Northern Gas Networks

A22.g - Offtakes and PRS E&I

Engineering Justification Paper

Contents

1. Summary table

Name of Project	*Offtake and PRS E&I – RIIO-GD3*		
Scheme Reference	*A22.g.NGN*		
Primary Investment Driver	*Asset health/ Obsolescence/ Resilience/Compliance*		
Project Initiation Year	*2026/2027*		
Project Close Out Year	*2030/31*		
Total Installed Cost Estimate (£)	*£16.98m*		
Cost Estimate Accuracy (%)	*+/- 5%*		
Project Spend to date (£)	*£0m*		
Current Project Stage Gate	*Specific delivery identification*		
Reporting Table Ref	*5.01 LTS, Storage & Entry*		
Outputs included in RIIO-GD3 Business Plan	*As per BDPT above, impact of programme in NARM BPDT*		
Spend apportionment	**RIIO-GD2**	**RIIO-GD3**	**RIIO-GD4***
	£9.43m	*£16.98m*	*c. £12-14m*

*Expecting all investments listed for RIIO-GD3 to complete in RIIO-GD3. RIIO-GD4 cost estimate based on indicative asset health spend in RIIO-GD3.

2. Executive summary

As we move into RIIO-GD3, we are intervening on proportionally more offtake and pressure reduction station (PRS) assets in order to both maintain risk at an acceptable level and ensure cost efficiency. These investments are also vital from a safety point of view. From an Electrical and Instrumentation (E&I) and telemetry perspective, this will require a comprehensive investment plan in order to ensure that we have the appropriate infrastructure in place to support our investments, ensuring we can utilise the full range of capabilities that are available from those assets. This EJP covers 104 E&I and Telemetry interventions:

- 41 full E&I upgrades
- 11 partial E&I upgrades
- 12 site lighting column replacements
- 25 generator replacements
- 15 telemetry upgrades

We considered the impact of undertaking a more proactive approach to 'Do More' and undertake 20% more interventions during RIIO-GD3, or to scale back E&I interventions to accommodate work in other areas and reduce E&I works by 20% to 'Do Less'. A summary is provided in table 1 below.

	Number of Interventions	Total RIIO-3 Cost (£m)
Preferred Option	104	16.98
Do More Option	124	20.27
Do Less Option	84	13.68

Table 1 Options summary

E&I costs proposed for RIIO-GD3 (£16.98m) are significantly increased on the projected RIIO-GD2 spend (£9.4m) on a comparable 23/24 price basis. Note that a significant amount of the differential in volumes (254) of the interventions carried out in RIIO-GD2 related to GPRS sunsetting.

	RIIO-GD2		RIIO-GD3 EJP Preferred Option	
	Workload units	Capex (£m) 23/24 prices	Workload units	Capex (£m) 23/24 prices
Electrical & Instrumentation	320	9.43	104	16.98

Table 2 RIIO-GD2 vs RIIO-GD3 investment

RIIO-GD2 investment was primarily made for asset health purposes with a balanced split on partial/full upgrades. RIIO-GD3 has seen a shift to a focus on a full upgrade lead programme which is larger than that of the RIIO-GD2 programme due to a combination of deteriorating asset health and obsolescence of our E&I and Telemetry assets (for example, see Case Study 1 and Case Study 2 within Section 5.1). RIIO-GD3 also sees an additional programme of generator replacements to provide us with resilience against electricity network outages from storms which are projected to occur more frequently, and more intensely, in the future. This was a key learning from Storm Arwen. We also consider that there are compliance drivers such our need to provide colleagues with a safe working environment, resulting in our lighting column investments where we have identified issues with existing light sources.

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

3. Introduction

This Engineering Justification paper details our proposals for investment on our Offtake and PRS E&I infrastructure and assets during RIIO-GD3. It acts as a narrative to be used in conjunction with the accompanying Cost Benefit Analysis (CBA). 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 continue throughout RIIO-3. However, there are also compliance and supplier requirements which will require the intervention across our mechanical assets, resulting in associated E&I upgrade requirements in some cases.

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

During RIIO-GD3 we are planning for 65 full E&I upgrades in total. However, where the mechanical intervention cannot be carried out without the E&I replacement, the cost and any associated NARM benefit has been included within the mechanical asset EJP rather than being incorporated in this EJP so that we can more accurately reflect the costs and benefits associated with those mechanical interventions. For example, there are 20 E&I upgrades associated with boiler house installations covered within A22.d NGN RIIO-GD3 Investment Decision Pack - Offtakes & PRS - Preheating and 4 E&I upgrades required alongside meter upgrades which are covered in A22.e NGN RIIO-GD3 Investment Decision Pack - Offtakes & PRS - Odorant & Metering.

Some of the key E&I interventions required in RIIO-GD3 are noted below. Each of these planned interventions will require upgrades to our core E&I infrastructure to ensure we have the necessary capabilities in place to support the technologies.

- A significant number of the planned full and partial E&I upgrades are driven by the need to upgrade due to concerns over the age and condition (asset health) or obsolescence of the existing E&I installations. As technology of our mechanical equipment improves, our E&I functionality needs to adapt accordingly. A similar narrative is true for investment drivers behind Telemetry Upgrades.
- The generator investments provide us with resilience against electricity network outages from storms which are projected to occur more frequently, and more intensely, in the future. This was a key learning from Storm Arwen and is discussed in more detail in **Appendix A8 – Climate Resilience Strategy**. The sites that we have identified as requiring generators are either new sites where no generators currently exist but have been identified as in need of one, are replacements due to existing generators having reached the end of their useful life, or requiring some additional back up power facility to support the installation of new equipment (such as boiler houses).
- We plan to install lighting columns as 12 sites. This is an important safety driven investment which helps to provide our colleagues with a safe working environment, as required under the Health and Safety at Work etc Act 1974. Our existing power and flood lighting has exceeded its expected life and due to integrity and safety concerns we are not able to drop flood light columns as an alternative solution (see Case Study 2 for a real life example).

Fourteen of the sites planned for intervention have also been identified as within the 1 in 1000 year flood zone, meaning there is risk of flooding at these sites. Two of these sites are offtakes and twelve are PRS. Each site has modelled potential flood water depths of 0.4m+ now and into the future. We have determined that we will pro-actively invest in these 'at risk' sites to raise sensitive kit further off the ground (to c.1-1.2m). This has the benefit of both ensuring we can benefit from the efficiency savings of carrying out the works at the same time, but also increasing our resilience against potential flood risk, as per our climate resilience strategy.

Our preferred strategy results a maintenance of risk levels compared to start of RIIO-GD3 levels and a significant reduction in supply interruption level (due to the nature of the impact E&I interventions have on consequence measures in the NARM model). Risk, service levels and payback are similar across all options considered. The Do More option was rejected on ground of increased cost resulting in our cost efficiency objectives not being met (for further details on customer support for this, see Insights 1, 9 and 10 referenced in section 5). The Do Less option was rejected on grounds of not meeting our compliance objective, but also due to health and safety and resilience requirements (see Sections 8.1 to 8.5 and Section 9). Unit costs are provided within Table 7.

We have used a combination of our Value Framework and our asset data and expertise to determine the appropriate interventions during RIIO-GD3. Subject matter experts helped to identify where investments could be used to improve our resilience (from both a climate and physical security point of view). Our strategy is set out in the table below detailing the driver for investment.

Intervention	Workload units	Capex (£m) 23/24 prices	Driver
E&I - full upgrades	41	11.48	Asset Health/ Obsolescence
E&I - partial upgrades	11	0.88	Asset Health/ Obsolescence
Lighting Columns	12	0.80	Asset Health / Health & Safety / Resilience
Generator Replacement	25	3.25	Resilience
Telemetry upgrades	15	0.57	Asset Health/ Obsolescence
Total	**104**	**16.98**	**0**

Table 3 RIIO-GD3 Workload, Cost and drivers

4. Equipment summary

E&I is critical for our network. E&I provides the backbone which ensures our assets can integrate into our network as a whole by combining electrical engineering with instrumentation technology. Our electrical assets are critical to support of safe working on our PRS and offtakes sites ensuring adequate lighting and heating are provided along with providing power for instrumentation, telemetry, emergency and back up power to systems like our preheating and security systems. Our Instrumentation is vital to enable NGN System control to remotely monitor and control the network 24/7. It is also critical for monitoring performance and providing reliable indications for all safety related functions in the network, from monitoring LGT injection rates to slam shut indications and enabling remote pressure and temperature control. Continued investment in E&I is vital to ensure that our assets can function at optimal performance but also to minimise the risk of our assets or infrastructure becoming obsolete.

Our E&I interventions will include everything from design, procurement, construction and commissioning. Our E&I assets are relatively old and our proposals look to remove obsolete and outdated equipment, replacing it with modern sustainable alternatives. We will also look at improved compliance in line with updated regulations (such

as BSEN 7671), for example fitting Surge Protective Devices (SPDs) and Arc Fault Detection Devices (AFDDs) to our electrical distribution. Part of these works will also include things such as renewing cabling, back up power generation, primary distribution, final circuits, PSU's, lighting, heating and earthing on our electrical assets replacing pressure transmitters, switches, temperature transmitters, thermometers, valve and heating control systems and alarms on our instrumentation systems which have all exceeded their expected asset life.

5. Problem / opportunity statement

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

Drivers for required investment have been discussed in full in the Introduction Section. These include deteriorating age and condition of E&I equipment. Without investment to counteract this we would be facing increased risk and supply interruption levels (including increased duration of interruptions). We have also identified the need for resilience investments in electrical generators on our sites in response to findings from Storm Arwen. Health and safety is also driving investment in lighting columns over RIIO-GD3. Without these investments, we would not be able to maintain a safe, resilient and compliant network for our customers and our workforce.

NGN's Value Framework

We have developed the NGN Value Framework which we use to assess the value of intervention options consistently across asset classes for both CBA and business planning purposes.

We use the NARMs 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 NARMs assumptions and uses values common across GDN's such as the base price year, industry approved values such as the cost of carbon or the social cost of an injury. In addition, we use values specific to our business such as the cost of maintenance or the cost of loss of supply. The quantities used are specific to our network, such as the number of domestic properties at risk of a supply interruption, and have been derived from system data, network analysis or assumptions based on demands, flow and redundancy.

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

- **Customer Risk** – Avoided GDN costs through a reduction in costs of supply incidents (loss of supply). These costs have been calculated from historic incidents and the probability and scale of the incidents are based on NARMs models.
- **Health & Safety Risk** – Societal benefits in avoided costs through reductions in the probability of fatality or non-fatality injury. These costs are in accordance with the NARMS 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 NARMS methodology and industry approved values.

- **Compliance Risk** – Avoided GDN costs through a reduction in costs of fines and paying for explosion damage. These costs are in accordance with the NARMS methodology. They have been separated from direct Financial Risk as we consider them highly uncertain and likely significantly underestimated by the values in NARMs, 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 NARMS methodology.

Our E&I equipment is vital to ensuring the correct functioning of our assets and failure of the E&I equipment could have a knock on impact on the functioning of the mechanical asset. As detailed in Section 6, the E&I condition impacts the consequence of failure aspects of the risk model for the mechanical assets with which it is associated, and therefore also impacts risk. The examples of consequence above therefore rightly relate to mechanical assets.

What is the outcome that we want to achieve?

From our stakeholder research (for example, see Insight 1, 9 and 10 from Appendix A3 below) 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. Our investment in generators is an important part of us delivering against Insight 10.

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

Table 4 customer insights

We know that our customers expect value for money and that we will make the right investment decisions for both our existing and future customers. We have proposed four objectives covering risk, cost, service and uncertainty. These will be used to determine how successful each option considered is at delivering against our customers expectations. There are trade offs to meeting these objectives. By way of example, if we want to maintain or reduce risk then we will need to invest and this may impact upon our cost efficiency objective. We therefore have carefully balanced these competing objectives as part of our options analysis which follows later in this EJP.

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 across all mechanical asset classes will increase by 19% for Offtakes and PRS overall within the RIIO-GD3 period. In addition, we want to manage increasing risks to provide a safe working environment for our operatives and avoid loss of supply events. We will aim to maintain risk throughout RIIO-GD3 to plus or minus 10% from the RIIO-GD3 starting position. However, we understand the need to balance this ambition with service and cost constraints.

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

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

We want to ensure efficient costs

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

Our objective in RIIO-GD2 was to maintain cost. However, the objectives we are setting out are becoming increasingly conflicted with one another as we move into RIIO-GD3. For example, increasing rises in risk and supply interruption from deterioration in the asset health of our assets, alongside obsolescence and compliance, are key drivers for additional investment in RIIO-GD3 over and above the levels we saw in RIIO-GD2. We view maintaining risk and service levels and delivering a reliable, safe and compliant network for customers as a higher priority than maintaining cost at RIIO-GD2 given the evidenced need for additional investment, which is shown and discussed in our options appraisal. We are continually committed to providing a balanced programme of work and delivering value for customers. We have therefore updated our efficiency objective in RIIO-GD3 to be to minimise 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 31-37% within the RIIO-GD3 period, to a point where we would be expecting an additional supply interruption approximately every 3 years from this increase. Our RIIO-GD3 investments need to target this service measure and reduce it back down to a more acceptable level.

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

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

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

We want to ensure compliance with all relevant Health and Safety, or technical Regulations. During RIIO-GD3 we are required to undertake a number of interventions for compliance reasons. For E&I, we need to ensure compliance with Regulations such as BSEN 7671 when upgrading our E&I equipment. However, there are also Health and Safety concerns regarding the lighting that is in place at some sites, which is the driver behind that particular investment.

How will we understand if the spend has been successful?

This asset class is covered within the NARMs methodology and we have set a relative risk target on which we will annually report performance against. Note that for the E&I asset class there is an adjustment factor applied based on condition. However, the factor is applied to probability of consequence nodes in the model such as duration of loss of gas, should a release of gas failure occur, or duration of undetected downstream gas escapes following a low odorant failure). It does not impact on the probability of failure of the mechanical assets.

In addition to the NARMs 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.

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

5.1. Narrative real-life example of problem

CASE STUDY 1 – METER REPLACEMENT 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 Flow Weighted Average Calorific Value (FWACV), otherwise known as a Flow Rack was no longer fit for

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

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 that was installed at the time was the original installation and approximately 40 years old – it was therefore not compliant with the latest Regulations. Although the primary reason for the upgrade was due to condition and the existing equipment becoming obsolete, other operational factors, such as the single stream nature of the site and the inability to isolate at any time meant that a new E&I building needed to be installed alongside the existing site to allow for continuity of supply.

CASE STUDY 2 – LIGHTING

During audits and maintenance activities a number of our larger Flood lighting columns have been identified as having issues. These columns have been in situ for a number of years (many over 20 years) and in a number of cases the bases for the columns have been buried and surrounded with gravel, over time the condition of the columns at the base has deteriorated to the point where we are no longer able to routinely lower them for maintenance, meaning there is a risk of further damage and ultimately an inability to maintain adequate lighting levels on site without intervention. Through RIIO-GD3 we will look to replace these types of columns not only replacing them but improving the technology for innovative solutions which improve lighting levels and including ability to mount additional security measures easily while also reducing manual handling and working at height risks to staff working on them and reducing the time and man power required to maintain fittings. Our improved flood lighting also brings about additional benefits by ensuring our sites remain safe and secure from unwanted access.

5.2. Project boundaries

The boundaries of spend provided in this EJP relate only to intervention on E&I at our offtake and PRS sites. It does not include any other offtake or PRS assets such as the cost of pre-heaters, pressure control assets, filters, meters or civils for example. These are covered in their own respective Investment Decision Packs A22.b to A22.f. It includes all necessary project costs such as design, procurement of materials, construction (including labour and materials), commissioning and overheads.

Where an E&I intervention is required as part of a mechanical asset intervention (for example, where upgrading a water bath heater to a boiler house requires additional investment in E&I in order to support the additional

functionality offered by that mechanical asset upgrade) then the E&I cost has been attributed to the relevant asset class EJP and associated CBA (in this example, preheating) in order to accurately reflect the true cost and benefit of undertaking that intervention and has not been included within this E&I EJP or CBA in order to avoid double counting.

The benefits of the lighting columns, generator replacements and telemetry upgrades were not able to be modelled in our decision support software using NARM. These benefits are also therefore not included within the CBA and to ensure that the CBA results are reflective and fair, we have therefore also excluded these costs from the CBA. These have not been included within our impact on risk or service levels or within the CBA analysis as the impact of these interventions are not able to be modelled under the NARM Methodology and so we have no industry agreed basis to do so. However, these elements are key components in protecting the underlying assets and ensuring they continue to operate safely and efficiently; as well ensuring that we remain requirement with relevant legislation. Therefore, we expect the benefits of these elements to be of a similar magnitude to those covered by the NARM methodology and represent value for money for customers over the time period to 2050. We provide a summary of costs according to whether they are included or excluded from the CBA in table 5.

	CBA RIIO-GD3 Costs (£m)	Non-CBA RIIO-GD3 Costs (£m)	TOTAL (£m)
E&I - full upgrades	11.48		
E&I - partial upgrades	0.88		
Lighting Columns		0.80	
Generator Replacement		3.25	
Telemetry upgrades		0.57	
TOTAL	**12.36**	**4.62**	**16.98**

Table 5 RIIO-GD3 CBA vs non CBA costs

6. Probability of failure

The Probability of Failure (PoF) is the probability a mechanical asset will fail at a given point in time. A failure would not necessarily lead to a supply interruption, however it would require a response from our engineering team. For example, a supply outage could lead to a loss of the remote view of the asset (via the PH Adams on our boiler houses for example). Other instruments may stop functions and / or lock up in their last known position which could impact on our supply or demand assumptions.

When justifying our RIIO-GD3 Capital Investment, our Cost Benefit Analysis uses the recently updated NARMS methodology to calculate the failure rate of our Offtake and PRS assets. The NARMs methodology algorithm used to calculate 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 NARMS methodology to understand the types of failure of Offtake and PRS filters 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 NARMS methodology these failures have been categorised into Failure Modes.

Failure Modes have been developed by modelling the outcomes rather than components of which there are many. This avoids the need to accurately identify root cause which can often be difficult to diagnose. The Failure Modes for which offtake and PRS mechanical assets are a contributing factor can 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.

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 Odorant – Failure of containment of odorant such as corrosion of the odorant tank.

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.

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 NARMS 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 of the asset is above or below ground.

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

Fencing / Security Risk – 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.

We model the impact on risk and service level of the mechanical assets associated with the E&I using the NARM methodology (above). There is an adjustment factor applied to the NARM modelling associated with the mechanical assets to which the E&I asset relates to. This adjustment factor is based on condition for the E&I asset but the factor is applied to probability of consequence nodes in the model – see Section 7 (for example duration of loss of gas, should a release of gas failure occur, or duration of undetected downstream gas escapes following a low odorant failure)., It does not impact on the probability of failure of the mechanical assets. Therefore, there is direct impact on the consequence of failure and therefore supply interruption levels, but risk levels are not impacted to the same extent as risk calculation takes into account the probability of failure of the mechanical asset as well as the consequence of failure.

Table 6 details the relationship between E&I condition and the modifying factor applied to model calculations as described above.

Condition Grade	Description	E&I Factor
1	As new	0.5
2	No signs of deterioration to equipment	0.8
3	Minor signs of deterioration to equipment leading to occasional faults	1
4	Significant signs of deterioration to equipment leading to increasing numbers of faults	1.5
5	Severe issues, unable to operate, unable to monitor or transmit system faults	2

Table 6 E&I Model modification factors

The reliability of E&I and Telemetry is also taken account of in the model calculations: Where greater than or equal to 99% uptime is observed, a factor of 1 is applied. For uptime of less than 98% a factor of 2 is applied.

Changes to the NARMs Methodology

LTRB Updates

The NARMs methodology has been updated since RIIO-GD2 to incorporate changes for long term risk modelling and some changes in failure rates and deterioration rates to better reflect reality. This was carried out as a cross GDN project, underwent a consultation process and is awaiting approval by Ofgem. Please refer to full details of updated methodology changes in the updated version of the NARM Risk Methodology document. A brief summary of the 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 end of life (EOL) and provide much more realistic LTR analysis. Pressure control and governors regulator and slam shut failure analysis was also updated, now providing a system view of reliability, 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 is to better reflect the reality of operation of the above-mentioned assets. ICS performed a validation process on the results of the changes to the model and LTR as part of the project, but further validation across GDNs is required.

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

6.1. Probability of failure data assurance

The data used in our probability of failure calculations comes directly from the NARMs methodology. The failure models are based on various industry standard guidelines (see GDN Asset Health Risk Reporting Methodology document) and the failure rates have been statistically derived using actual asset information such as age or material and historic failure data taking into consideration other influencing factors such as weather or temperature.

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

Our 2024 Data improvement plan assesses key areas of data for robustness and completeness:

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

Our **Asset Health and Failure Data** includes design specification, age, condition, duty, capacity, location and environmental health factors. All sites are audited and assessed based on site type and criticality with 10% of all sites visited annually. These audits are used to define any issues with condition or compliance which then forms part of our decision making process for site upgrades. 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 subject matter expert input on current cost trends (See section 8.7). 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 if E&I equipment were 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 NARMS 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.

For E&I specifically, an adjustment factor is applied based on condition. However, the factor is applied to probability of consequence nodes in the NARM model (for example duration of loss of gas, should a release of gas failure occur, or duration of undetected downstream gas escapes following a low odorant failure). It does not impact on the probability of failure of the mechanical assets.

Given E&I supports a large number of our offtake and PRS assets in one way or another, there are a wide range of failure consequences:

Customer Risk

- **Offtake / PRS Site Failures** – a failure of the site resulting in loss of supply to downstream domestic, commercial or industrial consumers. Failure of E&I equipment can for example increase the duration of undetected downstream gas escapes following a Low Odorant or Low Temperature failure.
- **PRE Odour Release / High Odour** – an Increase in Publicly Reported Escapes in the vicinity of the Offtake due to Odour Release or High Odour. For example, failure of the E&I operating on the odorant and metering, pressure control or preheating assets may result in an increase in the duration of a loss of gas consequence following a Release of Gas failure with a knock-on effect for explosion risk.

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. These could result from E&I failures resulting in, for example, a low odorant failure going undetected, potentially increasing the duration of escapes.

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 such as repair.

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

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

Total monetised risk = PoF x PoC x CoC

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

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

Our Commitment to Resilience

Chapter 5 of our Business Plan demonstrates our longstanding commitment to ensuring that we are able to operate and maintain a resilient network. We have formalised our Resilience Framework and developed a number of individual resilience strategies which allow us to maintain our high standards. Our Resilience Framework ensures that we continually review the hazards facing our business and assess whether mitigations that we have in place remain sufficient or need to change. This is relevant to our asset management strategies as we need to take into account exogenous factors when considering both short and long term investment plans. Our Network Asset Management Strategy which is set out in **Appendix A18** brings this all together.

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

The E&I upgrades that we are carrying out in RIIO-GD3 are a key part of our plans to maintain are current high standards of resilience by ensuring our sites remain physically safe and secure from unwanted access. The benefits introduced from our proposals include the ability to install or improve the following:

- Flood lighting
- Intruder detection systems
- Installation of cameras and audio equipment

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

8. Options considered

This section summarises all options considered with regards to interventions on E&I and telemetry across Offtake and PRS sites. There are various ways in which we can intervene on our assets within this asset group. Each intervention has its own merits and drawbacks and the key to good asset management is to understand how the assets behave and use data and information to ensure the right decisions are made to balance risk and value to deliver a safe and reliable service for our customers. The interventions available for this asset group are:

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

Refurbishment – A proactive planned intervention which includes inspection and replacement or servicing of major components and soft parts with the intention of extending the expected life of the asset. Refurbishment of our E&I assets is generally not undertaken for two main reasons:

- It tends to be more cost effective to undertake regular maintenance of the assets up until the time of replacement.
- It is not always possible to change out individual components (such as gaskets or seals for example) as most E&I equipment is required to be rated and certified.

This means that the general approach taken for E&I is to maintain the system up until we need to replace it.

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. As above, we would look to replace our E&I equipment where general maintenance is no longer sufficient, but repair is not possible due to rating and certification requirement.

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. Where we are investing in additional mechanical assets, we may require E&I investment alongside this in order to facilitate proper functionality of the mechanical asset.

Removal – We would generally look to remove E&I equipment where it was no longer required, both from a business perspective and a compliance perspective. We are not considering the removal of any E&I 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

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 and 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, including global values such as the cost of carbon and specific values such as the loss of supply, costs from our updated unit cost analysis (see section 8.66 and the NARMs 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 below is a simplified representation of this process.

Figure 1 how we make asset decisions

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 obtain the best value investments over RIIO-GD3, by applying constraints such as maintain risk and maintain investment cost, with the objective of maximising value from intervention. The resulting intervention plan recommendations were then reviewed by subject matter experts who fed back on specific site and asset intervention applicability, providing additional bottom-up insights around factors such as obsolescence and compliance. This information was used to further develop the modelling and intervention selections by applying additional constraints within the modelling process.

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

The different options we have modelled are set out below in Sections 8.1 to 8.5. These have been appraised against our objectives in Section 5 to determine a preferred option. In summary, our preferred option for E&I and telemetry centres around upgrading existing equipment that is at risk of becoming (or is already) obsolete in order to continue to maintain 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 subject matter expert'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 over investment. It is important to note however that the options discussed have implications on a combination of safety, reliability and compliance which are discussed in the options analysis review. A deferral investment option was also considered.

We provide a summary output schedule under each option in Table 9 and detailed information on how we have reached our unit cost assumptions are provided in section 8.6.

Ofgem CBA Template Assumptions

For all CBAs in our RIIO-GD3 submission, we used an assumed weighted average cost of capital (WACC) of 3.92% based on Ofgem guidance (a real average basis). We have assumed a depreciation Acceleration Factor of 100% across all CBAs and scenarios, i.e. no additional acceleration of depreciation. For Capex CBAs we have assumed a capitalisation rate of 33.7% based on our Totex forecasts in BPDTs and 100% for Repex CBAs. First year of expenditure outflow is set to 2027 in all scenarios for consistent relative NPV calculations. This is in line with Ofgem guidance for RIIO-GD3 and the approach taken in RIIO-GD2. We consider that the plausible ranges of these parameters would not materially affect CBA outcomes and have provided only one version of templates with these consistently applied (as they can be adjusted by Ofgem in any case).

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

8.1. Baseline - (do minimum/ do nothing)

This option is used as the baseline against which other options are measured. It does not include any capital investment but instead considers the cost of ongoing maintenance activities and repairs on failure which is included in 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.

The baseline option shows that there will be an increase in risk of 18% and an increase of supply interruption levels of 11% above start of RIIO-GD3 levels if we were to adopt this Do Nothing/ Do Minimum option (Table 11). The primary driver of risk increase is carbon risk as the cost of carbon is increasing, but we also see significant increases from all of the other categories of risk over RIIO-GD3 (Table 13).

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

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

The preferred option for our E&I and telemetry asset class consists of a comprehensive suite of upgrades, including 104 interventions at a cost of £16.98m:

- 41 full upgrades (replacement)
- 11 partial upgrades (partial refurb)
- 12 site lighting column replacements
- 25 generator replacements
- 15 telemetry upgrades

This programme of works has been carefully selected in order to provide the backbone support for the interventions to be undertaken in other asset classes (for example through the full and partial E&I upgrades). Many of our sites are utilising E&I equipment that is now at the end of its useful life and/or is obsolete and can no longer adequately support the mechanical assets that rely on it. The investment driver for telemetry upgrades is also a mixture of asset health and obsolescence.

Our E&I interventions will include everything from design, procurement, construction and commissioning. Our E&I assets are relatively old and our proposals look to remove obsolete and outdated equipment, replacing with modern sustainable alternatives. We will also look at improved compliance in line with updated regulations (such as BSEN 7671), for example fitting SPDs and AFDDs to our electrical distribution.

Our existing power and flood lighting has exceeded its expected life and, due to integrity and safety concerns, we are no longer able to lower flood light columns for maintenance purposes (it would not be safe to do so given corrosion of the hinges for example). The lighting column replacements are an important investment which is necessary to protect the health and safety of our colleagues, ensuring they are operating in well lit conditions (See Case Study 2). Our colleagues have a right to a safe working environment and it is our legal obligation to provide them with one (for example, under the Health and Safety at Work etc. Act 1974[2]).

As mentioned earlier, 14 of the sites planned for intervention have also been identified as within the 1 in 1,000 year flood zone, meaning there is risk of flooding at these sites. We will be raising equipment off the ground at these sites as we carry out other E&I interventions which provides additional climate resilience benefits by protecting our assets from potential flooding.

We are proposing to install or replace 25 generator investments in RIIO-GD3. Each of these are intended to provide us with resilience against electricity network outages from storms which are projected to occur more frequently, and more intensely, in the future. This was a key learning from Storm Arwen and is discussed in more detail in **Appendix A8 – Climate Resilience Strategy**. The sites that we have identified as requiring generators are either new sites where no generators currently exist but have been identified as in need of one, are replacements due to existing generators having reached the end of their useful life, or requiring some additional back up power facility to support the installation of new equipment (such as boiler houses).

As a package, our E&I planned interventions are integral to maintaining and enhancing our physical site security by offering the facility to install or improve things such as flood lighting, intruder detection systems and CCTV for example.

In respect of our objectives (set out in Section 5):

Risk Objective (maintain +/- 10%). We are meeting this objective. Our preferred option results in a 0.1% risk increase from 2026, which means risk is being maintained to almost the same levels as the start of RIIO-GD3. (see Table 11) It should be noted that all risk categories are mitigated to maintain levels or below (within bounds) except Carbon risk, owing to the rise in carbon cost (see Table 13).

Service level objective (maintain SI levels +/- 10%). We are over delivering on this objective, decreasing supply interruption levels to 44% below start of RIIO-GD3 levels. Whilst we recognise that the reduction is significant, we are confident that our investments are proportionate and balanced and that the service improvements will be positive for our customers. The significant reduction in SI levels follows from the fact that E&I interventions impact directly on consequences of failure of mechanical assets in the model (see Section 7), risk decreases to a lesser extent because the probability of failure of the mechanical asset is not impacted (see Section 6 and Table 11).

Efficiency objective (minimise RIIO-GD3 spend over and above RIIO-GD2 levels) - We recognise that our RIIO-GD3 spend is to be £12.3m more on a comparable price basis, however, we also need to consider the key drivers for the proposed investment. Whilst RIIO-GD2 was primarily asset health driven, RIIO-GD3 investments are due to concerns around obsolescence of existing assets, health and safety or resilience. We demonstrate this graphically below:

[2] https://www.hse.gov.uk/legislation/hswa.htm

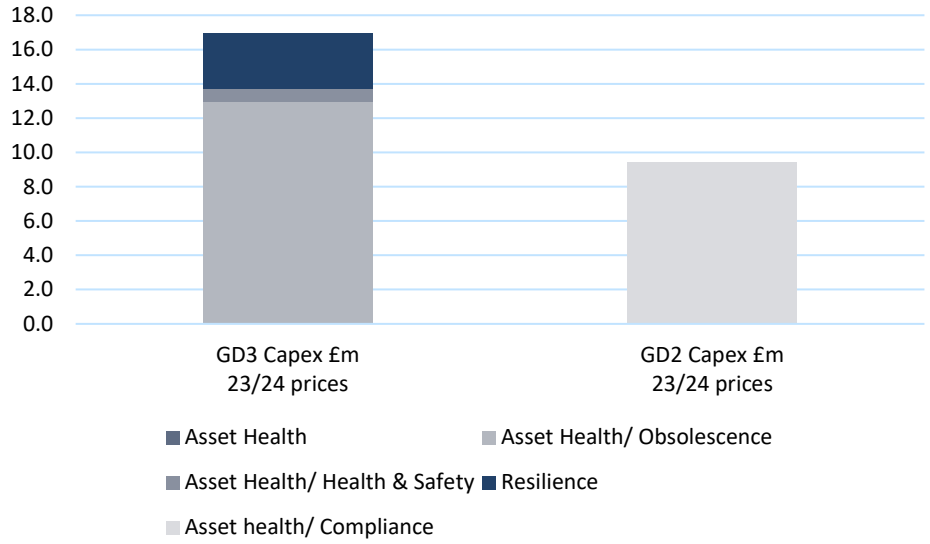

Figure 2 RIIO-GD2 versus RIIO-GD3 spend breakdown

On a like for like basis therefore, we have minimised our purely asset health related E&I spend by carefully selecting our assets for intervention in order to replace outdated equipment to overcome obsolescence issues or where faults are already occurring, to improve working conditions for staff to address health and safety concerns around lighting, and to learn from past experiences (such as the aftermath of Storm Arwen) by investing in additional back up power. We are therefore confident that we have met our efficiency objective.

Uncertainty objective: We want to ensure that our investments pay back within 16 years. Our preferred scenario pays back within 12, which means we are also meeting our certainty objective under this option. (see Table 11).

Compliance objective: We want to ensure we are compliant with legislation relevant to each asset class. The lighting column replacements that we are planning across 12 sites are necessary to ensure that our operational colleagues are working in a well-lit, safe environment, such is our duty to provide as a responsible employer. We are unable to lower lighting columns due to corrosion and rusting of the bases, meaning replacement is the only viable alternative. As we are upgrading our E&I equipment we are also ensuring compliance with the relevant technical standards such as BSEN 7671. We are therefore confident that our compliance objective is met under this option.

8.3. Second option summary – Do more and increase volume of interventions by 20%

We have considered the impact if we were to increase our interventions by 20% across the board. This would allow us to intervene across more sites, upgrading more E&I assets to replace more of our aging assets with the latest technology. This was designed to be a pro-active option under which we increased the volume of interventions in order to ensure more of our sites were ready for the interventions likely to take place in RIIO-GD4, whilst also increasing our resilience by installing an additional 5 generators to provide back up power in case of an emergency. Under this option, we would increase to 124 interventions at a cost of £20.27m:

- 49 full E&I upgrades (replacement)
- 13 partial E&I upgrades (partial refurbishment)
- 14 sites for lighting column upgrades
- 30 generators

- 18 telemetry upgrades

In respect of our objectives set out in Section 5:

Risk objective (maintain risk +/- 10%). Under this option we would spend £3.3m more than our preferred option. This option reduces risk by 0.7% (compared to a small 0.1% increase under out preferred option) meaning it meets our risk objective. It should be noted that all risk categories are mitigated to maintain levels or below (within bounds) except Carbon risk, owing to the rise in carbon cost.

Service level objective (maintain SI levels +/- 10%). We are over delivering on this objective, decreasing supply interruption levels to 44% below start of RIIO-GD3 levels. Whilst we recognise that the reduction is significant, we are confident that our investments are proportionate and balanced and that the service improvements will be positive for our customers. The significant reduction in SI levels follows from the fact that E&I interventions impact directly on consequences of failure of mechanical assets in the model (see Section 7), risk decreases to a lesser extent because the probability of failure of the mechanical asset is not impacted (see Section 6).

Efficiency objective (minimise RIIO-GD3 spend over and above RIIO-GD2 levels). This particular option involves going above and beyond what we know we need to address to overcome concerns around obsolescence, health and safety and resilience. We did not feel that the additional cost of £3.3m (above our preferred scenario) to consumers could be justified in that we would be taking on additional work under this option that could realistically wait until RIIO-GD4. In addition to this, we also have concerns over the deliverability of carrying out the additional work, especially when considering the other projects taking place. On that basis, we do not consider that this option can deliver against our efficiency objective.

Uncertainty Objective. we want to ensure that our investments pay back within 16 years. Our Do More scenario pays back within 14, which means we are also meeting our certainty objective under this option.

Compliance objective. We want to ensure we are compliant with legislation relevant to each asset class. All of the interventions carried out would be to the same standards as under our preferred scenario. We would therefore meet our compliance objective under this option.

8.4. Third option summary – Do less and reduce volume of interventions by 20%

We also considered the impact if we were to scale back our interventions in RIIO-GD3 in order to free up resource for other projects to be undertaken. We considered that our reduction in volume needed to produce a reasonable cost saving, whilst also freeing up enough resource to justify delaying some interventions, without undermining the entire portfolio of works. After careful consideration, we determined that aa 20% reduction in volumes would be a reasonable option as it would both reduce our spend and free up enough resource that we could deploy colleagues and contractors elsewhere as necessary. This would result in 84 interventions being carried out, at a cost of £13.68m. This option would see our interventions reduce:

- 33 full E&I upgrades (replacement)
- 9 partial E&I upgrades (partial refurbishment)
- 10 sites for lighting column upgrades
- 20 generators
- 12 telemetry upgrades

In respect of our objectives set out in Section 5:

Risk objective (maintain risk +/- 10%). Under this option we would undertake 84 interventions, costing £13.68m, which is £3.3m less than our preferred option. This option increases risk by 0.9% (compared to a small 0.1% increase under out preferred option) meaning it still meets our risk objective. It should be noted that all risk categories are mitigated to maintain levels or below (within bounds) except Carbon risk, owing to the rise in carbon cost.

Service level objective (maintain SI levels +/- 10%). We are over delivering on this objective, decreasing supply interruption levels to 43% below start of RIIO-GD3 levels. Whilst we recognise that the reduction is significant, we are confident that our investments are proportionate and balanced and that the service improvements will be positive for our customers. The significant reduction in SI levels follows from the fact that E&I interventions impact directly on consequences of failure of mechanical assets in the model (see Section 7), risk decreases to a lesser extent because the probability of failure of the mechanical asset is not impacted (see Section 6).

Efficiency objective (minimise RIIO-GD3 spend over and above RIIO-GD2 levels). We are spending less in RIIO-GD3 under this option (£3.3m compared to the preferred option), though we are compromising on resilience of the network to storms if we select this option. More specifically:

- The generators that we plan to invest in within our preferred scenario have been identified in order to provide additional resilience against future storm damage, or are required for operational reasons to support new or existing mechanical assets at those sites. Reducing the number of generators as we have considered in this option from 25 to 20 would impact on our resilience. This was an area that our customers were supportive of investment in as highlighted earlier. Note that generators do not fall under NARM and so the risk of this has not been included within the CBA.
- The 15 telemetry upgrades planned in our preferred scenario are at sites that have been selected specifically to support site upgrades or to replace existing telemetry with an unacceptable failure rate. We have considered the possibility of reducing these interventions in this option from 15 to 12, but have deemed this reduction to be an unacceptable risk to failure. Note telemetry does not fall under NARM and so the risk of this has not been included within the CBA.

Uncertainty Objective. We want to ensure that our investments pay back within 16 years. Our Do Less scenario pays back within 10, which means we are also meeting our certainty objective under this option.

Compliance objective. We want to ensure we are compliant with legislation relevant to each asset class. The lighting column replacements identified at the 12 sites for the preferred option are health and safety driven given the age of the existing lighting and the inability to drop flood lighting columns as an alternative solution. In this option we are considering reducing these interventions from 12 to 10 sites, there are health and safety concerns that would then arise from poorly lit (or unlit) premises were the existing lighting to fail during RIIO-GD3. Note that lighting columns do not fall under NARM and so the risk of this has not been included within the CBA. We cannot meet our compliance objective for this reason.

8.5. Fourth option summary – Deferral of investment

The fourth option we considered was deferral of the investments detailed in our preferred option in Section 8.2 to RIIO-GD4.

Given the drivers for this workstream are a mixture of asset health, obsolescence and compliance, we did not consider deferral of investment to be a viable option and for this reason it has not been modelled.

8.6. Options technical summary table

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

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

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

As demonstrated above, the unit costs used in both our Cost Benefit Analysis and capital expenditure forecasts have been derived using historical project cost knowledge, SME input on current cost trends and current cost quotations, to provide confidence in their accuracy, consistency and credibility.

Since the introduction of SAP HANA S4 in Oct 2019 we have captured project costs at a more granular level to support regulatory reporting and to aid future investment decisions. During RIIO-GD1 the Unit Cost Database (UCD) was developed, this used extensive volumes of project cost data to derive cost curve models and provide a cost trend allowing for an accurate cost estimate, the allowances for RIIO-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 RIIO-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.

We outline below a breakdown of the interventions to be carried out under the various options.

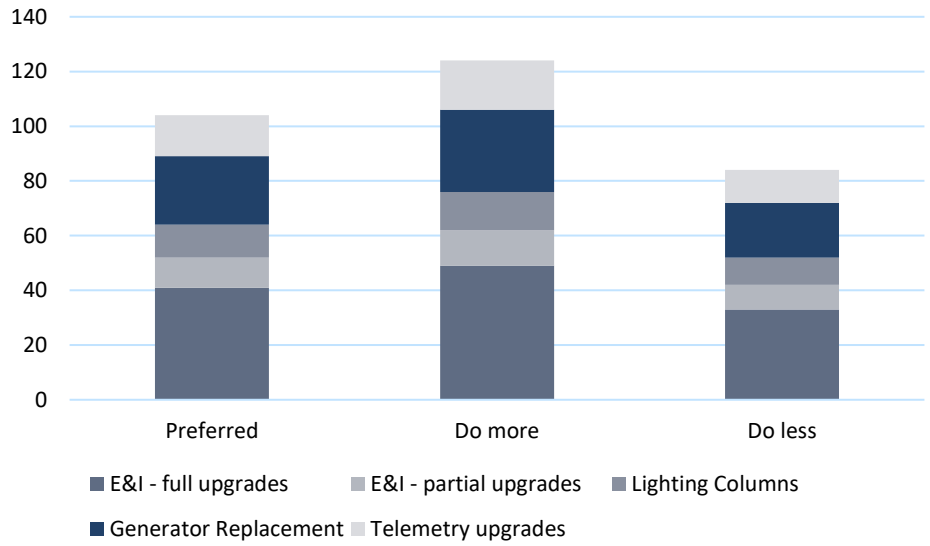

Figure 3 Options breakdown

Table 7 provides a summary of the assumed unit costs applied in modelling and CBA analysis for E&I. For the avoidance of doubt, costs are shown in 2023/24 prices.

Intervention	GD3 Unit Cost 23/24 prices
E&I - full upgrades (replacement)	**£280,000**
E&I - partial upgrades (partial refurbishment)	**£79,937**
Lighting Columns (per site)	**£66,667**
Generator Replacement	**£130,000**
Telemetry Upgrades	**£37,795**

Table 7 Unit Cost Summary Table

Option	First Year of Spend	Final Year of Spend	Volume of Interventions	Equipment or Investment Design Life	Total Installed Cost (RIIO-GD3 Capex) 23/24 prices
Baseline (Do Nothing)	N/A	N/A	0		£0
First Option Summary – Preferred option	2026/27	2030/31	104	10 years	£16,976,240
Second Option Summary – Do more	2026/27	2030/31	124	10 years	£20,272,834
Third Option Summary – Do less	2026/27	2030/31	84	10 years	£13,679,646
Fourth Option Summary – Deferral	2031/32	2036/37	104	10 years	£16,976,240

Table 8 options cost technical summary table

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

Workload Intervention Volumes	2026/27	2027/28	2028/29	2029/30	2030/31	Total
Preferred Option	21	22	19	22	20	104
Do More Option	25	25	24	25	25	124
Do Less Option	18	14	19	15	18	84

Table 9 Workload interventions volume by option

9. Business case outline and discussion

Option	Description	Objectives					Comments
		Maintain Risk (+/- 10%)	Maintain Supply Interruptions (+/- 10%)	Efficiency	Uncertainty	Compliance	
-	Baseline	Not Met (+18%)	Not Met (+11%)	N/A	N/A	Not Met	
1	Preferred	Met (+0.1)	Over delivery (-44%)	Met minimisation using SME expertise	Met (12yrs)	Met	
2	Do More	Met (-0.7%)	Over delivery (-44%)	Not Met - additional £3.3m spend	Met (14yrs)	Met	Additional spend not justified by any further risk or service level performance. These objectives are already being met or exceeded in the Preferred option.
3	Do Less	Met (+0.9%)	Over delivery (-43%)	Cost Reduction (£5.9m) - refer to comments	Met (10yrs)	Not Met	Cost reduction of £3.3m compared to the Preferred option. Risk and service levels are comparable to the Preferred option. However, the risks arising from not carrying out non-NARM investments under this option are not detailed within the risk and CBA analysis. It is for health and safety and resilience reasons that this option has been rejected in favour of the preferred option.
4	Deferral	Not Modelled	Not Modelled	Not Modelled	Not Modelled	Not Met	

Table 10 Options appraisal summary

Table 10 details a summary of the options appraisal against objectives carried out in Sections 8.1 to 8.5.

Our business case (CBA, risk and SI analysis summary tables can be found in Section 9.2).

In Summary:

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

Option 2 the Do More has been rejected as this costs an additional £3.3m but this additional spend delivers little benefit in risk and service levels over and above that of the preferred option, where objectives for these are either being met or exceeded. Therefore, we have assessed the additional spend in this option to be unjustified.

Option 1 (preferred) and Option 3 (Do Less) deliver similar risk and service level reductions (meeting or overdelivering on these objectives in the case of risk and SI respectively).

Both the Do Less and preferred option deliver paybacks inside of the 16 year threshold set out in Ofgem's guidance so meet the criteria of the uncertainty objective. The key difference between these two options is that Option 3 (Do Less) achieves cost reduction by the consideration of the reduction of interventions which have health and safety and resilience investment drivers. We are compromising on health and safety and resilience of the network to storms if we select this option. As discussed, the risks arising from not carrying out these non-NARM investments under this Do Less option are not detailed within the risk and CBA analysis because they are not covered by the NARM model. It is therefore on guidance from subject matter experts and for health and safety and resilience reasons that we have deemed Option 3 to be unacceptable and chosen Option 1 as our preferred option. Option 1 will enable us to deliver a balanced programme of work ensuring we can meet our licence and customer commitments around reliability, safety, compliance and value for money.

As detailed in Section 8.1 to 8.5 we are maintaining risk but over delivering on SI reduction because of the way E&I interventions impact risk within the model. The significant reduction in SI levels follows from the fact that E&I interventions impact directly on consequences of failure of mechanical assets in the model (see Section 7), risk decreases to a lesser extent because the probability of failure of the mechanical asset is not impacted.

Our Preferred option is detailed in full in Section 10.1.

9.1. Key business case drivers description

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

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

All alternative options should be compared to the baseline position, which is shown in Table 12. The baseline position outlines what we expect our annual shrinkage position to be assuming zero interventions on E&II assets across Offtakes and PRS. The present value of each alternative relates to our expected reduction in shrinkage given the funding received under each option. To value each of these efficiency gains we have used the non-traded price of carbon dioxide, as quoted by Ofgem. As noted above, each alternative option also analyses the impact of the change in customer, compliance, financial and health and safety risk. The preferred strategy development is discussed in Section 8.2 with the options (sensitivity analysis) detailed in Sections 8.1 to 8.5.

As detailed in Section 8.2 and the executive summary the primary drivers for investment in E&I are asset health, obsolescence, resilience and compliance.

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

9.2. Business case summary

The analysis results for each of the options detailed in Sections 8.1-8.5 are summarised in Table 11, Table 12 and Table 13. Options appraisal is detailed in Sections 8.1 to 8.5 for each option and option selection is detailed at the start of Section 9.

As shown below, all options result in a positive NPV compared to the baseline by 2040, which is to be expected given payback of the respective options range between 10 and 14 years.

		RIIO-3 Secondary Interventions						Objectives			
Option	Desciption	Full System E&I Upgrade	Partial E&I Upgrade	Lighting Columns	Telemtry Upgrade	Generator Replacement	Total NPV compared to Baseline at 2070 (£m)	Total Risk Change from 2026	RIIO-3 Total Capex Cost (£m)	Supply Interruption change from 2026	Payback (years)
-	Baseline	0	0	0	0	0	-£ 1,477	18.3%	0	11.1%	-
1	Preferred	41	11	12	15	25	£ 163	0.1%	£17.0	-43.8%	12
2	Do More	49	13	14	18	30	£ 170	-0.7%	£20.3	-44.0%	14
3	Do Less	33	9	10	12	20	£ 156	0.9%	£13.7	-43.2%	10

Table 11 Options Summary Risk, SI impact and CBA

			Forecast		Total NPV Compared to Baseline (£m)									
Option	Description	No. of Secondary Interventions in RIIO-3	Capex RIIO-3 (£m)	Totex RIIO-3 (£m)	2035	2040	2045	2050	2060	2070	Payback (years)	Total Risk Change from 2026	Supply Interruption change from 2026	Preferred Option
-	Baseline	0	0	0	-£ 73.8	-£ 114.4	-£ 154.7	-£ 195.1	-£ 819.9	-£ 1,476.6	-	18.3%	11.1%	N
1	Preferred	104	17.0	17.0	-£ 2.0	£ 2.3	£ 6.7	£ 11.0	£ 90.2	£ 163.0	12	0.1%	-43.8%	Y
2	Do More	124	20.3	20.3	-£ 3.6	£ 0.8	£ 5.3	£ 9.8	£ 93.5	£ 170.5	14	-0.7%	-44.0%	N
3	Do Less	84	13.7	13.7	-£ 0.4	£ 3.9	£ 8.1	£ 12.2	£ 87.4	£ 156.2	10	0.9%	-43.2%	N

Table 12 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	24.6%	14.3%	13.4%	14.1%	14.3%	**18.3%**
1	Preferred	21.6%	5.7%	-43.1%	-25.0%	5.7%	**0.1%**
2	Do More	21.6%	5.0%	-43.2%	-32.1%	5.0%	**-0.7%**
3	Do Less	21.6%	6.5%	-43.1%	-19.0%	6.5%	**0.9%**

Table 13 Options Summary detailed risk summary

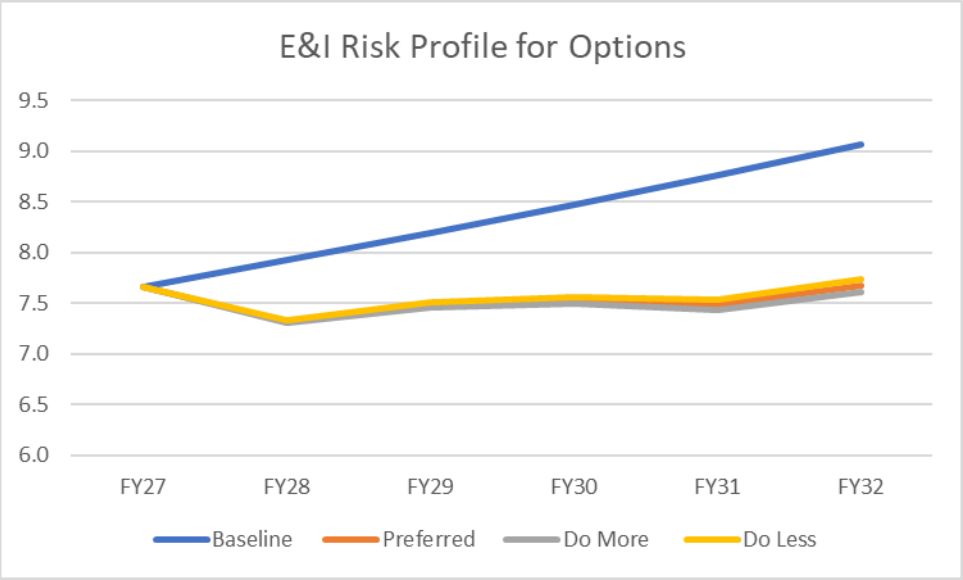

Figure 4 E&I Risk Profile for Options

10. Preferred option scope and project plan

10.1. Preferred option

The preferred option for our E&I and telemetry asset class consists of a comprehensive suite of 104 upgrades at a cost of £16.98m, including:

- 41 full upgrades
- 11 partial upgrades
- 12 site lighting column replacements
- 25 generator replacements
- 15 telemetry upgrades

This option achieves our aim of maintaining risk and service levels to an acceptable level, compared with our position at the start of RIIO-GD3 whilst minimising spend and ensuring compliance with our licence requirements. Service levels are significantly improved upon by virtue of how and E&I intervention acts on a consequence of failure node within the NARM model. Further detail on this and options appraisal and selection can be found in Sections 8.1 to 8.5 and Section 9.

Our 'Do More' option was rejected on the basis that the additional costs to our consumers could not be justified. The 'Do Less' option met all objectives except for our compliance objective as it resulted in the health and safety of our colleagues and also our resilience to future storms potentially being compromised.

Costs for E&I for the RIIO-GD3 EJP are significantly increased (£17.0m) on the projected RIIO-GD2 spend (£9.4m) on a comparable 23/24 price basis. RIIO-GD2 investment was primarily made for asset health purposes with a balanced split on partial/ full upgrades. RIIO-GD3 has seen a shift to a focus on a full upgrade lead programme which is larger than that of the RIIO-GD2 programme due to a combination of deteriorating asset health and obsolescence on our E&I and Telemetry assets. RIIO-GD3 also sees an additional programme of generator replacements to provide us with resilience against electricity network outages from storms which are projected to

occur more frequently, and more intensely, in the future. This was a key learning from Storm Arwen. We also consider that there are compliance drivers such our need to provide colleagues with a safe working environment resulting in our lighting column investments where we have identified issues with existing light sources.

Long Term Risk impact on Preferred Option

Table 14 provides details of the Preferred option Capex spend alongside Single Year Risk benefit and Long Term Risk benefit output as shown in our NARM BPDT. Long Term Risk calculations allow for accrual of benefit over the life of the intervention. These intervention lives are detailed in full in our NARM BPDT submission. Section 5.2 Project boundaries detail the investments within our Preferred option where we have been able to model risk and risk reduction under NARM.

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

	Capex Spend (£m)	Capex Spend (£m)	NARM BPDT	
	All Investments	NARM Modelled Investments	Single Year Risk Benefit (R£m)	RIIO-3 Long Term Benefit Output (R£m)
E&I	16.98	4.62	2.00	27.39

Table 14 Long term risk presentation for E&I

10.2. Asset health Spend Profile

We have spread our expected E&I spend across the period to ensure a broadly flat expenditure profile. We expect to spend between £3.02m and £3.58m per annum. Where we expect higher spend in years 1 and 5, this is due to the plan to carry out one additional E&I full upgrade, as can be seen below.

£m 23/24 prices		2026/27	2027/28	2028/29	2029/30	2030/31	Total
E&I - full upgrades		£2.52	£2.24	£1.96	£2.24	£2.52	**£11.48**
E&I - partial upgrades		£0.16	£0.24	£0.16	£0.16	£0.16	**£0.88**
Lighting Columns		£0.13	£0.20	£0.13	£0.20	£0.13	**£0.80**
Generator Replacement		£0.65	£0.65	£0.65	£0.65	£0.65	**£3.25**
Telemetry upgrades		£0.11	£0.11	£0.11	£0.15	£0.08	**£0.57**
Total		**£3.58**	**£3.44**	**£3.02**	**£3.40**	**£3.54**	**£16.98**

Table 15 Asset spend profile

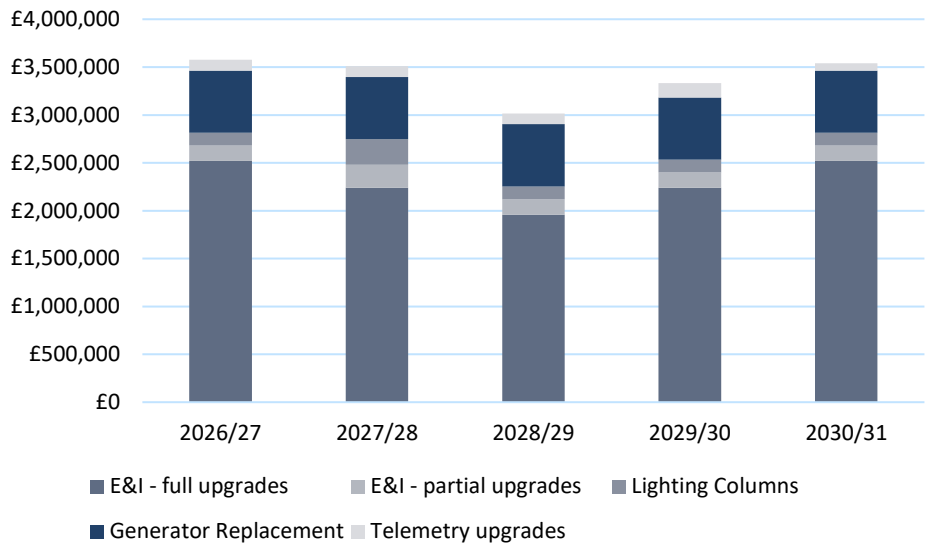

Figure 5 asset spend profile

As shown, the largest area of spend relates to full E&I upgrades (£9.2m total), followed by generators (£3.3m total). The total forecast capital expenditure for Offtakes and PRSs has been included within the accompanying CBA.

Cost comparisons between RIIO-GD3 and RIIO-GD2 for E&I are presented in Section 10.1.

10.3. Investment risk discussion

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

Workload Risk Mitigations

- We have used the NARMs methodology to calculate individual failure rates and subsequent consequence risk associated with mechanical assets on Offtake and PRS sites. (E&I failure impacts on the consequence of failure of the mechanical asset to which is associated, and also implicitly impacts the total risk valuation.)
- All our Offtake and PRS sites are surveyed and inspected regularly with all sites inspected every two years. We also carry out audits of all electrical and instrumentation assets with all sites inspected at least once every 10 years. This information along with maintenance test results are used to determine where we need to intervene on our assets.
- As most of our equipment installed on our Offtake and PRS sites is standardised as far as reasonably practical so that our most expensive and critical components are easily sourced and our spares holdings can be limited.
- 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 subject matter experts 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, using our internal design team to reduce reliance on third parties.

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.

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 have 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.

Unit Cost Risk Mitigations

We have used our updated unit cost analysis (see section 8.7) to determine our unit costs.

We are not planning to undertake new work activities. We have undertaken all interventions previously and have historic costs allocated within our unit cost analysis.

We have well developed processes and assurance activities in place, with scrutiny and challenge provided throughout. This ensures that we can deliver value for money by driving cost efficiency. Details on unit cost processes are provided within Section 8.6.

We have experienced Project Managers who have a proven track record of delivering this type of work in the past and we have a commercial team of quantity surveyors who are focussed on delivering value for money.

10.4. Project plan

We have planned our E&I interventions to ensure we have the required resourcing available over the period. We are planning for between 19 and 23 interventions per annum.

Workload Intervention	2026/27	2027/28	2028/29	2029/30	2030/31	Total
E&I - full upgrades	9	8	7	8	9	**41**
E&I - partial upgrades	2	3	2	2	2	**11**
Lighting Columns	2	4	2	2	2	**12**
Generator Replacement	5	5	5	5	5	**25**
Telemetry upgrades	3	3	3	4	2	**15**
Total	**21**	**22**	**19**	**22**	**20**	**104**

Table 16 workload profile

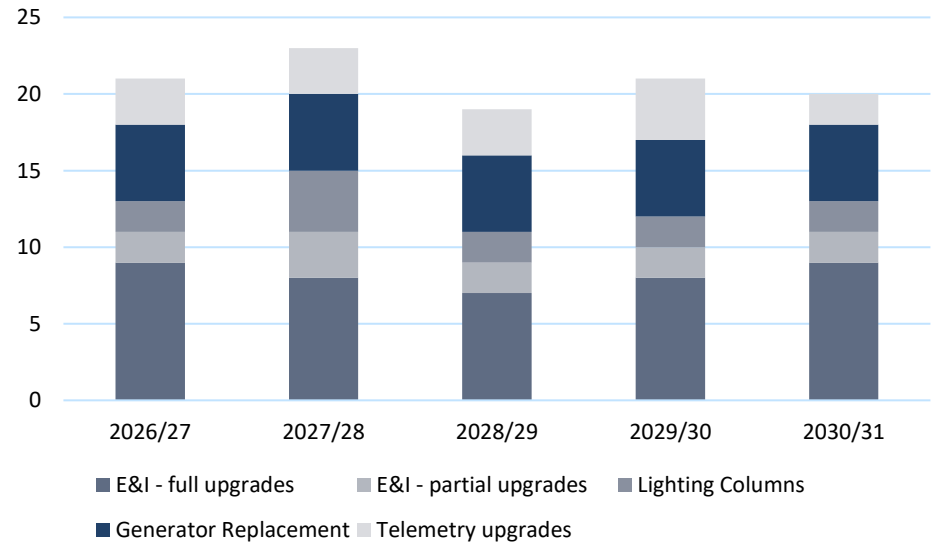

Figure 6 workload profile

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

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

10.5. Key business risks and opportunities

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

Risks

Some of our E&I activities are quite specialist and reliant on a small pool of third party resource for delivery, so we are sometimes constrained by contractors' availability. We aim to try and reduce our reliance on this limited resource by using our internal design team as much as possible and we will continue to work with our contract delivery partners to develop staff and ensure that we are able to support all works both internally and externally. E&I approvers and appraisers who are vital to design sign off are also quite limited, so we are also working to add new people to the list of approvers and appraisers, both internally and externally, to try and remove this as a bottleneck.

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

Opportunities

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 reduces 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. This, combined with the ability to improve or deploy intruder detection systems, cameras and audio equipment following our E&I upgrades, is an important part of enhancing our physical site security which is a key part of maintaining overall network resilience.

We will look to ensure efficiency by considering 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.

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

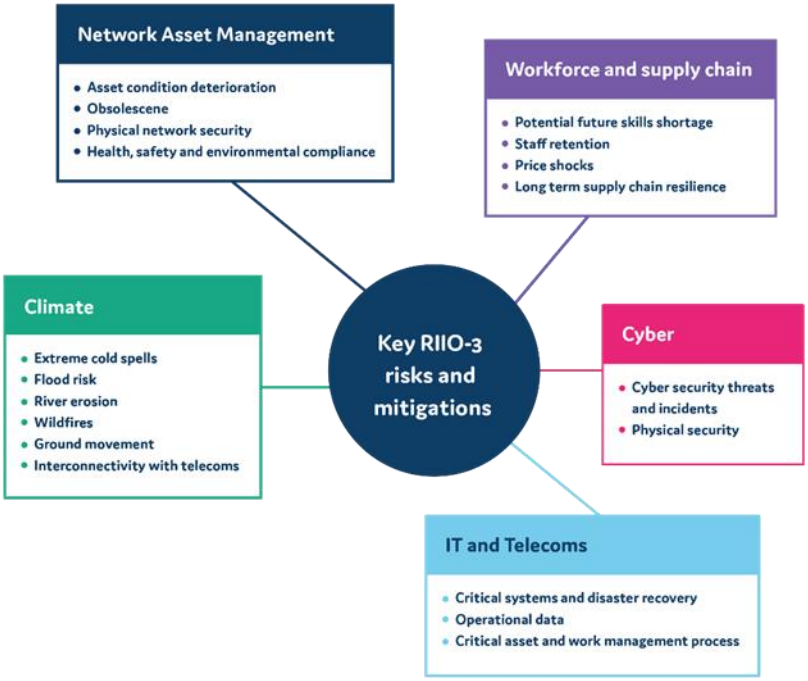

Figure 8 Key RIIO-GD3 risks and mitigations

10.6. Outputs included in RIIO-GD2 plans

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