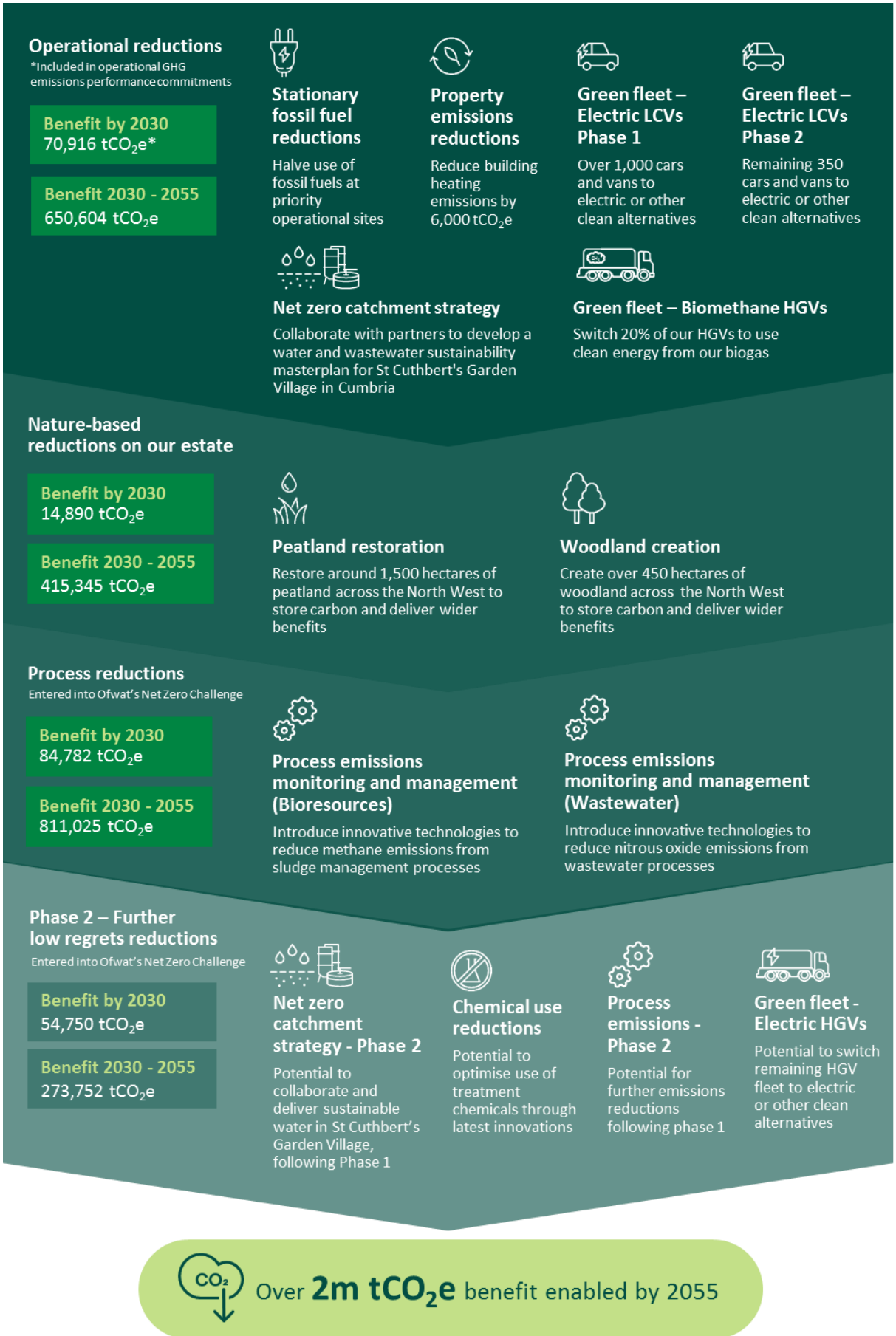


Table 1: Summary of key information for net zero enhancement programme

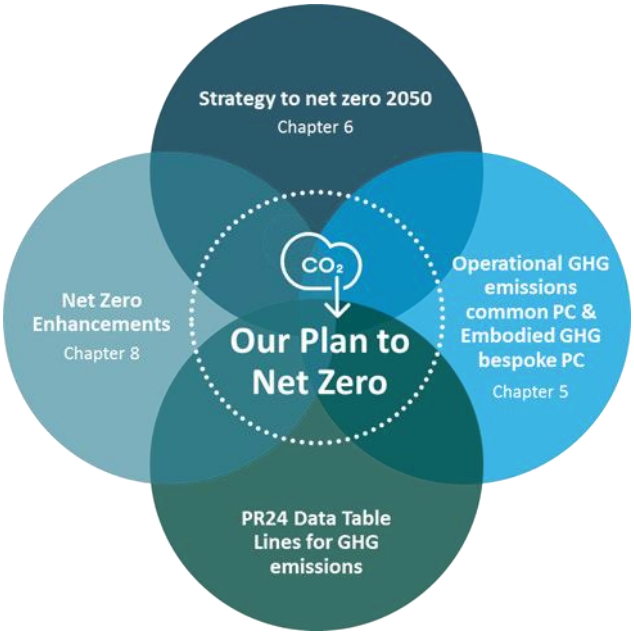
Project reference	Net zero enhancement case	Total AMP8 operational emissions benefit (tCO_2e)	Total operational emissions benefit 2030 – 2055 (tCO_2e)	Total AMP8 embodied emissions (tCO_2e)	Total AMP8 Totex (£m)
Operational reductions (AMP8 emissions included in the AMP8 Common GHG Performance Commitments)					
E00001337	Stationary fossil fuel reductions	-35,277	-277,922	27	12.62
E00001340	Transport fossil fuel reductions - Green fleet LCVs phase 1	-19,060	-225,458	0	8.80
E00001341	Transport fossil fuel reductions - Green fleet LCVs phase 2	-6,590	-77,950	0	17.70
E00001342	Transport fossil fuel reductions - Green fleet Biomethane HGVs	-3,866	-38,659	0	1.20
E00001346	Property enhancements	-6,123	-30,615	141	3.59
E00001425	Net zero catchment strategy	Enabling benefits in phase 2	Enabling benefits in phase 2	0	1.00
Nature-based reductions on our estate (Reportable emissions relate to Pending Issuance Units, PIUs)					
E00001344	Peatland restoration	-13,227	-277,767	0	20.00
E00001345	Woodland creation	-1,663	-137,578	0	2.50
Process reductions (Entered into Ofwat's Net Zero Challenge)					
E00001338	Process emissions (Bioresources)	-22,077	-183,973	548	13.60
E00001339	Process emissions (Wastewater)	-62,705	-627,052	30	33.71
Phase 2 – further low regrets reductions (A range of potential projects, entered into Ofwat's Net Zero Challenge)					
E00001425	Further low regrets emissions reductions in AMP8	-54,750	-273,752	1,203	81.63

5. Introduction and Executive Summary

5.1 Net zero in our PR24 business plan

5.1.1 The affordability and resilience of our operations and services fundamentally rely on a stable climate and a healthy natural environment. Consequently, GHG emissions management and reduction is of exceptional importance to UUW and our customers. We have therefore integrated the goal for net zero throughout our PR24 business plan. This document covers our net zero enhancement proposals, projects with a primary driver of emissions reduction. This is an essential part of our net zero plan which is set out in supplementary document *UUW37 – Our strategy to net zero 2050*. Figure 3 summarises the core elements of our plan to net zero in our PR24 submission.

Figure 3: Our plan to net zero, integrated throughout our PR24 business plan



5.1.2 We have built on our advanced track record of reductions and disclosures to produce an ambitious plan for net zero by 2050 across scopes 1, 2 and 3. Our ambition and commitments are based on international best practice and climate science trajectories, striving for the overall UK legal duty to be net zero by 2050. This approach aligns to the global goal of the Paris Agreement to limit temperature rises to well below 2°C above pre-industrial levels, the target agreed by the international community.

5.1.3 We have already made strong progress by deploying many of the most cost effective solutions, such as investment in a portfolio of new renewable energy facilities and moving to use only certified green electricity throughout our operations. This has reduced our operational emissions by more than 70% since 2010, assessed using the current best practice market-based method. We are well on our way to delivering our six carbon pledges including ambitious Science-Based Targets (SBTs) which are key activities and milestones towards net zero 2050.

5.1.4 The new Environment Act will make it much harder to deliver further absolute reductions and achieve net zero because of substantial growth from the emissions associated with the required new infrastructure, electricity and chemicals. Despite these challenges, we have identified options to reduce emissions whilst providing additional benefits. In developing our latest plans, we have innovated and optimised to contain the emissions from the delivery of our legal and regulatory requirements. However, we cannot entirely mitigate the substantial growth pressures and achieve substantial further reductions within existing base allowances.

5.1.5 To retain a science-based trajectory in AMP8 and beyond will require transformation and substantial investment beyond our historic base allowances. Having assessed costs, benefits and technical feasibility

of our needs and options, our AMP8 plan delivers low regrets interventions which strive for the most sustainable long-term approach towards the priorities agreed with customers and stakeholders, including affordability, improvements to service and the water environment, and GHG emissions. As well as reductions in emissions from base and standard enhancement expenditure, our £196.3 million net zero enhancement programme is critical to our goals for net zero and delivers immediate and multiple benefits.

5.1.6 Measured using global best practice GHG reporting methods, and with support from Ofwat, our plan will:

- Reduce operational emissions by around 43 per cent during AMP8; mitigating growth pressures and going further to deliver overall reductions to support our operational emissions SBT;
- Avoid and defer approximately 858,000 tCO_2e of operational and embodied emissions during AMP8, reducing the emissions of our plan by nearly 40 per cent from what they would have been without our focus on efficiency and innovation;
- Deliver essential enablers for further reductions in the longer-term, enabling more than 2 million tCO_2e benefits by 2055;
- Inform the new best practice standard for the measurement, reporting and management of emissions which are challenging to the whole sector, including innovative proposals for process emissions and a bespoke performance commitment (PC) for scope 3 emissions from many large infrastructure projects; and,
- Enable wider complementary benefits for: water; resource and cost efficiency; public health improvements from better air quality and recreation; and nature.

5.1.7 We will work with our partners and strive to go even further during delivery in AMP8.

5.1.8 Our integrated approach achieves these outcomes through two inter-related areas of focus:

- **Optimising GHG emissions throughout our business plan** – We applied our carbon assessment framework with support from expert third parties to forecast, reduce and avoid emissions by valuing them throughout our decision making. With substantial new legal requirements and other factors, there are many upward pressures on emissions. However, we have focused on efficiency and innovation to keep emissions as low as possible while maintaining and further improving infrastructure and services for customers. For example, we expect emissions reductions from base and enhancement programmes for sludge treatment, biosolids recycling, leakage reduction, demand management and measures to help customers be water efficient. We have embraced nature based approaches, surface water removal and hybrid solutions where they have lower emissions than traditional solutions.
- **Focusing specifically on GHG emissions through our net zero enhancement programme** - To retain a science-based trajectory in AMP8 and beyond will require transformation and substantial investment beyond our historic base allowances. We have developed a £196.3 million net zero enhancement programme that, if supported by Ofwat, prioritises the most cost effective deployable projects with emissions reduction as the primary driver, and which also deliver many wider benefits. As well as immediate reductions by 2030, this programme provides essential enablers to longer-term benefits that will accelerate decarbonisation for both us and the sector, as we are committed to sharing our learning from new innovations and ways of working.

5.1.9 We have rigorously applied the GHG preference hierarchy to optimise further emissions reductions as we strive to keep our emissions on a science-based trajectory despite the substantial growth pressures. We are pursuing a wide range of opportunities, striving for efficiency first and using purchased offsets only as a last resort and not at all before 2030.

5.1.10 Our plan includes a stretching target in the operational GHG PCs that Ofwat is introducing for water and wastewater in AMP8, as well as an innovative and challenging bespoke performance commitment for embodied emissions.

5.1.11 Using Ofwat's methodology for the common PCs, our plan shows a 12% decrease in water and 11% increase in wastewater operational emissions in 2029/30 from a 2021/22 baseline. Ofwat's methodology for these PCs is different to our standard reporting approach that aligns to international best practice, for example it uses static emissions factors to avoid reporting changes associated with GHG accounting updates. This means that emissions reported using the PC methodology will increasingly diverge through AMP8 from 'actual' emissions in our company GHG reporting and will require careful communication to stakeholders.

5.1.12 In this document and our net zero enhancement programme, all emission values referenced have been calculated using Ofwat's common PC methodology unless stated otherwise. We have taken this approach because the net zero enhancements closely relate to the common operational emissions PCs.

5.2 Our net zero enhancement programme

5.2.1 We've developed an ambitious enhancement programme specifically targeting GHG emissions reductions. Undertaking this programme in AMP8 is vital to our low regrets, adaptive long-term emissions reduction plan and overall ambition to reach the national legal requirement for net zero 2050 and maintain a science-based trajectory that supports the national legal five year carbon budgets.

5.2.2 The programme is summarised in Figure 2 and Tables 2 to 4 and a detailed overview of each project is provided in the rest of this document. With support from Ofwat, the programme will see £196.3 million invested to deliver benefits across all aspects of our operational emissions plus essential enablers to future action and longer-term emissions benefits. Every area of focus in our programme delivers strong benefits in AMP8, and the cost benefit improves notably in the longer term with even more benefits growing over time. The programme is summarised in Figure 2, targeting a total emissions benefit of over 2 million tCO_2e by 2055, including the following components:

- 70,916 tCO_2e of immediate reductions in AMP8, reportable in Ofwat's common operational GHG emissions PC methodology, enabling an estimated benefit of 650,603 tCO_2e over the longer term;
- 14,890 tCO_2e of further reductions enabled and formalised in Pending Issuance Units (PIUs) in AMP8 by delivering peatland restoration and woodland creation schemes with GHG emissions reduction as the primary driver. These projects will enable an estimated benefit of 415,345 tCO_2e over the longer-term, and wider natural environment benefit. These activities are over and above other catchment management projects in our Water Industry National Environment Programme (WINEP);
- 84,782 tCO_2e of reductions targeted in AMP8 by improving the monitoring, measurement and management of process emissions, enabling an estimated benefit of 811,025 tCO_2e over the longer-term;
- 54,750 tCO_2e of reductions targeted in AMP8 through an adaptive second phase of work to develop and deliver innovations in the latter half of AMP8 while managing uncertainties, enabling an estimated benefit of 273,752 tCO_2e over the longer-term.

5.2.3 This programme offers financial and resource efficiency, with savings reflected in our business plan proposals for AMP8 and beyond. There are further complementary benefits for biodiversity, water quality, flood management, and public health through cleaner air and improved recreation.

5.2.4 To grow the benefits even further, we will share our learning with others and collaborate to advance the sector's approach to priority challenges and opportunities in working to net zero. We will help lead the sector to define new best practice standards in key areas of operational emissions, which will provide sector level resilience to an evolving policy landscape.

5.2.5 This programme has been optimised from an initial 26 identified projects with GHG emissions reduction as the primary driver. These were challenged and consolidated to 10 projects in the first phase of the programme, to start immediately in AMP8. In addition, more opportunities will be further developed ready for delivery with confidence in phase 2, later in AMP8.

5.2.6 Without this enhancement programme we are at serious risk of not being able to maintain a science-based trajectory, or deliver essential enablers for our long-term duty to net zero by 2050.

5.2.7 This enhancement programme, with support from Ofwat, will deliver a step change in a number of priority areas of our operational emissions. Projects will enable us to greatly reduce our use of fossil fuels at our treatment sites and in our fleet by switching to latest available alternative technologies. By funding the cost difference from base budgets, we can switch vehicles and operational processes to use electricity and other alternatives to fossil fuels. We can also switch a proportion of our heavy goods vehicles (HGVs) to run on biomethane from our operational processes, further embracing the circular economy.

5.2.8 Further emissions benefits can be secured in AMP8 and for the long-term by creating more woodland on our land, and going further than regulatory schemes in our WINEP to restore even more of our peatland. These projects deliver benefits for resilience of water services, public health and nature.

5.2.9 Two projects within our net zero enhancement programme are focused on transforming how we monitor and manage process emissions. These projects do not include costly, speculative technologies for which poor evidence currently exists. Our extensive due diligence, supported by sectoral and recent Defra work, highlights the potential for high mitigation, low cost options making best use of our existing asset base. We can build on work to date to better understand and monitor emissions from treatment processes, and take rapid mitigation action at high opportunity sites. This will enable a more accurate measurement and reporting methodology based on monitored process data instead of the current sector standard which uses low confidence estimates based on population equivalents. This improvement, over time, will support best value mitigation across our entire asset base and the implementation of changing technologies. This is a challenging and substantial source of operational emissions for any wastewater company and we will share our learning and collaborate to help transform the sector measurement standard and management strategy.

5.2.10 A unique and time limited opportunity is linked to the large development of St Cuthbert's Garden Village in and around Carlisle. The unique position of this large new development presents the opportunity to create a truly integrated and strategic approach to clean, surface and wastewater for the new development that can generate innovation and set the standard for replication elsewhere. To protect customers from uncertainties we propose a two phase approach. The first phase will see collaboration and investigation to develop a multi-agency vision, masterplan and other critical enablers for the goal of a low GHG emissions and sustainable community development, focused on water-related priorities. This will inform if, how and when more substantial work can take place in a potential second phase. See section 6.9 for further details.

5.2.11 With a fast moving external environment, there is uncertainty in how innovation and associated cost-benefit and deliverability will evolve between now and the latter years of AMP8. Our programme includes an adaptive second phase of activity to help protect customers from this risk at the same time as pushing boundaries to ensure the required rate of emissions reduction to achieve a science-based trajectory. Building on our on-going assessment, this project would deploy latest cost-effective and technically feasible options to address more areas of operational emissions. For example, we are exploring further opportunities from the advances in the process emissions and net zero catchment strategy projects. We are exploring how to decarbonise essential chemicals and go further with the HGVs in our fleet which remains a global challenge with rapidly evolving technological developments. Other options may come to light as part of our adaptive and low regrets approach that remains agile to ensure we deploy the right approaches at the right times and in the right places.

5.3 Our net zero enhancement programme allocation

5.3.1 The PR24 data table guidance accompanying the net zero enhancement data tables CW21 and CWW22 states "selected schemes should make up the company level net zero enhancement programme (as presented in CW3 and CWW3) and those schemes not part of the company level programme but are suitable for consideration in the net zero challenge should be given the Feasible dropdown option."

5.3.2 The projects selected as part of our net zero enhancement programme have been split into net zero enhancement cases and those for inclusion in Ofwat's net zero challenge.

5.3.3 The eight cases classified as 'selected' in Table 4 below and data tables CW21 and CW22 have been submitted as net zero enhancement projects, outside of the challenge. These consist of project types which are more developed and relatively more readily deployable forms of innovation that require additional funding in AMP8 beyond base expenditure to cover new activities or an uplift in cost compared to traditional alternatives.

5.3.4 A further three cases have been identified as 'feasible' for inclusion in the net zero enhancement challenge. These cases consist of cutting edge innovation to help tackle systemic long-term challenges to our, and the sectors, route to net zero 2050.

5.4 Our net zero enhancement programme application to the operational GHG emissions common performance commitments

5.4.1 Six of the projects are reportable against the common GHG PC methodology and as such can reduce the associated PCLs by a total of 70,916 tCO_2e additional reduction across all price controls. This goes beyond our base and standard enhancement programmes.

5.5 Protecting customers through Price Control Deliverables (PCD)

5.5.1 This enhancement case is below the materiality threshold to require a PCD under Ofwat's guidance. However, we recognise the value for a PCD to protect customers in the emerging and evolving space of net zero. It is important that outcomes are delivered for customers because they have shown strong support for action towards net zero, and in the absence of PCs which apply to all projects within the enhancement case.

5.5.2 The proposed PCD will be aligned to the eight projects submitted as net zero enhancement projects, outside the net zero challenge. The PCD will be measured in tonnes of carbon dioxide equivalent (tCO_2e). This consistent unit enables comparison between projects within the PCD, even though their methodologies and delivery mechanisms are different.

5.5.3 We present in Table 2 the scheme delivery expectations.

Table 2: Summary of PCD delivery expectations

Scheme delivery expectations	
Description	Delivery of operational GHG emissions reduction. The proposed PCD will be aligned to the eight projects submitted as net zero enhancement projects, outside the net zero challenge. This includes: • Stationary fossil fuel reductions; • Transport fossil fuel reductions - green fleet LCVs phase 1; • Transport fossil fuel reductions - green fleet LCVs phase 2; • Transport fossil fuel reductions - green fleet Biomethane HGVs; • Property emissions reductions; • Peatland restoration; • Woodland creation, and; • Net zero catchment strategy. The total AMP8 Totex value for these projects included within this PCD is £67.6 million. Note: year 5 presents a minus cost value due to the decreasing capex profile (majority of the capex is profiled at the start of AMP8 so the emissions reduction benefits can be realised) and the opex benefits received from projects such as green fleet.
Output measurement and reporting	Tonnes of carbon dioxide equivalent (tCO_2e). This consistent unit enables comparison between projects within the PCD, even though their methodologies and delivery mechanisms are different. GHG emissions reductions will be reported and monitored through our Annual Performance Report (APR). The PCD will be measured once at the end of AMP8 and will not continue into AMP9. Note: tCO_2e from peatland restoration and woodland creation will be provided as Pending Issuance Units (PIUs) at the end of AMP8 with Carbon Units expected to be available for use against reportable emissions from 2032 for Woodland and 2035 for Peatland, according to current best practice frameworks.
Assurance	Measurement of the PCD will be independently verified by an expert third party. Assurance will provide confidence that the output has been delivered and these meet the forecast benefits of the work. A second layer of customer protection is provided for the six projects which align to the delivery of the two common operational GHG emissions PCs for water and wastewater: • Stationary fossil fuel reductions; • Transport fossil fuel reductions - green fleet LCVs phase 1; • Transport fossil fuel reductions - green fleet LCVs phase 2; • Transport fossil fuel reductions - green fleet Biomethane HGVs; • Property emissions reductions, and; • Net zero catchment strategy. This includes a financial and reputational penalty for under performance. The company takes the risk on cost increases beyond the funds identified in this programme to deliver the forecast benefit.
Conditions on scheme	We will deliver the outcomes of GHG emissions reduction by 31 March 2030. If approved, the programme will deliver 85,806 tCO_2e operational GHG emissions reduction in AMP8, including 14,890 tCO_2e in Pending Issuance Units (PIUs) associated with peatland restoration and woodland creation schemes. The PCD will be measured once at the end of AMP8 and will not continue into AMP9.

Scheme delivery expectations	
PCD payment rate	£432 / tCO_2e of operational GHG emissions reduction. Late delivery will incur a penalty of 25% if the scheme is delivered more than twelve months late. The payment rate will be prorated with partial delivery of the scheme.

5.5.4 We present in Table 3 the PCD forecast deliverables and forecast benefits.

Table 3: Price control deliverable

Deliverable	Unit	2025-26	2026-27	2027-28	2028-29	2029-30
tCO_2e from 2025-2030 net zero enhancements	Cumulative tCO_2e	9,135	20,156	34,541	52,472	85,806

5.5.5 Table 4 shows how our net zero enhancement programme has been allocated against the PCL, within the net zero challenge fund and application of PCDs.

Table 4: Net zero enhancement case allocations

Project reference	Net zero enhancement case	Net zero enhancement or Net zero challenge fund	CW21 / CWW22 data table dropdown used	Price control deliverable (PCD) applied	Quoted tCO_2e to reduce PCL directly	Water/wastewater allocation	Location reference
Operational reductions							
E00001337	Stationary fossil fuel reductions	Net zero enhancement	Selected	Yes	Yes	Wastewater	Section 6.1
E00001340	Transport fossil fuel reductions - Green fleet LCVs phase 1	Net zero enhancement	Selected	Yes	Yes	Water and Wastewater	Section 6.2
E00001341	Transport fossil fuel reductions - Green fleet LCVs phase 2	Net zero enhancement	Selected	Yes	Yes	Water and Wastewater	Section 6.2
E00001342	Transport fossil fuel reductions - Green fleet Biomethane HGVs	Net zero enhancement	Selected	Yes	Yes	Wastewater	Section 6.2
E00001346	Property emissions reductions	Net zero enhancement	Selected	Yes	Yes	Water and Wastewater	Section 6.3
E00001425	Net zero catchment strategy	Net zero enhancement	Selected	Yes	Yes	Wastewater	Section 6.4
Nature-based reductions on our estate							

Project reference	Net zero enhancement case	Net zero enhancement or Net zero challenge fund	CW21 / CWW22 data table dropdown used	Price control deliverable (PCD) applied	Quoted tCO_2e to reduce PCL directly	Water/wastewater allocation	Location reference
E00001344	Peatland restoration	Net zero enhancement	Selected	Yes	No	Water	Section 6.5
E00001345	Woodland creation	Net zero enhancement	Selected	Yes	No	Water	Section 6.6
Process reductions							
E00001338	Process emissions (Bioresources)	Net zero challenge	Feasible	No	No	Wastewater	Section 6.7
E00001339	Process emissions (Wastewater)	Net zero challenge	Feasible	No	No	Wastewater	Section 6.8
Phase 2 – further low regrets reductions							
E00001426	Further low regrets emissions reductions in AMP8	Net zero challenge	Feasible	No	No	Water and Wastewater	Section 6.9

6. Net zero enhancement schemes

6.1 E00001337 Stationary fossil fuel reductions

6.1.1 **Headline:** Halving the use of fossil fuels at priority operational sites by switching to alternative fuels, saving over 35,000 tonnes of GHG emissions in AMP8 and over 300,000 tonnes by 2055.

6.1.2 This net zero enhancement case delivers a step change in reducing fossil fuel use in our treatment operations. Swapping to low/zero GHG emissions energy sources will deliver a reduction of over 35,000 tCO_2e over the course of AMP8, and more over the long-term. To minimise the cost we are proposing a series of retrofit actions at a number of sites, as opposed to replacing with brand new assets.

Table 5: Summary of key information for stationary fossil fuel reductions

Key information	
Total AMP8 operational emissions benefit (tCO_2e)	-35,277*
Total operational emissions benefit 2030 – 2055 (tCO_2e)	-277,922**
Total AMP8 embodied emissions (tCO_2e)	27
Total AMP8 Totex (£m)	12.62
Wider benefits	Improving public health Increased resilience
Net Zero Enhancement or Challenge	Net zero enhancement
Applies to the GHG common performance commitment level	Yes – Wastewater

Price Control

6.1.3 The total cost and emissions for this enhancement have been entered into PR24 data table CWW22 in line with the price control allocation spilt shown in Table 6.

Table 6: Price control allocation for stationary fossil fuel reductions

Project reference	Enhancement case name	Water Resources	Water Network+	Wastewater Network+	Bioresources
E00001337	Stationary fossil fuel reductions	0%	0%	0%	100%

Ofwat Assessment Gates

6.1.4 In addition to the overarching assessment shown in section 4 above, the specific assessment below applies to this enhancement.

Table 7: Ofwat's assessment gates for stationary fossil fuel reductions

Gate	Summary
Need for enhancement investment	Evidence: This enhancement allows us to reduce our direct emissions associated with the use of stationary fossil fuels by around half. This is achieved by swapping to low/zero emissions fuels used in the sludge treatment process, including asset enhancements to enable equipment to run on alternative fuels. This enhancement is essential to our ability to retain a science-based trajectory to the national legal requirement for net zero 2050 and five year carbon budgets. Base: This enhancement does not overlap with any activities delivered through base as all proposed activities and costs relate to new/refurbished assets specifically for the benefit of GHG emissions, and the uplift in cost required to switch fuel to a lower emissions alternative. All viable emissions reductions from reducing fossil fuel use that can be delivered through base expenditure have already been implemented or are planned to be implemented, for example our continual drive for fuel efficiency. Previous enhancement: This enhancement case does not overlap or duplicate with any activities already funded at previous price reviews. Timing of expenditure: We will deliver the required upgrades at the start of AMP8 in line with the cost profile above to maximise the emissions benefits from switching fuels to a lower GHG emissions alternative. This enhancement is needed at this time as part of our optimal pathway to retain a science-based trajectory to the national legal requirement for net zero 2050 and five year carbon budgets. Implicit allowance: This enhancement case involves the installation of new equipment and replacement or modification to existing assets in order to deliver a step change in reducing fossil fuel use in treatment operations. Currently the allowance in base is valued as a continuation of existing assets as they are using traditional fossil fuels to deliver current service levels across our treatment operations. The requested cost for this enhancement claim is therefore the incremental cost change required to switch to a lower GHG emissions fuel. Long-term delivery strategy: Our core pathway includes low regrets action in AMP8 across all aspects of our GHG emissions towards a science-based trajectory that supports national legal requirements for net zero and five year carbon budgets. Our approach works to secure wider benefits including service resilience, cost efficiency, recreation (public health) and nature, along with enabling activity to unlock further benefits and acceleration beyond 2030. The alternative option to this pathway and enhancement case would be to continue as we have to date, with fossil fuel consumption. This would not support a science-based trajectory.
Best option for customers	Having assessed the further options to reduce our GHG emissions, this is one of our lowest cost options per tCO_2e. This project will also reduce particulates to help improve local air quality and protect customer's health.

Gate	Summary
Cost efficiency	Assurance: Third party assurance has been undertaken on this enhancement case for the GHG emissions values presented. For cost, our enhancement programme has been considered efficient after review from third party assurance. Evidence: We assessed a broad range of options and prioritised the most cost effective of those viable for delivering further reductions in the near term. We have also taken measures to keep costs as low as possible. For example, this enhancement uses retrofit options rather than installing new assets which would have been financially expensive and emit additional embodied emissions. The level of cost efficiency is demonstrated by the £/tCO_2e, and this enhancement case was one of the most cost-beneficial of the viable options we can deploy in AMP8 to achieve further emissions reductions. Furthermore, the cost-benefit of this enhancement is even stronger in the long-term as we expect further emissions benefits from the investment beyond AMP8, subject to latest assessments in the future. The capex and opex costs for the asset improvements and the switch to alternative fuels is based on estimates from UU's engineering department and site assessments undertaken by a third party. Modelled efficiency: There are currently no agreed industry benchmarks for the cost associated with this enhancement case as it is new for the sector to invest in activity where GHG emissions reduction is the primary driver. Actions to improve emissions have typically been very low cost or a by-product of other priorities, and this is not an indicator of future costs and options needed to achieve required goals. During delivery, we will use market competition to ensure the best rates, for example when purchasing the alternative fuels.
Customer protection	This enhancement case is below the materiality threshold to require a PCD under Ofwat's guidance. However, we recognise the value for a PCD to protect customers in the emerging and evolving space of net zero. We are therefore proposing a PCD that will cover the cost and GHG emissions benefit delivered by the eight projects submitted as net zero enhancement projects which includes this enhancement case. This PCD will cover the full cost and tCO_2e benefit delivered by the eight projects submitted as net zero enhancement projects which includes this enhancement case, as per details outlined in section 5.5. The PCD will be measured in tCO_2e. This consistent unit enables comparison between projects within the PCD, even though their methodologies and delivery mechanisms are different. This enhancement case has an added layer of customer protection through the validation and verification of GHG emissions reductions that can be made through showing declining use of fossil fuels in our operations from our agreed baseline position for the common operational GHG emissions PC. As the GHG emissions reduction from this enhancement is captured in the common PC and the target (or performance commitment level, PCL) this provides additional customer protection, i.e. there will be financial and reputational penalty for under performance.

Need for enhancement investment

6.1.5 Switching to lower emissions fuels, for example biogas, will be critical for meeting the UK's legally binding commitment to achieve net zero by 2050. This case focuses on our stationary fossil fuel use, most of which is from heating requirements for sludge treatment and in generators. Fossil fuels are commonly used to supply the heat requirement of the thermal processes essential to treating sewage sludge, e.g. gas oil/diesel, kerosene, natural gas. Low GHG emissions options are available, but require additional capital investment and ongoing opex costs. Modifications or new equipment is often required to enable them to run on alternative fuels. Alternative fuels have a higher unit cost and no commercial driver over traditional fossil fuel.

6.1.6 This enhancement case will invest in new equipment at sludge treatment centres to transition from fossil fuels to a renewable alternative in the sludge or wastewater treatment processes. For example,

using locally produced biogas, hydrogen or other renewable fuels such as Hydrotreated Vegetable Oil (HVO) or through technologies such as heat pumps or electric boilers.

6.1.7 In addition to reducing our own emissions, by increasing our use of alternative fuels we can increase the market size for such fuels and therefore have decarbonisation benefits beyond our reportable emissions, as a result of our procurement choices.

6.1.8 We explore our transport-related fuels in other net zero enhancement cases later in this document.

Emissions reduction benefits

6.1.9 We anticipate a total cumulative emissions reduction in our operational emissions of 35,277 tCO_2e by 2030 from successful delivery of this enhancement case.

6.1.10 Table 8 has been taken from our PR24 data table submission and provides the AMP8 tCO_2e benefits delivered from this enhancement case. Mirroring PR24 data tables CW21 and CWW22 for net zero enhancements, the emissions are presented as cumulative operational reductions in tCO_2e. The benefits are stated as negative values as per Ofwat's PR24 data table guidance.

6.1.11 The overall scheme impact includes both operational and embodied emissions as per Ofwat's data table guidance. The embodied emissions have been added as an emissions increase on to the operational emissions reductions. For additional details, see the CWW22 data table supporting commentary document.

Table 8: AMP8 emissions reduction benefits for stationary fossil fuel reductions

Scheme benefits (cumulative impact on tCO_2e)	Scheme benefits (cumulative impact on tCO_2e)	Scheme benefits (cumulative impact on tCO_2e)	Scheme benefits (cumulative impact on tCO_2e)	Scheme benefits (cumulative impact on tCO_2e)	Overall scheme impact on total greenhouse gas emissions (total impact on tCO_2e)
2025-26	2026-27	2027-28	2028-29	2029-30	2029-30
-7,055.380	**-14,110.760**	**-21,166.140**	**-28,221.520**	**-35,276.900**	**-35,249.920**

Long-term emissions reduction benefits

6.1.12 Table 9 mirrors the PR24 data table submission, tables CW21 and CWW22 for net zero enhancements, but provides the AMP9 tCO_2e benefits delivered from this enhancement case to show some of the longer term emissions benefits. Emissions impacts are presented as cumulative operational tCO_2e from AMP8 to AMP9. The benefits are stated as negative values as per Ofwat's PR24 data table guidance. The 'overall scheme impact' includes both operational and embodied emissions as per Ofwat's data table guidance. For additional details, see the CWW22 data table supporting commentary document.

6.1.13 For the overall AMP9 position we have assumed no embodied emissions as these long-term benefits relate to the delivery of the AMP8 enhancement project that this funding relates. These benefits are also shown in the PR24 data table CWW15.

6.1.14 The AMP9 emissions reduction benefits are forecast to be slightly greater than those in AMP8, offering an additional circa. 3,000 tCO_2e per year compared to AMP8. This stems from the interaction between the current use of biogas in the site combined heat and power (CHPs) and switching to boilers, which will require additional electricity import to replace that lost from CHP. The electricity import is rated at a static grid emissions factor aligned to the common GHG PC methodology until the end of AMP8 (2030), however beyond AMP8 we have assumed there will be additional benefit from grid decarbonisation and a potential change to PC methodology at PR29.

Table 9: AMP9 emissions reduction benefits for stationary fossil fuel reductions

Scheme benefits (cumulative impact on tCO_2e)	Scheme benefits (cumulative impact on tCO_2e)	Scheme benefits (cumulative impact on tCO_2e)	Scheme benefits (cumulative impact on tCO_2e)	Scheme benefits (cumulative impact on tCO_2e)		Overall scheme impact on total greenhouse gas emissions (total impact on tCO_2e)
2030-31	2031-32	2032-33	2033-34	2034-35	2034-35	2030-31
-45,491.973	**-55,707.046**	**-65,922.119**	**-76,137.191**	**-86,352.264**	**-86,352.264**	**-45,491.973**

Enhancement expenditure

6.1.15 We believe we can reduce our GHG emissions by over 7,000 tCO_2e per year by 2030 through a £12.6 million programme of work. We have rejected options that require a higher cost in AMP8, for example excluding investment in new boilers and other heating plant. Our analysis shows it is more cost effective to wait and deliver these more costly upgrades as part of future asset renewal investment.

6.1.16 The AMP8 costs associated with this enhancement case are presented in Table 10. This claim is for £12.62 million enhancement investment over and above base totex. The costs are spilt into capital costs which require £6.46 million of investment to install new equipment and/or provide equipment modifications to existing assets to enable use of the new lower emissions fuel alternative instead of fossil fuel. There are consequential opex costs to purchase additional electricity import to replace that lost from CHP.

Table 10: AMP8 costs for stationary fossil fuel reductions

Net zero	2025-26	2026-27	2027-28	2028-29	2029-30	Total
Greenhouse gas reduction (net zero); enhancement capex	£6.466m	£0	£0	£0	£0	£6.466m
Greenhouse gas reduction (net zero); enhancement Opex	£2.553m	£1.422m	£0.433m	£0.949m	£0.798m	£6.156m
Greenhouse gas reduction (net zero); enhancement Totex	£9.019m	£1.422m	£0.433m	£0.949m	£0.798m	£12.622m

Long-term costs

6.1.17 In developing and optimising this enhancement case we have assessed long-term considerations, including ongoing maintenance and financial needs. We have designed this enhancement case to stand alone in AMP8 and not constrain future needs or opportunities. Cost implications beyond AMP8 will be further considered at each future price review using latest available information. To maintain a science-based trajectory to net zero, we do not think it is likely that we would revert back to a higher emissions option. Our forecast at this point is that differential costs will reduce over time and therefore future base allowances are expected to be sufficient to maintain the improvements.

6.2 E00001340, E00001341 and E00001342 Transport fossil fuel reductions

6.2.1 **Headline:** Saving around 30,000 tonnes of GHG emission in AMP8 and over 250,000 tonnes by 2055 by transitioning all remaining cars and vans in our fleet to electric or other low carbon options, and enabling 20 per cent of our HGVs to use clean energy from our biogas.

6.2.2 This enhancement case will provide GHG emissions reduction benefits in UUW's scope 1 emissions associated with company owned transport, supporting Science-Based Targets by 2030. This involves a transition to a green fleet by procuring over 1,300 low emission Electric Vehicle (EV) cars and vans (or other low carbon options) and switching our Bioresources HGV fleet to biofuel (20 per cent of our total HGV fleet).

6.2.3 The below narrative is spilt into three separate enhancement cases covering our green fleet ambitions for both Light Commercial Vehicles (LCVs) and Heavy Goods Vehicles (HGVs).

Table 11: Transport fossil fuel reductions - green fleet enhancement case references

Project reference	Enhancement case name
E00001340	Transport fossil fuel reductions - green fleet LCVs phase 1
E00001341	Transport fossil fuel reductions - green fleet LCVs phase 2
E00001342	Transport fossil fuel reductions - green fleet Biomethane HGVs

Table 12: Summary of key information for Transport fossil fuel reductions - green fleet

Key information	E00001340 Transport fossil fuel reductions - Green fleet LCVs phase 1	E00001341 Transport fossil fuel reductions - Green fleet LCVs phase 2	E00001342 Transport fossil fuel reductions - Green fleet Biomethane HGVs
Total AMP8 operational emissions benefit (tCO_2e)	-19,060*	-6,590*	-3,866*
Total operational emissions benefit 2030 – 2055 (tCO_2e)	-225,458**	-77,950**	-38,659**
Total AMP8 embodied emissions (tCO_2e)	0	0	0
Total AMP8 Totex (£m)	8.80	17.70	1.20
Wider benefits	Improving public health	Improving public health	Improving public health
Net Zero Enhancement or Challenge	Net Zero Enhancement	Net Zero Enhancement	Net Zero Enhancement
Impact on common performance commitment PCL (GHG emissions)	Yes – Water and Wastewater	Yes – Water and Wastewater	Yes –Wastewater

**Emissions benefits are stated as negative values to show a reduction, as per Ofwat's PR24 data table guidance*

***Total operational emissions aligns to PR24 data tables CW15 and CWW15*

Price Control

6.2.4 Table 13 presents the price control allocation for each of the three green fleet enhancement cases, as presented in the PR24 data tables CW21 and CWW22.

Table 13: Price control allocation for Transport fossil fuel reductions - green fleet

Project reference	Enhancement case name	Water Resources	Water Network+	Wastewater Network+	Bioresources
E00001340	Transport fossil fuel reductions - green fleet LCVs phase 1	4%	32%	32%	33%
E00001341	Transport fossil fuel reductions - green fleet LCVs phase 2	4%	32%	32%	33%
000001342	Transport fossil fuel reductions - green fleet Biomethane HGVs	0%	0%	0%	100%

Ofwat Assessment Gates

6.2.5 In addition to the overarching assessment shown in section 4, the specific assessment in Table 14 applies to the green fleet enhancement cases.

Table 14: Ofwat's assessment gates for Transport fossil fuel reductions - green fleet

Gate	Summary
Need for enhancement investment	**Evidence:** This enhancement allows us to reduce our emissions associated with the use of fossil fuels in transport by swapping to low/zero emissions vehicles in our fleet. This enhancement is essential to our ability to retain a science-based trajectory to the national legal requirement for net zero 2050 and five year carbon budgets. **Base:** This enhancement case does not overlap with any activities delivered through base. This case includes only extra costs for switching away from fossil fuel vehicles, complementing AMP8 base allowances to replace some vehicles with a like for like option (fossil fuel engine) at end of life. Our LCV phase 1 and Bio HGV enhancement cases will replace existing diesel vehicles which have come to the end of their life and are due for renewal at the beginning of AMP8. The costs associated with this case cover the uplift costs to EV only, above and beyond base expenditure. Our LCV phase 2 will replace the final 353 LCVs with green options in the second half of AMP8, earlier than their planned replacement in order to transition the whole LCV fleet within the period. This LCV phase 2 case seeks the full vehicle and associated costs, with no overlap with AMP8 base expenditure because they would not otherwise be replaced in AMP8. **Previous enhancement:** This enhancement case does not overlap or duplicate with any activities already funded at previous price reviews. **Timing of expenditure:** We will deliver the vehicle replacements throughout AMP8 in line with the cost profile above, taking into account vehicle replacement schedules and asset life profiles to maximise the emissions reductions benefits from switching to lower emissions alternatives. This enhancement is needed on these timescales as part of our optimal pathway to retain a science-based trajectory to the national legal requirement for net zero 2050 and five year carbon budgets. **Implicit allowance**: For our LCV phase 1 and Bio HGV low regrets enhancement cases the implicit allowance within base is valued as a continuation of existing fleet with like for like vehicle replacements (diesel) at the end of their life. The requested cost for this enhancement claim is the incremental uplift cost required to switch to a lower GHG emissions fuel alternative. Our phase 2 LCV proposal is to replace the remaining LCV fleet to switch 100% to green options, and therefore no implicit allowance in AMP8 base is included for this. **Long-term delivery strategy:** Our core pathway includes low regrets action in AMP8 across all aspects of our GHG emissions towards a science-based trajectory that supports national legal requirements for net zero and five year carbon budgets. Our approach also works to secure wider benefits including service resilience, cost efficiency, recreation (public health) and nature, along with enabling activity to unlock further benefits and acceleration beyond 2030. The alternative option to this pathway would be to continue as normal with fossil fuel consumption, which would not support a science-based trajectory.
Best option for customers	The switch from fossil fuel to EVs and biomethane provides the best option for customers and communities, having assessed alternative options to reduce our GHG emissions. This project will also reduce particulates and nitrous oxides to help improve local air quality and protect customer's health.

Gate	Summary
Cost efficiency	**Assurance:** Third party assurance has been undertaken on this enhancement case for the GHG emissions values presented. For cost, our enhancement programme has been considered efficient after review from third party assurance. **Evidence:** We assessed a broad range of options and prioritised the most cost effective of those viable for delivering further reductions in the near term. We have also taken measures to keep costs as low as possible. For example, we have experience in purchasing and trialling low emission vehicles and the cost data for our green fleet LCV enhancement cases has been calculated from recent manufacturer quotes. A standard uplift has been applied to reflect FY23 pricing. **Modelled efficiency:** There are currently no agreed industry benchmarks for the cost associated with this enhancement case as it is new for the sector to invest in activity where GHG emissions reduction is the primary driver. Actions to improve emissions have typically been very low cost or a by-product of other priorities, and this is not an indicator of future costs and options needed to achieve required goals. During delivery, we will use market competition to ensure the best rates, for example when purchasing alternative low emission vehicles.
Customer protection	This enhancement case is below the materiality threshold to require a PCD under Ofwat's guidance. However, we recognise the value of a PCD to protect customers in the emerging and evolving space of net zero. We are therefore proposing a PCD that will cover the cost and tCO_2e benefit delivered by the eight projects submitted as net zero enhancement projects which includes this enhancement case. This PCD will cover the full cost and tCO_2e benefit delivered by the eight projects submitted as net zero enhancement projects which includes this enhancement case, as per details outlined in section 5.5. The PCD will be measured in tCO_2e. This consistent unit enables comparison between projects within the PCD, even though their methodologies and delivery mechanisms are different. This enhancement case has an added layer of customer protection through the validation and verification of GHG emissions reductions that can be made through showing declining use of fossil fuels in our transport from our agreed baseline position for the common operational GHG emissions PC. As the carbon reduction from this enhancement is captured in the common PC and the target (PCL) this provides additional customer protection, i.e. there will be financial and reputational penalty for under performance.

Figure 4: Overview of Transport fossil fuel reductions – green fleet enhancement case

LCVs	
E00001340 Transport fossil fuel reductions - green fleet LCVs phase 1	**E00001341** Transport fossil fuel reductions - green fleet LCVs phase 2
Planned diesel LCV replacements with EVs Replace 1021 diesel LCVs by EVs. This enhancement case is for the uplift from diesel to EV from our base expenditure.	**Replace all remaining diesel LCVs** Replace remaining 353 diesel LCVs by EVs, delivering a full EV LCV fleet on top of those agreed in base.

HGVs
E00001342 Transport fossil fuel reductions - green fleet Biomethane HGVs
20% Bioresources HGVs to biomethane in AMP8 Replace 21 Bioresources diesel HGV with biomethane.

6.2.6 Our base funding for fleet includes the cost of like for like (fossil fuel) replacements for vehicles reaching the end of their asset lives, and other ongoing maintenance costs to keep a safe and reliable approach. In AMP7 we are stretching base budgets, and have secured extra funds through success in national innovation competitions, to trial the purchase of EVs and other alternative fuels, and to install essential enabling work including charging infrastructure. We are also reducing vehicle numbers and mileage wherever we can, for example through more use of remote digital technologies.

6.2.7 Building on these strengths in AMP8, we need to move from pilot trials and early adoption actions to transformation at pace and scale if we are to achieve a science-based trajectory. These three enhancement cases therefore seek the new and additional costs to make the switch to green options, and in LCV phase 2, to switch a few years earlier than planned replacement dates. Prices for the appropriate low emissions vehicles have been increasing in many cases, following major disruptions to supply chains and strong consumer demand outstripping manufacturing capacity which continues to mature.

6.2.8 Our LCV phase 1 enhancement case plans to replace 1,021 LCV diesel vehicles which have come to the end of their life and are due for renewal in early AMP8. Our LCV phase 2 proposal seeks to go beyond this and replace the remainder of our LCV fleet (353 vehicles) earlier than their planned renewal to enable us to convert 100 per cent of our LCV fleet to full EV's or other low carbon options. The assumptions for the LCV enhancement cases have been built from the work we have undertaken in recent years.

6.2.9 Due to the increasing costs of HGVs in the market, the best available cost-effective option when looking at the direct totex impacts for HGV replacement that we can deliver from base is a like for like diesel replacement. Building on work we have undertaken in AMP7, we are proposing a HGV enhancement case to convert 21 of our bioresources HGVs to Biomethane.

6.2.10 We are undertaking further investigation and innovation with the market to inform how and when we can act confidently and cost-effectively on the reminder of our HGV fleet where there is currently no cost attractive and technically feasible option. To aid in this transition, we have trialled various forms of cleaner fuels for trucks, including Compressed Natural Gas (CNG), Liquid Natural Gas (LNG), and Hydrotreated Vegetable Oil (HVO). We continue to collaborate with the supply chain and aim to be the first in the sector to demonstrate the real world use of EV HGVs, working with Innovate UK. To manage this uncertainty and protect customers interests, the adaptive phase 2 project in our net zero enhancement programme includes this as one potential area of focus later in AMP8. This is detailed in Section 6.9.

Emissions reduction benefits

6.2.11 Table 15 has been taken from our PR24 data table submission for net zero enhancements in CW21 and CWW22, and provides the AMP8 tCO_2e benefits delivered from this enhancement case. The benefits are stated as negative values as per Ofwat's PR24 data table guidance.

6.2.12 The overall scheme impact includes both operational and embodied emissions as per Ofwat's data table guidance. The embodied emissions have been added as an emissions increase on to the operational emissions reductions. For additional details, see the CW21 and CWW22 data table supporting commentary documents.

Table 15: AMP8 emissions reduction benefits for Transport fossil fuel reductions - green fleet

Scheme ID	Scheme benefits (cumulative impact on tCO_2e)	Scheme benefits (cumulative impact on tCO_2e)	Scheme benefits (cumulative impact on tCO_2e)	Scheme benefits (cumulative impact on tCO_2e)	Scheme benefits (cumulative impact on tCO_2e)	Overall scheme impact on total greenhouse gas emissions (total impact on tCO_2e)
	2025-26	2026-27	2027-28	2028-29	2029-30	2029-30
E00001340 Transport fossil fuel reductions - green fleet LCVs phase 1	-520.631	-2,212.682	-5,857.100	-11,906.833	-19,060.305	-19,060.305
E00001341 Transport fossil fuel reductions - green fleet LCVs phase 2	-180.003	-765.012	-2,025.031	-4,116.662	-6,589.900	-6,589.900
E00001342 Transport fossil fuel reductions - green fleet Biomethane HGVs	-154.634	-618.538	-1,391.710	-2,474.152	-3,865.862	-3,865.862

Long-term emissions reduction benefits

6.2.13 Table 16 mirrors the PR24 data table submission, tables CW21 and CWW22 for net zero enhancements but provides the AMP9 tCO_2e benefits delivered from this enhancement case to show the longer term emissions benefits from delivering this enhancement case. Emissions impacts (tCO_2e) are presented as cumulative operational tCO_2e from AMP8 to AMP9. The benefits are stated as negative values as per Ofwat's PR24 data table guidance. The final column 'overall scheme impact' includes both operational and embodied emissions as per Ofwat's data table guidance. For 2034-35 we have assumed no embodied emissions as these long-term benefits relate to the delivery of the AMP8 enhancement project.

6.2.14 The AMP9 GHG emissions reduction benefits associated with each green fleet enhancement case is presented in the table below. There is emerging evidence about the real world lifespan of electric LCVs, with potential benefits in having less moving parts in the vehicle but also battery degradation reducing the potential range over time. For the purposes of this enhancement case and calculating the below emissions reductions, we have assumed an LCV will last approximately seven years and a biomethane HGV nine years. The GHG emissions benefit is ongoing beyond 2035 as an avoided benefit from the alternative fossil fuel saving.

Table 16: AMP9 emissions reduction benefits for Transport fossil fuel reductions - green fleet

Scheme ID	Scheme benefits (cumulative impact on tCO_2e)	Scheme benefits (cumulative impact on tCO_2e)	Scheme benefits (cumulative impact on tCO_2e)	Scheme benefits (cumulative impact on tCO_2e)	Scheme benefits (cumulative impact on tCO_2e)	Overall scheme impact on total greenhouse gas emissions (total impact on tCO_2e)
	2030-31	2031-32	2032-33	2033-34	2034-35	2034-35
E00001340 Transport fossil fuel reductions - green fleet LCVs phase 1	-27,664.569	-36,268.834	-44,873.099	-53,477.364	-62,081.629	-62,081.629
E00001341 Transport fossil fuel reductions - green fleet LCVs phase 2	-9,564.734	-12,539.568	-15,514.402	-18,489.235	-21,464.069	-21,464.069
E00001342 Transport fossil fuel reductions - green fleet Biomethane HGVs	-5,412.207	-6,958.552	-8,504.897	-10,051.242	-11,597.587	-11,597.587

Wider benefits

6.2.15 Additional benefits of a green fleet include improved air quality through the elimination of harmful tailpipe pollutants at street level, as well as reduction in noise pollution.

6.2.16 We expect our green fleet changes to reduce opex costs over time, with EVs needing reduced maintenance, lower cost of fuel, and protection against fuel price volatility. Estimated savings are built into the totex proposals for these cases, as shown in the tables. However we note this is emerging technology for the mainstream and energy costs are volatile and subject to unpredictable global events.

Enhancement expenditure

6.2.17 The AMP8 costs associated with each green fleet enhancement case is presented in Table 17.

Table 17: AMP8 costs for Transport fossil fuel reductions - green fleet

Net zero	2025-26	2026-27	2027-28	2028-29	2029-30	Total
E00001340 Transport fossil fuel reductions - green fleet LCVs phase 1						
Greenhouse gas reduction (net zero); enhancement water capex	£2.569m	£3.211	£6.422	£5.446m	£0	£17.649m
Greenhouse gas reduction (net zero); enhancement water Opex	-£0.210	-£0.800m	-£1.747	-£2.744m	-£3.319m	-£8.847m
Greenhouse gas reduction (net zero); enhancement water Totex	£2.359m	£2.411m	£4.648m	-£2.702m	-£3.319m	£8.802m
E00001341 Transport fossil fuel reductions - green fleet LCVs phase 2						
Greenhouse gas reduction (net zero); enhancement capex	£3.021m	£3.777m	£7.553m	£6.405m	£0	£20.756m
Greenhouse gas reduction (net zero); enhancement Opex	-£0.073m	-£0.277m	-£0.613m	-£0.949m	-£1.147m	-£3.059m
Greenhouse gas reduction (net zero); enhancement Totex	£2.949m	£3.500m	£6.940m	£5.456m	-£1.147m	£17.697m
E00001342 Transport fossil fuel reductions - green fleet Biomethane HGVs						
Greenhouse gas reduction (net zero); enhancement capex	£0.306m	£0.306m	£0.306m	£0.306m	£0.306m	£1.528m
Greenhouse gas reduction (net zero); enhancement Opex	-£0.013m	-£0.039m	-£0.065m	-£0.091m	-£0.117m	-£0.326m
Greenhouse gas reduction (net zero); enhancement Totex	£0.293m	£0.266m	£0.240m	£0.214m	£0.188m	£1.202m

Long-term cost

6.2.18 In developing and optimising this enhancement case we have assessed long-term considerations, including ongoing maintenance and financial needs. We have designed this enhancement case to stand alone in AMP8 and not constrain future needs or opportunities. Cost implications beyond AMP8 will be further considered at each future price review using latest available information. To maintain a science-based trajectory to net zero, we do not think it is likely that we would revert back to a higher emissions option. Our forecast at this point is that differential costs will reduce over time and therefore future base allowances are expected to be sufficient to maintain the improvements.

6.3 E0001346 Property emissions reductions

Headline: Saving over 6,000 tonnes of GHG emissions in AMP8, and over 35,000 tonnes by 2055, by switching energy sources needed for heating to reduce use of fossil fuels in key buildings

6.3.1 This enhancement case is focused on decarbonising heat within our UUW owned property portfolio, in particular our largest office site at Lingley Mere. Through alternative heating systems and efficient boiler replacements this enhancement case is estimated to save 6,123 tCO_2e for a cost of £3.59m.

Table 18: Summary of key information for property emissions reductions

Key information	
Total AMP8 operational emissions benefit (tCO_2e)	-6,123*
Total operational emissions benefit 2030 -2055 (tCO_2e)	-30,615**
Total AMP8 embodied emissions (tCO_2e)	141
Total AMP8 Totex (£m)	3.59
Wider benefits	Improving public health Increased resilience
Net Zero Enhancement or Challenge	Net Zero Enhancement
Impact on common performance commitment PCL (GHG emissions)	Yes – Water and Wastewater

**Emissions benefits are stated as negative values to show a reduction, as per Ofwat's PR24 data table guidance*

***Total operational emissions aligns to PR24 data tables CW15 and CWW15*

Price Control

6.3.2 As this enhancement case is applicable to both water and wastewater the cost and total emissions has been calculated and apportioned between both data tables CW21 and CWW22 in line with the price control allocation spilt shown in Table 19.

Table 19: Price control allocation for property emissions reductions

Project reference	Enhancement case name	Water Resources	Water Network+	Wastewater Network+	Bioresources
E0001346	Property Enhancements	0%	33.333%	33.333%	33.333%

Ofwat Assessment Gates

6.3.3 In addition to the overarching assessment shown in section 4 the specific assessment in Table 20 applies to this enhancement.

Table 20: Ofwat assessment gates for property emissions reductions

Gate	Summary
Need for enhancement investment	**Evidence:** This enhancement allows us to reduce our direct emissions associated with fossil fuel use in our properties. This is achieved by replacing assets used for heating to enable the switch to low emission fuel alternatives. This enhancement has no overlap between the case focused on stationary fuel use on key operational sites. This enhancement is essential to our ability to retain a science-based trajectory to the national legal requirement for net zero 2050 and five year carbon budgets. **Base:** This enhancement does not overlap with any activities delivered through base as all proposed activities and costs relate to the purchase of new assets specifically for the benefit of GHG emissions. All viable emissions reductions from reducing fossil fuel use that can be delivered through base expenditure have already been implemented or are planned to be implemented, for example our continual push for fuel efficiency. **Previous enhancement:** This enhancement case does not overlap or duplicate with any activities already funded at previous price reviews. **Timing of expenditure:** We will deliver the required upgrades at the start of AMP8 in line with the cost profile below to maximise the emissions reductions benefits from switching fuels to a lower GHG emissions alternative. This enhancement is needed at this time as part of our optimal pathway to retain a science-based trajectory to the national legal requirement for net zero 2050 and five year carbon budgets. **Implicit allowance**: This enhancement case involves the installation of new assets to deliver a step change reduction in our direct emissions from fossil fuel use at our property sites. Currently the implicit allowance in base is valued as a continuation of existing assets using fossil fuels. The requested cost for this enhancement claim is that required to purchase new assets and switch to a lower GHG emissions fuel alternative. **Long-term delivery strategy:** Our core pathway includes low regrets action in AMP8 across all aspects of our GHG emissions towards a science-based trajectory that supports national legal requirements for net zero and five year carbon budgets. Our approach also works to secure wider benefits including service resilience, cost efficiency, recreation (public health) and nature, along with enabling activity to unlock further benefits and acceleration beyond 2030. The alternative option to this pathway and enhancement case would be to continue as normal with fossil fuel consumption, which would not support a science-based trajectory.
Best option for customers	A number of appropriate options have been explored for heat decarbonisation to meet the identified need such as air source heat pumps, ground source heat pumps, water source heat pumps and electric boilers/heating. This feeds into the wider UK government's ambition to create a low carbon heat network in the plan to reaching net zero. Local low carbon heat networks can offer a communal solution for low emission heating that often provide lower cost energy bills in the long run. Having assessed the further options to reduce our GHG emissions, the three projects selected under this enhancement case (detailed below) are the best viable option for GHG emissions reduction and cost efficiency in our properties. This enhancement will also reduce particulates to help improve local air quality with associated health benefits.

Gate	Summary
Cost efficiency	**Assurance:** Third party assurance has been undertaken on this enhancement case for the carbon values presented. For cost, our enhancement programme has been considered efficient after review from third party assurance. **Evidence:** We assessed a broad range of options and prioritised the most cost effective for delivering emission reductions in the near term. We have taken measures to keep costs as low as possible. The capex costs presented for this enhancement case have been estimated using existing consumption data, in conjunction with a number of supplier visits, to estimate building heat demands and appropriately size the heat pump system required. Costs have been compared against a similar scheme priced by our facilities management provider for another water utility company but formal tenders have not been obtained at this stage. Boiler replacement estimates are based on an average system size and cost model. Beyond AMP8, subject to assessment of latest circumstances, we expect the carbon reduction benefits from this investment to continue, further reducing the cost per tonne of CO_2e. **Modelled efficiency:** There are currently no agreed industry benchmarks for the cost associated with this enhancement case as it is new for the sector to invest in activity where GHG emissions reduction is the primary driver. Actions to improve emissions have typically been very low cost or a by-product of other priorities, and this is not an indicator of future costs and options needed to achieve required goals. During delivery, we will use market competition to ensure the best rates.
Customer protection	This enhancement case is below the materiality threshold to require a PCD under Ofwat's guidance. However, we recognise the value for a PCD to protect customers in the emerging and evolving space of net zero. We are therefore proposing a PCD that will cover the cost and tCO_2e benefit delivered by the eight projects submitted as net zero enhancement projects which includes this enhancement case. This PCD will cover the full cost and tCO_2e benefit delivered by the eight projects submitted as net zero enhancement projects which includes this enhancement case, as per details outlined in section 5.5. The PCD will be measured in tCO_2e. This consistent unit enables comparison between projects within the PCD, even though their methodologies and delivery mechanisms are different. This enhancement case has an added layer of customer protection through the validation and verification of GHG emissions reductions that can be made through showing declining use of fossil fuels in our operations from our agreed baseline position for the common operational GHG emissions PC. As the carbon reduction from this enhancement is captured in the common PC and the target (PCL) this provides additional customer protection, i.e. there will be financial and reputational penalty for under performance.

Need for enhancement investment

6.3.4 As part of the UK government's strategy to reach net zero by 2050, the Heat and Buildings Strategy[4] was released in October 2021 which states there needs to be a transition towards low carbon buildings and decarbonising heat in buildings with the ambition of moving away from burning fossil fuels for heating purposes. This enhancement enables alignment to this and wider UK net zero strategy.

6.3.5 The scope of works has been spilt into three projects all with the aim of decarbonising our properties beyond our ongoing push for energy efficiency. Table 21 provides the high level information for each project including the total enhancement case cost and tCO_2e benefits.

[4] DESNZ (2021) Heat and buildings strategy: https://www.gov.uk/government/publications/heat-and-buildings-strategy

Table 21: Property emissions reductions project breakdown

Project	Cost (£)	AMP8 estimated tCO_2e benefits
Low emission heating system (Phase 1)	£1,340,000	-3,129 tCO_2e
Boiler replacement (Phase 1)	£1,150,000	-1,135 tCO_2e
Boiler replacement (Phase 2)	£1,100,000	-1,859 tCO_2e
Total	**£3,590,000**	**-6,123 tCO_2e**

Heat pumps

6.3.6 As part of this enhancement case a hybrid heating and cooling system will be installed at Lingley Mere with the primary aim of reducing GHG emissions from UUW's property portfolio and aligning to longer term net zero ambitions. A hybrid heating solution provides resilient option for emissions reduction benefits in the long-term whilst maintaining comfort levels required for colleagues.

6.3.7 Lingley Mere is located on Lingley Mere Business Park in Warrington and is the registered UK address for UUW. It consists of eight office buildings that sit at the heart of UUW operations, home to up to 2,800 colleagues who are key to serving customers. Electricity consumption is circa 4,830,000 kWh per year and natural gas circa 6,670,000 kWh. Over 90 per cent of natural gas consumed at Lingley Mere is in four main buildings. This project aims to reduce this consumption.

6.3.8 This enhancement case will install a high temperature heat pump (ASHP) in conjunction with a chilled water supply for maximum efficiency. This is estimated to provide an average benefit of 626 tCO_2e per year from operational GHG emissions. A targeted building management system will be installed along with the plant for ongoing monitoring and targeting to drive continued improvements and increase efficiencies in future years beyond AMP8.

6.3.9 The benefits of installing a hybrid heating solution provides resilience in the event of a power outage, as heating can still be delivered via the retained heating source. The system has additional thermal storage capabilities providing an opportunity to charge the system utilising off peak electricity rates. The system assets can be sized to the requirements of each building and deliver additional operational efficiencies through an effective building management system (BMS) system.

Boiler replacement (1st Phase)

6.3.10 23 sites across UUW's property portfolio with oil fed boilers have been identified. As part of this enhancement case these identified boilers could be replaced with an energy efficient renewable alternative to enable a transition away from burning fossil fuels for heating. Replacing these boilers will reduce the amount of fuel UUW uses in heating within the 23 sites identified providing operational GHG emission benefits and long-term resilience. This cannot be considered a maintenance activity as the project involves replacing functioning assets which are expected to continue to run and burn fossil fuels. The concept of this project is therefore to accelerate our emissions reductions from within our property portfolio programme through this enhancement with emissions reductions as the primary driver.

6.3.11 The estimated GHG emissions benefits for replacement at the 23 sites identified is 200 tCO_2e per year, based on an average rating of 70 kW.

Boiler replacement (2nd Phase)

6.3.12 22 sites across UUW's property portfolio with natural gas boilers have been identified. As part of this enhancement case these identified boilers could be replaced with an energy efficient renewable heat pump to enable a transition away from burning fossil fuels for heating. Replacing these boilers will reduce the amount of fuel UUW uses in heating within the 22 sites identified providing operational GHG emission benefits and long-term resilience. This cannot be considered a maintenance activity as the project involves replacing functioning assets which are expected to continue to run and burn fossil fuels. The concept of this project is therefore to accelerate our emissions reductions from within our property portfolio programme through this enhancement with emissions reductions as the primary driver.

6.3.13 The estimated GHG emissions benefits for replacement at the 22 sites identified is 130 tCO_2e per year, based on an average rating of 60 kW.

Emissions reduction benefits

6.3.14 Table 22 has been taken from our PR24 data table submission for net zero enhancements CW21 and CWW22 and provides the AMP8 tCO_2e benefits delivered from this enhancement case. The table below mirrors the PR24 data table submission, tables CW21 and CWW22 for net zero enhancements, emissions impacts (tCO_2e) are presented as cumulative operational tCO_2e. The benefits are stated as negative values as per Ofwat's PR24 data table guidance.

6.3.15 The overall scheme impact includes both operational and embodied emissions as per Ofwat's data table guidance. The embodied emissions have been added as an emissions increase on to the operational emissions reductions. For additional details, see the CW21 and CWW22 data table supporting commentary documents.

Table 22: AMP8 emissions reduction benefits for property emissions reductions

Scheme benefits (cumulative impact on tCO_2e)	Scheme benefits (cumulative impact on tCO_2e)	Scheme benefits (cumulative impact on tCO_2e)	Scheme benefits (cumulative impact on tCO_2e)	Scheme benefits (cumulative impact on tCO_2e)	Overall scheme impact on total greenhouse gas emissions (total impact on tCO_2e)
2025-26	2026-27	2027-28	2028-29	2029-30	2029-30
-1,224.608	-2,449.216	-3,673.824	-4,898.433	-6,123.042	-5,982.042

Long-term emissions reduction benefits

6.3.16 Table 23 mirrors the PR24 data table submission, tables CW21 and CWW22 for net zero enhancements but provides the AMP9 tCO_2e benefits delivered from this enhancement case to show the longer term emissions benefits from delivering this enhancement case. Emissions impacts (tCO_2e) are presented as cumulative operational tCO_2e from AMP8 to AMP9. The benefits are stated as negative values as per Ofwat's PR24 data table guidance. The final column 'overall scheme impact' includes both operational and embodied emissions as per Ofwat's data table guidance, for 2034-2035 we have assumed no embodied emissions as these long-term benefits relate to the delivery of AMP8 enhancement project that this funding relates.

Table 23: AMP9 emissions reduction benefits for property emissions reductions

Scheme benefits (cumulative impact on tCO_2e)	Scheme benefits (cumulative impact on tCO_2e)	Scheme benefits (cumulative impact on tCO_2e)	Scheme benefits (cumulative impact on tCO_2e)	Scheme benefits (cumulative impact on tCO_2e)	Overall scheme impact on total greenhouse gas emissions (total impact on tCO_2e)
2030-31	2031-32	2032-33	2033-34	2034-35	2034-35
-7,347.649	-8,572.258	-9,796.866	-11,021.475	-12,246.083	-12,246.083

Wider benefits

6.3.17 This enhancement case is aligned to UUW's wider long-term plan to meet net zero by 2050 and reduce GHG emissions from the property portfolio through decreased fossil fuel use in heating systems. Decarbonising the heating systems in UUW's property also provides wider benefits from cost efficiencies in operating and maintaining systems.

Enhancement expenditure

6.3.18 The costs to deliver the above enhancement case project in AMP8 are presented in the table below. In order to deliver the full GHG emission scheme benefits, our proposal is to install the heat pump system before the end of 2025 in order to achieve the full annual carbon saving mentioned in the section above.

6.3.19 Table 24 provides the capex costs only for asset replacement, the existing boilers will be retained as a backup in the event of a power outage therefore there is no future operational maintenance benefit.

Table 24: AMP8 costs for property emissions reductions

Net zero	2025-26	2026-27	2027-28	2028-29	2029-30	Total
Greenhouse gas reduction (net zero); enhancement capex	£3.5900m	£0	£0	£0	£0	£3.590m
Greenhouse gas reduction (net zero); enhancement Opex	£0	£0	£0	£0	£0	£0
Greenhouse gas reduction (net zero); enhancement Totex	£3.590m	£0	£0	£0	£0	£3.590m

Long-term costs

6.3.20 In developing and optimising this enhancement case we have assessed long-term considerations, including ongoing maintenance and financial needs. We have designed this enhancement case to stand alone in AMP8 and not constrain future needs or opportunities. Cost implications beyond AMP8 will be further considered at each future price review using latest available information. To maintain a science-based trajectory to net zero, we do not think it is likely that we would revert back to a higher emissions option. Our forecast at this point is that differential costs will reduce over time and therefore future base allowances are expected to be sufficient to maintain the improvements.

6.4 E00001425 Net zero catchment strategy

6.4.1 **Headline:** Working with partners to develop a sustainability masterplan and test innovative approaches for low carbon water and wastewater priorities in the major new development of St Cuthbert's Garden Village

6.4.2 From a unique starting position, this project will collaboratively produce a sustainable masterplan and net zero catchment strategy to shape the major new urban development of St Cuthbert's Garden Village which is planned over the years ahead. This exploratory first phase seeks to enable transformational benefits in the ongoing delivery of the Village, and which would continue to be felt for the lifespan of

the new community. Delivery would come in potential further phases of work to secure the most sustainable approaches practically possible at the new WwTW needed to serve the Garden Village, and in how water and drainage is best managed throughout the development. This next stage is captured in the adaptive second phase of our enhancement programme, later in this document.

6.4.3 St Cuthbert's Garden Village is anticipated to be one of the largest development projects in the North West. The new community that is being built from scratch on the southern edge of the city of Carlisle was designated a Garden Village in 2017 as part of the Government's garden towns and villages programme. The local plan is to build approximately 10,000 houses over a 30 year period, together with retail, leisure, health and education facilities. This presents a unique opportunity to further develop integrated water management planning, building on our leading work with Greater Manchester and others in the North West and setting the national standard. The project would also seek to explore options to test and trial latest innovations.

6.4.4 Potential benefits specific to water and wastewater customers relate to the management of surface water while minimising the need for infrastructure and investment in the sewer network and at the wastewater treatment works over the long-term (such as re-use of by-products and local composting treatment solutions), reduced water use (such as demand management activity and grey water recycling), and wider emissions reduction benefits associated with other aspects of household energy use (such as heating water). There may also be complementary benefits for others. Establishing partnerships and co-funding will be a strong theme of this work to inform most cost-effective delivery in future phases. This project will enable us to apply methods learned in this catchment to apply to other suitable projects across the North West.

Table 25: Summary of key information for Net zero catchment strategy

Key information	
Total AMP8 operational emissions benefit (tCO_2e)	This phase 1 project will quantify long-term benefits to be explored in phase 2.
Total operational emissions benefit 2030 - 2055 (tCO_2e)	This phase 1 project will quantify long-term benefits to be explored in phase 2.
Total AMP8 embodied emissions (tCO_2e)	0
Total AMP8 Totex (£m)	1.00
Wider benefits	Improving water quality Natural environment protection Increased resilience
Net Zero Enhancement or Challenge	Net Zero Enhancement
Impact on common performance commitment PCL (GHG emissions)	Yes - Wastewater

Price Control

6.4.5 The total cost and emissions for this enhancement has been entered into the PR24 data table CWW22 in line with the price control allocation spilt shown in Table 26.

Table 26: Price control allocation for net zero catchment strategy

Project reference	Enhancement case name	Water Resources	Water Network+	Wastewater Network+	Bioresources
E00001425	Net Zero Catchment Strategy	0%	0%	100%	0%

Ofwat Assessment Gates

6.4.6 In addition to the overarching assessment shown in section 4 the specific assessment in Table 27 applies to this enhancement.

Table 27: Ofwat assessment gates for net zero catchment strategy

Gate	Summary
Need for enhancement investment	**Evidence:** This enhancement will result in the delivery of a strategic masterplan and net zero catchment strategy for the St Cuthbert's Garden Village, developed in collaboration with a wide range of partners that could include Carlisle Council and the site developers. This will put net zero at the heart of development planning. More holistically this enhancement case will seek to provide an exemplar of master planning that supports the UK's net zero ambitions including and beyond the water cycle. In addition, the master planning process will aim to enhance the resilience of the new development to climate extremes. This enhancement is essential to our ability to retain a science-based trajectory to the national legal requirement for net zero 2050 and five year carbon budgets, particularly in identifying ways to reduce emissions associated with new water and wastewater infrastructure. **Base:** This enhancement does not overlap with any activities delivered through base as all proposed activities and costs relate to future growth in and around Carlisle. **Previous enhancement:** This enhancement case does not overlap or duplicate with any activities already funded. Our PR24 enhancements case titled 'Ww Supply & Demand' includes Carlisle wastewater treatment works for the expected increase in population. The catchment master planning will compliment but does not overlap. **Timing of expenditure:** We will deliver the net zero catchment strategy over the course of AMP8 as the development progresses, in line with the cost profile below. This enhancement is needed at this time if it is to inform the development near the outset for maximum potential. It is also needed as part of our optimal pathway to retain a science-based trajectory to the national legal requirement for net zero 2050 and five year carbon budgets. **Implicit allowance**: There is no implicit allowance for developing a net zero catchment strategy for this new development, this is above and beyond base service provision. The costs set out within this claim are the capital costs required for enabling this. **Long-term delivery strategy:** Our core pathway includes low regrets action in AMP8 across all aspects of our GHG emissions towards a science-based trajectory that supports national legal requirements for net zero and five year carbon budgets. Our approach works to secure wider benefits including service resilience, cost efficiency, recreation (public health) and nature, along with enabling activity to unlock further benefits and acceleration beyond 2030.
Best option for customers	Developing an integrated net zero vision and masterplan for St Cuthbert's Garden Village will directly support customers who will live in the community, through improved quality of place, wellbeing benefits and, importantly, delivery of energy and water efficient homes with reduced bills (compared to traditional) and enhancement resilience to climate shocks. All customers will benefit from any efficiency generated in delivering services to the new community, and any learning that is hoped to inform national approaches across the country in the longer term.

Gate	Summary
Cost efficiency	**Assurance:** Third party assurance has been undertaken on this enhancement case for the carbon values presented. For cost, our enhancement programme has been considered efficient after review from third party assurance. **Evidence:** We assessed a broad range of options and prioritised the most cost effective of those viable for delivering further reductions in the near term. We have taken measures to keep costs as low as possible. The new development at St Cuthbert's Garden Village is closely associated with building of the Carlisle Southern Link Road which is currently under construction. The AMP8 spend profile has therefore been 'front-ended' to allow the vision masterplan and policies to move forward quickly and maximise the ability to influence the shape of the new community, within the bounds of UUW's ability to do this. Co-funding opportunities with Carlisle Council, developers and (potentially) other partners such as the Environment Agency will be explored. **Modelled efficiency:** There are currently no agreed industry benchmarks for the cost associated with this enhancement case as it is new for the sector to invest in activity where GHG emissions reduction is the primary driver.
Customer protection	This enhancement case is below the materiality threshold to require a PCD under Ofwat's guidance. However, we recognise the value for a PCD to protect customers in the emerging and evolving space of net zero. We are therefore proposing a PCD that will cover the cost and GHG emissions benefit delivered by the eight projects submitted as net zero enhancement projects which includes this enhancement case. This PCD will cover the full cost and tCO_2e benefit delivered by the eight projects submitted as net zero enhancement projects which includes this enhancement case, as per details outlined in section 5.5. The PCD will be measured in tCO_2e. This consistent unit enables comparison between projects within the PCD, even though their methodologies and delivery mechanisms are different. This enhancement case has an added layer of customer protection through the validation and verification of GHG emissions reductions that can be made through this case from our agreed baseline position for the common operational GHG emissions PC. As the carbon reduction from this enhancement is captured in the common PC and the target (PCL) this provides additional customer protection, i.e. there will be financial and reputational penalty for under performance.

Need for enhancement investment

6.4.7 The water industry has a key role in helping the UK to meet its legally binding commitment to achieve net zero by 2050. One area where the industry can contribute is through embedding net zero ambitions into the development of an integrated strategy for water, "layering" approaches by starting with consideration of low carbon treatment options and moving to a more strategic approach. Having separate surface and foul drainage systems reduces flows in sewer networks, which in turn diminishes the need for pumping and reduces the volumes of water requiring treatment at wastewater treatment works, saving on energy and chemical use and therefore GHG emissions.

6.4.8 St Cuthbert's Garden Village is a new community that is being planned and built from scratch on the southern edge of the city of Carlisle. This unique starting position presents an opportunity to create a vision for a truly integrated and strategic approach to clean, surface and wastewater for St Cuthbert's Garden Village, as part of a holistic low carbon masterplan for the whole community. The development includes around 10,000 new homes (equating to roughly 22,000 population equivalent) over a 30 year period, new employment opportunities, community facilities and a new Southern Link Road. It is one the most ambitious housing development projects being actively progressed in the North of England, and is one of the leading projects for meeting the growth ambitions of the Cumbria Local Enterprise Partnership.

6.4.9 We propose a programme of work that would allow us to take a leading role with the Council and developers in producing an exemplar vision and masterplan for a net zero community, delivering on the

Council's masterplan framework and sustainability strategy for the community. We will create a sustainable vision and masterplan for St Cuthbert's Garden Village, driving the adoption of exemplar sustainable standards for new homes and their supporting infrastructure, and which provide added value to the new community while showcasing the role that water can play in driving broader net zero and climate resilience ambitions.

6.4.10 A key component of this would be integrated water management and efficient water use, and the ambition is to deliver a vision that supports net zero holistically across all aspects of community master-planning. The approach taken will support development of similar approaches elsewhere in the UK and thereby contribute towards the UK's legal obligations for net zero.

6.4.11 The deliverable from this first phase would comprise a masterplan vision document, developed in collaboration with partners to support a trial programme of interventions across the new Garden Village, subject to build out and phasing. The project could also explore the creation of planning policy documentation that would support the adoption of similar approaches in other parts of the North West and the UK. The masterplan will consider ways in which the development can minimise the need for infrastructure and investment over the long-term while delivering a holistic sustainable approach. This could include working with developers on storing surface water, recycling grey water, exploring ways to protect the sewers in operation (such as making smarter design choices and increasing community engagement) and potential reuse of low grade heat from the sewer network. Along with exploring ways to minimise the need at the treatment works (enhanced treatment solutions and local composting) and opportunities to re-use by products from the treatment process.

6.4.12 A holistic approach to the new community at St Cuthbert's, including water efficient homes, would help reduce energy use, while planning for surface water separation and green urban spaces would create a community that is more resilient to climate shocks. This would contribute to broader (national) net zero and sustainability ambitions. Domestic water use is also one of the key drivers of household energy consumption and therefore reducing water provides energy savings (and in turn more affordable household bills).

Emissions reduction benefits

6.4.13 At this early stage it is not possible to accurately quantify the potential for emissions reductions, as it is dependent on the phasing of the St Cuthbert's Garden Village development. This first phase of work is to explore this in detail with partners to develop a masterplan, vision and supporting policies. We do not expect this first phase to deliver reductions itself, but the work completed in early AMP8 will be the enabler to substantial future emissions reductions as the development commences, and those benefits would continue to be felt for the lifespan of the new community. We would also explore options to test and trial latest innovations that could deliver reductions in this phase, depending on potential and timing. This visionary project has the potential to inform improvements nationally for far wider benefits.

Long-term emissions reduction benefits

6.4.14 Table 28 mirrors the PR24 data table submission, tables CWW22 for net zero enhancements but provides the AMP9 tCO_2e benefits delivered from this enhancement case to show the longer term emissions benefits from delivering this enhancement case. At this stage it is not possible to fully quantify the potential for emissions reductions benefits associated with this the net zero catchment strategy, as it is dependent not least on the phasing of the St Cuthbert's Garden Village development. We have assumed no emissions in the below table as long-term benefits will be generated from subsequent projects (potentially in phase 2) which are in addition to this specific £1 million investigation project.

Table 28: AMP9 emissions reduction benefits for net zero catchment strategy

Scheme benefits (cumulative impact on tCO_2e)	Scheme benefits (cumulative impact on tCO_2e)	Scheme benefits (cumulative impact on tCO_2e)	Scheme benefits (cumulative impact on tCO_2e)	Scheme benefits (cumulative impact on tCO_2e)	Overall scheme impact on total greenhouse gas emissions (total impact on tCO_2e)
2030-31	2031-32	2032-33	2033-34	2034-35	2034-35
0	0	0	0	0	0

Wider benefits

6.4.15 This enhancement case could clearly provide wider benefits that go beyond the net zero agenda. It is not possible at this stage to quantify those benefits. However, Table 29 provides a high level qualitative indication of the nature of wider benefits that this enhancement case could support, broken down against the Wider Environmental Outcomes metrics as defined by the Environment Agency for the PR24 WINEP.

Table 29: Net zero catchment strategy wider environmental outcomes

Wider Environmental Outcome	High level qualitative assessment of potential wider benefits
Net zero	• Management of storm water flows on the surface, reducing embedded carbon of underground infrastructure and operational carbon from pumping, storage and treatment of storm water. • Water efficient housing reducing water demand within the development, leading to reduction in GHG emissions from drinking water treatment and distribution, of potentially circa. 200 tCO_2e per year. • Reduced use of water in households results in lower household energy use and leads to reduced GHG emissions. Even a 10% reduction compared to typical new builds could amount to substantial emissions saving across 10,000 proposed new homes. • Quality of urban environment in the new community promotes low carbon (and healthy) local travel choices such as walking and cycling. • Potential to support options for a renewable district heating system and the production of long-term stable solutions. Heat recovery best supports carbon and energy neutrality.
Natural Environment	• Good quality green and blue/green spaces in the community provide new habitat and contribute to increased biodiversity. • Quality of urban environment within the new community promotes low carbon (and healthy) local travel choices such as walking and cycling, leading to greater engagement of community with their local environment.
Catchment Resilience	• Management of storm water flows on the surface attenuates peak flows off the development and reduces risk of flooding. • Collaborative working with the Environment Agency could identify opportunities to address wider flood risk issues in the Caldew and Petteril river catchments and contribute to reduced risk downstream in Carlisle.

Wider Environmental Outcome	High level qualitative assessment of potential wider benefits
Access, amenity and engagement	• Quality of urban space including green areas contributes to greater use of space for access and recreation, and encourages walking and cycling as modes of transport. • Holistic approach to net zero across the community as a whole (not just water) provides greater opportunity to engage with customers on a broader sustainability agenda, including water, but also energy use in the home, making low carbon travel choices, local biodiversity, etc. • Opportunity to explore creation of additional customer facing elements such as shaping principles for the community (for example, planning constraints around paving over gardens), water efficient devices and water metering. In addition, education, learning and even apprenticeship opportunities could be created.

Enhancement expenditure

6.4.16 The AMP8 costs associated with this enhancement case are presented in Table 30.

Table 30: AMP8 costs for net zero catchment strategy

Net Zero	2025-26	2026-27	2027-28	2028-29	2029-30	Total
Greenhouse gas reduction (net zero); enhancement capex	£0.500m	£0.250m	£0.150m	£0.100m	£0	£1.000m
Greenhouse gas reduction (net zero); enhancement Opex	£0	£0	£0	£0	£0	£0
Greenhouse gas reduction (net zero); enhancement Totex	£0.500m	£0.250m	£0.150m	£0.100m	£0	£1.000m

6.4.17 Partnership funding will be explored to supplement the funding in this enhancement to aid the delivery of the masterplan and for delivery in phase 2, working in collaboration with Carlisle City Council and the site developers. It may also be possible to unlock broader funding streams, for example engagement with the Environment Agency may identify opportunities for slowing the flow of water into Carlisle thus contributing to flood risk management objectives in the city. Nature-based solutions within or near the development may also attract funding from the private sector via, for example, payments for Biodiversity Net Gain and/or carbon benefits.

Long-term costs

6.4.18 In developing and optimising this enhancement case we have assessed long-term considerations, including ongoing maintenance and financial needs. We have designed this enhancement case to stand alone in AMP8 and not constrain future needs or opportunities. Cost implications beyond AMP8 will be further considered at each future price review using latest available information. To maintain a science-based trajectory to net zero, we do not think it is likely that we would revert back to a higher emissions option. Our forecast at this point is that differential costs will reduce over time and therefore future base allowances are expected to be sufficient to maintain the improvements.

6.5 E00001344 Peatland restoration

6.5.1 **Headline:** Restore around 1,500 hectares of peatland in the North West to store carbon and deliver wider benefits

6.5.2 As part of this enhancement case UUW will undertake habitat restoration works across 1,494 hectares of peatland by 2030, verified by Natural England (or equivalent standard). This enhancement case is aligned to our long-term strategy to reach net zero, and carbon reduction benefits will be realised beyond AMP8 due to the length of time involved in restoring natural process in peatland hydrology and ecology; needed to have fully functioning, low emissions peatland.

Table 31: Summary of key information for peatland restoration

Key information	
Total AMP8 operational emissions benefit (tCO_2e)	-13,227*
Total operational emissions benefit (tCO_2e)	-277,767**
Total AMP8 embodied emissions (tCO_2e)	0
Total AMP8 Totex (£m)	20.00
Wider benefits	Improving water quality Natural environment protection Increased resilience
Net Zero Enhancement or Challenge	Net Zero Enhancement
Impact on common performance commitment PCL (GHG emissions)	No

**Emissions benefits are stated as negative values to show a reduction, as per Ofwat's PR24 data table guidance*
**Pending Issuance Units only*

***Total operational emissions aligns to PR24 data tables CW15 and CWW15*

Price Control

6.5.3 The total cost and emissions for this enhancement has been entered into the PR24 data table CW21 in line with the price control allocation spilt shown in Table 32.

Table 32: Price control allocation for peatland restoration

Project reference	Enhancement case name	Water Resources	Water Network+	Wastewater Network+	Bioresources
E00001344	Peatland restoration	0%	100%	0%	0%

Ofwat Assessment Gates

6.5.4 In addition to the overarching assessment shown in section 4 the specific assessment in Table 33 applies to this enhancement.

Table 33: Ofwat's assessment gates for peatland

Gate	Summary
Need for enhancement investment	**Evidence:** This enhancement case will undertake habitat restoration works across 1,494 hectares of peatland by 2030, providing future reportable GHG emissions benefits achieved through carbon sequestration. This enhancement is essential to our ability to retain a science-based trajectory to the national legal requirement for net zero 2050 and five year carbon budgets. **Base:** This enhancement case does not overlap with any activities delivered through base as all viable emissions reductions that can be delivered through base expenditure have been explored. This case also does not overlap with any other enhancement case proposed in AMP8. The 1,494 hectares associated with this case will be delivered as additional hectares of peatland restoration with a GHG emissions reduction primary driver, above and beyond that proposed within our AMP8 WINEP programme. **Previous enhancement:** This enhancement case does not overlap or duplicate with any activities already funded at previous price reviews. Due to the additionality clause contained in version 2 of the Peatland Code, reportable emissions reduction benefits can only be quantified from any project activity that would not have happened anyway e.g. schemes delivered for regulatory purposes under WINEP cannot be claimed. This net zero enhancement case has the primary driver of GHG emissions reduction and is therefore quantifiable against reportable emissions. **Timing of expenditure:** We will deliver the required hectares of restoration over the course of AMP8 in line with the cost profile below. This enhancement is needed at this time as part of our optimal pathway to retain a science-based trajectory to the national legal requirement for net zero 2050 and five year carbon budgets. Land management interventions take time to grow the emissions benefits, and delaying this work will delay the creation of essential emissions benefits over the decades ahead. **Implicit allowance**: There is no implicit allowance for delivering additional peatland restoration associated with this enhancement, this is above and beyond base service provision. The costs set out within this claim are the capital costs required for enabling this. **Long-term delivery strategy:** Our core pathway includes low regrets action in AMP8 across all aspects of our GHG emissions towards a science-based trajectory that supports national legal requirements for net zero and five year carbon budgets. Our approach works to secure wider benefits including service resilience, cost efficiency, recreation (public health) and nature, along with enabling activity to unlock further benefits and acceleration beyond 2030.
Best option for customers	Peatland restoration will deliver the primary benefit of GHG emissions reductions over the long-term while also improving water quality, reducing treatment needs and improving flood resilience. This will reduce the impacts of climate change and conserve the natural environment in the North West. According to the International Union for Conservation of Nature (IUCN), 70% of drinking water supplied in the UK originates from peatland sources. This value is particularly the case for UUW customers, with the majority of England's peat in the North West.

Gate	Summary
Cost efficiency	**Assurance:** Third party assurance has been undertaken on this enhancement case for the carbon values presented. For cost, our enhancement programme has been considered efficient after review from third party assurance. **Evidence:** We assessed a broad range of options and prioritised the most cost effective of those viable for delivering further reductions in the near term. We have taken measures to keep costs as low as possible. The costs presented below are deemed efficient as they have been calculated using base costs from historical peatland delivery projects we have undertaken in previous AMPs. Our programme will restore an initial 850 hectares of eroding bare (oxidising) peat, followed by 644 hectares modified peat types by 2030 at an estimated total cost of £40 million. In AMP7 Nature 4 Climate (N4C) grant funding was available where N4C would provide up to 75% of the cost from third party grants. In AMP8 N4C grant funding will not be available, however, within our cost estimations we have assumed there will be some grant funding available from partner leverage funding. We have assumed this is likely to be a 50/50 spilt. Therefore the proposed cost submitted for this enhancement case is half of the required £40m to restore the full 1,494 hectares within AMP8. The alternative to peatland restoration in terms of reducing the impact of eroded peat soil (dissolved organic carbon) on drinking water quality is to upgrade the water treatment works. Without an upgrade the water treatment works may have to operate on a reduced throughput to remove the increase in dissolved organic carbon load. This has an impact on the volume of the output of the water treatment works which may have a knock on impact on local and regional supply and demand and would have increased GHG emissions. In the short-term view, this could be seen as a more expensive option for GHG emissions reduction, however it is one of the best options in the longer term beyond AMP8 as we expect emissions reduction benefits from this investment case to be greater from AMP9 onwards due to on-going carbon sequestration and peatland code verification periods. **Modelled efficiency:** There are currently no agreed industry benchmarks for the cost associated with this enhancement case as it is new for the sector to invest in activity where GHG emissions reduction is the primary driver. Actions to improve emissions have typically been very low cost or a by-product of other priorities, and this is not an indicator of future costs and options needed to achieve required goals. During delivery, we will use market competition to ensure the best rates for example in the appointment of contractors.
Customer protection	This enhancement case is below the materiality threshold to require a PCD under Ofwat's guidance. However, we recognise the value for a PCD to protect customers in the emerging and evolving space of net zero. We are therefore proposing a PCD that will cover the cost and GHG emissions benefit delivered by the eight projects submitted as net zero enhancement projects which includes this enhancement case. This PCD will cover the full cost and tCO_2e benefit delivered by the eight projects submitted as net zero enhancement projects which includes this enhancement case, as per details outlined in section 5.5. The PCD will be measured in tCO_2e. This consistent unit enables comparison between projects within the PCD, even though their methodologies and delivery mechanisms are different.

Need for enhancement investment

6.5.5 Deterioration in land quality due to climate change has both direct and indirect impacts. Hotter, drier summers increase the risk of wildfire (and vulnerability to arson) which can spread for long periods of time and permanently damage the area. However, restoring the peatland can reduce this risk. Severe weather events can cause flooding, subsidence and landslip events which in turn have associated health, safety and environmental impacts. One of the main lessons learned from the wildfires experienced in the last five years is the susceptibility of upland catchment systems to these events until the process of restoration and 're-wetting' has fully taken hold. To address this issue we have reviewed the resilience of our catchments and will undertake work over the next 25 years to improve catchment resilience to these types of events. Supported by partners such as Moors for the Future and co-created with

stakeholders, the overarching purpose is to restore natural processes to improve the resilient functioning of the catchment hydrology and vegetation.

6.5.6 With over 56,000 hectares of land in the North West, UUW aims to mitigate and control these impacts through creating additional woodland and restoring peatland on our land. The Ofwat cost models currently don't taken into consideration amount of land and therefore our proposal is over and above historic base costs. This enhancement case will provide the expenditure required to accelerate the resilience of our land allowing us to restore an additional 1,494 hectares of peatland within AMP8.

6.5.7 When in poor condition (dry and eroding) upland peat habitats emit carbon dioxide through oxidisation, therefore restoring these eroding habits can reduce emissions initially by reducing oxidisation and then through sequestering carbon dioxide and storing it. Given our extensive AMP8 programme and anticipated growth pressure we face in the future, aligning our long-term net zero strategy to the GHG management hierarchy is imperative.

6.5.8 UUW will have restored 500 hectares of peatland by 2025 from existing restoration projects as part of our pledge to restore 1000 hectares by 2030. Due to future pressures and the nature of our AMP8 programmes delivering additional hectares in AMP8 through base expenditure will be extremely challenging. This enhancement case will allow us to continue our restoration works preserving the environment within the North West for our customers.

6.5.9 We aim to work with partners, such as Moors for the Future to undertake habitat restoration works across the 1,494 hectares of peatland by 2030. This enhancement case will initially target eroding peat as this is the type of peat typically known to emit the most CO_2e from its deterioration, followed by restoring peatland in modified conditions back to nearly natural. Our programme will restore an initial 850 hectares of eroding bare peat, followed by 644 hectares modified peat types by 2030 at an estimated total cost of £40 million. In AMP7 Nature 4 Climate (N4C) grant funding was available where N4C would provide up to 75 per cent of the cost from third party grants. In AMP8 N4C grant funding will now no longer be available, however, within our cost estimations we have assumed there will be some grant funding available from partner leverage funding. We have assumed this is likely to be a 50/50 spilt. Therefore the proposed cost submitted for this enhancement case is £20 million to restore the full 1,494 hectares within AMP8. The Peatland Code verification requires a minimum of 5 years post intervention, therefore carbon credits will be verified beyond AMP8. The expected carbon reductions benefit is 13,227 tCO_2e per year from 2030. We have sought opportunities for partnership working and obtaining grant funding, such that the best value for customers and the environment is secured. We are confident in our ability to achieve grant funding based on our historic evidence.

6.5.10 Following restoration, between 1 and 3 years after the restoration start date the project will be evaluated against the Peatland Code by an approved validation body (e.g. Natural England). Upon project validation Pending Issuance Units (PIUs) are listed for all carbon units within the project. PIU act as a 'promise to deliver' Peatland Carbon Units. Upon issue of PIUs, verification takes place at year 5 of the project start date and at least every 10 years after when Peatland Carbon Code Units (PCU's) are issued. PCUs represent measurable amounts of carbon dioxide equivalent (CO_2e) reductions from the peatland. As per the Peatland Code, one carbon unit equals 1 tonne of carbon dioxide equivalent. We have presented this PIU value in our AMP8 PR24 data tables in year 5.

6.5.11 As part of this enhancement case, each scheme delivered in this programme will be assured by Natural England (or equivalent standard). Third party assurance can be completed by Natural England where the site is designated SSSI/SAC/SPA and where public money has been used as matched funding. This process will confirm restoration activity has occurred to move the habitat towards favourable condition. All carbon credits will then be validated through the Peatland Code (or equivalent standard where appropriate). Restoration activities to deliver an uplift in condition status will use associated emissions factors as defined in the Peatland Code protocol V2[5].

[5] https://www.iucn-uk-peatlandprogramme.org/sites/default/files/2023-03/FieldProtocol_%20v2_clean_0.pdf

Dependencies

6.5.12 There are external dependencies for this enhancement case as we are reliant on partners, tenants and sphagnum moss supply chains which may cause minor fluctuations on enhancement case delivery in AMP8. However we have a good history of peatland restoration since UUW's Sustainable Catchment Management Programme (SCaMP) in 2005 and continued demonstration through current UUW restoration projects across the North West.

Emissions reduction benefits

6.5.13 Table 34 has been taken from our PR24 data table submission for net zero enhancements CW21 and provides the AMP8 tCO_2e benefits delivered from this enhancement case. Emissions impacts (tCO_2e) are presented as cumulative operational tCO_2e. The benefits are stated as negative values as per Ofwat's PR24 data table guidance. The final column 'overall scheme impact' includes both operational and embodied emissions as per Ofwat's data table guidance.

6.5.14 The Peatland Code Guidance V2, provides the following guidance relating to its use of GHG statements from Peatland restoration.

- "A Pending Issuance Unit (PIU) is effectively a 'promise to deliver' a Peatland Carbon Unit in the future. It is not 'guaranteed' and therefore cannot be used to report against UK-based emissions until verified. However, it allows companies to plan to compensate for future UK based emissions or make credible CSR statements in support of peatland restoration. At the start of a project, all units available are PIUs as the restored peatland hasn't yet made any emissions reductions."; and
- "A Peatland Carbon Unit (PCU) is a tonne of CO_2e emissions savings from a Peatland Code certified peatland. It has been independently verified, is guaranteed to have been achieved, and can be used to report against a business's UK-based emissions as soon as it is purchased."

6.5.15 As part of this enhancement case all of the 1,494 hectares of peatland in AMP8 will be assured and PIUs issued following completion of the projects. These PIUs will be used to evidence that the project has been completed and provide confirmation of the proposed 13,227 tCO_2e annual carbon benefit to be delivered from 2030. Following verification by the Peatland Code, carbon units will be provided after a minimum of 5 years post intervention. We intend to use these carbon units within our UK-based emissions reporting when reporting our total net emissions. We therefore expect to see wider carbon benefits beyond AMP8, linked to our long-term ambitious and net zero strategy.

6.5.16 The overall scheme impact includes both operational and relevant embodied emissions as per Ofwat's data table guidance. The embodied emissions have been added as an emissions increase to the operational emissions reductions. For additional details, see the CW21 data table supporting commentary document.

Table 34: AMP8 emissions reduction for peatland restoration

Scheme benefits (cumulative impact on tCO_2e)	Scheme benefits (cumulative impact on tCO_2e)	Scheme benefits (cumulative impact on tCO_2e)	Scheme benefits (cumulative impact on tCO_2e)	Scheme benefits (cumulative impact on tCO_2e)	Overall scheme impact on total greenhouse gas emissions (total impact on tCO_2e)
2025-26	2026-27	2027-28	2028-29	2029-30	2029-30
0	0	0	0	-13,227.000	-13,227.000

6.5.17 We anticipate a reduction of 13,277 tCO_2e annually from 2030 as shown in Table 35. Emissions reductions are calculated using the approved calculation and emissions factors as per the Peatland Code

protocol V2, which takes into account the relevant peatland condition. GHG 'leakage' (as per the Peatland Code has also been accounted for within our assumptions, defined by the code as "assessment of leakage and its significance is project specific but examples of leakage may include an increase in stocking density outside of the project area leading to degradation or the burning of other areas of peatland to compensate for the area under restoration." Within our calculation methodology assumptions have been made on the level of loss we expect from the project area, either due to wildfire, stock ingress or failure of parts of the restoration work. We have assumed 0 embodied emissions as we do not expect this to be material.

Table 35: Enhancement case long-term scheme benefits

Intervention period	Hectares delivered	Carbon reduction (tCO_2e/yr.) most likely estimate	Earliest that the carbon benefit can be recognised (PIU)	Earliest that the carbon benefit can be claimed (PCU)*
AMP8 Net Zero enhancement	1494 ha	13,227 tCO_2e	2030	2035

**Earliest date that the carbon reduction can be claimed as a peatland carbon unit under the latest Peatland Code*.

Long-term emissions reduction benefits

6.5.18 Table 36 mirrors the PR24 data table submission, tables CW21 and CWW22 for net zero enhancements but provides the AMP9 tCO_2e benefits delivered from this enhancement case to show the longer term emissions benefits from delivering this enhancement case. Emissions impacts (tCO_2e) are presented as cumulative operational tCO_2e from AMP8 to AMP9. The benefits are stated as negative values as per Ofwat's PR24 data table guidance. The final column 'overall scheme impact' includes both operational and relevant embodied emissions as per Ofwat's data table guidance, for 2034-2035. We have assumed no embodied emissions as these long-term benefits relate to the delivery of AMP8 enhancement project that this funding relates.

Table 36: AMP9 emissions reduction for peatland restoration

Scheme benefits (cumulative impact on tCO_2e)	**Scheme benefits (cumulative impact on tCO_2e)**	**Scheme benefits (cumulative impact on tCO_2e)**	**Scheme benefits (cumulative impact on tCO_2e)**	**Scheme benefits (cumulative impact on tCO_2e)**	**Overall scheme impact on total greenhouse gas emissions (total impact on tCO_2e)**
2030-31	2031-32	2032-33	2033-34	2034-35	2034-35
0	0	0	0	-13,227	-13,227 0

Wider benefits

6.5.19 Restoring peatland has many wider benefits when compared with other interventions outside of carbon reductions. Peat habitats delivery multiple benefits including water quality, flood resilience, wildfire resilience and SSSI condition (biodiversity). With different types of peat condition delivering different scales of benefit.

6.5.20 Peatlands can be particular important for conversing rare plant and wildlife species within the UK, restoring peatlands can prevent declining numbers and help establish certain habitats. Along with acting as a natural flood management and prevention system, due to their water storage capacities (IUCN[6]).

[6] https://www.iucn-uk-peatlandprogramme.org/about-peatlands/peatland-benefits

Enhancement expenditure

6.5.21 The AMP8 costs associated with this enhancement case are presented in Table 37 and include the costs for undertaking surveys to establish the condition of the peatland before restoration to ensure full potential and provide confidence in enhancement outcomes and delivery.

6.5.22 In AMP7 Nature 4 Climate (N4C) grant funding was available where N4C would provide up to 75 per cent of the cost from third party grants. In AMP8 N4C grant funding will not be available, however, within our cost estimations we have assumed there will be some grant funding available from partner leverage funding. We have assumed this is likely to be a 50/50 spilt. The costs within this enhancement case and provided under CW21_1 represent 50 per cent of the total to restore the full 1,494 hectares within AMP8.

Table 37: AMP8 costs for peatland restoration

Net zero	2025-26	2026-27	2027-28	2028-29	2029-30	Total
Greenhouse gas reduction (net zero); enhancement capex	£2.000m	£5.400m	£5.400m	£5.400m	£1.800m	£20.000m
Greenhouse gas reduction (net zero); enhancement Opex	£0	£0	£0	£0	£0	£0
Greenhouse gas reduction (net zero); enhancement Totex	£2.000m	£5.400m	£5.400m	£5.400m	£1.800m	£20.000m

Long-term costs

6.5.23 In developing and optimising this enhancement case we have assessed long-term considerations, including on-going maintenance and financial needs. We have designed this enhancement case to stand alone in AMP8 and not constrain future needs or opportunities. Cost implications beyond AMP8 will be further considered at each future price review using latest available information. To maintain a science-based trajectory to net zero, we do not think it is likely that we would revert back to a higher emissions option. Our forecast at this point is that differential costs will reduce over time and therefore future base allowances are expected to be sufficient to maintain the improvements.

6.6 E00001345 Woodland creation

6.6.1 **Headline:** Create over 450 hectares of woodland in the North West to store carbon and deliver wider benefits

6.6.2 As part of this enhancement case UUW will create 465 hectares of woodland from planting trees by 2030, verified by the Woodland Carbon Code (WCC[7]) (or equivalent standard). This enhancement case is aligned to our long-term delivery strategy to reach net zero, therefore carbon reduction benefits will be phased beyond AMP8 due to tree lifecycles.

[7] https://woodlandcarboncode.org.uk/

Table 38: Summary of key information for woodland creation

Key information	
Total AMP8 operational emissions benefit (tCO_2e)	-1,663*
Total operational emissions (tCO_2e)	-137,578**
Total AMP8 embodied emissions (tCO_2e)	0
Total AMP8 Totex (£m)	2.50
Wider benefits	Improving public health Improving water quality Natural environment protection Increased resilience
Net Zero Enhancement or Challenge	Net Zero Enhancement
Impact on common performance commitment PCL (GHG emissions)	No

**Emissions benefits are stated as negative values to show a reduction, as per Ofwat's PR24 data table guidance*
**Pending Issuance Units only*

***Total operational emissions aligns to PR24 data tables CW15 and CWW15*

Price Control

6.6.3 The total cost and emissions for this enhancement has been entered into the PR24 data table CW21 in line with the price control allocation spilt shown in Table 39.

Table 39: Price control allocation for woodland creation

Project reference	Enhancement case name	Water Resources	Water Network+	Wastewater Network+	Bioresources
E00001345	Woodland Creation	0%	100%	0%	0%

Ofwat Assessment Gates

6.6.4 In addition to the overarching assessment shown in section 4 the specific assessment in Table 40 applies to this enhancement.

Table 40: Ofwat's assessment gates for woodland creation

Gate	Summary
Need for enhancement investment	**Evidence:** This enhancement case will create 465 hectares of woodland by 2030, providing future reportable GHG emissions benefits achieved through carbon sequestration. This enhancement is essential to our ability to retain a science-based trajectory to the national legal requirement for net zero 2050 and five year carbon budgets. **Base:** This enhancement case does not overlap with any activities delivered through base as all viable emissions reductions that can be delivered through base expenditure have been explored. This case also does not overlap with any other enhancement case proposed in AMP8. **Previous enhancement:** This enhancement case does not overlap or duplicate with any activities already funded at previous price reviews. Due to the additionality clause contained within the WCC, reportable emissions reduction benefits can only be quantified from any project activity that would not have happened anyway e.g. schemes delivered for regulatory purposes under WINEP cannot be claimed. This net zero enhancement case has the primary driver of GHG emissions reduction and is therefore quantifiable against reportable emissions. **Timing of expenditure:** We will deliver the required hectares over the course of AMP8 in line with the cost profile below. This enhancement is needed at this time as part of our optimal pathway to retain a science-based trajectory to the national legal requirement for net zero 2050 and five year carbon budgets. **Implicit allowance**: There is no implicit allowance for delivering additional woodland creation associated with this enhancement, this is above and beyond base service provision. The costs set out within this claim are the capital costs required for enabling this. **Long-term delivery strategy:** Our core pathway includes low regrets action in AMP8 across all aspects of our GHG emissions towards a science-based trajectory that supports national legal requirements for net zero and five year carbon budgets. Our approach works to secure wider benefits including service resilience, cost efficiency, recreation (public health) and nature, along with enabling activity to unlock further benefits and acceleration beyond 2030.
Best option for customers	This enhancement case offers wider benefits to customers outside of GHG emissions reduction mitigating the impacts of climate change including recreation and conserving the natural environment in the North West.

Gate	Summary
Cost efficiency	**Assurance:** Third party assurance has been undertaken on this enhancement case for the carbon values presented. For cost, our enhancement programme has been considered efficient after review from third party assurance. **Evidence:** We assessed a broad range of options and prioritised the most cost effective of those viable for delivering further reductions in the near term. We have taken measures to keep costs as low as possible. The costs presented below are deemed efficient as they have been calculated using base costs from historical woodland creation delivery projects we have undertaken in previous AMPs. Predicted capex spend to deliver this enhancement case of 465 hectares by 2030 is £5 million. Given available funding routes in AMP7, our cost estimations are that there will be some grant funding available from partnership funding and we have assumed this is likely to be a 50/50 spilt. The costs in this enhancement case and provided under CW21 represent 50% of the total to create the full 465 hectares within AMP8. This means that UUW are retaining some of the risk involved with this enhancement to present a cost efficient case. Therefore the proposed cost submitted for this enhancement case is £2.5 million to create 465 hectares of woodland within AMP8 In the short-term view, this could be seen as a more expensive option for emissions reduction, however it is one of the best options in the longer term beyond AMP8 as we expect emissions reduction benefits from this investment case to be greater from AMP9 onwards due to on-going carbon sequestration and WCC verification periods. **Modelled efficiency:** There are currently no agreed industry benchmarks for the cost associated with this enhancement case as it is new for the sector to invest in activity where GHG emissions reduction is the primary driver. Actions to improve emissions have typically been very low cost or a by-product of other priorities, and this is not an indicator of future costs and options needed to achieve required goals. During delivery, we will use market competition to ensure the best rates for example in the appointment of contractors.
Customer protection	This enhancement case is below the materiality threshold to require a PCD under Ofwat's guidance. However, we recognise the value for a PCD to protect customers in the emerging and evolving space of net zero. We are therefore proposing a PCD that will cover the cost and GHG emissions benefit delivered by the eight projects submitted as net zero enhancement projects which includes this enhancement case. This PCD will cover the full cost and tCO_2e benefit delivered by the eight projects submitted as net zero enhancement projects which includes this enhancement case, as per details outlined in section 5.5. The PCD will be measured in tCO_2e. This consistent unit enables comparison between projects within the PCD, even though their methodologies and delivery mechanisms are different.

Need for enhancement investment

6.6.5 Deterioration in land quality due to climate change has both direct and indirect impacts. Hotter, drier summers lead to fire, flood, subsidence and landslip events which in turn have associated health, safety and environmental impacts. With over 56,000 hectares of land in the North West, UUW aims to mitigate and control these impacts through creating additional woodland and restoring peatland on our land. This enhancement case will provide the expenditure required to continue our land management allowing us to create an additional 465 hectares of woodland within AMP8.

6.6.6 We aim to work with partners to create over 465 hectares of woodland in the North West to store carbon and deliver wider benefits. Creating woodland through the planting of trees removes carbon dioxide (CO_2) from the atmosphere through the process of photosynthesis which improves air quality, while also providing wider biodiversity benefits and benefits to society through the creation of more green spaces. Our projects will be registered and verified by the WCC a quality assurance standard for UK-based woodland creation projects. Once created and registered UUW will monitor the carbon sequestration using the WCC calculator. The first verification year is 5 years after planting to ensure good tree growth, therefore benefits from the first planting under this enhancement case won't be verified until at least 2031.

6.6.7 UUW has experience in woodland creation across the region giving confidence that the emissions reductions benefits can be achieved from this enhancements case. A recent example (from 2023) is at our Greenbooth South site where planting was completed in partnership to create 19 hectares of new woodland. This project has been registered with the WCC and is estimated to sequester 1,435 tCO_2e within 30 years.

Emissions reduction benefits

6.6.8 Table 41 has been taken from our PR24 data table submission for net zero enhancements CW21 and CWW22 and provides the AMP8 tCO_2e benefits delivered from this enhancement case. The benefits are stated as negative values as per Ofwat's PR24 data table guidance. The final column 'overall scheme impact' includes both operational and embodied emissions as per Ofwat's data table guidance.

6.6.9 Due to the nature of this enhancement case, trees don't sequester carbon as soon as they are planted. It takes on average five years of tree growth before any reportable carbon benefits can be realised, however Pending Issuance Units (PIU) can be generated. The WCC provides the following guidance relating to its use of GHG statements from woodland creation:[8]

- "Pending Issuance Units (PIU) are a 'promise to deliver' carbon units in a given time frame. The purpose of these units is to demonstrate the quantity of potential future sequestration;
- "Woodland Carbon Units (WCU) are verified carbon sequestration which can be used or reported. When a project is verified, PIUs which have been confirmed as sequestered will be converted to WCUs. These units can be considered a guaranteed, delivered carbon units and as such can be retired and used/reported. One unit is equal to 1 tonne of carbon dioxide equivalent (tCO_2e) sequestered; and
- Upon project validation PIU which act as a 'promise to deliver' Woodland Carbon Units (WCUs) in future (based on predicted sequestration) are listed on the UK Land Carbon Registry. Projects are then reviewed at year five and at least every ten years after the project start date, in line with WCC guidance. If performing well, PIUs are than converted into WCU's which can be used against reportable emissions.

6.6.10 As part of this enhancement case all of the 465 hectares within AMP8 will be assured and PIUs issued following completion of the projects. These PIUs will be used to evidence that the project has been completed and provide confirmation of the proposed carbon benefit to be delivered from 2030. We have presented these PIU values in our AMP8 PR24 data tables. We expect woodland carbon units to be available for use in our UK-based emissions reporting from 2033, following verification.

6.6.11 The overall scheme impact includes both operational and embodied emissions as per Ofwat's data table guidance. The embodied emissions have been added as an emissions increase on to the operational emissions reductions. We have assumed no embodied emissions as we do not expect this to be material. For additional details, see the CW21 data table supporting commentary document.

Table 41: AMP8 emissions reduction benefits for woodland creation

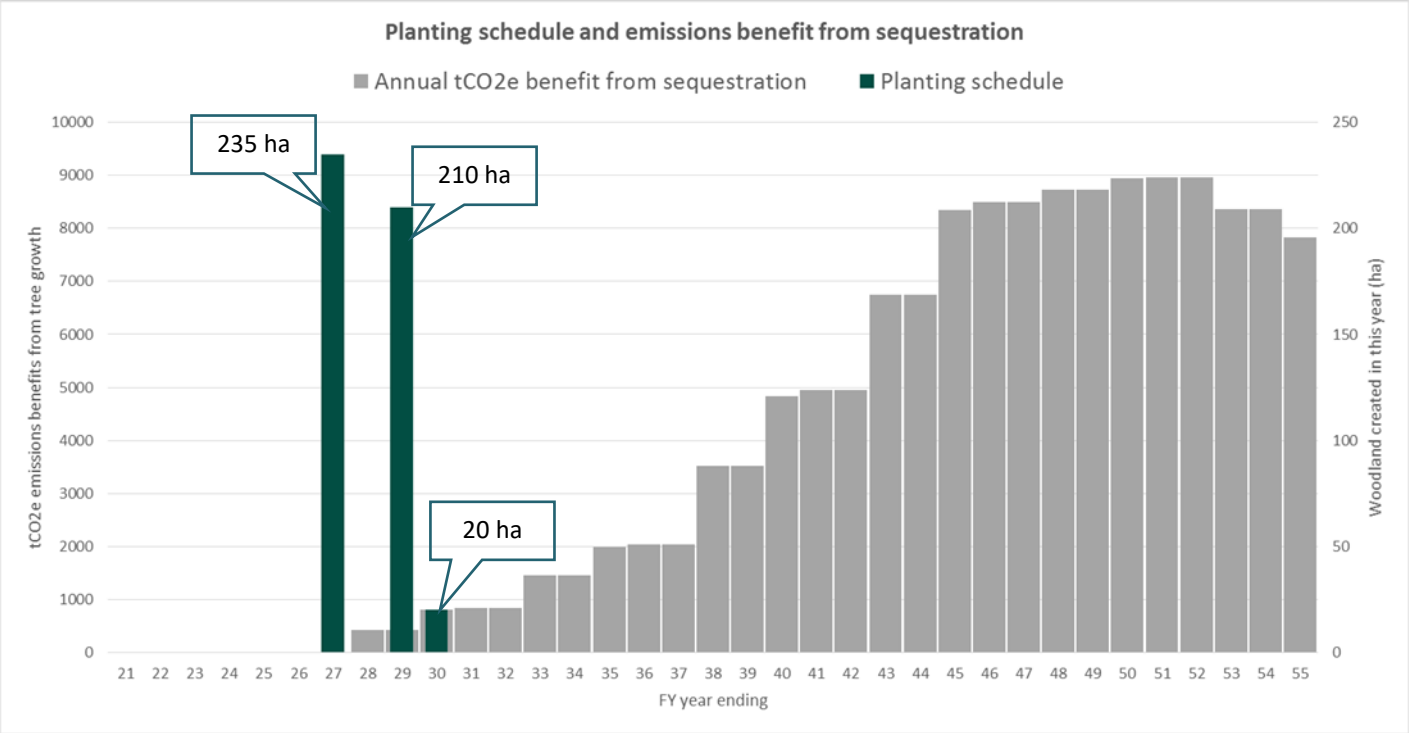
Scheme benefits (cumulative impact on tCO_2e)	Scheme benefits (cumulative impact on tCO_2e)	Scheme benefits (cumulative impact on tCO_2e)	Scheme benefits (cumulative impact on tCO_2e)	Scheme benefits (cumulative impact on tCO_2e)	Overall scheme impact on total greenhouse gas emissions (total impact on tCO_2e)
2025-26	2026-27	2027-28	2028-29	2029-30	2029-30
0	0	-427.015	-854.03	-1,662.63	-1,662.63

[8] The Woodland Carbon Code (2022): https://woodlandcarboncode.org.uk/images/PDFs/Woodland_Carbon_Code_V2.2_April_2022.pdf

Long-term emissions reduction benefits

6.6.12 Beyond AMP8, we anticipate a reduction of 137,578 tCO_2e by 2055. This is the forecasted annual cumulative carbon sequestered between 2025 and 2055 from the 465 hectares planted. Emissions reductions are calculated using the WCC calculator, the UKWC emission factors take into account ground preparation, species, numbers of tress, ESC, growth rates/YC modules and the woodland management regime. Figure 5 presents the anticipated planting schedule for the 465 hectares included within this enhancement case (dark green bars) and the forecast annual tCO_2e benefit expected out to 2055.

Figure 5: Enhancement case long-term scheme benefits



Wider benefits

6.6.13 Woodland creation is an important part of contributing to healthy land and water based eco-systems, creating and enhancing habitats for wildlife and increasing biodiversity. Trees are also known for improving water quality through reducing mineral, organic matter, and potential contaminant run off, increasing water retention, and acting as a natural way to control flooding through providing increased soil stability. For example, relative to bare soil or managed grassland, woodland reduces fluvial flooding risk to downstream populations by reducing rainfall flows entering rivers. It does this through canopy interception, higher infiltration and water storage in soils, impeding water flows and reducing siltation. Tree planting along rivers is also know to help stabilise riverbanks and can help prevent landslips.

6.6.14 Planting trees and creating woodland areas have wider social benefits creating green spaces for customers and communities in the North West. Providing public access to our woodlands for customer use creates additional recreation benefit through the form of walking and running routes further supporting the health and well-being of our customers.

Enhancement expenditure

6.6.15 During AMP7 we have used the Defra Nature 4 Climate Fund pot and the Woodland Creation route, however, there is no guarantee these funding streams will remain into AMP8, presenting a need for this enhancement case as part of our long-term strategy to reach net zero. Given available funding routes in AMP7, our cost estimations have assumed there will be some grant funding available from partnership funding and we have assumed this is likely to be a 50/50 spilt. The costs within this enhancement case and provided within CW21represent 50 per cent of the total to create the full 465 hectares within

AMP8. This means that UUW are retaining some of the risk involved with this enhancement to present a cost efficient case. Therefore the proposed cost submitted for this enhancement case is £2.5 million to create 465 hectares of woodland within AMP8. We have sought opportunities for partnership working and obtaining grant funding, such that the best value for customers and the environment is secured. We are confident in our ability to achieve grant funding based on our historic evidence.

6.6.16 The capex costs have been profiled within the first three years of AMP8 as upfront costs will be incurred to start the projects before any carbon benefit can be realised due to planting schedules and tree growth years as outlined in the section above.

Table 42: AMP8 costs for woodland creation

Net zero	2025-26	2026-27	2027-28	2028-29	2029-30	Total
Greenhouse gas reduction (net zero); enhancement capex	£0.835m	£0.835m	£0.830m	£0	£0	£2.501m
Greenhouse gas reduction (net zero); enhancement Opex	£0	£0	£0	£0	£0	£0
Greenhouse gas reduction (net zero); enhancement Totex	£0.835m	£0.835m	£0.830m	£0	£0	£2.501m

Long-term costs

6.6.17 In developing and optimising this enhancement case we have assessed long-term considerations, including ongoing maintenance and financial needs. We have designed this enhancement case to stand alone in AMP8 and not constrain future needs or opportunities. Cost implications beyond AMP8 will be further considered at each future price review using latest available information. To maintain a science-based trajectory to net zero, we do not think it is likely that we would revert back to a higher emissions option. Our forecast at this point is that differential costs will reduce over time and therefore future base allowances are expected to be sufficient to maintain the improvements

6.7 E00001338 Process emissions (Bioresources)

6.7.1 **Headline:** Introduce innovative technologies to monitor and reduce the release of methane from sludge management processes

6.7.2 This net zero enhancement relates to process emissions associated with Bioresources and provides a major reduction in fugitive methane releases. It goes beyond business as usual by providing a further benefit to the current lowest GHG emissions digestion process defined in the carbon accounting workbook, which is thermal hydrolysis (THP) with Anaerobic Digestion (AD). The proposal is to use new technology to extract more biogas from the sludge which would otherwise be lost to atmosphere. The biogas is recovered and used for energy production. The benefit of the energy generation is captured in the proposed totex costs.

6.7.3 This project will implement new technology at three sludge treatment sites processing circa 50 per cent of UUW's total raw sewage sludge. The technology will provide a novel degassing solution to remove

methane and capture this for energy generation. The net zero enhancement we are presenting provides the net cost to implement the solution.

Table 43: Summary of key info for process emissions (Bioresources)

Key information	
Total AMP8 operational emissions benefit (tCO_2e)	-22,077*
Total operational emissions benefit 2030 – 2055 (tCO_2e)	-183,973**
Total AMP8 embodied emissions (tCO_2e)	548
Total AMP8 Totex (£m)	13.60
Wider benefits	Improving public health Increasing resilience
Net Zero Enhancement or Challenge	Net Zero Challenge
Impact on common performance commitment PCL (GHG emissions)	No

**Emissions benefits are stated as negative values to show a reduction, as per Ofwat's PR24 data table guidance*
***Total operational emissions aligns to PR24 data tables CW15 and CWW15*

Price Control

6.7.4 The total cost and emissions for this enhancement has been entered into the PR24 data table CWW22 in line with the price control allocation spilt shown in Table 44.

Table 44: Price control allocation for process emissions (Bioresources)

Project reference	Enhancement case name	Water Resources	Water Network+	Wastewater Network+	Bioresources
E00001338	Process emissions (Bioresources)	0%	0%	0%	100%

Ofwat Assessment Gates

6.7.5 In addition to the overarching assessment shown in section 4 above the specific assessment in Table 45 applies to this enhancement.

Table 45: Ofwat's assessment gates for process emissions (Bioresources)

Gate	Summary
Need for enhancement investment	**Evidence:** The Climate Change Committee (CCC) 6th budget published in December 2020 recognises that reducing wastewater process emissions is a major challenge, proposing a 21% reduction in process emissions from wastewater treatment by 2030. This enhancement allows us to reduce our emissions associated with bioresources process emissions by implementing new technology at three sites processing circa 50% of UUW's total raw sludge. Elovac technology will provide a novel degassing solution to remove methane and capture this for energy generation. This enhancement is essential to our ability to retain a science-based trajectory to the national legal requirement for net zero 2050 and five year carbon budgets. **Base:** This enhancement does not overlap with any activities to be delivered through base, or any previous funding from earlier price reviews as all proposed activities and costs relate to the installation of new technology specifically for the benefit of GHG emissions. All viable emissions reductions from reducing process emissions that can be delivered through base expenditure have already been implemented or are planned to be implemented **Previous enhancement:** This enhancement case does not overlap or duplicate with any activities already funded at previous price reviews. This net zero enhancement case is to install new Elovac technology and therefore is separate to any Industrial Emissions Directive (IED) related scope of works. As this only applies to Thermal Hydrolysis (THP) with Anaerobic Digestion (AD), which does not use open secondary digesters there is no overlap between this enhancement case and the investment to achieve IED compliance. **Timing of expenditure:** We will deliver the required installation in the first two years of AMP8 in line with the cost profile above to maximise the emissions reductions benefits. During commissioning we will complete performance tests which will measure the methane recovered and returned to the gas holder. Upon installation and commissioning we will then monitor and measure the methane recovered and look to start mitigating measures from year three onwards, aligned to the carbon reduction profile set out below. This enhancement is needed at this time as part of our optimal pathway to retain a science-based trajectory to the national legal requirement for net zero 2050 and five year carbon budgets. **Implicit allowance**: This enhancement case involves the installation of new equipment in order to deliver a step change in monitoring and reducing process emissions. There is no implicit allowance for the use of alternative technology to capture and mitigate methane emissions, this is above and beyond base service provision. The costs set out within this claim are the capital costs for the new technology equipment and installation. **Long-term delivery strategy:** Our core pathway includes low regrets action in AMP8 across all aspects of our GHG emissions towards a science-based trajectory that supports national legal requirements for net zero and five year carbon budgets. Our approach works to secure wider benefits including service resilience, cost efficiency, recreation (public health) and nature, along with enabling activity to unlock further benefits and acceleration beyond 2030. The alternative option to this pathway and enhancement case would be to continue as we have to date. This would not support a science-based trajectory.
Best option for customers	Multiple options were considered for operating a WwTW differently to achieve a reduction in methane emissions, as listed in the description of the enhancement case, Elovac is a newer, innovative technology that provides the best option. There is no other technology currently available, we are therefore presenting the best feasible option.

Gate	Summary
Cost efficiency	**Assurance:** Third party assurance has been undertaken on this enhancement case for the carbon values presented. For cost, our enhancement programme has been considered efficient after review from third party assurance. **Evidence:** We assessed a broad range of options and prioritised the most cost effective of those viable for delivering further reductions in the near term. We have taken measures to keep costs as low as possible. The level of cost efficiency is demonstrated by the £/tCO_2e, and this enhancement case was one of the most cost-beneficial of the viable options we can deploy in AMP8 to achieve further emissions reductions. Furthermore, the cost-benefit of this enhancement is even stronger in the long-term as we expect further emissions benefits from the investment beyond AMP8 to be identified, subject to assessments in the future. The trials undertaken in AMP7 provide evidence that this enhancement case provides the most cost effective option for delivering the required carbon reductions. All 3 sites applicable for Elovac technology have been selected in this case. We have found no alternative technology available that is applicable to UUW sites currently that provides the same outcomes and reduction in methane emissions. The costs provided for this enhancement have been provided by UUW's Estimating Team and are based on supplier data and cost curves from a database of costs for asset equipment installation. Where historical costs have been used as the basis for calculation of the cost curves they have been updated to reflect FY23 rates. **Modelled efficiency:** There are currently no agreed industry benchmarks for the cost associated with this enhancement case as it is new for the sector to invest in activity where GHG emissions reduction is the primary driver. Actions to improve emissions have typically been very low cost or a by-product of other priorities, and this is not an indicator of future costs and options needed to achieve required goals.
Customer protection	• This project will be entered into the net zero challenge and we do not propose a PCD, or a PCL reduction, at this time. By definition, these are more challenging and uncertain projects that involve innovation and can only proceed if successful in the national challenge competition. Protections will be provided by Ofwat's approach to the challenge. We propose customer protections similar to those in the innovation fund, where project milestones are agreed at the project outset which are then reported against. • We will publish progress in our Annual Performance Report to aid transparency.

Need for enhancement investment

6.7.6 For the UK water sector the term process emissions refers to nitrous oxide and methane which are formed and released from wastewater and sludge treatment. These gases are released unintentionally from the treatment process and can have significant impact on climate change due to their high global warming impact, and therefore need to be minimised. This enhancement case will focus on methane, and a separate enhancement case includes reduction in nitrous oxide.

6.7.7 The digestion process is widely used in the wastewater industry to stabilise raw sewage sludge. The resulting product has beneficial properties when applied to land by providing organic matter and nutrients into the soil. During the digestion process bacteria produces methane which can be used in CHP engines to create power and heat which can be used on site or exported offsite. Methane is a potent GHG, 25 times stronger than carbon dioxide in causing global warming. Post digestion there are two main pathways for uncontained methane emissions; the first from entrained biogas and the second from continued bacterial activity.

6.7.8 Advanced anaerobic digestion (AAD) sites have processes in place downstream of digestion to prevent the digestion process continuing therefore negating this pathway for fugitive methane emissions. These can be further enhanced by using new technology that allows methane recovery (vacuum degassing). This targets the biogas which is entrained in the digested sludge. Our development of this net zero enhancement has included working with potential suppliers to confirm the potential methane recovery

available and how we can optimise this. By installing this technology we can reduce fugitive releases to atmosphere.

Emissions reduction benefits

6.7.9 The approach proposed for the common PC to calculate methane emissions from sludge treatment is based on the raw dry tonnes of sewage sludge processed by specific digestion technologies multiplied by an emissions factor as per the carbon accounting workbook (CAW) v17. However as this approach has a direct connection to population growth and amount of sewage sludge treated, meaningful reductions cannot be reflected using this methodology and the GHG emissions impact of the process emissions are therefore currently under reported. For PC reporting the proposed accounting methodology will not capture the carbon benefit from the capturing of methane. Therefore, for this enhancement case we have used a different method to forecast the potential emissions reductions benefits in AMP8 and beyond.

6.7.10 We forecast the methane captured and recovered will provide a carbon benefit by 2030 of circa 7,359 tCO_2e per year. The carbon reduction over AMP8 is phased as the first two years will require time for construction and commissioning as per the spend profile set out below. In order to calculate these emissions we have used the principles of the CAW with the latest emission factor used for methane from the IPCCs Fourth Assessment Report, as per GHG Protocol guidance. As this emissions reduction does not currently benefit our reportable emissions in the common operational GHG emissions PC methodology, this enhancement case should not be used to reduce the PCL. This enhancement case will provide on site monitoring and therefore enable improvements in methodology for us and the sector.

6.7.11 Table 46 has been taken from our PR24 data table submission for net zero enhancements CWW22 and provides the AMP8 tCO_2e benefits delivered from this enhancement case. The table below mirrors the PR24 data table submission, tables CW21 and CWW22 for net zero enhancements, emissions impacts (tCO_2e) are presented as cumulative operational tCO_2e. The benefits are stated as negative values as per Ofwat's PR24 data table guidance.

6.7.12 The overall scheme impact includes both operational and embodied emissions as per Ofwat's data table guidance. The embodied emissions have been added as an emissions increase onto the operational emissions reductions. For additional details, see the CWW22 data table supporting commentary document.

Table 46: AMP8 emissions reduction benefits from process emissions (Bioresources)

Scheme benefits (cumulative impact on tCO_2e)	Scheme benefits (cumulative impact on tCO_2e)	Scheme benefits (cumulative impact on tCO_2e)	Scheme benefits (cumulative impact on tCO_2e)	Scheme benefits (cumulative impact on tCO_2e)	Overall scheme impact on total greenhouse gas emissions (total impact on tCO_2e)
2025-26	2026-27	2027-28	2028-29	2029-30	2029-30
0	0	-7,358.919	-14,717.838	-22,076.757	-21,528.347

Long-term emissions reduction benefits

6.7.13 Table 47 mirrors the PR24 data table submission, table CWW22 for net zero enhancements but provides the AMP9 tCO_2e benefits delivered from this enhancement case to show the longer term emissions benefits from delivering this enhancement case. Emissions impacts are presented as cumulative operational tCO_2e from AMP8 to AMP9. The benefits are stated as negative values as per Ofwat's PR24 data table guidance. The final column 'overall scheme impact' includes both operational and embodied emissions as per Ofwat's data table guidance, for 2034-2035 we have assumed no embodied emissions

as these long-term benefits relate to the delivery of AMP8 enhancement project that this funding relates.

Table 47: AMP9 emissions reduction benefits from process emissions (Bioresources)

Scheme benefits (cumulative impact on tCO_2e)	Scheme benefits (cumulative impact on tCO_2e)	Scheme benefits (cumulative impact on tCO_2e)	Scheme benefits (cumulative impact on tCO_2e)	Scheme benefits (cumulative impact on tCO_2e)	Overall scheme impact on total greenhouse gas emissions (total impact on tCO_2e)
2030-31	2031-32	2032-33	2033-34	2034-35	2034-35
-29,435.676	-36,794.596	-44,153.515	-51,512.434	-58,871.353	-58,871.353

Wider benefits

6.7.14 In removing entrained biogas from digested sewage sludge the density of sludge increases. This could have a positive impact on the downstream dewatering treatment of the sludge. Supplier data suggests an improvement of 1-2 per cent dry solids (DS) in sludge thickness, the impact of this would mean less volume of biosolids being transported to landbank. Reducing the number of tanker movements and the associated GHG emissions. It would also provide more stable stockpiles of biosolids which are then less prone to leaching or slumping during storage (reducing the need for subsequent interventions and associated GHG emissions).

Enhancement expenditure

6.7.15 Cost to deliver project in AMP8 are provided within Table 48. The capex costs required to deliver this enhancement case are profiled in the first two years of AMP8 to maximise the emissions reductions benefits that can be realised from 2027-28 onwards when onsite monitoring can begin.

Table 48: AMP8 costs for process emissions (Bioresources)

Net zero	2025-26	2026-27	2027-28	2028-29	2029-30	Total
Greenhouse gas reduction (net zero); enhancement capex	£7.250m	£7.250m	£0	£0	£0	£14.500m
Greenhouse gas reduction (net zero); enhancement Opex	£0	£0	-£0.283m	-£0.316m	-£0.306m	-£0.905m
Greenhouse gas reduction (net zero); enhancement Totex	**£7.250m**	**£7.250m**	**-£0.283m**	**-£0.316m**	**-£0.306m**	**£13.595m**

Long-term costs

6.7.16 In developing and optimising this enhancement case we have assessed long-term considerations, including ongoing maintenance and financial needs. We have designed this enhancement case to stand alone in AMP8 and not constrain future needs or opportunities. Cost implications beyond AMP8 will be further considered at each future price review using latest available information. To maintain a science-based trajectory to net zero, we do not think it is likely that we would revert back to a higher emissions

option. Our forecast at this point is that differential costs will reduce over time and therefore future base allowances are expected to be sufficient to maintain the improvements.

6.8 E00001339 Process emissions (Wastewater)

6.8.1 **Headline:** Introduce innovative technologies to monitor and reduce the release of nitrous oxide from wastewater processes

6.8.2 This case focuses on wastewater process emissions. We are proposing an ambitious and sector leading nitrous oxide emissions reduction programme that is innovative and focused on driving a low cost for delivery (£/tCO_2e). The solution goes beyond any current international programme of nitrous oxide reduction.

Table 49: Summary of key information

Key information	
Total AMP8 operational emissions benefit (tCO_2e)	-62,705*
Total operational emissions benefit 2030 – 2055 (tCO_2e)	-627,052**
Total AMP8 embodied emissions (tCO_2e)	30
Total AMP8 Totex (£m)	33.71
Wider benefits	Improving public health Increasing resilience
Net Zero Enhancement or Challenge	Net Zero Challenge
Impact on common performance commitment PCL (GHG emissions)	No

Emissions benefits are stated as negative values to show a reduction, as per Ofwat's PR24 data table guidance
**Total operational emissions aligns to PR24 data tables CW15 and CWW15*

Price Control

6.8.3 The total cost and emissions for this enhancement has been entered into the PR24 data table CWW22 in line with the price control allocation spilt shown in Table 50.

Table 50: Price control allocation for process emissions (wastewater)

Project reference	Enhancement case name	Water Resources	Water Network+	Wastewater Network+	Bioresources
E00001339	Process Emissions (Wastewater)	0%	0%	100%	0%

Ofwat Assessment Gates

6.8.4 In addition to the overarching assessment shown in section 4 above the specific assessment in Table 51 applies to this enhancement.

Table 51: Ofwat's assessment gates for process emissions (Wastewater)

Gate	Summary
Need for enhancement investment	**Evidence:** The Climate Change Committee (CCC) 6th budget published in December 2020 recognises that reducing wastewater process emissions is a major challenge, proposing a 21% reduction in process emissions from wastewater treatment by 2030. While we and the sector were unsuccessful in proposals a few years ago for national programmes to test and develop measurement solutions, we have continued to progress research in AMP7 on the measurement of emissions (both nitrous oxide and methane). This is now enabling us to propose accelerated actions to reduce nitrous oxide emissions through this enhancement case in AMP8. This enhancement case seeks to reduce our nitrous oxide emissions associated with wastewater processes, through the installation of new equipment. This enhancement is essential to our ability to retain a science-based trajectory to the national legal requirement for net zero 2050 and five year carbon budgets. Any learning will be shared with the sector as this case is both stretching and innovative to accelerate change and facilitate nitrous oxide reduction. **Base:** This enhancement does not overlap with any activities to be delivered through base, or any previous funding from earlier price reviews as all proposed activities and costs relate the installation of additional equipment specifically for the benefit of GHG emissions. All viable emissions reductions from reducing process emissions that can be delivered through base expenditure have already been implemented or are planned to be implemented. **Previous enhancement:** This enhancement case does not overlap or duplicate with any activities already funded at previous price reviews. **Timing of expenditure:** We will deliver the required installation in the first two years of AMP8 in line with the cost profile above to maximise the emissions reductions benefits. During commissioning performance tests will be completed. Upon technology installation and commissioning, we will then monitor and measure nitrous oxide emissions and start mitigating measures as through a phased programme of work commencing in year 3 onwards, aligned to the carbon reduction profile set out below. This enhancement is needed at this time as part of our optimal pathway to retain a science-based trajectory to the national legal requirement for net zero 2050 and five year carbon budgets. **Implicit allowance**: This enhancement case involves the installation of new equipment in order to deliver a step change in monitoring and reducing process emissions, this is above and beyond base service provision. The costs set out within this claim are the capital costs for the new technology equipment and installation. **Long-term delivery strategy:** Our core pathway includes low regrets action in AMP8 across all aspects of our GHG emissions towards a science-based trajectory that supports national legal requirements for net zero and five year carbon budgets. Our approach works to secure wider benefits including service resilience, cost efficiency, recreation (public health) and nature, along with enabling activity to unlock further benefits and acceleration beyond 2030. The alternative option to this pathway and enhancement case would be to continue as we have to date. This would not support a science-based trajectory.
Best option for customers	Multiple options were considered for operating a WwTW differently to achieve a reduction in nitrous oxide emissions, as listed in the description of the enhancement case. All options aside from real time control were considered high cost options and were discounted from this enhancement case as they were not considered the most cost effective in achieving nitrous oxide emissions reduction.

Gate	Summary
Cost efficiency	**Assurance:** Third party assurance has been undertaken on this enhancement case for the carbon values presented. For cost, our enhancement programme has been considered efficient after review from third party assurance. **Evidence:** We assessed a broad range of options and prioritised the most cost effective of those viable for delivering further reductions in the near term. We have taken measures to keep costs as low as possible. The level of cost efficiency is demonstrated by the £/tCO_2e, and this enhancement case was one of the most cost-beneficial of the viable options we can deploy in AMP8 to achieve further emissions reductions. Furthermore, the cost-benefit of this enhancement is even stronger in the long-term as we expect further emissions benefits from the investment beyond AMP8, subject to assessments in the future. The costs provided for this enhancement have been calculated based on a pilot at Oldham WwTW. Actual costs for monitoring nitrous oxide emissions online at one site have been used and extrapolated to estimate costs for all 17 proposed sites. We have also utilised quotes from a supplier for Nereda sites and MABR solution and quotes from the UU Estimating Team. A low cost (real time control option) and high cost (more capital intensive option which includes more installation of equipment) were explored. The low cost option was selected as best value for this enhancement case, and therefore only the costs for real time controls are included. **Modelled efficiency:** There are currently no agreed industry benchmarks for the cost associated with this enhancement case as it is new for the sector to invest in activity where GHG emissions reduction is the primary driver. Actions to improve emissions have typically been very low cost or a by-product of other priorities, and this is not an indicator of future costs and options needed to achieve required goals. During delivery, we will use market competition to ensure the best rates.
Customer protection	• This project will be entered into the net zero challenge and we do not propose a PCD, or a PCL reduction, at this time. By definition, these are more challenging and uncertain projects that involve innovation and can only proceed if successful in the national challenge competition. Protections will be provided by Ofwat's approach to the challenge. We propose customer protections similar to those in the innovation fund, where project milestones are agreed at the project outset which are then reported against. We will publish progress in our Annual Performance Report to aid transparency.

Need for enhancement investment

6.8.5 Nitrous oxide and methane are formed and released from wastewater and sludge treatment. These releases are unintentional and undesirable due to their global warming impact, and therefore need to be minimised. This enhancement case will focus on nitrous oxide, and a separate enhancement case includes reduction in methane (Process Emissions – Bioresources).

6.8.6 The treatment of wastewater to meet permit conditions requires the removal of ammonia (NH3). The majority of ammonia is converted to nitrogen (N2) which is released to air and is harmless. However, some nitrous oxide is also formed and released, which has a high global warming potential being 298 times that of carbon dioxide.

6.8.7 Based on the scope and proposed methodology for reporting GHG emissions for the common PCs, we estimate nitrous oxide emissions represent 10 per cent of our forecast GHG emissions for AMP8. The current sector GHG reporting methodology used for the PC is widely acknowledged to under report the impact of process emissions in light of latest scientific developments. Using the Intergovernmental Panel for Climate Change (IPCC) methodology, our nitrous oxide process emissions could be circa 270,000 tCO_2e per year. Using the IPPC methodology for nitrous oxide increases our emissions by circa 230,000 tCO_2e per year and becomes the single largest emissions source of our operational emissions.

6.8.8 To minimise nitrous oxide emissions from wastewater treatment we need to:

- Reduce emissions from our existing assets/operations; and

- Ensure planned investment for new treatment solutions are optimised to minimise nitrous oxide emissions.

6.8.9 This net zero enhancement focuses on reducing nitrous oxide emissions from UUW's existing assets/operations. For planned investment we are incorporating low nitrous oxide emission solutions into our solution development (optioneering).

6.8.10 The rationale for focusing on our existing assets/operations for this net zero enhancement is to:

- Accelerate delivery of a step change in reducing nitrous oxide reductions into AMP8;
- Create learning to develop solutions that can be replicated in future AMPs; and
- Provide the first phase of reduction at the lowest cost.

6.8.11 As this is a common challenge for the sector, we will share our learning with other companies including via a Community of Practice group of various wastewater companies working with Jacobs, and a Process Emissions Liaison Group of various wastewater companies and Water UK.

6.8.12 The Climate Change Committee (CCC) in their 6th budget, published in December 2020, recognise that reducing wastewater nitrous oxide process emissions is a major challenge. The CCC's Balanced Pathway for 2050 proposes a 20 per cent reduction in nitrous oxide emissions from wastewater, with a potential to go to 50 per cent by deploying innovation which has yet to be developed.

6.8.13 The CCC estimates that the 25 year cost to deliver a 20 per cent reduction in nitrous oxide emissions is £204 per tCO_2e. Therefore, this gives an investment of £5,100 per tCO_2e over 25 years. To deliver a 50 per cent reduction the CCC forecast is £554 which is £13,296 per tCO_2e over 25 years. These are useful benchmarks to compare with our proposed enhancement case.

6.8.14 In support of this net zero enhancement, we expect to have invested £0.3 million by the end of AMP7 in trialling new monitoring techniques for nitrous oxide (and methane) emissions along with developing understanding on how we can implement change to reduce nitrous oxide formation.

6.8.15 Using our learning, our proposal for this net zero enhancement is to deliver a ~10 per cent reduction in nitrous oxide emissions by 2030. We plan to deliver this through optimisation of 17 of our largest WwTWs, comprising enhanced monitoring and real time control improvements.

6.8.16 This is an ambitious "low cost" solution to deliver nitrous oxide reductions that will enable further reduction in AMP9 and beyond. The AMP8 cost for our proposal is £538 per tCO_2e. Over 25 years we estimate the cost would be £215 per tCO_2e. Therefore, our approach is aligned with the CCC benchmark.

6.8.17 Based on the common GHG PC method, the reduction in nitrous oxide emissions will be 10,000 tCO_2e by 2030, although this will not show in reportable emissions in the PC performance as this uses static emission factors and is based on population equivalent. Using the IPPC latest factors, the emissions reduction are expected to be ~63,000 tCO_2e by 2030. For the purposes of this enhancement submission, we have used the IPCC emissions factors as the most accurate known methodology.

Proposed solution

6.8.18 To develop our submission we have completed the following:

- A site screening exercise across our largest 50 WwTWs, to determine which sites to prioritise for monitoring and mitigation based on asset types, population served, estimated nitrous oxide emissions, co-location of sludge treatment and potential mitigation actions that could be taken at each site. 17 wastewater sites were selected, which are estimated to account for 64 per cent of UUW's total nitrous oxide emissions; and
- Invested in piloting nitrous oxide emissions monitoring and management at our Oldham WwTW to build our capability allowing us to put forward this net zero enhancement. Based on the above we propose to monitor and mitigate nitrous oxide emissions from 17 WwTWs.

6.8.19 For monitoring purposes, on-line liquid phase nitrous oxide monitors will be installed, situated one per lane in each Activated Sludge Plant (ASP) on each of the 17 sites. This will enable continuous monitoring, which is considered best practice (based on studies in Denmark [9][10][11]) to establish an emissions baseline and variation through the seasons.

6.8.20 To reduce nitrous oxide emissions, "low" and "higher" cost options were considered and compared against each other in terms of cost and tCO_2e reduction achieved.

6.8.21 The "low" cost option involves all of the following at each site:

- Installation of one nitrate analyser per lane;
- Installation of one ammonia analyser every two lanes;
- Installation of real time control to integrate current and new analysers with the control system, to adjust dissolved oxygen (DO) and minimise nitrous oxide production; and
- Cost provision for people and systems development as part of this control.

6.8.22 The benefits from the proposed net zero enhancement are summarised in Table 52. The GHG emissions reduction forecast is based on the IPCC emissions factor (which aligns with the CCC and therefore allows a comparison of our costs with the CCC benchmarks).

Table 52: Low cost option identified for process emissions (wastewater) enhancement case

Parameter	Units	Low cost option
CO_2e reduction	tCO_2e/AMP	62,705
AMP8 totex	£m/AMP	33.71
AMP8 £/tCO_2e	£/tCO_2e	538
25 year £/tCO_2e	£/tCO_2e	215
CCC cost forecast (over 25 years)	£/tCO_2e	204

Discounted higher cost options

6.8.23 We assessed higher cost options for the work, which are summarised in Table 53. We rejected these options due to the scale of investment needed relative to the "additional" nitrous oxide reduction achieved in comparison to the lower cost options. We will continue to monitor the costs and benefits of alternative options in case they can provide an opportunity in our phase 2 project or in subsequent AMPs for our existing assets and be incorporated into planned investment programmes. The options considered were:

- Retrofit Enhanced Biological Phosphate Removal (EBPR) solution;
- Retrofit Fine Bubble Diffused Air (FBDA);
- Balancing return liquors from sludge treatment assets including installing pumps and pipework; and
- Retrofit a Membrane Aerated Biofilm Reactor (MABR) in existing anoxic zones in the ASP.

6.8.24 For information, the additional cost to deliver the higher cost options is summarised below. For AMP8 it shows a threefold increase in costs for the higher cost options. These costs are subject to change as calculations are refined and cannot be related to any potential additional phase 2 project delivered on process emissions as per section 6.9.

[9] Danish EPA Report

[10] Unisense webinar 23rd May 2022 as presented and discussed by 2 Dutch Water Utilities

[11] Analysis of the potential contribution to energy and climate neutrality from Danish technology within the global wastewater sector

Table 53: Higher cost option identified for process emissions (wastewater) enhancement case

Parameter	Units	High cost options
CO_2e reduction	tCO_2e/AMP	96,939
AMP8 totex	£m/AMP	114.78
AMP8 £/tCO_2e	£/tCO_2e	1,184
25 year £/tCO_2e	£/tCO_2e	245
CCC cost forecast (over 25 years)	£/tCO_2e	204

Emissions reduction benefits

6.8.25 Table 54 is from our PR24 data table submission for net zero enhancements CWW22 and provides the AMP8 tCO_2e benefits delivered from this enhancement case. Emissions impacts (tCO_2e) are presented as cumulative operational tCO_2e. The benefits are stated as negative values as per Ofwat's PR24 data table guidance.

6.8.26 The figures presented in the table below relate to emissions based on the IPCC methodology. The current sector reporting methodology used for the PC is widely acknowledged to under report process emissions (CAW v17 methodology). Using the Intergovernmental Panel for Climate Change (IPCC) methodology provides a value that is believed to be closer to actual emissions, and also aligns with the CCC and therefore allows a comparison of our costs with the CCC benchmarks.

6.8.27 The emissions reduction presented below does not benefit our reportable emissions in the common PCs for operational GHG emissions.

6.8.28 The overall scheme impact includes both operational and embodied emissions as per Ofwat's data table guidance. The embodied emissions have been added as an emissions increase onto the operational emissions reductions. For additional details, see the CWW22 data table supporting commentary document.

Table 54: AMP8 emissions reduction benefits from process emissions (Wastewater)

Scheme benefits (cumulative impact on tCO_2e)	Scheme benefits (cumulative impact on tCO_2e)	Scheme benefits (cumulative impact on tCO_2e)	Scheme benefits (cumulative impact on tCO_2e)	Scheme benefits (cumulative impact on tCO_2e)	Overall scheme impact on total greenhouse gas emissions (total impact on tCO_2e)
2025-26	2026-27	2027-28	2028-29	2029-30	2029-30
0	0	-12,541.041	-37,623.123	-62,705.206	-62,675.206

Long-term emission reduction benefits

6.8.29 Table 55 mirrors the PR24 data table submission, table CWW22 for net zero enhancements but provides the AMP9 tCO_2e benefits delivered from this enhancement case to show the longer term emissions benefits from delivering this enhancement case. Emissions impacts (tCO_2e) are presented as cumulative operational tCO_2e from AMP8 to AMP9. The benefits are stated as negative values as per Ofwat's PR24 data table guidance. The final column 'overall scheme impact' includes both operational and embodied emissions as per Ofwat's data table guidance. For 2034-2035 we have assumed no embodied emissions as the long-term emissions benefits from this enhancement case relate to the expenditure and delivery of AMP8 enhancement project only.

6.8.30 The figures presented in the table below relate to emissions based on the IPCC methodology. The current sector reporting methodology used for the PC is widely acknowledged to under report process emissions (CAW v17 methodology). Using the Intergovernmental Panel for Climate Change (IPCC) methodology provides a value that is believed to be closer to actual emissions, and also aligns with the CCC and therefore allows a comparison of our costs with the CCC benchmarks.

6.8.31 The emissions reduction presented below does not benefit our reportable emissions using CAW. This could be mitigated if the methodology within the CAW is improved for reporting process emissions.

Table 55: AMP9 emissions benefits from process emissions (Wastewater)

Scheme benefits (cumulative impact on tCO_2e)	Scheme benefits (cumulative impact on tCO_2e)	Scheme benefits (cumulative impact on tCO_2e)	Scheme benefits (cumulative impact on tCO_2e)	Scheme benefits (cumulative impact on tCO_2e)	Overall scheme impact on total greenhouse gas emissions (total impact on tCO_2e)
2030-31	2031-32	2032-33	2033-34	2034-35	2034-35
-87,787.288	-112,869.370	-137,951.452	-163,033.535	-188,115.617	-188,115.617

Wider benefits

6.8.32 Alongside reducing nitrous oxide emissions we will be able to create process management outcomes that optimise both permit compliance and nitrous oxide reduction. Working collaboratively and sharing learning with others will support driving a future step change in reducing sector wide emissions of nitrous oxide.

Wider benefits

6.8.33 The costs to deliver the project in AMP8 are provided within Table 56. The costs assume monitoring equipment is installed in year one, and ongoing costs are in line with asset replacement schedules. Note: costs are subject to change as calculations are refined.

Table 56: AMP8 costs for process emissions (Wastewater)

Net zero	2025-26	2026-27	2027-28	2028-29	2029-30	Total
GHG reduction (net zero); enhancement capex	£25.477m	£0.131m	£0.158m	£0.131m	£0.183m	£26.081m
GHG reduction (net zero); enhancement opex	£1.525m	£1.525m	£1.525m	£1.525m	£1.525m	£7.626m
GHG reduction (net zero); enhancement totex	£27.002m	£1.656m	£1.683m	£1.656m	£1.708m	£33.706m

Long-term costs

6.8.34 In developing and optimising this enhancement case we have assessed long-term considerations, including ongoing maintenance and financial needs. We have designed this enhancement case to stand alone in AMP8 and not constrain future needs or opportunities. Cost implications beyond AMP8 will be further considered at each future price review using latest available information. To maintain a science-based trajectory to net zero, we do not think it is likely that we would revert back to a higher emissions option. Our forecast at this point is that differential costs will reduce over time and therefore future base allowances are expected to be sufficient to maintain the improvements.

6.9 E00001426 Phase 2 - Further low regrets emissions reductions in AMP8

6.9.1 **Headline:** Managing risk to customers in this fast evolving space by developing further innovations for delivery in the latter half of AMP8, targeting 54,750 tCO_2e of reductions in AMP8 and 273,752 tCO_2e over the longer-term.

Purpose

6.9.2 As part of our net zero enhancement programme we propose an agile approach in a second phase that helps manage the uncertainty and opportunity of the rapid evolution in the cost-benefit and technical feasibility of GHG emissions reduction options. This approach will allow us to protect customers interests by delivering the required further reductions in GHG emissions to maintain a science-based pathway while also keeping a strong focus on financial value to ensure a low regrets approach. We propose this enhancement case is part of the net zero challenge, reflecting the innovative and adaptive nature.

6.9.3 We have identified a series of cutting edge innovations that are expected to offer good value, technically feasible interventions for deployment in late AMP8, but which require further investigation and development to ensure an optimal and low regrets package of actions. Our ongoing work combined with monitoring and partnering for evolution in the marketplace will narrow the potential options to confirm the optimal actions for delivery in late AMP8. We propose an enhancement case of £81.6 million to deliver circa 54 750 tCO_2e reduction, to be confirmed with Ofwat upon final technical review of selected interventions through the challenge process. These values have been calculated based on averages from other projects within our programme and therefore shouldn't be used to amend the PCL of the common PCs for operational GHG emissions.

Table 57: Summary of key information for phase 2

Key information	
Total AMP8 operational emissions benefit (tCO_2e)	-54,750*
Total operational emissions benefit 2030 -2055 (tCO_2e)	-273,752**
Total AMP8 embodied emissions (tCO_2e)	1,203
Total AMP8 Totex (£m)	81.63
Wider benefits	Improving public health Improving water quality Natural environment protection Increased resilience
Net Zero Enhancement or Challenge	Net Zero Challenge
Impact on common performance commitment PCL (GHG emissions)	No

6.9.4 The projects detailed in Table 58 are currently under technical review and have been proposed (but not yet selected) for inclusion in our phase 2 project due to alignment with our longer term emissions reduction strategy and net zero by 2050 ambitions.

Table 58: Potential phase 2 net zero projects

Net zero enhancement cases (Phase 2)	Location reference
Transport fossil fuel reductions - green Fleet – Electric HGVs	Section 6.5
Chemical reduction	Section 6.6
Process emissions (Phase 2)	Section 6.7
Net zero catchment strategy (Phase 2)	Section 6.8

Price control

6.9.5 As this enhancement case is applicable to both water and wastewater the cost and total emissions have been calculated and apportioned between both data tables CW21 and CWW22 in line with the price control allocation spilt in Table 59.

Table 59: Price control allocation for Phase 2

Project reference	Enhancement case name	Water Resources	Water Network+	Wastewater Network+	Bioresources
E00001426	Phase 2 – AMP8 Innovation	1%	27%	32%	41%

Ofwat assessment gates

6.9.6 In addition to the overarching assessment shown in section 4 above, the specific assessment below applies to this enhancement.

Gate	Summary
Need for enhancement investment	Evidence: This enhancement case aims to deliver an estimated 54,750 tCO_2e of reductions in AMP8 through a second phase of work to develop and deliver innovations in the latter half of AMP8, enabling an estimated benefit of 274,000 tCO_2e over the longer term. Due to uncertainty and rapid evolution in the market, the potential interventions in our proposed phase 2 require further investigation to confirm the optimal approach. Base: This enhancement does not overlap with any activities delivered through base as all proposed activities and costs relate to new projects that will be delivered with GHG emissions reduction as the primary driver to aid sector learning on the journey to net zero as innovation and technology advance over AMP8. Previous enhancement: This enhancement case does not overlap or duplicate with any activities already funded at previous price reviews. Timing of expenditure: This enhancement is needed at this time as part of our optimal pathway to retain a science-based trajectory to the national legal requirement for net zero 2050 and five year carbon budgets. Long-term delivery strategy: Our core pathway includes low regrets action in AMP8 across all aspects of our GHG emissions towards a science-based trajectory that supports national legal requirements for net zero and five year carbon budgets. Our approach also works to secure wider benefits including service resilience, cost efficiency, recreation (public health) and nature, along with enabling activity to unlock further benefits and acceleration beyond 2030. The alternative option to this pathway and enhancement case would be to continue as normal, which would not support a science-based trajectory.

Gate	Summary
Best option for customers	Having extensively assessed further options to reduce our GHG emissions, the potential projects in phase 2 include our lowest cost options for short term reductions, per tonne of CO_2e. This project is likely to reduce particulates to help improve local air quality and protect customer's health.
Cost efficiency	Assurance: Third party assurance has been undertaken on this enhancement case for the carbon values presented. For cost, our enhancement programme has been considered efficient after review from third party assurance. Modelled efficiency: There are currently no agreed industry benchmarks for the cost associated with this enhancement case as this is the first AMP Ofwat have made enhancement funding available with GHG emissions reduction as the primary driver. During delivery, we will use market competition to ensure the best rates.
Customer protection	This project will be entered into the net zero challenge and we do not propose a PCD, or a PCL reduction, at this time. By definition, these are more challenging and uncertain projects that involve innovation and can only proceed if successful in the national challenge competition. Protections will be provided by Ofwat's approach to the challenge. We propose customer protections similar to those in the innovation fund, where project milestones are agreed at the project outset which are then reported against. The potential phase 2 interventions are not yet ready to be cost effectively delivered with certainty, and therefore an agile and adaptive approach is proposed to protect customers. We propose further review with Ofwat as part of the challenge process. We will publish progress in our Annual Performance Report to aid transparency.

Forecast emissions reduction benefits

6.9.7 For phase 2 we anticipate a forecast cumulative emissions reduction in our operational emissions of circa 54,750 tCO_2e by 2030, and detailed in Table 60. This has been estimated as an average of the other projects in our net zero enhancement programme and is subject to change dependant on the final project list.

6.9.8 Table 60 has been taken from our PR24 data table submission and provides the forecast AMP8 tCO_2e benefits delivered from this enhancement case. Mirroring PR24 data tables CW21 and CWW22 for net zero enhancements, the emissions are presented as cumulative operational reductions in tCO_2e. The benefits are stated as negative values as per Ofwat's PR24 data table guidance.

6.9.9 The overall scheme impact includes both operational and embodied emissions as per Ofwat's data table guidance. The embodied emissions have been added as an emissions increase onto the operational emissions reductions. For additional details, see the CW21 and CWW22 data table supporting commentary documents.

Table 60: AMP8 emissions reduction benefits for Phase 2

Scheme benefits (cumulative impact on tCO_2e)	Scheme benefits (cumulative impact on tCO_2e)	Scheme benefits (cumulative impact on tCO_2e)	Scheme benefits (cumulative impact on tCO_2e)	Scheme benefits (cumulative impact on tCO_2e)	Overall scheme impact on total greenhouse gas emissions (total impact on tCO_2e)
2025-26	2026-27	2027-28	2028-29	2029-30	2029-30
0	0	-18,250.113	-36,500.225	-54,750.338	-53,547.073

Green fleet – electric HGVs

6.9.10 **Headline:** Potential to swap remaining HGV fleet to electric or other low-emissions alternatives

6.9.11 A potential project in phase 2 of the net zero enhancement programme is to swap more of our fossil fuel HGVs to go beyond those included in phase 1. This potential project has been costed to convert the remaining HGVs to electric vehicles building on our trial with Innovate UK this AMP, however other low carbon options continue to be investigated.

6.9.12 We have completed a number of successful trials involving HGV trucks running on Compressed Natural Gas (CNG) and HVO (Hydrotreated Vegetable Oil). As the CNG is produced from natural sources rather than fossil fuel, it can reduce carbon emissions by up to 90 per cent and is cleaner burning, resulting in less pollutants. Feedback on the vehicle performance, driveability and economy of the truck were positive, however, there were challenges identified with re-fuelling due to limited access of fuel stations across the North West. In addition there are long-term maintenance considerations that need to be understood before any future introduction within the fleet.

6.9.13 The aim of this intervention would be to replace our remaining 86 Bioresources diesel HGVs to electric to complete our need for a 100 per cent green fleet that no longer relies on fossil fuels. We currently estimate this would cost approximately £59 million and would deliver a GHG emissions reduction of approximately 12,000 tCO_2e. We have not included this option in phase 1 activity because it currently shows a higher cost per unit of operational GHG emissions (£ / tCO_2e) when compared to our other net zero enhancement cases. However, the market for cost and technical innovation is evolving rapidly, and greening our fleet is imperative to our long-term strategy.

6.9.14 We are actively working with the market in this area and monitoring latest costs and technologies. This is likely to be a strong option for deployment in phase 2 in late AMP8.

Chemical use reduction

6.9.15 We are exploring options to reduce our chemical use, or switch to more sustainable alternatives. This is a sizable area of operational emissions which, without innovation, will grow as we comply with tighter environmental standards. Interventions could also offer wider benefits for cost and resource efficiency, pollution, and operational supply chain resilience. One example is shown below, but we also explore others that we hope will mature sufficiently for further action in late AMP8.

Enhanced biological phosphorus removal (EBPR)

6.9.16 Controlling phosphorous discharged from the wastewater treatment process is a key factor in preventing eutrophication of surface waters. The presence of excessive phosphorus can cause many water quality problems including decreased recreation and conservation value, loss of local wildlife and the possible impact of algal toxins on potable water treatment. Phosphate removal in wastewater treatment is typically achieved through chemical dosing, where phosphorus is removed using salts of aluminium, iron or calcium which are added to the effluent at different stages of the process. Phosphate forms precipitates with the metal ions and is removed at a later stage in the treatment process with the sludge.

6.9.17 As permit requirements get tighter and total phosphorus limits reduce, additional chemical dosing is required i.e. tertiary dosing towards the end of the treatment process. In AMP8, new environmental legislation requires many wastewater treatments works across our region to meet a new lower 0.25mg/l phosphorus permit.

6.9.18 An alternative approach and opportunity to remove phosphorus is through enhanced biological phosphorus removal (EBPR). This process is applied to activated sludge plants (ASPs) and utilises anaerobic and aerobic tanks to enrich heterotrophic bacteria to accumulate large quantities of polyphosphate within their cells and enhance the phosphorus removal process (biologically). EBPR typically needs to be retrofitted onto existing ASP tanks where an anaerobic zone is added to the process, in addition to other ancillary assets to facilitate the process.

6.9.19 Whilst EBPR cannot completely remove the need for chemical dosing for tight phosphorus permits, it can drastically reduce the dosing requirements and thus have a beneficial impact on operational emissions.

6.9.20 We have already included the installation of EBPR at multiple wastewater treatment works as part of schemes in our new WINEP. We are exploring the potential to go further through retrofit of EBPR at additional sites, which presents another options for phase 2 in late AMP8.

Process emissions - Phase 2

6.9.21 **Headline:** Potential for further emissions reductions building on the advances achieved in the two process emissions projects in phase 1 of the net zero enhancement programme.

6.9.22 This project would focus on a second phase of the process emission projects in wastewater and/or bioresources, taking learning from the first phase to develop our understanding further.

Net zero catchment strategy – Phase 2

6.9.23 It is likely that a wide range of potential interventions and ambitions will come to light during the collaborative creation of the sustainable development masterplan for the St Cuthbert's Garden Village in phase 1. Phase 2 would seek to move from exploration to delivery, with interventions that might include, for example:

- Reducing potable water demand through new technologies;
- Blue green infrastructure to manage surface water and/or waste water;
- Reusing low grade heat from the sewer network;
- Partnering with housing developers for water and drainage efficiencies;
- Decarbonisation of the new wastewater treatment works through innovations; and

6.9.24 Increased and targeted community engagement on 'use less' and 'what not to flush' campaigns.

6.9.25 The project would also look to explore opportunities to implement innovative technologies to reduce GHG emissions at the new wastewater treatment works proposed for St Cuthbert's Garden Village included within our supply and demand standard enhancement case (UUW65_ww).

6.9.26 Through this project we would aim to embed net zero principles and low carbon technologies throughout St Cuthbert's Garden Village and at the heart of the community.

6.9.27 We believe this project could provide a blueprint for the development of new low carbon wastewater treatment works that can be applied to similar developments across the UK. We would look to share the outputs and lessons learnt from this project with the wider industry to support the water sectors vision of achieving net zero by 2050.

7. Customer protection

7.1 Introduction

7.1.1 It is important that customers have confidence that we will deliver the enhancement schemes that get reflected in our PR24 final determinations and they are suitably protected in the event of non-delivery, or if there are material changes to deliverables (including changes to dates), which leads to a change in cost (including changes in the timing of required expenditure). Ofwat proposes that, if companies fail to deliver or are late delivering improvements to customers, then price control deliverables (PCDs) should, where appropriate, be used to compensate customers. In section 8.8.9 of Chapter 8, we have proposed an approach to PCDs that aims to provide customer protection, such that customers are fairly compensated for non-delivery (such as due to a change in regulatory requirements) or late delivery (including as a result of a change to a regulatory date), between PCDs, any related ODI underperformance payments, and cost sharing arrangements.

7.2 Price Control Deliverable

Table 61: PCD summary

Scheme delivery expectations	
Description of deliverable	Delivery of operational GHG emissions reduction. The proposed PCD will be aligned to the eight projects submitted as net zero enhancement projects, outside the net zero challenge. This includes stationary fossil fuel reductions, transport fossil fuel reductions - green fleet LCVs phase 1, transport fossil fuel reductions - Green fleet LCVs phase 2, transport fossil fuel reductions - green fleet Biomethane HGVs, property emissions reductions, peatland restoration, woodland and net zero catchment strategy. The total AMP8 Totex value for these projects included within this PCD is £67.6 million. Note: year 5 presents a minus cost value due to the decreasing capex profile (majority of the capex is profiled at the start of AMP8 so the emissions reduction benefits can be realised) and the opex benefits received from projects such as green fleet.
Output measurement and reporting	Tonnes of carbon dioxide equivalent (tCO_2e). This consistent unit enables comparison between projects within the PCD, even though their methodologies and delivery mechanisms are different. GHG emissions reductions will be reported and monitored through our annual APR reporting. The PCD will be measured once at the end of AMP8 and will not continue into AMP9 We will undertake projects that deliver the total tCO_2e referenced in this PCD (85,806 tCO_2e) based on the expected GHG emissions benefit we will deliver. As each project is completed we will confirm the expected benefit. In the event of any variance in scope the updated tCO_2e value will be calculated.

Scheme delivery expectations	
Assurance	Measurement of the PCD will be independently verified by an expert third party. Assurance will provide confidence that the output has been delivered and these meet the forecast benefits of the work or equivalent where there is variance in scope. Note: Following current best practice in a fast evolving area, the tCO_2e from peatland restoration and woodland creation will be provided as "Pending Issuance Units" at the end of AMP8 with Carbon Units available (for use against reportable emissions) from 2032 for Woodland and 2035 for Peatland. Following restoration, the peatland and woodland projects will be evaluated against the Peatland/Woodland Carbon Code by an approved validation body (e.g. Natural England). A second layer of customer protection is provided for the six projects which align to the delivery of the two common operational GHG emissions PCs for water and wastewater (stationary fossil fuel reductions, transport fossil fuel reductions - green fleet LCVs phase 1, transport fossil fuel reductions - green fleet LCVs phase 2, transport fossil fuel reductions - green fleet Biomethane HGVs, property emissions reductions and net zero catchment strategy), therefore adding a financial and reputational penalty for under performance. The company takes the risk on cost increases beyond the funds identified in this programme to deliver the forecast benefit.
Conditions on scheme	None
Impact on PCs	82.65% of the total emissions under this PCD (85,806 tCO_2e) will impact the common PC for operational GHG emissions in AMP8. The remaining 16.35% of emissions from peatland restoration and woodland creation are excluded as reportable carbon units are not available until AMP9 (therefore no impact on the common PC for operational GHG emissions). ODI impact = 82.65% of full GHG ODI rate (£130) = £107.44.

7.2.1 In our PCD template *UUW32 - PCD Excel Sheet* we have assumed a wholesale WACC of 3.23 per cent, in line with Ofwat's guidance. We have assumed a 50 per cent totex cost sharing rate, which is applied before calculating PCDs. We have applied a further 50 per cent for Bioresources (where applicable), to ensure that only 25 per cent of Bioresources totex is at risk from PCDs, given the lack of RCV guarantee, and general uncertainty in cost recovery from future Bioresources price controls. For late delivery we have applied a proportionate value of annual opex, and assumed 3.5 per cent of capex, which provides a fair reflection of the time value of money of any related deferred capital spend.

Table 62: PCD delivery profile

	Unit	AMP8	2024	2025	2026	2027	2028	2029	2030	Ultimate delivery
Cumulative delivery target for PCD	**tCO_2e**		**-**	**-**	**9,135.26**	**20,156.21**	**34,540.82**	**52,471.63**	**85,805.64**	**85,806**
AMP8 Capex (22/23 pb)	£	73,489,375	-	-	19,287,273	13,778,825	20,660,899	17,656,807	2,105,571	
AMP8 Opex (22/23 pb)	£	-6,076,028	-	-	2,257,790	306,344	- 2,019,922	- 2,834,961	- 3,785,279	
ODI impact per unit of PCD volume	£/tCO_2e	107.44								

Table 63: Price Control Allocation

Price Control	Unit	Price Control Allocation
Water resources	%	0.90%
Water network+	%	37.04%
Wastewater Network+	%	24.67%
Bioresources	%	37.39%

Table 64: PCD Incentive rates

	Unit	WR	WN+	WwN+	BR
Overall delivery	£/tCO_2e	4	160	107	81
Time value rate	£/tCO_2e	0	6	4	3
Late delivery	£/tCO_2e	0	9	6	4

8. Conclusion

8.1.1 In conclusion, we've developed an innovative and ambitious enhancement programme specifically targeting GHG emissions reductions. Undertaking this programme in AMP8 is vital to our low regrets, adaptive long-term emissions reduction plan and overall ambition to reach the national legal requirement for net zero 2050 and maintain a science-based trajectory that supports the national legal five year carbon budgets.

Appendix A Key terms and references

Key term	Definition	Reference
Greenhouse gases (GHG)	Gases that absorb and emit radiation and when in the atmosphere raise the surface temperature of the planet. Greenhouse gas emissions are usually defined as the six gases listed in the Kyoto Protocol: carbon dioxide (CO2); methane (CH4); nitrous oxide (N2O); hydrofluorocarbons (HFCs); perfluorocarbons (PFCs); and sulphur hexafluoride (SF6).	Intergovernmental Panel on Climate Change (IPCC) The Greenhouse Gas (GHG) Protocol (2015): A Corporate Accounting and Reporting Standard
The Greenhouse Gas Protocol: A Corporate Accounting and Reporting Standard	Provides standards and guidance for the preparation and reporting of a GHG emissions inventory.	WRI/WBCSD: The Greenhouse Gas (GHG) Protocol (2015): A Corporate Accounting and Reporting Standard
Scope 1 emissions	Direct GHG emissions from sources that are owned or controlled by a company.	The Greenhouse Gas (GHG) Protocol (2015): A Corporate Accounting and Reporting Standard
Scope 2 emissions	GHG emissions from the generation of purchased electricity.	The Greenhouse Gas (GHG) Protocol (2015): A Corporate Accounting and Reporting Standard
Scope 3 emissions	Indirect emissions (not included in scope 2) that occur in the value chain of the reporting company, including both upstream and downstream emissions.	The Greenhouse Gas (GHG) Protocol (2015): A Corporate Accounting and Reporting Standard
Scope 3 emissions categories	15 defined categories, shown in the diagram in the Key Terms section near the start of this document.	Corporate Value Chain Accounting Reporting Standard
Direct emissions	Emissions that occur from sources that are owned or controlled by a company.	The Greenhouse Gas (GHG) Protocol (2015): A Corporate Accounting and Reporting Standard
Indirect emissions	Emissions that are not owned or controlled by a company, including emissions associated with the generation of purchased electricity (scope 2) and other indirect emissions (scope 3).	The Greenhouse Gas (GHG) Protocol (2015): A Corporate Accounting and Reporting Standard

Key term	Definition	Reference
Operational emissions (UK Water Sector)	Direct and indirect emissions of greenhouse gases from operational activities. The regulated operational emissions boundary in the water sector includes scope 1 emissions, scope 2 emissions, scope 3 emissions from the following activities: Business travel on public transport and private vehicles used for company business, Outsourced activities (where emissions would be scope 1 and 2 if not outsourced), and Purchased electricity: extraction, production, transmission and distribution, Purchased heat: extraction, production, transmission and distribution, Purchased fuels: extraction, production, transmission and distribution, Chemicals, Disposal of waste.	Ofwat PR24 operational greenhouse gas emissions performance commitment definitions for water and wastewater
Capital carbon	GHG emissions associated with the creation, refurbishment and end of life treatment of an asset. NB: For simplicity we map this as the same as Scope 3 Category 2 (Capital goods) emissions.	UKWIR (2022) Calculating Whole Life/Totex Carbon PAS 2080:2016 Carbon Management in Infrastructure
Embodied or embedded emissions	Embodied or embedded emissions are those that result from all activities involved in creating or maintaining a built asset, including extraction and transport of materials and capital emissions.	UKWIR (2022) Calculating Whole Life/Totex Carbon
Location-based method	A method to quantify scope 2 GHG emissions based on average energy generation emission factors for defined locations, including local, subnational, or national boundaries.	Greenhouse Gas (GHG) Protocol: Scope 2 Guidance
Market-based method	A method to quantify scope 2 GHG emissions based on GHG emissions emitted by the generators from which the reporter contractually purchases electricity bundled with instruments, or unbundled instruments on their own.	The Greenhouse Gas (GHG) Protocol: Scope 2 Guidance
Emissions factors	Emissions factors are values that represent the GHG emissions from a unit of activity data.	The Greenhouse Gas (GHG) Protocol (2015): A Corporate Accounting and Reporting Standard
Global Warming Potential	A factor describing the radiative forcing impact (degree of harm to the atmosphere) of one unit of a given GHG relative to one unit of carbon dioxide.	The Greenhouse Gas (GHG) Protocol (2015): A Corporate Accounting and Reporting Standard

Key term	Definition	Reference
Climate Change Act 2008	UK legislation which includes a requirement for the UK Government to set legally-binding carbon budgets for the country to achieve net zero by 2050.	Climate Change Act 2008
UK carbon budgets	It is a requirement of the Climate Change Act that the UK Government sets carbon budgets to net zero 2050. These budgets put a cap on the amount of greenhouse gases emitted in the UK over a five-year period. 4th budget covers 2023 to 2027 (max of 1,950 $mtCO_2e$) 5th budget covers 2028 to 2033 (max 1,725 $mtCO_2e$) 6th budget covers the period 2033-2037.	Climate Change Act 2008
Climate Change Committee (CCC)	Independent, statutory body established under the Climate Act 2008.	Climate Change Act 2008
Science-Based Targets (SBTs)	Targets that are in line with what the latest climate science says is necessary to meet the goals of the Paris Agreement – to limit global warming to well-below 2°C above preindustrial levels and pursue efforts to limit warming to 1.5°C.	SBTi Corporate Net-Zero standard Version 1.0 (2021)
Science-Based Targets initiative (SBTi)	SBTi is a partnership between CDP, the United Nations Global Compact, World Resources Institute (WRI) and the World Wide Fund for Nature (WWF) that define and promote best practice in emissions reductions and net-zero targets in line with climate science.	Sciencebasedtargets.org
PAS 2080:2023	Publically available standard for managing carbon in buildings and infrastructure.	PAS 2080:2023 Carbon Management in Buildings Infrastructure

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Water for the North West

UUW67

Power Resilience

October 2023

Enhancement Case 26

United Utilities

Water for the North West

Contents

1. Enhancement submission

<table>
<tr><th colspan="2">Enhancement submission</th></tr>
<tr><td>Title:</td><td>Power resilience</td></tr>
<tr><td>Price Control:</td><td>Water Network Plus and Wastewater Plus</td></tr>
<tr><td>Enhancement headline:</td><td>In providing water and wastewater services, we have an interdependency of power supply and the effects of its failure. Power resilience is gaining increasing focus with regulators across the industry and government.

This enhancement case is to address the specific risk of widespread regional or national power outage or the implementation of rota cuts to maintain UK grid stability during periods of supply shortfall. These interruptions are likely to last for many hours if not days based on reasonable worst case planning assumptions included within the National Risk Register.

This enhancement expenditure targets investment the most important sites that are not already benefiting from alternative power sources.

Our base expenditure already provides some resilience to local (site specific) power issues. This includes the development of monitoring and contingency plans, maintenance of emergency generation plant and alternative supply vehicles, procurement of additional emergency response provided by the market, and base maintenance at some of our sites that suffer from short term 'brown out' power interruptions.

We now require enhancement expenditure to provide United Utilities with a new level of improved resilience at our most important sites to protect services, customers and the environment.</td></tr>
<tr><td>Enhancement expenditure

(FY23 prices)</td><td>
<table>
<tr><th></th><th>AMP8 Capex inc TI (£m)</th><th>AMP8 Opex (£m)</th><th>AMP8 Totex (£m)</th></tr>
<tr><td>Pre RPE and Frontier Shift</td><td>18.505</td><td>2.129</td><td>20.633</td></tr>
<tr><td>Post RPE and Frontier Shift</td><td>18.083</td><td>2.067</td><td>20.150</td></tr>
</table>

The table above shows the total expenditure, inclusive of accelerated programme and transitional investment, on both a pre-efficiency (i.e. pre frontier shift and real price effects basis, consistent with the cost data tables), and a post efficiency and RPE basis (i.e. consistent with the value we propose to be recovered from price controls). All numbers referenced hereafter in this enhancement case are on a post efficiency and RPE basis.</td></tr>
<tr><td>This case aligns to :</td><td>• Ofwat Final Methodology guidance on securing resilience to ‘specific hazard’ that are outside of management control

• Evidence of the increasing risk of the exogenous factors, and how it is likely to change in the future. Including transitional risks to a low carbon generation network and threats identified in the UK Nation Risk Register.</td></tr>
</table>

	• Quality regulators (The Drinking Water Inspectorate (DWI)) identifying that power resilience is an emerging concern that they expect companies to address as part of their long-term water quality plans, specifically as a result of climate change. • The Department for Energy, Security and Net Zero (DESNZ)), supported by Defra and WaterUK, have in the last couple of years increased their attention on how the UK needs to develop contingency plans to deal with possible nationwide power losses – including national exercises to understand the risk and consequences of such an event. • Cabinet Office investigations to further develop understanding of dependencies across the UK's infrastructure, including water and power. Recent events that have threatened regional and national power resilience and changed the current level of risk and are likely to further increase the level of future risk. For example Storm Arwen in 2021, Summer 2022 heat wave and winter 2022 threat of national power shortages as a result of a volatile gas availability and droughts in Europe / Norway affecting imports. For full reconciliation between enhancement costs and data table lines, see enhancement mapping tabs in *UUW117 – Project allocations CW3 and CWW3.*
PCD	Expenditure for this enhancement case is below the 1% price control de-minimus when grouped with other Resilience expenditure.

2. Enhancement case summary

Gate	Summary	Location reference
Need for enhancement investment	• All of our operational sites that require power have their own contingency plans in place. This includes standby power generation at some sites supported by range of deployable mobile generators in our emergency plant stores, as well as commercial arrangements for the supply of emergency generators to sites within 4 hours of a power interruption incident being reported. This is provided by base expenditure. However, recognising that the 4 hour lead time of generator to deployment could be detrimental to our services we are seeking to further reduce the risks posed at the most important sites.	*4.1*
	• During AMP7 we have seen energy resilience receive greater attention across both the water and wider industry from regulators and the government. Increased energy prices, particular gas, driven in part by the Russo-Ukraine War has created an unstable energy market and the threat of fuel shortages has threatened the potential need for planned power rota disconnections across the UK in the winter of 2022 as a result of gas availability for existing thermal generation. This has resulted in energy resilience being driven high up on the agenda, as evidenced by accelerated interest from Government into the power vulnerability of the UK's infrastructure.	*4.2*
	• Climate change has changed the current level of risk is likely to result in further changes in risk. Widespread droughts across Western Europe in the summer of 2022 led to reduced availability of imports from France and Norway, which reduced the UKs energy supply demand head room, leading to forecasts of potential rota cuts in late 2022. The Electricity System Operator (ESO) was required to import electric from Belgium at one point during the 2022 heatwave at the highest unit rate ever to maintain network stability in the London region. Recent Storms such as Arwen in 2021 and Eunice in 2022 both exceeded the UKs planning assumptions last refreshed in 2013.	*4.6*
	• Transitional risk of moving to low carbon generation will result in a greater role for intermittent power generation (solar / wind) in the UK grid mix, this may expose the grid more frequent and more volatile generation capability day to day. At the same time as the UKs aging nuclear power plants are being decommissioned faster than new ones are being constructed. Nuclear is a key part of the UK national energy security strategy to be able to provide base load during periods of low renewable energy generation.	
	• There are dependant service provider performance considerations. we know there is limited planned investment to improve distribution resilience from the perspective of the Distribution Network Operators (DNO), as observed in the final determinations of RIIO2[8].	
	• The National Security Risk Assessment Methodology Review (NSRA) and National Risk Register (NRR) assessments have identified that the risk of 'failure of the national electricity transmission system' remains static in terms of likelihood, but the impact has significantly increased. Likelihood is currently classified (as of 2022) as 3 on a scale of 1 (low) to 5 (high) likelihood, and impact as 5 of a scale of 1 (limited) to 5 (catastrophic). Additionally the Risk	

	Register has added an attack on global energy supplies to its list of major threats to national security for the first time.	
Best option for customers	• Our approach to delivering best value is robust and consistent across all of our enhancement cases. Our approach uses a rich mix of metrics to help us drive value and efficiency in developing our business plan. Consistency of the approach is driven through our PR24 Value Tool which allows us to quantify and value environmental and social benefits, costs and risks. For more detail on this approach please see 'Our approach to deliver best value totex'. • Options development and selection: installation of onsite power generation and fuel (low carbon) for a minimum of 72 hours of continuous running, to bridge the gap to DNO resilience performance aspirations. Note that while the submission is based on the installation of traditional fixed generation plant, we will seek to value engineer the final built solutions based on the latest best available technology. Specifically the emerging large battery solutions, or a hybrid option of stored power and generation capability. • Applying company risk appetite considerations and intelligence from DNOs that supply our most important assets. • Resilience assessment- the preferred option selected delivers against all aspects of the 4Rs; redundancy, reliability, resistance, and response and recovery.	*5.1* *5.2* *5.4* *5.3* *5.5* *6.4*
Cost efficiency	• The enhancement case for a power generator to be installed at each identified site and is valued at a totex cost of £20,149,595. • The costing for this enhancement case has been developed via a bottom up build and tested against market providers of generators which is continuously reviewed for cost efficiency. We continually refresh our existing contract approaches to ensure we continue to deliver best value for customers. • Third-party assurance statement	*7.1* *7.2* *7.3*
Customer protection	• We have worked in partnership with the DNOs in our region, Electricity North West Limited (ENWL) and Scottish Power Energy Networks (SPEN), with the aim to ensure that customer are not paying twice for power resilience, to both the DNO and to the water company. • For our most important sites, that currently do not have any backup power resilience, we have been able to develop an understanding of their resilience practises and standards to start to further inform this enhancement case – for example planned investment, network configuration and standard / aspirational levels of service restoration. • Clearly this is based on the UK grid having power to distribute. In the event of a regional or national power outage the DNOs will not be in a position to provide their existing resilient supplies. Nor will there be preferential restoration.	*Section 8*

3. Introduction

3.1.1 This document sets out an enhancement case of £20,149,595 to specifically address the threat of a regional or national power interruption to some of our most important sites. To enable United Utilities to provide continuity of service and reduce the risks associated from of a supply side power loss.

3.1.2 The collection, treatment, and distribution of water and wastewater is fundamentally energy intensive. The UK water industry uses just over two per cent[1] of the total electricity used in the UK per year to provide reliable wholesome water to customers and to recycle treated water safely back to the environment.

3.1.3 As United Utilities, like the rest of sector, de-carbonises our business operations and as the UK energy generation sector also decarbonises, there is greater importance placed on the use of renewable sources of generation to meet UK base load demand for energy. By their very nature these sources are less reliable than thermal generation plants and production capacity is impacted by the weather, with significant swings from day to day production capabilities.

3.1.4 United Utilities is developing and promoting the use of nature-based solutions to help treat water and wastewater to ever tighter standards in a low energy intense way, however this does not offset the overall demand for increasing amounts of energy from the UK grid.

3.1.5 Access to reliable and consistent sources of energy are essential to the effective operation of modern water and wastewater treatment assets, due in part to their energy intensity but also the proliferation of monitoring and system feedback loops in treatment processes to ensure compliance. The reliability of energy is an issue that the DWI acknowledge[2] as risk to long-term water quality and the risk to reliability of energy sources associated with a changing climate.

3.1.6 It is essential that we understand our own energy infrastructure vulnerabilities, but also any cascading interdependences on other third-party sites. We need to take appropriate steps to ensure that they are robust and have the appropriate level of resilience to power disruption.

3.1.7 Energy resilience is a key issue facing all of the UKs economic infrastructure providers including the water industry. The Department for Energy Security and Net Zero are clear in their expectation that sectors are responsible for ensuring their own contingency planning and business continuity arrangements, including for power resilience.

3.1.8 To achieve our long-term ambitions of minimising service disruptions to customers and protecting the environment, we need our most important sites to be supported by a reliable back-up source of power. This solution will deliver resilience now and in the future, accounting for climate change in both a benign and extreme future. With wetter winters and more extreme weather predicted, the likelihood of power disruptions and their impacts is heightened, with the increasing frequency and severity of storms and flood risk. Our most important sites would have an extra layer of protection through the provision of a back-up power supply.

3.1.9 Energy resilience has also become a priority for other regulators and the UK government:

(a) The Drinking Water Inspectorate (DWI) have signalled that power resilience is a major driver for PR24. They have also recognised the link between carbon and resilience and have indicated that resilience should be prioritised.

(b) The Department for Energy, Security and Net Zero (DESNZ), supported by Defra and WaterUK, are developing contingency plans to deal with possible nationwide power losses. This is aimed at reviewing the impact that a national power outage could have on a providers' ability to maintain services. This culminated in a nationally coordinated simulation exercise in March 2023 to

[1] Water companies use just over two per cent of the total energy used in the UK each year, Great Britain's monthly electricity stats, 2023

[2] Access to reliable and consistent sources of energy are essential to effective delivery of water and wastewater services, DWI: Long Term Planning for the Quality of Drinking Water Supplies, 2020

understand the likely impact of national power outage on key service providers including the water sector.

(c) DESNZ are clear in their expectation that sectors are responsible for ensuring their own contingency planning and business continuity arrangements, including for power resilience.

(d) UK Cabinet Office have recently initiated a data gathering exercise across the UK's infrastructure providers, including a review of dependencies on power supplies.

3.1.10 Data from the last 4 years (2019-2022), demonstrates that 24 per cent of our wastewater pollution incidents (category 1 to 3) were a result of power failure. Whilst the proposed enhancement would not mitigate this risk completely, it provides a robust solution to reduce the risk and impact to customers and the environment in the event of a mains power loss at some of these locations, to bridge the gap between the loss in mains supply and the mains power being restored.

3.1.11 The end of 2022 saw the National Grid announce the consideration of planned emergency power cuts across the UK, known as rota disconnections. Although, it was deemed that it wasn't necessary to enforce these at the time, the UK remains on high alert that these are a possibility in future months and years.

4. Need for enhancement investment

4.1 Current provisions

4.1.1 All of our operational sites that require power have contingency plans in place. This includes standby power generation at some sites supported by a range of deployable mobile generators included in our emergency plant, as well as commercial arrangements for the supply of emergency generators to sites within 4 hours of a power interruption incident being reported. This is provided by base expenditure. However, recognising that the 4 hour lead time of generator to deployment could be detrimental to our resilience we are seeking to further reduce the risks posed at the most important sites in response to a changing risk position.

4.1.2 Following engagement with our Local Resilience Forum (LRF) partners we anticipate that in the event of a regional or national power incident or a planned rota disconnection, other parties, including the distribution network operators themselves and emergency services including major hospitals and the police would also likely be reliant upon the same third-party suppliers to provide emergency generation, leading to the potential for a 'first come first serve culture', and possible shortage of emergency energy back-up supply, suggesting that these should not be relied upon in the event of a catastrophic regional or national network failure.

4.1.3 To help to manage and reduce the risk that power interruptions pose, UUW is proposing enhancement expenditure to provide an improved level of resilience in response to the changing risk landscape. We have specifically targeted our investment to our most important sites, through the completion of an assessment of our asset base to reach a shortlist of sites that would benefit from having a permanent form of power resilience present. This investment in generator power will help to provide continuity of service at our important sites in the event of a significant supply-side power interruption, to bridge the gap to grid power being restored.

4.2 Change in National Risk

4.2.1 The National Security Risk Assessment Methodology Review (NSRA) and National Risk Register (NRR), which is the public-facing version of NSRA, are a classified assessments of the risks that could cause a national-scale emergency in the UK[3]. Assessments have identified that the risk of 'failure of the national electricity transmission system' remains static in terms of likelihood, but the impact has increased. Likelihood is currently classified (as of 2022) as 3 on a scale of 1 (low) to 5 (high) likelihood, and impact as 5 of a scale of 1 (limited) to 5 (catastrophic). This has increased from 4 (significant) in 2019. This shift is due to both the predicted length of impact and also central government having an improved understand of the depth of the impacts of power failure in recent years. Therefore, it is prudent that we take an in depth look at our power resilience and offset the current and future risk of supply interruptions.

4.2.2 The UK's National Risk Register has added an attack on global energy supplies to its list of major threats to national security. The addition was confirmed after the Cabinet Office released its latest National Risk Register, which outlines the most serious risks the government considers are threatening the UK.

4.2.3 The reasonable worst case planning assumption for a national power outage is that customers would be gradually reconnected with intermittent supply within a few hours. 60% of demand would be reconnected within 2 or 3 days, creating a stable "skeletal network".

4.3 Climate Change

4.3.1 Climate change has changed the current level of risk, and will continue to do so. Widespread droughts across Western Europe in the summer of 2022 led to reduced power generated by French nuclear power plants due to limited cooling water availability as reported by the French Court of Auditors highlighted the issues regarding the safety and operation of nuclear power plants because of the

increasingly unstable supply of the water necessary for cooling reactors. Drought and low water levels caused some plants to be turned off temporarily last summer. Additionally the drought effected the stored water in Norway used to generate hydropower which led hydropower in Norway to reach its lowest output in 20 years. Record droughts like this have been made 20 times more likely due to climate change, according to scientists[3]. This impacted by the UK power supply by placing a further increased demand on gas as an alternative power source and reduced the amount of imports / level of redundancy in the European supply system risking supply demand shortfalls, leading to forecasts of potential rota cuts in late 2022.

4.3.2 The Electricity System Operator (ESO) was required to import electricity from Belgium at one point during the 2022 heatwave at the highest unit rate ever (5000% above normal rates[4]) to maintain network stability in the London region.

4.3.3 Recent Storms such as in Arwen in 2021 and Eunice in 2022 both exceeded the UKs energy system planning assumptions that were last refreshed in 2013[5], indicating a change in risk profile.

4.3.4 In January 2023, the UK Government published the UK's Third Climate Change Risk Assessment (CCRA3), it reports that all energy-related infrastructure is at risk from the impact of climate change as high and low temperatures, snow and ice, high winds and lightning can all cause disruption to the energy network. It elaborates that there is a risk to energy infrastructure from flooding, including the flood of facilities, damage to power lines and disruption to power stations. Data shows 178 power stations and 575 substations are currently at significant risk from surface water flooding[6]. The impact of climate change further heightens this risk.

4.3.5 Our climate change research[7] demonstrated that 68% of household customers are concerned about the impact of power cuts on supply.

4.4 Energy vulnerability – performance of dependant service providers

4.4.1 United Utilities, like all water companies, are dependent upon the UKs Distribution Network Operators (DNOs) for a continuous reliable supply of power. The UK power distribution sector is regulated much like the water sector with reliability performance commitments. Similar to the water sector they have a measure of customer minutes lost.

4.4.2 In the last periodic review of prices for the energy distribution sector (RIIO-ED2) the sector showed little ambition[8] to provide more resilient services. This is true of Electricity North West Limited (ENWL) and Scottish Power Energy Networks (SPEN) the two Distribution Network Operators (DNOs) for the majority of our operational region, see anticipated performance table below for the next period.

Table 1: Ofgem performance commitments (customer minutes lost) for ENWL and SPEN

DNO Network	2023/24	2024/25	2025/26	2026/27	2027/28
ENWL	25.7	25.2	24.7	24.2	23.7
SPEN (SPMW)	26.5	25.4	24.9	24.4	23.9

Ofgem performance commitments (customer minutes lost) for ENWL and SPEN taken from RIIO-ED2 Final determination.

[3] https://www.fitchsolutions.com/country-risk/norways-green-transition-pose-risks-electricity-supply-and-long-term-growth-prospects

[4] https://www.bbc.co.uk/news/uk-england-london-62296443

[5] https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1081116/storm-arwen-review-final-report.pdf

[6] Power stations and substations at risk of flooding, CCRA3 Briefing Energy, June 2021

[7] DJS Research on behalf of United Utilities, Climate Change and Resilience, January 2021

[8] Ofgem RIIO-ED2 Final Determinations company specific final determinations, November 2022

4.4.3 Additionally, in the eyes of the DNOs each one of our treatment plants is only recorded as a single customer, based on the number of service connections and does not reflect the customer served by that asset which could be many thousands. This is a gap that asset operators are now reviewing, coordinated by the Cabinet Office.

4.5 Energy vulnerability – geopolitical risks

4.5.1 In 2022, the ongoing geo-political situation in Ukraine and Russia exacerbated issues creating a volatile energy market and resulted in soaring oil and gas prices all over the world. Due to limited availability of natural gas exports from Russia significant short falls in gas supplies across Europe were observed, reducing the availability of European imports of gas, as a result Ofgem forecast that 'Due to the war in Ukraine and gas shortages in Europe, there is a significant risk that gas shortages could occur during the winter 2022/23 in Great Britain ('GB'). As a result, there is a possibility that GB could enter into a Gas Supply Emergency[9]'. One of the first industries to be disconnected to shed demand in such an emergency are large gas-fired power stations, exposing the nation grid to shortfalls in supply.

4.6 Energy vulnerability – transitional risks

4.6.1 The British Energy Security Strategy reinforces government strategy to increasingly move to renewable sources. Including new nuclear plants which are intended to provide base load capabilities during times of lower wind and solar generation, although notably the UK is being slow to construct these new nuclear plants and we expect to see the existing nuclear facilities decommissioned due to age before any substantial replacements come online. This increase the future dependency on intermittent power generation sources and therefore the risk of intermittent power resilience.

4.6.2 Figure 1 below shows the projected increase in use of intermittent power generation sources in the UK grid mix for a range of future projections.

Figure 1: Projected percentage increase of intermittent energy supplies

Multipe scenarios from the enery and emissions projections: net-zero strategy baseline (Department for Energy Security and Net-Zero)[10]

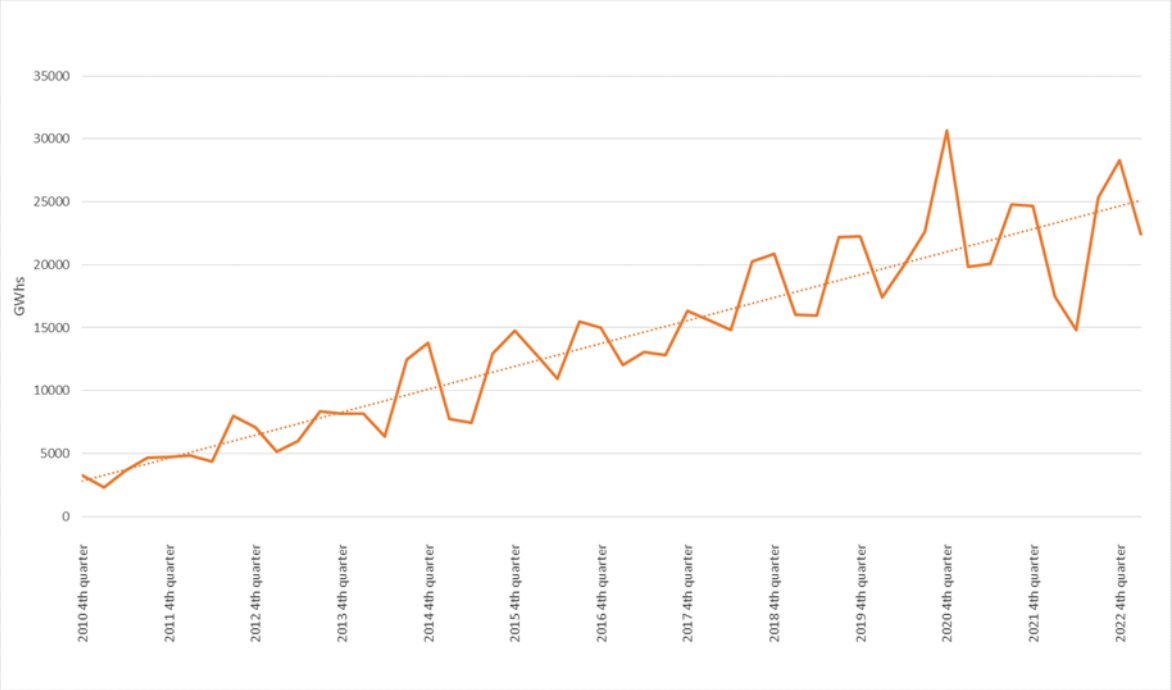
[9] https://www.ofgem.gov.uk/sites/default/files/2022-09/P448%20Urgency%20Decision%20Letter.pdf

[10]https://www.gov.uk/government/publications/energy-and-emissions-projections-net-zero-strategy-baseline-partial-interim-update-december-2021

4.6.3 The intermittent sources, shown in the above graph, are projected to increase to between 50% and 80% to 2050, from a current baseline of approximately 40%. By their nature they are intermittent, reliant upon wind and sunlight intensity to deliver against their installed capacity.

4.6.4 Figure 2 below, demonstrates the variability in electricity generation from intermittent renewables year on year. The upward trend is reflective of the increased installed generation capacity over the years, as new generation sources come online, but the key point is the observed variability in generated electricity, which means that it is difficult to predict the short falls in production needed to maintain a stable electricity network. This increases the risk to network stability and therefore interruption.

Figure 2: Recorded generation (GWh) by intermittent renewables 2010 to 2023 by quarter.



Data sourced from the Department for Energy Security and Net Zero (DESNZ), demonstarting the variablity (quarter to quarter) of energy production from intermittent renewable sources.

4.6.5 Comparing Figure 1 (increasing amount of UK energy generation from intermittent sources) and Figure 2 (variability of generation achieved) indicates that it is right to prepare for a future with an increasing amount of the UKs power coming from intermittent sources, and as the percentage of supply increases the risks from generation variability increases. Necessitating greater network balancing by the Electricity System Operator (ESO) to maintain the system within parameters (voltage and frequency), this could result in more network instability.

4.6.6 The UK energy resilience strategy includes the development of new nuclear generation capacity to help with this required balancing, but this is not anticipated to be online soon, or be of sufficient capacity to provide resilience during periods of lower renewable generation. Furthermore, most commercial nuclear plants are being retired this decade, with the last one – Sizewell B – due to close in 2035[11]. On current projections that will leave the UK with only 2 reactors in commercial operation compared to the 9 available today. This increases the risk of power disturbances or the potential for rota cuts to reduce demand to within supply capabilities especially during peak demands.

4.6.7 While United Utilities procures its electricity from 100% renewable sources, this is ultimately delivered via the UK national gird and is therefore exposed to any shortfalls in generation capacity or reduction of imports with Europe or Norway which are themselves threatened by climate change as previously discussed.

[11] Retirement of UK's nuclear power plants, UK/EDF to Extend Lifetimes of Four Nuclear Reactors at Heysham and Hartlepool, 2023.

4.6.8 United Utilities has a number of sites that have renewable energy systems onsite, including solar arrays and combined heat and power systems (CHP) which burn gas derived from digested sewerage to generate electricity for onsite composition or export. However these systems cannot be relied upon during a local, regional or nation grid failure as they require a grid connection to operate safely, and will automatically shut down in the event of a grid power outage.

4.7 Methodology

4.7.1 To improve how customers are protected from the impact of power disruption, we have completed an assessment to identify our water and wastewater assets that rely on an uninterrupted power supply for continuation of service, and which may be vulnerable to a potential power loss. We have allocated enhancement expenditure to these nominated sites, across both water and wastewater. These sites include treatment works and pumping stations which rely on an uninterrupted power supply to function and provide services. This will provide a new and improved level of service at these sites and to these customers.

4.7.2 Our selection process involved using an assessment which is already an established process embedded across the business, to grade the importance of each asset. This is key for the business; it is used to enable effective business decision making and prioritisation for various processes. We have used these assessments to help inform the scope for this enhancement case.

4.7.3 For water, importance is associated with two primary factors; the potential of customers to lose a wholesome supply of water, associated with a failure at a specific facility or network asset, and the potential of the regional supply system to be unable to provide sufficient water to customers due to a loss of available headroom. The importance of assets on the water supply system is assessed through a variety of hydraulic network models. These have been used to assess the maximum supply deficit associated with the total failure of any water treatment works, and also the maximum number of customers potentially impacted through the loss of each trunk or distribution main.

4.7.4 For wastewater facilities, this is associated with six primary factors, given an asset failure and/or an uncontrolled discharge of wastewater. These factors are the potential to:

(a) Degrade receiving water courses;

(b) Lead to pollution;

(c) Degrade bathing waters;

(d) Degrade shellfish waters;

(e) Lead to foul flooding; and,

(f) Lead to significant societal disruption.

4.7.5 The importance of assets on the wastewater supply system has been assessed through a variety of hydraulic network models. These have been used to assess the potential transport and dilution of key determinants associated with uncontrolled wastewater discharge.

4.7.6 The output of this data analysis allowed us to grade our assets in terms of importance into bands A-E; A being the most important and E being the least important, based upon the number of equivalent properties supported by each facility.

Table 2: Grading of our assets into bands

Band	Percentile of equivalent properties	Equivalent properties
A	Top 6%	>90,000
B	Top 10%	>44,000
C	Top 20%	>23,216
D	Top 35%	>12,600
E	Bottom 65%	<12,600

4.7.7 Our selection process for this enhancement expenditure has been those assets badged as band A or band B for both water and wastewater.

4.7.8 A further data analysis allowed us to gain a comprehensive understanding of the current level of power resilience already at these sites and if any power standby currently in situ is capable of supporting the average demand of the site. Sites that already had a sufficient generator on site, defined by a generator capable of supporting the average demand of that site within 150kVA, were excluded from the scope of this enhancement case. Sites without power generator but with an average demand of under 150kVA were also excluded from this scope.

4.7.9 The 150kVA threshold has been applied as generators 150kVA and smaller, compact enough to be easily transported to sites if needed during a power incident, and more numerous via the supply chain when compared to larger units. The sites excluded from the scope were deemed low risk, as they either had an average demand of less than 150kVA or, should a generator have been previously installed for resilience purposes any gap between the average demand and the generator capability is less than 150kVA, so again deemed low risk. In the event of a power interruption at the sites excluded from scope, an emergency generator from our third-party contractor would be deployed within the 4 hour lead time. Current contract performance for the deployment of emergency generators is good and provides us the assurance that this is an appropriate risk position, avoiding unnecessary expenditure in delivering an overly risk adverse position.

4.7.10 The result of this assessment is the identification of sites, across water and wastewater that would benefit from power resilience enhancement. These sites include treatment works and pumping stations which rely on an uninterrupted power supply to provide services. The shortlist of these sites have been reviewed and confirmed by our asset management and price control strategy teams.

4.7.11 This proposed enhancement case is for additional power generation, and not for the upgrading or replacement of any pre-existing generators previously installed to provide resilience.

4.8 Comparative information

4.8.1 The DNO's work to different design standards of resilience, and to different performance commitments/incentivisation than water companies. For example treating one meter as one customer when that customer could be a water treatment works with +2million customers supplied. Additionally engineering design standards and investment strategies under RIIO-ED1 (2018-2023) delivered flooding resilience to primary substations and up, leaving local substations unprotected against flooding, which many of our sites are connected to.

4.8.2 While the Electricity Supply Emergency Code (ESCE) provides the ability to seek additional protections from planned rota cuts to sites, it is no guarantee against disturbances. During a national power outage the winter planning assumptions DESNZ are that ESEC will only be initiated if rota cuts are likely to last 48-72hrs or more. Additionally the successful application for ESEC protection requires specific network characteristics. In the event of an unplanned rota cut ESEC protections are not guaranteed.

4.9 Management control

4.9.1 As part of our base expenditure, all of our operational sites that require power have contingency plans associated with their operation. This includes standby power generation at some sites supported by a range of deployable mobile generators and alternative supply vehicles included within our emergency plant.

4.9.2 We procure emergency generator provision from the market, providing emergency generators to sites within 4 hours of a power interruption incident being reported.

4.9.3 During AMP7 we have invested base maintenance expenditure, specifically across our waste water assets, to provide additional power resilience. For example installing small scale uninterruptable power supplies to key equipment to project the environment should a short scale power disturbance occur. These interventions are not just targeted at supply side issues but also onsite asset health considerations.

4.9.4 We continue to maintain our existing power generation engines across the fleet of company assets, including those supporting our Integrated Control Centre and data centres. We are proposing to upgrade an existing 9 generators at sludge processing plants to be able to run on biogas produced at the site to reduce reliance on grid supplies. More on this in *UUW67 – Cross Price Control Enhancement claims – case 25*.

4.9.5 Large significant supply side power interruptions and their impacts are specific hazards, which are outside of management control. However we recognise our duties to maintain continuity of supply and have developed this enhancement case to reduce the consequences of such events.

4.10 Scale and timing of investment

4.10.1 Our methodology has allowed us to create a shortlist of sites. Our selection process for this enhancement expenditure has been those assets graded as band A or band B in terms of importance (methodology explained in full above), as these assets support a significant number of equivalent properties based on the site calculations. A further data analysis allowed us to gain a comprehensive understanding of the current level of power resilience already at these sites and if any standby power currently in situ is capable of supporting the average demand of the site, rather than just protecting sensitive components.

4.10.2 We have determined that this investment needs to be completed in AMP8. Based on the evidence provided below we assess that the risk of significant power interruptions has increased, in terms of the likely consequence, and is anticipated to increase further over the period 2025 to 2030 as more nuclear plants are decommissions and more intermittent renewable supplies come on line. We have determined that for our most important sites that don't currently have any alternative power provision waiting until after 2030 poses a significant risk.

4.10.3 This risk will remain high on the agenda for future AMPs, we are periodically reviewing the importance of our assets and future AMPs may see the requirement for further investment at sites upgraded. We will also review if any of the rejected optioneering is relevant for those sites lower down on the measure.

5. Best option for customers

5.1 Approach to optioneering

5.1.1 Our approach to delivering best value is robust and consistent across all of our enhancement cases. Our approach uses a rich mix of metrics to help us drive value and efficiency in developing our business plan. Consistency of the approach is driven through our PR24 Value Tool which allows us to quantify and value environmental and social benefits, costs and risks. For more detail on this approach please see 'Our approach to deliver best value totex'.

5.1.2 In developing the solutions to address the identified need, we have considered multiple options. We completed CBA analysis of the option shortlist, considering the best value for customers and the environment over the long-term, and the conclusions are outlined in the below table.

5.2 Best value

5.2.1 The proposed option for investment, the installation of fixed generation capability is best value. This investment option:

- Has been cross checked with the services that distribution network operators provide.
- Will not address plant shut down from short term power disturbances (typically less than 90 seconds) but this risk hasn't changed.
- Is aligned to the driver that consequences of prolonged power outages has increased in risk (as observed in the national risk register)
- Still requires the continuation of the standby generator contract to cover less important sites.

5.2.2 Other options considered:

- Least cost option – business as usual, sites with current generation capacity will be maintained. A contract with a generator supplier will also be maintained for responsive deployment (i.e. adverse weather forecast) and reactive deployment (following failure of power supply). Considering the current increased risk, evidenced in the nation risk registers, and our analysis of the likely future risk increasing we have determined that the business as usual solution does not meet our needs.
- Risk transfer - The risk to power interruption will be transferred to the regional DNOs, as the best placed organisation to deal with the risk. This approach will be considered for less important assets and services where there is already a good level of redundancy in the United Utilities system, or the where population impacted is low.
- Alternative battery storage option – provide instant protection to short term power disturbances. However protection is time limited and can vary from minutes to a few hours (2-4) at most depending on if full site demand is required, compared to an unlimited duration as per the preferred solution, assuming that fuel can be procured. These solutions are best deployed against short duration power network disturbances not the increased risk of large scale power outages as recorded in the national risk registers. Comparative costs of a limited number of this emerging technology indicate that UPS solutions of significant capacity are 100% more expensive (at an equipment level) for significantly less resilience. We will continue to work with a leading supplier of battery sets to test if they are suitable for our intended application of permanent install and standby. We expect to trial such an installation at a small (<90kVA) sewerage pumping station in late 2023.

5.2.3 Future opportunities:

- We recognise that technology and prices of emerging technology can change rapidly. We will remain adaptable to new information and will always seek to value engineer solutions when new

information is available. For example considering alternative technologies such as hybrid battery / generator set combinations, which will provide instantaneous power resilience to short term power disturbances as well as longer duration power outages. But only where the solution provides an equivalent or better level of resilience to a standard generator installation.

5.3 Customer support

5.3.1 When customers were asked about what they believe our strategic priorities[12] to be, of the more discretionary investment opportunities, protecting the environment, meeting future challenges such as climate change and preventing pollution have a high combined importance. This combination makes 'current and future environmental concerns' the second most important combined priority after safe drinking water. This proposed enhancement case contributes to protecting both of these strategic priorities that are most important to customers; protecting against supply interruptions, pollution incidents and promoting safe and reliable drinking water.

5.3.2 Using the Ofwat ODI Rates Collaborative[13], Ofwat ranked performance commitments based on customer priorities. Internal and external sewer flooding and water supply interruptions made up the top three priorities, demonstrating that customers want to be protected against incidents that would result in any of these.

5.3.3 Our Bespoke ODI rates research[14] explored customer valuations and attitude to various scenarios of service issues over lengthier periods of time, than that explored in the Ofwat ODI Rates Collaborative research. The findings demonstrated that internal sewer flooding incidents were, and would, be most impactful to customers, supporting the view of the importance of having resilience on sites to protect against these types of incidents.

5.3.4 Our long-term research immersive ambitions research[15] demonstrated that the majority of customers believe action should be taken now to improve things for the future. Customer views are to explore investment beyond 'no regrets' approach, taking more of a proactive approach. Furthermore, the research indicated that customers want to see more urgent investment in core services that have a more immediate impact on lives and health; these include resilience and asset health-related services such as drinking water quality, lead pipe removal, maintenance, water leakage, sewer flooding and net zero ambitions. This proposed enhancement case is in line with the outcomes and of this research.

5.3.5 Our climate change research[16] demonstrated that 68% of household customers are concerned about the impact of power cuts on supply.

[12] Impact Research on behalf of United Utilities, Customer Priorities, December 2021

[13] Ofwat/CCW, Collaborative ODI Rates Research, October 2022

[14] Accent and PJM Economics on behalf of United Utilities, Bespoke ODI Rates Research, March 2023

[15] PwC on behalf of United Utilities, Long Term Delivery Strategy Ambition Testing, April 2023

[16] DJS Research on behalf of United Utilities, Climate Change and Resilience, January 2021

6. Options development

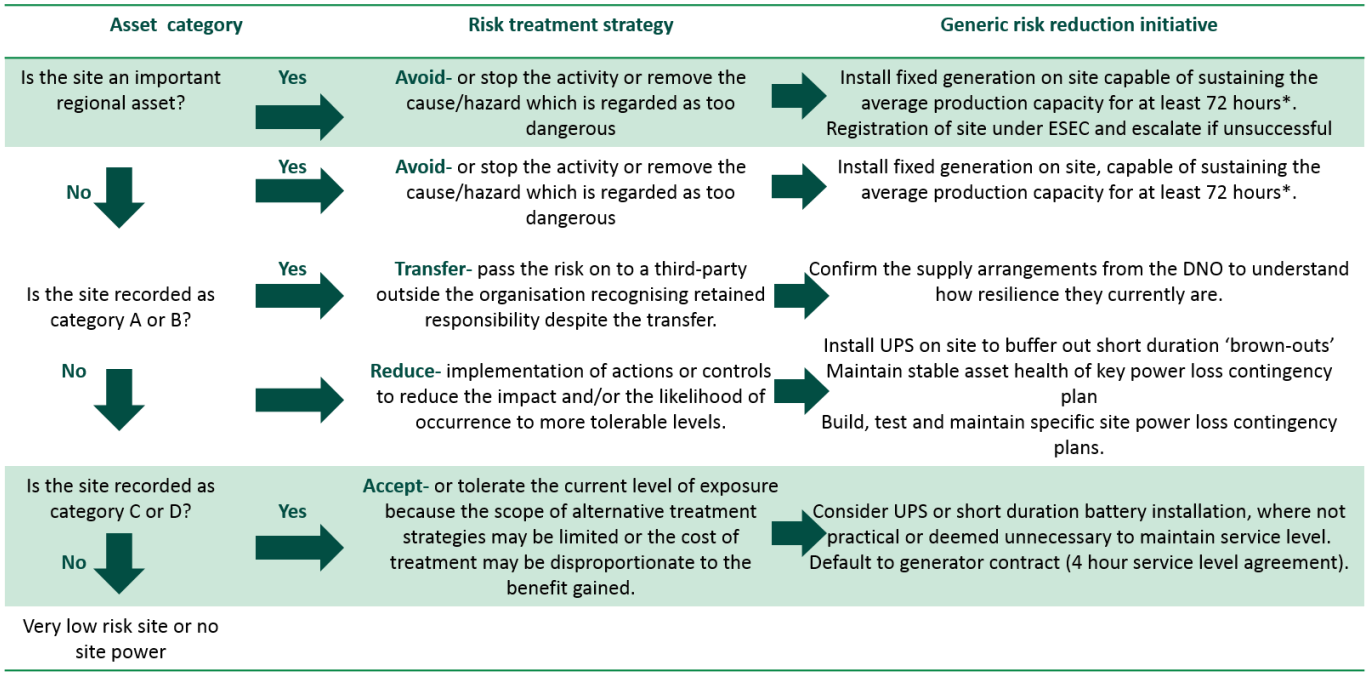
Table 3: Consideration of options for enhancing power resilience

Option	Analysis Outcome	Accept/ Reject
The current state of play, no permanent generators installed over and above those already in situ on sites. In the event of a power-related incident, an emergency generator would be delivered to site by third-party supplier within a 4 hour lead time. There is a cost associated with each of these 'call-outs', and also a risk of shortage of these emergency generators in this current climate and a potential national wide power outage.	These sites are our most important sites and by continuing with the emergency generator option, we risk service failure due to the 4 hour lead time and the potential, as explained above, of a shortage of these emergency generators.	Reject
Defer investment to next AMP	The sites identified are our most important sites, and in the current climate there would be impact to services and customers if this was to be delayed until next AMP.	Reject
Operational interventions to reduce site demand within the capability of existing on-site generation capacity – if present.	The sites identified are our most important sites. We cannot afford to reduce site treatment without risking service failure. For our less important sites, this may be an appropriate solution.	Reject
Reliance upon level of resilience provided by the DNOs (risk transfer) in our region, including identification of multiple connections to the grid and registration of sites with the Electricity Supply Emergency Code (ESEC).	The registration of sites with ESEC is not straight forward, specific electricity network conditions must be met (i.e. site is on a dedicated feed to enable continuous supply without keep unnecessary demand on the power system). This also only applies during 'planned rota disconnections' only and so does not address resilience of emergency or unplanned power outages.	Reject
Battery packs and Uninterruptable Power Supply (UPS) as an alternate energy source to generators.	Battery packs and Uninterruptable Power Supplies (UPS) provide good short-term power resilience to short duration disturbances (these are typically < 2 minutes but increasingly are becoming available with a 2-4 hour range.) but would not provide any reliable resilience against a longer supply outage. These may be applicable to less important assets where the time would sustain a site until a mobile generator could be installed.	Reject
Installation of onsite power generation and fuel for 72 hours of continuous running, to bridge the gap to DNO resilience performance aspirations. Using hydro-treated vegetable oil (HVO) as the fuel source.	Generators are a reliable source of energy and have fuel stocks which are easily able to be replenished. The 72 hours recommended fuel stock bridges the gap between a mains power loss and the anticipated DNO standards of the mains power being reinstated. The use of HVO as a fuel source provides increased resilience as it has a longer storage life – typically up to 10yrs vs 1yr for Diesel. HVO has additional benefits in that is has a lower emission factor than Diesel meaning lower CO2 emissions, helping to achieve our net zero ambitions.	Select

6.1 Risk appetite

6.1.1 In Figure 4 below we show how we have developed our strategy for securing power resilience in line with our corporate approach to risk appetite, determining the most appropriate solutions for the level of risk.

Figure 4: Power resilience risk appetite



6.2 Collaborative working

6.2.1 In developing our energy resilience plans we recognise the interdependencies between United Utilities and electricity distribution network operators (DNO).

6.2.2 We have worked in partnership with the DNOs in our region, ENWL and SPEN, and communicated the nature of what we are trying to achieve. We have been able to develop an understanding of their resilience practises and standards to start to further inform this enhancement case. For example the current network configuration around our assets, the inbuilt resilience, and the likely interruption times under business as usual operation. We have been able to cross-check where there are sites with multiple or dual supplies which have the potential to add an extra layer of resilience to some sites.

6.2.3 This collaboration has enabled us identify the individual sub-stations supplying the works and its status (Grid / Primary / Local) which helps us to understand the relative resilience of each supply. For example under previous price control periods the electricity distribution companies have built in flood resilience to grid and primary substations, but the risk is still present on a local level. We also now have intelligence as to the number and type of connections supplying our assets, this enables to make informed decisions about the current vulnerability to network failure, for example if a site supplied by ring / looped system or a single spur.

6.2.4 This collaborative understanding allows us to target our investment more specifically, and develop appropriate plans to determine which party is best placed to address energy resilience risks. This has allowed us to start developing plans to bridge the gap between current water company capability and resilience provision of the DNOs; ensuring that customer's money is spent appropriately.

6.2.5 This work has proven invaluable in better understanding our risk under business as usual operation, and helps to inform our risk assessment to dependant services. Fundamentally, however, it does not help to address the significant risk of a significant regional or national power outage. The information gathered and approach will be used to inform subsequent investment strategies for other sites.

6.3 Preferred option

6.3.1 To address the specific hazard of a large scale regional or national power outage our preferred option is to install onsite power generation capacity at our most important sites, with sufficient fuel for 72hrs of continuous running.

6.3.2 Generators are a reliable source of energy and have fuel stocks which are easily able to be replenished. The 72 hours recommended fuel stock bridges the gap between mains power being lost and the DNO engineering assumptions of when mains power is likely to be reinstated.

6.3.3 The enhancement case is for a power generator to be installed at each identified site and is valued at a totex cost of **£20,149,595** in AMP8.

Table 4: Breakdown of number of generators and associated size in kVA

Size of generator	Number of installations
250kVA Genset installation	19
500kVA Genset installation	18
1000kVA Genset installation	11
1500kVA Genset installation	2
2000 kVA Genset installation	1
	51

6.4 Resilience assessment

6.4.1 The preferred option selected delivers all types of mitigations across the 4Rs; redundancy, reliability, resistance, and response and recover.

Redundancy

6.4.2 This means maintaining efficient headroom or capacity in our systems to be able to absorb shocks. This enhancement claim provides redundancy in the system, so that in the event of a mains power loss, the back-up generators would provide approximately 72 hours' worth of energy resilience sufficient to run the site at average capacity.

Reliability

6.4.3 This enhancement investment will ensure that sufficient reliable power is available to maintain quality and quantify requirements at these sites. Providing protection against risks to power supply including transitional risks associated with UK power generation increasingly moving to renewable energy sources, high demand not being met, and extreme weather.

Resistance

6.4.4 Securing our assets, systems and processes against multiple risks. Through this enhancement investment, our assets will be protected against the potential damage to electricity distribution assets (either accidental, as a result of extreme weather / flood, or malicious act).

Response and recovery

6.4.5 Ensuring that we have the response capability to react to events when they do occur. By providing permanent power generators at these sites, meaning that our services at these key sites can be restored and sustained quickly. This also creates headroom in our regional response and recovery capabilities, enabling us to focus on restoration of sites that are not protected from a mains power loss.

6.5 Carbon assessment

6.5.1 A carbon assessment has been completed for the provision of fixed generators. The manufacture and installation is common to both fuel types; diesel and HVO. The total carbon value is 2462 and a breakdown is detailed below.

Table 5: Carbon assessment for provision of 51 power generators

	tCO2e	Number of installations	Carbon
Provision of generators (W800-310)			
250kVA Genset installation	23.1	19	438.9
500kVA Genset installation	34	18	612
1000kVA Genset installation	56.3	11	619.3
1500kVA Genset installation	79.2	2	158.4
2000 kVA Genset installation	102.6	1	102.6
	Totals	51	1931.2

Table 6: Carbon assessment for provision of containers to house power generators (option 1)

	tCO2e	Number of installations	Carbon
Container protection (option 1)			
250kVA Container (Typical) 6.0 x 2.5 x 2.5	7.3	18	131.4
500kVA Container (Typical) 6.2 x 3.0 x 2.5	9.0	17	153
1000kVA Container (Typical) 7.0 x 3.5 x 3.0	11.7	10	117
1500kVA Container (Typical) 7.0 x 3.5 x 3.0	11.7	1	11.7
2000kVA Container (Typical) 13.2 x 3.5 x 3.0	21.6	1	21.6
	Totals	47	434.7

Table 7: Carbon assessment for provision of containers to house power generators (option 2)

	tCO2e	Number of installations	Carbon
Container protection (option 2)			
250kVA Container (Typical) 6.0 x 2.5 x 2.5	17.8	1	17.8
500kVA Container (Typical) 6.2 x 3.0 x 2.5	20.3	1	20.3
1000kVA Container (Typical) 7.0 x 3.5 x 3.0	24.3	1	24.3
1500kVA Container (Typical) 7.0 x 3.5 x 3.0	24.3	1	24.3
2000kVA Container (Typical) 13.2 x 3.5 x 3.0	39.1	0	0
	Totals	4	86.7

Table 8: Carbon assessment for associated cabling

	tCO2e	Number of installations	Carbon
Associated cabling			
120mm2 1C SWA Cable - Direct Buried (20m included in standard generator)	0.118	19	2.242
240mm2 1C SWA Cable - Direct Buried carbon by metre (20m included in standard generator)	0.236	32	7.552
	Totals	51	9.794

7. Cost efficiency

7.1 Cost breakdown

7.1.1 The enhancement case for a power generator to be installed each identified site and is valued at a totex cost of £20,149,595.

Table 9: Investment Profile

	2026	2027	2028	2029	2030
Capex	£1,788,560	£3,408,146	£7,199,301	£4,652,334	£1,034,602
Opex	£ -	£87,742	£284,058	£722,507	£972,346
Totex	£1,788,560	£3,495,888	£7,483,359	£5,374,841	£2,006,948

7.1.2 Each of these generators are of an appropriate size to meet the average demand of that site. This cost includes:

(a) Power generator;

(b) Fuel (for 72 hours of continuous running);

(c) Fuel tank;

(d) Cabling;

(e) Programmable logic controller; hardware and software;

(f) Civil works;

(g) Container for each generator to be housed in for weather protection and security;

(h) Permits;

(i) Servicing; and,

(j) capex costs (inclusive of annual refuelling assuming up to 50hrs of annual running for testing and servicing, reactive running in an emergency will be additional opex cost.)

7.1.3 The split of the totex costs for water and wastewater sites is as follows:

Table 10: Breakdown of totex costs for Water Network Plus and Wastewater Network Plus

Business Area	Totex cost
Wastewater	£14,078,128
Water	£6,071,467
Total	£20,149,595

7.1.4 The split of the capex costs for water and wastewater sites is as follows:

Table 11: Breakdown of capex costs for Water Network Plus and Wastewater Network Plus

Business Area	Capex cost
Wastewater	£12,683,815
Water	£5,399,127
Total	£18,082,942

7.1.5 The split of the opex costs for water and wastewater sites is as follows:

Table 12: Breakdown of opex costs for Water Network Plus and Wastewater Network Plus

Business Area	Opex cost
Wastewater	£1,394,313
Water	£672,340
Total	£2,066,653

7.2 Industry comparison

7.2.1 The costing for this enhancement case has been sourced via the route of Managed Service Provider (MSP), this is a market-tested, benchmarked approach which is continuously reviewed for cost efficiency. We continually refresh our existing contract approaches to ensure we continue to deliver best value for customers.

7.2.2 At the start of AMP7 United Utilities contracted with a single Managed Service Provider (MSP), however in order to maximise use of the supply chain and remove costs associated with a managed service we insourced the management of our high volume low value maintenance activities along with tendering a number of packages to be delivered by a wider supply chain, focussing on bringing many SME's (c.85% of awarded suppliers), as part of a new Maintenance Sourcing Strategy.

7.2.3 The Maintenance Sourcing strategy set out to achieve a number of key objectives: Reduce management cost (12% vs 32.7%), increase asset availability (through optimising maintenance activities, following root cause analysis), reduced repair cycle times (target 30 days) and insourcing activities where viable. Via this approach we have made 76 separate awards, generating savings of circa £5m since June 2021 and asset return to service times have been reduced by circa 50% thereby delivering further value for customers.

7.2.4 This effectively changes the boundary of our relationship with the supply chain for a significant proportion of our lower value, high volume maintenance requirements. In this new model United Utilities takes the responsibility for the management of the contractors, allocation of work etc. that was previously delivered by the MSP.

7.3 Third party assurance

7.3.1 We commissioned a specific piece of third party work to assure the cost efficiency of our enhancement cases:

- A bottom-up benchmarking exercise (Faithful and Gould).

7.3.2 We consider that the complementary and independent output of this piece of work demonstrates that our cost estimates are efficient and represent excellent value for money for our customers.

7.3.3 We provide a description below.

Bottom-up benchmarking (Faithful and Gould)

7.3.4 Faithful and Gould undertook a bottom-up deep dive into the cost efficiency of our enhancement cases. This involved a close examination of our cost base relating to a sample of our enhancement programme, with comparisons made to similar activity carried out by third party companies across a variety of sectors.

7.3.5 F&G looked at our direct costs across each of the following categories:

(a) Staff including site supervision

(b) Mobilisation and site set up, running and removal of site offices and welfare

(c) Temporary services for general site use, such as water to wash out concrete skips

(d) Attendant plant and equipment, such as cranes, forklift for unloading deliveries etc

(e) Attendant labour, defined as hourly paid operatives not involved in productive works

(f) Site consumables, such as waste skips

(g) Set-up site compounds, erecting hoardings etc

(h) O&M manuals

(i) Health and safety

7.3.6 It also looked at the contractor's indirect costs (e.g. overhead and design costs) and UUW's indirect costs (e.g. land acquisition costs). Due to the size of the programme, F&G examined a sample of our enhancement cases. However, this sample included projects from each of our enhancement categories and covered £1.246bn of expenditure. Therefore, we consider this sample to representative of our overall enhancement programme.

7.3.7 F&G noted the effectiveness of UUW's cost estimation process:

"In addition to the benchmarking data held by Faithful+Gould we understand that UUW has applied multiple internal and external challenges to progressively refine the cost estimation undertaken to date. In particular we note UUW's use of its Investment Programme Estimating System (IPES) which is a bespoke parametric estimating tool containing data from AMP3 to AMP7, to provide historical cost curves alongside estimated data from third party organisations."

7.3.8 F&G found that our proposed costs are in line with rates typically seen across the industry:

"Overall, UUW's approach of utilising historic cost curves, market testing and obtaining specialist third party quotations demonstrates a sound proactive approach to cost planning. In total £1.2bn of schemes underwent targeted cost assessment with £573m making up the construction works element.

After presenting our initial findings it was encouraging to see UUW's commitment to addressing our findings and applying these to the wider enhancement estimates, charting a strategic route towards greater efficiency and scope clarification.

In light of this Cost Assurance work and evidence of UUW's responsive actions we have concluded that the data we have benchmarked is within a reasonable alignment with anticipated market rates."

8. Customer protection

8.1 Overview

8.1.1 It is important that customers have confidence that we will deliver the enhancement schemes that get reflected in our PR24 final determinations and they are suitably protected in the event of non-delivery, or if there are material changes to deliverables (including changes to dates), which leads to a change in cost (including changes in the timing of required expenditure). Ofwat proposes that, if companies fail to deliver or are late delivering improvements to customers, then price control deliverables (PCDs) should, where appropriate, be used to compensate customers. In our PR24 *Chapter 8 - Delivering at efficient cost, section 8.8.9* we have proposed an approach to PCDs that aims to provide customer protection, such that customers are fairly compensated for non-delivery (such as due to a change in regulatory requirements) or late delivery (including as a result of a change to a regulatory date), between PCDs, any related ODI underperformance payments, and cost sharing arrangements.

8.2 Power resilience enhancement price control deliverable

8.2.1 We have not included a PCD for this area as it is small in size, and below Ofwat's indicated threshold.

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