

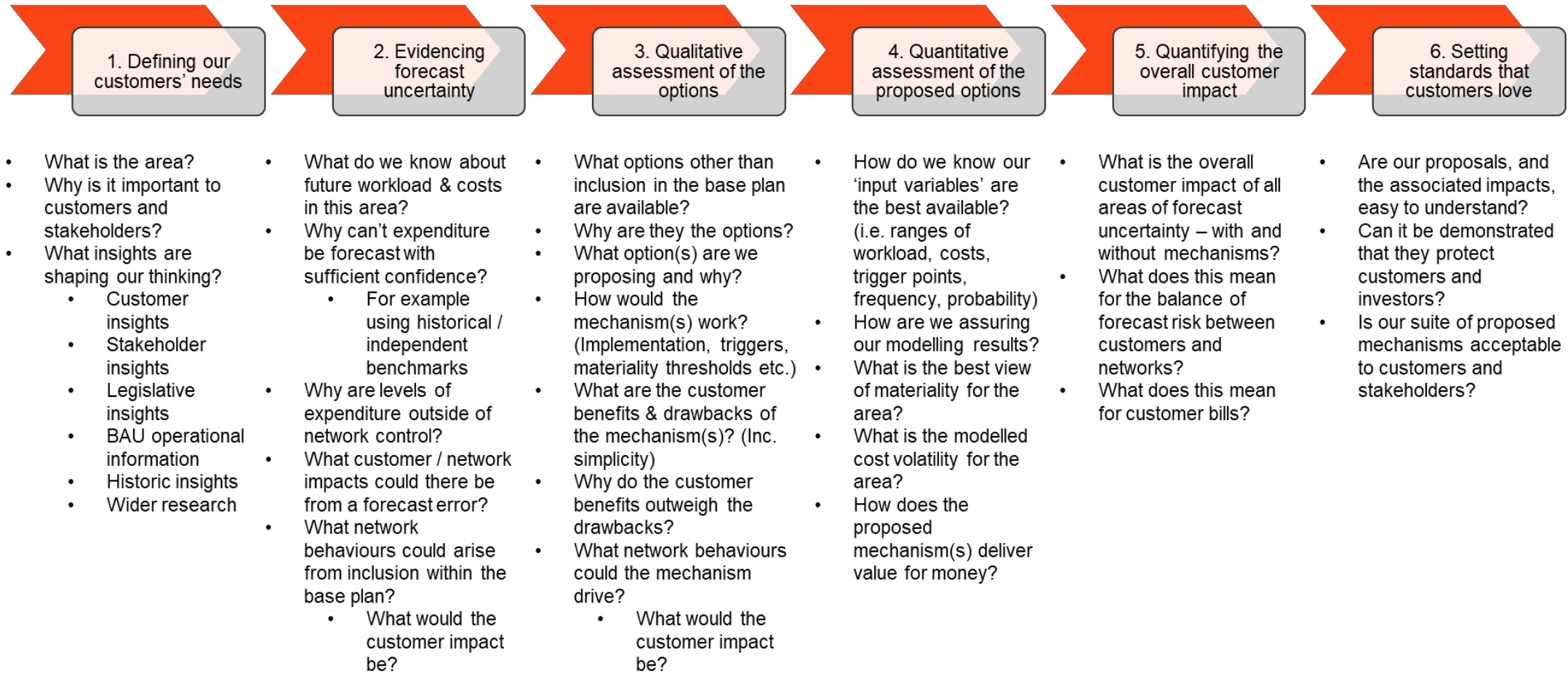
Appendix 10.13

Uncertainty Mechanism Case

Lowestoft project

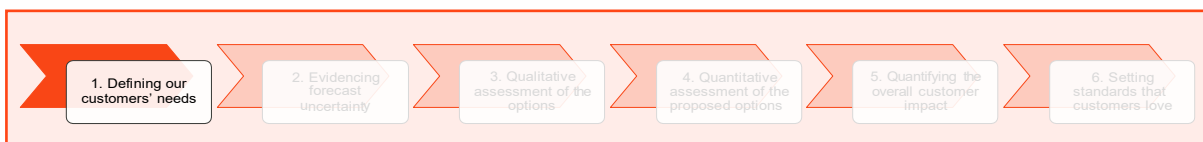


Cadent's systematic approach to developing uncertainty mechanisms to manage forecast uncertainty



Uncertainty area			
Demand uncertainty	Legislative uncertainty	Cost confidence	Heat Policy
<p>Lowestoft project</p> <p>Cadent proposal</p> <p>Re-opener Uncertainty Mechanism</p> <p>Following the collapse of the quay at Lowestoft Harbour in 2012, the existing intermediate pressure (IP) gas pipeline in the quay had to be abandoned. As a temporary solution, three high-density PE (HDPE) pipes operating at IP were connected through a service tunnel under the Harbour.</p> <p>This solution was expected to remain in place for only two years whilst a permanent solution was developed. However, obstacles in the surrounding environment have limited our ability to install a permanent new pipe using horizontal directional drilling, or an equivalent technique. Consequently, the HDPE pipes remain in place, while additional issues with the surrounding network have materialised. This includes a future risk to our licence conditions on maintaining a secure supply for a 1-in-20 peak winter demand.</p> <p>We are currently undertaking feasibility work to identify the most appropriate solution. However, until this is concluded there is significant uncertainty on the best solution and therefore the amount of investment required to address this risk. Our proposals for a re-opener mechanism ensure that we will only recover efficient expenditure for a solution that has been developed through a robust optioneering process. They limit the opportunity for windfall gains from a potentially low confidence cost item.</p>			

1. Defining the need



1.1. What is the area?

Throughout our operations, we are focused on maintaining the security of supply for our customers and ensuring the overall safety of our network.

In 2012, subsidence in Lowestoft Harbour resulted in the collapse of the quay, requiring us to abandon the existing gas pipeline that was in the quay. In response to this event, three 63mm intermediate-pressure, high-density PE (HDPE) pipes were installed through a service tunnel under Lowestoft Harbour, allowing us to maintain a supply of gas to our customers.

The pipes installed in Lowestoft tunnel were originally designed as a 2-year temporary arrangement to deal with the immediate aftermath of the quay collapsing while a permanent solution was developed and commissioned. However, efforts to undertake horizontal directional drilling (HDD) across the Harbour were unsuccessful due to the presence of deep

buried obstacles. Consequently, the HDPE pipes installed in Lowestoft tunnel have remained in place beyond their intended design life.

We have identified several issues within the network surrounding Lowestoft, associated with these pipes:

- The network is currently under policy design compliance for a 1-in-20 peak day winter demand. However, there are low pressures in the South Lowestoft IP network. The tunnel crossing is one of the pinch points on the system. The low pressure at peak demand creates a future risk of failing to meet our licence conditions maintaining a 19-mbar pressure supply to customers if growth occurs.
- There are potential hazards associated with the HDPE pipes being in the service tunnel at Lowestoft Harbour, rather than being buried. These hazards include the potential for mechanical damage to the pipes.
- Finally, the wider South Lowestoft IP network has many bolted gland joints and sections of pipeline with reduced depth of cover. Additionally, the majority of the network is approximately 60 years old and consequently has a number of operational and integrity issues which result in a number of failures and associated ongoing repair costs. The options we are considering have to address both the capacity constraint and these operational and integrity issues in an optimal way for the benefit of our customers.

As described in subsequent sections, work is still underway to evaluate the potential options to address the risk identified at Lowestoft, creating uncertainty over the project cost over RIIO-2. We have a clear understanding of the need for investment but face considerable uncertainty on the appropriate expenditure required to address the risks.

1.2. Why is it important?

We have a requirement to maintain the security of supply to our customers. Our supply-demand modelling has shown that for the area south of Lowestoft Harbour we have breached our design policy for assuring adequate pressure to our customers. Whilst remaining within our 1-in-20 licence conditions we are not offering customers the usual reliability of service to which we operate. This is an issue we must mitigate.

There are further risks associated with the use of HDPE pipe within the service tunnel itself, including the risk of mechanical damage and fire. Early challenges have prevented the development of a permanent solution to date. It is important that we address this risk in RIIO-2 for the safety of our customers and the provision of a reliable gas supply.

1.3. What insights are shaping our thinking?

We are focused on maintaining the security and safety of supply to our customers, who value this as a high priority. Customers have a primary expectation that we operate our assets in such a way as to keep their supply of gas flowing and keep them safe throughout the process.

Since the initial collapse of the quay in Lowestoft, we have undertaken engineering studies to consider options for a permanent solution and to survey the condition of the temporary solution in Lowestoft tunnel. The scope of these studies is outlined below:

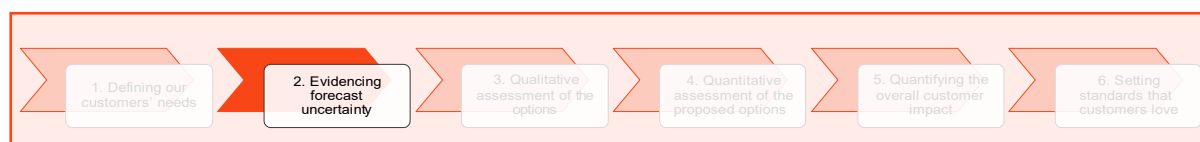
Table 1: Existing studies on Lowestoft

Description	Outcome	Author & Date
Feasibility study to assess the potential to repair the Harbour wall following its collapse in 2012.	Proposed use of sheet piles to repair the wall.	GL Noble Denton Report 14971 Oct 2012
Risk assessment for the temporary (12-month) installation of 3 HDPE pipes in the Harbour tunnel.	Conclusion that, following mitigation, risks of leaks were as low as reasonably practicable.	GL Noble Denton Report 13276 Nov 2012
Design report for the installation of permanent 200NB steel gas pipeline in the Harbour tunnel to replace existing HDPE pipes.	The report provided the detailed design for this work.	GL Noble Denton Report 14971 April 2014
Tunnel survey report assessing condition of supporting structure for the 3 HDPE pipes.	The report concluded that the structure was suitable for an additional 2 years' service if recommended remediation work was carried out.	DNV GL Report 17ORR95-1 Jan 2018
HAZID/ optioneering study for three options for the tunnel: 1) No change 2) Installing a new PE100 pipe in the tunnel 3) Installing a steel pipeline in the tunnel	The conclusion was that all options were possible with low residual risk, providing risk reduction measures are implemented.	Rosen April 2019

We have undertaken network analysis and hazard identification assessments to inform our understanding of asset health, and levels of risk now associated with the piping in the service tunnel at Lowestoft Harbour.

The need to demonstrate the security of supply has been reinforced through our engagement with customers. Safety, including prevention of emergency situations, was also consistently highlighted as the most important or joint most important priority across each engagement method during phase 1 research. This included deliberative workshops, a domestic-customer survey, a public survey, focus groups with hard to reach groups, stakeholder interviews and vulnerability interviews. The Cadent employee survey in May 2019, found that 'guaranteed gas supply' was scored as the fourth-highest priority (with a weighted score of 4.49 out of 5) for staff when answering as 'customers' (the survey asked staff to consider questions both as customers and employees).

2. Evidencing the uncertainty



2.1. What we know about the future

We know that there is now a risk that we may fail to meet our licence conditions maintaining a 19-mbar pressure supply at the ECV to customers if growth occurs. We therefore know with certainty that we need to introduce a permanent solution in RIIO-2 at Lowestoft.

Comparing uncertainty to costs included in our base plan

We are aware of costs associated with the setup of the Lowestoft project that will be independent of the solution selected through the optioneering process. These opex costs are summarised below and have been included in our baseline expenditure proposals.

Table 2: Baseline costs associated with the Lowestoft Project

Base costs £m, 18/19 prices	2021/22	2022/23	2023/24	2024/25	2025/26
Opex associated with project set up	0.21	0.00	0.00	0.00	0.00

Our proposal for an uncertainty mechanism does not interact with these costs. As discussed in Section 4, the costs we propose to reclaim through this mechanism cover the capital expenditure associated with the preferred solution. Including setup costs in the base plan ensures we can undertake preparatory work to deploy this solution in a timely manner during RIIO-2.

2.2. Why we face forecasting difficulties

There is a clear need to undertake work at Lowestoft Harbour given the network risks that have been identified. However, there is uncertainty over the most appropriate option for a permanent solution, which will be determined following feasibility studies that are currently being carried out. The challenges associated with the specific project mean that this is a complex process:

- Previous attempts to use HDD under Lowestoft Harbour have failed due to engineering challenges with depth of bore, sub-surface structure obstructions, and risk of damage to quay walls.
- Modifications to the Harbour tunnel would be complicated and require specialist subcontractors.
- The current Harbour tunnel is owned by Anglian Water - future works in the tunnel will require their cooperation.
- Adjacent landowners in the Harbour area will only agree to new permanent works via a land sale or an easement being agreed. This results in Cadent taking on significant risk, which is difficult to quantify, with associated costs for any future quay damage.
- The current tunnel IP pipe crossing, although undersized, provides flexibility and resilience to the South Lowestoft IP network. Solutions which remove the tunnel crossing would require extensive reinforcement of this network to maintain resilience.
- There is a predicted increasing trend for peak gas demand in the area due to new housing developments, increasing the demand on the network.

Our position in the project lifecycle for Lowestoft drives the forecasting difficulty we face. As outlined in Section 1.2, a previous approach using HDD was unsuccessful. We subsequently undertook a post-project review, looking to understand the requirements of an alternative solution. This project has now entered its second life cycle, as we look to assess the feasibility of these alternatives. The timing of this life cycle does not allow us to submit a detailed preferred option as part of our RIIO-2 submission.

We are not able to control the difficulties that have historically delayed the identification of a permanent solution. However, we are continuing to develop a **better view** of the required costs in this area, as demonstrated by our ongoing feasibility studies. This provides an opportunity during the determination process to present evidence to support a higher confidence cost estimate.

2.3. Network impacts and behaviours from including in the base plan

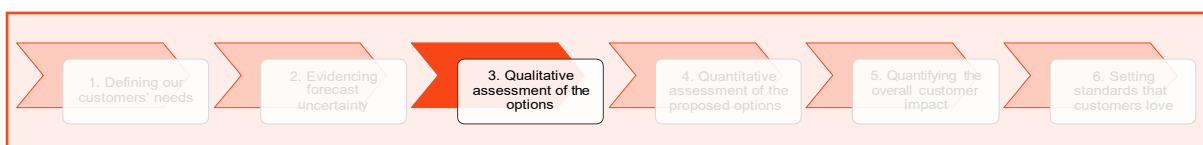
The risk with including costs in our base plan for the Lowestoft project is that we would be required to develop a cost forecast that has not been informed by the conclusions of ongoing feasibility studies. This would be based on indicative cost ranges rather than robust engineering studies, and it creates a risk that the solution ultimately chosen does not align with a baseline cost estimate made today.

If we were to include costs in our base plan, there would be an incentive to include an appropriate pricing of risk into our estimates to ensure we had adequate funding to introduce the option supported by future conclusions from feasibility studies.

However, this creates **a risk to customers**. If we were to include a cost estimate that turned out above the amount required to deliver the option later identified through our optioneering process, this could create an opportunity for windfall gains. In contrast, **a risk to Cadent** is created in the scenario whereby a cost estimate is included that does not adequately provide for the identified solution, creating a financial risk.

Removing this expenditure from our base plan ensures that costs are incurred for, and customers only pay for, work to deliver the most appropriate solution at Lowestoft Harbour. The alternative option would be the inclusion of low-confidence costs in our base plan, creating risks both to our customers and to our business. Project success will result in a cost-effective solution that removes constraints on the network arising from Lowestoft Harbour crossing, mitigating risks that Cadent will not meet its licence conditions while forming a safe and reliable network that can be maintained into the long term.

3. Qualitative assessment



3.1. Options for addressing uncertainty

Given the uncertainty on the solution that will be identified through feasibility studies, we have identified and evaluated how we could address this risk:

Table 3: Evaluating options for uncertainty mechanisms

Mechanism Option	Description
Volume driver	A volume driver is not appropriate. Expenditure related to Lowestoft Harbour is for a specific project rather than a workload with a measurable unit cost.
Re-opener mechanism	<p>A re-opener accounts for uncertainty in costs when both the design and requirement for projects is unknown. Lowestoft Harbour is well suited to this mechanism, as the specification of the project will be known at a future date.</p> <p>This mechanism would allow us to develop an evidence-based cost forecast once feasibility studies have concluded, which would be subject to review from Ofgem. This could include considering the role of competition to achieve an efficient price for the project.</p>
Use it or lose it allowance (PCD)	This would involve stating a PCD as part of our RIIO-2 plan. While this would protect customers from under-delivery, a PCD does not address the challenge we face in forecasting a total cost at present given the unknown scope of the solution. There is also a risk that barriers are created if there are insufficient funds to deliver the required solution.

We have also undertaken a qualitative assessment of uncertainty in this area to further understand the need for an uncertainty mechanism for Lowestoft.

Table 4: Qualitative assessment of risks posed by Lowestoft

Volume risk	Unit cost risk	Impact on outputs	Material cost / bill impact
Low	High	Medium	Medium

Further detail on our assessment is provided below:

- **Volume risk:** Our work in this area is driven by the identified risks at Lowestoft Harbour. While we have control during the optioneering process to identify an appropriate solution, we are unable to control the risks that it must address.
- **Unit cost risk:** Given the information currently available at this stage of the project lifecycle, there is considerable uncertainty over cost forecasts. This will be reduced once feasibility studies have concluded.
- **Impact on outputs:** This area has implications for customers in the Lowestoft area. This includes for our outputs linked to the environment, shrinkage, interruptions to supply and safety.
- **Material cost / bill impact:** As discussed further in Section 5, this may be a material area of cost that has will bill implications, specifically in the East of England.

3.2. Our proposed uncertainty mechanism

We are proposing to address uncertainty related to the Lowestoft project using a **re-opener mechanism** in RIIO-2, with a 1% materiality threshold and an anytime trigger¹. This mechanism would allow us to make a submission to Ofgem during RIIO-2 once the materiality threshold is breached. This assessment of materiality is conducted at the individual network, rather than Cadent level. In this submission, we would propose the costs we intend to recover from customers, providing evidence on why they are appropriate and efficient. This mechanism ensures that scrutiny remains over any costs we intend to reclaim.

Operation of the proposed re-opener in practice

- **Form of the trigger:** The identification of risks outlined in Section 1.1 has already triggered the need for work to go ahead in RIIO-2. Costs relating to the Lowestoft project will be triggered following the completion of feasibility studies and the identification of a preferred solution through the optioneering process.
- **Mitigating the likelihood of the trigger:** It is not possible or appropriate to consider mitigating the likelihood of the trigger taking place. Risks have already been identified that must be addressed through a permanent solution in RIIO-2.
- **Claiming costs through the re-opener:** As outlined above, we have proposed that costs can be reclaimed at anytime during the RIIO-2 period for this mechanism, once a materiality threshold has been breached. As part of this process, we would demonstrate costs incurred in implementing a permanent solution and provide evidence to support their appropriateness. This would include the output of feasibility studies used to identify the most appropriate option.

3.3. Evaluating our proposed uncertainty mechanism

A re-opener allows us to make the best use of the conclusions that will be drawn from feasibility studies that are currently underway. This work will produce a cost estimate supported by engineering justifications. As outlined in Section 2.3, there are risks associated with including a cost estimate in our base plan at present, creating opportunities for Cadent to make windfall gains or losses.

Nevertheless, it is important to fully evaluate the behaviours that our proposed uncertainty mechanism will encourage, to ensure they do not create perverse incentives. Below, we consider the positive behaviours that a mechanism should promote.

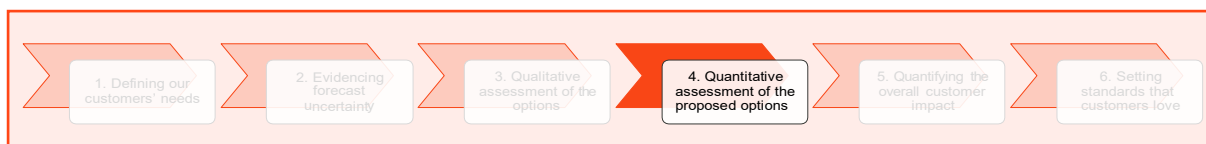
Table 5: Evaluating incentives created by our proposed uncertainty mechanism

¹For the purposes of our modelling and analysis, we have used a 1% materiality threshold, as is used in RIIO-1. However, due to potentially significant changes in financeability and totex sharing arrangements in RIIO-2, we are assessing if the materiality threshold should be revised. Further details are provided in Appendix 10.00

Behaviours and incentives	Evaluation
To minimise costs	The costs we submit to Ofgem through the re-opener process will be subject to review and challenge. Any costs identified as inefficient will be disallowed. This creates an incentive to focus on incurring efficient costs and demonstrating them with robust evidence.
To deliver required work	<p>Alongside reviewing the efficiency of costs submitted through the re-opener process, Ofgem will focus on ensuring that these only relate to relevant activities. Any costs submitted for work Ofgem does not believe to be required will be disallowed, creating an incentive to focus on work with a compelling need.</p> <p>Compared to the base plan, one could consider that a re-opener does not maintain the same incentive to deliver the project itself. However, the risks identified in Section 1.1 of this document demonstrate the strong need for this work. We would remain driven to install a permanent solution at Lowestoft under a re-opener mechanism to mitigate the risks to our network and customers.</p>
To take a whole systems approach	Opportunities for taking a whole-systems approach at Lowestoft can be considered through the optioneering process. This incentive is not diluted by the use of a re-opener mechanism, we would have the opportunity to evidence the benefits of whole-system solutions through our submission to Ofgem in the re-opener process.

A potential drawback for customers is that any costs incurred through the re-opener mechanism may introduce some bill volatility, with adjustments made in-period to account for additional investment. However, our submission to reclaim costs will be subject to scrutiny by Ofgem before any conclusion is reached on revenue adjustments. We would be incentivised to focus on articulating why the future solution deployed at Lowestoft Harbour is the best option from both a safety and cost perspective. Customers are also protected by the application of the materiality threshold, which ensures that adjustments are only made to our price control for significant deviations from our base plan.

4. Quantitative assessment



4.1. Inputs for uncertainty modelling

Given the limited information currently available from ongoing feasibility work, we have used high-level indicative costs associated with potential future options to demonstrate the level of uncertainty we currently face in Lowestoft.

Table 6 below outlines the project cost scenarios that have been included in our Monte Carlo analysis. These values have been selected to reflect existing estimates associated with options that have been identified during optioneering. These costs are only relevant to our

East of England network, given the location of Lowestoft Harbour, and are anticipated to be incurred during the first two years of RIIO-2.

Table 6: Input assumptions – Lowestoft total project costs per scenario

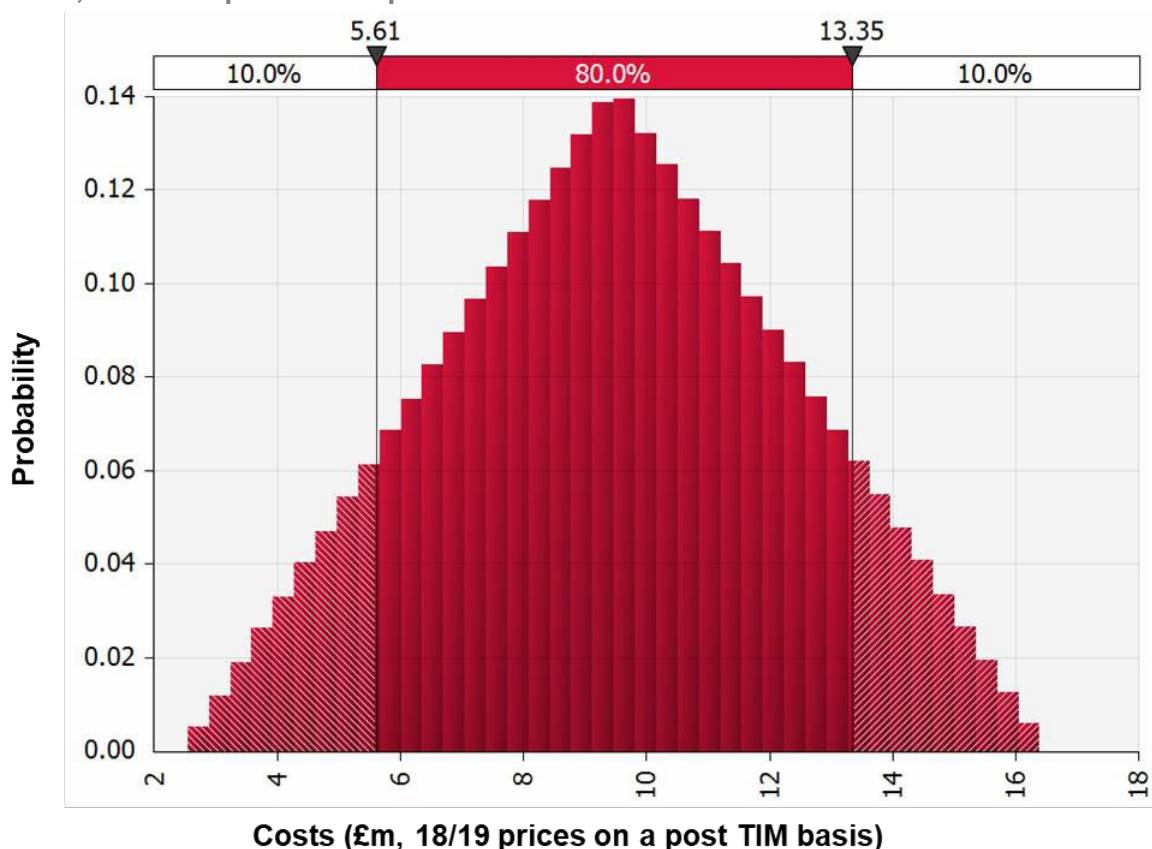
Cadent total project costs (£m, 18/19 prices)	Low	Likely	High
Lowestoft Harbour project costs	£6m	£23m	£40m

- **Low scenario:** This indicative cost is associated with a potential option whereby small interventions are made within the service tunnel at Lowestoft Harbour to reduce risks, such as improving ventilation and supports. This would fail to remove the HDPE pipelines, resolve network capacity issues or the ongoing risks associated with Lowestoft Harbour, and the use of the service tunnel would continue.
- **Likely scenario:** This indicative cost is associated with a potential option whereby the HDPE pipelines in the service tunnel under Lowestoft Harbour are replaced with a steel pipeline. While this option helps to resolve network-capacity issues and removes the risks associated with the HDPE pipework, the ongoing risks associated with Lowestoft Harbour and the use of the service tunnel would remain.
- **High scenario:** This indicative cost is associated with removing pipes in the service tunnel at Lowestoft Harbour, and undertaking reinforcement work to address network capacity issues.

4.2. Assessing uncertainty

Using our input data described above, we have undertaken Monte Carlo analysis to understand the range of cost impacts for this area of uncertainty in RIIO-2. This provides a distribution of the potential cost outcomes for Lowestoft, based on 10,000 iterations. This approach illustrates the high and low scenarios of uncertain costs, alongside the mean cost outcome and the associated volatility. Figure 1 below summarises this distribution

Figure 1: Monte Carlo - Total RIIO-2 cost risk for Lowestoft, no mechanism. Costs, £m 18/19 prices on a post TIM basis



Minimum	Maximum	Mean	Standard Dev	Iterations
£2.54m	£16.40m	£9.48m	£2.86m	10,000

The results of our Monte Carlo analysis demonstrate the scale of uncertainty associated with cost estimates for a permanent solution at Lowestoft Harbour. Without the introduction of an uncertainty mechanism, there is a considerable risk that actual costs incurred in RIIO-2 may deviate from an initial estimate proposed as a baseline allowance. Furthermore, there are potential benefits of using competition to drive optimal costs for this project as the optioneering process progresses.

4.3. Impact of our proposed uncertainty mechanism

Table 7 below summarises the impact of introducing a re-opener mechanism to address this risk. As shown, the mechanism reduces both the materiality and volatility of the residual risk that remains sharing. As the uncertainty mechanism would ensure we only recovered appropriate and acceptable costs from customers, this is an improvement from pricing risk into our base plan.

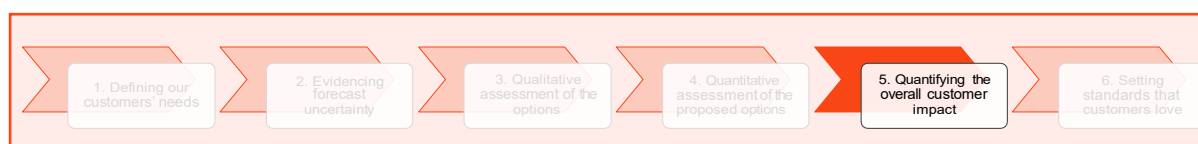
Table 7: Range of cost risks with and without mechanism, Lowestoft.
Costs, £m 18/19 prices on a post TIM basis.

Value	Without mechanism	With mechanism
Range of Impacts	£2.54m to £16.40m	£0.00m to £5.72m
Materiality (mean risk)	£9.48m	£0.50m
10 th Percentile	£5.61m	£0.00m
90 th Percentile	£13.35m	£3.30m
Standard Deviation	£2.86m	£1.46m

Several assumptions have been made to produce these results:

- Figures are presented on a post TIM basis, using a totex incentive rate of 40%.
- In the case of re-openers, we have assumed a 1% materiality threshold of average annual revenues. We have also assumed 100% of costs are reclaimed in re-openers.
- Finally, we have not considered the phasing of income in this analysis. We have focused on the value of risk and potential incomes.

5. Quantifying the customer impact



In Section 5 of Appendix 10.00 Our approach to managing risk and uncertainty, we have analysed the overall customer impact of uncertain costs with and without our proposed package of mechanisms. We have also evaluated how our proposed package recognises the trade-off between sharing exposure of cost risk between Cadent and our customers. In Chapters 10 and 11 of our Business Plan, we also quantify the impact of our proposed package of uncertainty mechanisms on customer bills in RIIO-2.

We have also quantified the bill impact associated with the Lowestoft project re-opener individually. Table 8 below summarises the potential bill impact per annum by the end of RIIO-2 for the P10, mean and P90 costs estimated in our Monte Carlo analysis. As the costs associated with this uncertainty mechanism are include an element of capex, this will include a bill impact extends beyond the RIIO-2 period. For the mean cost impact, this is equivalent to £0.08 per annum.

Table 8: RIIO-2 end bill impact, P10 mean and P90 costs from uncertainty analysis

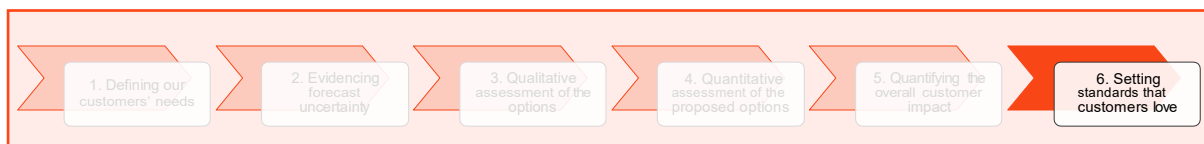
RIIO-2 end bill impact (£, 18/19 prices)	P10	Mean	P90
East of England	£0.18	£0.30	£0.43
London	N/A	N/A	N/A
North West	N/A	N/A	N/A
West Midlands	N/A	N/A	N/A

For the purpose of constructing bill impact estimates, we have evaluated the impact of the costs implied from our Monte Carlo analysis on a P10, mean and P90 basis. We have not considered the application of a materiality threshold in practice or the timing effects of

revenue recovery from the use of a re-opener mechanism. In practice, bill impacts would materialise with a lag following a successful claim through the mechanism. Therefore, the values presented above represent an extreme scenario for customers with materiality thresholds always breached.

The value of a bespoke uncertainty mechanism to customers does not obviously lend itself to be monetised in the same way of some of outputs commitments where we have calculated a social return on investment (SROI) or have clear willingness to pay data. One way the value could be calculated is to look at the value that might otherwise have needed to be forecast into the base expenditure plan that may not have been subsequently needed if the uncertainty did not arise, For example, you could take consider our likely cost estimate, and multiply this by the totex incentive sharing factor that the customer would be faced with (e.g., 60%). This is not as robust a method as SROI or willingness to pay but provides an indicative estimate. In the case of Lowestoft, this is equivalent to approximately **£14.22m in RIIO-2.**

6. Setting the standards



Our proposals for a re-opener mechanism are clear and simple for our customers to understand. We only propose to request funding for the costs associated with the most appropriate solution we identify for Lowestoft Harbour once feasibility studies have concluded. These proposals have also incorporated challenges we have received from our CEG.

When making a notification through the re-opener process, we would clearly articulate to customers the supporting detail and rationale behind our proposed expenditure. This would also provide an opportunity for further engagement during the re-opener window.

Our evaluation on the implications of including costs for Lowestoft in our base plan, as outlined in Section 2.3, and of the incentives associated with our proposed re-opener mechanism, demonstrate the benefits of this approach for customers and stakeholders.

Our overall approach to managing risk and uncertainty using uncertainty mechanisms has been tested with customers through our acceptability testing. A full discussion of this engagement is provided in Chapter 10. It is noted here that customers found this approach to be acceptable and that we had been thorough in our work to manage cost risk in RIIO-2.