water industry commission FOR SCOTLAND

2019 Decision Paper
Strategic Review of Charges 2021-2027

Asset replacement

Asset replacement

Introduction

This 2019 Decision Paper on asset replacement is the latest in a suite of papers that the Commission is publishing on the key topics informing the outcome of the Strategic Review of Charges 2021-27 (SRC21). Later this year the Commission plans to publish an update to its views on the prospects for future prices. These Decision Papers will help inform Scottish Water's co-created Strategic Plan, which is due for publication towards the end of 2019.

In February 2020 the Commission will set out any changes in its thinking following its review of Scottish Water's Strategic Plan. The Commission will publish its Draft and Final Determinations later next year.

This Decision Paper provides the Commission's views on:

- Positioning Scottish Water to play its full part in achieving Scotland's goal of net zero carbon emissions by 2045. This will require an innovative and sustainable approach to the replacement of assets;
- How an innovative, effective and efficient approach to the replacement of assets will ensure that current levels of customer service, water quality and environmental performance are, as a minimum, maintained in both the short and long term; and
- The level of investment likely to be required to continue to make progress in further improving water quality, the environment and supporting economic growth.

This Decision Paper takes full account of the Scottish Government's draft Objectives and Principles of Charging for SRC21, which set the policy framework for the industry.

The Commission has adopted the principles of Ethical Business Regulation, which encourages candour and transparency in all interactions between the regulators, the regulated and other stakeholders. This approach will encourage Scottish Water pro-actively to demonstrate that it is performing well and in the best interests of its customers and wider Scottish society. As such, the Commission has worked closely with Scottish Water and other stakeholders to improve the understanding of the levels of investment that will likely be required both to maintain and improve current levels of service and to begin to respond effectively to the climate emergency, highlighted by the Scottish Government.

Scottish Water is seeking to 'co-create' its Strategic Plan, drawing on the views of its stakeholders. This Decision Paper will help inform Scottish Water's Strategic Plan. It sets out the Commission's view on investment in the light of the Scottish Government's draft Objectives and Principles of Charging. The Commission may revisit its view if new information becomes available.

Scottish Water aims to finalise its Strategic Plan by 16 December 2019. If the Customer Forum agrees the Strategic Plan, Scottish Water and the Customer Forum should then progress towards agreeing how the plan is funded and any conditions that should apply, taking account of Minister's Principles of Charging and the Commission's views on the prospects for prices.

Executive Summary

The Commission's previous Decision Papers have highlighted:

- the significant impact that levels of investment have on prices;
- the likelihood that investment levels will need to rise in future;
- the importance of ensuring Scottish Water is adequately funded to meet the asset replacement challenge effectively and efficiently.
- the need to continue to invest in improvements to water quality, environmental compliance and to meet the challenge of climate change, including the transition to net zero carbon emissions by 2045.

The Commission recognises that Scottish Water manages a complex portfolio of assets which are diverse in type, age, lifespan, condition and criticality. As such, effective and efficient asset management (and, in particular, managing asset replacement) is a core function. The Commission is clear that, if Scottish Water is to play its full part in Scotland's achievement of net zero carbon emissions by 2045, there can be no question that Scottish Water faces a significant asset replacement challenge. It has a significant amount of work to do in understanding how it will meet this challenge.

In common with other asset intensive businesses, Scottish Water cannot predict exactly when assets will fail. As such, it is clearly in the customer interest that it is able to act prudently - particularly with regard to those assets that are critical to the performance that its customers and, more broadly, society value.

In coming to its decisions, the Commission wants to ensure that Scottish Water is able to manage its investment programme effectively and efficiently. The Commission recognises that investment will need to be prioritised and, as set out in 2018 Decision Paper 3, welcomes Scottish Water's agreement to create a multi-stakeholder investment planning and prioritisation group to achieve this. The Commission is clear that this process should ensure that all investment that is both urgent and important should be progressed expeditiously. In the Commission's view, such an approach should ensure that customers' bills remain as low as practicable over the long-term.

Scottish Water's understanding of its assets

The Commission's analysis is based on Scottish Water's best current understanding of its assets. Scottish Water recognises that it has to make further progress in developing this understanding, but its current work represents a good basis from which to start. The Commission is encouraged that Professor Dr. Bryan Adey of the Institute of Construction and Infrastructure Management (IBI), ETH Zürich has agreed to work with Scottish Water and report to stakeholders on progress.

Scottish Water has divided its assets into three main groups:

- Business Services assets;
- Assets that will need ultimately to be replaced; and
- Assets that will be refurbished on an ongoing basis and are likely never to be completely replaced.

Scottish Water has also set out a range for the likely asset life and replacement cost of each category of assets and assigned a confidence grade. As such, the Commission has been able to take particular account of the requirement to replace short and medium life assets that are likely to be critical to maintaining the improvements in levels of service that have been achieved in recent years.

The Commission drew on Scottish Water's analysis and asked itself two key questions:

- how long can any required transition in the amount of funding available for asset replacement take?
- how much may need to be spent over the short and medium term and on an ongoing basis?

The Commission's analysis

How long can any required transition be?

The Commission has identified that there will need to be a transition in funding that allows for the effective and efficient funding of all assets at the end of their lives. Without this, Scottish Water will not be making as full a contribution to Scotland's target of net zero carbon emissions as it could. There would also be a high risk of failures in customer service or an adverse impact on water quality and the environment. The Commission has therefore concluded that the transition to the long-term level of asset replacement must be complete by 2045.

The Commission has identified an additional milestone in any effective transition. It agrees that an average asset life of 18-26 years appears to be appropriate for short and medium life assets. Given the critical role of these assets in the levels of service and environmental performance of Scottish Water, the Commission considers that it is prudent to ensure that there is a high degree of confidence that these assets can be replaced when the time comes. The Commission's review of historical investment suggests that these assets are likely to be around 10 years old on average. This suggests there is a maximum window of 8-16 years to prepare for the replacement of the short to medium life assets. While there is more time to address the replacement of long-life assets, the Commission recognises that some of these will require replacement during the next regulatory period. It makes an allowance to this end. This initial milestone will have an important impact on how the transition to 2045 is managed.

How much needs to be spent?

The Commission has considered the need for investment across all asset categories. This paper concludes that, within an initial 8 to 16-year timeframe, Scottish Water will require to target asset replacement investment of around £480m per year in 2017-18 prices. This allows for a high degree of confidence that it can meet its need to replace short and medium life assets and begin to address longer term asset requirements.

Scottish Water will likely require around £300 million annually on average to achieve the water quality, environmental and customers service improvements required. It will also have to meet the demand for new connections from this allowance. This £300 million represents a relatively modest increase on historic levels of expenditure in this area.

The Commission has therefore concluded that, within the 8 to 16 year timeframe, Scottish Water should achieve an initial milestone of delivering an annual investment programme (replacement plus enhancement) of around £780 million in 2017/18 prices.

Based on Scottish Water's current understanding of its assets, the Commission has estimated the long-term asset replacement requirements as between £620m and £770m per year for the existing assets. Allowing for the ongoing average enhancement expenditure of £300m per year and the replacement costs of the new assets that the enhancement expenditure provides, the Commission's analysis suggests that the long-term target range for investment should be between £1 billion and £1.1 billion per year. This includes an assessment of the scope for ongoing efficiencies in the delivery of investment.

Inevitably, there is uncertainty around this long-term estimate of investment requirements. However, the Commission's review of Scottish Water's reported asset information suggests that Scottish Water's estimated asset lives appear more likely to understate, rather than overstate, the asset replacement challenge. The work being undertaken by Scottish Water, with support from Professor Dr Bryan Adey, to improve its understanding of asset lives and replacement costs will help ensure that customer's money is being spent effectively and efficiently throughout the transition.

It is important to emphasise that, during the transition to this sustainable level of investment, the overall condition of assets will deteriorate. Scottish Water will have to manage the impact on levels of service and compliance and make difficult choices about where and when to invest.

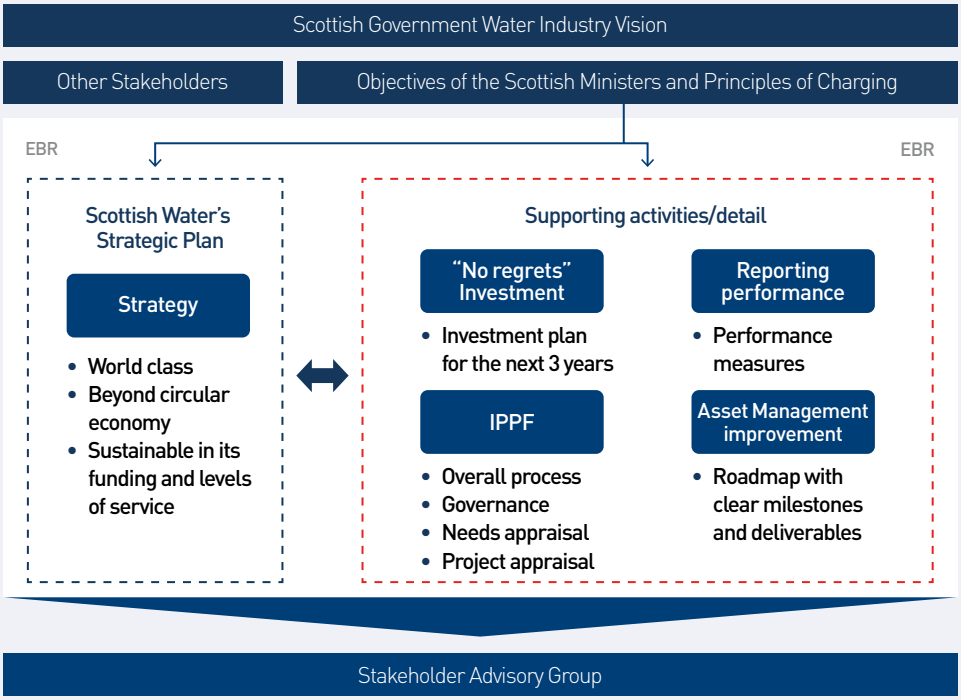
The following pages provide more detail on the approach the Commission has taken to assessing the asset replacement challenge.

Background

Historically, economic regulation has struggled to address asset repair, refurbishment and replacement...

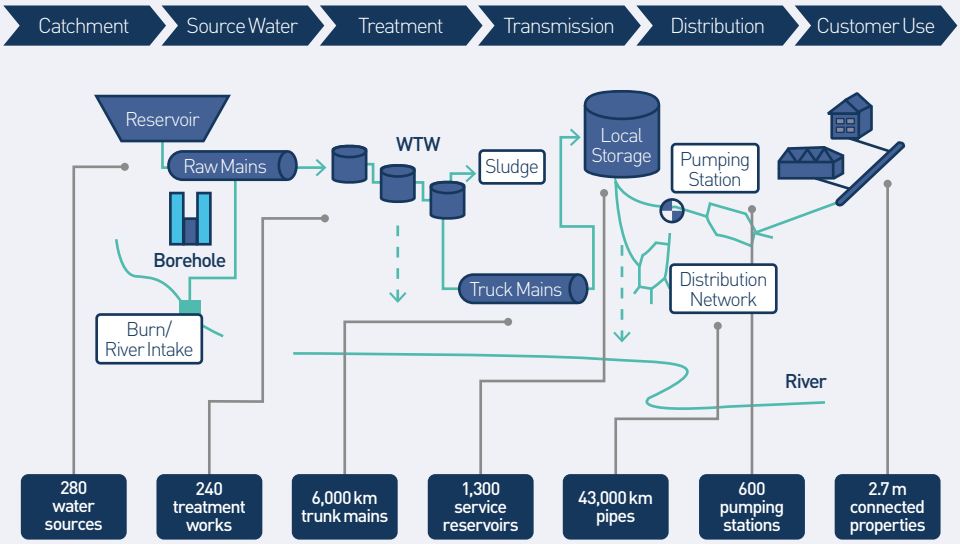
- Economic regulation seeks to mimic market forces. It establishes a hard budget constraint. Accepted wisdom suggests that keeping a regulated entity modestly short of money encourages efficiency.
- Regulators have successfully used this approach, in both the public and private sectors. Regulated companies subject to this discipline have reduced operating costs and improved operational effectiveness and efficiency.
- However, establishing this hard budget constraint has – perhaps necessarily - made regulation an adversarial process and caused asymmetries of information. Regulators have focused on funding regulated businesses for a regulatory control period. The regulatory control period is typically not consistent either with the time horizon of investment or the application of whole life cost analysis.
- Continuing on this basis was likely to become increasingly problematic as assets age. There are two possible (and mutually exclusive) regulatory responses:
  - **To accept these asymmetries and rely on high-level analysis and incentives; or**
  - **To work in detail with the regulated industry to understand its potential needs.**
- Scottish Water responded well to the hard budget constraint but it has resulted in a shorter term focus (for both the regulator and the regulated company) than is desirable. It seemed clear to the Commission that it should explore the second approach.
- The Commission has therefore adopted Ethical Based Regulation (EBR), first advanced by Professor Christopher Hodges. EBR requires candour in all conversations and interactions between the regulator and regulated company. It requires the regulated company to demonstrate to all of its stakeholders that it is operating effectively and efficiently. The focus of the regulator is now on how and why the money is spent. This contrasts with the previous focus on how much money was spent.

Scottish Water has responded positively to the challenges it faces: its Strategic Plan will support the Scottish Government's long-term industry vision and the associated Objectives and Principles of Charging...



Delivering the strategy will require Scottish Water to manage its assets effectively. These assets are often complex and comprise both shorter and longer life components...

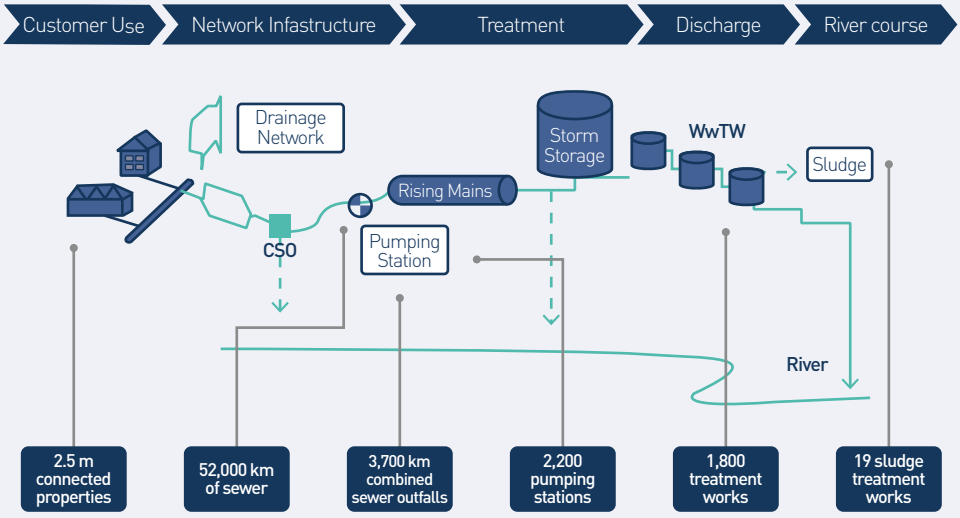
Assets for the supply of water



- Civil or pipe structures typically have long lives.
- Mechanical, electrical and instrumentation equipment may have a life of up to 25 years.
- IT and components such as membranes may need to be replaced every few years.
- Moreover, many of the elements of this system are quite complex, comprising a mix of long, medium and short life components.

Maintaining these assets is fundamental to the delivery of customer service and securing the improvements made to water quality and the environment...

Assets for the collection and treatment of waste water



- Some assets are critical to the maintenance of service to customers.
- Some elements of this system may never be fully replaced but will be repaired and refurbished to ensure that their condition and performance are maintained over time.
- Any component failure, even an apparently minor one, may have consequences beyond the service level to the customers that they serve. For example, Scottish Water's assets play an important role in mitigating the social and environmental impacts of flooding.
- Timely repair, refurbishment and replacement is an essential prerequisite of securing water quality, environment and customer service improvements.

So what are the implications for the future funding of the industry?

- A water company's assets are diverse in type, age, lifespan, condition and criticality.
- Effective and efficient planning of asset replacement is a core function of water businesses. Water and sewerage businesses face a significant challenge to manage such a diverse and complex portfolio of assets.
- Unfortunately, no water and sewerage company can predict exactly when failure will occur. It has to act prudently if it is to maintain (and improve) service levels.
- Appropriate asset maintenance and replacement underpins existing customer service and environmental performance. Appropriate asset maintenance and replacement will help make real progress towards communities' expectations of reducing waste and embracing the circular economy.
- Crucially, a water and sewerage company has to know that it will be able to access sufficient resources when it needs them – otherwise it may not be able, or even indeed willing, to pursue the most economic solutions.
- Insufficient resourcing of asset maintenance and replacement will reduce service levels in both the short and long-term and ultimately may well result in higher bills for customers than would otherwise have been necessary. Water companies have to make proper economic assessments of whether to repair, refurbish or replace assets.

Given its duty to future customers, the Commission must seek to ensure that it allows sufficient funding over the long-term for Scottish Water to maintain and replace its assets when necessary.

How assets are replaced in future will be a function of the opportunities and threats that will be present…

- Scottish Water will have to make considerable progress in understanding the condition and life of its assets and the carbon costs both from an operational and an embedded investment basis. There is a particular challenge in assessing the economic impact of carbon over the life of an asset. This will take time.
- The Commission will expect Scottish Water to produce robust project appraisals that meet the expectations of its stakeholders and ensure that the best value for money is achieved. This will require:
  - **a commitment to innovation and an openness to do things differently;**
  - **the incorporation of carbon pricing (in line with the industry's contribution to achieving Scotland's goal of net zero carbon by 2045) will affect initial investment decisions, ongoing operation and maintenance and decommissioning. Assuming that Scottish Water is currently operating efficiently and effectively, including carbon cannot reduce the financial cost of an intervention, but may increase financial cost making an alternative financial option most economic; and**
  - **an assessment of its use of the six capitals*, again recognising the potential impact on financial cost.**
- The selection of intervention is likely to be more complicated in future. There is a clear trend which suggests that the adoption of new technologies reduces asset lives. There may be lower upfront costs but the annualised costs of these shorter life asset solutions (taking into account carbon and resource use) may no longer be the most economic option.
- The commitment to innovation and an openness to do things differently may reduce financial costs and has been allowed for through the efficiency challenge. There is, however, a possibility that the existing asset stock will have a shorter remaining life than is currently estimated when the industry has a better understanding of the current and future price of carbon and how it will contribute to achieving Scotland's goal of achieving net zero carbon by 2045.

*A broader measurement of the value of a specific activity or output (Six Capitals: Financial, Manufactured, Intellectual, Human, Social and Natural)

In its earlier Decision Papers, the Commission identified that expenditure on asset replacement will likely increase...

- Scottish Water's reported capital expenditure currently includes asset repair and refurbishment, asset replacement, enhancement and growth investment.
- Moving forward, the Commission will allow for expenditure on responsive asset repair and refurbishment through an allowance for 'Tier 1 expenditure'*. Scottish Water should communicate clearly its activities on responsive asset repair and refurbishment and demonstrate the efficiency and effectiveness of its approach, including its carbon impact.
- Turning now to future capital expenditure:
  - **The average age of the civil engineering structures is increasing – many of the critical treatment works were built fifty or more years ago.**
  - **Expenditure on efficient asset replacement, given its importance to making real progress towards communities' expectations of reducing waste and embracing the circular economy, should normally be the first call on available capital expenditure.**
  - **Over the last twenty years, installing sophisticated treatment to meet higher water and environment quality has increased the proportion of short to medium life assets that Scottish Water operates.**
  - **Over the next twenty years, Scottish Water will take over the operation of all the PPP sites. This will likely increase the required level of expenditure on replacement (the savings have been allowed for in the Tier 1 efficiency challenge).**
- More recently, Scottish Water has been spending more on asset replacement. But, as discussed later, analysis with Scottish Water suggests current expenditure is below what may be the likely long-term requirement.
- The key questions are:
  - **What is the appropriate level of annual expenditure on asset replacement; and**
  - **How long a transition to a sustainable level of asset replacement, is consistent with effective and efficient delivery and ensuring the industry can, at least, maintain customer service and environmental performance?**

*Tier 1 expenditure includes operating, PPP, interest, repair and refurbishment costs.

In its earlier Decision Papers, the Commission identified that expenditure on improving services was unlikely to reduce...

- Scottish Water has reported annual expenditure of around £330 million on enhancement and growth investment for the last decade. However, detailed analysis of past investment suggests that this may overstate the actual expenditure on enhancement and growth of the asset stock.
- The current best estimate suggests that the industry has invested closer to £250m a year on enhancement and growth. The remainder (c.£80 million, annually) is accounted for by expenditure on replacing assets during the implementation of these incremental enhancement projects.
- The overall replacement cost of the asset base operated by Scottish Water has therefore been increasing at around £250 million a year (2017-18 prices).
- Scottish Water is also going to have to respond to the impact of climate change (for example, with regard to its effect on the quality of raw water). While there is obvious uncertainty, we have allowed for an additional £50m a year on average for enhancement expenditure going forward given the ambitions for the industry and for Scotland set out by the Scottish Ministers in their objectives.
- The Commission therefore considers it reasonable to assume that Scottish Water will need to invest at least £300m a year on average for the foreseeable future to meet the likely Objectives of the Scottish Ministers.

Scottish Water's information and analysis

Scottish Water is constantly working to improve its understanding of its asset replacement needs...

- Scottish Water is taking welcome steps to improve its monitoring of asset condition and its understanding of failure modes and expected asset lives. This is, however, likely to take time.
- As noted earlier, no water and sewerage company can predict exactly when failure will occur. It has to act prudently if it is to maintain (and improve) service levels.
- Scottish Water has set out its current understanding of its portfolio of assets and the likely asset lives and replacement costs of its various asset types. It has defined ranges for both asset life and replacement cost.
- As an example, Scottish Water currently estimates that its water mains could last up to around 130-140 years on average. Such estimates are obviously very uncertain - only a relatively small number of water mains in Scotland have reached even the estimated average age and there have been failures.
- Confidence in replacement costs and asset lives will increase when Scottish Water has experience of replacing similar assets.
- Scottish Water suggests these ranges be used for estimating the likely funding requirement to allow for appropriate and timely replacement of assets in future.
- Actuaries are in a similar position when they analyse the funding of pensions – they know only a limited amount about the members of a pension fund. They use statistics (reassessed when better information becomes available) to assess the required level of funding.
- Professor Dr. Bryan Adey of the Institute of Construction and Infrastructure Management, ETH Zürich has agreed to work with Scottish Water in this area. His involvement will likely be critical to building and maintaining stakeholder confidence.

As part of its analysis, Scottish Water has allocated its assets to the following three categories...

CATEGORY 1* Repair and Refurbish Assets in perpetuity	CATEGORY 2 Replace Assets	Category 3 Business Services
Sewers	Water and Waste Water Treatment Works	Digital
Raw Water Aqueducts	Treated Water Storage	Property
Dams and Impounding Reservoirs	Water and Waste Water Pumping Stations	Logistics
	Water Mains	Other Business Assets
	Sewage and Sludge Pumping Mains	
	Long and Short Sea Outfalls	
	Raw Water Mains	
	Combined Sewage and Emergency Overflows	
	Sludge Treatment Facilities	
	Other Water and Waste Water Operational Assets	

*Category 1 costs are allowed for in the 'Tier 1 Expenditure': operating, PPP, interest, repair and refurbishment costs

Scottish Water has also sought to categorise its different assets by their expected life...

	Water	Wastewater
Short-Life Assets	Water Meters MEICA	MEICA
Medium-Life Assets	Raw Water Pumping Stations	Sewage Pumping Stations
	Treated Water Pumping Stations	
Long-Life Assets	Raw Water Mains	Sewage and Sludge Pumping Mains
	Civil engineering structures	Combined Sewage and Emergency Outflows
	Treated Water Storage	Other Sewage Structures
	Water Mains >300mm	Cess and Septic Tanks
	Water Mains <300mm	Civil engineering structures
		Sludge Treatment Facilities
		Long and Short Sea Outfalls

Scottish Water analysed each category of asset and made a broad estimate of maximum likely ranges for replacement cost and average life...

	Replacement cost (£m)		Lifetime (years)	
	Low	High	Low	High
Water Service				
Source				
Raw Water Pumping Stations	£90	£160	25	50
Raw Water Mains	£540	£900	90	140
Water Treatment Works				
Civils	£1,190	£1,790	60	100
MEICA*	£1,460	£2,190	15	25
Distribution				
Treated Water Storage	£1,480	£2,920	60	100
Treated Water Pumping Stations	£150	£250	25	50
Water Mains >300mm	£3,480	£5,800	90	140
Water Mains <300mm	£8,360	£12,540	80	130
Water Meters	£70	£120	5	15
Waste Water Service				
Collection				
Sewage and Sludge Pumping Mains	£390	£650	50	100
Combined Sewage and Emergency Outflows	£300	£450	80	120
Sewage Pumping Stations	£900	£1,340	25	50
Other Sewage Structures	£200	£400	60	100
Cess and Septic Tanks	£240	£470	50	80
Waste Water Treatment Works				
Civils	£1,480	£2,230	60	100
MEICA*	£1,810	£2,720	15	25
Discharge				
Sludge Treatment Facilities	£150	£250	60	100
Long and Short Sea Outfalls	£350	£550	80	130
Business Services				
Waste Water Service PFI Sites				
Civils	£630	£940	60	100
MEICA*	£770	£1,150	15	25

*MEICA is mechanical, electrical, instrumentation, control and automation equipment

Scottish Water then made an assessment of its understanding of each of these asset categories and allocated an appropriate confidence grade...

Zone	Definition
Zone 1	Cases where Scottish Water judges it has a good level of understanding of both replacement cost and asset life
Zone 2	Cases where Scottish Water judges it has a good level of understanding of replacement cost but only a fair grasp of asset life.
Zone 3	Cases where Scottish Water judges it has a good level of understanding of asset life but only a fair grasp of replacement cost
Zone 4	Cases where Scottish Water judges it has a fair grasp of both replacement cost and asset life
Zone 5	Cases where Scottish Water judges it has a weak understanding of both replacement cost and asset life
Zone 6	Cases where Scottish Water judges it can not make an estimate of both replacement cost and asset life

The confidence grades (each of which has a different colour) give Scottish Water's view of the appropriate range for its replacement cost and life...

- This example is for raw water mains. The annual estimated cost reflects the replacement valuation (X Axis) divided by the Lifetime (Y Axis).
- Over time, there may be changes in expected asset lives, expected replacement costs and the positioning of expected annual replacement costs within the potential range of possible outcomes.

Raw Water Mains

Replacement Valuation (£m in 17/18 Prices)

Lifetime (Years)	540	568	595	623	651	678	706	734	762	789	817	845	872	900
90	6.0	6.3	6.6	6.9	7.2	7.5	7.8	8.2	8.5	8.8	9.1	9.4	9.7	10.0
94	5.8	6.0	6.3	6.6	6.9	7.2	7.5	7.8	8.1	8.4	8.7	9.0	9.3	9.6
98	5.5	5.8	6.1	6.4	6.7	6.9	7.2	7.5	7.8	8.1	8.4	8.6	8.9	9.2
102	5.3	5.6	5.9	6.1	6.4	6.7	7.0	7.2	7.5	7.8	8.0	8.3	8.6	8.9
105	5.1	5.4	5.6	5.9	6.2	6.4	6.7	7.0	7.2	7.5	7.8	8.0	8.3	8.5
109	4.9	5.2	5.5	5.7	6.0	6.2	6.5	6.7	7.0	7.2	7.5	7.7	8.0	8.2
113	4.8	5.0	5.3	5.5	5.8	6.0	6.2	6.5	6.7	7.0	7.2	7.5	7.7	8.0
117	4.6	4.9	5.1	5.3	5.6	5.8	6.0	6.3	6.5	6.8	7.0	7.2	7.5	7.7
121	4.5	4.7	4.9	5.2	5.4	5.6	5.8	6.1	6.3	6.5	6.8	7.0	7.2	7.5
125	4.3	4.6	4.8	5.0	5.2	5.4	5.7	5.9	6.1	6.3	6.6	6.8	7.0	7.2
128	4.2	4.4	4.6	4.9	5.1	5.3	5.5	5.7	5.9	6.1	6.4	6.6	6.8	7.0
132	4.1	4.3	4.5	4.7	4.9	5.1	5.3	5.5	5.8	6.0	6.2	6.4	6.6	6.8
136	4.0	4.2	4.4	4.6	4.8	5.0	5.2	5.4	5.6	5.8	6.0	6.2	6.4	6.6
140	3.9	4.1	4.3	4.5	4.6	4.8	5.0	5.2	5.4	5.6	5.8	6.0	6.2	6.4

Scottish Water has allocated a confidence grade to each category of asset. This reduces the implied range for annual average replacement costs...

	Zone Selection	Revised estimate for Replacement cost (£m)		Revised estimate for Asset Life (years)		Revised estimate for Cost per Year of Life	
		from	to			from	to
Water Service							
Source							
Raw Water Pumping Stations	Zone 4	£106	£144	31	44	£2	£5
Raw Water Mains	Zone 5	£595	£845	98	132	£5	£9
Water Treatment Works							
Civils	Zone 4	£1,328	£1,652	69	91	£15	£24
MEICA*	Zone 3	£1,628	£2,022	19	21	£77	£107
Distribution							
Treated Water Storage	Zone 4	£1,812	£2,588	69	91	£20	£37
Treated Water Pumping Stations	Zone 4	£173	£227	31	44	£4	£7
Water Mains >300mm	Zone 4	£4,015	£5,265	102	128	£31	£52
Water Mains <300mm	Zone 4	£9,325	£11,575	92	118	£79	£126
Water Meters	Zone 2	£89	£101	7	13	£7	£14
Waste Water Service							
Collection							
Sewage and Sludge Pumping Mains	Zone 4	£450	£590	62	88	£5	£10
Combined Sewage and Emergency Outflows	Zone 4	£335	£415	89	111	£3	£5
Sewage Pumping Stations	Zone 4	£1,002	£1,238	31	44	£23	£40
Other Sewage Structures	Zone 6	£200	£400	60	100	£2	£7
Cess and Septic Tanks	Zone 6	£240	£470	50	80	£3	£9
Waste Water Treatment Works							
Civils	Zone 4	£1,653	£2,057	69	91	£18	£30
MEICA*	Zone 3	£2,020	£2,510	19	21	£95	£133
Discharge							
Sludge Treatment Facilities	Zone 5	£165	£235	66	94	£2	£4
Long and Short Sea Outfalls	Zone 6	£350	£550	80	130	£3	£7
Business Services							
						£35	£50
Waste Water Service PFI Sites							
Civils	Zone 6	£630	£940	60	100	£6	£16
MEICA*	Zone 6	£770	£1,150	15	25	£31	£77
Rounded totals		**£26,890**	**£34,970**			**£470**	**£770**

*MEICA is mechanical, electrical, instrumentation, control and automation equipment

This allows Scottish Water to estimate the annual replacement liability for short, medium and long-life assets...

	Revised estimate for Cost per Year of Life	
	from £m/year	to £m/year
Short-Life Assets		
Water Service	£84	£121
Waste Water Service	£126	£210
Business Services	£35	£50
Medium-Life Assets		
Water Service	£6	£12
Waste Water Service	£23	£40
Short and Medium Life Assets	**£274**	**£433**
Long-Life Assets		
Water Service	£149	£248
Waste Water Service`	£42	£86
	£470	**£770**

- **Scottish Water's analysis suggests that a transition to around £430m (at the top end of the range circled) is required for it to have high confidence that it can replace all of its short and medium life assets.**
- **During any transition, Scottish Water will have to manage the risks associated with allowed for expenditure being below the expected long run requirement.**

*The totals do not add due to rounding

WICS' analysis

The Commission welcomes Scottish Water's progress in this area...

- Scottish Water has improved the efficiency and effectiveness of its planning and delivery of capital expenditure considerably since 2002. The Commission considers that Scottish Water should build on this work and improve its understanding of the condition, risks and failure modes of its assets. It also has to develop its understanding of asset lives and replacement costs. As such, the Commission is very supportive of the work that Scottish Water is doing with Professor Dr. Bryan Adey.
- Based on Scottish Water's current asset knowledge, its range estimates for asset lives and the potential replacement costs of assets appear to be broadly reasonable, albeit it appears more likely that they understate rather than overstate the future challenge. The Commission conducted a rigorous sensitivity analysis of its assessed range for investment. Its prospects for prices paper will similarly test the potential price profiles.
- For example, Scottish Water currently estimates that its water mains could last up to around 130-140 years on average. There are, however, only a small number of water mains in Scotland that have reached that age, and there have been some failures...
- The Commission also considers that Scottish Water's progress in developing its understanding of its assets should be reviewed regularly. Regular reviews will help maintain the confidence of customers and stakeholders more broadly.
- The Commission considers, particularly given its responsibility to future customers, that it should take a prudent approach.

The Commission has considered a range of factors in coming to its view of Scottish Water's long-term need for funding...

- The Commission will use Scottish Water's asset information to establish a long-term trajectory for prices. There are several further factors that the Commission has considered.
- The Commission identified three factors that could potentially increase the future cost of replacing assets:
  - **Replacing assets whilst not interrupting service;**
  - **Replacing assets in more developed areas (for example works may now be much closer to, or even in, built-up areas); and**
  - **New regulations, for example on safety or noise, may well increase future costs.**
- The Commission considers it reasonable to expect Scottish Water to continue to improve the overall efficiency of its asset management – albeit perhaps not as dramatically as in recent years. It also expects Scottish Water to access the benefits of innovation.
- Taking account of costs pressures and the scope for innovation, the Commission believes Scottish Water should match the productivity improvement of the economy as whole.

Ongoing investment in enhancement and growth will put an upward pressure on the replacement costs that the Commission has to allow for...

- The Commission notes the continuing need for investment in enhancing levels of service, improving water quality or the environment.
- Investment in enhancement and growth of £300 million a year (in 2017/18 prices) for 20 years would add £6 billion to total asset replacement cost.
- An additional £6 billion relative to Scottish Water's estimated asset replacement cost of £35 billion (see page 24) is very significant – around 15%.
- Due to increasing technical complexity, enhancement investment is often in short and medium life assets.
- It is typically more difficult to defer the replacement of short and medium life assets as they tend to have a more immediate impact on operational performance.
- Taking account of the likely mix of short, medium and long life assets in Scottish Water's investment in enhancement and growth, the Commission estimates that the future average annual replacement costs of these new assets at the end of the transition will likely be c.£130-180 million. This needs to be planned for.

The Commission has sought to draw on Scottish Water's analysis of asset lives to understand the urgency of making progress...

	Revised estimate for Asset Life	
	from years	to years
Short and Medium Life Assets		
Simple Average	18	22
Weighted Average	20	26
Widest reasonable range	**18**	**26**

- The industry appears to face an immediate challenge: to take appropriate account of the need to meet the asset replacement requirements of the short and medium life assets. This is an important initial milestone. Otherwise levels of service to customers and environmental performance could be compromised.
- A simple average of the information available on expected lives for the short and medium life assets suggests a range of 18 to 22 years.
- Weighted by replacement cost, this range increases to 20 – 26 years.
- The replacement cycle for short and medium life assets can therefore reasonably be viewed as 18 to 26 years.
- The risk that Scottish Water will not have sufficient resources to replace its assets efficiently and effectively rises as the length of the overall transition increases. Extending the overall transition will also result in there having to be more difficult choices in prioritising the available investment.

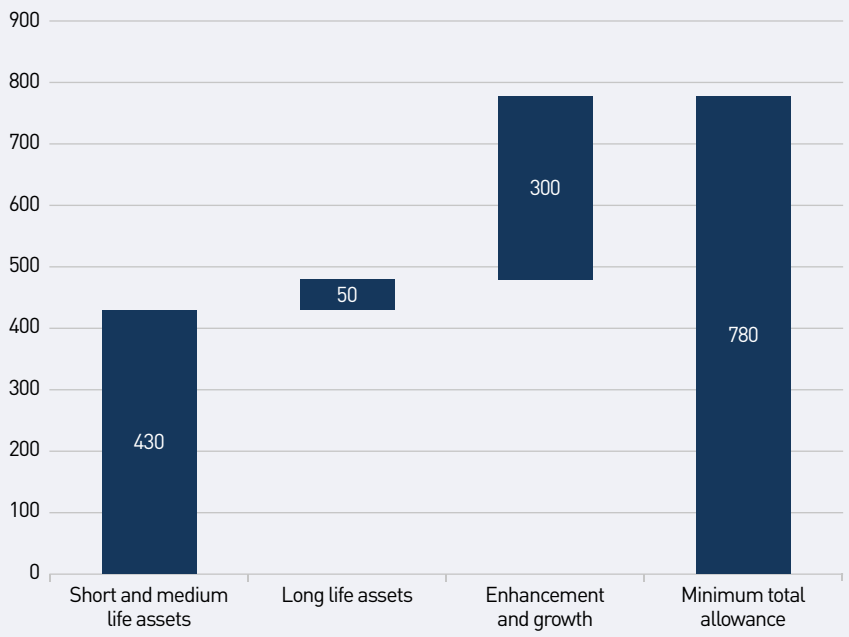
Scottish Water's short and medium life assets are already at least 10 years old on average. The initial milestone must take account of this...

- Scottish Water has to be funded to replace its short and medium life assets. In determining the level of funding available to Scottish Water, the Commission has to recognise that Scottish Water's short and medium life assets are already at least 10 years old on average (Scottish Water believe that the average asset life is actually around 13 years).
- To ensure that assets could be replaced at the end of their lives on average, Scottish Water will have to reach the appropriate average annual level of expenditure in 8 to 16 years (the expected short and medium asset life of 18 to 26 years minus the current estimated average life of 10 years).
- As previously noted, the much improved levels of compliance with water and wastewater standards is substantially due to investment in short and medium life assets. Failures in these assets would immediately impact compliance.
- As its assets age, Scottish Water will have to pay more attention to maintenance and cost management. Its decisions on replacement should be based on robust economic appraisal incorporating carbon. All else equal, extending the deadline for the sustainable funding of short and medium life assets beyond the maximum average remaining life of 16 years can only increase risk, may impact performance and may increase carbon emissions and costs. This would be inconsistent with the draft Objectives of the Scottish Ministers and the statutory duty of the Commission to have regard to the interests of future customers.
- The Commission notes that if the £430 million milestone for short and medium life assets, highlighted on page 25, were only reached at the end of the up to 16 year window there would be little or no resource available to meet the replacement of long life assets. As such, the Commission considers it to be prudent to allow for at least some replacement of long life assets in this interim period – an allowance of £50 million would seem to be a minimum prudent level given the identified £190 to £340 million range for long life assets. This requires asset replacement to reach £480 million (£430m for the short and medium life assets plus £50m for the long life assets) by 2037 at the latest.

Scottish Water will also have to invest in enhancement and growth during this period.

- The previous page set out the investment expenditure that will be required to meet the initial milestone (replacing short and medium life assets when they reach the end of their lives is critical to maintaining standards of service).
- The Commission recognises that Scottish Water will require at least a further £300m per annum on average over time to continue to improve water and wastewater quality, fund future growth and meet the industry's contribution to Scotland's target of net zero carbon emissions by 2045.
- This implies a minimum total allowance for replacement, enhancement and growth expenditure of £780m a year being achieved in the period between 2029 and 2037.

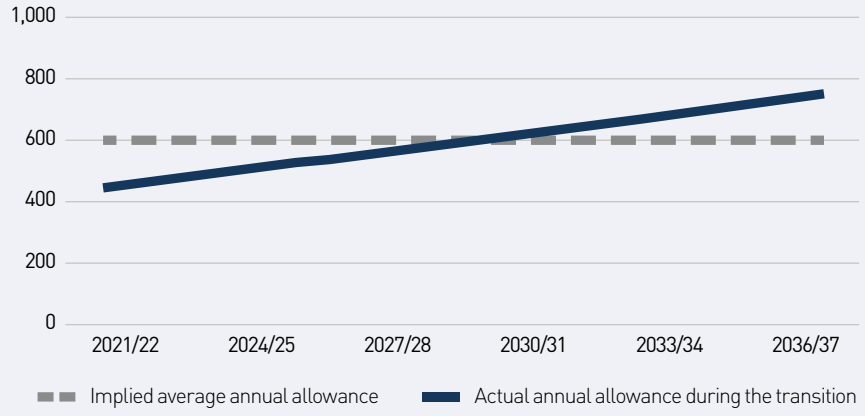
Minimum allowance during the period 2029 and 2037



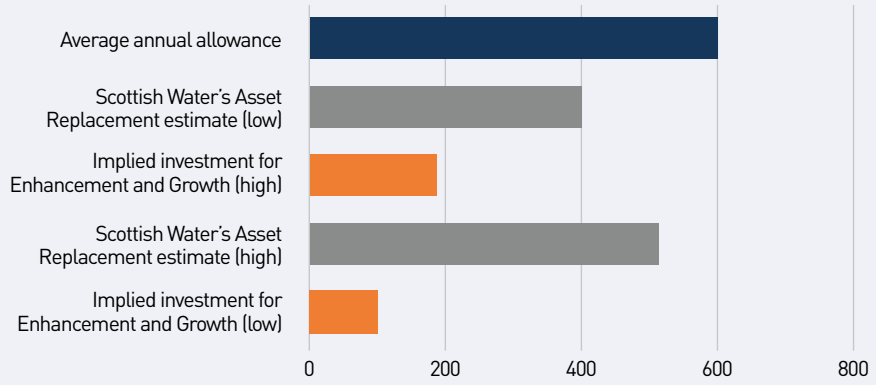
Scottish Water believes that its asset replacement investment needs will exceed that allowed for during the transition period.

- Achieving the initial milestone of a £480 million allowance for asset replacement, implies an average annual allowance over this time of around £300 million.
- Scottish Water currently expects that it may have to spend around £400m to £490m on average over the 8-16 years journey to the initial milestone. Such an expectation is obviously well in excess of the implied average annual allowance over this period.
- Priorities for investment will have to be defined through the investment planning and prioritisation framework.
- If Scottish Water is able to justify this additional spend on asset replacement at the investment planning and prioritisation group, only around £110m to £200m enhancement and growth investment on average would be available for enhancement and growth until the first milestone is reached. This range reflects the £600m average investment allowed for (£300m for enhancement plus an average of £300m for replacement) less £400m to £490m of expected expenditure on replacement).

Investment profile over the 8-16 years journey



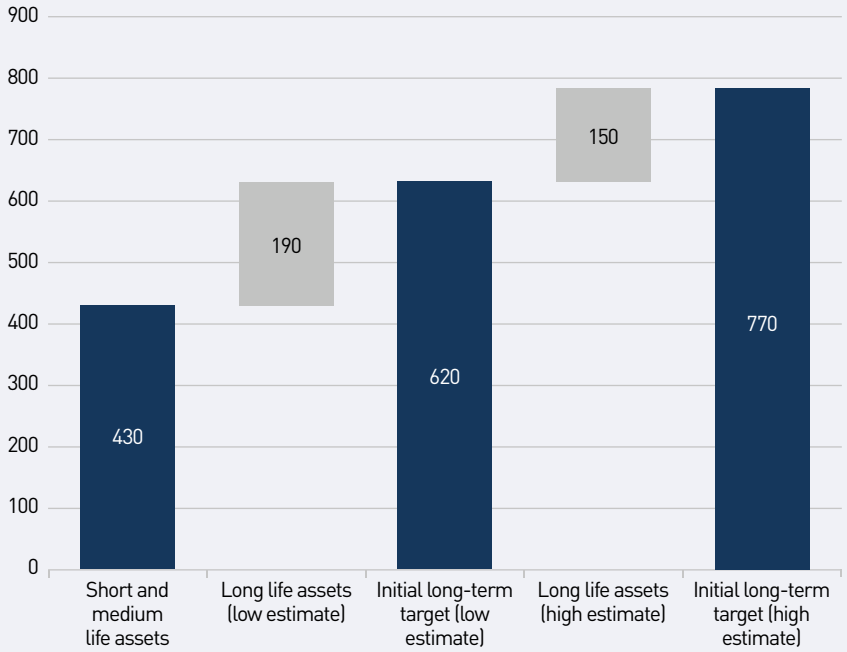
Potential investment remaining for enhancement and growth during the first 8-16 years



The Commission has also looked carefully at the appropriate allowance for asset replacement for the longer term – recognising that it will have to ensure long life assets can be replaced effectively and efficiently...

- This paper has explained that Scottish Water will require £430m each year in 2017-18 prices to meet its average annual expected expenditure on replacing short and medium life assets.
- It is also important to make progress towards meeting Scottish Water's estimate for the annual allowance that it will, in future, need to commit to the replacement of its long-lived assets. Scottish Water's analysis suggests a range for the replacement costs of long-life assets of between £190 and £340 million.
- This implies an initial long-term target range for replacement of the current asset base of £620–£770 million per annum (£430m plus £190–£340m).

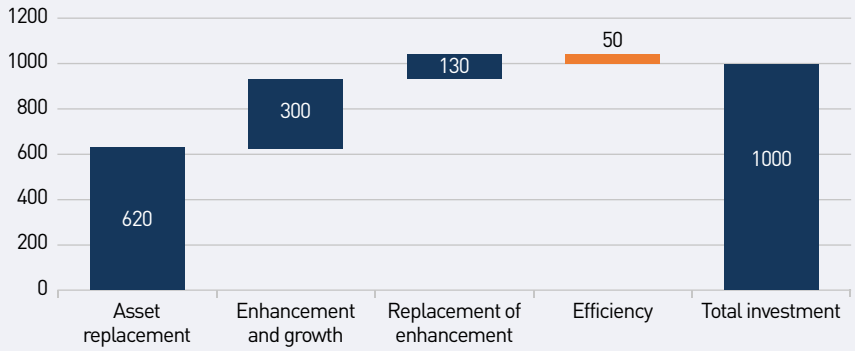
Initial long-term target range for replacement



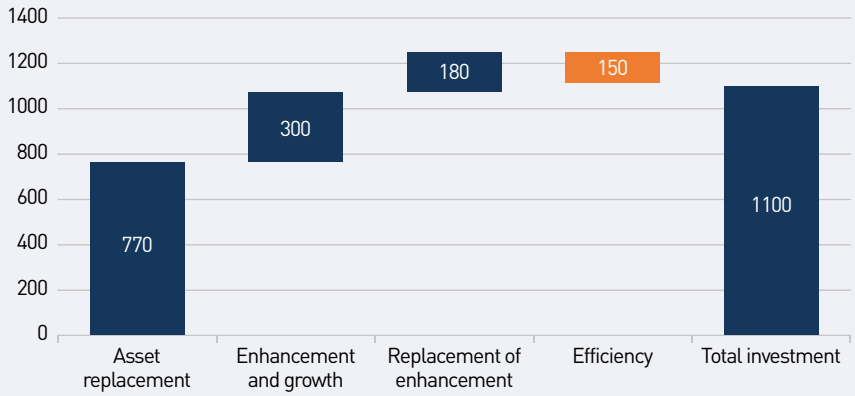
Playing a full part in Scotland's move to net zero carbon emissions requires the Commission to allow for effective and efficient replacement of all assets by 2045...

- Improving water and wastewater quality and funding future growth will likely require at least £300m of enhancement expenditure per annum.
- This would give a total allowance for replacement and enhancement expenditure of £920–£1070 million a year (the £620 to 770m from the previous page plus the £300m).
- Future replacement need arising from this new enhancement investment could reasonably be expected to require additional funding of £130-180 million a year by the 2045 deadline for net zero carbon emissions.
- This suggests a target total investment range of £1,050 million to £1,250 million before efficiency (£920m + £130m to £1,070m + £180m).
- The Commission considers that an efficiency challenge of £50–£150 million is broadly reasonable.

Target total investment (the bottom of the likely range)



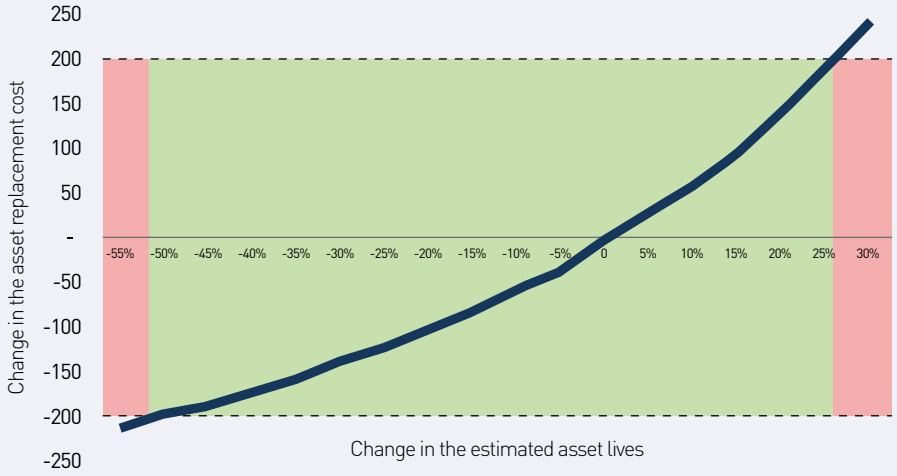
Target total investment (the top of the likely range)



Using the proposed broad range allows for the realistic potential uncertainty in average annual replacement costs

- The £200m range before efficiency allows for expected average annual replacement cost to vary by more than 25% from the central estimate.
- Some of Scottish Water's estimated asset lives (for example, water mains) appear more likely to understate rather than overstate the asset replacement challenge. Factoring carbon into this investment decision may further shorten asset lives (because of the carbon implications of more frequent repair interventions).

Asset Replacement Cost Sensitivity Analysis



Conclusion

There is a clear need to transition – and 2045 is a clear deadline...

- Analysis of Scottish Water's asset information suggests there is an initial milestone that must be met: the sustainable funding of short and medium life asset replacement.
- It seems prudent to plan on Scottish Water having high confidence that it can meet its need to replace short and medium life assets as soon as this is practically possible.
- There will also have to be a transition in funding that allows for the efficient and effective replacement of all assets when the time comes.
- By the end of any transition, expenditure should reach a level consistent with Scottish Water being able to replace all of its assets effectively and efficiently at the end of their lives. Scottish Water will be expected to play an important role in helping achieve Scotland's target of net zero carbon emissions by 2045. Appraisals will have to take account of carbon.
- Given the Scottish Government's 2045 target date for net zero emissions, it is essential that the industry is appropriately funded to meet its asset replacement needs on a sustainable carbon neutral basis by this point. This coincides with the end of the fourth regulatory control period.

The Commission's analysis suggests that the transition is achievable but challenging...

- It is important to emphasise that during the required transition, however effectively and efficiently it is managed, the overall average condition of assets will deteriorate. Scottish Water will have to manage the impact on levels of service and compliance.
- The Commission also notes that Scottish Water's assessment of its total asset replacement liability is more likely to understate than overstate the likely requirement. However, its analysis suggests that it is unlikely that the actual outturn will be outside the modelled range.
- There will, of course, be uncertainty about the cost that will be incurred in replacing assets. This uncertainty is compounded by particular uncertainty with regard to long-life assets. Scottish Water recognises that it has to take steps to improve its understanding of asset lives and replacement costs.
- Professor Dr. Bryan Adey of the Institute of Construction and Infrastructure Management (IBI), ETH Zürich has agreed to work with Scottish Water in this area and report to stakeholders on progress.
- The Commission may revise its view in its Final Decision Paper depending on the outcome of Scottish Water's co-creation of its Strategic Plan and the finalisation of Ministers' Objectives and Principles of Charging.

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