Northern Gas Networks

A22.a - Offtakes & PRS Overview

Engineering Justification Paper

Contents

1. Summary table

Name of Project	*Offtake and PRS – RIIO-GD3*		
Scheme Reference	*A22.a.NGN*		
Primary Investment Driver	*Asset Health/ Obsolescence/ Compliance/ Resilience /Capacity*		
Project Initiation Year	*2026/27*		
Project Close Out Year	*2030/31*		
Total Installed Cost Estimate (£)	*£130.77m*		
Cost Estimate Accuracy (%)	*+/-5%*		
Project Spend to date (£)	*£0*		
Current Project Stage Gate	*Specific delivery identification*		
Reporting Table Ref	*CV 5.01*		
Outputs included in RIIO-GD3 Business Plan	*As per BPDT above, impact of programme in NARM BPDT*		
Spend Apportionment	**RIIO-GD2**	**RIIO-GD3***	**RIIO-GD4****
	£61.97m	*£130.77m*	*£79-102m*

* For the purposes of drafting this Engineering Justification Paper (EJP), interventions involving fencing having been included within our A22.f NGN RIIO-GD3 Investment Decision Pack - Offtakes & PRS – Civils. These fencing interventions are noted as 'Security' within Other Capex in Table 6.17 of Chapter 6 of our Business Plan.

** Expecting all investments listed for RIIO-GD3 to complete in RIIO-GD3. RIIO-GD4 spend estimate has been based largely on indicative asset health spend in RIIO-GD3. See Investment Decision Packs A22.b to A22.g for further detail.

2. Executive summary

In RIIO-GD2 we carefully managed our approach to risk by focusing on maximising the life of our assets across Pressure Reduction Stations (PRS) and Offtakes in order to gain the most value out of them for our customers. This has served our customers well, as demonstrated in the paper prepared for NGN in 2024 titled "Incentivising truth telling, efficiency and value for consumers: Aligning outcomes with impact of frontier performance" which evidenced that NGN operates at the frontier in terms of cost efficiency and has generated significant savings for customers in RIIO-GD2 by driving down cost allowances for the industry as a whole. From a service point of view, we are far exceeding our outputs targets such as our unplanned interruption time of an average of 5 hours against our target of 10 hours.

Throughout RIIO-GD3 our aim is to manage total risk at a network level, however we understand the need to balance this ambition with service and cost constraints. In developing our RIIO-GD3 asset health plans we have therefore sought to maintain total risk at the same level as the starting position of RIIO-GD3 (with a tolerance level of around 10%). As risk is rising sharply in RIIO-GD3, we have planned to intervene on more assets than we have during RIIO-GD2 to meet our objectives around managing total risk. Our stakeholders have consistently told us that provision of a safe and reliable service is important to them, and we want to continue to provide exceptional service. Our RIIO-GD3 investments have been carefully developed in order to ensure that our supply interruptions can be maintained at the currently accepted level (plus or minus around 10%).

We are proposing a total of 680 individual interventions across all offtakes and PRSs at a total of £130.77m over RIIO-GD3, compared to our RIIO-GD2 spend of £61.97m, as shown in the table below. This investment is vital to ensure the safe and reliable functioning of our network. Note that volumes of interventions are not necessarily comparable due to differences in the way that general site civils in particular were previously recorded individually.

	RIIO-GD2		RIIO-GD3 EJP Preferred Option	
	Workload units	Capex (£m) 23/24 prices	Workload units	Capex (£m) 23/24 prices
O&M	43	10.29	42	12.49
Filters	18	0.89	17	3.83
PC	57	22.97	139	23.28
Preheating	63	14.40	107	45.82
E&I	320	9.43	104	16.98
General site civils	953	3.98	92	28.37
Other civils	446		179	
TOTAL	**1900**	**61.97**	**680**	**130.77**

Table 1 RIIO-GD2 vs RIIO-GD3 investment

The primary reasons for the cost increase in RIIO-GD3 include a move from a refurbishment led programme of works to extend asset lives in RIIO-GD2 to a more replacement focussed programme in RIIO-GD3 as asset deterioration continues and assets approach end of life. Increasing obsolescence issues arising with equipment across the asset classes putting replacement spares and ongoing maintenance at risk. Increasing compliance risks, this includes the pressures of ageing and deteriorating assets failing standards and also the requirement to meet low NOx requirements as required by the Medium Combustion Plant Directive (MCPD) which has led to a £14.4m investment in Preheating in RIIO-GD3. There are also significant investments in RIIO-GD3 to enable us to maintain capacity, resilience from climate change and storms and for operational reasons (£12.8m). Further detail is provided in individual Investment Decision Packs A22.b to A22.g.

3. Introduction

This Engineering Justification Paper details our proposals for investment on our Offtake and PRS assets during RIIO-GD3 and acts as a narrative to be used in conjunction with the Cost Benefit Analysis (CBA) associated with Investment Decision Packs A22.b to A22.g. 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 implemented a more robust maintenance and refurbishment strategy to extend asset life and ensure our gas transportation service continues to function safely and reliably whilst representing value for our customers. This strategy will largely continue throughout RIIO-GD3, however, there are also compliance and legislative requirements which we need to adhere to. For some asset classes, including preheating, filters and odorant, our strategy includes more asset replacements than refurbishments, which are required to ensure ongoing compliance with the relevant pieces of legislation. We discuss these further within Investment Decision Packs A22.b to A22.g.

This EJP aims to outline the justification for our proposed RIIO-GD3 Offtake and PRS investments as a whole, detailing our asset management decision-making process during which we analyse risk and value and trade-off between different intervention options. It explains the key drivers for investment in the entire asset class, the inputs and assumptions used in our Cost Benefit Analysis and how our proposed investment benefits our customers and stakeholders. Investment Decision Packs A22.b to A22.g provides the detail behind the individual asset class proposals.

This Engineering Justification Paper (EJP) looks at our RIIO-GD3 investment in our offtake and PRS assets as a whole. There are separate Investment Decision Packs which include EJPs which cover the following areas at offtake and PRS:

- A22.b NGN RIIO-GD3 Investment Decision Pack - Offtakes & PRS - Filters
- A22.c NGN RIIO-GD3 Investment Decision Pack - Offtakes & PRS - Pressure Control
- A22.d NGN RIIO-GD3 Investment Decision Pack - Offtakes & PRS - Preheating
- A22.e NGN RIIO-GD3 Investment Decision Pack - Offtakes & PRS - Odorant & Metering
- A22.f NGN RIIO-GD3 Investment Decision Pack - Offtakes & PRS - Civils
- A22.g NGN RIIO-GD3 Investment Decision Pack - Offtakes & PRS - Electrical & Instrumentation

There are a number of reasons for the higher required spend in RIIO-GD3, we discuss these in more detail in the individual EJPs mentioned earlier and highlight some key points below:

- One key driver for these interventions is compliance with health and safety legislation, such as the Pressure Systems Safety Regulations (PSSR)[1] which is mandated by the Health and Safety Executive (HSE)[2]. The aim of these Regulations is to prevent serious injury from the hazard of stored energy as a result of the failure of a pressure system, or one of its component parts. The Medium Combustion Plant Directive[3] is another important piece of health and safety legislation which ensure that we limit emissions of sulphur dioxide (SO_2), nitrogen oxides (NO_x) and dust which are harmful to both the environment and

[1] https://www.hse.gov.uk/pressure-systems/pssr.htm
[2] https://www.hse.gov.uk/
[3] https://www.gov.uk/guidance/medium-combustion-plant-mcp-comply-with-emission-limit-values

the health of our population. These are particularly relevant to our preheating interventions and lack of intervention would risk non-compliance with these important pieces of health and safety legislation.

- A large number of assets are now reaching, or have exceeded, their useful life. Ageing assets are also more challenging to maintain as it is becoming increasingly difficult to source replacement parts and also the specialist expertise to undertake work on these assets. Many interventions outlined in the A22.c NGN RIIO-GD3 Investment Decision Pack - Offtakes & PRS - Pressure Control, are driven by obsolescence concerns such as these. Further details, including age, asset health and fault trend analysis are included within Investment Decision Packs A22.b to A22.g**.**
- As we are upgrading our assets, we need to invest in additional electrical and instrumentation (E&I) equipment in order to support the additional functionality offered by those assets.
- We recently surveyed around half of our PRS and Offtake sites in order to assess the condition of buildings across them and provide evidence of the required investment to maintain safety and security at those sites. Full details on this survey are provided in A22.f NGN RIIO-GD3 Investment Decision Pack - Offtakes & PRS - Civils.
- We are proposing some investments which are linked to climate resilience, particularly from storms and flooding. We have taken key learnings from Storm Arwen into account in particular when putting these forward. Further details can be found in A22.g NGN RIIO-GD3 Investment Decision Pack - Offtakes & PRS - Electrical & Instrumentation.

4. Equipment summary

Offtakes are above ground sites which mark the start of our Local Transmission System and where we take gas, typically at up to 85 bar, from the National Transmission System (NTS) which is owned and operated by National Gas. The sites' primary roles are to record the volume and quality of gas taken from the NTS, to inject odorant to give the gas a distinctive smell and at all but two of our Offtakes to reduce the pressure of the gas to feed either high, intermediate, medium, or low-pressure networks.

PRS sites are above ground sites with a high-pressure inlet supplied from our Local Transmission System, whose primary function is to reduce the pressure of the gas to feed either high, intermediate, medium, or low-pressure networks. We do not record the volume and quality of the gas for billing purposes nor inject odorant as these tasks will have already been undertaken upstream at the Offtakes.

We own and operate 23 Offtake and 146 PRS sites each with different characteristics in terms of capacity, pressure cut and footprint but in the most part they all contain similar equipment, albeit by varying manufacturers, which undertake the same functions. The equipment on these sites are considered critical due to the high pressure of the gas and the significant numbers of customers these sites feed and so are designed, operated, and maintained to strict regulations, policies, and procedures.

We detail below the equipment at our Offtakes and PRS which are primary assets, with a simple definition. More information is available in the respective Investment Decision Packs A22.b to A22.g:

Filters

Removes debris from the gas thereby protecting downstream assets from damage. There are currently 184 filter systems installed on the network, as shown below:

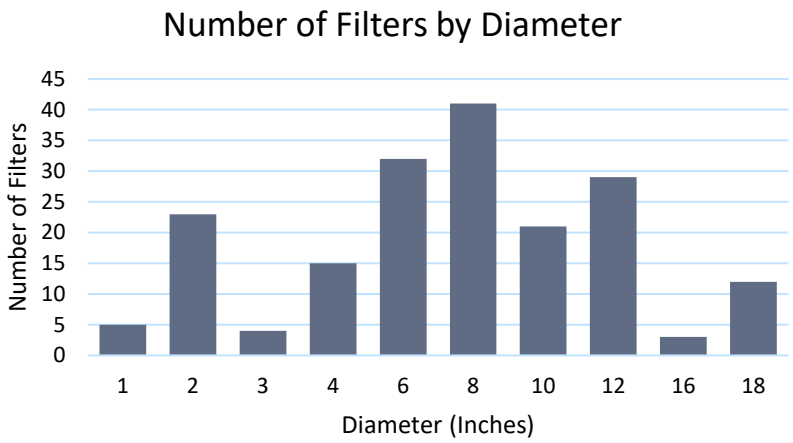

Figure 1 Number of Filters at Offtake and PRS Sites by size.

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 and Flow Weighted Average Calorific Value (FWACV) Rack. There are currently 23 metering systems installed on the network, split between turbine and ultrasonic meters as shown below:

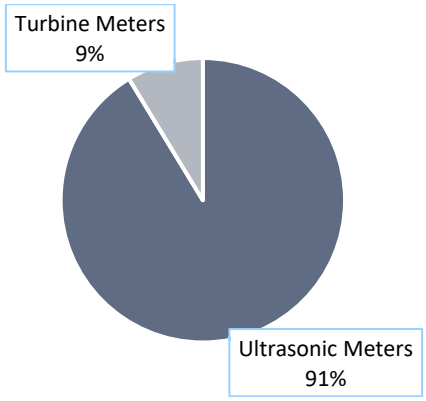

Figure 2 Types of network (fiscal) meters (%)

Preheaters

Heat the gas prior to pressure reduction to overcome the temperature loss created as natural gas is reduced in pressure, this is known as the Joule Thomson effect. This will prevent critical downstream assets such as regulators and associated control systems from freezing, thus protecting the assets. These assets are complemented with a control system that ensures the preheating functions as it should. There are currently 105 preheaters installed across the network including 66 boiler houses and 34 water bath heaters, as shown below. Other preheating includes electric heating.

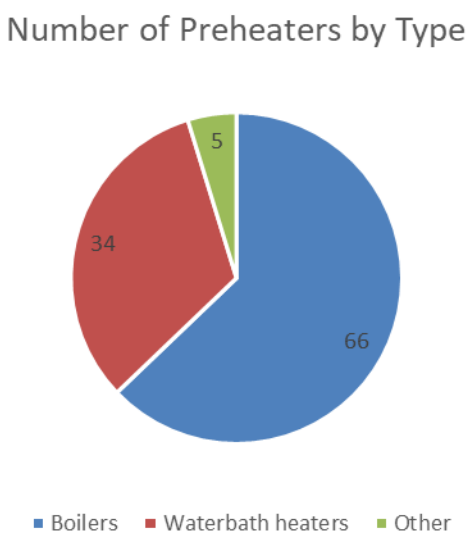

Figure 3 Number of Preheaters

Pressure Control

This system consists of regulators whose function is to reduce the pressure of gas in the network and Slamshuts, which protect the downstream network and customers from any over-pressurisation that could occur. These assets are supplemented by a control system that senses and controls the primary assets to ensure that they function correctly. There are currently 207 slam shut and regulator systems installed across the network.

The diagram below shows the number of systems according to diameter in inches.

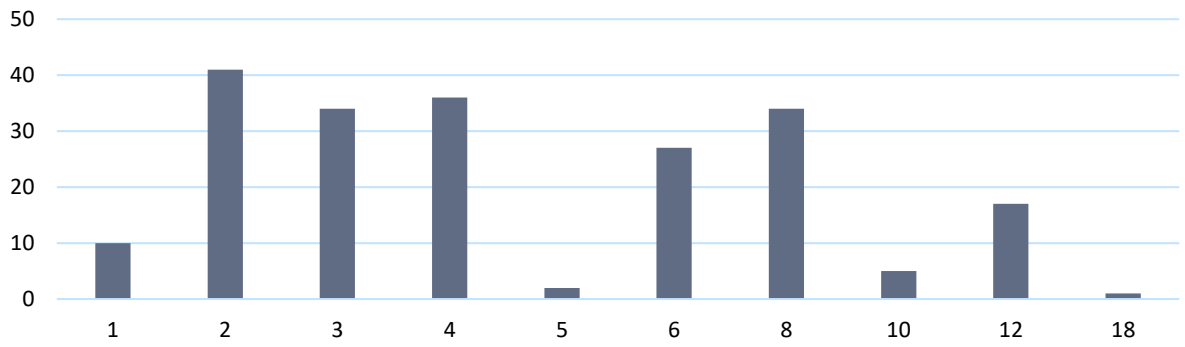

Figure 4 number of slam shuts and regulators by diameter (inches)

Odorant Injection System

This system consists of pumps, verometers, regulators, reliefs, tanks expansion vessels and instrumented control systems which inject 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.

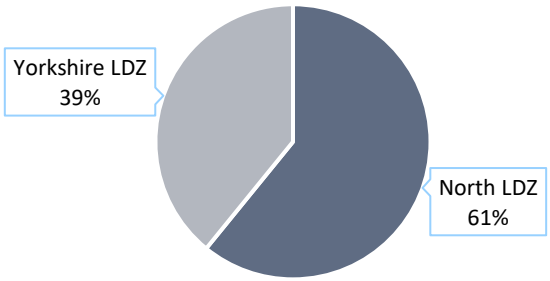

Figure 5 Odorant injection systems by LDZ (Local Distribution Zone)

The following equipment at Offtakes and PRS sites are considered as secondary assets:

- **Electrical, Instrumentation & Telemetry** – Sites have an electrical supply used to provide power to assets e.g. control system for a boiler or site lighting. Instrumentation equipment is used to monitor site metrics and telemetry systems relay this information to system control to allow faults and alarms to be picked up in real time.
- **Civils & Security** – Civil infrastructure is used for safe access onto and around the site. Buildings are used to house certain equipment and to provide security from intruders and protection from the elements. Security fences are used to mark the boundaries of our site and to deter intruders from gaining entry.
- **Associated Pipework** – above and below ground pipework transports the gas around the site and strategically positioned valves allow the control of flow through the site, cathodic protection is used to mitigate against the effects of corrosion on below ground pipework.

A summary of the number of asset systems by asset type is detailed below:

- Filters: 184
- Pressure control: 207
- Preheating: 105
- Odorant and metering: 46

The different types of interventions we have considered for Offtake and PRS assets are discussed in Section 8.

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

Investment Decision Packs A22.b to A22.g include a summary of asset health position at the start and end of RIIO-GD3 in Section 5.

5. Problem / opportunity statement

We are proposing a total of around 680 individual interventions across all offtakes and PRSs at a total of £130.77m over RIIO-GD3 for our preferred investment options. This investment is vital to ensure the safe and reliable functioning of our network. Whilst this is comparatively more than our spend during RIIO-GD2, there are a number of reasons for this (we discuss these in more detail in the individual EJPs mentioned earlier):

- One key driver for these interventions is compliance with health and safety legislation, such as the Pressure Systems Safety Regulations (PSSR)[4] which is mandated by the Health and Safety Executive

[4] https://www.hse.gov.uk/pressure-systems/pssr.htm

(HSE)[5]. The aim of these Regulations is to prevent serious injury from the hazard of stored energy as a result of the failure of a pressure system, or one of its component parts. The Medium Combustion Plant Directive[6] is another important piece of health and safety legislation which ensure that we limit emissions of sulphur dioxide (SO_2), nitrogen oxides (NO_X) and dust which are harmful to both the environment and the health of our population. These are particularly relevant to our preheating interventions and lack of intervention would risk non-compliance with these important pieces of health and safety legislation.

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Table 2 below shows our cumulative RIIO-GD3 cost for our preferred options across Offtake and PRS as a whole, by investment drivers. This is shown at the asset class detail in each of the Investment Decision Packs A22.b to A22.g.

Driver	GD3 Capex (£m 23/24 prices)
Asset Health	39.25
Asset Health/ Compliance	3.83
Asset Health/ Health & Safety	25.22
Asset Health/ Obsolescence	12.93
Obsolescence	12.29
Obsolescence/ Compliance	6.20
Compliance	14.62
Compliance/ Operational	3.61
Capacity	4.77

[5] https://hse.gov.uk/

[6] https://www.gov.uk/guidance/medium-combustion-plant-mcp-comply-with-emission-limit-values

Resilience	3.25
Operational	4.81
Total	**130.77**

Table 2 RIIO-GD3 Cost by investment driver for offtake and PRS

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

We have developed the NGN 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:

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.

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.

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.

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.

Offtake and PRS assets account for 10% of our total network risk and include five primary asset classes: Preheating, Filtering, Pressure Control, Metering and Odorant.

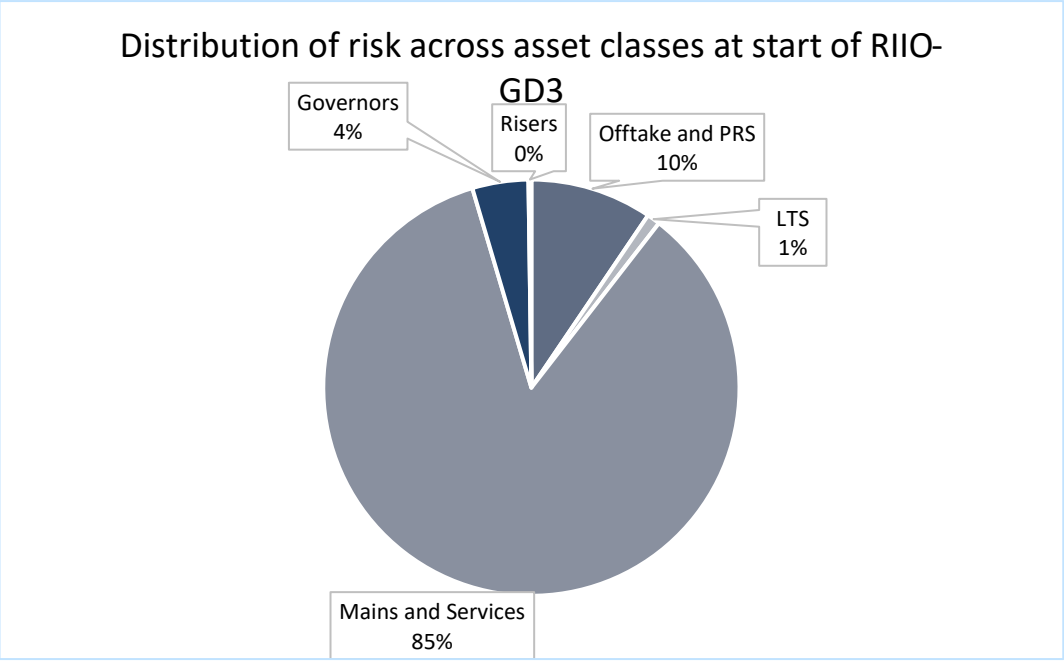

Figure 6 total value framework risk at start of RIIO-GD3

Table 3 below shows the risk profile of our Offtake and PRS assets at the start of RIIO-GD3 split by secondary asset class and risk category:

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 3 offtake and PRS assets risk profile

Of the five asset classes within offtakes, pressure control holds most risk at 42% and is predominantly made up of environmental risk, although compliance risk is also significant. Filters holds the second highest risk with 28%, again mainly split between environmental and compliance risk. Preheating and odorant and metering hold 17% and 13% of the risk on offtake and PRS respectively.

Environmental and compliance risk are the highest categories of risk across offtake and PRS this is due to the compliance requirements linked to our assets through regulations such as PSSR and also the increasing cost of Carbon.

Due to the complexity of some of our assets, failure could result from a magnitude of different circumstances. A few examples are detailed below:

Failure in preheating on site leading to low outlet temperatures – this may result from cracking of fire tubes, corrosion of the burner boxes, flues or outer shells, pump failure, heat exchanger failure and boiler failure. This will lead to a variety of outcomes such as integrity issues with downstream pipework, detrimental effects on pilot control systems, or hydrate or liquid formation which could influence the operation of pressure reduction equipment and other downstream assets. In the event of one or more of these failures, we would expect to see a loss of supply incident.

Failure in pressure control leading to low/high outlet pressures – This may result from failure of the regulators to control, potentially due to the soft parts perishing, failure of the pilot regulators or a complete failure of the regulator, failing either in the open or the closed position. This would lead to the primary protective device, the slam shut valve functioning which would stop gas supply and result in a loss of supply event, if the slam shut valve failed to function it would result in high outlet pressure which increases the risk of an explosion in the downstream network.

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 4 details this without intervention change:

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 4 offtake and PRS risk change over RIIO-GD3 without intervention

Over the course of RIIO-GD3, without intervention we will see total risk within the Offtake and PRS asset category increase by 19%. Each category is facing a significant risk increase, with odorant and metering seeing the most at 28%.

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 5 shows the impact on this service measure over RIIO-GD3 without investment.

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 5 offtake and PRS service level change over RIIO-GD3 without intervention

Without intervention in RIIO-GD3 the total expected number of supply interruptions will increase by 10% for Offtakes and PRS 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. When you consider that these assets form a critical part of our transportation service and asset failure on an Offtake may affect tens or hundreds of thousands of customers, with a loss of supply event resulting in customers off gas for a considerable length of time.

Consideration of 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, these vary by asset class and are discussed in Investment Decision Packs A22.b to A22.g.

This shows that 41% our Offtake and PRS assets have a health score of six or worse at the beginning of RIIO-GD3, increasing to 43% at the end of RIIO-GD3 without intervention. If our Preferred investment options are followed, this drops back down to 37%.

Please refer to specific commentary in Investment Decision Packs A22.b to A22.g – in particular regarding change in pressure control HI banding presentation following the NARM long term risk project.

	Health Index	1	2	3	4	5	6	7	8	9	10	Total
Baseline start of RIIO-GD3	Filters	7	0	3	8	115	19	11	15	1	5	**184**
	Pressure Control	5	34	9	9	6	10	5	9	11	109	**207**
	Preheating	3	8	8	33	40	6	4	2	0	1	**105**
	Odorant & Metering	24	0	3	3	4	12	0	0	0	0	**46**
End of RIIO-GD3 w/o intervention	Filters	7	0	3	3	119	19	8	19	1	5	**184**
	Pressure Control	5	25	16	8	5	8	11	9	9	111	**207**
	Preheating	3	0	14	26	45	3	7	4	2	1	**105**
	Odorant & Metering	24	0	0	3	3	14	2	0	0	0	**46**
End of RIIO-GD3 with interventions (Preferred Option)	Filters	18	4	3	3	110	18	7	15	1	5	**184**
	Pressure Control	6	27	17	10	4	8	11	9	10	105	**207**
	Preheating	23	2	37	9	25	0	4	3	2	0	**105**
	Odorant & Metering	40	0	0	0	1	5	0	0	0	0	**46**

Table 6 offtake and PRS asset health score summary

What is the outcome we want to achieve?

From our stakeholder research (for example, see Insight 1, 9 and 10 from Appendix A3 in Table 7) 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 4 of this document, for this group of assets, Customer risk is the main risk driver and so our objectives will focus around reliability, though we note that our interventions will also have positive impacts in these areas of health, safety, and the environment. 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 Medium Enterprise) customers' top priority, however stakeholders are supportive of investment to respond to significant challenges of climate resilience and decarbonisation. Balancing	Insight 1

the trade-off between investing now to future-proof and minimising expenditure to prioritise essentials poses a challenge.	
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 7 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 (Table 4) 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[7] and the Pressure Systems Safety Regulations[8]). RIIO-GD2 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

[7] https://www.gov.uk/guidance/medium-combustion-plant-when-you-need-a-permit
[8] https://www.hse.gov.uk/pressure-systems/pssr.htm

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 spend 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 industry leading service levels in RIIO-GD3.

From the analysis in the section above we understand that supply interruptions are increasing by 10% within the RIIO-GD3 period (Table 5) to a point where we would be expecting a supply interruption approximately every 3 years across our Offtake 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)[9], 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

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. We discuss the specific compliance requirements within Investment Decision Packs A22.b to A22.g.

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

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.

5.1. Narrative real-life example of problem

We provide below some examples of how we have intervened on our offtake and PRS assets.

CASE STUDY 1 – CYCLONIC SEPARATOR REPLACEMENT [redacted]

NGN utilise standard basket filters on the majority of high pressure sites. There are a small number of exceptions to this rule. During GD2 and into GD3 we are looking to remove the remaining cyclonic separators from the network and replace with standard basket filters. There are numerous reasons for this but mainly age and condition drive the decision to invest. Due to the limited number of these there is also a lack of retained knowledge of how to maintain and repair. The standardisation of equipment is a key consideration with a rapidly changing workforce.

CASE STUDY 2 – VOLUMETRIC REGULATOR REPLACEMENT [redacted]

[redacted]s the sole feed to Whitby, the site also supplies gas into the 17bar system that feeds down the east coast and in to the Hull area. It is a critical site for NGN. The project scope includes the replacement of 2 pressure reduction systems due to obsolete and poor condition equipment, a fiscal metering upgrade to allow for better measurement and as a result more accurate customer billing. The site configuration and set up also raised concerns from operational staff regarding the bunding surrounding the PRS equipment. This was originally installed for noise abatement as the previous regulators (a mixture of jetstream and V25) are reknowned for being noisy when operating. This requirement has been negated by choosing a regulator that suits the operating conditions but also ensures noise levels are manageable, it also improves working conditions for operational staff for regular maintenance activities.

CASE STUDY 3 – BOILER SYSTEM REFURBISHMENT [redacted]

Boiler systems became a feasible alternative to water bath heaters in the late 1990's to preheat gas at our sites. These systems consist of various components with different design lives. When we start to experience issues with a preheating system, for example where we are not able to economically repair the boilers, we will look to refurbish the system by only replacing the faulty/obsolete parts. A recent example is at [redacted] where frequency of faults and depletion of spares meant we replaced the boilers, pumps, and control system within the kiosk however all other components of the preheating system such as the kiosk, let down unit and heat exchangers remained. In addition to the refurbishment, a software and comms communications upgrade was completed that allows further detail to be seen by NGN system control and also allows a remote reset of the system, this will enable a reduction in callout and site visits. This refurbishment strategy has proven successful in RIIO-GD1 and RIIO-GD2. The plan is for it to continue into RIIO-GD3.

CASE STUDY 4 – METER REPLACEMENT AND E&I

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 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, and non-compliant with current standards. 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.

5.2. Project boundaries

The boundaries of spend proposed by this justification paper include capital investment on the PRS and offtake assets listed in Section 4. It includes all necessary project costs such as design, procurement of materials, construction, commissioning, and overheads. It does not include any costs associated with LTS pipelines.

Individual Investment Decision Packs A22.b to A22.g Section 5.2 detail what has and has not been included within cost benefit analysis and risk and service level benefit impact.

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 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:

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

Odorant & Metering

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 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.

Pre-heating

Failure Modes have been developed by modelling the consequences rather than specific component failures such as the burner ignition or control systems. This is because of the variances in heater designs and the complex relationships between components. The Failure Modes consist of:

Release of Gas – failure of a pressure containing component of the system such as the heat exchanger shells.

High or Low Outlet Temperature – where failure in the preheating system results in erroneous heat input for the gas flow through the site resulting in high or low outlet temperatures.

Capacity – where the system has insufficient capacity to meet a forecast 1:20 peak day downstream demand.

General Failure – relating to other failures not leading to a gas release, high or low temperatures or capacity failures such as water level alarms or exhaust flue adjustments.

Filters & 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 consist of:

Release of Gas – failure of a pressure containing component of the system such as filter bodies.

High or Low Outlet Pressure – where concurrent failure of both regulators and the slam shuts result in either over pressurisation or partial or total loss of the downstream system.

Capacity – where the system has insufficient capacity to meet a forecast 1:20 peak day downstream demand.

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 8 shows the Failure Rates of each primary asset at the start and end of RIIO-GD3 without intervention and the rate of failure over the RIIO-GD3.

Offtake and PRS Overview			
Asset	Total Expected no. of Failures		RIIO-3 Failure Rate
	Start RIIO-GD3	End RIIO-GD3	
Filters	51.142	53.145	2.003
Preheating	157.229	181.351	24.122
Pressure Control	160.184	164.157	3.972
Odorant	19.870	22.110	2.240
Metering	0.744	0.766	0.022
Total	**389.169**	**421.528**	**32.360**

Table 8 Offtake and PRS failure rates summary by asset class

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. Failure rates without intervention increase by 32 (8%) over RIIO-GD3, being driven more by Preheating 24 (15%) and Odorant 2 (11%). Analysis of failure rates by failure mode is provided within the individual Investment Decision Packs A22.b to A22.g.

Changes to the NARM Methodology

LTRB (long term risk benefit project) Updates

The NARM methodology has been updated since 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 updates include 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 in particular for Governor and Offtake and PRS mechanical assets - these now taper off towards EOL and provide much more realistic LTR analysis. Pressure Control and governors 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

With exception of the above two points, 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 the 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 2020/21. 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 8.6). 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 mechanical 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.

Types of Consequence

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). Some examples of these consequence risks for Offtake and PRS assets are included below (Investment Decision Packs A22.b to A22.g provide these in detail, specific to asset class):

Customer Risk

- **Offtake / PRS Site Failures** – a failure of the site resulting in loss of supply to downstream domestic, commercial, or industrial consumers.
- **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

- **Down stream gas escapes / Explosion** – an explosion at the asset itself or in the downstream network following failure. This could lead to subsequent death, injury and / or property damage. Failure of the asset can lead to an increase in downstream gas escapes, which in turn leads to an increased risk of explosion and injury / damage.

Carbon Risk

- **Down stream gas escapes / Loss of gas** - the volume of loss of gas from either the asset itself or in the downstream network constitutes the consequence of a failure. Environmental impact is assessed from the carbon equivalent of the gas lost.

Financial Risk

- **Down stream gas escapes / Loss of gas** - the volume of loss of gas from either the asset itself or in the downstream network constitutes the consequence of a failure. Financial risk is determined from the cost of the lost gas.
- **Ground Heave** – a preheater failure resulting in damage to structures, roads, and other assets due to low outlet temperatures. Financial risk is determined from the cost to repair the ground heave.
- The direct financial costs to the business for without-Intervention work to the assets such as repair.

Probability of Consequence

Within our assessment of asset risk, we use the Probability of Consequence data from the NARM methodology which has been calculated from a mix of observed data, shared GDN data, industry standard data and expertly elicited data.

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 investment options as detailed in the individual offtake and PRS asset engineering justification papers.

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 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, resilient, 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. An example of this would be replacement of corroded water

pipework on a heat exchanger following a planned Pressure Systems Safety Regulations (PSSR) major inspection. This intervention is the basis of our baseline options as detailed in the individual offtake and PRS asset engineering justification papers.

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. An example of this would be replacement of the gas coil and fire tubes within a Water Bath Heater to ensure it is fit for purpose for the foreseeable future.

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. An example of this would be the replacement of a Water Bath Heater with a Boiler House to deliver the same heating requirements but with more modern technology.

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. An example of this would be replacement of a pressure control system with larger diameter regulators to allow for increased gas flow through the site.

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. We are not considering the removal of any PRS assets within RIIO-GD3.

Future Energy Pathways

The 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 7 How we make asset decisions

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 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 and PRS 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 optimise 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 strategic analysis and optimisation using our Decision Support Tool (DST) to maximise the value of investments we are making. 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 doing more (such as carrying out more interventions, or upgrading from refurbishments to replacements), or doing less (such as scaling back on our interventions by a certain %), 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. The different options we have modelled are set out within Investment Decision Packs A22.b to A22.g in Sections 8.1 to 8.5. These have been appraised against our objectives in Section 5 to determine a preferred option for each asset class. In summary, we have produced a preferred option focussing on the investment drivers specific to each asset class 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. The SME's high level of site expertise and knowledge in combination with analysis in our Decision Support Software was critical to developing a balanced programme of work, whilst minimising the risk of overinvestment. It is important to note however that the options discussed have implications on a combination of safety, reliability and compliance which are discussed in our options analysis review within Investment Decision Packs A22.b to A22.g. A deferral investment option was also considered.

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, which is included within the financial risk element of the NARM modelling. There are no direct benefits accrued under this option however it does include societal impacts associated with leakage, fatality, and injury. Option summary tables at the top level for offtake and PRS are detailed in Section 9.2.

8.2. First option summary – Balanced strategy (preferred option)

This option is the secondary asset workload, cost and risk data taken from bottom-up strategic analysis and DST optimisations. This option allows us to understand the strategies at an asset level and will enable us to understand the value of the proposals in terms of NPV, CBA, risk impact and cost at a secondary asset level. Please refer to Investment Decision Packs A22.b to A22.g for further asset specific details. Option summary tables at the top level for offtake and PRS are detailed in Section 9.2.

8.3. Second option summary – Do more

This option considers the impact on our service and risk profile if we were to do more. The individual strategy varies across the asset class and are described in detail within Investment Decision Packs A22.b to A22.g. Option summary tables at the top level for offtake and PRS are detailed in Section 9.2.

8.4. Third option summary – Do less

This option considers the impact on our service and risk profile if we were to scale back investment to some extent. The individual strategy varies across the asset class and are described in detail within Investment Decision Packs A22.b to A22.g. Option summary tables at the top level for offtake and PRS are detailed in Section 9.2.

8.5. Fourth option summary – Deferral of investment

In each of the respective EJPs we also consider the implications of deferring investment of our preferred option out to the start of RIIO-GD4.

8.6. Options technical summary table

As the options used vary across the asset classes, they have not been replicated in this paper but can be viewed in detail in Section 8.2, Options Cost Summary Table of Investment Decision Packs A22.b to A22.g.

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 databases 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 basis.
    - Undertake robust Internal challenge with Independently appointed experts to weigh pros 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 9 through to Table 14 provide a summary of the RIIO-GD3 assumed unit costs, per asset class. For more detail please refer to **Investment Decision Packs A22.b to A22.g**.

Filter Asset	Intervention Type	Unit Cost (£)	Unit
Filter <8"	Replace	110,497	System
Filter >8"	Replace	265,025	System
Skid Unit	Replace	624,096	System

Table 9 Options Unit Cost Summary Table - filters

	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 — FWACV (Flow Computer)	£165,000
Odorant Injection System Upgrades (excl. tanks) - Replace	£350,000
Calorimeter - Sampling Point upgrade	£50,000

Table 10 Options Unit Cost Summary Table - odorant and metering

Intervention	Ofgem Intervention Type	GD3 Unit Cost 23/24
Non volumetric - Full system replacement	Replacement	£1,048,963
Non-volumentric partial system replacement - per system (equal to 4 units)	Refurbishment – full	£201,651
Regulator overhauls	Refurbishment – full	£70,000
Lineguard Cabinets	Refurbishment – partial	£62,000
Volumetric — Replacement	Replacement	£2,000,000
Capacity Upgrade — Regulator	Replacement (expanded capacity)	£1,055,845
Capacity Upgrade - Inlet or Outlet Pipework		£400,000

Table 11 Options Unit cost summary table – pressure control

Intervention		GD3 Unit Cost 23/24
NIC Preheating Replacement	Replacement	£1,201,788
Low NOx Compliance	Replacement	£1,201,788
E&I Upgrade associated with preheating replacement	Replacement	£280,000
Water Bath Heater to Boiler House - Replacement	Replacement	£1,201,788
Electrical preheating	Replacement	£500,000
E&I Upgrade associated with preheating replacement	Replacement	£280,000
Water Bath Heater Medium Refurb	Refurbishment — full	£171,376
Boiler House to Boiler House - Replacement	Replacement	£1,113,435
Boiler House Refurb	Refurbishment — full	£243,047
PH Adams Retrofit	Refurbishment - partial	£25,000

Table 12 Option Unit costs summary table - preheating

Intervention	GD3 Unit Cost 23/24
Building — Replace	£228,226
Building — Refurb	£57,985
General Site Civils (S) Offtake and PRS	£30,500
General Site Civils (M) Offtake and PRS	£65,200
General Site Civils (L) Offtake and PRS	£160,000
Site CP upgrades (Ground beds)	£73,179

Table 13 Options Unit costs summary table – Civils

Intervention	GD3 Unit Cost 23/24
E&I - full upgrades	£280,000
E&I - partial upgrades	£79,937
Lighting Columns	£66,667
Generator Replacement	£130,000
Telemetry upgrades	£37,795

Table 14 Options Unit Costs Summary Table - E&I

An Options Cost Technical Summary Table for each asset class can be found in the individual EJPs, detailing: First Year of Spend (2027), Final Year of Spend (2031), Volume of Interventions, Equipment or Investment Lifetime, and Total Installed Cost (RIIO-GD3 Capex).

9. Business case outline and discussion

Please refer to **Investment Decision Packs A22.b to A22.g** which provide the outline of the business case applicable to each asset class.

9.1. Key business case drivers description

Please refer to **Investment Decision Packs A22.b to A22.g** which provide the outline of the business case drivers description applicable to each asset class.

Below is a high-level summary of the key investment drivers for each asset class:

- A22.b NGN RIIO-GD3 Investment Decision Pack - Filters: asset health and compliance

- A22.c NGN RIIO-GD3 Investment Decision Pack - Pressure Control: obsolescence, compliance, asset health and capacity
- A22.d NGN RIIO-GD3 Investment Decision Pack - Preheating: asset health and compliance
- A22.e NGN RIIO-GD3 Investment Decision Pack - Odorant & Metering: obsolescence and compliance
- A22.f NGN RIIO-GD3 Investment Decision Pack Civils: asset health and health and safety
- A22.g NGN RIIO-GD3 Investment Decision Pack E&I: asset health, obsolescence, and resilience

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

9.2. Business case summary

Please refer to **Investment Decision Packs A22.b to A22.g** which provide the outline of the business case applicable to each asset class.

We have carried out a cost benefit analysis for Offtake and PRS at an aggregated level (including all costs and benefits as detailed within Investment Decision Packs A22.b to A22.g). For this aggregated CBA (preferred option), the pay back is 13 years. Table 15, Table 16 and Table 17 detail our risk and CBA analysis at an aggregate level across offtakes and PRS.

Option	Desciption	RIIO-GD3 Interventions		Total NPV compared to Baseline at 2070 (£m)	Objectives			
		Primary interventions	Secondary interventions		Total Risk Change from 2026	RIIO-GD3 Total Capex Cost (£m)	Supply Interruption change from 2026	Payback (years)
-	Baseline	0	0	-£ 12,303.91	17.9%	£ -	9.9%	N/A
1	Preferred	269	411	£ 1,520.17	4.3%	£ 130.78	-27.7%	13
2	Do More	306	544	£ 2,443.98	-4.9%	£ 181.19	-46.7%	12
3	Do Less	202	334	£ 770.59	9.9%	£ 101.71	-29.1%	16

Table 15 Offtake and PRS top level Risk, SI and payback summary

Option	Description	Total NPV Compared to Baseline (£m)						Payback (years)	Preferred Option
		2035	2040	2045	2050	2060	2070		
-	Baseline	- 694.64	- 1,079.32	- 1,461.78	- 1,844.79	- 6,881.12	- 12,303.91	N/A	N
1	Preferred	- 21.21	14.40	53.59	95.51	733.62	1,520.17	13	Y
2	Do More	- 28.26	25.95	85.31	148.59	1,200.64	2,443.98	12	N
3	Do Less	- 25.98	- 6.26	15.64	39.06	345.37	770.59	16	N

Table 16 Offtake and PRS 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	22.4%	14.1%	15.1%	12.5%	14.1%	**17.9%**
1	Preferred	17.6%	0.1%	-24.6%	-6.5%	0.8%	**4.3%**
2	Do More	12.6%	-6.7%	-49.8%	-20.4%	-5.5%	**-4.9%**
3	Do Less	19.6%	5.6%	-10.0%	4.3%	5.6%	**9.9%**

Table 17 Offtake and PRS options detailed risk summary

10. Preferred option scope and project plan

As mentioned earlier, there is a need to intervene on proportionally more assets during RIIO-GD3 as more of our assets are reaching the end of their assumed useful life. We know from fault trend data that age of an asset positively correlates with the number of faults that occur and so without intervention, we would be putting our service standards to our customers at risk. Whilst we have retained the strategy to maximise the life of our assets by refurbishing wherever possible, we demonstrate throughout **Investment Decision Packs A22.b to A22.g** that for a variety of reasons we now need to replace rather than refurbish in a number of areas. The primary drivers for this are compliance with health and safety legislation such as the PSSR or MCPD (for example with regards to preheating assets), or in other cases (such as in pressure control) there are increasing concerns around obsolescence of currently installed equipment across the network. Further discussion on increased spend in RIIO-GD3 over and above RIIO-GD2 levels can be found in Section 10.2.

10.1. Preferred option

Please refer to **Investment Decision Packs A22.b to A22.g** which provide the detail behind the preferred option applicable to each asset class. This includes an assessment of the impact on long term risk (undiscounted benefit). The analysis summary of our preferred option is provided within the tables in Section 9.2 at the aggregate level for offtakes and PRS.

10.2. Asset health spend profile

The total forecast capital expenditure for Offtakes and PRS's has been included within the relevant CBAs and can be referenced back to **Investment Decision Packs A22.b to A22.g**.

We have budgeted our planned investment across the RIIO-GD3 period to ensure that we have a stable spend profile each year, to avoid peaks and troughs. This is an important part of ensuring our plan is deliverable. We are budgeting to spend between £23m and £32m per annum across the offtake and PRS assets, as shown in the table below.

	2026/27 (£m)	2027/28 (£m)	2028/29 (£m)	2029/30 (£m)	2030/31 (£m)	Total (£m)
Filters	£0.49	£0.49	£1.11	£1.11	£0.64	£3.83
Pressure Control	£5.14	£3.37	£5.22	£2.88	£6.67	£23.28
Preheating	£14.19	£6.03	£10.63	£10.63	£4.33	£45.82
Odorant & Metering	£2.66	£2.87	£1.43	£2.48	£3.06	£12.49
Civils	£5.68	£5.66	£5.78	£5.66	£5.60	£28.38
E&I	£3.60	£3.40	£3.04	£3.36	£3.57	£16.98
TOTAL	**£31.75**	**£21.82**	**£27.23**	**£26.12**	**£23.87**	**£130.78**

Table 18 PRS and offtake spend profile

The charts below indicate that preheating is the largest area of spend, with £45.82m of investment planned in RIIO-GD3. This is primarily a safety led workstream, with intervention required in order to ensure compliance with the Medium Combustion Plant Directive. This Directive is an important piece of health and safety legislation which ensure that we limit emissions of sulphur dioxide (SO_2), nitrogen oxides (NO_X) and dust which are harmful to both the environment and the health of our population. For more detail, please refer to **A22.d NGN RIIO-GD3**

Investment Decision Pack - Offtakes & PRS Preheating. Pressure control is another area of significant spend, with the primary driver being existing equipment having reached the end of their useful life. The existing assets are nearing obsolescence and require replacing and upgrading. For more information see **A22.c NGN RIIO-GD3 Investment Decision Pack - Offtakes & PRS Pressure Control**. Civils requires similar investment amounts at just under £23m. The driver for this is also the buildings located across the relevant sites having reached or exceeded their useful life. We have undertaken a maintenance survey which has allowed us to provide a well justified investment proposal for RIIO-GD3 which will allow us to maintain site safety, which is vital for both our colleagues and the public. We outline the findings of that survey in **A22.f NGN RIIO-GD3 Investment Decision Pack - Offtakes & PRS Civils**. RIIO-GD3 requires us to invest more in our E&I functionality in order to support other interventions we are making (such as the move to ultra sonic metering and boiler houses) and is outlined in **A22.g NGN RIIO-GD3 Investment Decision Pack - Offtakes & PRS E&I**. The metering interventions are outlined further in **A22.e NGN RIIO-GD3 Investment Decision Pack - Offtakes Odorant & Metering**. Finally, our filter investment proposals, which are primarily driven by the need to comply with the PSSR following filter inspections highlighting signs of degradation, are outlined in **A22.b NGN RIIO-GD3 Investment Decision Pack - Offtakes & PRS Filters**.

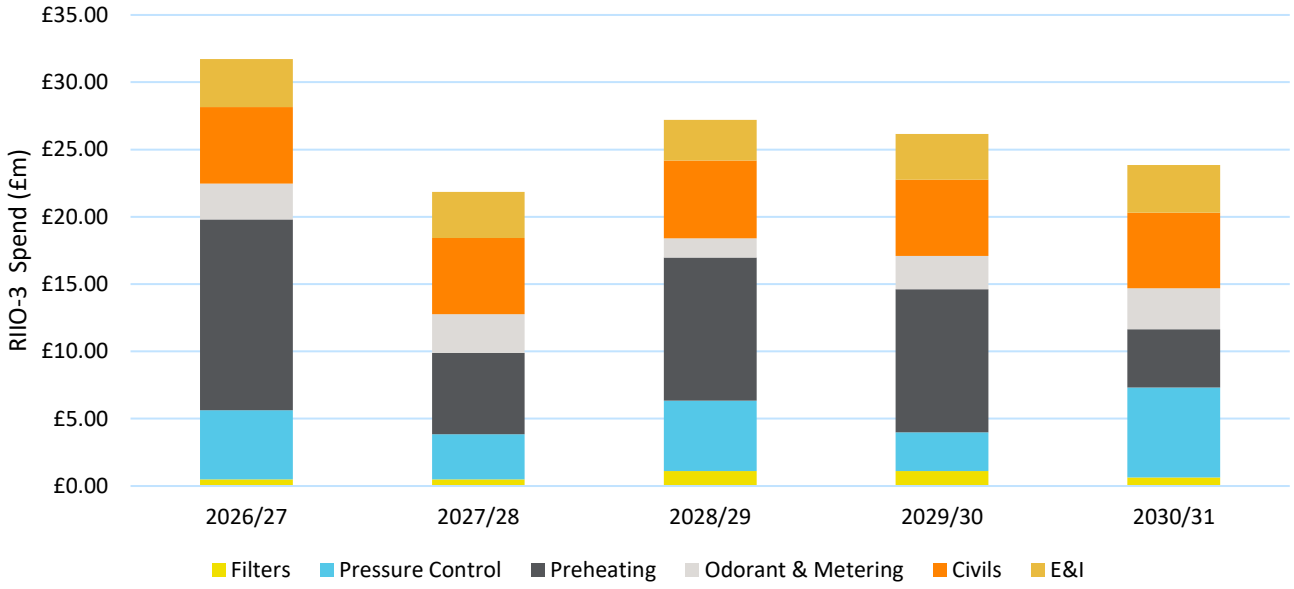

Figure 8 PRS and offtake asset health spend profile

The primary reasons for the cost increase in RIIO-GD3 (£68.8m above RIIO-GD2 spend) include a move from a refurbishment led programme of works to extend asset lives in RIIO-GD2 to a more replacement focussed programme in RIIO-GD3 as asset deterioration continues and assets approach end of life. Increasing obsolescence issues arising with equipment across the asset classes putting replacement spares and ongoing maintenance at risk. Increasing compliance risks, this includes the pressures of ageing and deteriorating assets failing standards and also the requirement to meet low NOx requirements as required by the MCPD directive which has led to a £14.4m investment in Preheating in RIIO-GD3. There are also significant investments in RIIO-GD3 to enable us to maintain capacity, resilience from climate change and storms and for operational reasons (£12.8m). Further detail is provided in individual Investment Decision Packs A22.b to A22.g.

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 8.3) 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 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 19 details our planned intervention profile over RIIO-GD3. We have carefully balanced our workload across the assets ensure that our plan is achievable given the resource available.

	2026/27	2027/28	2028/29	2029/30	2030/31	Total
Filters	3	3	4	4	3	**17**
Pressure Control	24	33	27	26	29	**139**
Preheating	27	17	24	24	15	**107**
Odorant & Metering	8	10	6	8	10	**42**
Civils	55	53	56	53	54	**271**
E&I	21	22	19	22	20	**104**
TOTAL	**138**	**138**	**136**	**137**	**131**	**680**

Table 19 offtake and PRS interventions project plan

We plan to undertake between 122 and 129 interventions per year across all offtakes and PRS's. The chart below highlights how we plan to flex our basket of work over the period; this is an important consideration as not all interventions will require the same level of resourcing.

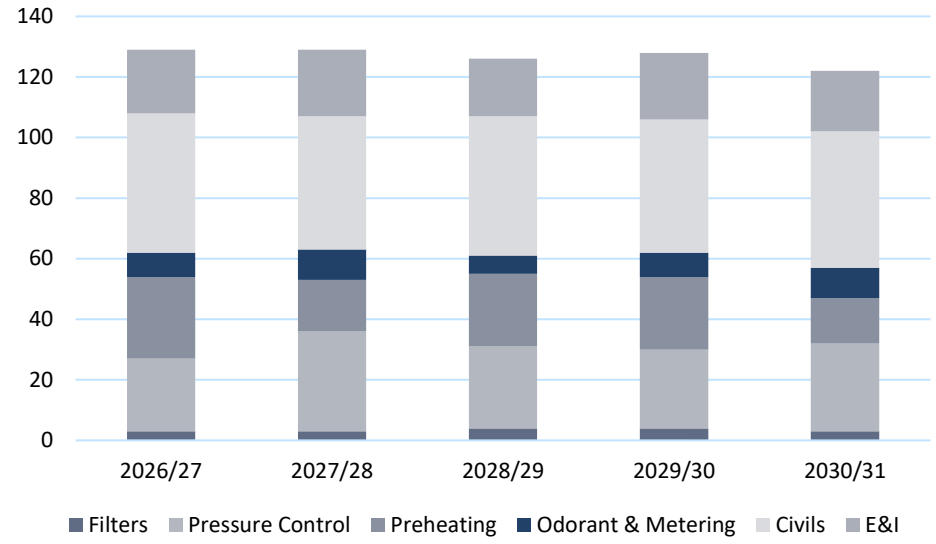

Figure 9 offtake and PRS project plan

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.

Figure 10 Example Offtake and PRS Project Planning Excerpt

A Risk Register for the investment over RIIO-GD3 is included within the CBAs relating to the individual asset classes and the key risks and mitigations are covered in Sections 10.3 and 10.5.

10.5. Key business risks and opportunities

We have noted above that many of our asset interventions are either based on asset condition and or legislative drivers in order to ensure compliance with the relevant Health and Safety legislation. We will therefore need to continue to adhere to these drivers to retain a safe and resilient transportation network. Some interventions, particularly within the pressure control and metering asset classes, are obsolescence led as our current assets are nearing the end of their useful life and in many cases, we are finding it increasingly difficult to source the parts to maintain them, meaning the assets require upgrading.

Risks

For filters, RIIO-GD3 workload has been assumed to be proportional to RIIO-GD2 workload following PSSR inspection, based on the number of PSSR inspections expected in RIIO-GD3. This assumes the rate of replacement following PSSR inspection will be consistent between price control periods. We have also assumed a median risk reduction rather than risk overstating risk reduction by taking the highest value risk reductions selected by the

decision support software as we cannot be sure which site PSSR inspections will lead to required replacement (see A22.b NGN RIIO-GD3 Investment Decision Pack - Offtakes & PRS - Filters). There is a risk that the actual replacement workload for filters and the risk reduction associated with this differs from that which has been predicted and modelled. This would impact on the network risk reduction we would see whether this would be positive or negative would depend on the differences we experience in reality. This will also have an impact on NARM risk reductions against target as we measure our workload interventions under the NARM framework in RRP in RIIO-GD3.

The lead time for bespoke filter units can be around 40 weeks in some cases. However, we carefully manage these lead times to ensure that we plan ahead, so that components and assets required to undertake the works are available at the allotted times.

A key driver for preheating investment is compliance with the MCPD which is driving 12 boiler house replacements. Our preheating equipment must comply with the Medium Combustion Plant Directive which states that any existing combustion plant with between 1 and 5 MW of thermal input must comply with a NOx limit of 250mg/Nm3 by 1st January 2030. Failure to replace our preheating equipment which is falling outside of these limits would mean non-compliance with the MCPD.

More generally, a number of our preheating assets are at or are exceeding 50 years old which would be their assumed useful life. Although age would not be a primary reason to intervene by itself, it can be viewed as a leading indicator to condition and faults and as the age of assets increase, it becomes more economical to replace rather than refurbish. This is the driver for a number of our asset health driven interventions as we are forward looking into the likely need to replace more assets in RIIO-GD3 compared to RIIO-GD2.

In RIIO-GD2 we undertook an innovation project in relation to NIC preheating trial to understand what alternative preheating systems were available and also to help us to overcome inefficiency of old kit such as water bath heaters. Where these trials proved unsuccessful or where we are facing issues with the equipment that is in place, we will need to replace those systems with a more suitable alternative. The risk would therefore be the potential for future issues with reliability, lack of future support or even non-compliance.

Internal delivery capability – Our RIIO-GD3 plan is ambitious, and we have worked hard to ensure deliverability of the proposed work volumes. Our Workforce and Supply Chain Resilience Strategy discusses the likely resourcing challenges we will face during RIIO-GD3 and our plans on how to address them.

Contractor/resource availability – Risk around market resource for over 100 lineguard cabinets, the ability for these to be manufactured at a pace required by the delivery programme with the appropriate ‘lead’ time. As this work is large volume but small value it is likely that if some of the lineguard refurbishments are contracted out that they will be given to a single supplier as a rolling programme. It is vital to ensure that commercial value is extracted, and that the delivery of the products meet the project installation timing requirements. We are employing early engagement and preparatory works in GD2 year 4 and 5 to help mitigate these risks.

Supply chain risk – NGN have had issues with the supply chain recently (in particular for volumetric skids) and also issues with Liability levels associated with the failure of equipment and the level of liability held by the manufacturer in the event of this. This has been recently resolved with one supplier. However, this is occurring more regularly and will need to continue to be closely managed in RIIO-GD3.

For Civils there is a risk of failure to invest in the assets assessed to be in urgent need of refurbishment or replacement, or diverting funds to upgrade assets that are not on the priority list, thus leaving insufficient budget to complete all the critical upgrade scope. This will create a consequential Health and Safety Risk that could lead to an official HSE Intervention.

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 been built into the analysis for unit costs used in the RIIO-GD3 planning process (see Section 8.3 for further details).

Opportunities

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 backup 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.

Whilst intervening on a filter following a PSSR inspection may be considered a reactive strategy in some respects, it ensures that we are investing in the right assets at the right time, which promotes value for our customers. By taking a more proactive approach and investing, for example, based on the life of the asset has been shown above to have a relatively small impact on risk. This is likely due to the redundancy that has been built into the network, with sites having at least 2, but sometimes 3 filters per site to minimise the risk of downtime due to filter asset failure.

Our preheating proposals include 25 PH Adams retrofit installations across preheating assets. This piece of kit allows for improved site metrics and communications. For example, it would enable remote monitoring and the ability to carry out activities such as remote reset. There are therefore potential efficiency savings going forwards where we can remotely fault repair rather than sending our maintenance team physically to the site.

Where there is opportunity to extend out the life of our preheating assets, we have opted for this option in order to ensure maximum cost efficiency. For example, where it is deemed a viable option to refurbish boiler houses or water bath heaters, we have opted for this in our preferred solution rather than replacing the asset entirely. We have planned interventions in such a way that our equipment is standardised, and our installation processes are consistent. This is important in the sense that our operational team become more experienced at dealing with these assets, which should reap benefits from both a cost and time efficiency point of view. Ensuring standardisation is also beneficial in terms of sourcing spares and retaining knowledge on an ongoing basis.

Obsolescence issues identified and plan initiated - While the original equipment manufacturer (OEM) has discontinued support for Audco Lineguard since the 1990s, individual components can still be maintained, albeit with limited availability of overhaul spares. Given the obsolescence and reliability concerns, a phased replacement of the Audco Lineguard system with modern, supported alternatives has been recommended. NGN has identified this problem and worked to put a plan in place for future replacement and general maintenance issues. This would ensure continued compliance with PSSR and reduce the risk of incidents.

For Civils there is an opportunity of output over-delivery by value engineering and packaging low skills/small jobs up into larger programmes to reduce tender costs and benefit from economies of scale. In addition, a better maintained Civils infrastructure on our sites will likely reduce our ‘slips, trips, and falls’ incident frequencies.

For E&I, we are aiming to use our in-house design team as much as possible to reduce reliance on third party contractors and will be standardising equipment further (for example the floodlight replacement) and producing generic approved designs to again reduce time and costs on projects. The design of our floodlighting will also take

advantage of new technology and will be able to support security equipment upgrades now and into the future meaning we are able to deploy security measures quickly in a more cost-effective manner.

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.

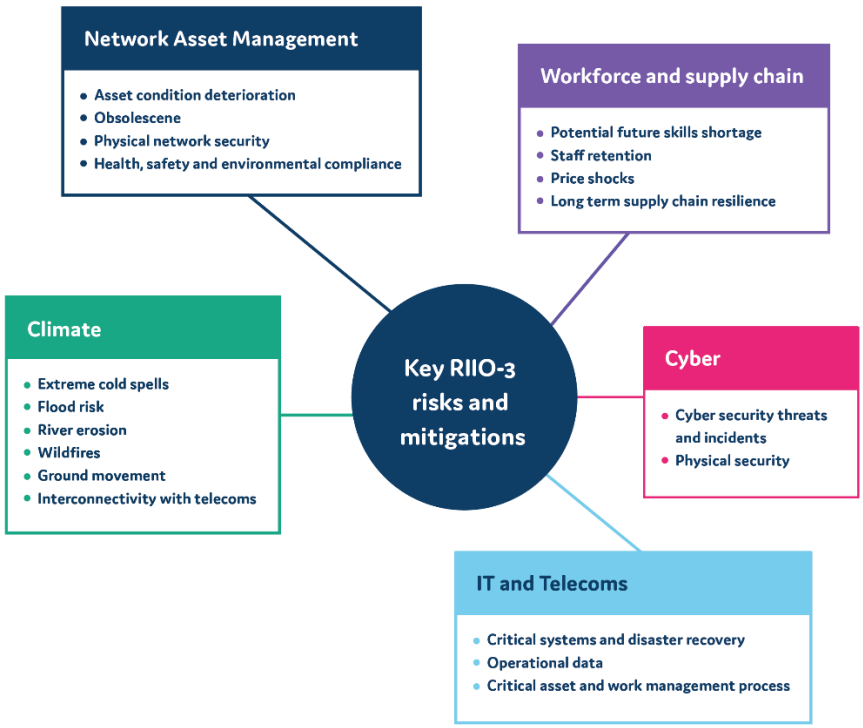

Figure 11 RIIO-GD3 Key Risks and Mitigation

10.6. Outputs Included in RIIO-GD2 plans

We do not propose to carry over any interventions from RIIO-GD2 into the RIIO-GD3 period.