Northern Gas Networks

A22.e - Offtakes Odorant & Metering

Engineering Justification Paper

Contents

1. Summary table

Name of Project	*Offtake and Pressure Reduction Sites – Odorant & Metering RIIO-GD3*		
Scheme Reference	*A22.e.NGN*		
Primary Investment Driver	*Obsolescence/ Compliance*		
Project Initiation Year	*2026/27*		
Project Close Out Year	*2030/31*		
Total Installed Cost Estimate (£)	*£12.49m*		
Cost Estimate Accuracy (%)	*+/-5%*		
Project Spend to date (£)	*£0*		
Current Project Stage Gate	*Specific delivery identification*		
Reporting Table Ref	*5.01 LTS, Storage & Entry*		
Outputs included in RIIO-GD3 Business Plan	*As per BDPT above, impact of programme in NARM BPDT*		
Spend apportionment	***RIIO-GD2***	***RIIO-GD3***	***RIIO-GD4****
	£10.29m	*£12.49m*	*c. £6-9m*

* Expecting all investments listed for RIIO-GD3 to complete in RIIO-GD3. RIIO-GD4 cost estimate is based on similar investment in metering systems and remaining odorant system replacement in RIIO-GD4.

2. Executive summary

During RIIO-GD3 we are planning 42 interventions across our metering and odorant assets, at a total cost of £12.49m. The existing assets are at risk of becoming obsolete and suppliers are moving towards ultra sonic metering.

There are 4 replacement upgrades on our fiscal metering driven by the move to all ultra sonic meters from orifice plate and turbine meters. This is driven by shippers in an effort to improve metering accuracy. Ultra sonic metering will help to reduce both the number and complexity of metering errors, which will deliver positive benefits for consumers. There are also 3 building replacements and 4 E&I upgrades associated with our planned meter upgrades.

In terms of non-NARM related investment, we have also identified a need to replace sampling points on some pipelines, which is required in order to maintain compliance with ISO10715. This standard gives means for ensuring that samples of natural gas and natural gas substitutes that are conveyed into transmission and distribution grids are representative of the mass to which they are allocated. We plan to undertake 4 Calorimeter sampling point upgrades in RIIO-GD3 at a total cost of £200,000. In order to ensure maximum efficiency, we will carry out these works at the same time as other works are being carried out on those same sites.

11 flow measurement rack replacements are required in RIIO-GD3 primarily due to obsolescence as these are no longer supported by the manufacturer (we replaced 9 in RIIO-GD2) at a cost of £1.8m. Of the 11 replacement interventions, 4 will be carried out alongside a meter upgrade.

The preferred option strategy for Odorant replacement in RIIO-GD3 is to continue the roll out of replacement that has begun in RIIO-GD2 across the majority of the remaining asset base to continue to tackle issues around obsolescence (16 offtakes). We modelled a 'Do More' option where we undertake more interventions and replace the earliest meters installed at the very beginning of our replacement programme, and also a 'Do Less' option where we halt the meter replacement programme entirely, as shown below.

	Number of Interventions	Total RIIO-GD3 Cost
Preferred Option	42	£12.49
Do More Option	51	£15.32
Do Less Option	14	£3.70

Table 1 Options summary

Costs for O&M for in the RIIO-GD3 EJP (£12.49m) are higher than projected RIIO-GD2 spend (£10.29m), as shown below. However, where RIIO-GD2 investment was primarily driven by meter obsolescence, there is a drive to replace obsolete odorant equipment, as well as complete investment in obsolete metering equipment in RIIO-GD3.

	RIIO-GD2		RIIO-GD3 EJP Preferred Option	
	Workload units	Capex (£m) 23/24 prices	Workload units	Capex (£m) 23/24 prices
Odorant & Metering	43	10.29	42	12.49

Table 2 RIIO-GD2 vs RIIO-GD3 investment

We view our preferred option as balanced programme required to deliver investments to combat obsolescence and compliance issues: maintaining a safe, reliable, compliant network of assets for our customers whilst minimising costs. The investments listed above in our preferred scenario and detailed further in the body of the EJP will enable for us to continue to meet our licence obligations over the course of RIIO-GD3.

3. Introduction

This Engineering Justification paper details our proposals for investment on our Offtake Odorant and Metering assets during RIIO-GD3 and acts as a narrative to be used in conjunction with the accompanying Cost Benefit Analysis. It explicitly follows Ofgem's guidance and is set out in accordance with the headings therein.

Our Offtake and PRS assets are a critical part of our gas transportation service and require ongoing maintenance, repair, refurbishment and replacement to ensure we manage increasing risks associated with asset health. During RIIO-GD2 we have been carrying out a replacement programme across our metering assets and upgrading our Turbine and Orifice meters to Ultrasonic meters. We aim to complete this programme of works in RIIO-GD3.

We also plan to continue the roll out of replacement of odorant injection systems that has begun in RIIO-GD2 across the majority of the remaining asset base to continue to tackle issues around obsolescence, in RIIO-GD3 targeting 16 offtakes.

This engineering paper aims to outline the justification for our proposed RIIO-GD3 Offtake Odorant and Metering investment, detailing our asset management decision-making process during which we analyse risk and value and trade-off between different intervention options. It explains the drivers for investment, the inputs and assumptions used in our Cost Benefit Analysis and how our proposed investment benefits our customers and stakeholders.

A22.c NGN RIIO-GD3 Investment Decision Pack - Offtakes & PRS - Pressure Control discusses the issues experienced on our Slamshuts having reached a point where it is increasingly difficult to source both replacement parts and the necessary expertise to undertake the works. Given we are experiencing a similar issue with impending obsolescence of our metering equipment, we have determined that we need to proactively invest. Allowing our metering equipment to result in a similar situation would not be a suitable solution, as it reduces our ability to intervene both on a proactive and reactive basis.

We have used a combination of our Value Framework and our asset data and expertise to determine the appropriate interventions during RIIO-GD3. Our preferred strategy includes the following 42 investments at a cost of £12.49m over RIIO-GD3:

- 4 fiscal meter upgrades (replacement)
- 4 E&I upgrades (replacement) associated with the meter upgrade above
- 3 building replacements associated with the meter upgrades above
- 11 flow rack upgrades (replacement)
- 16 odorant injection system upgrades (replacement)
- 4 calorimeter sampling point upgrades (replacement).

We highlight the driver for the works below.

	RIIO-3 EJP Preferred Option		
Intervention	**Workload units**	**Capex (£m) 23/24 prices**	**Driver**
Fiscal Meter Upgrade - Meter	4	3.07	Obsolescence
Fiscal Meter Upgrade - E&I	4	1.12	Obsolescence
Fiscal Meter Upgrade - Building Replacement	3	0.68	Obsolescence
Fiscal Meter Upgrade - FWACV	11	1.82	Obsolescence
Odorant Injection System Upgrades (excl. tanks) - Replace	16	5.60	Obsolescence
Calorimeter Upgrades - Sampling Point upgrade	4	0.20	Compliance
Total	**42**	**12.49**	

Table 3 preferred option by driver

Overall, our preferred strategy results in a 35% reduction in monetised risk from 2026 through to the end of RIIO-GD3. We also expect a 46% reduction in supply interruptions. The payback period for this option is 6 years, which is well within the 16 years suggested by Ofgem. Overall, we are confident that the achieved risk reduction and supply interruption represents good value for our customers.

Options appraisal is discussed in Sections 8.1 to 8.5 and Section 9.

The profile of the workload across the price control period is shown in more detail in Section 10.4 and the Spend profile is detailed in Section 10.2. Unit costs used within the cost benefit analysis have been fully detailed within Section 8.6.

4. Equipment summary

The odorant and metering at Offtakes and PRS's are considered as primary assets. The Odorant Injection System injects a distinctive smell to the gas, so leaks can be readily detected as natural gas has no smell. Odorisation is one of our main obligations as a gas transporter. We have 23 Odorisation Injection Systems across our network. 14 (61%) of these are classified as being in the North and 9 (39%) in Yorkshire.

The Odorisation Injection System is a facility to introduce odorant to the gas flow prior to its entry into the distribution network. Odour is injected via a pumping system into the LTS system at a National Offtake to give gas its distinctive smell. The odorant is stored in a tank surrounded by a concrete bund able to hold 110% of the capacity of the tank volume.

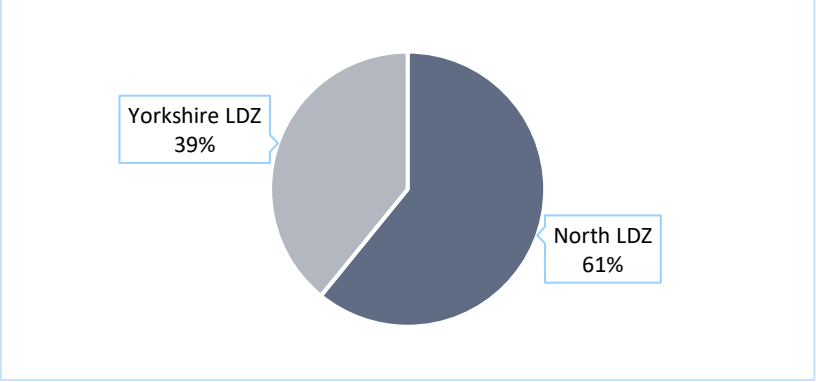

Figure 1 Odorant injection systems by LDZ (Local Distribution Zone)

Meters record the volume of gas that flows into our network, allowing accurate billing and management of the network capacity, meters are supplemented by auxiliary control systems such as a flow computer. We currently have three types of meters: Turbine, Orifice and Ultrasonic meters.

During RIIO-GD2 we have been undertaking a meter replacement programme to replace our remaining Orifice Plate and Turbine meters with Ultrasonic meters. Currently, out of the 23 metering systems installed across the network, around half of these are Ultrasonic, one third are Turbine and the remaining 17% are Orifice Plate meters.

A Metering System comprising of one or more requisite meters is installed on a National Transmission System Offtake . Metering Systems are used to ensure accurate reporting of the gas flow.

We have listened to industry concerns over the potential for our existing Turbine and Orifice metering assets to become obsolete and do not have adequate low flow measurement capability to fully meet the more dynamic flow measurement demands of the modern gas network. New technologies like ultrasonic meters allow sites to operate over a far greater range and flow accurately at low levels which not only provides increased uncertainty to the shippers but also means sites can be controlled over a wider range allowing entry of green gas like biomethane. The lack of diagnostic and preventative measurements these older technologies provide mean they need to be upgraded to newer USMs to remove risk to shippers and our customers of costly measurement errors.

By the end of RIIO-GD2, we expect to have replaced all of the outstanding Orifice Plate Metering systems with Ultrasonic metering systems. There should then be only 2 Turbine metering systems left on the network, with just over 90% upgraded to Ultrasonic meters, as shown below in Figure 2.

We also have a number of older generation Ultrasonic meters currently installed on the network which were installed very early on in our metering upgrade journey. These meters do not provide us with the full diagnostic information we require and do not meet the standards imposed on later upgrades.

The different types of interventions considered for metering and odorant are discussed in Section 8.

The change in Asset Health over RIIO-GD3 with and without investment is discussed in Section 5.

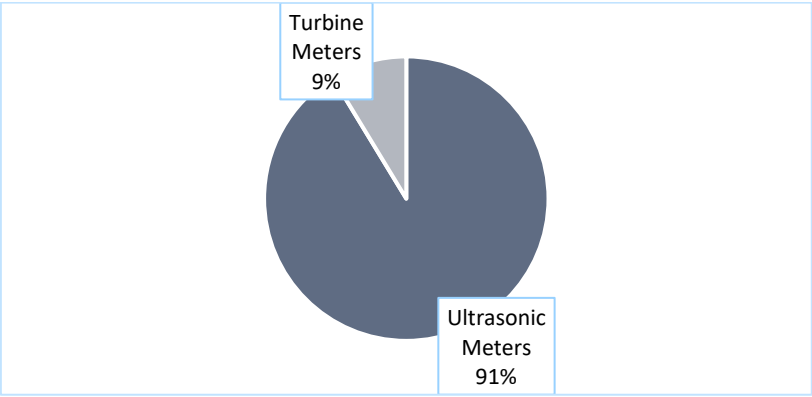

Figure 2 Meters by type - end of RIIO-GD2 position

5. Problem / opportunity statement

Why are we doing this work and what happens if we do nothing?

A failure in our metering or odorant assets could result in significant issues across the NGN network. First and foremost odorant injection provides gas with its characteristic smell and is the primary safety mechanism for detecting gas escapes. If we were to stop injecting odorant at any point in the network the smell downstream

would be affected, meaning gas escapes would go undetected, potentially resulting in the loss of life to members of the public in our network. Our metering assets are the primary input to the odorant injection system and provide the system with the required flow information in order for the odorant dosing to be correct meaning that it smells as it should to the general public. Along with providing inputs to the odorant system to ensure the correct amount of odorant is applied, the metering information is also used to record flow rates for energy transported through our network if the metering were to fail through put cannot be accurately determined resulting in measurement errors which have huge cost implications for gas shippers and ultimately impacts to customers' bills.

NGN's Value Framework

We have developed a Value Framework which we use to assess the value of intervention options consistently across asset classes for CBA and business planning purposes. We use the NARM methodology as the basis of our Value Framework and are consistent with the Consequence Measures. However, we have recategorized them into five risk groups, not four, so that there is clear distinction between NGN and societal costs and benefits and so that the present values being calculated are correct. This is further explained in our Network Asset Management Strategy. The five risk groups within our Value Framework are: Customer Risk, Health & Safety Risk, Environmental Risk, Compliance Risk and Financial Risk.

To derive a monetary value for the Cost of Consequence, each Consequence Measure is allocated a monetary value which is multiplied by the quantity of the consequence. The monetary values used within our Value Framework are based on the agreed NARM assumptions and uses values common across GDN's such as the base price year, industry approved values such as the cost of carbon or the social cost of an injury. In addition, we use values specific to our business such as the cost of maintenance or the cost of loss of supply. The quantities used are specific to our network such as the number of domestic properties at risk of a supply interruption and have been derived from system data, network analysis or assumptions based on demands, flow and redundancy.

When justifying our RIIO-GD3 capital programme the monetary value of each Consequence Measure is calculated to determine the benefit or avoided cost of an intervention. Examples include:

- **Customer Risk** – Avoided GDN costs through a reduction in costs of supply incidents (loss of supply). These costs have been calculated from historic incidents and the probability and scale of the incidents are based on NARM models.
- **Health & Safety Risk** – Societal benefits in avoided costs through reductions in the probability of fatality or non-fatality injury. These costs are in accordance with the NARM methodology.
- **Environmental Risk** – Societal benefits in avoided costs through reductions in the volume of carbon emitted when gas is leaked or consumed. These costs are in accordance with the NARM methodology and industry approved values.
- **Compliance Risk** – Avoided GDN costs through a reduction in costs of fines and paying for explosion damage. These costs are in accordance with the NARM methodology. They have been separated from direct Financial Risk as we consider them highly uncertain and likely significantly underestimated by the values in NARM, which does not consider reputation, legal and handling costs.
- **Financial Risk** – Avoided GDN costs through reductions in the costs to fix assets on failure and the direct financial cost of the gas leaked from and consumed by our assets. These costs are in accordance with the NARM methodology.

OT PRS Risk Profile (start RIIO-GD3)	Compliance Risk £m	Customer Risk £m	Environmental Risk £m	Financial Risk £m	Health & Safety Risk £m	Total Risk £m	%
Preheating (excl Low Nox)	1.59	3.48	0.78	0.27	0.59	**6.71**	14%
Preheating (Low Nox)	0.19	0.95	0.14	0.04	0.07	**1.40**	3%
Filters	3.31	0.01	7.68	1.29	1.22	**13.51**	28%
Pressure Control	3.92	0.07	12.28	2.14	1.44	**19.85**	42%
Odorant & Metering	1.29	2.89	0.00	1.70	0.43	**6.31**	13%
Total	**10.30**	**7.39**	**20.89**	**5.44**	**3.75**	**47.78**	

Table 4 Offtake and PRS risk profile at start of RIIO-GD3

As can be seen in Table *4*, metering and odorant together account for 13% of total risk across our Offtake and PRS sites at the beginning of RIIO-GD3. The predominant risk is customer risk, but compliance and financial risk are also significant contributors to total risk.

Without intervention, over the course of RIIO-GD3 risk increases predominantly due to deterioration of the assets but also due to other effects such as the rising cost of carbon. Table 5 highlights that without intervention we would see total risk to our odorant and metering assets increase by 28% over RIIO-GD3, the second highest increase of all our asset classes.

Our Decision Support Software allows us to understand various service measures associated with each asset and how these change over time with and without investment. For our Offtake and PRS assets the key service measure is the Total Expected number of Supply Interruptions (SI). Table 6 shows the impact on this service measure over RIIO-GD3 without investment. It highlights that we would be facing 24% increase in supply interruptions relating to our odorant and metering assets.

OT PRS Risk Change over RIIO-GD3 w/o intervention	%
Preheating (excl Low Nox)	17%
Preheating (Low Nox)	21%
Filters	13%
Pressure Control	20%
Odorant & Metering	28%
Total	**19%**

Table 5 Offtake and PRS risk change over RIIO-GD3 without intervention

OT PRS Service Level Change over RIIO-GD3 w/o intervention	%
Preheating (excl Low Nox)	
Preheating (Low Nox)	7.3%
Filters	8.5%
Pressure Control	0.6%
Odorant & Metering	24.2%
Total	**9.9%**

Table 6 Offtake and PRS service level change over RIIO-GD3 without intervention

Consideration of O&M Asset Health

We have utilised the NARM Value Framework in order to assess the health of our assets. We are however using the latest NGN asset data rather than the NARM data which is held in time as at the start of RIIO-GD2 for regulatory reporting purposes.

Offtake and PRS assets are assigned a Health Banding 1-10 based entirely on the total failure rate (i.e. the sum of all failure rate components). There are ranges of failure rates which assign an asset to bands 1-10. For preheating, if the asset has less than 0.24 total failure rate (expected number of failures per year), is it in band 1, but greater than 2.18 then it is in band 10.

Consideration of odorant and metering health trends is useful in the calculation of asset risk. Table 7 highlights the health of our assets using the NARM value measures and shows our odorant and metering assets are in good or average health. It shows that our metering assets remain at a score or 1 with and without investment. 52% of our odorant assets have a score of 6 or more at the start of RIIO-GD3. Without intervention, this rises to 70% by the end of RIIO-GD3. If our Preferred Option of investment is followed in RIIO-GD3, this falls back down to 22% at the end of RIIO-GD3 with investment.

Odorant Health Index	1	2	3	4	5	6	7	8	9	10	Total
Baseline start of RIIO-GD3	1	0	3	3	4	12	0	0	0	0	23
	4%	0%	13%	13%	17%	52%	0%	0%	0%	0%	100%
End of RIIO-GD3 w/o intervention	1	0	0	3	3	14	2	0	0	0	23
	4%	0%	0%	13%	13%	61%	9%	0%	0%	0%	100%
End of RIIO-GD3 with interventions	17	0	0	0	1	5	0	0	0	0	23
	74%	0%	0%	0%	4%	22%	0%	0%	0%	0%	100%

Metering Health Index	1	2	3	4	5	6	7	8	9	10	Total
Baseline start of RIIO-GD3	23	0	0	0	0	0	0	0	0	0	23
	100%	0%	0%	0%	0%	0%	0%	0%	0%	0%	100%
End of RIIO-GD3 w/o intervention	23	0	0	0	0	0	0	0	0	0	23
	100%	0%	0%	0%	0%	0%	0%	0%	0%	0%	100%
End of RIIO-GD3 with interventions	23	0	0	0	0	0	0	0	0	0	23
	100%	0%	0%	0%	0%	0%	0%	0%	0%	0%	100%

Table 7 offtake and prs odorant and metering asset health profile

What is the outcome that we want to achieve?

From our stakeholder research (for example, see Insight 1, 9 and 10 from Appendix A3 as shown in Table 8) we know that network reliability and cost remain our customers key priorities. Customers also value the importance of improving resilience against extreme weather, such as storms. From the risk analysis in Section 5 of this document, for this group of assets, customer risk is the main risk driver. We also know that our customers expect value for money and that we make the right investment decisions for both our existing and future customers. We have proposed five objectives covering risk, cost, service, uncertainty and compliance. These will be used to determine how successful each option considered is at delivering against our customers' expectations.

What we heard	Appendix A3
Keeping bills as low as possible continues to be domestic and SME (Small and Medium Enterprise) customers' top priority, however stakeholders are supportive of investment to respond to significant challenges of climate resilience and decarbonisation. Balancing the trade-off between investing now to future-proof and minimising expenditure to prioritise essentials poses a challenge.	Insight 1
Customers expect our top sustainability commitment to be keeping our infrastructure resilient. This means continuing to reliably supply customers in the short and long term, regardless of climatic conditions and impacts experienced by interconnected sectors (such as telecommunications, road networks etc). As customers are satisfied with the performance and availability of our services, they prefer us to maintain service levels at levels similar to today, and asked for us to reduce future risk with targeted investments to enhance removal, reduction, resistance and recovery strategies.	Insight 9
The impact of climate change requires us to proactively reduce the vulnerability of networks to storms, particularly in rural areas, and a collaborative, cross-network approach. 'Preventing supply interruptions from extreme weather by providing back up power' was the most highly valued service improvement among billpayers in our Customer Value Perception study (on average, respondents were willing to pay £0.53pp at 75%).	Insight 10

Table 8 customer insights

Risk Objective: to maintain total risk to the same level as the starting position of RIIO-GD3 (plus or minus 10%)

We want to manage total risk.

We know that our customers value safety and reliability as their number one priority and without intervention total risk will increase by 19% for Offtakes and PRS overall (28% for O&M, Table 5) within the RIIO-GD3 period. In addition we want to manage increasing risks to provide a safe working environment for our operatives and avoid loss of supply events. We will *aim* to maintain risk throughout RIIO-GD3 to plus or minus 10% from the RIIO-GD3 starting position, however we understand the need to balance this ambition with service and cost constraints.

We are on track to meet our NARM target in RIIO-GD2. As the regulatory landscape is likely to broadly remain the same in RIIO-GD3, we have seen no need to take a step change approach to risk and have therefore adopted a risk objective that is consistent with that adopted in RIIO-GD2.

Efficiency Objective = to minimise spend in RIIO-GD3 over and above RIIO-GD2 levels

We want to ensure efficient costs.

We know that our customers expect us to invest their money wisely and efficiently to enable a reduction in their bills. To do this we need to make sure we maximise value from our existing assets before we replace them, however, we must understand the whole life cost of the decisions we make to ensure we are doing the right thing both now and in the future. As risk is rising sharply in RIIO-GD3 it is expected that we will need to intervene on more assets than we have during RIIO-GD2 to meet our objectives around managing total risk. To avoid escalating costs we therefore need to think of pioneering solutions to ensure we are delivering value for money for our customers. Whilst our RIIO-GD3 spend exceeds our RIIO-GD2 spend at a total level, a significant proportion of this is compliance led driving the need for asset replacement (for example to ensure ongoing compliance with Health and Safety legislation such as the Medium Combustion Plant Directive and the Pressure Systems Safety Regulations).

Our aim at outset is to maintain spend relating to asset health in RIIO-GD3 broadly in line with RIIO-GD2 levels, where this is possible. We discuss this in more detail in **Section 10.2**.

Our objective in RIIO-GD2 was to maintain cost. However, the objectives we are setting out are becoming increasingly conflicted with one another as we move into RIIO-GD3. For example, increasing rises in risk and supply interruption from deterioration in the asset health of our assets, alongside obsolescence and compliance are key drivers for additional investment in RIIO-GD3 over and above the levels we saw in RIIO-GD2. We view maintaining risk and service levels and delivering a reliable, safe and compliant network for customers as a higher priority than maintaining cost at RIIO-GD2 given the evidenced need for additional investment, which is shown and discussed in our options appraisal. We are continually committed to providing a balanced programme of work and delivering value for customers. We have therefore updated our efficiency objective in RIIO-GD3 to be to minimise cost in RIIO-GD3 over and above RIIO-GD2 levels.

Our unit costs are discussed in Section 8.6.

Service Objective = to maintain supply interruptions to the same level as the starting position of RIIO-GD3 (plus or minus 10%)

We want to continue to provide exceptional service

The key service measure for our PRS assets is the Total Expected number of Supply Interruptions. Table 1.06 of the 2023/24 Regulatory Reporting Pack (RRP) submission highlights that our current customer satisfaction scores for unplanned interruptions are exceeding the targets set by Ofgem (9.37 target against our actual performance of between 9.543 and 9.650 between 2022 and 2024). We therefore consider that current service levels are acceptable to our customers and provide a suitable benchmark.

As the regulatory landscape is likely to broadly remain the same in RIIO-GD3, adopting risk and service level objectives that are consistent with that adopted in RIIO-GD2 seems appropriate. Other Reliability metrics outlined in Table 1.06 demonstrate that we are currently operating a highly reliable network. Our aim therefore to maintain our RIIO-GD2industry leading service levels in RIIO-GD3.

From the analysis in the section above we understand that supply interruptions are increasing by 10% overall for Offtake and PRS (24% for O&M, Table 6) within the RIIO-GD3 period to a point where we would be expecting a supply interruption approximately every 3 years across Offtakes and PRS at the end of RIIO-GD3 without intervention. Our RIIO-GD3 investments need to target this service measure and reduce it back down to a more acceptable level.

Certainty Objective = to ensure our investments pay back within 16 years

We will protect our customers from future uncertainty

To ensure the investments we make in RIIO-GD3 are right for both our existing and future customers, and to avoid the risk of asset stranding we must ensure that our investments offer a payback before either the asset life or a point in time where future uncertainty could reduce the forecasted benefits, whichever is the smallest time period. The RIIO-GD3 Business Plan Guidance states that a 16 year payback period is appropriate for the GD sector (page 45)[1], meaning that any new, refurbished or replaced equipment that pays back within this time frame will be deemed suitable for investment.

Compliance Objective = to ensure we are compliant with legislation relevant to each asset class

[1] https://www.ofgem.gov.uk/publications/RIIO-GD3RIIO-GD3-business-plan-guidance

We want to ensure compliance with all relevant Health and Safety, or technical Regulations

During RIIO-GD3 we are required to undertake a number of interventions for compliance reasons. For Odorant and Metering, we need to ensure compliance with Regulations such as ISO10715.

How will we understand if the spend has been successful?

This asset class is covered within the NARM methodology, and we have set a relative risk target on which we will annually report performance against.

In addition to the NARM target, we would expect to keep the number of supply interruptions from Offtake and PRS asset failure at a manageable level, ideally at the same level seen during RIIO-GD2. During the price control period we would also expect to see a reduction in the numbers of faults and remedials picked up during routine maintenance and PSSR inspections.

Our Decision Support Software allows us to understand various service measures associated with each asset and how these change over time with and without investment.

5.1. Narrative real-life example of problem

CASE STUDY 1 – METER REPLACEMENT

The fiscal metering system at [redacted] had numerous issues with the existing turbine meters regularly failing. This resulted in potential loss of metering (reduced to working on a single stream for periods of time) and an ongoing cost to replace and recalibrate the existing meters regularly. The other associated equipment including the FWACV rack was no longer fit for purpose including a lot of obsolete and unsupported components. It was also identified that the site didn't have adequate site back up power, this meant that a standby generator was included within the scope, to allow resilience in extreme weather events that have been more prevalent in the past 5 years. The scope on site rectified all these issues and also completed a full E&I upgrade at the same time. The E&I was the original installation, approximately 40 years old, meaning a lot of non-compliance.

Although the main reason was a condition/obsolescence upgrade, other operational factors, such as the single stream nature of the site and the inability to isolate at any time meant that a new E&I building needed to be installed alongside the existing site to allow for continuity of supply.

CASE STUDY 2 – ODOURANT REFURBISHMENT

The odorant injection system is a critical asset with many component parts such as the expansion tank, controllers, pumps, filters, velometers, pipework, electrical, instrumentation and telemetry systems. These systems have far exceeded their design life and are beginning to show an increased number of faults. Over RIIO-GD1 we upgraded the control system to deal with an

obsolescence issue. Over the course of RIIO-GD2 we have carried out works to extend the life of the systems as a whole renewing all soft parts and overhauled the pumps and verometers to ensure they are able to be maintained into RIIO-GD3. As part of these works we also upgraded the System control interface module (SCIM) to further enhance our capabilities so that faults can be reset remotely, this upgrade also future proofs the system for upgrade to the new ZEO system. These upgrades reduce the risk of a health and safety incident that could occur from incorrect injection of odorant into the gas. The refurbishment of the system was a cost-effective solution to the increasing risk we were holding on this asset class and enables us to extract the maximum value out of this piece of equipment by extending its asset life beyond our initial expectations.

5.2. Project boundaries

The boundaries of spend provided in this EJP relate only to the intervention of Odorant and Metering assets our offtake and PRS sites. Any directly associated costs for required E&I, buildings or civils interventions has been included within the Odorant and Metering CBA, only where it is directly linked to an Odorant and Metering intervention. We have done this to ensure that our CBAs are taking into account all costs applicable to our Odorant and Metering interventions. Where the costs relating to E&I, buildings or civils has been accounted for in the Odorant and Metering CBA, it has not been included in the CBA relating to Civils or E&I specifically to avoid double counting those costs. As the NARM benefit would be associated with the mechanical intervention, we have not attributed any further NARM benefit to any E&I, buildings or civils interventions within the Odorant and Metering CBA since to do so would overstate the NARM benefit and not provide a true reflection of the benefits of the intervention being carried out.

It includes all necessary project costs such as design, procurement of materials, construction (including labour and materials), commissioning and overheads. It does not include any other offtake or PRS assets such as the cost of pre-heaters, pressure control or filters for example, or LTS pipelines which are all covered under separate engineering justification papers (EJPs).

Any directly associated costs for required E&I, building replacement and FWACV upgrade been included within the Odorant and Metering (O&M) CBA, only where it is directly linked to an O&M intervention. We have done this to ensure that our CBAs are taking into account all costs applicable to our O&M interventions. Where the costs relating to E&I and Civils have been accounted for in the O&M CBA, they have not been included in the CBA relating to E&I or Civils specifically to avoid double counting those costs. As the NARM benefit would be associated with the mechanical intervention, we have not attributed any further NARM benefit to any of these interventions within the O&M CBA since to do so would overstate the NARM benefit and not provide a true reflection of the benefits of the intervention being carried out.

Costs related to the Calorimeter Sampling Point upgrade have been included within our CBA. However, as benefits of this intervention cannot be modelled under NARM, the benefits are excluded from our CBA. This would lead to our CBA being slightly conservative for O&M interventions.

6. Probability of failure

The Probability of Failure (PoF) is the probability an asset will fail at a given point in time. When justifying our RIIO-GD3 Capital Investment, our Cost Benefit Analysis uses the recently updated NARM methodology to calculate the failure rate of our Offtake and PRS assets. The NARM methodology algorithm used to calculate the initial failure rate (to which deterioration is applied) for each Failure Mode is:

Failure rate including factors = Failure rate excluding factors x Fault Detection Rate x Coastal Factor x Housing Factor x FS Factor x Flood Factor x Kiosk Factor

This section discusses how we have used the NARM methodology to understand the types of failure of Offtake and PRS assets as well as the rate of failure, or deterioration, which is a function of the assets attributes, age and condition.

Types of Failure

A failure in an asset is defined as the inability of an asset to fulfil one or more of its intended functions to a standard of performance that is acceptable and gives rise to a detrimental outcome. In the NARM methodology these failures have been categorised into Failure Modes, and for this group of three primary assets, can be split into the following three categories:

- Odorant & Metering
- Pre-heating
- Filtration & Pressure Control

Failure Modes have been developed by modelling the outcomes rather than components of which there are many. This avoids the need to accurately identify root cause which can often be difficult to diagnose. The Failure Modes for Odorant and Metering consist of:

Over / Under or No Meter Reading – meter read errors where the readings are higher, lower or not being read at all and in addition meter read errors affect the measurement of odorant being injected into the system.

High or Low Odorant – where levels of high or low odorant are injected into the gas supply.

Release of Gas – failure of a pressure containing component of the system such as site pipework.

Release of Odorant – failure of containment of odorant such as corrosion of the odorant tank.

General Failure – relating to other failures not leading to a safety, environmental or gas supply consequence such as failure of instrumentation or telemetry systems.

The Failure Rate for an asset is the frequency of failures at a given point in time, typically measured as the number of failures over a year. We use the Initial Failure Rate from the NARM methodology which has been elicited through structured and formal workshops and adjust it by age, asset attributes and condition to achieve a more accurate estimate for the initial likelihood of failure for an asset. These scaling factors are:

Condition Risk (Effective Age) – this is the modified default age of an asset according to its condition.

Location Risk – a multiplication factor is applicable for assets within 3km of the coast.

Housing Risk – a multiplication factor is applicable depending on whether the housing is above or below ground.

Kiosk Risk – a multiplication factor is applicable depending on the condition of the building/kiosk.

Fencing / Security Risk (FS Factor) – a multiplication factor is applicable depending on the condition of the fencing and security.

Flood Risk – a multiplication factor is applicable depending on the flood zone the asset is located.

Table 9 and Table 10 show the Failure Rates for Odorant and Metering by failure mode at the start and end of RIIO-GD3 without intervention and the rate of failure over the RIIO-GD3 period for Offtake assets. Without intervention in RIIO-GD3 the failure rate of our Offtake and PRS odorant assets will increase by 2.2 (11%) and our metering assets by 0.02 (3%), predominantly driven by increases in General Failure and Low Odorant failure which

are the dominant failure modes for odorant. These failures will result in a response from our maintenance team and could result in a loss of supply for our customers. The number of failures is a leading indicator in understanding the condition of these assets.

Odorant			
Failure Mode	Total Expected no. of Failures		RIIO-3 Failure Rate
	Start RIIO-GD3	End RIIO-GD3	
General Failure	12.140	12.773	0.633
High Odorant	0.690	0.887	0.197
Low Odorant	6.799	8.141	1.342
Release of Gas	0.160	0.206	0.046
Release of Odorant	0.080	0.103	0.023
Total	**19.870**	**22.110**	**2.240**

Table 9 Failure rates over RIIO-GD3 for Odorant without intervention

Meters			
Failure Mode	Total Expected no. of Failures		RIIO-3 Failure Rate
	Start RIIO-GD3	End RIIO-GD3	
Over Meter Reading	0.040	0.051	0.011
Under Meter Reading	0.704	0.715	0.011
Total	**0.744**	**0.766**	**0.022**

Table 10 Failure rates over RIIO-GD3 for Metering without intervention

Changes to the NARM Methodology

LTRB Updates

The NARM methodology has been updated since RIIO-GD2 to incorporate changes for long term risk modelling and some changes in failure rates and deterioration rates to better reflect reality. This was carried out as a cross GDN project, underwent a consultation process and is awaiting approval by Ofgem. Please refer to full details of updated methodology changes in the updated version of the NARM Risk Methodology document. A brief summary of the update includes updates enabling GDNs to report on Long Term Risk (LTR) increases and impact of investments on this metric. Data has been pooled across networks enabling an update to deterioration curves to include an end of life (EOL) assumption to eliminate artificially high rates of deterioration towards EOL in the previous models for Governor and Offtake and PRS mechanical assets - these now taper off towards end of life (EOL) and provide much more realistic LTR analysis. Pressure Control and governor's regulator and slamshut failure analysis was also updated, now providing a system view of reliability and failure and deterioration in relation to under and over pressurisation in the updated version of the model. Mains deterioration was also reviewed as part of the project. The effect of these changes which have been implemented in the production of the GD3 business plan analysis is to better reflect the reality of operation of the above-mentioned assets. ICS performed a validation process on the results of the changes to the model and LTR as part of the project, but further validation across GDNs is required.

Updates to the methodology have been discussed with Ofgem during their development and have gone out to consultation. Formal approval is to follow on from the consultation. It was agreed with Ofgem that model updates as part of this project including Long Term risk would be used for RIIO-GD3 business planning purposes.

6.1. Probability of failure data assurance

The data used in our probability of failure calculations comes directly from the NARM methodology. The failure models are based on various industry standard guidelines (see GDN Asset Health Risk Reporting Methodology

document) and the failure rates have been statistically derived using actual asset information such as age or material and historic failure data taking into consideration other influencing factors such as weather or temperature.

We have an annual process for gathering asset data from the business to support NARM RRP delivery, with majority of data coming ultimately from SAP. There is a documented process where the business leads supplying the data carryout reasonableness checks on the data supplied to the Asset Strategy team, who then carryout validation and consistency checks.

Our 2024 Data improvement plan assess key areas of data for robustness and completeness:
Our **Core Asset Data** for PRS's includes location, fault data, health indices customers, capacity, obsolescence and maintenance costs. Each year we update the fault data within our systems as a requirement for Regulatory Reporting therefore this data is up to date as of 2023/24. Our Core Asset Data is assessed to be robust and complete.

Our **Asset Health and Failure Data** includes design specification, age, condition, duty, capacity, location and environmental health factors. All other factors within this category are static and are only updated when we install new assets. Our Asset Health and Failure Data has been assessed as having some data gaps and assumptions have been applied. This applies in particular to default condition data being applied to some kiosks and no condition data for fences or control systems. Through Smarter Work Management Systems, field work capture capabilities will be developed to improve this. If assumed condition assumptions are lower than reality, this will lead to a conservative calculation of baseline risk and risk reduction on intervention; and vice versa.

Our **Financial Data** includes all the financial data held in the core system that is used within the risk models. We have recently updated all the interventions costs within the system using historical project cost knowledge and SME input on current cost trends (See section 8.5. Data relating to cost nodes in the modelling have been inflated to 2023/24 prices using the Ofgem agreed inflation factors. Our Financial Data has been assessed as having some data gaps and assumptions have been applied. If assumed financial costs are lower than reality, this will lead to a conservative calculation of baseline risk and risk reduction on intervention, and vice versa.

It is recognised in the NARM methodology that the GDNs will have data gaps and will not hold the same level of asset data. To facilitate the population of the Monetised Risk modelling, a flexible but consistent methodology (with options) will be utilised to derive the Probability of Failure, Deterioration, Probability of Consequence and associated impacts of Intervention. This is set out in Table 6 of the NARM Methodology and ranges from Option A (GDN specific data from company systems) to Option B(Pooled/Shared data – where applicable) to Option C (Global/Assumed). Assumed data could be data that has been analysed to be representative of the population, arrived at by expert elicitation, or arrived at by researching relevant published studies/reports.

7. Consequence of failure

This section sets out the potential consequence were odorant and metering assets at our offtake sites to fail to operate as expected. We will consider the impact on customers, safety and the environment.

For each failure there may be a Consequence of Failure (CoF) which can be valued in monetary terms. In the NARM methodology the CoF is calculated as the Probability of Consequence (PoC) multiplied by the quantity and Cost of Consequence (CoC) and are linked directly to Failure Modes which categorise the asset failure.

The NARM methodology sets out the Consequence Measures for each Failure Mode categorised into four risk groups: Customer Risk, Health & Safety Risk, Carbon Risk and Other Financial Risk. Within the CBA we quantify

each of these risks over time (note that health and safety risk is split between fatality risk and non-fatality risk). These are detailed below for Offtake and PRS assets:

Customer Risk

- **PRE Odour Release / High Odour** – an Increase in Publicly Reported Escapes in the vicinity of the Offtake due to Odour Release or High Odour.

Health & Safety Risk

- **Release of Gas** – a loss of gas arising from the Odorant/Metering asset itself
- **DS Undetected Escapes** – undetected gas escapes downstream.
- **Explosion** – an explosion, either at the Odorant/Metering asset itself or in the downstream network.

Carbon Risk

- **Release of Gas** – a loss of gas arising from the Odorant/Metering asset itself or in the downstream network resulting in environmental impact due to the carbon equivalent of the gas content.

Financial Risk

- **Release of Gas** – a loss of gas arising from the Odorant/Metering asset itself or in the downstream network resulting in an associated cost.
- The direct financial costs to the business for without-Intervention work to the assets such as such as repair.

All of these aspects of risk have been taken into account to analyse the impact on total risk with respect to the start of GD3 level for all of our options in Section 9, and within our cost benefit analysis.

Where the principal of total monetised risk, applied across the asset base, is:

Total monetised risk = PoF x PoC x CoC

Different supply/demand scenarios have not been considered during our modelling as the current NARM Methodology does not include analysis for this. This is a future update to NARM in gas distribution that has been identified within the Methodology document and will be reviewed by the networks through NARM working groups. Overall, we are forecasting a slow recovery from impacts of the cost of living crisis and total domestic demand is forecast to return to 2021 levels between 2029 and 2031 for the NE and NO distribution zones of our network. This is based on established econometric modelling and demand forecasting methodologies.

Although the NARM Methodology does not account explicitly for supply demand scenario analysis, the fault and failure data we currently base our modelling calculations includes data collected over a period of historic years, which goes back to before 2021. Consequence data from company systems also reflects the latest available view for our asset base at 2023/24 and is also based on data from historic events collected over a period of time. Therefore, we do not anticipate demand to have a material impact on our investment decisions or their benefits during the 20 years from the start of RIIO-GD3.

Our Commitment to Resilience

Chapter 5 of our Business Plan demonstrates our longstanding commitment to ensuring that we are able to operate and maintain a resilient network. We have formalised our Resilience Framework and developed a number of individual resilience strategies which allow us to maintain our high standards. Our Resilience Framework ensures that we continually review the hazards facing our business and assess whether mitigations

that we have in place remain sufficient or need to change. This is relevant to our asset management strategies as we need to take into account exogenous factors when considering both short- and long-term investment plans. Our Network Asset Management Strategy which is set out in **Appendix A18** brings this all together.

We have introduced a range of other resilience strategies, such as **Appendix A8 – Climate Resilience Strategy**. A climate risk assessment sets out the risks facing NGN currently, in 2050 and in 2100, as set out in section 1.5.2 of the strategy. The climate scenario risk analysis did not identify high risks for either the 2oC or worst-case 4oC warming scenarios assessed. As such, this recognises our resilience to material climate change risks in the long to very long term (2050+). This is due to our comprehensive asset integrity and management procedures that are in operation to ensure asset condition and performance. In addition, there is inherent resilience afforded by gas infrastructure assets being a sealed, pressurised system principally located underground. Resilience levels to climate change risks will be greater in lesser warming scenarios should they arise, due to lower climatic extremes. The likely current and future climate risk has been factored into our preferred strategies across Offtake and PRSs from the outset by utilising our SME knowledge and risk assessments mentioned above.

We are taking a similar approach to RIIO-GD2 in putting together our investment plan, taking a balanced approach to asset management to ensure a safe, reliant and compliant network – ensuring we can continue to meet our licence obligations whilst at the same time minimising costs for customers.

8. Options considered

Types of Intervention

There are various ways in which we can intervene on our assets within this asset group. Each intervention has its own merits and drawbacks and the key to good asset management is to understand how the assets behave and use data and information to ensure the right decisions are made to balance risk and value to deliver a safe and reliable service for our customers. The interventions available for this asset group are:

Maintenance and repair – pre-planned inspections and reactive repair works to ensure that performance is optimised, and the asset reaches its expected life. This intervention is the basis of our baseline option detailed in Section 8.1.

Refurbishment – a proactive planned intervention which includes inspection and replacement or servicing of major components and soft parts with the intention of extending the expected life of the asset.

Replacement – installation of a new asset to replace an existing asset, often because of poor condition, the new asset will be of the same capacity but likely be a newer model or design.

Addition – installation of a new asset on our network to provide extra capacity or increased service levels, usually in response to increased growth, customer requests or a Cost Benefit Analysis assessment.

Removal – where we no longer require an asset, or we can manage our network in a more efficient manner we decommission and dispose of the asset from our network.

Future Energy Pathways

Assumed proportion of methane is important within the risk calculations and CBA as within the NARM methodology the carbon equivalent of the methane content of the gas lost from our assets is quantified, resulting in a monetised Carbon Risk. Gas can be lost from our mechanical assets through leakage or failure. Civils and E&I asset condition and failure are important because they influence the failure rate of mechanical assets; and the duration of the loss of gas consequence respectively.

We have gone with the default assumption of current assumed proportion of methane CO2 in natural gas projected forwards due to uncertainties in the potential energy pathways and because this is reflective of the current gas quality legislation. However, we acknowledge that significant changes to gas demand or the allowed methane content of gas, for example due to the blending with or conversion to hydrogen, would impact the benefits of our investments.

We have not explicitly modelled changes in the methane content of gas in our CBAs, as overall gas demand and the change in CO2 content of the gas is not expected to be different enough to materially impact the NPV, Payback & Option Ranking of our preferred investment programme. Our chosen programme represents value for money over a 20-year period regardless and is mainly driven by customer benefits such as avoiding loss of supply. The investments also ensure that we are compliant with relevant legislation. Our strategy therefore represents a no regrets investment programme that is consistent with net zero and will deliver value to customers whether a hydrogen or electrification pathway is chosen.

How we make Asset Decisions

Figure 3 How we make asset decisions.

We aspire to make conscious decisions that are balanced across our asset portfolio to ensure we can leverage the most value out of our assets. In making conscious decisions we can evaluate the risk we hold as a business and the impact it has on our strategic objectives. Asset management relies on accurate data, during RIIO-GD2 we have been working to improve our data and the way we capture and store this information, so it can be used to benefit our decision-making process. We use a wide range of asset data, global values such as the cost of carbon and specific values such as the loss of supply, costs from our updated unit cost analysis (see section 8.6) and the NARM methodology to calculate risk and value. Technical experts analyse options and set constraints (such as a constraint with the objective of maintaining risk) within our Decision Support Software which maximises the value of our investments for the given constraints. We use the value measures from our Decision Support Software in Ofgem's Cost Benefit Analysis template to compare the Net Present Value (NPV) of each option against the baseline option to determine the most suitable capital programme in RIIO-GD3. The diagram above is a simplified representation of this process.

Options Analysis

We consider various options when making asset management decisions to ensure the interventions we undertake are in the best interests of our customers and are optimal in terms of asset performance, capital expenditure and risk management.

Our Decision Support Software is used to quantify risk and level of service measures and to aid asset management decision making. Optimisation within the software allows us to maximise the value of investments we are making, but we also combine this with bottom-up analysis and constraint application which comes from collaboration with our subject matter experts.

Our process for Offtake assets is to undertake asset class optimisations where we set different constraints for our options and use our Decision Support Software to optimise within each secondary asset class. By undertaking optimisations at this level, we are allowing the system to maximise the value from investments within each asset class. Once we have run these optimisations, we analyse the results in terms of risk, service and cost and use Ofgem's CBA template to understand the customer benefits derived from each option.

In the early stages of options analysis, optimisations were carried out in our decision support software to obtain the best value investments over RIIO-GD3, by applying constraints such as maintain risk and maintain investment cost with the objective of maximising value from intervention. The resulting intervention plan recommendations were then reviewed by SMEs, who fed back on specific site and asset intervention applicability providing additional bottom-up insights around factors such as obsolescence and compliance. This information was used to further develop the modelling and intervention selections by applying additional constraints within the modelling process.

A preferred option has been arrived at using a combination of bottom-up analysis and optimisation using our Decision Support Tool (DST) to maximise the value of investments we are making, to maintain our cost efficiency objective. From this preferred option, further sensitivity analysis is undertaken to see if we can in any way improve the option. This sensitivity analysis is undertaken at the asset class level looking at the different effects of refurbishment and replacement interventions, as well as seeing if there is more merit in delaying the investment. During this sensitivity analysis we will also run each asset class individually through Ofgem's CBA template to ensure that they have a positive Net Present Value and within a reasonable timeframe. This provides additional confidence that our decision support software hasn't been inadvertently constrained during the first stage and not been able to deliver the best value for our customers.

Odorant and Metering have been linked together in one programme as agreed with Ofgem in bilateral meetings. They inter-relate to one another, with errors in metering impacting on the amount of odorant injected into the gas, and they are subject to a combined risk map within the NARM methodology.

The different options we have modelled are set out below in Sections 8.1 to 8.5. These have been appraised against our objectives in Section 5 to determine a preferred option. In summary, we have produced a continuation of the metering upgrade and odorization system programme option which we have deemed appropriate to maintaining a safe, reliable and compliant network. Subject matter experts were consulted to create reasonable Do More and Do Less options, with a particular focus on practical deliverability of the programme of works. It is important to note however that the options discussed have implications on a combination of safety, reliability and compliance which are discussed in the options analysis review. A deferral investment option was also considered.

We provide a summary output schedule under each option and detailed information on how we have reached our unit cost assumptions are provided in section 8.6.

Ofgem CBA Template Assumptions

For all CBAs in our RIIO-GD3 submission, we used an assumed weighted average cost of capital (WACC) of 3.92% based on Ofgem guidance (a real average basis). We have assumed a depreciation Acceleration Factor of 100% across all CBAs and scenarios, i.e. no additional acceleration of depreciation. For Capex CBAs we have assumed a capitalisation rate of 33.7% based on our Totex forecasts in BPDTs and 100% for Repex CBAs. First year of expenditure outflow is set to 2027 in all scenarios for consistent relative NPV calculations. This is in line with

Ofgem guidance for RIIO-GD3 and the approach taken in RIIO-GD2. We consider that the plausible ranges of these parameters would not materially affect CBA outcomes and have provided only one version of templates with these consistently applied (as they can be adjusted by Ofgem in any case).

We have not provided direct Opex associated with each CBA scenario as it would require us to artificially and subjectively divide up our maintenance and repair expenditure into each sub-asset class (CBA) and make a judgement on how this would be affected by each scenario. We do not record or report data at this level and we have no robust basis on which to provide it. In reality, maintenance and repair teams attend to multiple asset classes in single visits as part of an efficient function. Instead, we have provided the objectively calculated VF Financial risk, which is based on agreed industry NARM based calculations for estimating impacts on Opex under each CBA scenario. For those asset groupings not covered by NARM we have only included benefits and impacts of key benefits e.g. leakage. We consider this to be a more robust and objective approach to our CBAs. We have completed the NARM monetised risk memo lines from values in the NARM BPDT for baseline and preferred where they are available and relevant.

8.1. Baseline – Do minimum/nothing

This option is used as the baseline for which all other options are measured against. It does not include any capital investment but instead considers the cost of ongoing maintenance activities and repairs on failure. There are no direct benefits accrued under this option, however it does include societal impacts associated with leakage, fatality and injury.

The baseline option shows that there will be an increase of risk of 28% and an increase of supply interruption levels of 24% above start of RIIO-GD3 levels if we were to adopt this Do Nothing/ Do Minimum option (Table 15). All categories of risk contribute significantly to this increase in risk, Carbon risk slightly more so than others as the cost of carbon is increasing (Table 17).

Given our objectives in Section 5 of maintaining risk and supply interruption levels, this option has been deemed to be unacceptable, but forms the option against which the following options have been measured against.

8.2. First options summary – Continue on with the meter upgrade programme (preferred option)

Our preferred option for the Odorant and Metering asset class for Offtake involves a total of 42 interventions across the board at a cost of £12.49m, broken down as follows:

- 4 fiscal meter replacements
- 4 E&I upgrades (replacement) directly associated with the meter upgrade above
- 3 building replacements directly associated with the meter upgrades above.
- 11 flow rack upgrades (replacement / refurbishment)
- 16 odorant injection system upgrades (replacement)
- 4 calorimeter sampling point upgrades (replacement).

We are well underway with our meter replacement programme which ensures standardisation of our current metering system with an industry leading solution and provides improvements in reliability and repeatability for our shippers. We have listened to industry concerns over the potential for our existing Turbine and Orifice

metering assets to become obsolete and the lack of diagnostic and preventative measurements these older technologies provide mean they need to be upgraded to remove risk to shippers and our customers. Some components of the metering system such as some of the Flow computers are now obsolete so these will be addressed by upgrading the FWACV rack to newer systems.

In terms of non-NARM related investment, we have also identified a need to replace sampling points on some pipelines, which is required in order to maintain compliance with ISO10715. This standard give means for ensuring that samples of natural gas and natural gas substitutes that are conveyed into transmission and distribution grids are representative of the mass to which they are allocated. We need to undertake 4 Calorimeter sampling point upgrades in RIIO-GD3 to maintain compliance with these Regulations.

11 omni flow rack replacements are required in RIIO-GD3, primarily due to obsolescence as these are no longer supported by the manufacturer (we replaced 9 in RIIO-GD2) at a cost of £1.8m. Of the 11 replacement interventions, 4 will be carried out alongside a meter upgrade.

The odorant injection systems are a vital part of ensuring the safety of our network, as any potential gas leaks can be more easily identified by their distinctive smell. These systems have been in use since 1995 and have undergone several minor upgrades and overhauls since then to keep them in an operational state, however the current system is now at the end of its serviceable life and is being replaced by the Original Equipment Manufacturer (OEM). As a result of this we have begun trailing a new system in GD2 which we are now planning to roll out across the network to tackle this obsolescence. Under our preferred strategy we will upgrade 16 of the odorant injection systems which will mean that most units are upgraded, freeing up spare components for the four sites which will not be upgraded as part of these works.

The preferred option shows that there will be a decrease of total risk of 35% and a decrease of supply interruption levels of 46% compared to start of RIIO-GD3 levels if we were to adopt this option (Table 15). We see the risk falls by about 50-80% across all categories of risk (Table 17).

In respect of our objectives set out in Section 5:

Risk objective (maintain risk +/- 10%) – we are overdelivering on this risk objective (-35%). This is to be expected as the main drivers for investment are obsolescence and compliance and the continuation/ completion of the roll out of replacement programmes for our odorant and metering assets begun in RIIO-GD2.

Service level objective (maintain SI levels +/- 10%) – we are overdelivering on this risk objective (-46%). Again, as for risk, this is to be expected as the main drivers for investment are obsolescence and compliance and the continuation/ completion of the roll out of replacement programmes for our odorant and metering assets begun in RIIO-GD2.

Efficiency objective (minimise RIIO-GD3 spend over and above RIIO-GD2 levels) – RIIO-GD3 spend under this option is £2.2m above forecast RIIO-GD2 spend levels. Despite an overspend, we believe we are meeting this objective by using our SME's high level of site expertise and knowledge in combination with analysis in our Decision Support Software to develop a balanced programme of work meeting the requirement of increased workload driven by obsolescence and compliance, whilst minimising the cost for customers in our investment solutions.

Uncertainty objective: This option pays back in 6 years delivering positive NPV from 2032 onwards. This meets Ofgem's requirement of paying back in less than 16 years.

8.3. Second options dummary – Do more and upgrade all 20 odorant injection systems and increase metering by 20%

The second option that we have considered is to accelerate the completion of this programme of interventions and aim to increase the number of odorant injection system replacements from 16 to 20. Whilst this would mean we would have replaced all remaining odorant systems by the end of RIIO-GD3, this needs careful consideration in terms of practical deliverability alongside our other baskets of work. We noted earlier that a small number of ultrasonic meters that were installed early in the journey do not meet the standards that we have imposed on later upgrades (for example we have made use of live condition-based monitoring since RIIO-GD1, which these meters do not contain the functionality for). This option would mean that we would complete the outstanding meter upgrades and also upgrade ultra sonic meters that were originally installed which do not meet current standards (see Section 5).

This Do More option involves a total of 51 interventions across the board at a cost of £15.32m, broken down as follows:

- 5 fiscal meter replacements
- 5 E&I upgrades (replacement) directly associated with the meter upgrade above
- 3 building replacements directly associated with the meter upgrades above.
- 13 flow rack upgrades (replacement / refurbishment)
- 20 odorant injection system upgrades (replacement)
- 5 calorimeter sampling point upgrades (replacement).

The Do More option shows that there will be a decrease of total risk of 94% and a decrease of supply interruption levels of 95% compared to start of RIIO-GD3 levels if we were to adopt this option (Table 15). We see the risk falls by about 120% across all categories of risk (Table 17).

In respect of our objectives set out in Section 5:

Risk objective (maintain risk +/- 10%) – we are significantly overdelivering on this risk objective (-94%) (Table 15). Our preferred option has been determined by our analysis and SME's as a balanced plan to meet obsolescence and compliance risks in RIIO-GD3. The additional cost (£2.8m) and risk and service benefits over and above the preferred option do not therefore seem justified or aligned with our customers' expectations around keeping bills as low as possible (Section 5).

Service level objective (maintain SI levels +/- 10%) – we are significantly overdelivering on this risk objective (-95%). Again, we deem this to be unjustified for the same reason as risk, detailed above.

Efficiency objective (minimise RIIO-GD3 spend over and above RIIO-GD2 levels) – RIIO-GD3 spend under this option is £2.8m above the preferred option and £5.0m above forecast RIIO-GD2 spend levels. We believe this level of increased spending in order to accelerate our completion of replacement works for odorant and metering is not justified and is not aligned with our customers' expectations around keeping bills as low as possible (Section 5).

Uncertainty objective: This option pays back in 4 years delivering positive NPV from 2030 onwards. This meets Ofgem's requirement of paying back in less than 16 years.

8.4. Third options summary – Do less and halt the meter replacement programme whilst scaling back odorant injection upgrades

The third option we considered was whether it would be beneficial to halt the meter replacement programme at the end of RIIO-GD2. This would leave 4 fiscal meters that would not have been upgraded – given the afore mentioned concerns over obsolescence of our turbine and orifice meters, this would require very careful consideration. Not replacing these 4 meters would increase the likelihood of the assets becoming obsolete but in the meantime, these existing metering assets do not provide the diagnostics capabilities that are available from ultrasonic meters and are also unlikely to be as accurate.

Whilst we would undertake 16 odorant injection system upgrades under our preferred option, under this option we considered the impact of also scaling this back to undertake only 10. Whilst this would mean a slower paced roll out of replacements to our odorant injection systems, freeing up resource, we highlighted above that the existing assets have reached the end of their serviceable life. Given the positive correlation between asset age and fault occurrences, our view is that we should intervene on these assets now in order to reduce the risk of faults. This is coupled with obsolescence issues we have on odorant systems.

We did not reduce the number of planned Calorimeter interventions given these are specifically compliance led to ensure ongoing compliance with ISO10715. This option results in only 14 interventions being carried out in RIIO-GD3.

This Do Less option involves a total of 14 interventions across the board at a cost of £3.70m, broken down as follows:

- 10 odorant injection system upgrades (replacement)
- 4 calorimeter sampling point upgrades (replacement)

The Do Less option shows that there will be a maintenance of risk 0% and a decrease of supply interruption levels of 22% compared to start of RIIO-GD3 levels if we were to adopt this option (Table 15). We see the risk falls by about 25-30% for most of the risk categories where carbon risk falls by more (c.60%) (Table 17).

In respect of our objectives set out in Section 5:

Risk objective (maintain risk +/- 10%) – we are meeting this risk objective (0%). However, there would be significant concern around obsolescence and accuracy issues relating to 4 meters and risk of rising faults on 6 odorant injections systems that have reached end of life under this option.

Service level objective (maintain SI levels +/- 10%) – we are overdelivering on this risk objective (-22%). However, as highlighted under the risk objective there would be significant concern around obsolescence and accuracy issues relating to 4 meters and risk of rising faults on 6 odorant injections systems that have reached end of life under this option.

Efficiency objective (minimise RIIO-GD3 spend over and above RIIO-GD2 levels) – RIIO-GD3 spend under this option is £8.8m less than the preferred option and £6.6m below projected RIIO-GD2 spend. We believe this level of decreased spending is not justified if we are to continue to maintain a safer, reliable and compliant network.

Uncertainty objective: This option pays back in 11 years delivering positive NPV from 2037 onwards. This meets Ofgem's requirement of paying back in less than 16 years.

8.5. Fourth options summary – Defer investment

The fourth option we considered was deferral of the investments detailed in option 8.2 (continue with Meter Upgrade programme) to RIIO-GD4.

The 4 planned calorimeter upgrades are to ensure compliance with ISO10715. Deferring this investment by 5 years would put our compliance with this important piece of safety legislation at risk. We discussed the potential implications of not upgrading the 4 remaining meters in RIIO-GD3 in Section 8.4 above.

We did not consider deferral of investment to be a viable option and for this reason it has not been modelled.

8.6. Options technical summary table

NGN's expenditure forecasts are built on a tried and tested, robust and efficient process. This is founded in asset management principles that has seen NGN consistently benchmarked as the most efficient gas distribution company by Ofgem since 2005. It should be noted that "robust and efficient costs" should not be interpreted as lowest cost. We have and are currently experiencing external and internal cost drivers that are increasing the cost to deliver some workloads and maintain service and compliance objectives. At NGN robust and efficient costs are defined as those which address the network, customer service and environmental risk in an effective and enduring way, to avoid future additional costs or service interruptions. Notably, Health and Safety and Security of Supply are priority drivers in determining the appropriate balance of risk and cost which enables investment decision making. As such, our costs are efficient over the life of the intervention and not just at a point in time, which would reduce cost but risk service failures or increased costs in future periods.

NGN's efficient and robust process to determine expenditure is as follows:

1. Historic analysis of previous investment programmes to understand how expenditure has been effective in managing network risk (NARM) and the service levels that have been delivered. This provides the actual delivered cost of reducing risk and delivering services levels.
2. Forward looking analysis of risk profile, cost drivers and pressures to understand what the forecast programme of work is and the cost associated with maintaining or enhancing performance. This allows a clear articulation of how actual delivered efficiency translates into future cost, accounting for any cost variance.
3. A comparison of historic cost base versus forward projection to ensure costs are targeted at addressing compliance requirements (HSE), supply demand and account for additional costs drivers or challenging areas of work. To ensure costs are robust we embed the following process.
    - Compare asset specific costs against Third party industry database to understand where deviations from average costs might be and the reason for these changes. Third party data base provided by Aqua Consultants who maintain database for other regulated sectors.
    - Compare costs against Yr3 Industry RRP to assess how NGN costs compare to current delivered costs across GDNs (with Aqua Consultants highlighting that NGN's unit costs were competitive when compared to other GDNs).
    - Compare future investment programme to current actuals using Ofgem GD2 benchmarking to understand where NGN may be benchmarked on a like for like for like basis.
    - Undertake robust Internal challenge with Independently appointed experts to weigh pro's and cons of business case and relevance of costs to meet service levels and manage network risk.

4. The costs are then deemed to be robust and efficient from an NGN perspective and will be subject to a final technical scrutiny by an external consultant to ensure costs, benefits and risk removal are justified.

As demonstrated above, the unit costs used in both our Cost Benefit Analysis and capital expenditure forecasts have been derived using historical project cost knowledge, SME input on current cost trends and current cost quotations, to provide confidence in their accuracy, consistency and credibility. Since the introduction of SAP HANA S4 in Oct 2019 we have captured project costs at a more granular level to support regulatory reporting and to aid future investment decisions. During RIIO-GD1 the Unit Cost Database (UCD) was developed, this used extensive volumes of project cost data to derive cost curve models and provide a cost trend allowing for an accurate cost estimate, the allowances for GD2 were driven by the UCD. External Project management, untimely delivery by contractors and 3rd party delays could all impact on costs, but uncertainty risk relating to unit cost was built in during the development of the UCD in RIIO-GD1 and has carried through as these costs have been developed into the unit costs for developing the RIIO-GD3 business plan, as described below. The RIIO-GD3 unit rates incorporate analysis of efficient historical projects (note that we removed outliers from our sample in cases where we had identified things such as significant delays, unusually high mobilisation/demobilisation rates to ensure those inefficient costs were excluded). No explicit efficiency over and above this is included within this EJP appendix as our efficiency target is covered within the main business plan - a 0.5% Ongoing Efficiency (OE) target. This means that in reality, NGN will be subject to a further 0.5% cost reduction target throughout RIIO-GD3 in order to meet the OE objectives that will be set by Ofgem (refer to Chapter 6 of NGN's business plan).

As a reliable starting point, our RIIO-GD2 unit cost allowances were converted to 23/24 prices, RIIO-GD2 project costs and forecasts were then compared against the 23/24 allowances. Where there were significant variances time was spent with delivery and commercial Subject Matter Experts to thoroughly review those costs. Technology improvements (new functionality), resource scarcity and project management are examples of where we have seen deviations in the GD2 allowance, these have been reflected in the base RIIO-GD3 unit costs.

We have Framework partners in place for Capex delivery projects which improve certainty and ensure efficiency of costs.

Table 11 below provides a summary of the assumed unit costs applied in modelling and CBA analysis for metering and odorant. For the avoidance of doubt, costs are shown in 2023/24 prices.

	GD3 Unit Cost 23/24
Fiscal Meter Upgrade - Meter	£768,000
Fiscal Meter Upgrade - E&I (Electrical & Instrumentation)	£280,000
Fiscal Meter Upgrade - Building Replacement	£228,000
Fiscal Meter Upgrade - Civils	£67,000
Fiscal Meter Upgrade – CP (Cathodic Protection)	£70,000
Fiscal Meter Upgrade - Telemetry	£38,000
Fiscal Meter Upgrade - Generator	£130,000
Fiscal Meter Upgrade – FWACV (Flow Computer)	£165,000
Odorant Injection System Upgrades (excl. tanks) - Replace	£350,000
Calorimeter Sampling Point upgrade	£50,000

Table 11 RIIO-GD3 Unit Costs

Option	First Year of Spend	Final Year of Spend	Volume of Interventions	Equipment or Investment Design Life	Total Installed Cost (RIIO-GD3 Capex) 23/24 prices
Baseline (Do Nothing)	2026/27	2030/31	N/a	N/a	N/a
First Option Summary – Preferred Option	2026/27	2030/31	42	Around 20 years	£12,491,000
Second Option Summary – Do more and increase metering by 20% and accelerate odorant injection system upgrades	2026/27	2030/31	51	Around 20 years	£15,319,000
Third Option Summary – Do less and undertake no metering interventions and reduce odorant to 10	2026/27	2030/31	14	Around 20 years	£3,700,000
Fourth Option Summary – Defer Investment	2031/32	2036/37	42	Around 20 years	£12,491,000

Table 12 Options Cost Technical Summary Table

We detail below how our output schedule would differ under each of the options:

Workload Intervention Volumes	2026/27	2027/28	2028/29	2029/30	2030/31	Total
Preferred Option	8	10	6	8	10	42
Do More Option	10	12	9	10	10	51
Do Less Option	2	3	3	3	3	14

Table 13 Workload intervention volumes by option

9. Business case outline and discussion

Option	Description	Objectives					Comments
		Maintain Risk (+/- 10%)	Maintain Supply Interruptions (+/- 10%)	Efficiency	Uncertainty	Compliance	
-	Baseline	Not Met (+28%)	Not Met (+24%)	N/A	N/A	Not Met	Discounted as does not meet maintain risk and SI level objectives
1	Preferred	Overdelivery (-35%)	Overdelivery (-46%)	Increase of (£2.2m on RIIO-GD2 spend). Met using SME expertise	Met (6yrs)	Met	Over-delivery on risk and SI objectives are to be expected as the main drivers for investment are obsolescence and compliance and the continuation/ completion of the roll out of replacement programmes for our odorant and metering assets begun in RIIO-GD2.
2	Do More	Significant Overdelivery (-94%)	Significant Overdelivery (-95%)	Not Met - additional £2.8m spend compared to Preferred	Met (4yrs)	Met	Additional spend results in significant over delivery of objectives. This option is not aligned with our customers' expectations around keeping bills as low as possible
3	Do Less	Met (0%)	Overdelivery (22%)	Cost Reduction - £8.8m less than Preferred - refer to comments	Met (11yrs)	Not Met	This cost reduction has come from a cut back to the metering and odorant replacements set out in the Preferred option. There would be significant concern around obsolescence and accuracy issues relating to 4 meters and risk of rising faults on 6 odorant injections systems that have reached end of life under this option.
4	Defer to RIIO-4	Not modelled	Not modelled	Not modelled	Not modelled	Not Met	Places compliance at risk and risk from failing and obsolescent assets.

Table 14 Options appraisal summary

Table 14 details a summary of the options appraisal against objectives carried out in Sections 8.1 to 8.5.

In Summary:
The baseline option has been rejected as this increases risk and service levels over start of RIIO-GD3 levels significantly. This is unacceptable and misaligned with our objectives of maintaining risk and SI levels.

Option 2 the Do More has been rejected as this costs an additional £2.8m (over the preferred option) but this additional spend leads to an increased over delivery of risk and service level reductions compared to start of RIIO-GD3 levels that is not justifiable for the associated increase in cost. It is also misaligned with our customers' expectations around keeping bills as low as possible (Section 5). For these reasons it has been discounted.

Option 3 Do Less meets or over delivers on risk and service level objectives. However, the significant cost reduction (£8.8m) compared to the preferred option comes from a cut back to the metering and odorant replacement programmes tackling end of life assets and obsolescence. Obsolescence poses significant risk to accuracy and continuing servicing and maintenance, whilst end of life assets pose the increased risk of failure and faults and associated consequences including compliance and health and safety. For this reason, this option has been discounted.

Option 4 Deferral has been discounted due to the risk to compliance and risk from failing and obsolete assets.

Option 1 is the preferred option as it delivers the best-balanced programme of work combating compliance, obsolescence and end of life assets whilst minimising spends for customers. As it is a continuation of a replacement rollout programme to combat the aforementioned investment drivers, it is no surprise that the risk and service level objectives are surpassed for odorant and metering. The investment payback is 6 years, and the programme of work will ensure we can meet our licence and customer commitments around reliability, safety, compliance and value for money.

Our Preferred option is detailed in full in Section 10.1.

9.1. Key business case drivers description

This section discusses the development of the preferred strategy and sensitivity analysis then undertaken.

We have assessed the present value of each investment option utilising Ofgem's CBA template. To calculate all present value figures, we have compared the capital and operational costs associated with each option and overlaid them against the leakage reductions (associated with reduced numbers of failures) and reductions in risk relating to customer, compliance, financial and health and safety we expect each to attain.

All alternative options should be compared to the baseline counterfactual of the baseline position, which is shown in Table 16. The baseline position outlines what we expect our annual shrinkage position to be assuming zero interventions on Odorant and Metering assets across Offtakes and PRS. The present value of each alternative relates to our expected reduction in shrinkage given the funding received under each option. To value each of these efficiency gains we have used the non-traded price of carbon dioxide, as quoted by Ofgem. As noted above, each alternative option also analyses the impact of the change in customer, compliance, financial and health and safety risk. The preferred Strategy development is discussed in Section 8.2 with the options (sensitivity analysis) detailed in Sections 8.1 to 8.5.

The Key Drivers for investment in metering and odorant are obsolescence and maintaining compliance.

We are well underway with our meter replacement programme which ensures standardisation of our current metering system with an industry leading solution, and provides improvements in reliability and repeatability for our shippers. We have listened to industry concerns over the potential for our existing Turbine and Orifice

metering assets to become **obsolete** and the lack of diagnostic and preventative measurements these older technologies provide mean they need to be upgraded to remove risk to shippers and our customers. Some components of the metering system such as some of the Flow computers are now obsolete so these will be addressed by upgrading the FWACV flow rack to newer systems. Under our Do More option in Section 8.3, we are also proposing to upgrade 2 previously installed ultra sonic meters that do not meet current required standards.

In terms of non-NARM related investment, we have also identified a need to replace sampling points on some pipelines, which is required in order to **maintain compliance** with ISO10715. This standard gives the means for ensuring that samples of natural gas and natural gas substitutes that are conveyed into transmission and distribution grids are representative of the mass to which they are allocated.

The odorant injection systems are a vital part of ensuring the safety of our network, as any potential gas leaks can be more easily identified by their distinctive smell. These systems have been in use since 1995 and have under gone several minor upgrades and overhauls since then to keep them in an operational state, however the current system is now at the end of its serviceable life and is being replaced by the Original Equipment Manufacturer (OEM). As a result of this we have begun trailing a new system in GD2 which we are now planning to roll out across the network to tackle this **obsolescence**.

Conditionalities included within our options analysis are detailed in Section 7.

9.2. Business case summary

The analysis results for each of the options detailed in Sections 8.1-8.5 are summarised in Table 15, Table 16 and Table 17. Options appraisal is detailed in Sections 8.1 to 8.5 for each option and option selection is detailed at the start of Section 9.

Option	Desciption	RIIO-3 Primary Interventions		RIIO-3 Secondary Interventions		Total NPV compared to Baseline at 2070 (£m)	Objectives			
		Replace	Refurb	Calorimeter Upgrade	Building Replace		Total Risk Change from 2026	RIIO-3 Total Capex Cost (£m)	Supply Interruption change from 2026	Payback (years)
-	Baseline	0	0		0	-£ 1,627.7	28.0%	0	24.2%	-
1	Preferred	28	7	4	3	£ 859.8	-35.4%	12.5	-46.4%	6
2	Do More	35	8	5	3	£ 1,577.7	-93.9%	15.3	-95.4%	4
3	Do Less	10	0	4	0	£ 326.2	0.1%	3.7	-22.3%	11

Table 15 Options summary risk, SI impact and CBA

Option	Description	No. of Primary Interventions in RIIO-3	Forecast		Total NPV Compared to Baseline (£m)						Payback (years)	Total Risk Change from 2026	Supply Interruption change from 2026	Preferred Option
			Capex RIIO-3 (£m)	Totex RIIO-3 (£m)	2035	2040	2045	2050	2060	2070				
-	Baseline	0	0	0	-£ 60.0	-£ 94.1	-£ 128.1	-£ 162.5	-£ 851.8	-£ 1,627.7	-	28.0%	24.2%	N
1	Preferred	35	12.5	12.5	£ 11.5	£ 27.8	£ 44.7	£ 62.2	£ 435.0	£ 859.8	6	-35.4%	-46.4%	Y
2	Do More	43	15.3	15.3	£ 30.6	£ 61.7	£ 93.3	£ 125.5	£ 809.0	£ 1,577.7	4	-93.9%	-95.4%	N
3	Do Less	10	3.7	3.7	£ 5.7	£ 12.7	£ 19.4	£ 26.0	£ 162.7	£ 326.2	11	0.1%	-22.3%	N

Table 16 Options summary including NPV

Option	Desciption	Risk Change from 2026					Total Risk
		Total VF Carbon Risk	Total VF Compliance Risk	Total Customer Risk	Total VF Financial Risk	Total VF Health & Safety Risk	
-	Baseline	35.8%	25.9%	28.8%	28.3%	28.1%	**28.0%**
1	Preferred	-47.3%	-44.5%	-27.4%	-41.1%	-39.9%	**-35.4%**
2	Do More	-81.7%	-93.6%	-94.2%	-93.5%	-93.6%	**-93.9%**
3	Do Less	-23.1%	-2.0%	2.9%	-2.4%	-2.4%	**0.1%**

Table 17 Options detailed risk summary

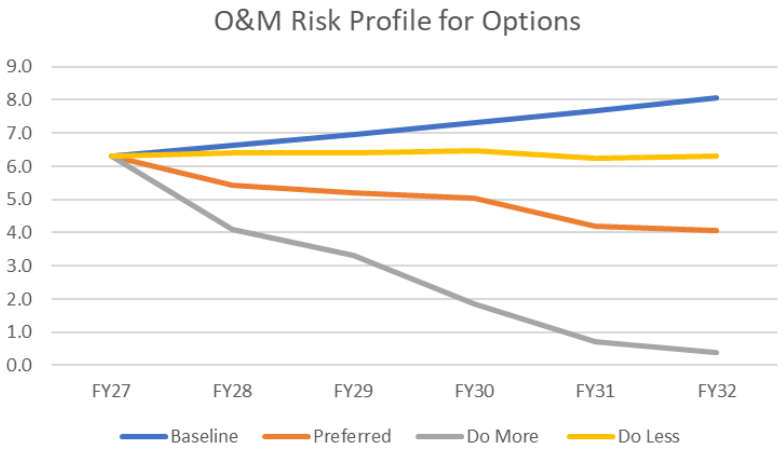

Figure 4 Odorant and Metering Risk Profiles for Options

10. Preferred option scope and project plan

Our preferred option results in 42 interventions across metering and odorant assets. Just over one third of these relate to odorant injection upgrades, one quarter are flow rack upgrades, 10% are sampling point upgrades, another 10% are metering upgrades with associated E&I upgrades. The remaining 7% relate to building replacement directly related to those meter upgrades. We discuss our preferred option in more detail below.

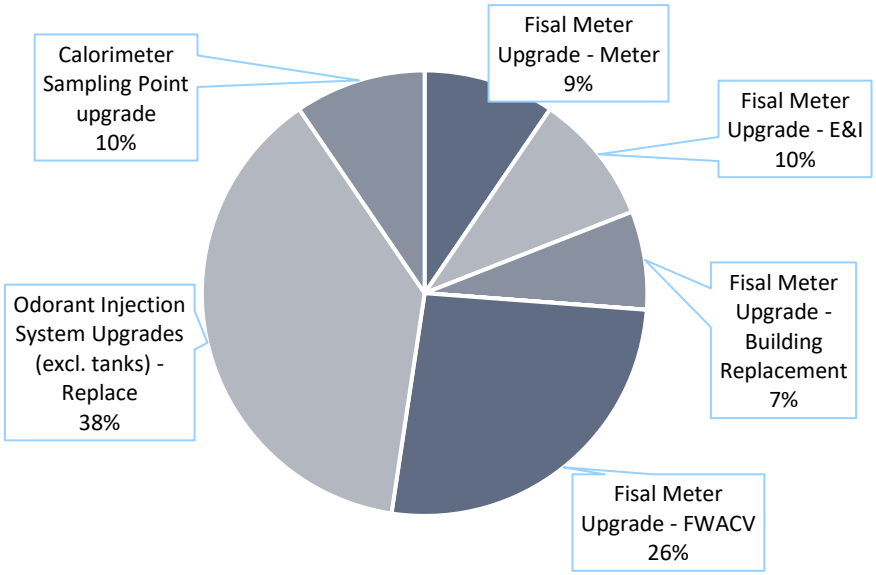

Figure 5 Breakdown of odorant and metering interventions.

10.1. Preferred option

Our preferred option for the Odorant and Metering asset class for Offtake assets is Option 1. This involves a total of 42 interventions across the board at a cost of £12.49m, broken down as follows:

- 4 fiscal meter upgrades (replacement)
- 4 E&I upgrades (replacement) associated with the meter upgrade above
- 3 building replacements associated with the meter upgrades above.
- 11 flow rack upgrades (replacement)
- 16 odorant injection system upgrades (replacement)
- 4 calorimeter sampling point upgrades (replacement).

This plan has been carefully designed in order to ensure that we can continue to deliver on the meter upgrade programme that are already rolling out during RIIO-GD2RIIO-GD2. It ensures that our meters are upgraded from Orifice Plate or Turbine meters, to ultrasonic meters. Whilst the meter upgrade will ensure standardisation of our assets, the ultrasonic meters will also improve accuracy of our metering, which is positive for our customers and shippers.

This option also ensures continuation of the delivery of odorant replacement already begun in RIIO-GD2. The odorant injection systems have been in use since 1995 and have undergone several minor upgrades and overhauls since then to keep them in an operational state, however the current system is now at the end of its serviceable life and is being replaced by the OEM (Original Equipment Manufacturer).

Investment is largely driven by compliance and obsolescence issues that have arisen and which have been discussed more fully in Section 8. Occurrence of these issues have driven a higher investment cost and workload for RIIO-GD3 than for RIIO-GD2 for us to remain in a position to be able to service our assets and be compliant. Total risk and service levels achieve levels that are significantly better than our stated aim as we are replacing assets to counter compliance and obsolescence rather than targeting asset health issues alone, as these aforementioned drivers outweigh asset health drivers in this asset class. Our cost benefit analysis has shown that

our preferred strategy is delivering value for money (positive NPV values) and guarding against uncertainty with a payback period of 6years (less than our objective of 16 years).

Costs for O&M for in the RIIO-GD3 EJP (£12.5m) are higher than projected RIIO-GD2 costs (£10.3m). However, where RIIO-GD2 investment was primarily driven by meter obsolescence, there is a drive to replace obsolete odorant equipment, as well as complete investment in obsolete metering equipment in RIIO-GD3.

Long Term Risk impact on Preferred Option

Table 18 provides details of the Preferred option Capex spend alongside Single Year Risk benefit and Long Term Risk benefit output as shown in our NARM BPDT. Long Term Risk calculations allow for accrual of benefit over the life of the intervention. These intervention lives are detailed in full in our NARM BPDT submission. Section 5.2 Project boundaries detail the investments within our Preferred option where we have been able to model risk and risk reduction under NARM.

We have provided undiscounted Long Term Risk benefit both here and in the NARM BPDT. Further clarification with SRWG is needed around the requirement for discounting LTR.

	Capex Spend (£m)	Capex Spend (£m)	NARM BPDT	
	All Investments	NARM Modelled Investments	Single Year Risk Benefit (R£m)	RIIO-3 Long Term Benefit Output (R£m)
Odorant & Metering	12.49	9.83	2.35	60.51

Table 18 Long term risk for odorant and metering

10.2. Asset health spend profile

The total forecast capital expenditure for Offtakes and PRS's has been included within the accompanying CBA. A breakdown is provided below. We have carefully balanced our investment spend across the years so that we avoid peaks and troughs of significant spend. Whilst 2028/29 is the lowest spend of each of the 5 years, this is due to no meter upgrades being carried out in this particular year.

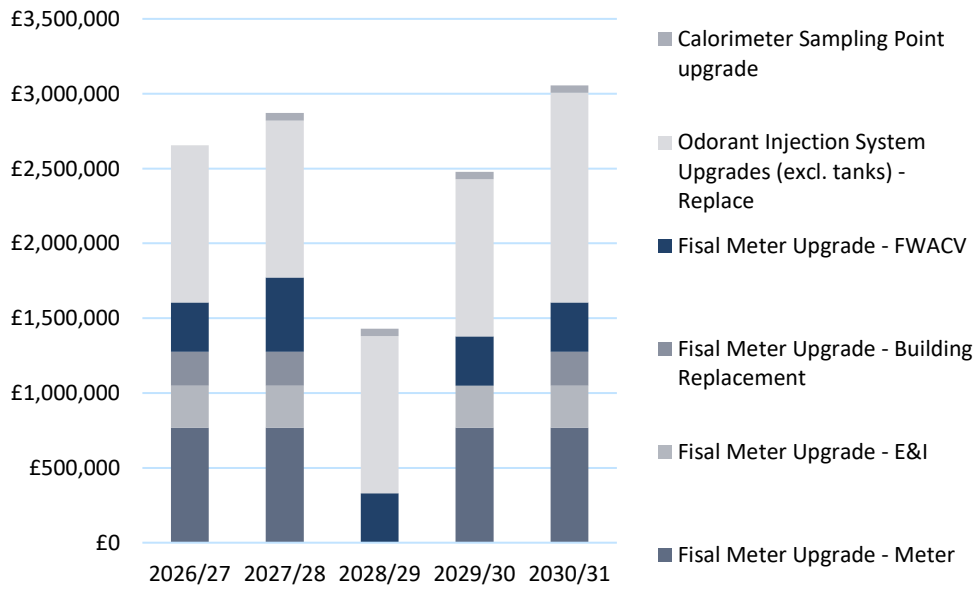

Figure 6 O&M Spend Profile for RIIO-GD3

£m (23/24 prices)	2026/27	2027/28	2028/29	2029/30	2030/31	Total
Fiscal Meter Upgrade - Meter	0.77	0.77	0	0.77	0.77	3.07
Fiscal Meter Upgrade - E&I	0.28	0.28	0	0.28	0.28	1.12
Fiscal Meter Upgrade - Building Replacement	0.23	0.23	0	0	0.23	0.68
Fiscal Meter Upgrade - FWACV	0.33	0.50	0.33	0.33	0.33	1.82
Odorant Injection System Upgrades (excl. tanks) - Replace	1.05	1.05	1.05	1.05	1.40	5.60
Calorimeter Sampling Point upgrade	£0	0.05	0.05	0.05	0.05	0.2
Total	**2.66**	**2.87**	**1.43**	**2.48**	**3.06**	**12.49**

Table 19 Spend Profile

A comparison of RIIO-GD2 and RIIO-GD3 costs is included in Section 10.1.

10.3. Investment risk discussion

We have controls and processes in place throughout the development of our RIIO-GD3 Capital Expenditure programme to ensure we mitigate both our customer's and our own exposure to risk. Workload and unit cost risks are inherent when forecasting failure rates and intervention solutions for large populations of assets. The bullet points below outline the steps we have undertaken to ensure we limit these risks to provide an accurate capital programme.

Workload Risk Mitigations

- We have used the NARM methodology to calculate individual asset's Probability of Failure which uses asset attributes to determine specific failure rates.
- As most of our equipment installed on our Offtake and PRS sites are from a few select manufacturers, for example our boiler houses are almost exclusively from Armstrong's, we have not witnessed different failure rates across the populations.
- We have considered various options including workload volumes and chosen the solution which provides our customers with the most appropriate balance between cost, risk and service.
- There is an increase in workload for RIIO-GD3 over RIIO-GD2, therefore there are increasing risks around delivery of project workload to timescales, however we have experienced Project Managers who have a proven track record of delivering this type of work. Some Particular risks to delivery have been discussed in Key Business Risks below.
- We have consistently engaged on our preferred strategy with our SMEs and operational colleagues to ensure that our strategy is both viable and deliverable.
- As part of the above, we have ensured adequate internal and external resource for design and delivery.
- We have procurement strategies in place which take into account the likely volumes and lead times we could experience. Our Workforce and Supply Chain Resilience Strategy (Appendix A7) has been developed with this in mind.
- Our project managers have been engaged throughout so that we have developed appropriate workload planning procedures.
- Land requirements have been factored into our project plans to ensure that they are dealt with well in advance of project construction to avoid undue delays.

Unit Cost Risk Mitigations

- We have used our updated unit cost analysis (see section 8.6) to determine our unit costs.
- We are not planning to undertake new work activities. We have undertaken all interventions previously and have historic costs allocated within our unit cost analysis.
- We have well developed processes and assurance activities in place, with scrutiny and challenge provided throughout. This ensure that we can deliver value for money by driving cost efficiency. Details on unit cost processes are provided within Section 8.6.
- We have experienced Project Managers who have a proven track record of delivering this type of work in the past and we have a commercial team of quantity surveyors who are focussed on delivering value for money.

Section 4.1 of **Appendix A7 – Workforce and Supply Chain Resilience Strategy** sets out some of the supply chain challenges that we have faced throughout RIIO-GD2. It acknowledges how NGN is a comparatively smaller GDN, which reduces our buyer power (section 4.1.2) and also discusses the significant inflationary pressures that have been placed on GDNs (section 4.1.4). For example, it discusses how the prices charged for coiled pipes have increased by 82% in the period from January 2020 to August 2023. In spite of these challenges, we are confident that our input unit costs remain efficient. This Appendix also touches on a number of external shocks which have impacted on things such as lead times. Examples include the Covid-19 pandemic, the Suez Canal blockage, Russia's invasion of Ukraine and rising geopolitical tensions. We outline in the strategy how we expect volatility to continue across our supply chain, and that we will utilise storage facilities in order to mitigate against supply input shortages. We plan to resource our supply chain and procurement team appropriately to help us overcome these challenges.

Appendix A21 – Cost Assessment and Benchmarking Approach demonstrates how, despite challenges facing us, NGN leads the industry in terms of cost efficiency, having been ranked the most efficient operator by Ofgem in both RIIO-GD1 and RIIO-GD2. This Appendix further outlines the value of NGN in Ofgem's cost assessment modelling at RIIO-GD2 by showing how NGN's frontier setting performance enabled Ofgem to set cost allowances that were £211 million lower than they would otherwise have been. In other words, our efforts to lead the sector on cost efficiency have resulted in significantly lower bills for consumers across the whole country.

We have achieved this position by being innovative in our thinking and directly and aggressively challenging industry norms and practices by bringing forward market-led, commercially focussed business solutions across almost every area of our business. For example:

- NGN introduced modern labour terms and conditions (T&Cs) for the majority of its operational workforce, leading to a significant reduction in legacy staff costs.
- NGN introduced a Direct Service Provider (DSP) model, leveraging small local engineering firms to deliver its replacement program instead of relying on the traditional 'tier 1' companies that have typically dominated the industry.
- Given that NGN has made strong productivity improvements over time, we have re-invested our outperformance payments in areas that (among other things) improve our productivity further. For example, we have used outperformance to invest heavily in IT systems through the SAP4 Hana investment and 'Future Ways of Working' programme. These projects are expected to significantly improve the customer experience and enable NGN to become a data-focused business.

We also outline in this Appendix our suggestion to target a 0.5% Ongoing Efficiency (OE) target, alongside the reasons why this is an appropriate level (see section 6 of the Appendix). This means that in reality, NGN will be subject to a further 0.5% cost reduction target throughout RIIO-GD3 in order to meet the OE objectives that will be set by Ofgem.

We outlined above how we have faced price increases significantly above inflation during RIIO-GD2. The Real Price Effects (RPE) methodology attempts to adjust for the difference between input price inflation and consumer

price inflation. We outline in the Appendix our broad support for RPEs, however we note that during RIIO-GD2, all networks have seen relatively large swings in real term allowances year to year due to RPE and inflation volatility from the geopolitical energy shocks in 2022 and 2023. RIIO-GD3 therefore presents an opportunity to refine the basket of reference indices to better capture GDNs actual input price movements and better mitigate this risk. The impact of RPEs have not been factored into our unit cost pricing.

10.4. Project plan

Table 20 shows our planned workload intervention profile over RIIO-GD3 for our preferred investment option.

Workload interventions	2026/27	2027/28	2028/29	2029/30	2030/31	Total
Fiscal Meter Upgrade - Meter	1	1	0	1	1	**4**
Fiscal Meter Upgrade - E&I	1	1	0	1	1	**4**
Fiscal Meter Upgrade - Building Replacement	1	1	0	0	1	**3**
Fiscal Meter Upgrade - FWACV	2	3	2	2	2	**11**
Odorant Injection System Upgrades (excl. tanks) - Replace	3	3	3	3	4	**16**
Calorimeter Upgrades - Sampling Point upgrade	0	1	1	1	1	**4**
Total	**8**	**10**	**6**	**8**	**10**	**42**

Table 20 Planned intervention timeline

Project planning is currently underway for RIIO-GD3. The screenshot below provides an insight to the level of detail to which we are going into developing Offtake and PRS investment projects, which are being planned at the site level. The excerpts show the timings and milestones for the key project stages of an example project. There is greater level of detail below this that can be drilled into.

A Risk Register for Odorant and Metering investment over RIIO-GD3 is included within the CBA and the key risks and mitigations are covered in Sections 10.3 and 10.5.

10.5. Key business risks and opportunities

We discussed in section 7 that we are not expecting any changes to supply or demand scenarios in RIIO-GD3.

Risks

Increased reliability – Most of the sites being completed in GD2 have a single meter stream and a bypass arrangement. Having two streams installed will bring the sites up to the same standard as how GDNs build all aspects of a gas site, but also will mean a back up is immediately available if one stream fails. Moving away from some older technologies like turbine meters and Orifice plate metering also mean that we are able to make use of

significant diagnostic information and condition-based monitoring to proactively manage our metering assets ensuring that any errors are detected early and reduce the overall impacts of any miss measurement to shippers and our customers.

Cost variability - External Project management, untimely delivery by contractors and 3rd party delays could all impact on costs. However, framework partners who deliver the capex workload are rigorously challenged to deliver value for money and alternative partners are continually being used were cost or delivery is a challenge. Uncertainty risk associated with unit costs has also be built into the analysis for unit costs used in the RIIO-GD3 planning process (see Section 8.6 for further details).

Large volumes of replacement works to be carried out in RIIO-GD3. We have extensive knowledge of the current issues with our odorant and metering assets and are confident that as long as significant changes do not occur this strategy will deliver the improvements required. We have carried out replacements for odorant and metering with similar scopes of works – with RIIO-GD3 interventions being a continuation of replacement programmes begun in RIIO-GD2. Our project managers have experience in delivering such projects and the team will be structured in such a way as to help us meet the increased replacement workload for odorant systems.

Opportunities

Efficiencies – the level of efficiency depends on the site we are working on, the type of asset being replaced, and whether the site gas supply can be isolated. Ideally if we were carrying out 3 separate replacements (crossing asset types) on a single site we would look to do all the work at the same time to minimise mobilisation and demobilisation cost for instance.

We discuss in Chapter 5 of our Business Plan how we are mitigating against the immediate risks facing our business in the RIIO-GD3 period. In terms of network asset management we have identified asset condition deterioration, obsolescence and compliance – all of which are relevant to the odorant and metering interventions set out in our preferred strategy. There are also wider considerations which indirectly impact on our investment decisions. Our Workforce and Supply Chain Resilience Strategy (Appendix A7) sets out our plans to tackle potential future skills shortages. Whilst we are not envisaging specific skills shortages in the RIIO-GD3 period thanks to our long standing commitment to ensuring we have a 24/7, highly skilled workforce, we do need to ensure that our longer term investment proposals are deliverable given the future challenges we may face as an industry. This strategy also discusses how we ensure that we have a resilient supply chain that can withstand shocks and unforeseen circumstances. This is also an important consideration given the limited supplier and resource pool facing increased demand as we move towards Net Zero.

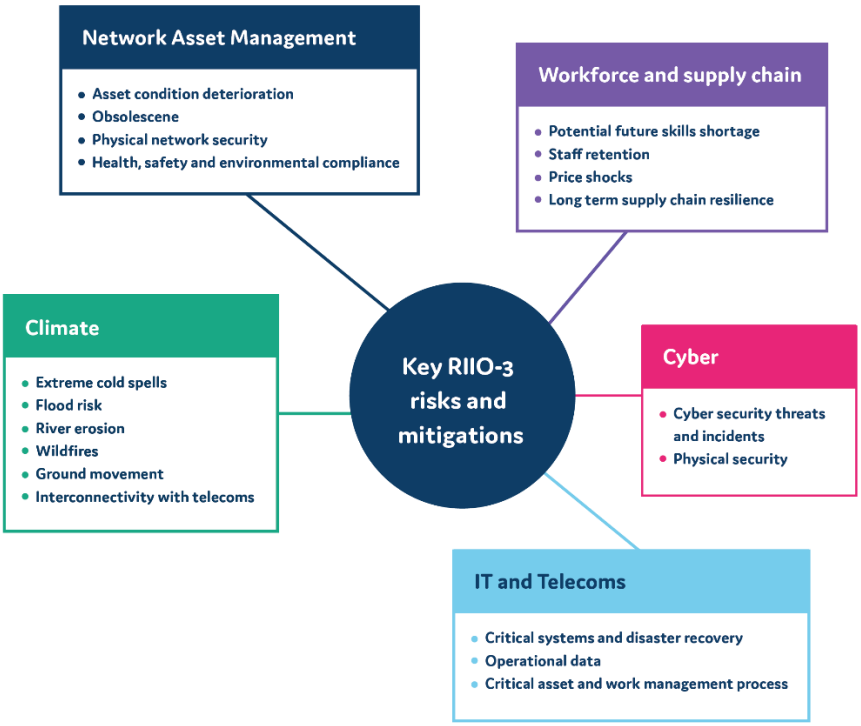

Figure 8 - RIIO-GD3R key risks and mitigations

10.6. Outputs included in RIIO-GD2 plans

We do not expect to carry over any RIIO-GD2 interventions into RIIO-GD3.