9 Costs and efficiency

This chapter provides information on the cost forecasts that underpin our Plan. We explain the drivers of our costs, clarify and justify our assumptions on efficiency, explaining how we have ensured our Plan is ambitious and efficient. We explain how we have factored in the Energy Networks Association core scenario, summarise the trends in and justification of our costs and explain how we have optimised our Plan to manage significant workload and cost pressures.

This chapter has the following structure:

Key messages

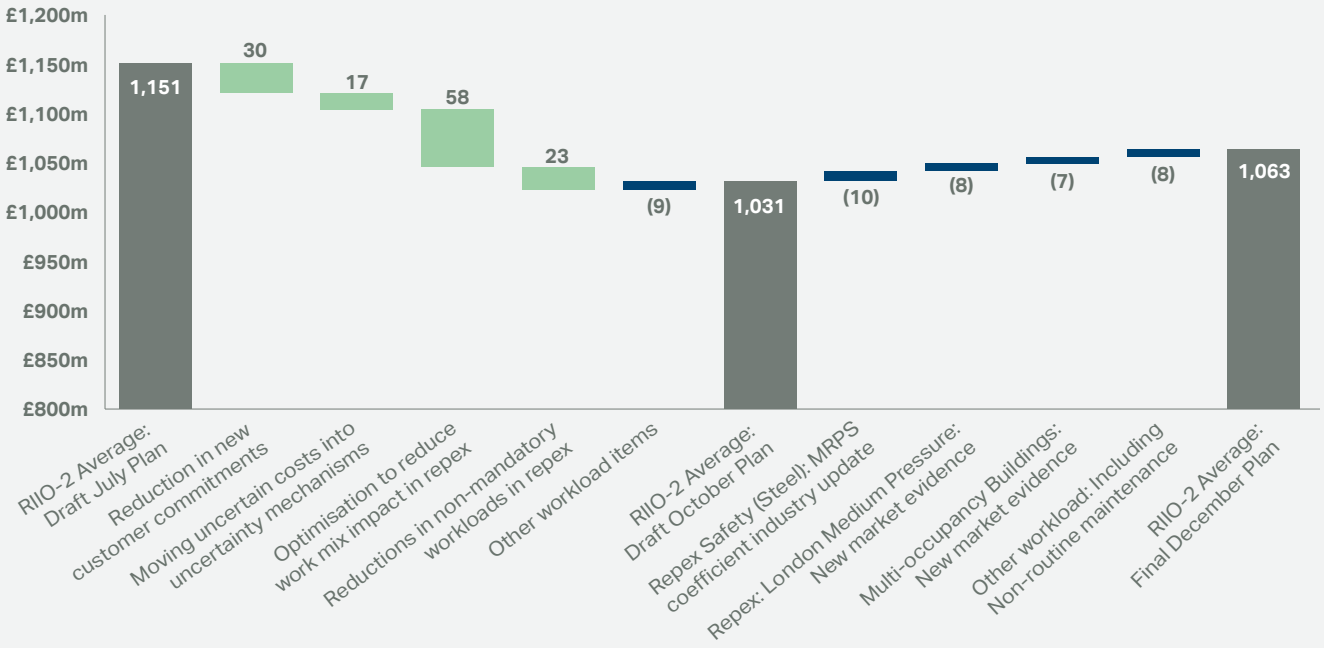
- We are forecasting investment of £3,146m in RIIO-2. £2,392m of this is on replacement activities mainly driven by our Iron Mains Risk Reduction programme.
- We have worked hard to optimise our Plan ensuring we mitigate and offset significant upwards workload and cost pressures, by focusing on totex solutions and challenging our non-mandatory work volumes.
- We have instigated a transformation programme that will deliver a step-change in our cost performance over the rest of RIIO-1 and into RIIO-2. We have closed the efficiency gap by £29m in 18/19 and are well on our way to delivering further progress by 20/21. This significant efficiency programme reduces our proposed cost projections by £92m p.a. against our RIIO-1 average totex.
- Our standalone RIIO-2 efficiencies represent a 0.94% p.a. ongoing efficiency, ahead of Bank of England estimates of total factor productivity and the RIIO-1 benchmarks. By the end of RIIO-2 this equates to a £43m reduction (4.6%) on our underlying annual totex spend.
- We have benchmarked our Plans against industry costs and other external costs and our planned totex is 2.2% lower than the forecast upper quartile efficient level over the RIIO-2 period, addressing our historic performance gap.
- Our average annual totex in RIIO-2 is 1% or £6m lower than RIIO-1, as our efficiencies more than offset other workload and cost pressures.
- We have built our Plan around the industry core scenario. Alternative scenarios have a limited impact on our operations due to our legislative requirements to operate a safe network. Where we have optionality on economically justified workload, we have applied a high hurdle rate to ensure our investment plan is 'no regrets'.
- We are confident that our Plan is stretching and ambitious and presents great value for all of our customers.

Costs and efficiency

Changes in our totex plan between July and December

We have been through a thorough review process to refine our totex forecasts over the last six months, ahead of our December Plan submission. This has resulted in a significant reduction in our investment spend as we have completed analysis on our replacement expenditure, updated our capital programme and have completed our Cost Benefit Analysis and asset health modelling in line with the sensitivities we had previously outlined. The changes in our average totex between plans are detailed in Figure 09.01 below:

Figure 09.01: Cadent RIIO-2 average annual totex – key movements between our July, October and December 2019 plans



The increase between October and December is driven by two areas. First, we have completed an industry audit on the risk scores allocated to steel mains which has increased individual pipe's risk scores and increased our workload by 17km p.a. This is in line with our previous approach and simply updates the final risk scores; Secondly, we have updated costs where we have sought market evidence or detailed design to provide high confidence costs. This includes updating our London Medium Pressure cost estimates, on the back of completing conceptual design that highlights the specific engineering challenges of the proposed work. We had also initiated a tender process to support the cost estimates for our MOBs fault repair programme and have reflected the initial bids in our pricing for this work. This leaves a reduction of £88m p.a. against our July draft with totex circa 1% lower than RIIO-1.

9.1 Affordability at the heart of our plan

Our plan sets out our toughest ever efficiency challenge, recognising that our overall cost performance is a key component of setting standards that customers love. Our transformational Plan will **deliver £155m of efficiencies over the RIIO-2 period with an average annual efficiency of 0.94% p.a.** in RIIO-2; this is significantly higher than average UK productivity (e.g. Bank of England forecast Total Factor Productivity of 0.3% p.a. to Q1 2022) which places us ahead of the identified upper quartile efficient level, a clear marker of the challenge we have set for ourselves. To further illustrate the scale of our ambition, if we compare our Plan totex forecasts to the cost of service we started with at the creation of Cadent in 2017, we are committing to deliver over £505m of savings, reducing our average annual costs by £101m p.a. (circa 10%). This should take us to the frontier benchmark through challenging decades of custom and practice, building a new and dynamic culture within our business.

9.1.1 Our transformation journey

In 2016 our CEO initiated a strategic project to assess the extent to which our current operating model was limiting our ability to deliver the same performance and efficiency levels as other GDNs. Over several months, we spent time with the other GDNs and other utility companies and organisations with large field force operations and/or a high degree of workforce planning requirements. This extensive piece of benchmarking work identified three key themes where our operating model was hindering our ability to compete on costs and service:

1. Our operating scale was significantly larger than more successful organisations. **Our highly centralised model had built a level of complexity that others had mitigated** by creating much smaller, more local operating depots. This complexity blurred accountability and moved Decision-making away from those closest to our customers. In effect we were experiencing diseconomies of scale.

2. **There was a gap between our strategy and operational plans.** Whilst our strategy was developed at an organisational level, our process-centric operating model meant that operating plans were typically developed at a process level, for example, separate plans for emergency, connections and planned work. This approach, whilst allowing us to effectively document and focus on specific customer journeys, created significant inefficiencies as resources were generally allocated to a single process – even when carrying out very similar activities such as resource planning.

3. Our **salary structures were higher** and our terms and conditions were less flexible than other GDNs and most similar organisations. Whilst all GDNs started with the same terms and conditions following the process to sell four of National Grid's distribution networks, others had tackled this sooner.

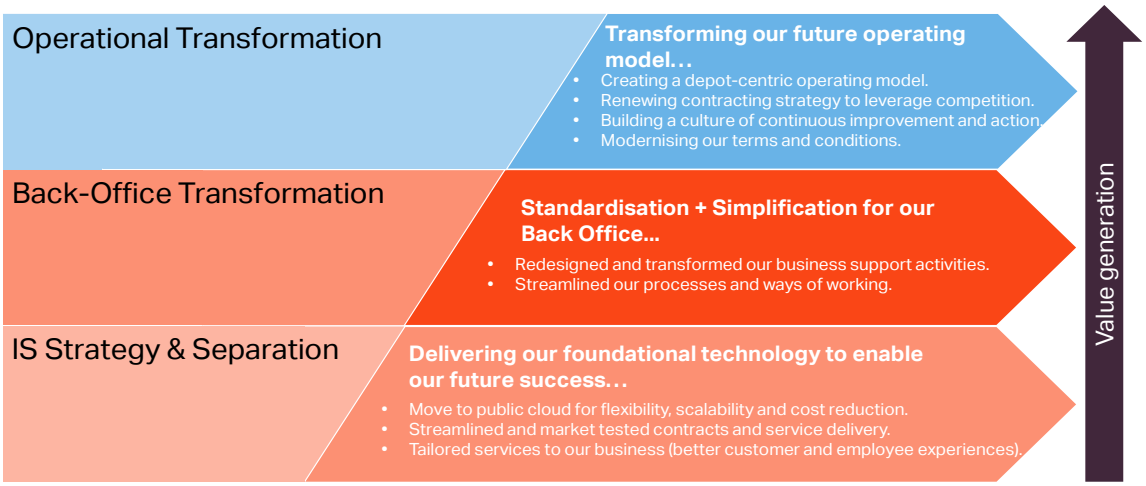
Costs and efficiency continued

Shortly after the strategic project finished, National Grid confirmed its intention to sell the remaining four gas distribution networks, causing us to put these changes on hold as we established ourselves as a stand-alone entity. The process took over two years to complete, but we are now progressing our business transformation at pace, building on the themes identified pre-sale and also leveraging further opportunities that the separation from National Grid has presented – for example, we are developing our own IT strategy, moving away from a traditional onshore physical environment to secure virtual infrastructure solutions based on a cloud-based approach with software as a service.

9.1.2 Delivering transformed experiences

The key components of our transformation programme are shown in the figure below:

Figure 09.02: Our transformation journey during RIIO-1



Our business transformation will see us shift from a highly centralised process-centric operating model into a more regionally aligned model creating much simpler operating areas, clearer lines of accountability and much closer proximity to customers and assets. It will facilitate a more geographically aligned stakeholder engagement process and build on the learning of two recent success stories where we have trialled a more regional approach. The first of these transformed our complaints handling process, which has helped us to shift our performance from the back of the GDN pack to near the front, whilst saving c.£700k in opex a year. We have also established regional Revenue Officers, working with local teams to ensure that claims related to damages to our assets are processed efficiently and effectively. This led to a significant decrease in missed revenue.

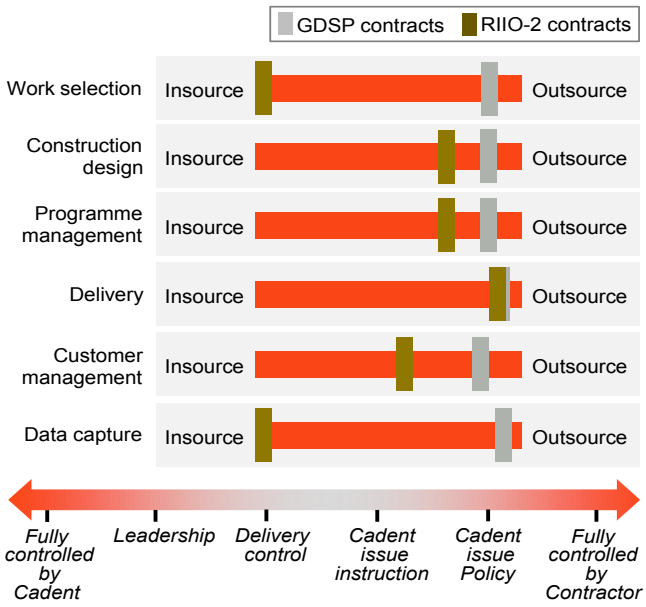
In early 2019 we embarked on four pilot studies, involving one depot in each network. These have tested different aspects of the transformation ranging from how connections work is delivered, to creating a single replacement delivery team. In each case, lessons have been and continue to be learned. In May 2019 we completed the appointment of four Network Director roles implementing the high level realignment into a network model under a newly appointed Chief Operating Officer (COO). Our Transformation Programme remains on track to complete the teams' realignment under the new Network Directors. We are moving asset-related decisions into the Networks and creating a much closer link between workload planning and delivery. This will be completed by early 2020.

The key components of our transformation programme are described in more detail below:

Operational transformation:

- **Creating a depot-centric operating model:** We have learnt that our scale can sometimes hinder our performance. In the past, we have centralised Decision-making and accountability for customers. This has created a separation from the customers we are trying to serve. As a result we have not been able to respond fast enough in a world where our customers expect more and where their needs are dynamic.
- **Renewing our contracting strategy to leverage competition:** Another critical part of our programme is our contracting approach. We have two large strategic partners – with Balfour Beatty in the West, and tRIIO in the East who are responsible for delivering our mains replacement programme. Whilst these contracts benefit from scale and flexibility and have driven significant cost efficiencies for customers, they have not delivered the customer service standards we require in RIIO-1. As we move into RIIO-2 we are looking to move to a more localised approach and to explore the Tier 2 contracting market, opening up our works to more providers and increasing competition in the market. We are already testing this with our construction management model in the North West. This is trialling a new way of working, allowing us to market-test the work as well as test both our (and our contractors') capability to deliver in this way. The diagram below shows how we are evolving our Gas Distribution Strategic Partners ('GDSP') contracts to ensure the skills and accountabilities are better balanced.

Figure 09.03: Our updated contracting strategy



- **Building a culture of continuous improvement and action:** We have invested heavily in our ability to deliver continuous improvement and this remains a key enabler in delivering increased levels of performance in RIIO-1 and RIIO-2. By developing an action-orientated, customer-focused, continuous improvement culture, with innovation and a competitive pull for new ideas, we will permanently transform our culture and in turn our performance. Without this cultural shift our strategy will not deliver what we want in the long term and so creating this environment, where our people can thrive, is critical. We describe our approach to innovation in **Chapter 8**.

- **Modernising our terms and conditions:** We have been reviewing our terms and conditions to ensure they are representative of the market and critically align with delivery of great customer outcomes. For example, we recently introduced new terms and conditions which are much more aligned with market median pay. We used several industry and non-industry, specific pay and reward benchmarks to baseline these against and agreed their implementation from October 2018. This, in addition to a commitment to a zero management pay increase in 2019, are amongst the initiatives to address the third core finding from the benchmarking review we completed in 2016.

In focus – A depot-centric model

We have set about transforming our operating model designed around the customer experience. To enable this, we have set out to create 'Customer Operations Areas', naturally aligned to Customer communities (e.g. Leicester, Stoke-on-Trent). The local team will be accountable for all customer outcomes, they will be engaged in our asset investment process and have full visibility and control over their workloads. The model will incorporate a modern, technology-enabled direct labour organisation, which matches market levels of costs and productivity. This will also allow us to integrate with locally based, and more agile, contractors.

We have also recognised that to support fast and effective local decision-making, we need to reset the leadership model from a historically hierarchical, command-control model to a commitment/promise-based approach, supporting entrepreneurial attributes in our engineers and local leaders.

We will also decentralise and geographically align core business support capabilities to enable decision-making close to the customer, including planning, work management, commercial controls and complaints management. The model will enable new ways of working and delivery methods with the fast adoption of new technology and local teams leading input to innovation.

Back-office transformation:

- **Creating a back office that is tailored to our needs:** We have taken the opportunity to redesign and transform our back office. As part of the National Grid shared services model we were subject to a 'one size fits no one' approach which caused many frustrations and delays for us. We have focused on streamlining our processes and ways of working to ensure we deliver the best outcomes for gas distribution customers.

IS strategy and separation:

- **A clear IS strategy:** IS is a key component of our operations and given our scale is a significant driver of costs. As we move off legacy National Grid systems, our IS function is a key enabler of what we want to achieve now and into the future. We need to become more efficient in the way we deliver IS. We have streamlined and market tested contracts and service delivery and used the transition to define tailored services to our business with a move to the latest cloud-based technology.

As we have described in the previous section, we have built our transformation plans and efficiency forecasts from the bottom-up, based on a number of external benchmarks and insights.

9.2 Benchmarking our plan

We have undertaken a thorough process to establish the efficient benchmark for the industry which, when combined with our ambitious efficiency plans, gives us confidence we are proposing a stretching plan for our customers. We have done this in four steps:

- Established current upper quartile performance
- Assessed ongoing efficiency
- Defined our efficiency ambition
- Tested how we compare to the upper quartile

The remainder of this section summarises our assessment; further details are provided in **Appendix 09.20 Resolving our benchmark performance gap**.

9.2.1 Establishing current upper quartile performance

We have considered a range of alternative cost benchmarking sources, including:

- **International gas distribution benchmarking:** Previously, Ofgem and GDNs have looked into the possibility of benchmarking outside the United Kingdom but found it very difficult to make valid comparisons due to differences in legislation, age of pipe, iron mains population, exchange rates and level of separation between supply, metering, transmission and distribution. We have reviewed external assessments of Phoenix Natural Gas and Firmus Energy in Northern Ireland and the eight GDNs[1]. In 2017 The Utility Regulator used this benchmarking to find that GB GDNs were significantly more efficient than the Northern Irish equivalents[2].

- **Other external benchmarks:** Ofgem have completed external benchmarking of Business Support costs by asking Hackett Group to use their database to compare energy utilities to other comparable industries. This revealed that the GDNs compared favourably and we have all since reduced Business Support Opex by 16%. This would indicate that GDN support costs are efficient when compared with other industries.

  As part of our RIIO-2 planning we have also tried to assess our current performance against other industries for our business support, repex and connections. This has highlighted the difficulty of normalising across industries and data sets, and we have found it difficult to trust the results of the work, even where it shows our activities as leading on efficiency. This demonstrates the difficulty of using external benchmarks for econometric modelling. However we have successfully used external benchmarking across a range of activities such as reviewing our operating model, our customer strategy and new IS infrastructure post-separation.

In developing our cost performance forecasts we have looked at our position in relation to competitors in the UK. To do this, we have evolved the RIIO-1 benchmarking methodology.

We have supported Ofgem through the Cost Assessment Working Group ('CAWG') process. Our analysis concluded that regression is the best technique, but that application of this technique suffers from the fact that the sector involves only eight data points from three network ownership groups. We also conclude that the mixture of both scale and workload drivers, as identified and used in RIIO-1, best meet Ofgem's criteria for models.

1 Deloitte, Annex 4 – GD17 Efficiency Advice, Final Report 11 March 2016.
2 Utility Regulator, Annex 5, Indicative Findings from Top Down benchmarking, GD17, paragraph 4.9.

Costs and efficiency continued

We have thus developed the RIIO-1 disaggregated (bottom-up) and aggregated (top-down) models and taken the following steps:

- We made pre-model normalisations for regional factors. We updated the RIIO-1 two-way regional factor for pay and have also updated for other one-way factors which we have re-evidenced; these are set out in full in **Appendix 09.21 Cadent's regional factors**. These include a number of specific external factors, the majority of which impact costs in our London network (c.£44m p.a., 17%), as well as our East of England network (which includes the Tottenham area) whilst keeping the RIIO-1 regional factors for other gas distribution networks. We have corroborated our London factors by taking part in a joint project with other London network operators, led by NERA and Arcadis, to identify common London factors across water, electricity and gas networks.
- On the disaggregated cost models, we have identified some improved drivers and updated driver coefficients based on engineering and business insight and model fit. However, we think there are limitations to the use of such models as some of the bottom-up models perform poorly from a statistical perspective (r-squared values are typically below 0.7). Across the GDNs, differences in organisational structure, cost allocation, capitalisation policy and solution choices (opex vs capex trade-offs) make it difficult to use bottom-up benchmarking approaches exclusively.
- We have used these new disaggregated models to refresh the totex model, including changing coefficient weights for the current industry proportion of totex for each of the elements. This produces a good model fit, with an r-squared value of over 0.98.

Following Ofgem's consultation on RIIO-2 cost assessment tools, we have also tested the alternative scale-based composite variables put forward. We observed in our response that these have a worse model fit, with three outliers and they do not address known asset differences between networks.

This analysis allowed us to update the aggregated totex model and identified that the 2017/18 performance gap was £50m. However, the disaggregated, bottom-up, view of the efficiency gap was 58% higher than the aggregated, top-down, view – highlighting that it would be wrong to attach undue confidence to a particular approach. Given the known inconsistencies in individual disaggregated cost models and the resultant poor model fits, we conclude that the top-down model should have more weight and so we have derived our assessment of the current performance gap by giving 67% weight to the top-down model. The results identified that our 2017/18 performance gap efficient UQ network level was £60m (6%) p.a.

We have now run the models on the 2018/19 outturns, which has confirmed that we are on track to remove the performance gap by 2020/21, with the gap now down to 3.2% as illustrated in Table 09.01.

Table 09.01: Cadent 2018/19 efficiency gaps

£m p.a.	2017/18	2018/19
Totex (top-down) gap	50	24
Bottom-up gap	79	44
Weighted average gap*	**60**	**31**
Gap as % of totex	6.0%	3.2%

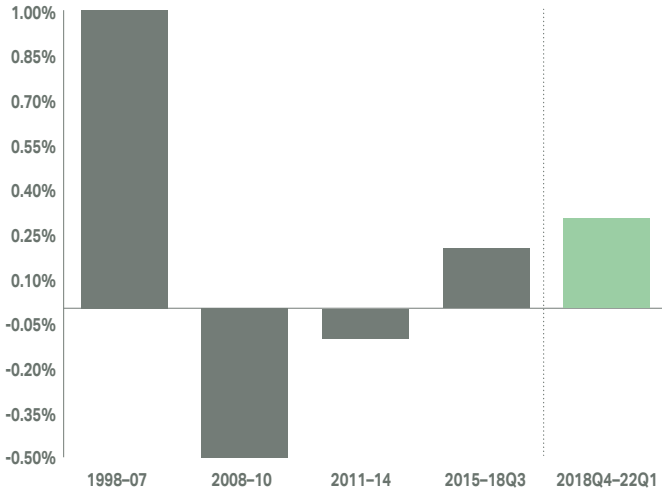
* Given better totex regression fit, using 67% totex, 33% bottom-up weights.

By network, we find that our West Midlands network is on the UQ efficient level, but our other three networks are 3.2% to 4.2% off the pace.

9.2.2 Assessing ongoing efficiency

In order to construct our RIIO-2 Plan, including the provision of an external benchmark against which to compare our forecasts, we wanted an external view about the pace of future productivity improvements. We therefore commissioned a report from First Economics through the ENA that we have submitted alongside our business plan.

Figure 09.04: UK total factor productivity growth



Source: BoE February 2019 Inflation Report

To summarise, the report sets out that productivity growth has been far weaker in the 12 years since 2007 than beforehand as shown in Figure 09.04. Although no one knows how the speed and extent to which productivity growth will improve, authoritative opinion from the OBR and Bank of England would suggest that the most likely outcome is only a small further recovery until 2022 at the earliest.

We have also reviewed Ofwat's Draft Determination of 1.5% p.a. ongoing efficiencies which flows from the combined assessment of long-term historic EU-Klems based assessment of Total Factor Productivity and the opportunity that PR19 might give due to the relatively new totex and outcomes based regimes. We note that the majority of water companies, including some of the fast-tracked companies, are contesting Ofwat's view of the scope for ongoing efficiencies.

In addition to these areas we also considered the potential for innovation to materially shift the efficiency frontier. During RIIO-1 we have used the Innovation incentive mechanism to research new robotic techniques, such as CISBOT. Although the technical development has been successful, and it clearly has benefits on the outcomes we are able to deliver for customers, the low volume of this technology has not materially shifted the efficiency frontier. We have included innovation benefits delivered in RIIO-1 in our cost forecasts and also included forecast benefits in RIIO-2, but these are not material enough to alter our view of sector average productivity.

We consider that a fair central assumption for RIIO-2 period must be below the RIIO-1 assessment and we have thus taken a mid-point of an average 0.53% p.a., equivalent to an eight year ongoing efficiency challenge of 3.4% through to the end of RIIO-2.

9.2.3 Our efficiency ambition

Our ongoing efficiency assumptions are detailed in Figure 09.05. This projection is based on our starting year of 17/18 and assumes flat workload to isolate the efficiencies we are committing to within our RIIO-2 Plan.

Building on our ongoing transformation programme we have assessed further opportunities, including:

- Further efficiencies in operating costs from realising the full benefits of local management accountability, including more flexibility of the workforce to balance more efficiently the different demands.
- Contracting best practice: where changing the contract structures and capturing native competition from our move to local management will drive replacement and capital efficiencies. The level of cost efficiency is however dampened by market price pressures that are protected from our current contracting arrangements.

- Benefits from identifying new best practice, not just from within the industry.
- RIIO-1 innovation.
- A level of unknown efficiencies that will be delivered though future innovation or other, as yet unidentified, improvements.

Overall, in eight years from 2017/18 we are seeking a 11.3% improvement which will reduce our cost base, excluding changes in workload/outputs, by £505m over the RIIO-2 period, with 70% of the savings targeted for delivery before the start of RIIO-2 in order to close the performance gap.

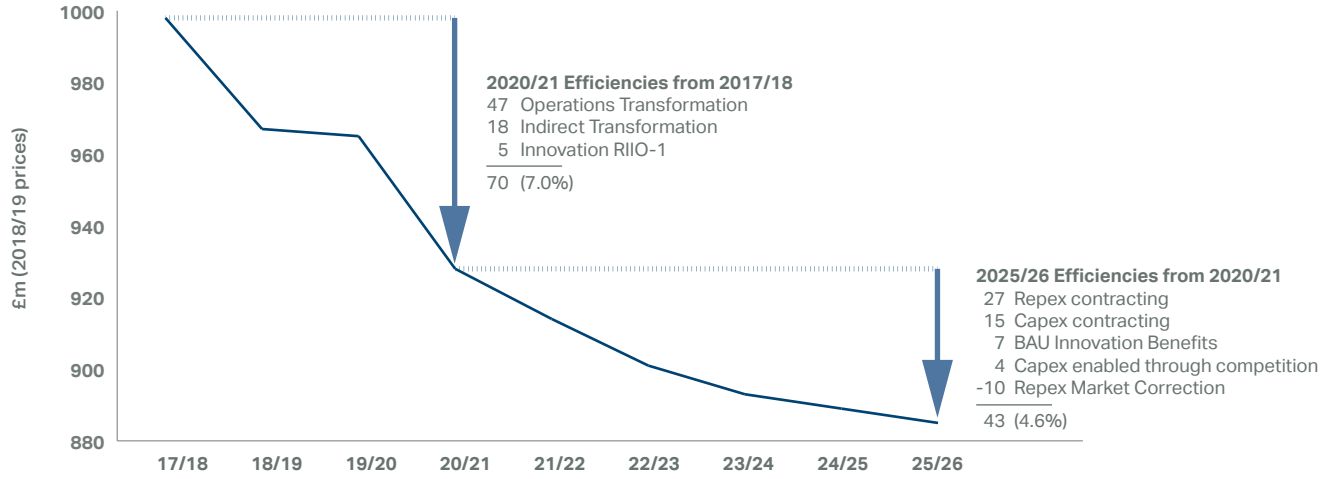
Over the RIIO-2 period we are seeking a 4.6% (0.94% p.a.) cost efficiency improvement, this is above the current UK level of 0.3% p.a. and our assessment of the benchmark for ongoing efficiency improvement of 0.53% p.a.

Table 09.02: Totex efficiency opportunities to 2025/26

17/18 to 25/26		RIIO-2 Period	
8 Year	p.a.	5 Year	p.a.
11.3%	1.5%	4.6%	0.94%

In addition to these ongoing efficiencies our Plan also includes additional output efficiencies where we have committed to deliver new customer commitments at no extra cost to our customers. This provides additional stretch and is the equivalent to delivering **an additional 0.1% annual efficiency** each year in RIIO-2.

Figure 09.05: Totex efficiency forecasts from 2017/18 (flat workload, 2018/19 constant prices)

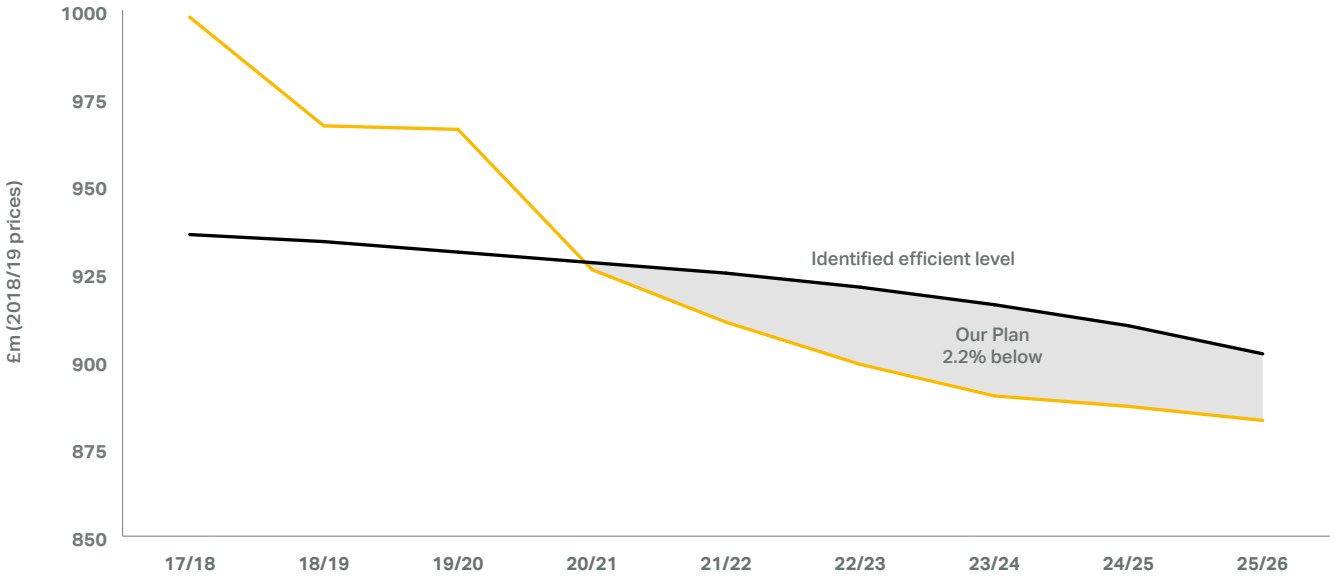


* Based on normalised Totex (i.e. adjusted for benchmarking regional differences)

9.2.4 How we compare to the upper quartile

Using our modelled 2018/19 performance gap of £31m (3.3%) and our assessment of the benchmark ongoing efficiency assumption of 0.53% p.a. our Plan is 2.2% below the efficient level over the RIIO-2 period (and below the efficient level in every individual year). Finally, the Figure 09.06 compares our cost forecasts against our view of an efficient network.

Figure 09.06: Cadent cost efficiency vs efficient level



Costs and efficiency continued

This illustrates that this is an ambitious Plan that is driving significant cost reductions whilst increasing levels of service for our customers. By the start of RIIO-2 our forecasts will close the current performance gap and in RIIO-2 go beyond delivering a plan that is 2.2% ahead of the upper quartile. We have made strong progress against this Plan already closing the gap from 6% to 3.3% in 18/19 (a £29m improvement).

The next section outlines the key cost drivers of our business.

9.3 Understanding our cost drivers

Through our benchmarking and transformation journey it has been important to ensure we have a clear understanding of our cost drivers. This has helped to support Decision-making in RIIO-1 but also to ensure we understand our costs clearly moving into RIIO-2 to ensure we deliver the right outcomes for our customers.

The cost drivers for our business fall under three distinct categories:

- **Price** which reflects the unit cost of performing an individual activity. These unit cost drivers are dominated by our labour rates.
- **Volume** which reflects how much work we need to do, largely driven by the legislation and the condition of our asset base.
- **Work type** which reflects the complexity of different work types we need to complete.

We are clear on the importance of managing all of these drivers to ensure we are executing the right work, at the right level and at the most affordable price for our customers.

Price: Three material factors influence the unit costs of our activities

There are three principal factors that impact our unit cost performance: our transformation programme, underlying labour prices, and the productivity of our direct and contract labour workforce.

These are discussed briefly in turn below:

- **Business transformation and innovation –** Our transformation programme will be a key driver of our cost performance for the remainder of RIIO-1 and in RIIO-2, as will the successful deployment of innovation and competition (described in **Chapter 8**).
- **Labour costs –** The work we undertake is labour intensive. Given this, a key unit cost driver is labour costs. The increasing UK demand for construction resources has an impact on the labour costs we face. We are seeing significant labour market cost pressures and expect this to continue in RIIO-2 given the large number of competing UK infrastructure projects.
- **Productivity –** There are two principal challenges in this area. First, we need to maximise the utilisation of our emergency workforce as traditional meter work drops off due to the roll out of smart metering (discussed in more detail later in this chapter). Second, we are working to increase the number of jobs our teams can complete in a day. For example, in the case of connections, a typical job can take three to five hours. If we can consistently complete jobs in three hours it is possible to deliver two jobs a day.

Volume: There are three principal drivers of work volume

- **Existing or emerging safety requirements** underpin much of our investment plan. As we move into areas of higher service density (terraced streets versus suburban estates) our overall costs increase. New and emerging risks must be addressed, and these can drive additional workload such as high-risk steel pipes or high rise buildings.
- **Economic change** is also a key driver of customer driven work, particularly the volume of connections we undertake and the volume of customer driven work such as diversions and reinforcement (albeit the majority of these costs are recoverable from customers). We are seeing an increase in demand from new customer types such as Compressed Natural Gas filling stations, power generators and shale developers. We are looking at different options for how to manage capacity on the network to best accommodate these customers' needs.
- New initiatives to respond to the **energy system transition** will also drive costs. For example, reconfiguring our networks to allow more sustainable gas sources to be connected is likely to add new costs.

Work type: The mix of work we complete has a material impact on our costs

There will be a change in the mix of **replacement work** that we need to undertake over RIIO-2:

- **Insertion rates –** The extent to which we are able to insert plastic pipes into the existing pipes, rather than having to open cut (dig out an entire new trench) to lay new gas pipes.
- **Project length –** The length of projects that we are able to build impacts on the costs to complete as fixed mobilisation costs are spread over a smaller portion of work or shorter lengths.
- **Material type –** The type of material used in existing pipes has an impact on the techniques we can use. For example, it is more difficult to deploy insertion techniques on steel mains because they cannot be easily cut. Similarly, it can be impossible to insert plastic pipes into existing pipes that have a small diameter.
- **Surface type –** For example, it takes longer to complete work on concrete roads than it does on a suburban grass verge.

Our maintenance and intervention cycles cause peaks and troughs in costs. For example, the mix of work on exposed crossings will change during RIIO-2. We will be intervening on more rail crossings which have a higher unit cost than the canal or road crossings which we have addressed in RIIO-1.

Before we turn to our cost forecasts we will address how we have built our Plan around the industry core scenario.

9.4 How we have adopted the ENA core scenario

We worked with the other gas and electricity networks to determine a Core Scenario that will be adopted by each company in its RIIO-2 Business Plan. We have led an initiative with other networks to understand and communicate how future supply and demand uncertainty impacted our expenditure plans.

The conclusions of this initiative, which was presented to the RIIO-2 Customer Challenge Group, can be found in the **Appendix 09.19 – ENA common RIIO-2 scenarios**. Our Plan is based on this core scenario and where we have identified uncertainty in customer demand we have included appropriate uncertainty mechanisms in our Plan (more detail can be found in **Chapter 10, Managing risk and uncertainty**).

The primary Building Blocks for the gas networks are set out below. In the Tables, materiality was judged to be 'high' if the annual impact was expected to exceed £25m and 'low' if the annual impact was below £5m.

Table 09.03: Supply changes

FES Building Block	Materiality	Network View	2017 reference	GB by 2030	Cadent by 2030
Shale reserves	High	Low	0	5–15bcm	2–6bcm
Low carbon gases	High	Medium	0.25bcm	0.8–1.8bcm	0.39–0.89bcm
Gas vehicles	Low	Medium	1k	48k–104k	24k–51k

Table 09.04: Demand changes

New Building Block	Materiality	Network View	2017 reference	GB by 2030	Cadent by 2030
Hydrogen conversion (including blending)	High	Low	0	0–22bcm	0–11bcm
Gas generation	High	Medium	2.3GW	3.9–9.6GW	2.0–4.8GW
Gas peak demand	Low	High	5.5TWh	>5TWh	1.8TWh

9.4.1 Change in demand over RIIO-2

We assessed the scale of the impact of changes in gas supply and demand on all lines of proposed expenditure. Through this process, we sought to distinguish between baseline costs and costs that will vary in light of uncertain circumstances. Where there is a large range of uncertainty and a significant impact, we have determined volume drivers that can be used to deliver higher or lower revenue in response to actual triggering circumstances.

Our analysis shows that only a very small element of our proposed expenditure has a primary dependence on the future levels of gas supply and demand.

The majority of investment for gas distribution is driven by customers' strong desire to receive a safe and reliable supply of gas. This is supported and underpinned by our safety case obligations. Hence the vast majority of our Business Plan expenditure is non-load related investment. The level of our investment is not particularly sensitive to the level of flows on our network.

9.4.2 Flexibility against future scenarios

Whilst there is broad consensus on the potential ranges for supply and demand changes out to 2030, there is more uncertainty surrounding the multiple pathways to energy transition from 2030 to 2050. We have tested our plans against the ranges of demand and supply forecasts.

To try to help understand future scenarios for the gas network, we have used the four possible stable 2050 End States for the gas network. All these scenarios envisage a substantial change to the way the gas network is used.

Figure 09.07: Possible 2050 End States

Green Gases	The gas network is retained but is delivering low carbon green gases such as biomethane, blended with hydrogen.
Re-purposed for Hydrogen	The gas network is repurposed to transport hydrogen safely to homes, businesses, industry power generators and the transport sector.
Peak and Emergency Energy Store: 'Powerbank'	The gas network is retained to transport hydrogen or green gas to deal with peak and emergency conditions, such as cold spells, or renewable electricity generation shortfalls. Homes would use hybrid heating systems to use clean electricity for most of the year, but an efficient gas boiler on peak days.
Decommissioned	The gas network is decommissioned. This would need close to full electrification of heat and new large scale secure and reliable energy sources for power generation and peak heat. This would require very large scale and highly visible infrastructure upgrades, to at least duplicate the existing electricity grid.

Ensuring flexibility in our plan:

– Use of uncertainty mechanisms

– Targeting innovation

– Investment appraisal

We have assessed the implications of each of these scenarios for the current gas network and hence for our RIIO-2 Plan. We have used uncertainty mechanisms, targeted innovation and adapted our investment appraisal approach to ensure we have the required flexibility in our plan.

Use of Uncertainty Mechanisms:

- We can see a wide range of uncertainty for gas entry (shale and low carbon gases) so we are proposing a re-opener to trigger a revenue driver mechanism to provide financial support for entry enablement. This means that revenues will only be provided if we get a clear signal that these developments are taking place and would be triggered by a charging and access review.
- We are including a flexible revenue driver to support reinforcements for peaking gas generation, and a supporting dedicated customer management service.
- We will undertake connection and reinforcement activities at an earlier stage, but only where there is sufficient risk sharing with the regional authority or other party to avoid asset stranding.

Targeting innovation:

- We have included propositions for a number of projects and other initiatives that will help to develop these pathways, in particular the role of clean gas and further work into hydrogen and hydrogen blending. This ensures our plan is both flexible to develop with the technology and also is proactive in helping to explore these pathways.

Costs and efficiency continued

Investment appraisal:

- Given one of the potential scenarios sees a move away from gas for heating in the long term, we have also tested our plans to minimise the risk of new investments becoming stranded if future policy decisions drive large-scale decommissioning.
- We have not included in our plan any significant discretionary costs that could be avoided or postponed. In our mains replacement plans, we are not proposing a significant level of CBA driven investment beyond maintaining our legal safety obligations.
- We have taken a cautious approach to our investment appraisal using a range of investment indicators such as payback periods, NPV, and NPV spend ratios, to evaluate options, ensuring value for money and a no regrets investment plan.
- We have not identified any anticipatory investment with a sufficiently robust benefits case to justify inclusion in our Plan. Such initiatives will need to be enabled via RIIO-2 uncertainty mechanisms or innovation mechanisms.

9.4.3 Peak demand

Government are expected to deliver the major strategic heat policy decisions in the middle of the next decade, which will be towards the end of the RIIO-2 period, if not later. Until major policy decisions are taken and implemented, we expect to continue to see annual gas demand slowly declining, driven by energy efficiency measures.

However, we do not expect to see a significant reduction in peak demand. The work we have undertaken with the other gas networks shows the impacts of increasing levels of decentralised gas generation in peak conditions. This generation is critical to the secure and reliable operation of the electricity network that cannot rely on intermittent renewables at all times. There is 4.3GW of decentralised gas generation expected by 2030 across our networks indicated by all the energy networks in the ENA's Common RIIO-2 Scenario.

Consumer behaviours may also be changing, and we are commissioning work in RIIO-1 to investigate how to better forecast peak demands. Working from home, and people's prioritisation for personal comfort could result in higher domestic peak demands during very cold spells.

The Chancellor announced earlier this year that he is looking to explore options under which only low carbon fuels can be fitted in new homes post 2025 and hence no traditional gas boilers could be fitted unless they were supported by renewable gas or hydrogen. Whilst this will impact the new connection market as alternatives are assessed, this will not affect the existing heat load which is by far the most material impact on network requirements.

All these demand uncertainties are accommodated by our use of volume drivers for connections and reinforcement capital expenditure.

9.5 Our totex forecast

The following sections describe in turn the key movements and trends in cost across our Business Plan. We have addressed these trends by cost category (operating costs or Opex, Replacement Costs or Repex and Capital Costs or Capex). Before we address Opex, Repex and Capex expenditures we will turn our attention to our totex cost forecasts.

We have set stretching targets across our cost base whilst transforming the services we offer

We seek to deliver the best outcome for our customers by selecting the right interventions, including interventions that increase operating costs, as opposed to capital expenditure. This is demonstrated through our whole life cost investment approach that considers the benefits of enhanced maintenance versus new investment to ensure we are delivering the most effective solution.

Our plans set out a forecast spend of £5,317m totex over the RIIO-2 period. This will allow us to continue to deliver 99.998% reliability, operate a 24/7 gas emergency service for all of our networks and operate the gas emergency number on behalf of the UK as well as a range of new outputs that are set out in **Chapter 7, Our commitments**.

Alongside these services we will continue to invest in our network with £3.1bn of expenditure on our assets to address ongoing deterioration and the increasing risk of some of our aging assets.

Table 09.05 shows our totex forecasts for RIIO-2; we have adjusted these numbers for the purposes of the remainder of this chapter to allow a like-for-like comparison against RIIO-1 – all of these costs have been included in our customer bill modelling. To ensure transparency the adjustments we have made are detailed below:

- **Output cases –** we have removed the additional costs for customer-driven output cases.
- **Xoserve costs –** Xoserve costs are being treated as pass-though in RIIO-2 as confirmed by Ofgem's sector specific Decision Document. We have not included these in our controllable cost forecasts, nor in the RIIO-1 comparison.
- **Pension admin costs –** the treatment of pension admin costs is changing between RIIO-1 and RIIO-2. These costs will be funded as part of our totex allowances in RIIO-2 where previously they were considered as a non-controllable cost. We have therefore excluded them from our like-for-like comparison.

Guaranteed standards

We have not included costs within our totex forecasts for Guaranteed Standards of Performance (GSOP) payments as per the regulatory guidance. However, we do not agree with this approach as it does not reflect the efficient level of costs for our networks. Within **Appendix 09.21** we have set out in full why we believe an efficient level of cost should be funded and our assessment of what that level of costs should be.

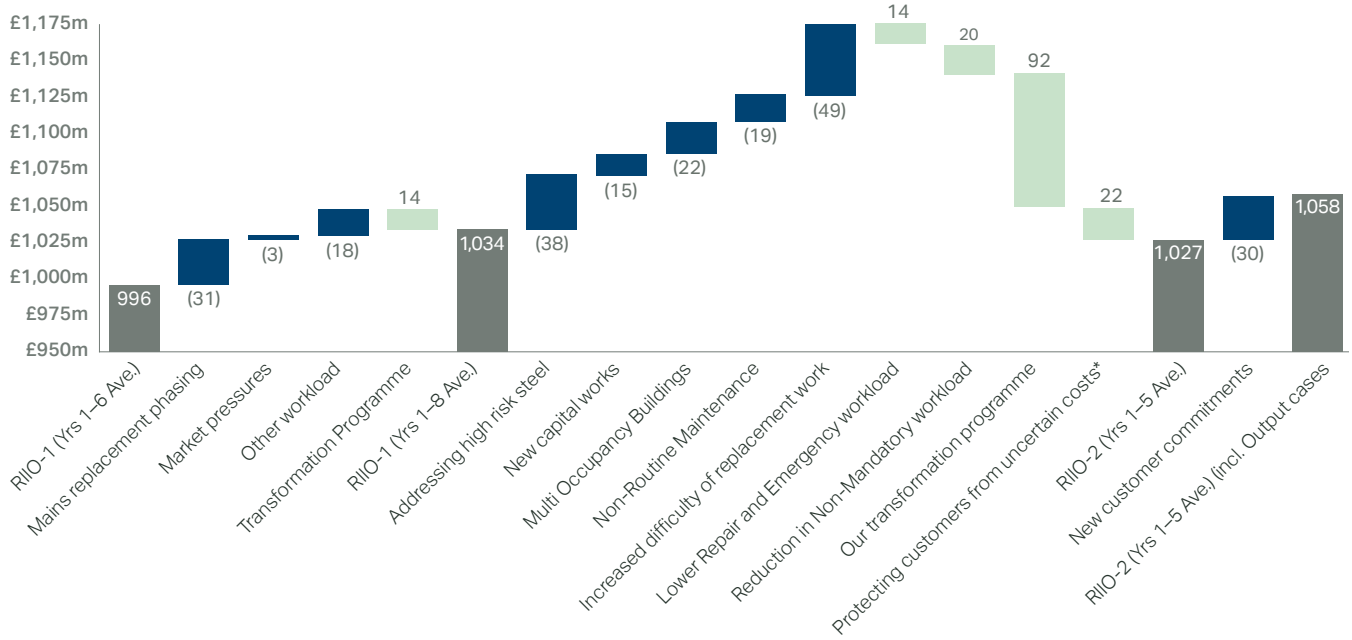
Table 09.05: Like-for-like totex summary

	RIIO-1			RIIO-2						RIIO-1	RIIO-2	Var
£'m (2018/19 price base)	2019	2020	2021	2022	2023	2024	2025	2026	RIIO-2 Total	Av.	Av.	Av.
Opex	423	434	384	415	403	403	385	385	**1,991**	448	398	(50)
Capex	160	218	190	157	180	168	140	109	**754**	153	151	(2)
Repex	432	526	538	478	479	480	478	476	**2,392**	432	478	46
Totex: Adjusted	**1,016**	**1,178**	**1,112**	**1,051**	**1,063**	**1,051**	**1,003**	**970**	**5,137**	**1,034**	**1,027**	**(6)**
Memo items												
Opex: Output Cases	–	–	–	17	18	19	19	20	**93**	–	19	19
Opex: Xoserve	10	13	12	–	–	–	–	–	**–**	15	–	(15)
Opex: Pension Admin	–	–	–	6	6	6	6	6	**29**	–	6	6
Capex: Output Cases	–	–	–	5	5	16	16	17	**59**	–	12	12
Capex: Xoserve	8	10	9	–	–	–	–	–	**–**	6	–	(6)
Totex: Reported	**1,033**	**1,201**	**1,133**	**1,078**	**1,091**	**1,091**	**1,044**	**1,012**	**5,317**	**1,055**	**1,063**	**8**

Our forecast spend represents a decrease in our underlying total expenditure (totex) of £6m p.a. or 1% compared to our RIIO-1 eight year average spend. We have a number of movements within our forecasts that are set out in Figure 09.08 below. We have worked hard to offset the cost and workload pressures by optimising our plan across totex and focusing on delivering the work that matters most to our customers alongside the delivery of a significant and ambitious programme of efficiencies in RIIO-2 (equating to 0.94% p.a.).

We have also been engaging on a number of new and ambitious customer commitments that we have built in after engagement with our customers. Through our engagement and triangulation process the total value of our proposed commitments has reduced from £60m that we set out in July to £30m in our final Plan. If you include these new customer driven costs our average totex in RIIO-2 will increase by £24m p.a. or 2%.

Figure 09.08: RIIO-1 vs RIIO-2 average totex (18/19 constant prices)



* RIIO-1 Totex includes areas of spend which we are proposing become Uncertainty Mechanisms in RIIO-2. We have re-baselined the level of uncertain costs that are being requested via Ex Ante allowances.

Managing demand uncertainty

We have proposed that we use volume drivers and Uncertainty Mechanisms to help us effectively manage demand growth risk for our customers. We have put forward mechanisms for connections, reinforcement and diversions with a low case scenario included in our base plan to guard against windfall gains. We will be required to review the base volumes if our proposed mechanisms are not accepted by Ofgem to ensure we include a most likely cost forecast in our plans.

The key movements (described in more detail below) are reflective of the changing expectations of our customers, stakeholders and community. We have been challenged constantly through our engagement (both internally and externally) to improve service whilst it also remains clear there is no appetite for any reduction in the safety or reliability of the essential service we offer.

To allow a better understanding of our costs in RIIO-2 we have included first the key movements we are forecasting out to the end of RIIO-1, against our average annual costs and then how our total RIIO-1 average annual costs compare against our RIIO-2 average annual cost forecasts. It is important to consider our eight year costs as this gives a true like-for-like position and accounts for the phasing of our investment plans in RIIO-1. We reported in our 2018/2019 Regulatory Financial Reporting an Enduring Value adjustment of c. £400m reflecting the amount of re-phasing of workload into the final two years of RIIO-1.

Table 09.06: Key movements in our average annual costs (Totex)

Source of movement	Category of movement	Comment	Average annual cost
Key movements outlined between RIIO-1 1–6 year average and our RIIO-1 forecast 8–year average spend			
Mains replacement phasing	Volume	We are forecasting to increase our replacement length over the remainder of RIIO-1. To ensure delivery of this workload we have established an alternative contracting arrangement.	£31m
Market pressures	Price	We have seen increases in unit rates for our investment programme. This is a result of a constrained contractor market. However, this impact has been softened by the pain/gain sharing arrangement with the contractors.	£3m
Other workload	Volume	We aim to complete a number of asset health investments, which will increase our average spend.	£18m
Transformation programme	Price	Our transformation programme will offset some of these increases. This will close the performance gap to the other gas distribution networks.	£-14m
Total			**£38m**

Costs and efficiency continued

Source of movement	Category of movement	Comment	Average annual cost
The next step on the trace shows the change in average annual spend between RIIO-1 and RIIO-2			
Addressing high risk steel	Volume	We are proposing to introduce a structured replacement programme for our high risk metallic mains, principally steel mains. December increase due to industry review of risk scores on steel pipes	£38m
New capital works	Volume	We have a number of new capital projects that are built on cost benefit justifications. This has reduced in December as we have refined our investment cases including our pre heating programme and tools and equipment lines	£15m
Multi-occupancy Buildings	Volume	We are continuing with higher levels of MOB workload into RIIO-2 including a proactive replacement programme targeting the highest risk risers. The increase in cost in our December plan represents the results of a tender process for our fault repair programme that points to a higher cost per job.	£22m
Non-Routine Maintenance	Volume	This is a continuation of the increased levels of Non-Routine Maintenance we have experienced at the end of RIIO-1 (e.g. CP and crossings) December increase reflects latest workload and pricing data (e.g. non-chargeable diversions & PRI coatings)	£19m
Increased difficulty of replacement work	Mix	We face a more difficult replacement work mix. In order to mitigate this increasing difficulty, we have optimised across totex including costs for reinforcement to enable insertion. Increased in December due to a detailed review of London MP	£49m
Lower repair and emergency workload	Volume	We are forecasting lower workload volumes in our emergency and repair workloads. As we replace the aged leaky mains we are forecasting a reduction in external escapes and repairs on our network.	£-14m
Reduction in non-mandatory workload	Volume	In RIIO-2 we are proposing a reduction in our non-mandatory replacement volumes. This is intended to support the overall bill position but also ensures that we are focusing on the highest payback projects and minimising any risk of stranding.	£-20m
Our transformation programme	Price	This represents the benefits from our transformation programme.	£-92m
Protecting customers from uncertainty costs	Volume	There is a significant amount of uncertainty on customer driven workload for reinforcement and connections over RIIO-2. In order to protect our customers from this uncertainty we have proposed a revenue driver for this work. We have therefore included a lower volume of this work in our base Plan to ensure that we do not over recover.	£-22m
Total			**-£6m (1%)**
New customer commitments	Volume	We are proposing a number of new services and commitments that we have built on the back of our engagement with customers.	£30m
Total			**£24m (2%)**

Labour costs: managing our most material cost driver

As discussed earlier, our labour costs are the most significant driver of our overall unit rates. We aim to have a reward framework that achieves the right balance between retaining and motivating our employees and providing value for customers.

We have taken a number of actions to ensure that we are managing our labour costs in the most efficient way. For example, at the start of RIIO-1 we revised our T&Cs, introduced an RPI linked pay deal and revised our pensions arrangements among other actions.

More recently, for the latest round of pay deals, we have:

- **Aligned to the market median.**
- **Frozen managers' pay –** For managers, where there is not joint negotiation, we took the decision to implement a 0% pay increase in 2018/19.
- **Introduced new terms and conditions –** In addition, new T&Cs for new starters for field force, staff and managers have been introduced, which are fully aligned to our market median principles. For field engineers it also shifts from a 37 to 42 hour working week.

As we look ahead we are considering how best to secure maximum utilisation of our workforce. This is likely to involve greater integration with other types of work such as replacement and connection as part of our new resourcing and contracting strategy in RIIO-2.

The cost of our output commitments – Delivering standards that all of our customers love

As described in **Chapter 5, Enhanced Engagement** we are completing unprecedented volumes of stakeholder and customer engagement to help us understand what our customers want, need and expect from our services. We have included an ambitious set of customer commitments that will allow us to deliver against these rising expectations and we have tested them with our customers.

In total, we have included £30m p.a., circa £7.5m per network of additional costs to deliver on these commitments in RIIO-2. In summary the costs that we are proposing within our totex forecasts are set out in Table 09.07. All of these costs and commitments have been tested with our customers.

Table 09.07: Cost of our commitments

	21/22	22/23	23/24	24/25	25/26	RIIO2 Total	Average Annual
Deliver a resilient network	–	–	–	–	–	0.0	–
Quality experience	17.1	18.0	18.7	19.3	20.3	93.4	18.7
Environment	4.7	4.8	15.6	15.7	15.7	56.5	11.3
Trust	–	–	–	–	–	0.0	–
Total	**21.8**	**22.8**	**34.3**	**35.1**	**36.0**	**149.9**	**30.0**

The detailed proposals that cover these areas of spend are included in **Chapter 7** and associated appendix.

The £150m of additional costs described above do not include costs that we have agreed our shareholders will bear. For example, we have not included the cost of our community fund (the Cadent Foundation) which represents a commitment of circa £30m over the period within our trusted outcome. We have also not included additional costs for areas such as transparency where we are already delivering best practice enhanced reporting and where the benefits of delivery outweigh the costs (e.g. zero avoidable waste to landfill).

There are a number of areas where we are also committing to deliver additional outputs for no extra cost. We are challenging ourselves to deliver this additional stretch output efficiency as our customers have told us they want these services and expect us to deliver them. This equates to £19m of additional services that we are delivering for free or an additional £3.8m of output efficiency per year in RIIO-2. The Table below breaks these down by area and includes provision of time-bound appointments, measuring and enhancing our services and better road works information. The stretch output efficiencies and shareholder funded commitments are a demonstration of our ambition and commitments to setting the standards that all of our customers love.

Table 09.08: Stretch output efficiencies

	2022	2023	2024	2025	2026	Total	Annual average
Measuring and enhancing accessibility and inclusivity	1.0	1.0	1.0	1.0	1.0	4.9	1.0
Better roadworks information	2.0	2.0	2.0	2.0	2.0	10.1	2.0
Coordinating with others	0.2	0.2	0.2	0.2	0.2	1.0	0.2
Tackling the theft of gas	0.6	0.6	0.6	0.6	0.6	3.0	0.6
Total	**3.8**	**3.8**	**3.8**	**3.8**	**3.8**	**19.1**	**3.8**

9.6 Our opex forecast

We have set ourselves an ambitious target to reduce our operating costs to ensure we deliver value for money for our customers and set standards that others will aspire to. The activities that our operating costs cover are diverse, including our Emergency and Repair processes, our contact centres, our maintenance activities and the majority of our support functions including finance, regulation, HR and procurement among others. These activities ensure we deliver a safe and reliable service for our customers and that we have the business structure behind the scenes to support this. In total we are forecasting to spend £1,991m across our four networks in RIIO-2, an average of £398m p.a. and a reduction of £50m p.a. when compared to RIIO-1. We are stretching ourselves significantly to deliver more for our customers all whilst reducing our annual costs by 11% on average.

Table 09.09: Cadent Opex summary

	RIIO-1			RIIO-2						RIIO-2
£'m (2018/19 price base)	**2019**	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**	**RIIO-2 Total**	**Av.**
Emergency	51	49	47	46	45	43	41	40	**215**	**43**
Repairs	79	78	69	65	62	59	57	55	**297**	**59**
Maintenance	77	97	77	105	101	104	94	97	**500**	**100**
Of which: Routine Maintenance	44	44	37	35	35	34	33	33	**170**	**34**
MOBs (Incl. Buy-Outs)	3	7	6	19	19	21	19	20	**98**	**20**
Non-Routine Maintenance	30	46	34	51	47	49	41	44	**232**	**46**
Other Direct Activities (ODA)	13	12	11	10	10	10	10	10	**51**	**10**
Work Execution	221	236	203	225	218	216	202	201	**1,063**	**213**
Work Management	87	84	79	80	77	76	74	74	**381**	**76**
Business Support (Ex IT&T)	51	52	50	47	46	46	47	47	**234**	**47**
IT & Telecoms	50	46	39	45	47	46	46	46	**230**	**46**
Training & Apprentices	14	15	14	17	16	17	16	17	**83**	**17**
Opex: Adjusted	**423**	**434**	**384**	**415**	**403**	**403**	**385**	**385**	**1,991**	**398**
Memo items										
Output Cases	–	–	–	17	18	19	19	20	**93**	**19**
Xoserve	10	13	12	–	–	–	–	–	**–**	**–**
Pension Admin	–	–	–	6	6	6	6	6	**29**	**6**
Opex: Reported	**433**	**447**	**396**	**438**	**427**	**427**	**410**	**411**	**2,113**	**423**

Figure 09.09 details how our operating cost forecast is changing between RIIO-1 and RIIO-2. This demonstrates how we are delivering significant efficiencies to offset a number of workload pressures.

Costs and efficiency continued

Figure 09.09: RIIO-1 vs RIIO-2 average Opex (18/19 constant prices)

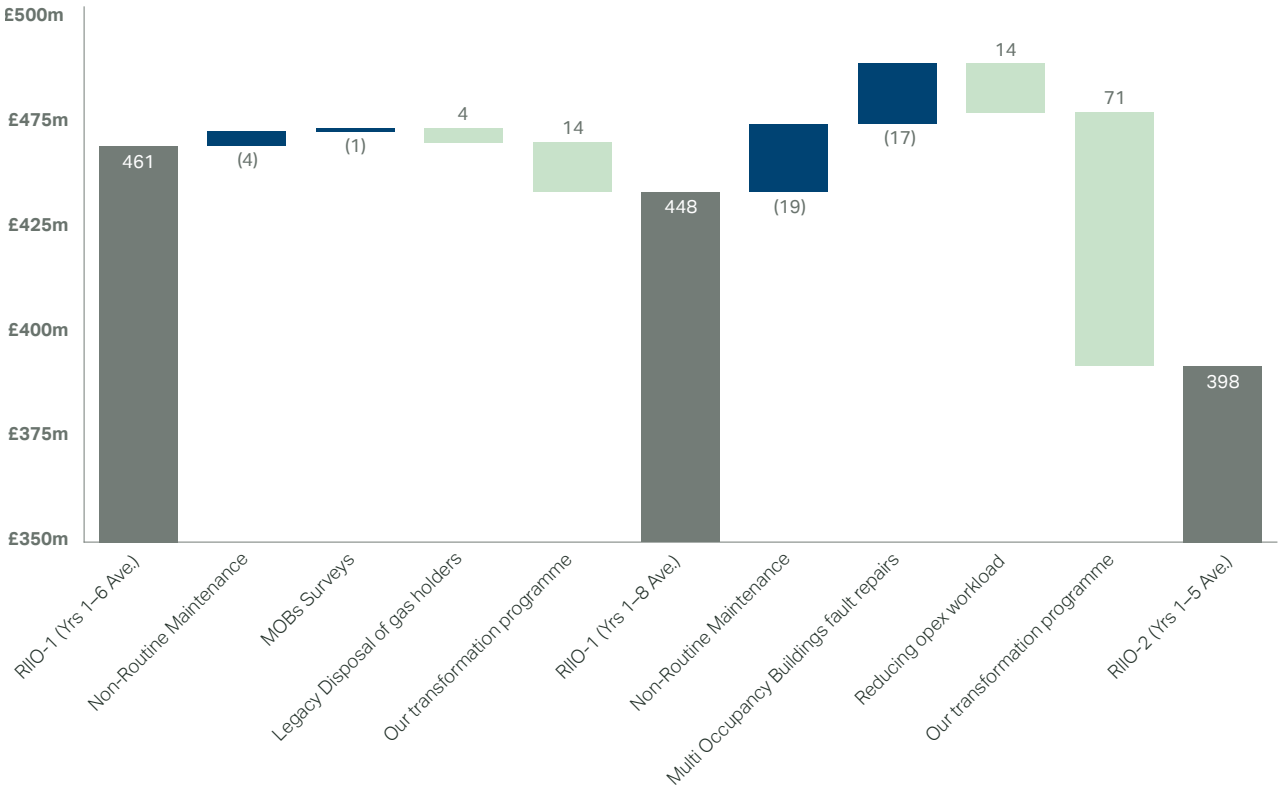


Table 09.10: Key movements in our average annual costs (Opex)

Source of movement	Category of movement	Comment	Average annual cost
Key movements outlined between RIIO-1 1–6 year average and our RIIO-1 forecast 8 year average spend			
Non-Routine Maintenance	Volume	We are seeing increased volumes of non-routine maintenance at the end of the RIIO-1 period. For example we have material increases in activity associated with cathodic protection and crossing maintenance in response to HSE enforcement.	£4m
MOBs Surveys	Volume	We have an increased volume of surveys over the end of RIIO-1 as we address a number of asset data issues that we have identified. These surveys have increased our average costs by £1m as we have accelerated this programme. This structured programme of pro-active surveys will continue into RIIO-2 on a cyclical basis.	£1m
Legacy disposal of gas holders	Volume	We incurred costs disposing of our gas holders in the first part of RIIO-1. These were one off costs and are not therefore recurring in the last two years of the price control. These are discussed further below.	£-4m
Our transformation programme	Price	We have taken the opportunity presented by separations to drive significant efficiencies across our front and back office operations.	£-14m
Total			**£-13m**
The next step on the trace shows the change in average annual opex spend between RIIO-1 and RIIO-2			
Non-routine maintenance	Volume	A continuation of the increased volume of non-routine maintenance we have experienced at the end of RIIO-1. This is described in more detail below.	£19m
Multi-occupancy Buildings fault repairs	Volume	Increased volumes of work as part of our fault repair programme that will progressively remove building safety related faults. This is a continuation of a programme of work initiated in RIIO-1 with additional spend on our Medium Rise assets in response to our RIIO-1 survey programme.	£17m
Reducing opex workload	Volume	Reductions in opex workloads on the back of our investment programme. This includes reductions in our repair volumes as a result of our mains replacement programme.	£-14m
Our transformation programme	Price	The continued implementation of our transformation programme, as described earlier in this chapter, which focuses on our opex performance as this is where we have the largest gap to the industry benchmarks.	£-71m
Total			**£-50m**

9.6.1 Emergency

Our emergency function operates 24 hours a day, 365 days a year to respond to public reported gas escapes. The annual cost of emergency work execution is forecast to reduce from £51m currently to £47m by the end of RIIO-1 and further to £40m by the end of RIIO-2. This reduction is driven by:

- Reduced workload
- Improved productivity through better work management
- Revised T&Cs and changes to DC:DB pension mix
- Fewer engineers
- Changes to our operating model associated with our transformation programme

There are two key drivers of costs within our emergency team, productivity and workload.

Productivity

We have invested a considerable amount in our emergency activities. We have sought to ensure that our teams have access to leading-edge resourcing and scheduling tools. This investment has delivered:

- **A flexible workforce strategy and contracting approach** that enables us to move resources into the Gas Distribution Strategic Partnerships in the summer and then flex resources the other way during the winter when we experience high volumes of public reported escapes.
- **A balance of planned and reactive work –** We use a long-term forecast of workload, including the impact of planned work, to establish a robust forecast of reactive work. We then supplement this reactive work forecast with additional jobs that require a complementary skill set. This generates a balance of plannable and reactive work that allows us to optimise the productivity of our field force. In particular, we undertake both domestic and industrial and commercial metering work. We have also integrated additional services to support customers in vulnerable situations into our processes such as carbon monoxide awareness discussions, and fitting of locking cooker valves for customers suffering from dementia.
- **Flexible and responsive systems –** Should the circumstance arise where the volumes of reactive work do not materialise as forecasted, the emergency resources are able to request additional work be sent out to them in the field.
- **Performance management –** Our dispatch team who are managing 'on the day' performance will continue to monitor productivity levels and will assign additional short duration work to the Field Force where appropriate. This includes additional services to support customers in vulnerable situations such as carbon monoxide awareness discussions.

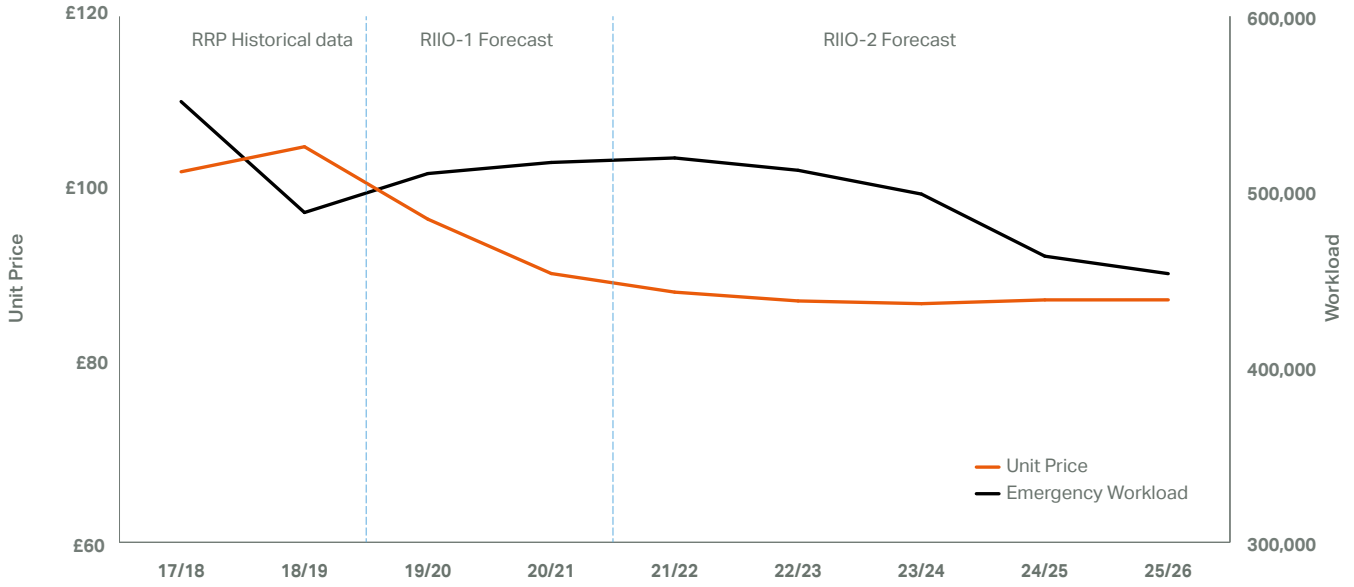
Looking ahead, we are continuing to review how we might get maximum utilisation out of the emergency and repair workforce. This is likely to involve greater integration with other types of work including replacement and connection activities alongside the further development of our services for customers in vulnerable situations. For example, we are exploring how we best use these resources to help reduce safety risks in the home and reduce future emergency situations.

Workload

Emergency workload is driven by Public Reported Escapes. This is reactive, customer-driven work. About 80% of the work relates to issues within a customer's premises. Historical regression analysis shows that this work is reducing by approximately 2% per year. This regression trend has been used to forecast RIIO-2 work.

A minority of workload is driven by gas network escapes. This work is forecast to reduce based on our modelling of the impacts of our mains replacement programme. Our modelling suggests that network escapes will reduce during RIIO-2 and this has been factored into our work forecast (the dip in workload in 18/19 was the result of a particularly warm year).

Figure 09.10: Emergency workload forecast



Costs and efficiency continued

9.6.2 Repair

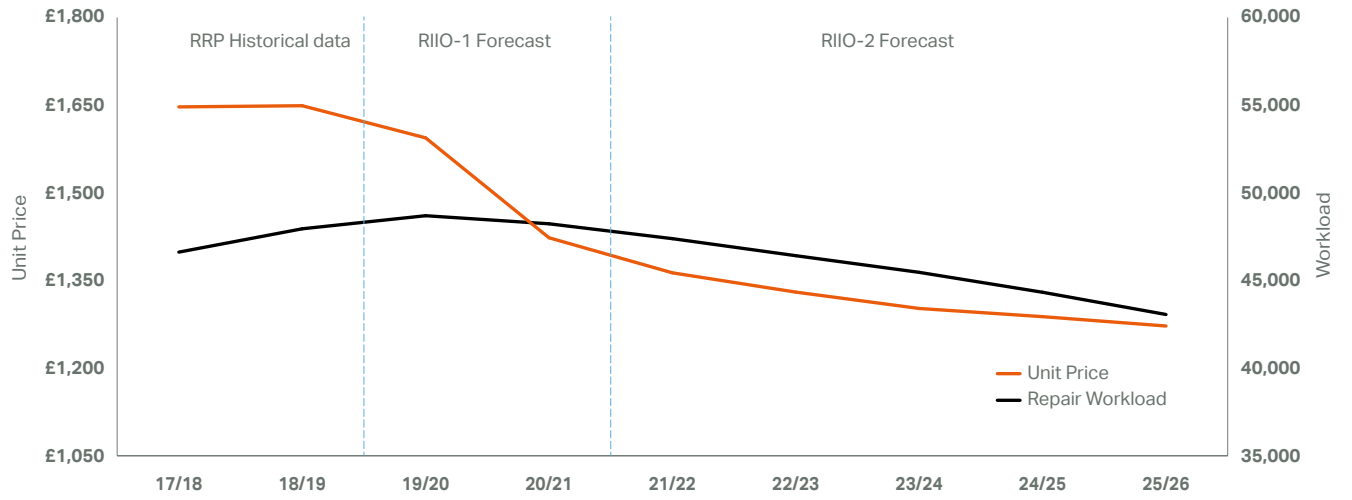
Our repair teams are responsible for remediating external gas escapes from our network. Typically this involves identifying the source of the leak, safely excavating the road, footpath or verge to access the leaking iron main or steel service pipe before repairing the affected pipework. Once the repair and safety checks are complete, the excavated area is appropriately reinstated.

The annual cost is forecast to reduce from £79m currently to £69m by the end of RIIO-1 and further to £55m by the end of RIIO-2. The reductions are partly driven by:

- Reducing workload
- Productivity improvements through the removal of the challenging 'Repair Risk' measure during RIIO-1
- A focus on multi-skilling and utilising resources on capex & repex work wherever possible
- Revised Terms and Conditions and changes to Defined Contribution: Defined Benefit pension mix

The modelling of our mains replacement programme indicates that workload will reduce over RIIO-2 based on a strategy of 'least whole-life asset cost' interventions. Our model has been audited by Costain who made a positive assessment of its quality.

Figure 09.11: Repair workload forecast



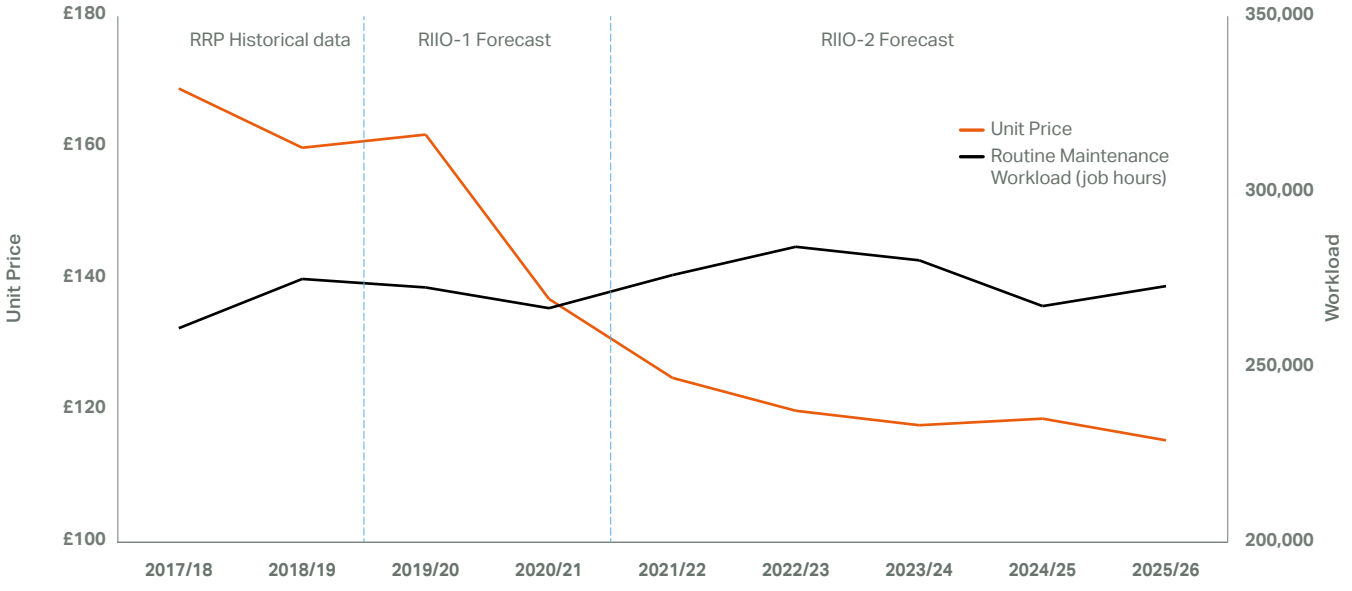
9.6.3 Maintenance

Our maintenance teams are responsible for ensuring we operate the network safely and maintain its reliability and resilience through appropriate interventions based on sound asset data and management decisions. Typically this involves proactively carrying out routine and non-routine maintenance activities in line with our policies.

Routine maintenance spend has, and is expected to, decline over time as we optimise our activities and policies using a risk-based approach to maintenance frequency interventions, improve efficiency and productivity via multi-skilling, innovate and adopt new technology and invest in capital expenditure to replace / upgrade our operational assets as required. Work volumes are forecasted based on our planned cyclical maintenance data.

However, there are two other key movements in our maintenance costs, the impact of MOB fault repairs and our non-routine maintenance programme (which has flattened work volumes).

Figure 09.12: Routine maintenance workload forecast



The impact of fault repairs as part of our Multi-occupancy Building Safety programme

During RIIO-2, we expect to undertake in the region of 275,000 non-gas related asset repairs at a cost of £84.5m. As part of our wider programme of improving safety in MOBs, we have identified a number of faults associated with our assets, which do not directly impact the flow of gas. For example, we have identified valve boxes outside MOBs with broken lids which may amount to a tripping hazard, missing electrical continuity bonds and signs identifying our pipes as gas pipes that have been obscured. We are introducing an extensive repair programme to remedy these types of non-gas related asset repairs, building on work initiated in RIIO-1.

We have estimated fault volumes using the results from previous MOBs surveys and taking into account the volume of MOBs surveys planned to be undertaken through the RIIO-2 period under our rolling survey programme.

In considering how to manage this essential work, we looked at the following options:

1. Do nothing – This is not a credible option. It is the least-cost option but will not ensure compliance with our obligations.
2. Remedy identified faults over the RIIO-2 period – In this option we continue our scheduled surveys and inspections and remedy the faults identified over the RIIO-2 period. Any high risk faults would be dealt with immediately, with lower risk faults scheduled into a larger programme of works based on risk. This is the least-cost option that ensures that we also comply with our obligations.
3. Remedy all faults identified within a short space of time, e.g. within days to a number of weeks – In this option, we would remedy all faults within days or weeks of them being identified, rather than over the longer RIIO-2 period. Were we to adopt this for outstanding faults, we would require higher resource levels and this would impact costs and customer bills.

We have proposed the second option in our Plan. This is the least-cost, reasonably practical solution at this point in time. It is our aspiration to move to fault resolution within prescriptive timescales in RIIO-3. We have confidence that overall this is the best option for customers as lower delivery would not be compliant and higher output would add to costs and may not be deliverable.

In RIIO-1 this type of work has been delivered by our direct labour when they were not engaged on emergency or mains repair activity. In RIIO-2, we are increasing the rate of work delivery significantly, therefore we will be using different business processes and newly contracted resources to deliver it. In light of this we derived a draft cost estimate for our October Plan that was based on our current costs and applied a 40% efficiency factor. We have now completed a tendering exercise to obtain rates for this work which did not support this level of efficiency or indeed any change in historic rates. We have however challenged ourselves and set a 15% reduction in our plan. This work is described in more detail in **Appendix 09.04 – Transforming the Experience for Multi-Occupancy Building Customers – Risers**.

The impact of our Non-Routine Maintenance Programme

Our Non-Routine Maintenance Programme ensures that we have a current understanding of the performance of our assets against our safety and reliability standards and that we are making the correct interventions to meet our customers' and stakeholders' expectations.

The programme includes packages of low-cost high-volume work such as cathodic protection, civils, valves and pipeline inspections among others. We are forecasting an increase of £14m p.a. over RIIO-2 as we continue to spend in line with the enhanced level of investment delivered in the second half of the RIIO-1 period.

During RIIO-1 we have seen a material increase in activity on cathodic protection and crossing maintenance in response to HSE enforcement action. This activity will continue into RIIO-2 as we maintain our focus on delivering to the safety standard that our regulator expects. This work was not fully funded in RIIO-1.

We are expanding our programme of survey and intervention on our civil structures and valve assets to ensure we comply with safety legislation.

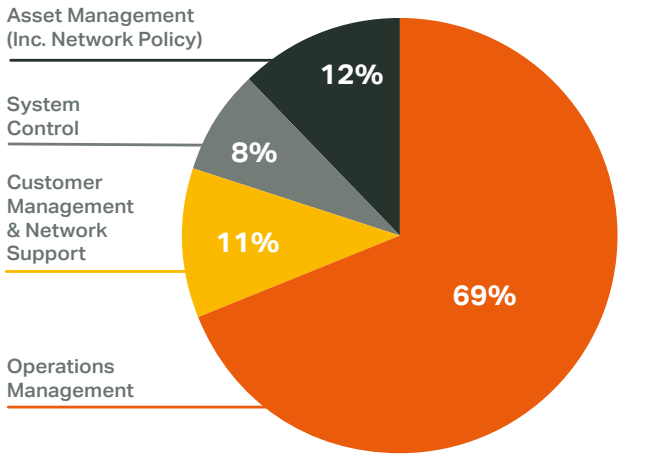
The final area of change is our reduced depth of cover programme. This work ensures that we have appropriate protection around our pipelines to prevent damage from third party activities (in particular agricultural practices). We have significantly stepped up work in this area over the second half of RIIO-1 in response to this emerging risk which we identified via our survey data and are forecasting to continue at this level of activity through RIIO-2.

9.6.4 Other controllable opex

i) Work management

Operations Management drives the majority of costs within our work management activity. This is in turn driven by FTE numbers which are closely linked with the Work Execution activities (emergency, repair and maintenance) described above – it covers supervision and management of the field force, planning, scheduling and dispatch and other centrally co-ordinated activities.

Figure 09.13: Work management cost breakdown



We are forecasting reductions in our work management costs from £79m at the end of RIIO-1 to £74m by the end of RIIO-2. This is a result of reducing workload in emergency and repair, coupled with our ambitious transformation programme.

ii) IS

Through RIIO-1, we have significantly reduced our IS operating costs as we have separated from National Grid and exited from the transitional service arrangements. We are now a standalone business, less complex, with no cost allocation or sharing of our IT estate, wholly reflective of other businesses of a similar size.

For RIIO-2, we have continually challenged the operating costs and level of investment that we will need in technology, aiming to balance the investment needed to realise changes in ways of working, changes in services to customers and data flows, yet maintaining control of the costs of investment to customers. Our RIIO-2 operating costs are lower than in RIIO-1, though our proposed investment in innovative technology, investment in our data, and the need to protect our activity from cyber criminals will inevitably create upward pressure through the period.

Costs and efficiency continued

iii) Business support and Training and Apprentices

Our business support costs include the cost of our support functions including finance, HR, regulation and our other central functions. This category also covers the costs of developing our ongoing stakeholder engagement plan across the business. We are forecasting to spend an average of £47m p.a. on our business support costs for our four networks over RIIO-2. Since the sale and separation of Cadent, we have made significant efficiencies in this area of our business and we have included additional efficiencies in RIIO-2.

Our training and apprentice costs are a critical element of our business plan as we continue to ensure we have the right skills and capabilities not just in RIIO-2 but also into the future. As with most large modern organisations our success depends on us having a broad range of skills and competencies and using them effectively. We are currently identifying an upward trend in employee turnover associated with changing socioeconomic patterns, changing terms and conditions and pensions schemes, and the changing expectations and aspirations that younger workers have. These changes provide opportunity, but also some material risk to our business. Presently we face challenges in: the acquisition and retention of some specific technical skills (including cyber, gas mains layers and niche technical areas of gas engineering); achieving greater diversity and inclusion particularly in field force teams, and; undergoing a demographic shift where our aging workforce retire (typically) and younger, much less experienced people take on responsibility. These challenges can present real risk to our delivery. Our RIIO-2 Plan continues the work done in RIIO-1 by investing £83m strategically to mitigate risks and tackle the several and varied challenges we face to improve the services we offer our customers, through attractive career paths and opportunities for our staff.

9.7 Our repex forecast

We are continuing to invest in our network to keep our customers safe and warm. Our replacement activity forms by far the largest single category of expenditure within our Business Plan and is almost entirely driven by legislative requirements in the form of the Pipelines Safety Regulations and HSE policy. The activities that form part of this cost category include the IMRRP, Other mains replacement including high risk steel replacement and economically justified mains, Multi-occupancy Buildings and other service replacement. In total we are forecasting to spend £2,392m over the RIIO-2 period which represents 47% of our controllable costs.

Table 09.11: Replacement summary

	RIIO-1			RIIO-2						RIIO-2
£'m (2018/19 price base)	2019	2020	2021	2022	2023	2024	2025	2026	RIIO-2 Total	RIIO-2 Av.
Iron Mains Risk Reduction Programme:										
Tier 1 Mains[1]	200	243	247	239	230	224	224	223	**1,140**	**228**
Tier 1 associated services	92	117	115	110	107	105	104	104	**529**	**106**
2" Steel*	4	5	5	4	4	4	4	4	**18**	**4**
Other Mains Replacement										
Tier 2A & 2B mains and associated services	18	43	43	4	5	6	6	6	**29**	**6**
Tier 3: Mains and associated service	35	15	15	20	22	24	23	23	**113**	**23**
Other Policy & Condition*	20	30	29	32	43	51	50	50	**226**	**45**
Multi-Occupancy Buildings (MOBs)	19	29	40	23	23	24	24	24	**118**	**24**
Services Not Associated with Mains Replacement	44	44	44	46	45	43	43	42	**219**	**44**
Repex: Adjusted	**432**	**526**	**538**	**478**	**479**	**480**	**478**	**476**	**2,392**	**478**
Memo items	–	–	–	–	–	–	–	–	**–**	**–**
Repex: Reported	**432**	**526**	**538**	**478**	**479**	**480**	**478**	**476**	**2,392**	**478**

1 All diversions included in this line, as per Business Plan Data Table.

Our Plan requires an increase of average repex costs by £46m p.a. or 11% forecast for RIIO-2 reflecting the introduction of new work types, in particular our high risk steel programme. The cost forecast also incorporates the changing nature of our mains replacement programme introducing a new work mix including lower rates of insertion, a higher proportion of larger mains being replaced and shorter project lengths, which we have already tried to mitigate in our Plan as far as possible, halving the expected cost increase that was originally expected. Finally these workload changes are partially offset by our ambitious ongoing efficiencies of 0.94% p.a.

Figure 09.14 shows the length of mains that we are forecasting to replace over the RIIO-2 period. Table 09.12 shows how the Business Plan data maps against the key drivers of the work. There are three principal drivers of mains replacement that are detailed in turn below; these are the IMRRP, other safety driven work and other economically justified work. In total we are forecasting to deliver 8,525km of mains over RIIO-2 at an average of 1,705km per year. This workload is detailed in **Appendix 09.02 Distribution Mains and Associated Services**.

Table 09.12 Cadent total mains replacement volumes (km) by driver

		Work driver				
			Other mains			
BPDT cat	Sub cat	IMRRP	Safety Driven	CBA	Total	Average length
Tier 1 Mains	IMRRP	7,692	0	0	**7,692**	1,538
Tier 1 Mains	IMRRP Dynamic Growth	93	0	0	**93**	19
Other policy and condition	Steel ≤2"	153	0	0	**153**	31
Tier 2A &2B	Tier 2a	0	37	0	**37**	7
Tier 2A &2B	Tier 2b	0	0	53	**53**	11
Tier 3	Tier 3	0	31	15	**47**	9
Other policy and condition	Tier 1 >30m	0	6	30	**35**	7
Other policy and condition	Steel	0	262	147	**408**	82
Other policy and condition	Asbestos	0	1	6	**7**	1
	Total	**7,938**	**337**	**250**	**8,525**	**1,705**
	Average annual length	**1,588**	**67**	**50**	**1,705**	

The cost trace shown below highlights these changes in more detail.

Figure 09.14: RIIO-1 vs RIIO-2 average Repex

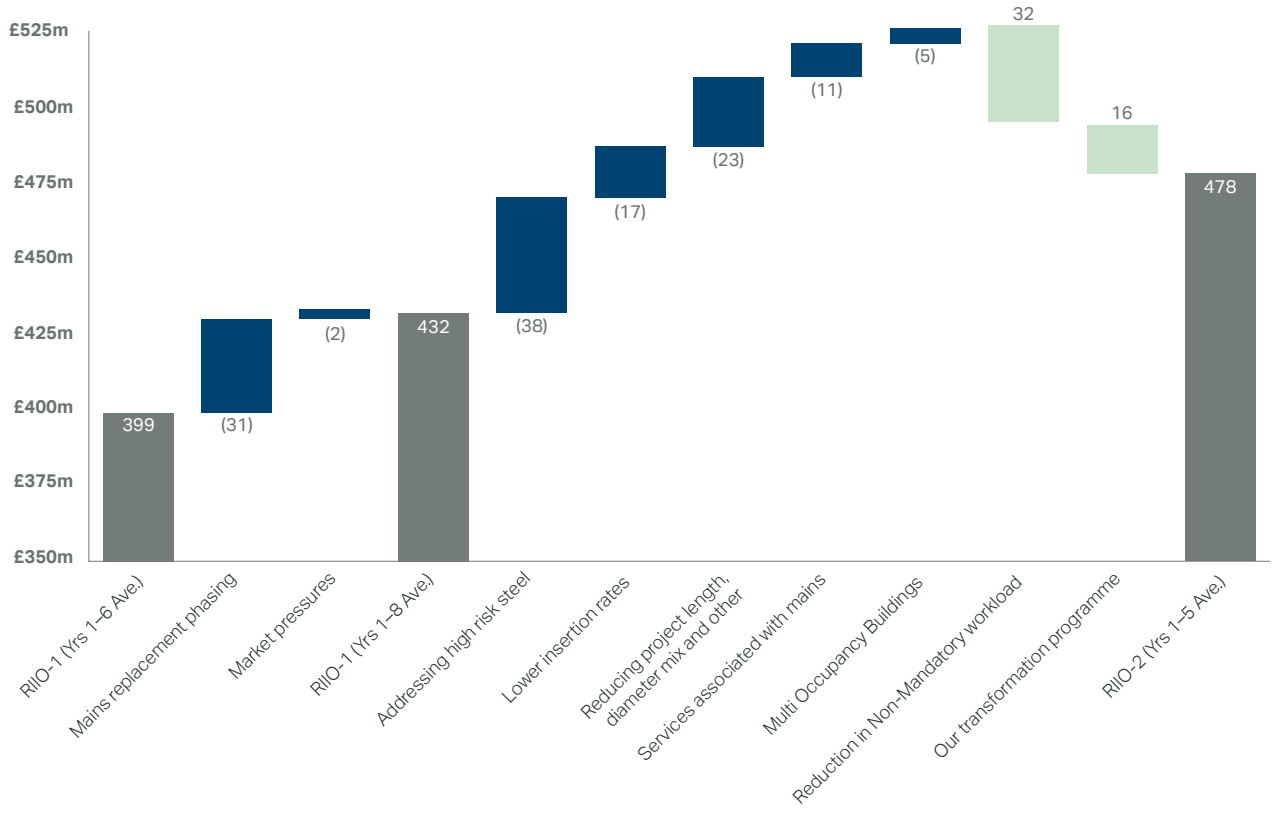


Table 09.13: Key movements in our average annual costs (Repex)

Source of movement	Category of movement	Comment	Average annual cost
Key movements outlined between RIIO-1 years 1–6 average and our RIIO-1 forecast 8 year average spend			
Mains replacement phasing	Volume	We are forecasting to increase our replacement length over the remainder of RIIO-2 in line with our RIIO-1 eight year output targets. We have had a number of challenges in the delivery of our replacement workload including a congested contractor market and an increasingly difficult work mix. To ensure delivery of this workload we have established an alternative contracting arrangement to test our proposed RIIO-2 contracting model. This arrangement ('Construction Services North West') will deliver 150km over the reminder of RIIO-1.	£31m
Market pressures	Price	Over the last 12 months we have seen increases in unit rates for our investment programme, particularly on our mains replacement activity. This is a result of a constrained contractor market with a number of other major investment programmes competing for similar labour pools.	£2m
Total			**£33m**

Costs and efficiency continued

Source of movement	Category of movement	Comment	Average annual cost
The next step on the trace shows the change in average annual repex spend between RIIO-1 and RIIO-2			
Addressing high risk steel	Volume	We are proposing to introduce a structured replacement programme for our highest risk steel mains that addresses continued deterioration of these pipes on our network. Our models of the risk associated with individual pipes show that the highest risk mains in our asset base are almost all steel mains, underlining why this programme is being put in place and its importance. This is partially offset by a reduction in economically justified mains that sit outside of the IMRRP.	£38m
Lower insertion rates	Mix	We are forecasting a reduction in the length of pipe we can insert meaning more open cut work where we have to excavate the entire route of the pipe increasing costs. In order to mitigate these cost pressures we have optimised across totex increasing our reinforcement spend by £7m p.a. therefore allowing an increased volume of insertion providing a lower overall totex cost. We have also optimised for pressure and reflected this in our leakage baselines. In total this has reduced the impact of lower insertion rates from £35m in our July Plan to £17m in our October Plan.	£17m
Reducing project length, diameter mix and other	Mix	We are forecasting increasingly shorter project lengths in RIIO-2 as we address the higher risk mains and have less optionality of work as we approach the end of the programme. This will increase overall cost per metre as the mobilisation costs (site set up) are shared across a smaller length of pipe. Other areas that impact on this work mix include replacing proportionally more large diameter mains in RIIO-2 and the changing nature of our London Medium Pressure programme. The unit cost of completing work on our London medium pressure scheme is increasing as the complexity of the engineering and stakeholder environment increases. This is set out in more detail in our engineering justification for this specific programme of work. We have challenged ourselves to mitigate these cost pressures and have invested in our modelling capability which has reduced the overall impact of work mix from £33m in our July Plan to £17m in our October Plan.	£23m
Services associated with mains	Volume	Our service densities (the number of services per km of main replaced) are changing across our networks reflecting the changing nature of the mains that we are replacing. Service densities are expected to decrease in the EoE network by 7% as we move towards the more rural East Anglia part of the network. However, we are expecting service densities in North London to increase by 23% as we tackle more urban areas, this will also have an impact on the number of planned interruptions. We are not expecting to see a change in service density in either the North West or West Midland networks.	£11m
Multi-occupancy Buildings	Volume	This is an area of work that we have already seen increases in RIIO-1 and are forecasting to continue into RIIO-2. Our MOBs intervention strategy is aimed at improving experiences for our customers in this area through targeted replacement in our highest risk buildings to reduce interruption volumes and increase our service levels.	£5m
Reduction in non-mandatory workload	Volume	In RIIO-2 we are proposing a reduction in our non-mandatory replacement volumes. We have included our minimum statutory lengths for the IMRRP and have proposed a reduction in our other non-mandatory mains (economically justified mains). This is intended to support the overall bill position but also ensures that we are focusing on the highest payback projects minimising any risk of stranding where there is uncertainty over future investment.	£-32m
Our transformation programme	Price	This represents the benefits we expect to deliver through the continued implementation of our transformation programme. For replacement this includes moving to a depot-centric operating model and changing our contracting model which will introduce greater accountability, less overheads and localisation. These efficiencies are also offsetting significant price pressures that are currently absorbed into our contracting arrangements. This equates to £10m of market pressures that are being offset by £26m of efficiency in RIIO-2, leaving a £16m net reduction. This is a 4% reduction over the period or 0.8% p.a. (increasing to 1.2% p.a. if one accounts for the absorbed price pressures). This represents a stretching and ambitious plan for our customers.	£-16m
Total			**£46m**

The remainder of this section outlines in more detail the spend on our Iron Mains Risk Reduction Programme (IMRRP), other mains replacement, Multi-occupancy buildings and services not associated with mains replacement.

9.7.1 The Iron Mains Risk Reduction Programme ('IMRRP')

The Iron Mains Risk Reduction Programme is one of our key safety programmes. Under this programme we work to reduce the risk associated with cast and ductile iron pipes within 30 meters of buildings. Often, this requires replacing the iron pipes, which are prone to fracture and corrosion, with safer, more efficient polyethylene pipes.

Our work in this area is mandated by the HSE and is also necessary to ensure compliance with specific gas safety regulations, including the Pipelines Safety Regulations 1998 (PSR) (specifically Regulations 8, 9, 13 and 13A), the Gas Safety (Management) Regulations (GS(M)R) (specifically in relation to the duty to prepare and comply with a safety case (Regulations 3 and 5)) and more broadly under sections 2 and 3 of the Health and Safety at Work Act (HSWA). The HSE have been clear that it will be necessary to continue with the IMRRP throughout the RIIO-2 period.

In addition to reducing the risk associated with iron pipes, the IMRRP also delivers additional benefits for customers, including reduced leakage (reducing bills and reducing greenhouse gas emissions), reduced reactive repair costs (reducing bills) and greater reliability (reduced chance of interruptions). These wider benefits have been established by the Ofgem and HSE commissioned report by CEPA and AESL and by KPMG more recently, who concluded that the IMRRP would largely remain cost beneficial even if the safety benefits are excluded.

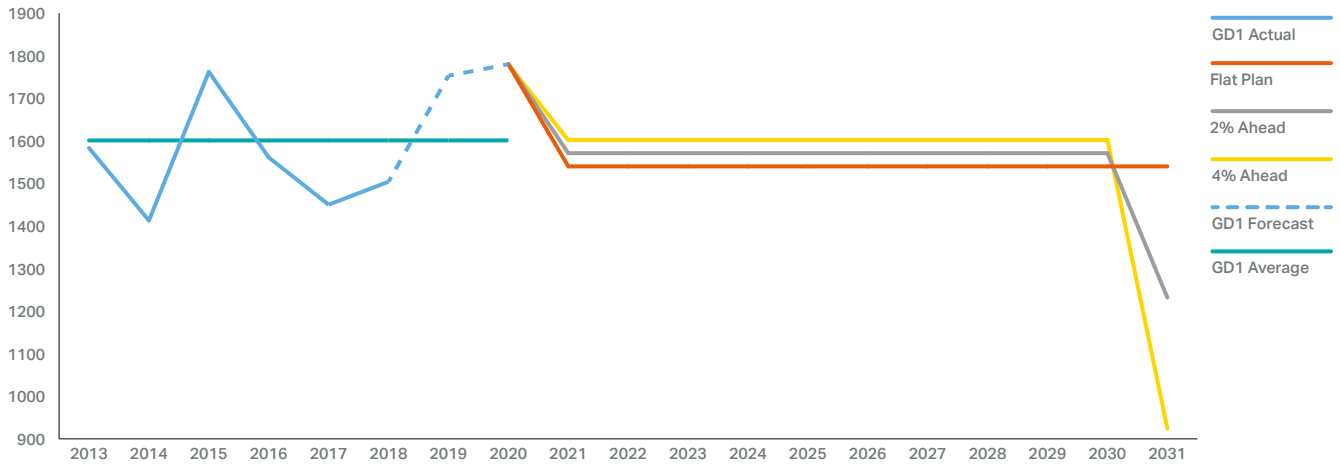
Many of our steel pipes have a risk score similar to, or greater than, our iron pipes. Steel pipes are not covered by the IMRRP but are still subject to the requirements of PSR, GS(M)R and HSWA. We are proposing to introduce a structured programme akin to the IMRRP to manage the risk associated with our steel pipelines and this is covered in the following section (9.7.2).

IMRRP options

Length of mains replaced

We are forecasting to replace 1,557km p.a. of tier 1 iron mains in RIIO-2. This sets us on a flat run rate to 2032. As part of our RIIO-2 options analysis we have investigated the risk that is posed by a hard stop to the programme at the end of March 2032 (the 'cliff edge') by analysing various delivery scenarios. The cliff-edge risk is created where a high volume of work is focused on a fixed delivery date and ends suddenly, at that time this creates challenges in maintaining a large workforce which knows it will be disbanded as well as providing zero margin for error on delivery. The scenarios we considered included the acceleration of delivery to allow a controlled ramp down of investment towards the end of the programme through running at 2% and 4% ahead of programme respectively (see figure below).

Figure 09.15: IMRRP delivery RIIO-1 and RIIO-2+ options



In selecting a flat profile, we assessed the overall delivery of our mains replacement commitments and the relative risk of our asset base. A flat profile mitigates delivery risks in RIIO-2 and difficulty of work is forecast to change (see following section) and also balances affordability for our customers. This ensures we are delivering against our legislative requirements whilst also managing delivery, risk and affordability.

How we have optimised our replacement programme with our customers

Although we have an absolute requirement to complete the IMRRP, we do have some discretion about how we deliver it in a way that delivers maximum benefit to our customers. There are multiple ways that the IMRRP can be prioritised and delivered. Each of the approaches will trade off outputs which include: mains safety risk, delivery efficiency, repair benefit, leakage and customer experience. We have tested these trade offs with our customers and more detail of this can be found in **Chapter 7, Our commitments**.

How the mix of our mains replacement work is changing

As we move towards the end of the IMRRP we are seeing the nature of the work changing considerably. This is a product of a number of things including the various incentive regimes that have been employed over the course of the programme and the simple fact that as you have less work to do there is less choice (and therefore flexibility) in delivery. The key changes in our work mix are:

Costs and efficiency continued

Table 09.14 Changing mix of replacement work

Lower levels of insertion – as we have continued to manage leakage on the network we have managed system pressures as low as practicably possible. This coupled with the profile of the remaining work mix and future growth forecast means that, our ability to insert mains (push plastic mains through the in-situ metallic mains and avoid excavating an entire road) is reducing, causing a significant change in mix and total costs. Typically it costs around twice the rate of insertion to open a main.
The average project length – average project length is a key driver of efficiency. All projects have a fixed cost mobilisation element and the longer the scheme the more this cost is shared driving overall rates down. As we address the most customer beneficial pipes in RIIO-2 this is driving shorter project lengths.
Moving towards larger diameter mains – as we move towards the end of the programme we are completing more large diameter mains (at the top of the tier 1 banding). This has the impact of driving total costs up as generally the larger the main the higher the unit rate (larger mains need greater material costs, larger excavations and more specialist labour).
Work moving into different geographies – as we approach the end of the programme we also have regional variations in rates. For example we must complete more work in East Anglia and central London which is more costly than either the East Midlands or outer London. These changes in location will increase unit rates.

We have innovated to build the tools and capability to help us model this workload allowing us to run multiple scenarios and optimise our programme to the benefit of our customers. We have challenged ourselves to mitigate these cost pressures through considering how we can optimise across totex to deliver the best outcome for our customers and have significantly reduced our totex forecasts as a result from our initial July Plan. Additional detail on worktypes by network and on how the balance of work is changing into RIIO-2 is provided in **Appendix 09.02 Distribution Mains and Associated Services (Iron, PE, Steel & Other)**.

In focus – Insertion rates: optimising our plan to deliver value for our customers

Once we have established that a main is still required and needs replacing, we optimise the design, enabling the use of no-dig techniques such as insertion. Whether we can insert a pipe or not is the most significant driver of total scheme costs and, on aggregate, the most significant driver of cost in our mains replacement programme; we have separate unit costs for insertion and open-cut.

Insertion is generally the most efficient method of replacing mains. This technique, when compared to other options, dramatically reduces the amount of excavation work needed, which in turn reduces cost and disruption to the public. The method does, however, reduce the capacity of the network – the newly inserted pipe is smaller and therefore can transport less gas.

Wherever possible, we will design replacement projects that enable maximum insertion. However, in the following circumstances, it may be more economic to open-cut mains:

- Where capacity and security of supply must be maintained at or near existing levels and reducing the size would compromise customer service (insertion reduces the diameter of the pipe carrying gas).
- Where there are many connections and digging out each connection is more expensive than an open-cut replacement of the entire main (This is particularly relevant for steel pipelines which are more difficult to 'break into' than iron pipes are).
- If mains are in roads with service connections, where it may be more efficient to lay a new pipe in the footpath and abandon the existing main in the road.
- For deep mains, where connections would require large and shuttered excavations.
- For mains with numerous bends and fittings, such as valves and syphons, that must be excavated and removed to allow the insertion of the lengths in between.

RIIO-2 insertion rates

To enable us to have confidence in the assumptions we have made for insertion for RIIO-2 and beyond, we have carried out several studies to test the options available:

- Reviewing pre RIIO-1 delivery and the level of insertion achieved.
- Designing networks using an innovative semi-automated process on a sample of areas.
- Designing networks using a manual approach to validate the automated approach.

Our detailed modelling that we have completed over the summer of 2019 shows that with pressure increases and target reinforcements (where it is cost beneficial to do so), we can achieve higher average insertion rates. For RIIO-2, we have made the planning assumption that an average 86% insertion rate can be achieved on tier 1 mains, given pressure increases and strategic reinforcement.

We do not consider insertion rates above 86% to be as realistic as the level of pressure increases and the reinforcement required would be unsustainable and not cost beneficial for customers. The delivery of this insertion rate will be challenging. However, it is in customers' interests as it equates to a saving of £25m p.a. compared to the 76% baseline. We have reflected this modelling into our leakage baselines and reinforcement volumes within our capital plans.

2" Steel associated with our IMRRP

As part of the IMRRP, we replace all steel pipes ≤2" diameter when found during routine mains renewal operations. This is in view of the marginal cost of undertaking replacement in conjunction with mains replacement activity. The benefit of this investment is an improvement in safety for customers and the avoidance of having to revisit the same location to replace these assets later.

Information about the majority of the ≤2" steel mains is not digitised, and therefore it is not possible to precisely calculate the length we will encounter with routine mains renewal activity. To calculate the volume of ≤2" steel that will be replaced in RIIO-2 we have used previous years' volumes as a function of the length of IMRRP tier 1 being renewed. This is then applied to our RIIO-2 forecast IMRRP mains replacement length.

Table 09.15 2: Steel per km of IMRRP

2" Steel	KM IMRRP (Y5/6)	KM ≤2" Steel (Y5/6)	km ≤2" Steel /km IMRRP
EoE	1064	16	0.015
NL	632	10	0.016
NW	653	18	0.027
WM	526	13	0.025

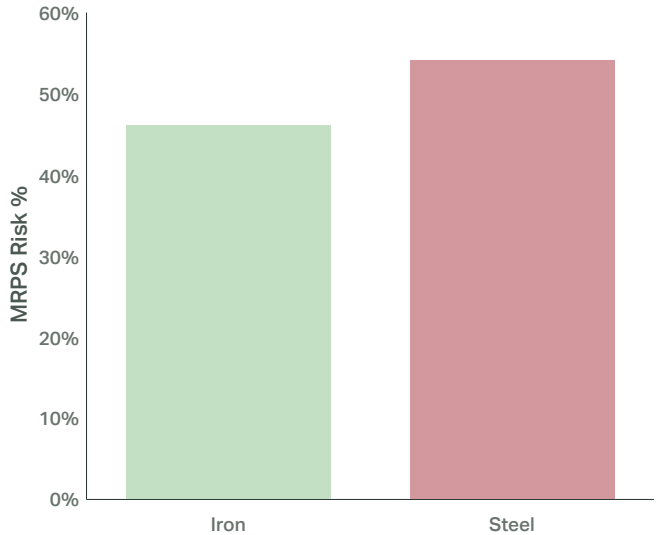
9.7.2 Other safety driven mains (including high risk steel)

We are forecasting to replace 337km of other safety driven mains in RIIO-2 addressing high risk steel or other high risk mains outside of the IMRRP.

We have 5,569km of non-PE assets (metallic, asbestos etc.) which have MRPS risk scores and are not part of a HSE mandated IMRRP programme. 84% of these assets are steel. We have a duty to maintain these assets in an efficient and safe working order.

At the start of the IMRRP the incident risk associated with iron mains was far higher than the incident risk associated with any other category of mains. Over the course of the IMRRP the iron risk has been reduced significantly. We are now at the point where the risks posed by iron is less than that of other materials (see Figure 09.16) The vast majority of these mains are steel mains with a very small volume of asbestos in isolated cases. This has led us to review the risks associated with non-IMRRP assets and propose a new way forward.

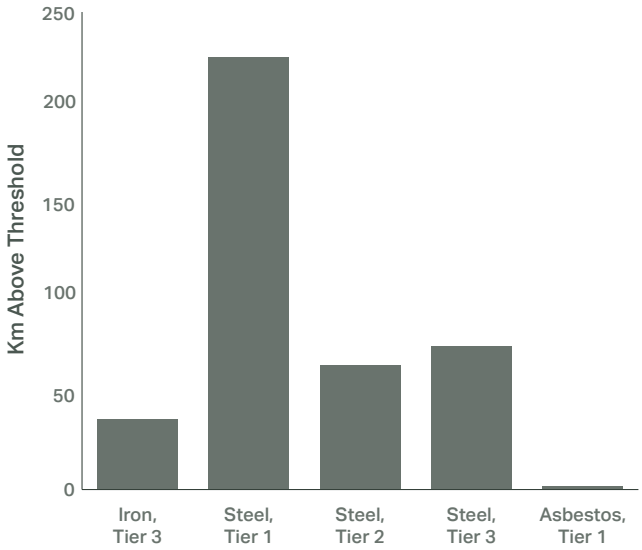
Figure 09.16: MRPS risk for iron and steel



In order to ensure we were able to compare the risk scores of different material types we commissioned an independent expert report by DNVGL. This concluded that 'the mathematical structure and coefficients of the Steel Risk Model are as up to date as the other models used for mandatory replacement. The Steel Risk Model is therefore a valid basis for the risk assessment of steel distribution pipes within 30m of buildings'.

Consistent with the approach to iron mains we have also calculated risk thresholds for mains outside the IMRRP at a level which ensures no individual should be exposed to a risk of more than 1 in 1,000,000 of fatality as a result of being within 30m of such an asset. This creates a risk score at which we should replace the asset to ensure we are appropriately managing the risk. Applying these risk thresholds to the risk scores in MRPS identifies 403km of non-mandatory assets that are above the risk threshold (mains outside of the IMRRP). The majority of these assets are tier 1 steel.

Figure 09.17: Non-IMRRP above threshold



Managing risk in RIIO-2

Our proposed RIIO-2 Plan is to manage all distribution mains using the industry Mains Replacement Priority System and an evolution of the threshold setting approach we have used in RIIO-1.

In order to balance deliverability, keeping customers safe and affordability, we have also looked at options for prioritising the renewal of these high risk mains in RIIO-2. There are three principal options that we considered that are summarised in the table below:

Table 09.16: Mains risk options

	Prioritisation options	Description
1	No prioritisation	This option would see us replacing all mains above the risk threshold
2	Based on qualifying leaks	Replacement of mains that are above the risk threshold and have a leak on the main (as opposed to leaks on adjacent mains that impact on the risk score)
3	Based on age	Replacement of mains above the threshold and laid before 1957

Costs and efficiency continued

DNVGL recommended that we should prioritise based on the quality of manufacture and installation of steel mains through time. This considers improvements in material quality, coating, jointing and installation over time. We agree with this analysis and have included option number three in our plans to renew assets above the pipe specific threshold (for steel only those that were laid before 1957) and all pipes (regardless of age) that are above the community threshold.

The impact of our approach is that we will renew 337km of mains that are above the safety threshold in RIIO-2 which will reduce the overall risk on our networks and ensure we meet our obligations to maintain a safe network. We are continuing to engage with the HSE on this issue, which is supportive of our analysis and proposals, to ensure that we are meeting the expectations of our safety regulator.

9.7.3 Economically justified mains

In total we are proposing to complete 250km (50km per year) of economically justified work across the RIIO-2 period. Under the RIIO framework pipes can be put forward for remediation under cost-benefit principals ('asset management repex'). We consider cost-benefit driven activity a critical element of our asset management strategy as it allows us to deliver maximum value for our customers. Our CBA approach for RIIO-2 is aligned with Ofgem's principles, ensuring that direct and indirect costs are captured; it is transparent in its calculations and follows cost-benefit best practice. For further detail on the CBA approach, please see **Appendix 09.00 Overview: how we have developed our investment plan**.

The investment need and delivering maximum benefit for customers

Selecting mains on a CBA basis allows us to renew pipes that have significant operating costs or other customer impacts associated with them. Costs can be caused by a pipe experiencing leaks, which may be caused by ground movement. Mains that have repeated leaks can have low MRPS risk scores and, therefore, not feature as a safety pipe. Such mains can continue in operation for many years because they do not pose a high safety risk to the public.

Our RIIO-2 CBA approach is a significant improvement over the top-down methodology used in RIIO-1. The approach for RIIO-2 uses a bottom-up assessment of all pipes in the Cadent network to assess their individual CBA attributes. At the same time, the approach aims to group CBA-positive mains activity into larger schemes to improve efficiency.

To establish our proposed lengths for RIIO-2 we tested customers' preferences for additional cost beneficial pipe replacement beyond the safety driven minimum, testing a zero option, with two enhanced levels of investment. The majority of customers chose enhanced investment levels, although some customers selected no additional investment.

9.7.4 Multi-occupancy buildings

Our customers in MOBs are our worst served customers in the event they are interrupted and as we have acknowledged publicly, we must improve the service we offer to them. We have set out in full our strategy for improving performance for these customers in **Appendix 09.04 Transforming the Experience for Multi-Occupancy Building Customers - Risers**. This covers all aspects of our service provision from maintenance, investment and welfare and engagement.

We want to ensure customers are not left vulnerable without gas and are kept safe. This requires us to do work to address the risks to these objectives. We have grouped these risks into three areas:

- Customer service – reduce the number and duration of interruptions and continue to work to mitigate the impact of any interruptions that occur.
- Process safety – preventing a network gas escape causing an explosion or fire: we will invest to ensure that our assets remain broadly acceptable or broadly acceptable if ALARP (as low as reasonably practical) level risks, and by targeted intervention we expect to improve the assets that today have the highest risk profile and reduce the number of interruptions.
- Building safety – protecting customers from non-gas safety risks associated with our apparatus: we will identify and fix faults and work with building owners working closer with them on building safety will also establish relationships that will help if we need to carry out work to restore supplies and mitigate the impact of supply failure.

In producing our plans we have analysed the impact they will have on each of these three areas.

Options considered

We considered several investment options, which we discussed with customers. Detail of these options and our engagement are included in **Appendix 09.04**. Here is a summary:

- Invest to deliver flat monetised risk (monetised risk is calculated using an Ofgem agreed model that takes into account different risks and combines them into a single monetary value). This option was considered because there is an expectation that monetised risk should be flat or decrease over time and we needed to understand the customer bill implications of doing this.
- Invest to minimise numbers of interruptions: modelled as investing to deliver a 4% p.a. reduction in interruptions. This option was considered because interruptions are important and we needed to understand the cost benefit of investing to reduce them.
- Balanced investment: we carried out analysis using an enhanced version of the monetised risk model to determine what combination of actions and investment levels would produce the best NPV for customers and then model the impact on the three risk areas.

In every case we included mandatory work examples which include restoring supplies after interruption and the repair of faults that result in our not complying with buildings and other regulations.

Based on a combination of customer feedback and our analysis of the cost benefit to customers of the different options, we have selected the 'balanced investment' option as the basis of our Plan.

Summary of proposed actions and what they deliver

Our proposed actions are designed to work together as a package. They deliver by improving our assets, dealing with issues more effectively and mitigating the impact of failure on customers. Table 09.17 describes these actions and how they support our customers. Details of these proposals are included in **Appendix 09.04**. In total the proactive replacement of risers equates to £109m of our repex plan over the five years of RIIO-2.

Table 09.17: Our proposals for Multi-Occupancy Buildings

Action	How action improves safety	How action improves customer experience
Improve asset condition by targeted intervention.	Reduces the risk of operating riser pipes by eliminating a trip hazard.	Reduces number of interruptions by: • Better condition assets are less likely to fail. • Repair of faults prevents their impacting customers.
Improve operational response to asset failure.	Reduces risk through faster and more effective repairs that utilise the best possible techniques and innovations.	Reduces number of interruptions and delivers faster restoration times.
Create building specific management plans for all High Rise Buildings (HRBs) to improve delivery of proactive intervention and operational response.	Working with the building owner enables a more holistic approach to safety. This is aligned with the principles being recommended by the Hackitt review.	Improves customer experience by establishing a relationship with the owner and identifying customers in vulnerable situations to anticipating their needs.
Continually work to improve interruption mitigation measures.	Improving welfare provision and response to customers will enhance their safety by avoiding dangerous behaviours such as the use of old standby appliances and avoiding 'cold homes'.	Improved welfare package reduces the impact of interruption on customers.
Energy Exchange Programme, selective elimination of risk where there is cooking only load or very few customers in a large building.	Eliminates ongoing gas related risk from impacted buildings.	Progressively reduces number of inefficient supplies to buildings reducing bills in the long run.

9.7.5 Service not associated with mains replacement

We also complete a number of service replacements that are not associated with mains replacement. These are high-volume, low-cost activities and we have used the RIIO-1 volumes and cost as the basis of our forecast. We have ruled out a do-nothing scenario as this work is customer or safety driven. Except for bulk steel renewals, the activity is reactive.

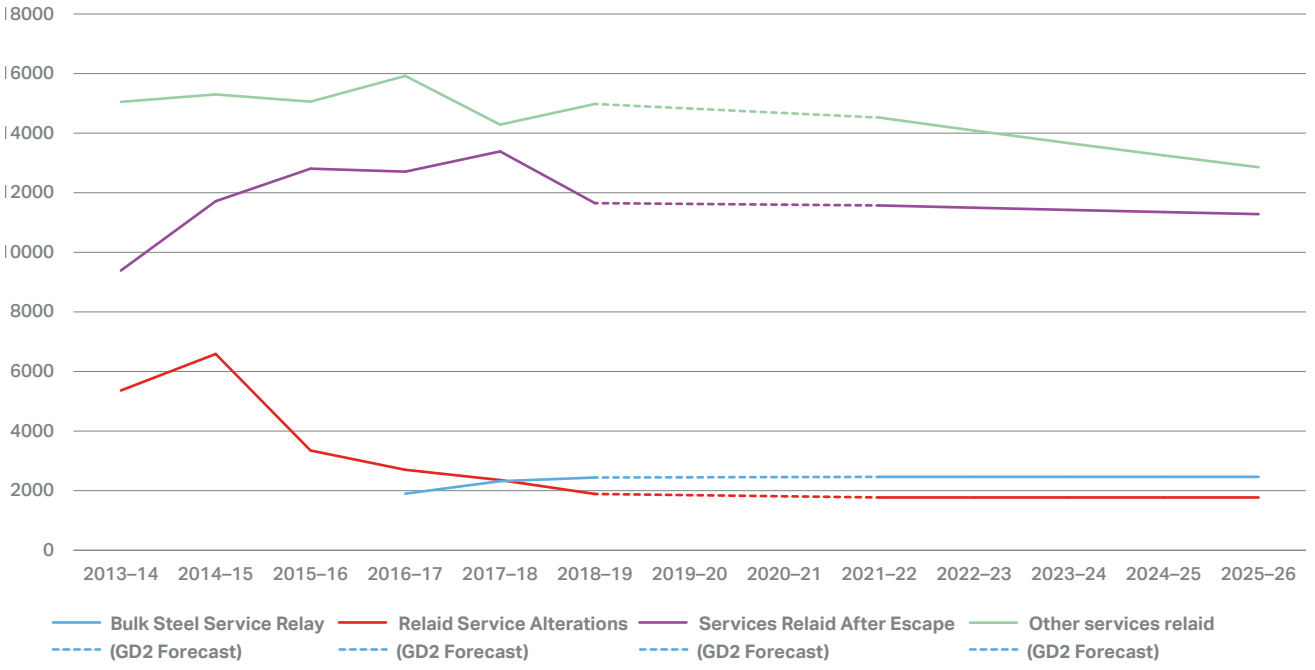
To forecast the number of service repairs we would expect in RIIO-2, we have used historic trends adjusted for the investment we are making in the IMRRP. There are four drivers of work in this area and the methodology we have followed for each of them is set out below:

- **Services Re-laid After Escape –** This work is driven by asset health. As the service pipes age, the rate of failure is expected to increase. However, our mains renewal programme is counteracting this through the renewal of mains-associated services. Over RIIO-1, we have seen year on year variation in the replacement rate, driven by service failure but no overall reduction in failure volume. For RIIO-2, we have taken the average replacement over the past three years and applied a top-down workload reduction to account for the delivery of the IMRRP.
- **Re-laid Service Alterations –** This is a customer-driven activity and is not affected by the replacement of services through the IMRRP. We have observed a decrease in the volume of service alterations over RIIO-1; we have therefore used the last available year of data (minimum volume experienced in RIIO-1) to forecast the work into RIIO-2. Using an average volume over RIIO-1 would have lead to a higher volume in the forecast.
- **Bulk Steel Service Relay –** Regulation 13 of the Pipelines Safety Regulations 1996 ('PSR') requires the operator of a pipeline to ensure that it is maintained in an efficient state, in efficient working order and in good repair. This duty is absolute and, in the case of steel service pipes, maintenance means replacement. The bulk steel process identifies locations with high service-failure rates (service failure is five times more likely than average) and proactively promotes the renewal of the services in that area. This is a new initiative introduced in RIIO-1 and therefore we are not proposing to change the approach until we have delivered the work for a period and have been able to assess the benefits. The volume of services this promotes will not reduce through mains replacement activity and therefore we have used the average volume over the past years to forecast workloads.
- **Other Services Re-laid –** This work is customer driven, with most of the work being to address poor-pressure issues caused by the growth in customers' demand for gas. We saw an increase in workload over the first years of RIIO-1, with a flattening off and decrease in the 2018/19 reported numbers. To forecast RIIO-2 volumes, we have used the last available year of data (minimum volume in recent years) to forecast the work into RIIO-2. This work is split into PE and Non-PE renewal. On the Non-PE workload, we have applied a top-down workload efficiency to account for the delivery of the mains renewal programme.

The volume of interventions forecast can be seen in the chart below. This totals £219m over the RIIO-2 period (circa £44m p.a. across our four networks).

Costs and efficiency continued

Figure 09.18: Forecast non-mains service replacement volume



9.8 Our capex forecast

Our capital investment programme is critical in ensuring security of supply, reliability and safety of our network for our 11m supply points. There are three principal aspects to our investment programme.

First, we invest in our above ground network to ensure it continues to deliver the levels of service our customers expect. This includes a range of investments from complex systems such as our pressure reduction systems and waterbath heaters through to the integrity of civil structures and site security.

The second aspect of our capital programme is all about ensuring we have the right technological and operational assets in place to support our people in delivering a service they and our customers can be proud of. This includes investing in tools, equipment, vans, operational sites and critically the IS infrastructure to allow us to issue, record and measure work for our customers as well as our cyber security programme to keep our operational and non-operational systems safe from a growing number of external threats.

Finally, we invest in the form of new connections to the network. Although this is a competitive market we incur capital spend where we are obligated to subsidise customer driven works through either the domestic load connection allowance (we fund the first ten metres of domestic connections) or where a customer requested diversion or reinforcement means we have to replace an asset that we would have replaced anyway due to its age and/or condition (betterment).

In focus – Enabling UK infrastructure development

UK infrastructure continues to develop and expand, and to meet this need we are required to move our assets if they are constraining growth. The majority of this work is funded by the development company, for example in constructing London's 'super sewer' Thames Water funded £5m of alterations to Cadent's network in London. In RIIO-1 we have already begun work on moving and protecting assets to accommodate the route of HS2 – this work will continue throughout RIIO-2 as the route cuts through our area of operation from London to Birmingham and beyond.

We have a statutory duty to move our pipelines and other assets where they compromise safe development. We have worked closely with infrastructure developers to understand and respond to their needs in a timely and efficient fashion. In some cases the infrastructure provider delivers the required diversion work themselves and we adopt the completed assets.

RIIO-2 will see Heathrow Expansion and work on the new Dartford Crossing as well as a range of smaller infrastructure projects across our regions. We forecast that the workload driven by growth will be 30% higher p.a. in RIIO-2, particularly as a result of HS2. Although the majority of this work is funded by third parties we need to ensure that we are resourced to deliver this increase in addition to other activities.

Not all of our customer-driven diversion work is fully chargeable to the requestor. Hence this category adds to our overall length of replacement work. We anticipate this to be around 24km p.a. for the RIIO-2 period.

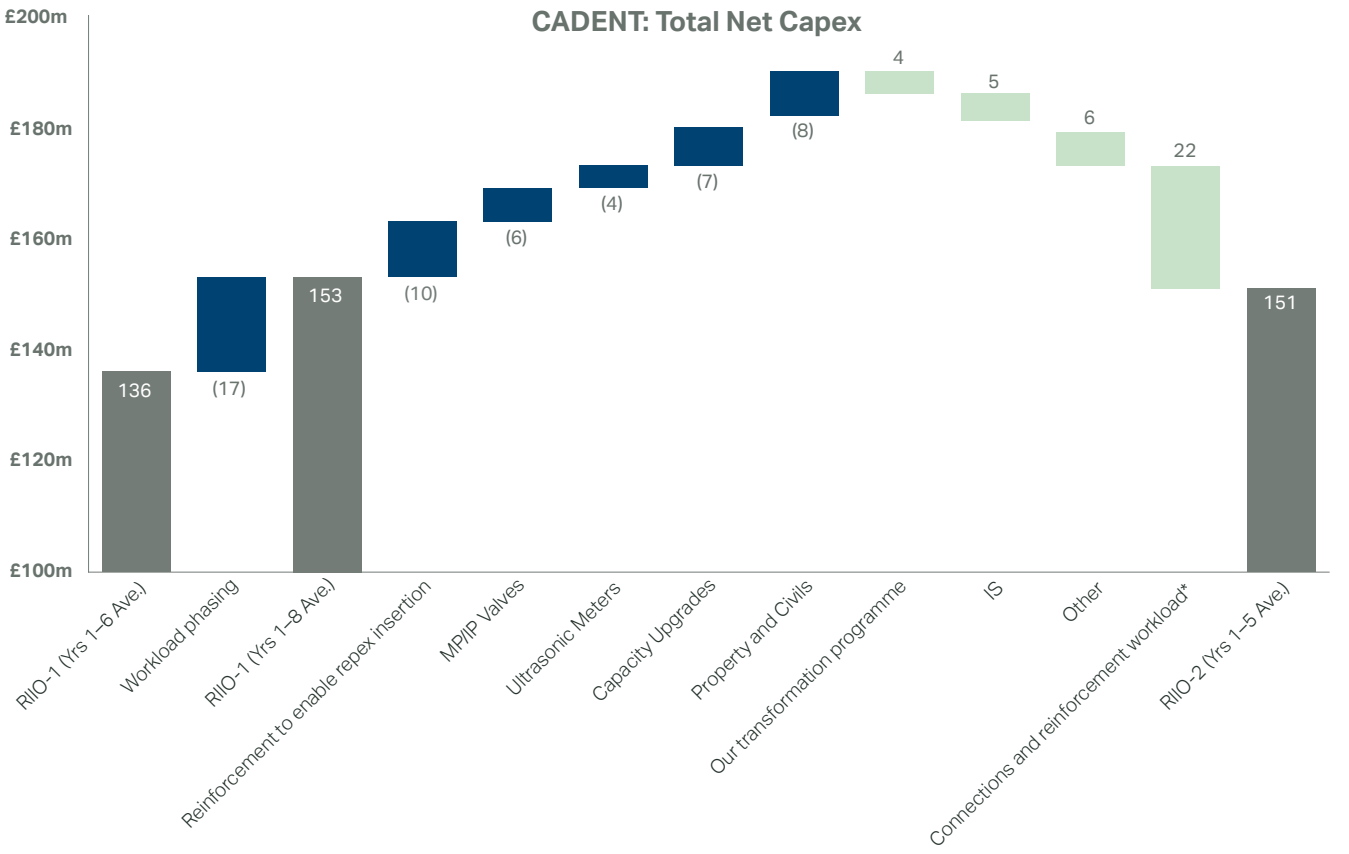
Table 09.18 sets out our forecast capital expenditure for the RIIO-2 period. In total we are forecasting to invest £754m (£151m p.a.) over the period.

Table 09.18: Capex summary

	RIIO-1			RIIO-2						RIIO-2
£'m (2018/19 price base)	2019	2020	2021	2022	2023	2024	2025	2026	RIIO-2 Total	Av.
LTS Pipelines	(2)	3	0	9	6	4	6	1	**27**	**5**
Storage (Non-LTS)	–	–	–	0	1	–	–	–	**2**	**0**
PRS	25	39	40	16	20	21	15	14	**87**	**17**
NTS Offtakes	7	6	6	8	17	13	13	7	**60**	**12**
Embedded Gas Entry Points	0	–	–	–	–	–	–	–	**–**	**–**
LTS	30	49	46	34	46	39	34	23	**176**	**35**
Reinforcement (<7barg)	13	15	18	13	12	12	6	6	**48**	**10**
Governors	10	13	10	4	3	4	3	3	**17**	**3**
Connections	37	38	38	22	22	22	22	22	**112**	**22**
Other Capex	61	94	68	68	79	79	60	50	**337**	**67**
Of which: IT & Related Telecom	30	44	19	26	30	24	23	18	**121**	**24**
Land, Buildings, Furniture & Fittings	5	7	8	1 6	21	21	9	5	**73**	**15**
MP/IP Valves	3	9	6	8	8	9	9	9	**44**	**9**
Transport & Plant	10	9	10	16	17	12	14	5	**65**	**13**
Capex: Adjusted	**160**	**218**	**190**	**157**	**180**	**168**	**140**	**109**	**754**	**151**
Memo items										
Output Cases	–	–	–	5	5	16	16	17	**59**	**12**
Xoserve	8	10	9	–	–	–	–	–	**–**	**–**
Capex: Reported	**168**	**228**	**198**	**162**	**185**	**184**	**156**	**126**	**812**	**162**

The trace shown below shows the key movements comparing our RIIO-2 forecasts with our RIIO-1 average spend.

Figure 09.19: RIIO-1 vs RIIO-2 average Capex



* RIIO-1 Totex includes areas of spend which we are proposing become Uncertainty Mechanisms in RIIO-2. We have re-baselined the level of uncertain costs that are being requested via Ex Ante allowances.

Costs and efficiency continued

Table 09.19: Key movements in our average annual costs (Capex)

Source of movement	Category of movement	Comment	Average annual cost
Key movements outlined between RIIO-1 yrs 1–6 average and our RIIO-1 forecast 8–year average spend			
Workload phasing	Volume	We have a number of asset health investments we are completing over the remainder of RIIO-1 which will increase our average spend. This includes the completion of more complex capital projects to deliver our monetised risk output commitments alongside increased investment in IS and connections.	£17m
Total			**£17m**
The next step on the trace shows the change in average annual spend between RIIO-1 and RIIO-2			
Reinforcement to enable repex insertion	Volume	As described in our repex commentary we have looked to a totex solution to mitigate forecast decreases in insertion rates. By increasing our reinforcement spend we are able to achieve higher levels of insertion and reduce the impact by £18m p.a.	£10m
MP/IP Valves	Volume	In RIIO-1 we began a programme to improve the condition of MP valves – following survey work we have now begun to invest in the region of £7m per year in RIIO-1. This work will continue and expand into GD2 to ensure compliance with our pipeline safety regulations requirements. Valves need to be operable to contain leaks on pressurised pipelines, without these controls the consequence of pipeline failure is greatly increased.	£6m
Ultrasonic Meters	Volume	We will begin a ten year programme to replace all of our 1960s/70s mechanical 'orifice plate' measuring devices with modern ultrasonic units. This will improve metering accuracy and reduce whole life costs.	£4m
Capacity upgrades	Volume	We are investing to increase capacity at a number of our Above Ground Installations to ensure they remain compliant with our 1 in 20 standards. This investment ensures we will continue to deliver the levels of reliability our customers and stakeholders expect.	£7m
Property and civil structures	Volume	We have reviewed our property strategy and have tested options through CBA to ensure we both meet our operational requirements and deliver at the lowest whole life cost. We are also investing to protect civil structures that are in our care and require remediation to ensure they meet current safety standards.	£8m
Our transformation programme	Price	The continued implementation of our transformation programme as described earlier in this chapter, which in capex is focused on delivering further benefits associated with our IS transformation and continual improvement through innovation and competition.	£-4m
IS	Volume	Our IS costs are decreasing when compared with RIIO-1 as we have moved many of our services into the cloud and have completed our separation from National Grid.	£-5m
Other	Volume	Reductions across a number of areas as we have optimised our capital plans, for example implementation of more targeted interventions on our governor population.	£-6m
Connections and reinforcement workload	Volume	We are proposing to include an uncertainty mechanism for our customer driven workload due to uncertainty in our cost forecasts.	£-22m
Total			**£-2m**

In focus – Our approach to asset management

We have applied asset management best practice throughout our Business Plan to optimise our programme and make the right decisions for current and future customers.

Over the last five years we have invested heavily in developing our asset management capabilities through improving the quality of our asset data though surveys and data analytics, developing and implementing risk-based prioritisation and introducing optimisation software that allows us to perform complex scenario analysis. As part of our continuous improvement culture we also seek out best practice and engage with other regulated businesses such as Network Rail, Severn Trent and the Canal and River Trust.

For our investment plan we have a clear process that we have followed which is illustrated in the flow below. This has helped us ensure our investment plan is targeted according to our customers' expectations, presents the most optimal outcome and has the appropriate regulatory treatment.

This is described in more detail in **Appendix 05.02 - Detail of our 6 phases of engagement**. In summary, we first look to establish the need which involves identifying customer expectations, considering asset condition and performance and our legislative requirements. We then develop and analyse options for resolving the issue including build and non-build solutions and supporting cost benefit analysis. We then test these options against our ambition and strategic priorities before assessing the most appropriate regulatory treatment that ensures the risk is managed effectively and customers are protected.

The following section summarises our capital plan by area of spend. All of our Plans have been through detailed review and options analysis. This detail can be found in the Appendices to this chapter and we have pulled out summaries of the main areas of spend below. We have provided the Appendices in the form of Engineering Justification Papers ('EJP') and Major Project Justifications ('MPJ') as set out by Ofgem in their RIIO-GD2 Investment Decision Pack guidance v2. In line with this guidance we will provide the remaining packs as part of our December submission.

9.8.1 Local transmission system (including governors)

Gas is delivered into the Local Transmission System (LTS) of each of our networks via offtakes from the NTS. Gas under high pressure in the LTS is moved around to feed our distribution networks and reduced to lower pressures, before being delivered to customers.

This contains a number of subcategories of spend, the most material of which are Pressure Reduction Stations, Governors and NTS offtakes.

i) Pressure Reduction Stations ('PRS') (including Governors)

Our pressure reduction stations regulate the transition of pressure from the HP network to IP, MP and LP. Investment in this area is required to ensure compliance with Pressure System Safety Regulations and maintain security of supply for our customers. Pressure reduction systems are aged and many are now obsolete with no commercially available spares. Through a refined and improved approach to targeting we will reduce investment in GD2 whilst maintaining the same level of risk.

In building our Plan we considered three options in this area:

Option 1: We also worked with an independent consultant to take a fresh look at how we might deliver work in this area. We provided all of our asset and failure data to Enzen and asked them to produce a risk based response unconstrained by our current way of working. The option they developed combined an understanding of obsolescence, asset performance (both observed maintenance rates and wider industry insight on the performance of different makes/models).
Option 2: We used our risk models to develop a 'maximum whole life benefits' option.
Option 3: We used our risk models to develop a 'hold total monetised risk flat option'.

The preferred approach (Option 1) identified a lower cost, targeted approach focused on replacement of failing components within obsolete systems. Whilst all three options will maintain risk, the targeted approach will do so at lowest cost and we have therefore included this in our Plan. More detail on these investment cases can be found in **Appendices 09.07 and 09.08**. We applied this same approach across all of our pressure tiers (> and < 7barg) which covers investment across both our PRS and Governor investment lines. The solution we have proposed in this area is an example of how we have applied asset management best practice to deliver the best outcome for our customers.

Costs and efficiency continued

ii) NTS offtakes

Within this category there are two main areas of change, meters and capacity upgrades.

Meters (+£4m p.a.) – We will begin a ten year programme to replace all of our original 1960s/70s mechanical 'orifice plate' and 'turbine' measuring devices with modern ultrasonic units. These units have given good service since installation however we can no longer secure spares, engineered to the required standards to guarantee accuracy, to maintain the assets in service.

Replacement will also improve accuracy of recording, a positive outcome for Shippers, and avoiding meter outage due to failures. We have evaluated frequency of failure and consequences. For consequence analysis we have considered the duration of a failure, the size of the sites being impacted and the availability of alternative supplies. This has allowed us to rank our sites on the basis of risk. We have then considered different packages of work within the ranked list.

Option 1: Replacement of entire metering system upon failure over 5 or 10 years.
Option 2: Replacement of asset components upon failure.

Given the low failure rate observed to date we have selected option 1 over a 10 year programme which will see the, replacement of high risk assets in RIIO-2 and medium in RIIO-3.

Capacity Upgrades (+£7m p.a.) – We have identified a number of sites which due to demand increases in their supply networks no longer meet their 1 in 20 obligations for supply resilience. Whilst customer supplies are secure under normal operation, there is a risk of interruption to whole communities under extreme weather conditions – the time at which customers most need to be kept warm. We will invest to ensure a reliable and resilient supply is maintained for our customers.

As part of our response to the capacity constraint we have considered both onsite and offsite solutions. For offsite it is possible to reinforce or upsize assets in the wider network to remove the constraint. For onsite we have conducted a study to identify the specific assets or components which are limiting flows and considered replacement of assets in different combinations to achieve the desired outputs. This work has been supported by design studies to better understand the costs of different options.

Using this approach we have identified the least cost solution to provide the necessary capacity as opposed to a one size fits all approach or full site rebuilds. This has been applied on a site by site, asset by asset basis. This will achieve our legislative requirements at the lowest cost to customers. More detail will be provided in the engineering justification paper for capacity upgrades in line with the requirements set out by Ofgem.

9.8.2 Reinforcement and connections

The Gas Licence Condition 4B outlines that for domestic customers who require a gas connection within 23m of a relevant main that the costs incurred in delivering the work for the first ten meters on public land is paid for by general consumers through transportation charges. Enabling reinforcements are triggered by the need for our network to accommodate new housing, transport, gas fired peaking generation plants, business or industrial developments approved by the Local Authorities.

We are seeing a marked increase in spend to address local developments particularly in the East of England (Oxford/ Cambridge corridor etc.). We have also seen a marked increase in reinforcement for 'peaking generation' (garage sized gas turbines installed to produce electricity during price peak conditions) which we expect to continue.

Within connections our transformation processes and new contracting arrangements are forecast to reduce unit costs. Based on analysis of housing data we are forecasting an increase in connection volumes.

We have conducted external studies to evaluate the impact of growth through time. Given the customer driven nature of this work there is limited optionality. However we recognise the challenges in forecasting demand for new domestic connections. Whilst there is a trend between new housing and new connections, the timing and predictability of housing forecasts is less certain, with delays in planning applications and dependencies on investments from developers. Our options analysis in this area has therefore focused on the most appropriate, and fair, regulatory treatment for our customers. The options considered in this area are outlined below (with more detail provided in **Appendix 10.00 Our approach to managing risk and uncertainty**.

Table 09.20: Summary of uncertainty mechanisms

Mechanism Option	Description
Volume driver	This relies on a relevant unit cost estimate to forecast costs when volumes of work are uncertain. This would effectively address the uncertainty around changing customer demand in RIIO-2. It would also make use of cost information gathered from our existing experience of reinforcements in RIIO-1.
Re-opener mechanism	A re-opener accounts for uncertainty in costs when both the design and requirement for projects in RIIO-2 is unknown. As uncertainty in these areas is driven by volumes, rather than the specification of a project, this is not applicable in this setting.
'Use it or lose it' allowance	This would involve a Price Control Deliverable ('PCD') as part of our RIIO-2 Plan. Whilst this would protect customers from under-delivery, a PCD does not address the challenge we face in forecasting a total cost given uncertainty in volumes. There is also a risk that barriers are created if there are insufficient funds to deliver the required work.

In summary our assessment concluded that the most appropriate treatment for these areas of spend is a volume driver and we have reflected this in our base Plan. This addresses the volume uncertainty and makes use of the established unit costs for these areas of spend. We have included a base level of investment in our totex submission with any growth then being managed through the proposed uncertainty mechanism.

9.8.3 Other Capex

We have a number of other areas of investment including IS, property, vehicles, tools and equipment and valves. The following section summarises the most material changes in these areas.

i) Information Services ('IS')

We are proposing to invest £121m across RIIO-2 in our information technology and services. This includes investing in:

- **Core IS services (£86m)** – Renewal and modernisation of our existing IS estate embracing the latest technology including cloud computing to keep the energy flowing. Further detail on our IS investment plans can be found in **Appendix 09.30**.

Core IS services – Cadent in the cloud

Cloud computing is now widely recognised as providing the best, most efficient way of procuring computing capability. It brings a number of benefits:

- A low-cost, scalable, and highly reliable infrastructure platform.
- By adopting a public cloud platform we are able to secure low variable/pay as you go costs (that can scale with business and applications) instead of the need to invest upfront on infrastructure.
- We do not need to work around long lead times for the provision of services and computing environments as these are now rapidly deployed in the cloud, accelerating business agility.

In the later years of RIIO-1, Cadent is moving to secure public cloud computing, away from traditional enterprise IT supported by in-house or private cloud data centres. The expectation is that the current application landscape will look very different through RIIO-2.

We expect cloud computing can help us radically change things during the next RIIO period:

- Cloud computing is a means by which computing becomes fully commoditised and invisible, driving stability, resilience and availability and a benchmark for performance and cost.
- Data centres will operate like ecosystems. Commoditised hardware and run time environments will converge with value added services offered as standard to combine functionality. We expect that automation (robotics), machine learning and integration will become ubiquitous and connections and changes in this integrated environment will occur automatically.
- Other cloud services, for example data & analytics and the internet of things (which we will seek to utilise to increase our data collection from our networks and improve our decision-making) will become practical propositions. Before cloud, these would require significant effort, time and money to establish and maintain.
- Cadent's IS will continue to mature as an organisation, potentially taking on a larger responsibility, brokering cloud services with a mix of service providers, managing commercial arrangements, multiple cloud services, partners and interactions. This needs investment in new skills (cloud – architecture, system administration, operations management, billing, monitoring, vendor management, business relationship management).

The benefits of this approach are built into our overall efficiency forecasts.

- **Data, Digitalisation and IT innovation (£17m)** – We are investing to support our ambition to become a data driven digital business. This supports the recommendations by the Energy Data Task Force and will ensure we play a full part in the digital energy system of the future. We will set out more detail on our digitalisation strategy in our December Plan. Further details on our data and digitalisation strategy can be found in **Appendix 07.02.02**.

Data, digitalisation and IT innovation – Building a data driven business

Data is central to everything we do as a business. With our renewed focus on our customers, we are investing in data and the effective utilisation and management of data as a key enabling capability to make us the best at what we do – keep the energy flowing to our 11m homes and businesses with exceptional safety and value outcomes.

Following a comprehensive data maturity assessment, and embracing the opportunities presented as we migrate to the cloud and separate from National Grid, we know where we need to invest to realise our vision and set the standards that our customers love and others aspire to.

We have experimented with innovations around Machine Learning and Artificial Intelligence to drive a whole new approach to how we manage our plant protection.

Through this data driven innovation we will be able to improve safety across our network by analysing a broader geographical area of our network than we currently do, all at a lower operating cost. This will mean we can decommission existing practices of using helicopters and line walk crews, further improving safety within our operations.

Part of our roadmap is to explore the development of a Digital Twin of our network, which will provide the flexibility to augment real world scenarios, helping us plan the most effective maintenance works and optimise distribution of gas. In this context we are reviewing the output from the Energy Data Task Force.

Our move to cloud computing has presented a number of fantastic opportunities around the Internet of Things and Big Data, where we plan to invest in a range of innovations, to build on our network and create a sophisticated smart network that generates new data that will provide insights to drive effective planning across our distribution network. In total we are investing £8m in IS projects that either directly or indirectly build increased capability in this area.

- **Cyber security (£18m)** – Investing in the security of our IT and operation technology estates. As we approach RIIO-2, cyber security is an area of increasing focus. New standards are being determined for a wider set of systems as part of the NISR. We need to ensure we make the necessary preparations to protect all of our systems and data, and prevent service failures for our customers. We discuss our cyber resilience and Business IT resilience in section 7.2 of **Chapter 7** in more detail and provide our full strategies in **Appendices 07.02.00 and 07.02.01**.

ii) Ensuring the physical security of our key assets

Alongside our cyber security plans we have also set out our physical security requirements. We have been working with BEIS to understand how threats are evolving and have contributed to the development of their new PSUP document which describes the levels of protection required for sites of different sensitivities. We have presented network analysis showing the number of customers reliant on each of our sites and BEIS have confirmed those sites which need protection and to what standard. The details of this work are restricted but the need to provide and maintain protection at 19 sites has been confirmed at a total cost of £21m.

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iii) Property and civil structures

Our property costs represent the cost of running our property estate including our central sites and our regional operational depots. In total this represents £58m over RIIO-2 for our property estate and £15m for civil structures (an £8m p.a. increase in average spend). The majority of this increase is driven by our property strategy which we have reviewed for RIIO-2. As we are reducing our headcount through our transformation process we have the opportunity to rationalise our property portfolio. We have considered a number of rationalisation options as part of our decision-making, including a move to a single site, split teams over two sites and retaining existing buildings. We have also considered different levels of refurbishment required through time. Although there will be an increase in spend in RIIO-2 to facilitate change our investment appraisal has identified this as the least cost option with a positive payback in RIIO-3.

iv) MP and IP valves

To ensure we remain compliant with Pipeline Safety Regulation we need to maintain the condition and operability of valves on our medium and intermediate pressure network. These critical valves were installed when the pipelines were originally constructed, up to 50 years ago, and have had limited remediation since. Our inspection programme during RIIO-1 has raised a number of issues around valve operability. Investment will vary from rebuilding of a chamber which has collapsed following third-party work, reinstating pressure points which have aged or been damaged or more comprehensive interventions to replace whole valve units.

We have examined options looking at the rate of delivering this programme. In summary the requirement to comply with PSR and the absence of a delivery constraint we are planning to complete the work over five years. This is a reasonably practicable approach and will see us invest £34m.

9.9 Non-controllable opex

Our non-controllable costs are operating costs borne by networks but not part of totex due to their non-controllable or semi-controllable nature. We expect that these will amount to around 13% of the domestic bill impact in RIIO-2 on average.

By far the largest component of this category is network formula rates. These are based on rateable values periodically assessed by the Valuations Office but are also influenced by the government's 'pence in the pound' decision when targeting rates revenue (i.e. rateable value x pence in pound = network rates bill). Networks actively engage with the Valuations Office in order to minimise costs. The implementation of the next rates review will coincide with the start of RIIO-2. We have emulated the approach taken by the Valuations Office to assess possible rates levels in the next price control period. In theory, we would expect to see reductions corresponding to the average regulatory allowed revenue profile.

Shrinkage is the cost of gas lost from the system, mainly from leakage, but also from theft and use in our own processes. Our Plan assumes shrinkage volume reductions of between 14% and 17% in RIIO-2, mainly driven by our ongoing mains replacement programme and pressure management. However, shrinkage costs are also influenced by the wholesale price of gas, which can be very volatile. The long-term forecast for gas prices combined with our expected volume reductions results in a fairly flat impact to consumers across RIIO-2.

Other smaller elements of pass-through cost are Ofgem licence fees, and Xoserve costs (key activities include transportation billing process and systems, supply point administration and demand estimation).

In total we are forecasting an average annual cost of £334m in RIIO-2 as detailed in the Table below.

Table 09.21: Forecast non-controllable costs

2018/19 Prices	2019	2020	2021	2022	2023	2024	2025	2026	RIIO-2	Average annual
Network Rates	203	202	200	175	175	175	175	175	**874**	175
NTS Exit Costs	89	92	102	106	106	102	99	96	**509**	102
Shrinkage	25	14	18	17	16	15	15	14	**77**	15
Established Pension Deficit Recovery Plan Payment	39	40	40	40	34	0	0	0	**74**	15
Xoserve	0	0	0	14	14	10	10	10	**57**	11
Ofgem Licence	8	8	8	8	8	8	8	8	**41**	8
Innovation (TBC)	4	5	6	7	7	6	6	6	**32**	6
Unfunded Innovation Costs	0	1	1	1	1	1	1	1	**4**	1
PPF Levy Costs	0	0	0	0	0	0	0	0	**0**	0
Pension Scheme Administration Costs	3	3	5	0	0	0	0	0	**0**	0
NTS Pension Recharge	20	0	0	0	0	0	0	0	**0**	0
Bad Debt	0	0	0	0	0	0	0	0	**0**	0
Supplier of Last Resort Claims	3	3	1	0	0	0	0	0	**0**	0
Non-controllable costs	**395**	**368**	**382**	**366**	**361**	**318**	**313**	**310**	**1,668**	**334**

9.10 Cost confidence

A key feature of Ofgem's business plan assessment is the treatment of high and low confidence costs. Within **Appendix 09.21** we have provided our view of Ofgem's ability to set allowances with confidence in more detail. This is a new area of policy and we look forward to working with Ofgem on developing this further up to initial determinations in the summer of 2020.

We have developed a systematic approach to help with this assessment and this is summarised in the figure below. This is a 2 stage approach that first considers the information available to Ofgem based on a number of inputs including for example regression analysis, trend data and market competition. We have then considered mitigations that have been put in place either through the development of the RIIO-2 framework (RPE indexation for example) or through our own business plan proposals (use of volume drivers in connections for example).

Figure 09.20: Cost Confidence for setting allowances

Factors		Developments/Mitigations		
• Totex regression updated • Bottom-Up regressions • Technical reviews • History trends • GDN comparators • Level of market purchased • Advanced project lifecycles	✚	• NARM & CBA developments • Identified inconsistencies • Indexation (especially labour) • Uncertainty mechanisms	▶	95% High Confidence 5% Low Confidences (48% Blended Sharing factor)

Our view of costs at present suggests the vast majority of our totex can be considered as high confidence (94%) which would equate to a blended sharing factor of 48%. This is enabled by mitigations we have put in place including volume drivers, competitive tenders and capturing large uncertain projects such as HyNet North West as re-openers to be considered when we have further developed the project.

9.11 Real Price Effects (RPEs)

We expect Real Price Effects ('RPEs') to be a higher profile issue at RIIO-2 than at RIIO-1 for two reasons. In order to remove a source of potential windfall gains or losses, Ofgem has decided to put in place a system of cost indexation so that certain cost allowances will flex in the period following changes in appropriate indices, which will feed through to allowed revenue in period. Second, because all revenues in RIIO-2 will be indexed by the CPIH measure of inflation rather than RPI, and since CPIH is typically up to 1% lower than RPI, we would normally expect the gap between nominal and real prices to be up to 1% greater than previously under RPI indexation.

We have supported Ofgem's proposal to index RPEs, subject to ensuring any index is representative of network costs, workable in practice and applied to material cost items. We propose the application of indices where the potential price variation for any costs as compared to the Plan is likely to be at least 0.5% of controllable totex, which equates to 0.2% of RoRE for Cadent. Against these criteria at this early stage of the process we propose that RPE indexation should be applied to labour (including contractors), oil which impacts heavily on material costs of PE pipe and plant hire.

Within our Plan, over the period of RIIO-2, we have used the latest forecast from March 2019 from the Office of Budget Responsibility ('OBR'), for labour and oil which are illustrated relative to CPI in Figure 09.21. From a starting point of 2018/19, labour costs are forecast to rise steadily to be 10% above CPI by 2025/26, whereas oil prices are forecast to decline sharply in 2019/20 and only gradually recover, such that by 2025/26 they will have risen by around 20% less than CPI. As discussed RPEs will have a more prominent impact on totex in RIIO-2 compared to RIIO-1 as a result of the switch to CPIH for the purpose of translating costs from real to nominal values. A significant part of the cost base is still strongly correlated with RPI rather than CPI and there is an inherent 1% wedge between the two indices which we have reflected in our analysis. Based on the initial analysis, labour costs through the cost of employees and contractors, account for around 75% of our totex base. Consequently we estimate that the labour RPE will cause an increase in costs of £61m over RIIO-2 assuming that the actuals will be in line with the forecast. PE pipe and reinstatement costs account for around 5% of our costs, which are heavily (circa two-thirds) dependent on the oil price. With the forecast reduction in the oil price this sees a projected reduction in costs of £4.1m over RIIO-2. For plant hire we have assumed zero RPE in our plan assuming it moves in line with CPIH as there is no forecast for the index for these costs (which have historically been volatile although currently in line with CPIH).

These cost impacts are given in the Table below. Overall this sees a 5.7% RPE effect over the seven years to 25/26 which is a 4.4% impact over RIIO-2.

Costs and efficiency continued

Figure 09.21: OBR price forecast

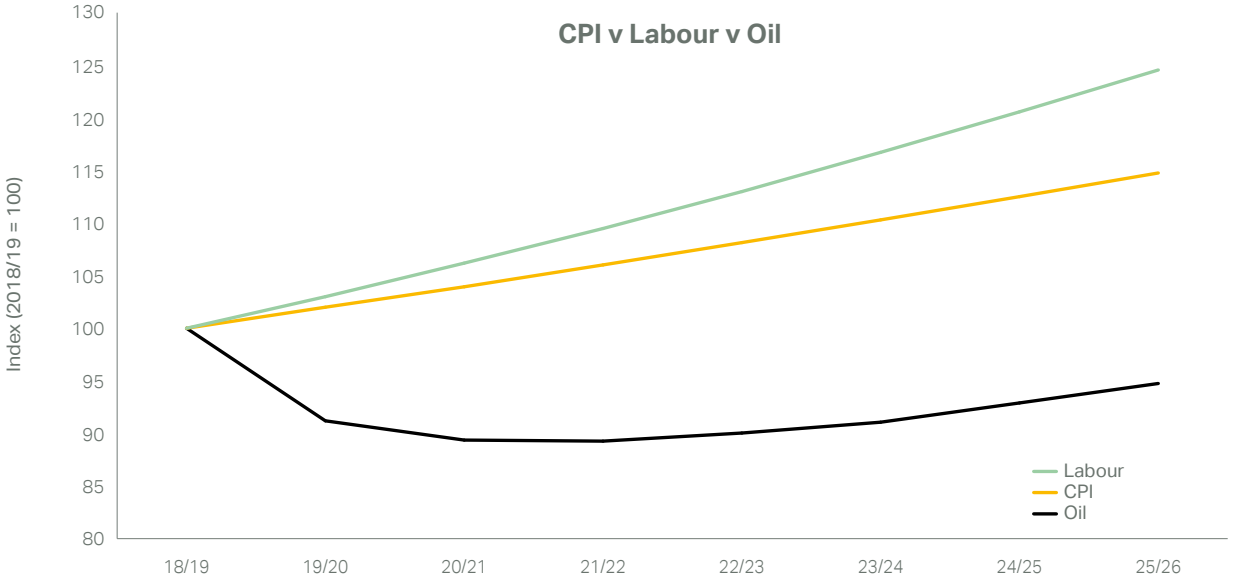

Table 09.22: Impact of RPE forecasts on Totex

£m, 18/19 prices	19/20	20/21	21/22	22/23	23/24	24/25	25/26
Labour RPE Impact	8.3	17.4	25.1	34.9	45.1	53.4	61.4
Oil RPE Impact	-2.8	-3.7	-3.8	-4.0	-4.2	-4.2	-4.1
Overall RPE impact	**5.5**	**13.7**	**21.3**	**30.9**	**40.9**	**49.2**	**57.2**
%increase from 2018/19	*0.5%*	*1.2%*	*2.0%*	*2.8%*	*3.8%*	*4.7%*	*5.7%*
%increase from 2020/21	*–*	*–*	*0.8%*	*1.6%*	*2.5%*	*3.5%*	*4.4%*

We will provide an updated view of RPEs and our proposals for the selection of appropriate indices in December once we have reviewed Ofgem's guidance.

Supporting evidence

The following Appendices set out evidence and supporting information that are relevant to this chapter:

- Appendix 09.00 Overview: how we have developed our investment plan
- Appendix 09.01 Introduction to Investment Decision Packs
- Appendix 09.02 Distribution Mains and Associated Services (Iron, PE, Steel & Other)
- Appendix 09.03 Services Not Associated with Mains Replacement
- Appendix 09.04 Transforming the Experience for Multi-Occupancy Building Customers - Risers
- Appendix 09.05 Offtakes & PRS Pre-Heating
- Appendix 09.06 London Medium Pressure
- Appendix 09.07 Offtakes & PRS Slamshut Regulators
- Appendix 09.08 Governors (District, I&C and Service)
- Appendix 09.09 LTS Pipelines (Piggable and Non-Piggable)
- Appendix 09.10 Offtakes & PRS Metering Systems
- Appendix 09.11 Offtakes & PRS Odourisation Systems
- Appendix 09.12 Security Interventions National Cat2a
- Appendix 09.13 Brunel Bridge Crossing Refurbishment
- Appendix 09.14 Offtakes & PRS Filters
- Appendix 09.15 Holford Salt Cavity E&I
- Appendix 09.16 Winnington Lane Crossing Replacement
- Appendix 09.17 Category 3 Mandated National Security Upgrades
- Appendix 09.18 Mersey Tunnel Access Refurbishment
- Appendix 09.19 ENA common RIIO-2 scenarios
- Appendix 09.20 Resolving our benchmarked performance gap
- Appendix 09.21 Cadent's regional factors
- Appendix 09.22 Real Price Effects
- Appendix 09.23 Capacity Upgrades – >7 bar reinforcements (AGIs)– Base case
- Appendix 09.24 Pipeline / Mains Diversions – Non-Chargeable >7 & < 7 bar – Base Case
- Appendix 09.25 Pipeline / Mains Diversions – Chargeable <7 & >7 bar – Base Case
- Appendix 09.26 Pipeline Reinforcements – Base Case
- Appendix 09.27 Connections – Base Case
- Appendix 09.28 Corporate Property
- Appendix 09.29 Property: Other
- Appendix 09.30 Technology (IT and Telecoms)
- Appendix 09.31 Valves (IP / MP valves)
- Appendix 09.32 Reduced Depth of Cover
- Appendix 09.33 Pipeline Sleeves
- Appendix 09.34 Vehicles & Mobile Plant
- Appendix 09.35 Cathodic Protection
- Appendix 09.36 Pipeline Crossings
- Appendix 09.37 Not Used
- Appendix 09.38 Controllable Opex Costs
- Appendix 09.39 Frontier Productivity Growth
- Appendix 09.40 Understanding the Baseline Level of Efficiency in London