Northern Gas Networks

A22.b - Offtakes & PRS Filters

Engineering Justification Paper

Contents

1. Summary table

Name of Project	*Offtake and Pressure Reduction Sites – Filters RIIO-GD3*		
Scheme Reference	*A22.b.NGN*		
Primary Investment Driver	*Asset Health / Compliance*		
Project Initiation Year	*2026/27*		
Project Close Out Year	*2030/31*		
Total Installed Cost Estimate (£)	*£3.83m*		
Cost Estimate Accuracy (%)	*+/-5%*		
Project Spend to date (£)	*£0*		
Current Project Stage Gate	*Specific delivery identification*		
Reporting Table Ref	*5.01 LTS, Storage & Entry*		
Outputs included in RIIO-GD3 Business Plan	*As per BDPT above, impact of programme in NARM BPDT*		
Spend Apportionment	**RIIO-GD2**	**RIIO-GD3**	**RIIO-GD4***
	£0.89m	*£3.83m*	*c.£3-4m*

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

2. Executive summary

This Engineering Justification Paper (EJP) sets out the interventions that we plan to undertake on filters at our Offtake and Pressure Reduction Stations (PRSs) during RIIO-GD3.

Interventions in this area are asset health driven, as it is imperative that filters remain is good condition in order to ensure gas continues to flow through our network in a safe and reliable manner.

The key driver for filter interventions is the Pressure Systems Safety Regulations (PSSR)[1] which is mandated by the Health and Safety Executive (HSE). The aim of these Regulations is to prevent serious injury from the hazard of stored energy as a result of the failure of a pressure system, or one of its component parts. Were we to allow our filters to degrade, we would increase our risk of non-compliance with this legislation which is vital to protect the health and safety of our workforce and the wider public.

In devising our preferred strategy, we also considered a 'Do More' option where we would intervene on an additional 3 filters in RIIO-GD3 to account for the fact our filters are older in RIIO-GD3 and therefore may need relatively more interventions than was the case in RIIO-GD2. We also considered we could 'Do Less' and not replace filters straight away upon failure, instead utilising some redundancy that is in place at those sites (accepting this would impact our resilience and increase risk). A summary is shown below.

Options	Number of Interventions	Total RIIO-3 Cost (£m)
Preferred Option	17	3.83
Do More Option	20	4.32
Do Less Option	9	1.97

Table 1 Options summary

Capex relating to filters for the RIIO-GD3 EJP (£3.83m) has increased on projected RIIO-GD2 spend (£0.89m), as shown in Table 2. This increasing expenditure is driven by continuing deterioration of asset health combined with the ongoing need to maintain compliance with PSSR Regulations. Whilst unit volumes are broadly in line with RIIO-GD2, total costs for RIIO-GD3 are higher due to the differences in workload type; for example we completed 10 single filter replacements in RIIO-GD2, whereas our filter replacements in RIIO-GD3 all relate to systems (which contain either 2 or 3 installed filters per site).

	RIIO-GD2		RIIO-GD3 EJP Preferred Option	
Asset	Workload units	Capex (£m) 23/24 prices	Workload units	Capex (£m) 23/24 prices
Filters	18	0.89	17	3.83

Table 2 RIIO-GD2 to RIIO-GD3 comparison

Our preferred option results in a risk increase of 6% and a reduction of supply interruption levels of 3% compared to start of RIIO-GD3 levels. This meets our maintain risk and service level objectives. Efficiency, uncertainty and compliance objectives are all also met under this option with a payback of 6 years. We view our preferred option as balanced programme required to deliver investments to combat deteriorating asset health and continue to meet compliance requirements: maintaining 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.

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

3. Introduction

This Engineering Justification paper details our proposals for investment on our Offtake and PRS filters during RIIO-GD3, and 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-GD3, however, there are also compliance and supplier requirements which will require the replacement of mechanical assets such as water bath heaters, odorant and metering systems. During RIIO-GD3 we will be replacing a number of filters in order to ensure compliance with the PSSR Regulations. Refurbishment of filters is not a viable strategy - it is not always possible to refurbish the asset depending to the severity or location of the defects. For example, the rectification of cracking can incur significant cost and as such would not be taken forward as a cost effective solution.

This engineering paper will outline the justification for our proposed RIIO-GD3 Offtake and PRS filters 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 CBA and how our proposed investment benefits our customers and stakeholders.

We ensure compliance with the PSSR by undertaking routine inspections of our filters every 12 years. This inspection involves taking the asset offline to undertake non-destructive testing of the filter body and welds. If the outcome of the inspection is that the filter condition is showing signs of cracking or other defects then our maintenance team will intervene, typically replacing the filter prior to the next inspection (which may be the following year). There is generally a lead time of up to a year once a filter has been identified as in need of replacement, to allow time for a robust engineering design to be completed and then go through the procurement process to have the filter sourced from the manufacturer. Where a bespoke filter is required, there could be a lead time of around 40 weeks production time to then receive this unique asset. In these instances, we can install a spool piece as a temporary solution to ensure that the asset can continue to function until we can carry out a full repair.

We have used our Value Framework (discussed further in **Section 5**) to determine the appropriate number of interventions required during RIIO-GD3, to carefully manage risk across this asset sub-class. The preferred option on filters has been arrived at by constraining the RIIO-GD3 workload proportional to the workload in RIIO-GD2 generated via PSSR inspections. This approach assumes that we will see the same proportion of workload identified through PSSR inspections on filters through the RIIO-GD3 period as occurred during RIIO-GD2. We deem this a reasonable assumption to maintain levels of risk and supply interruption levels in line with our objectives. The Decision Support Tool (DST) has then been optimised based on maximisation of value. With the exact site locations driven by the outcome of PSSR inspections and outcomes across the RIIO-GD3 period, we have modelled the *expected* workload volumes we expect to see. We have not selected the top risk reduction sites coming out of the DST optimiser due to the uncertainty whether these locations will emerge as those requiring intervention, following a PSSR inspection. We have therefore selected site interventions based on a median risk reduction, founded on the anticipated number of workloads. It has been assumed that replacement work will follow prior to the next inspection survey in the following year. Further detail on our Decision Making process and Options Analysis using the DST can be found in Section 8.

Using this methodology, our preferred option has identified the following investments at a cost of £3.83m over RIIO-GD3: 15 filter systems replacements and 2 skid unit replacements.

We set out the drivers for the investment of our preferred option for RIIO-GD3 in

	RIIO-GD3 EJP Preferred Option		
Intervention	**Workload Units**	**Capex (£m) 23/24 prices**	**Driver**
Filter replace <8'' (system)	9	0.99	Asset health / Compliance
Filter replace >8'' (system)	6	1.59	Asset health / Compliance
Replacement (Skid Unit)	2	1.25	Asset health / Compliance
Total	17	3.83	

	RIIO-GD3 EJP Preferred Option		
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Filter replace <8'' (system)	9	0.99	Asset health / Compliance
Filter replace >8'' (system)	6	1.59	Asset health / Compliance
Replacement (Skid Unit)	2	1.25	Asset health / Compliance
Total	17	3.83	

Table 3 RIIO-GD3 workload, cost and drivers

The profile of the preferred option workload across the price control period is shown in more detail in Section 10.4 and the Spend profile is detailed in Section 10.2. Unit costs used within the cost benefit analysis have been fully detailed within Section 8.7.

4. Equipment summary

Filtration is a key element of every NGN Offtake and PRS site. Except for a single system of cyclonic separator, which is planned to be replaced with standard filters early in GD3, filters are the only asset NGN utilise to clean the gas prior to it flowing through above ground assets that make up an Offtake or PRS. For this reason, the filters are the first asset (in terms of the flow of gas) on our high-pressure sites.

The overarching policy document IGE/TD/13 Edition 3 states "*If there is any possibility that dust or liquid could be present in the upstream gas system, consideration shall be given to incorporating a filtration system which, if adopted, should not be more stringent than is necessary to protect downstream equipment.*"

Filtration will remove any dust, air-borne particles and any oil/sludge that may be present in the pipelines and that is disturbed by the flow of gas. This debris would cause serious damage to the following equipment if it were to reach them:

- Meters
- Pressure control systems.
- Preheating

- All other inline equipment present on our offtake/PRS sites

We have filters installed across all our Offtake and PRS sites in order to remove debris from the gas stream thereby protecting downstream assets from damage. There are 184 filter systems installed across the network. These are all high-pressure systems relating to Offtake and PRS sites. Intermediate and Medium pressure filter systems are not considered as part of this EJP. Figure 1 shows the breakdown of filters according to their respective size; by their diameter (inches). In order to comply with industry standards all sites operate with working and standby streams.

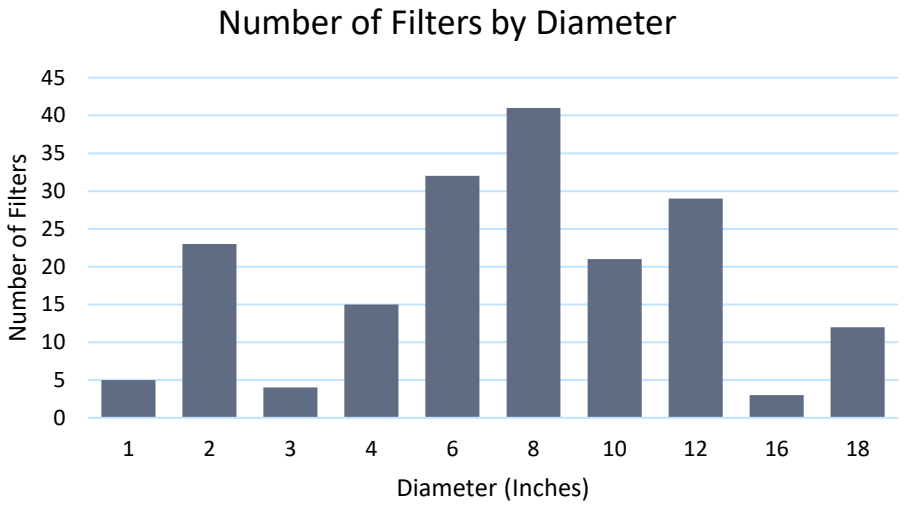

Figure 1 Number of Filters at Offtake and PRS Sites by size.

In addition to the annual maintenance checks carried out, PSSR surveys enable us to identify issues with our filters. We undertake a visual inspection of our filters every 6 years (carried out by NGN) and a major inspection will be carried out by a 3rd party every 12 years (or sooner if defects are found). The major inspection would generally involve the following:

1. The Filter is isolated, vented down and purged.
2. All fillet welds and load retaining parts and any other areas considered suspect on visual examination are grit blasted and cleaned.
3. All the above areas are subjected to Magnetic Particle Inspections.
4. The closure is examined for: -
    a. Excessive wear on bearing surface.
    b. Damage and signs of leakage from gaskets / seals.
    c. Hinge mechanisms operating freely and not binding when door closes and examined visually for cracks, wear or distortion.
    d. Door interlocks examined to ensure correct operation and in good repair.
5. All grit blasted areas repainted with primer and a finish coat.
6. VSO (visual) Inspection carried out by competent person.
7. Filter recommissioned on completion of inspection and no findings noted. If defects are noted and they are deemed serious enough, the filter will remain isolated, vented down and labelled up to avoid them being used.
8. All grit swept up and removed from site.
9. All necessary documentation completed.

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

The movement in Asset Health (Health Index) for our filters over RIIO-GD3 with and without investment is shown In Section 5.

5. Problem / opportunity statement

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

As already discussed in Section 4, filters at our Offtake and PRS sites are a vital piece of equipment to ensure our assets remain in good working order. Compliance with the PSSR is a legal requirement and failure to routinely maintain these assets would increase our risk of non-compliance with an important piece of legislation which is designed to ensure safety of the network. If we do not continue to invest in the filters across offtake and PRSs, we are increasing the risk of debris entering into the system which could potentially cause issues on other assets such meters or preheating systems. Ongoing investment is also required to avoid catastrophic failure of the pressure vessel due to defects. It is important that we monitor and replace filters when required as there are a number of contributing factors which can increase the chance of failure:

- **Age of the filter** – When we undertake a PSSR major inspection, it revalidates the filters for use for the next 12 years if no issues or defects are identified. However, there is still an increased risk of incident as the filter ages and is exposed to pressure, flow and weather conditions.
- **Maintenance issues** – Regular maintenance of filters is required to ensure that the filter elements are not blocked and are able to function as expected. This maintenance can pick up various issues, usually in relation to the opening / closing mechanisms. Again, these issues are expected to increase as the age of the assets increase.

Section 7 of this EJP sets out the consequences of failure; noting that we are at increased risk of failure if we do nothing.

As shown in Table 4, we have assessed the investment spend, relating to our required filter investments in RIIO-GD3, to be related to a mixture of asset health and compliance (with PSSR).

	RIIO-GD3 EJP Preferred Option		
Intervention	**Workload Units**	**Capex (£m) 23/24 prices**	**Driver**
Filter replace <8'' (system)	9	0.99	Asset health / Compliance
Filter replace >8'' (system)	6	1.59	Asset health / Compliance
Replacement (Skid Unit)	2	1.25	Asset health / Compliance
Total	17	3.83	

Table 4 RIIO-GD3 investment spend for filters by driver

NGN's Value Framework

We have developed a Value Framework which we use to assess the value of intervention options consistently across asset classes for CBA and business planning purposes. We use the Network Asset Risk Metric (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. We discuss each of these in more detail below.

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.

Quantifying Filter Risk at Offtake and PRS

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

Table 5 Offtake and PRS risk profile at start of RIIO-GD3

As can be seen in Table 5 , filters account for 28% of total risk across our Offtake and PRS sites at the beginning of RIIO-GD3. The predominating risk on filters is environmental risk, followed by compliance risk.

Due to the complexity of some of our assets, failure could result from a range of different circumstances. Filters are central to the efficient and safe operation of the assets, with failure potentially impacting on multiple asset classes. We note below two examples of failure modes which could be caused were the filters to fail:

Defects in the Filter system leading to release of gas – defects within filters systems which are allowed to propagate to failure would lead to an unconstrained release of gas. This would cause environmental impact and possible health and safety impact.

Blockage of Filter System resulting in Low Outlet pressures – Blockage of a Filter System due to upstream contamination may lead to the a reduction in outlet pressure leading to partial or total loss of downstream supplies, resulting in a loss of supply incident.

Without intervention, over the course of RIIO-GD3, risk increases predominantly due to deterioration of the assets but also due to other effects such as environmental risk and the rising cost of carbon. Table 6 highlights that without intervention we would see total risk to our filter assets increase by 13% over RIIO-GD3.

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

Table 6 Risk change for Offtake and PRS over RIIO-GD3 without intervention

Our Decision Support Software allows us to understand various service measures associated with our systems and how these change over time with and without investment. For our Offtake and PRS assets the key service measure is the Total Expected number of Supply Interruptions (SI). Table 7 shows the impact on this service measure over RIIO-GD3 without intervention. It highlights that we would be facing a 9% increase in supply interruptions for filters.

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

Table 7 Change in service level for Offtake and PRS over RIIO-GD3 without intervention.

Consideration of Filter Asset Health

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

Offtake and PRS assets are assigned a Health Banding 1-10 based entirely on the total failure rate (i.e. the sum of all failure rate components). There are ranges of failure rates which assign an asset to bands 1-10. For preheating, if the asset has less than 0.05 total failure rate (expected number of failures per year), is it in band 1, but greater than 0.45 then it is in band 10.

Consideration of filters health trends is useful in the calculation of asset risk. Table 8 highlights the health of our assets using the NARM value measures. This shows that 28% of our filter assets have a score of 6 or more at the start of RIIO-GD3. Without intervention, this remains at 28% (with some movement, increase, between bands) by the end of RIIO-GD3. If our Preferred Option of investment is followed in RIIO-GD3, this falls to 25% at the end of RIIO-GD3 with investment. This is because we are assuming median risk reduction for filters so movement to HI1 and HI2 bandings with intervention comes from mid-HI bandings.

Filters Health Index	1	2	3	4	5	6	7	8	9	10	Total
Baseline start of RIIO-GD3	7	0	3	8	115	19	11	15	1	5	184
	4%	0%	2%	4%	63%	10%	6%	8%	1%	3%	100%
End of RIIO-GD3 w/o intervention	7	0	3	3	119	19	8	19	1	5	184
	4%	0%	2%	2%	65%	10%	4%	10%	1%	3%	100%
End of RIIO-GD3 with interventions	18	4	3	3	110	18	7	15	1	5	184
	10%	2%	2%	2%	60%	10%	4%	8%	1%	3%	100%

Table 8 Offtake and PRS Filters Asset Health Scoring

What is the outcome that we want to achieve?

From our stakeholder research (for example, see Insight 1, 9 and 10 from Appendix A3 as shown in Table 9) 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 electrical generators is therefore important in delivering against Insight 10.

For this particular group of assets, environmental followed by compliance risk are the main risk drivers, as discussed in Section 5.

We have proposed five objectives covering risk, cost, service, uncertainty and compliance. These will be used to determine how successful each option considered is at delivering against our customer's expectations.

What we heard	Appendix A3
Keeping bills as low as possible continues to be domestic and SME (Small Medium Enterprise) customers' top priority, however stakeholders are supportive of investment to respond to significant challenges of climate resilience and decarbonisation. Balancing the trade-off between investing now to future-proof and minimising expenditure to prioritise essentials poses a challenge. How can we ensure intergenerational fairness amidst these competing priorities?	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 9 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 will use the five objectives covering risk, cost, service, uncertainty and compliance 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 will increase by 19% for Offtakes and PRS overall (13% for filters) within the RIIO-GD3 period. In addition, we want to manage increasing risks to provide a safe working environment for our operatives and avoid loss of supply events. We will aim to maintain risk throughout RIIO-GD3 to plus or minus 10% from the RIIO-GD3 starting position, however we understand the need to balance this ambition with service and cost constraints.

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

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

We want to ensure efficient costs

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

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

Our objective in RIIO-GD2 was to maintain cost. However, the objectives we are setting out are becoming increasingly conflicted 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 our 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 minimise cost in RIIO-GD3 over and above RIIO-GD2 levels.

RIIO-GD2 Our unit costs are discussed in Section 8.7.

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 (Table 7) we understand that supply interruptions are increasing by 10% for Offtake and PRS overall (9% for filters), within the RIIO-GD3 period, to a point where we would be expecting a supply interruption approximately every 3 years at the end of RIIO-GD3 across Offtakes and PRS without intervention. Our RIIO-GD3 investments need to target this service measure and reduce it back down to a more acceptable level.

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

We will protect our customers from future uncertainty

To ensure the investments we make in RIIO-GD3 are right for both our existing and future customers, and to avoid the risk of asset stranding we must ensure that our investments offer a payback before either the asset intervention life or a point in time where future uncertainty could reduce the forecasted benefits, whichever is sooner. The RIIO-GD3 Business Plan Guidance states that a 16 year payback period is appropriate for the GD sector (page 45)[2], 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 several interventions for compliance reasons. For filters, we need to ensure compliance with Regulations such as Pressure Safety Systems Regulations (PSSR) when upgrading our filtration assets.

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.

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. During the price control

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

period we would also expect to see a reduction in the numbers of faults and remedials picked up during routine maintenance and PSSR inspections.

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

5.1. Narrative real-life example of problem

This section provides a real-life example of where we have undertaken a filter intervention.

CASE STUDY 1 – FILTER DEFECTS [redacted]

Filters are classified as pressure vessels and are subject to routine inspections under the Pressure Systems Safety Regulations (PSSR). As part of these inspections defects may be found within the equipment, most of which can generally be repaired for example grinding of cracks or issues with the locking mechanisms however in the event of a severe defect the filter is condemned and must be replaced.

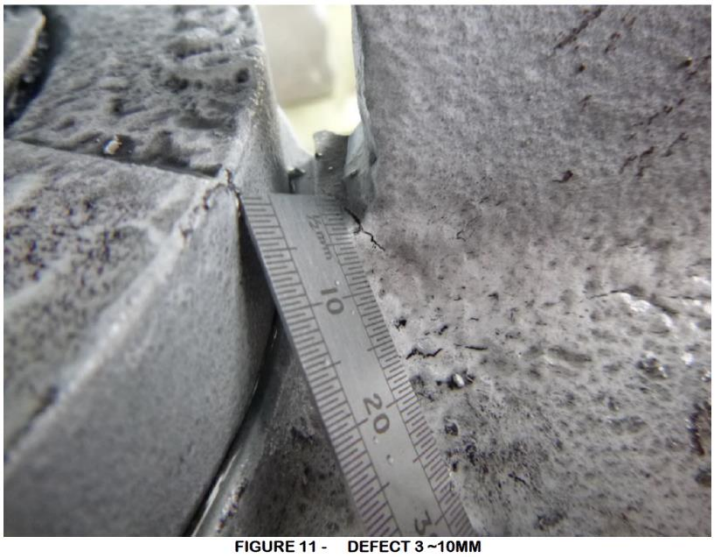

FIGURE 11 - DEFECT 3 ~10MM

During RIIO-GD2 an example of this was at [redacted] where we replaced a filter due to several defects. The filter at [redacted] is on a reduced inspection frequency. Inspection in 2024 revealed a total of 18 defects, 13 of which were previously identified in 2022. A number of these defects had grown in the last two years. The 5 additional defects were all new in the last two years.

The projects are relatively simple and small in scope but remove significant health and safety risks that may result from a sudden release of stored energy if the asset was to fail.

CASE STUDY 2 – CYCLONIC SEPARATOR REPLACEMENT [redacted]

NGN utilise standard basket filters on the majority of high pressure sites, though there are a small number of exceptions to this rule. During GD2 and into GD3 we are looking to remove the remaining cyclonic separators from the network and replace them with standard basket filters. There are numerous reasons for this, but the primary driver is the age and condition of the asset.

Due to the limited number of these there is also a lack of retained knowledge of how to maintain and repair. The standardisation of equipment is a key consideration given it promotes efficiency in terms of training and time spent.

5.2. Project boundaries

The boundaries of spend provided in this EJP relate only to the intervention on filters and skid units at our offtake and PRS sites.

It includes all necessary project costs such as design, procurement of materials, construction (including labour and materials), commissioning and overheads. It does not include any other offtake or PRS assets such as the cost of pre-heaters, E&I, civils or meters for example, or LTS pipelines which are all covered under separate Investment Decision Packs A22.a to A22.g.

All intervention costs listed within our options in Section 8 have been included within our CBA analysis. The benefits for the skid unit replacement interventions are not able to be modelled through NARMs, so the benefits of these interventions are not included within the CBA. This means that the results of the CBA (NPV and payback) are slightly conservative.

6. Probability of failure

The Probability of Failure (PoF) is the probability an 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.

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 the initial failure rate (to which deterioration is applied) for each Failure Mode is:

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

Factors are described further below.

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 filters 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. For example blocked filters due to upstream contamination could lead to low outlet pressures and potential loss of supplies.

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

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

The Failure Rate for an asset is the frequency of failures at a given point in time, typically measured as the number of failures over a year. We use the Initial Failure Rate from the 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 (FS Factor)** – a multiplication factor is applicable depending on the condition of the fencing and security.

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

Table 10 shows the Failure Rates for filters at the start and end of RIIO-GD3 without intervention, and the rate of failure over the period for filters at Offtake and PRS sites. Failures will increase by 2 (4%) over the period. This is driven by similar increases across all failure modes (except capacity). These failures will result in a response from our maintenance team and could result in a loss of supply for our customers. The number of failures is a leading indicator in understanding the condition of these assets.

Table 10 Offtake and PRS Filter failure rates over RIIO-GD3

Filters			
Failure Mode	Total Expected no. of Failures		RIIO-3 Failure Rate
	Start RIIO-GD3	End RIIO-GD3	
Capacity	0.00	0.00	0.00
General Failure	28.87	29.09	0.22
High Outlet Pressure	4.17	4.47	0.30
Low Outlet Pressure	4.06	4.34	0.29
Release of Gas	14.05	15.24	1.19
Total	**51.14**	**53.14**	**2.00**

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 slamshut failure analysis was also updated, now providing a system view of reliability and failure in the updated version of the model. Mains deterioration was also reviewed as part of the project. The effect of these changes which have been implemented in the production of the GD3 business plan analysis is to better reflect the reality of operation of the above-mentioned assets. ICS performed a validation process on the results of the changes to the model and LTR as part of the project, but further validation across GDNs is required.

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

6.1. Probability of failure data assurance

The data used in our probability of failure calculations comes directly from the 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 the majority of data coming ultimately from SAP. There is a documented process where the business leads supplying the data carryout reasonableness checks on the data supplied to the Asset Strategy team, who then carryout validation and consistency checks.

Our 2024 Data improvement plan 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 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 relates in particular to default condition data being applied to some kiosks and no condition data for fences or control systems. Through Smarter Work Management Systems, field work capture capabilities will be developed to improve this. If assumed condition assumptions are lower than reality, this will lead to a conservative calculation of baseline risk and risk reduction on intervention; and vice versa.

Our **Financial Data** includes all the financial data held in the core system that is used within the risk models. We have recently updated all the interventions costs within the system using historical project cost knowledge and SME input on current cost trends (see **Section 8.7)**. 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 were filters at our PRS and offtake sites 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.

Loss of supply to customers

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

Safety impact of failure

We highlighted earlier that filters fall within the scope of the PSSR. The intention of these Regulations is to protect against serious injury from the hazard of stored energy as a result of the failure of a pressure system or one of its component parts.

- **Down stream gas escapes / Explosion** – an explosion at the Filters 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.

Environmental impact of failure

- **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.
- 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 levels 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 on 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 2°C or worst-case 4°C warming scenarios assessed. As such, this recognises our resilience to material climate change risks in the long to very long term (2050+). This is due to our comprehensive asset integrity and management procedures that are in operation to ensure asset condition and performance. In addition, there is inherent resilience afforded by gas infrastructure assets being a sealed, pressurised system principally located underground. Resilience levels to climate change risks will be greater in lesser warming scenarios should they arise, due to lower climatic extremes. The likely current and future climate risk has been factored into our preferred strategies across Offtake and PRSs from the outset by utilising our SME knowledge and risk assessments mentioned above.

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

8. Options considered

This section summarises all options considered with regards to interventions on filters 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. For example, grinding of a filter crack where it is deemed possible as part of the remedial works following a PSSR inspection and follow up Dam

assessment. This intervention is the basis of our baseline option detailed in Section 8.1. Examples also include PSSR inspection on filters, routine maintenance on filters and VS02 inspection.

- **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. Otherwise, if these inspections conclude that refurbishment is not feasible / possible the option to refurbish is discounted.
- **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. There are two reasons we might replace a filter:
  - **Due to condition** - It is difficult to understand the condition of a filter without the results of a PSSR inspection as cracking and other issues are not readily visible. The decision was made not to upgrade based on visual condition alone for this reason. Some refurbishment work can be completed to bring the filters back up to a good condition visually, but this will be completed as more of a general work stream.
  - **Due to PSSR failure** - The three main options here are to; replace a single filter (When the other filters in the system are deemed to be reasonable condition); to replace a filter system (when the other filters in the system are in poor condition and it is economical to complete at the same time); or to replace the filter skid (this is mainly a constructability issue where it isn't possible to remove the filters without affecting the integrity of the site).
  - **Removal of filters** - There will be some instances where a filter can be removed without affecting the integrity of a site / filtration system. This is not common, but it will be identified at the project scope stage. Filters will not be removed if they are fully functional, and this will only be considered if there are issues with the filter.

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 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, 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 8.7) 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 CBA 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 2 How we make 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 SMEs, who fed back on specific site and asset intervention applicability providing additional bottom-up insights around factors such as obsolescence and compliance. This information was used to further develop the modelling and intervention selections by applying additional constraints within the modelling process.

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

The different options we have modelled are set out below in Sections 8.1 to 8.6. These have been appraised against our objectives in Section 5 to determine a preferred option. In summary, we have produced a Maintain Total Risk option which we have deemed appropriate to maintaining a safe, reliable, and compliant network. Subject matter experts were consulted to create reasonable Do More and Do Less options, with a particular focus on practical deliverability of the programme of works. The SME's high level of site expertise and knowledge in combination with analysis in our Decision Support Software was critical to developing a balanced programme of work, whilst minimising the risk of overinvestment. It is important to note however that the options discussed have implications on a combination of safety, reliability and compliance which are discussed in the options analysis review. A deferral investment option was also considered.

We provide a summary output schedule under each option in Table 13 and detailed information on how we have reached our unit cost assumptions are provided in section 8.7.

Ofgem CBA Template Assumptions

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

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

8.1. Baseline – Do minimum/nothing

This option is used as the baseline for which all other options are measured against. It does not include any capital investment but instead considers the cost of ongoing maintenance activities and repairs on failure which is accounted for 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 of risk of 13% and an increase of supply interruption levels of 9% above start of RIIO-GD3 levels if we were to adopt this Do Nothing / Do Minimum option (Table 15). The primary driver of risk increase is carbon risk as the cost of carbon is increasing, but significant increases are also seen from the other categories of risk over RIIO-GD3 (Table 17).

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

8.2. First options summary – Maintain total risk (preferred option)

This option aims to maintain risk to an acceptable level, compared with our position at the start of RIIO-GD3. Under this option, filter replacements have been chosen where they are associated with median risk.

The preferred option on filters has been arrived at by constraining the RIIO-GD3 workload to be proportional to the workload in RIIO-GD2, applied to the number of PSSR inspections surveys, this assumes that we will see the same proportion of required workload required following PSSR inspections on filters as occurred during RIIO-GD2. We deem this a reasonable assumption as analysis has shown the preferred option to maintain levels of risk and supply interruption levels to be in line with our objectives. The Decision Support Tool (DST) has then been optimised based on maximisation of value. Because we do not yet have named sites for filter replacements, this is as discussed dependent on PSSR inspection outcome, and we have modelled this on the workload number we expect to see. We have not selected the top risk reduction sites coming out of the optimiser, as we cannot be sure that it is these sites which will definitely come forward for intervention requirements following a PSSR inspection. We have therefore, selected site interventions based on a median level of risk reduction, based on expected number of workload. It is assumed that replacement work will follow prior to the next inspection survey in the following year. There is a risk that these assumptions will not be borne out in reality and these risks are discussed in Section 10.5.

This option aims to make 17 interventions at a cost of £3.83m over RIIO-GD3:

- 9 <8” Filter System Replacement
- 6 >8” Filter System Replacement
- 2 Skid Unit Replacement

The preferred option shows that there will be an increase of total risk of 6% and a decrease of supply interruption levels of 3% compared to start of RIIO-GD3 levels if we were to adopt this option (Table 15). We see the risk in all categories maintained to start of RIIO-GD3 levels within +/-10% with all categories of risk falling by between 5-9% from the baseline percentages (Table 17).

In respect of our objectives set out in Section 5:

Risk objective: (maintain risk +/- 10%) – we have assessed that we are meeting this objective as we are mitigating all risk categories to within +/-10% of start of RIIO-GD3 levels.

Service level objective: (maintain SI levels +/- 10%) – we have assessed that we are meeting this objective with this option, improving SI levels slightly below start of RIIO-GD3 levels (-3%).

Efficiency objective: (minimise RIIO-GD3 spend over and above RIIO-GD2 levels) – We are spending £2.9m more than projected RIIO-GD2 spend (£0.9m) with these options. We have met this objective by using our SME's high level of site expertise and knowledge in combination with analysis in our Decision Support Software, to develop a balanced programme of work meeting the requirement of increased workload caused by deteriorating asset health, and continuing to meet compliance requirements whilst minimising the cost for customers in our investment solutions.

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

As Skid Units are not able to be modelled in the software, note that there are no NARM benefits attributed to these interventions. Therefore, they do not contribute to risk reduction figures detailed in Table 15, meaning the risk reduction quoted is conservative. The cost of these has been included in the CBA however. The impact of this on the results of the cost benefit analysis (NPV and payback period) are that they are conservative.

8.3. Second options summary – Do more and further reduce risk by intervening on more filters to account for ageing

The average age of our filter assets is increasing in RIIO-GD3 compared to RIIO-GD2. As mentioned earlier, filter age usually correlates with an increased number of faults as age increases. This option aims to take a more pro-active approach by pre-emptively replacing more filters based on the age of the asset, by replacing at the end of its expected life, rather than waiting until the PSSR shows evidence of a need to intervene.

This Do More option aims to make 20 interventions at a cost of £4.32m over RIIO-GD3:

- 11 <8" Filter System Replacement
- 7 >8" Filter System Replacement
- 2 Skid Unit Replacement

We considered that this option would allow us to actively reduce risk across filter assets. We estimated that increasing our filter replacements outlined in our preferred strategy by 20% would equate to replacing our filter assets at the end of their 'useful life' in RIIO-GD3, rather than waiting for defects to occur. This would equate to 18 filter replacements, opposed to 15 in our preferred strategy.

As Skid Units are not able to be modelled in the software, note that there are no NARM benefits attributed to these interventions. The cost has been included in the CBA however. The impact of this is that Risk benefit, NPV and payback shown are conservative.

The Do More option shows that there will be an increase of total risk of 4% and a decrease of supply interruption levels of 4% compared to start of RIIO-GD3 levels if we were to adopt this option (Table 15). We see the risk in almost all categories of risk falling by between 6-10% from the baseline percentages (Table 17).

In respect of our objectives set out in Section 5:

Risk objective: (maintain risk +/- 10%) – with a risk increase of +4%, we have assessed that we are meeting this objective.

Service level objective: (maintain SI levels +/- 10%) – with a decrease in SI levels of 4%, we have assessed that we are meeting this objective.

Efficiency objective: (minimise RIIO-GD3 spend over and above RIIO-GD2 levels) – This option aims to replace filters proactively at end of expected life rather than on inspection. There are marginal additional benefits for the additional spend (£0.5 over the preferred option). This is therefore misaligned with our customers' expectations to keep bills as low as possible and this objective is not met.

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

8.4. Third options summary – Do less and accept an increase in risk across our filter assets

Under this option, we have proposed to accept an increased level of risk across our filter assets by scaling back the number of filter interventions by 50%, and to utilise the redundancy that is built into our sites as standard (for example each site will have 2 or 3 filters in place). This option would mean that rather than replacing filters straight away where faults are identified, we allow the remaining filter(s) to act as the primary filtration device(s) and accept that our resilience is likely to reduce as a result.

We did consider whether we could build refurbishment of some filters into this strategy, however - it is not always possible to refurbish the asset depending to the severity or location of the defects. Where refurbishment is a viable option, the costs associated with, for example, cracking rectification, are significant. For these reasons, we determined that reducing the number of replacements rather than swapping some to refurbishments, was a more realistic solution.

This Do Less option aims to make 9 interventions at a cost of £1.97m over RIIO-GD3:

- 5 <8" Filter System Replacement
- 3 >8" Filter System Replacement
- 1 Skid Unit Replacement

As Skid Units are not able to be modelled in the software, note that there are no NARM benefits attributed to these interventions. The cost has been included in the CBA however. The impact of this is that Risk benefit, NPV and payback shown are conservative.

The Do Less option shows that there will be a increase of total risk of 9% and an increase of supply interruption levels of 6% compared to start of RIIO-GD3 levels if we were to adopt this option (Table 15). We see the risk in almost all categories of risk falling by between 1-5% from the baseline percentages and Carbon risk is not able to be maintained (Table 17).

In respect of our objectives set out in Section 5:

Risk objective: (maintain risk +/- 10%) – although the increase in risk at an overall level (+9%) meets our objective, Carbon risk fails to be maintained under this option.

Service level objective: (maintain SI levels +/- 10%) – although the SI level (+6%) meets our objective, this is the only other option apart from the baseline (Do Nothing) position where SI level is increasing.

Efficiency objective: (minimise RIIO-GD3 spend over and above RIIO-GD2 levels) – This option reduces costs (£1.9m) by reducing the number of filters replacements compared to the preferred option. As the preferred option has been created based on the number of PSSR inspections in RIIO-GD3 and an inferred rate of filters requiring replacement following inspection determined from RIIO-GD2 data analysis, this Do Less option would put at risk our ability to keep pace with deterioration of the asset health of our filtration assets and maintain compliance with PSSR regulations.

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

8.5. Fourth options summary – Do less and refurbish rather than replace

This option seeks to refurbish rather than replace filter assets upon PSSR inspection failure. This option would require that assets are re-certified upon refurbishment. It is not always possible to refurbish the asset depending on the severity or location of the defects. Where refurbishment is a viable option, the costs associated with, for example, cracking rectification, are significant and for this reason this option has not been taken further to modelling and cost benefit analysis given it does not pose a viable option. It would also place our compliance obligations at risk.

8.6. Fifth options summary – Deferral of investment

The fourth option we considered was deferral of the investments detailed in option 8.2 (Maintain Total Risk) to RIIO-GD4.

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

8.7. 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 a Third-party industry database to understand where deviations from average costs might be and the reason for these changes. The Third-party database is provided by Aqua Consultants who maintain the database for other regulated sectors.
    - Compare costs against Yr3 Industry RRP to assess how NGN costs compare to the current delivered costs across GDNs (with Aqua Consultants highlighting that NGN's unit costs were competitive when compared to other GDNs).
    - Compare the future investment programme to current actuals using Ofgem GD2 benchmarking to understand where NGN may be benchmarked on a like for like basis.
    - Undertake robust Internal challenge with independently appointed experts to weigh pro's and cons of the business case and the relevance of costs to meet the required 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 provided a cost trend allowing for an accurate cost estimate, the allowances for GD2 were driven by the UCD. External Project management, untimely delivery by contractors and 3rd party delays could all impact on costs, but uncertainty risk relating to unit cost was built in during the development of the UCD in RIIO-GD1 and has carried through as these costs have been developed into the unit costs for developing the RIIO-GD3 business plan, as described below. The RIIO-GD3 unit rates incorporate analysis of efficient historical projects (note that we removed outliers from our sample in cases where we had identified things such as significant delays, unusually high mobilisation / demobilisation rates to ensure those inefficient costs were excluded). No explicit efficiency over and above this is included within this EJP appendix as our efficiency target is covered within the main business plan - a 0.5% Ongoing Efficiency (OE) target. This means that, NGN will be subject to a further 0.5% cost reduction target throughout RIIO-GD3 in order to meet the OE objectives that will be set by Ofgem (refer to Chapter 6 of NGN's business plan).

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

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

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

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

Table 11 Unit cost summary for filters interventions

For filters at our offtake and PRSs, we did not need to make any adjustments following the challenge session with our SMEs, as the RIIO-GD3 cost was in line with the costs actually incurred during the period.
Figure 3 shows the build-up of our RIIO-GD3 costs:

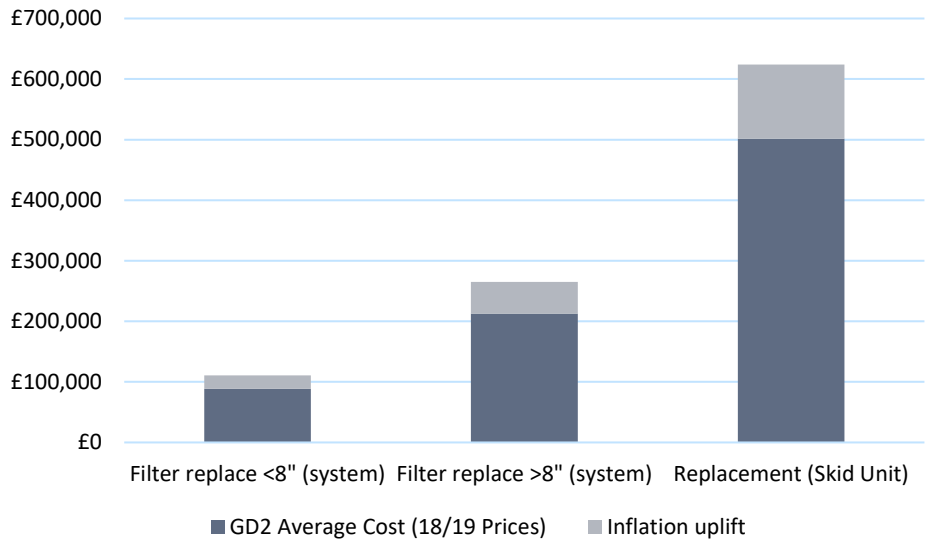

Figure 3 RIIO-GD3 Filter Cost

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	N/A	0
First Option Summary – Maintain Total Risk (Preferred Option)	2026/27	2030/31	17	40 years	£3,832,819
Second Option Summary – Do more and increase replacements by 20% to account for aging	2026/27	2030/31	20	40 years	£4,318,838
Third Option Summary – Do less and reduce replacements by 50%	2026/27	2030/31	9	40 years	£1,971,658
Fourth Option Summary – Do less and refurbish rather than replace	N/A	N/A	N/A	N/A	N/A

Fifth Option Summary – Defer investment	2031/32	2036/37	17	40 years	£3,832,819

Table 12 Options Cost Technical Summary Table

We detail in 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	3	3	4	4	3	17
Do More Option	3	4	4	5	4	20
Do Less Option	2	2	2	1	2	9

Table 13 Options Output Schedule

9. Business case outline and discussion

		Objectives					
Option	Description	Maintain Risk (+/-10%)	Maintain Supply Interruptions (+/-10%)	Efficiency	Uncertainty	Compliance	Comments
-	Baseline	Not Met (+13%)	Met (+9%)	N/A	N/A	Not Met	This option will not maintain compliance with PSSR.
1	Preferred	Met (+6%)	Met (-3%)	Met (-3%) £2.9m above RIIO-GD2 spend	Met (6yr)	Met	All risks mitigated to start of RIIO-GD3 levels. Note this option is based on assumptions of workload and risk reduction to be achieved (see section 8.2 for details and risks in section 10.5)
2	Do More	Met (+4%)	Met (-4%)	Not Met - additional £0.5m spend	Met (6yr)	Met	This option aims to replace filters proactively at end of expected life rather than on inspection. Marginal additional benefits for additional spend so option disregarded.
3	Do Less	Met (+9%)	Met (+6%)	Cost Reduction (£1.9m) - see comments	Met (6yr)	Not Met	Although Risk and Service level impacts meet out objectives (within bounds), they are higher than for the preferred option and carbon risk increases by more than 10%. As the preferred option has been based on workload rates following PSSR inspection, we have assessed that this reduced workload would put our compliance with PSSR regulations at risk.
4	Do Less (refurbish)	Not modelled	Not modelled	Not modelled	Not modelled	Not Met	Places compliance with PSSR at risk. THeIt is not always possible to refurbish the asset depending onto the severity or location of the defects. Where refurbishment is a viable option, Tthe costs associated with, for example, cracking rectification, are significant .
5	Deferreal	Not modelled	Not modelled	Not modelled	Not modelled	Not Met	Places compliance with PSSR at risk.

Table 14 Options appraisal summary

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

In Summary:

The baseline option has been rejected as this increases risk levels over start of RIIO-GD3 levels and does not meet compliance requirements. This is misaligned with our objectives set out in Section 5.

Option 2 the Do More has been rejected as this costs an additional £0.5m (over the preferred option) but this additional spend does not lead to a significant improvement on risk and service levels, or the propensity for us to meet our compliance requirements. It is therefore misaligned with our customers' expectations around keeping bills as low as possible (Section 5). For this reasons it has been discounted.

Option 3 Do Less meets our risk and service level objectives but the reductions from baseline are small, in particular for SI levels. This is the only option other than baseline where we would see an increase in our expected supply interruptions levels, which we would prefer to keep under tighter control to minimise potential impact on customers. This option meets payback requirements but the reduction in cost and associated workload puts at risk our ability to comply with PSSR regulations. For this reason, this option has been discounted.

Option 4 Do Less Refurbish and Option 5 Deferral have not been taken to modelling stages, as they have been discounted due to the risk to compliance and risk from failing assets due to deteriorating asset health.

Option 1 is the preferred option as it delivers the best-balanced programme of work combating deteriorating asset health, enabling us to maintain compliance, whilst minimising spend for customers. Maintaining risk and service level objectives are met, with all categories of risk being maintained and SI levels being slightly improved upon (-3%). Efficiency, uncertainty, and compliance objectives are all met for this option. The investment payback is 6 years, and the programme of work will ensure we can meet our licence and customer commitments around reliability, safety, compliance, and value for money. It should be noted that there is some level of risk around the forecasting of the workload and risk reductions. Further detail on the methodology we have applied can be found in Section 8.2 and risks are discussed further in Section 10.5.

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 scenario and overlaid them against the leakage reductions (associated with reduced numbers of failures) and reductions in risk relating to customer, compliance, financial and health and safety we expect each to attain.

All alternative options should be compared to the baseline counterfactual of the baseline position, which is shown in Table 15 Option summary risk and SI impact and CBA

. The baseline position outlines what we expect our annual shrinkage position to be assuming zero interventions on Filters 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 8.6.

The key investment drivers for Filters are asset health (age and deterioration) and maintaining compliance.

Interventions in this area are asset health and compliance driven, as it is imperative that filters remain is good condition to ensure gas continues to flow through our network in a safe and reliable manner.

Another key driver for filter interventions is the Pressure Systems Safety Regulations (PSSR)[3] which is mandated by the Health and Safety Executive (HSE). The aim of these Regulations is to prevent serious injury from the hazard of stored energy as a result of the failure of a pressure system, or one of its component parts. Were we to

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

allow our filters to degrade (asset health), we would increase our risk of non-compliance with this legislation which is vital to protect the health and safety of our workforce and the wider public.

Conditionalities included within our options analysis are detailed in Section 7

9.2. Business case summary

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

Option	Desciption	RIIO-3 Primary		Total NPV compared to Baseline at 2070 (£m)	Objectives			
		Replace	Refurb		Total Risk Change from 2026	RIIO-3 Total Capex Cost (£m)	Supply Interruption change from 2026	Payback (years)
-	Baseline	0	0	-£ 2,034.2	12.9%	£ -	8.5%	-
1	Preferred	17	0	£ 154.1	5.7%	£ 3.8	-2.9%	6
2	Do More	20	0	£ 187.6	4.2%	£ 4.3	-3.9%	6
3	Do Less	9	0	£ 81.1	9.1%	£ 2.0	5.9%	6

Table 15 Option summary risk and SI impact and CBA

Option	Description	No. of Primary Interventions in RIIO-3	Forecast		Total NPV Compared to Baseline (£m)						Payback (years)	Total Risk Change from 2026	Supply Interruption change from 2026	Preferred Option
			Capex RIIO-3 (£m)	Totex RIIO-3 (£m)	2035	2040	2045	2050	2060	2070				
-	Baseline	0	0	0	-£ 128.4	-£ 195.3	-£ 259.5	-£ 321.2	-£ 1,191.2	-£ 2,034.2	-	12.9%	8.5%	N
1	Preferred	17	3.8	3.8	£ 2.4	£ 6.5	£ 10.7	£ 15.0	£ 85.1	£ 154.1	6	5.7%	-2.9%	Y
2	Do More	20	4.3	4.3	£ 3.0	£ 8.0	£ 13.2	£ 18.4	£ 103.7	£ 187.6	6	4.2%	-3.9%	N
3	Do Less	9	2.0	2.0	£ 1.3	£ 3.5	£ 5.8	£ 8.0	£ 45.0	£ 81.1	6	9.1%	5.9%	N

Table 16 Options summary including NPV

Option	Desciption	Risk Change from 2026					Total Risk
		Total VF Carbon Risk	Total VF Compliance Risk	Total Customer Risk	Total VF Financial Risk	Total VF Health & Safety Risk	
-	Baseline	17.5%	6.4%	7.9%	8.4%	6.4%	**12.9%**
1	Preferred	9.3%	1.3%	-1.4%	0.1%	1.3%	**5.7%**
2	Do More	7.5%	0.4%	-1.7%	-1.7%	0.4%	**4.2%**
3	Do Less	13.1%	3.8%	6.7%	4.0%	3.8%	**9.1%**

Table 17 Options detailed risk summary

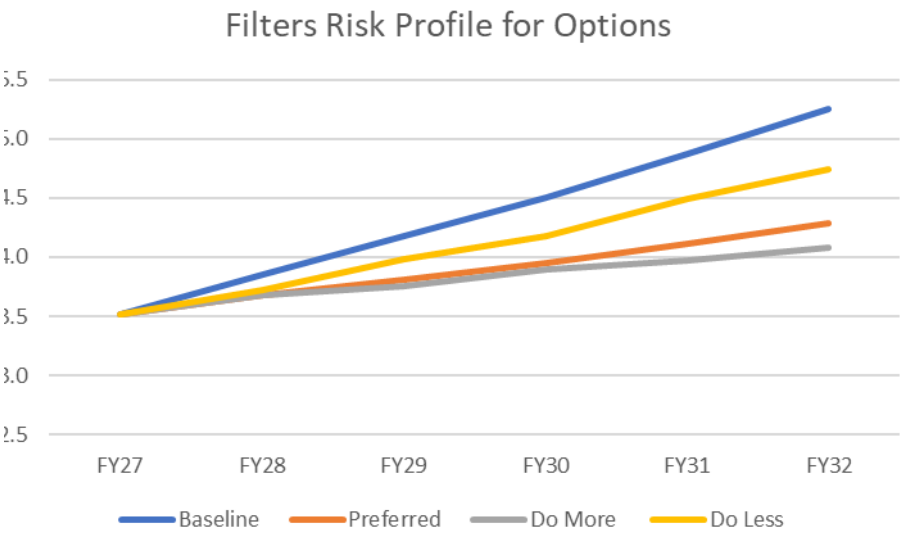

Figure 4 Filters Risk Profile for Options

10. Preferred option scope and project plan

The pie chart below highlights the breakdown of the 17 proposed interventions. As shown, the vast majority of these are filter replacements, but there also a small number of skid unit replacements required.

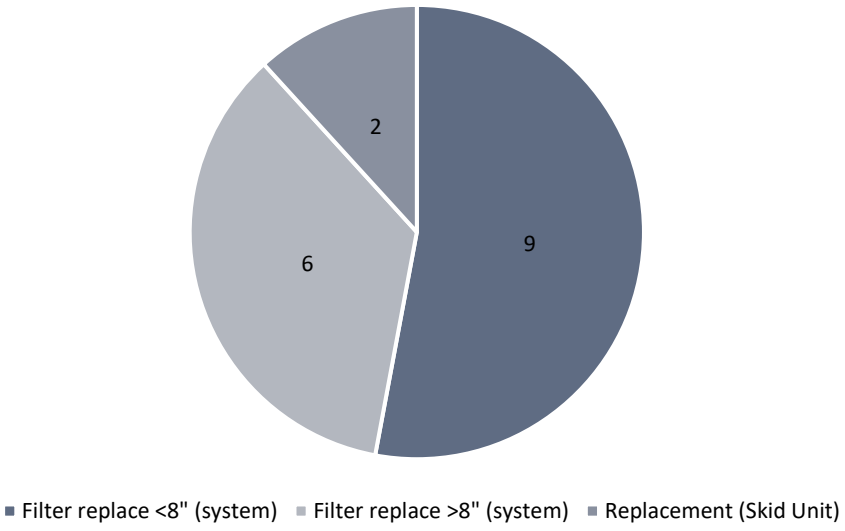

Figure 5 Planned RIIO-GD3 Filter Interventions by Type

We plan to intervene on a total of 17 assets across RIIO-GD3, at a total cost of £3.83m. We detail in Sections 10.2 and 10.4 how we plan to do this across the 5 year period.

10.1. Preferred option

The preferred option for Offtake and PRS filter interventions in RIIO-GD3 is our Second Options Summary – Maintain Total Risk.

This option aims to maintain risk to an acceptable level, compared with our position at the start of RIIO-GD3. Under this option, filters replacements have been chosen where they are associated with median risk. This

approach has been taken in order to avoid a high-risk target associated with systems we are unlikely to complete in GD3. Further discussion on this approach can be found in Section 8.2.

It uses our Decision Support software to optimise the portfolio of Offtake assets to deliver the maximum value, then selecting median risk values, whilst ensuring compliance with our legal requirements under the PSSR to account for interventions required due to the age of our existing assets. This option will have the benefit of maintaining total risk and current level of service for customers in respect of service interruption, across our filters portfolio which is in line with our strategic objectives set out in Section 5.

Our preferred option for the Filters asset class involves a total of 17 interventions over RIIO-GD3 at a cost of £3.83m, broken down as follows:

- 9 <8” Filter System Replacement
- 6 >8” Filter System Replacement
- 2 Skid Unit Replacement

Options appraisal is detailed in Section 8.2 and Section 9.

Costs for Filters for the RIIO-GD3 EJP (£3.83m) has increased on projected RIIO-GD2 spend (£0.9m). Drivers continue to be deteriorating asset health combined with maintaining compliance. A notable difference in RIIO-GD3 is the required replacement of 2 skid units.

Long Term Risk impact on Preferred Option

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

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

	Capex Spend (£m)	Capex Spend (£m)	NARM BPDT	
	All Investments	NARM Modelled Investments	Single Year Risk Benefit (R£m)	RIIO-3 Long Term Benefit Output (R£m)
Filters	3.83	2.58	1.13	40.45

Table 18 Long Term Risk for filters

10.2. Asset health spend profile

The total forecast capital expenditure for Offtakes and PRS filters has been included within the accompanying CBA.

We are proposing to replace 3 filters per year throughout RIIO-GD3. The stacked bar chart below highlights an increase in filter replacement spend in the year ending 2031, however, this is simply due to the planned replacement of 2 >8” systems in this year instead of 1 in the preceding years. The >8” systems are more expensive than the <8” systems, so the increase in cost in the final year of RIIO-GD3 is driven by unit costs rather than an increase in workload.

Years 3 and 4 of RIIO-GD3 are also expected to have higher intervention costs than other years. This is due to a replacement skid unit being factored into each of these years, which are expected to cost £624,000 including overheads.

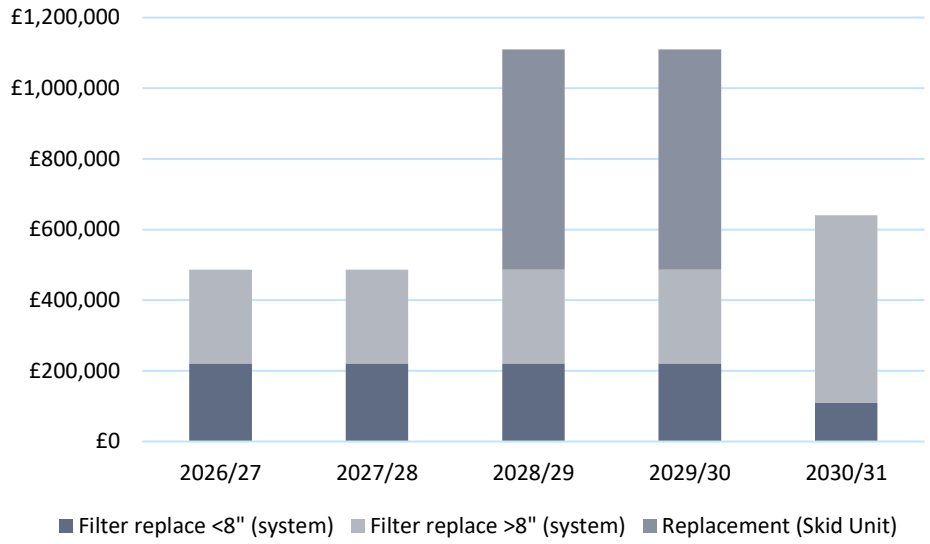

Figure 6 Asset Health Spend Profile - Filters

Replacement of skid units are more expensive than <8" filter replacements and >8" filter replacements (£110,000 and £265,000 respectively) given the additional work required. For example, replacement of the skid unit encompasses replacement of everything between the inlet and outlet pipe, rather than just replacement of the main filter element of the system. A simplistic example of this would be removal of the old skid unit, installation of a new base, installation of the entire new skid unit and reconnection to the existing pipework. This therefore requires additional components as well as taking more time to complete. Whilst the initial outlay is higher cost, the investment will provide greater benefits from a Totex perspective as it is more efficient to replace that entire unit, particularly in terms of economies of scale.

Table 19 highlights our expected spend each year.

£m 23/24 prices	2026/27	2027/28	2028/29	2029/30	2030/31	Total
Filter replace <8" (system)	0.22	0.22	0.22	0.22	0.11	**0.99**
Filter replace >8" (system)	0.27	0.27	0.27	0.27	0.53	**1.59**
Replacement (Skid Unit)	0	0	0.62	0.62	0	**1.25**
Total	**0.49**	**0.49**	**1.11**	**1.11**	**0.64**	**3.83**

Table 19 Asset spend profile

Overall, our planned investments sum to £3.83m during RIIO-GD3. Costs for Filters for the RIIO-GD3 EJP (£3.83m) has increased on projected RIIO-GD2 spend (£0.9m). Drivers continue to be deteriorating asset health combined with maintaining compliance. A notable difference in RIIO-GD3 is the required replacement of 2 skid units.

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

Unit Cost Risk Mitigations

We have used our updated unit cost analysis (see section 8.7) 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 ensure that we can deliver value for money by driving cost efficiency. Details on unit cost processes are provided within Section 8.7.

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

Section 4.1 of **Appendix A7 – Workforce and Supply Chain Resilience Strategy** sets out some of the supply chain challenges that we have faced throughout RIIO-GD2. It acknowledges how NGN is a comparatively smaller GDN, which reduces our buyer power (section 4.1.2) and 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. Despite 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 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, NGN will be subject to a further 0.5% cost reduction target throughout RIIO-GD3 in order to meet the OE objectives that will be set by Ofgem.

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

10.4. Project plan

This section sets out our Project Plan for Offtake and PRS filter interventions throughout RIIO-GD3. As shown in Table 20, our expected work profile is steady throughout the period, with 3 filter replacements to take place each year. In each of years 3 and 4 we have planned to replace 1 skid unit.

Workload Intervention	2026/27	2027/28	2028/29	2029/30	2030/31	Total
Filter replace <8" (system)	2	2	2	2	1	**9**
Filter replace >8" (system)	1	1	1	1	2	**6**
Replacement (Skid Unit)	0	0	1	1	0	**2**
Total	**3**	**3**	**4**	**4**	**3**	**17**

Table 20 Planned Filter Workload Intervention 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 filters 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

As detailed in Section 8.2, RIIO-GD3 workload has been assumed to be proportional to RIIO-GD2 workload following PSSR inspection, based on the number of PSSR inspections expected in RIIO-GD3. This assume the rate of replacement following PSSR inspection will be consistent between price control periods. We have also assumed a median risk reduction rather than risk overstating risk reduction, by taking the highest value risk reductions selected by the decision support software, as we cannot be sure which site PSSR inspections will lead to required replacement (see Section 8.2). There is a risk that the actual replacement workload for filters and the risk reduction associated with this differs from that which has been predicted and modelled. This would impact on the network risk reduction we would see and whether this would be positive or negative would depend on the differences we experience in reality. This will also have an impact on NARM risk reductions against target as we measure our workload interventions under the NARM framework in RRP in RIIO-GD3.

A key risk for filters is associated lead times. If the filter is large or bespoke then we have faced proposed lead times of around 40 weeks previously, with the reality of some being over 1 year. The mitigation for this has been to install a new spool piece in case the other filter(s) on site block up and need to be maintained. Other mitigations include prompt response to PSSR issues or maintenance feedback when there is a failure.

Final deliverability risk can sometimes be associated with the configuration of the site and the inability to isolate and remove filters, (simply due to location / proximity of isolation valves to the filters). This results in a much more prolonged process to design and deliver as the outcome is generally to utilise a temporary PRS. Mitigations are similar to those for long filter lead time (described above), alongside quick identification of issues and prompt design/procurement upon report of issues.

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

Opportunities

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

Efficiencies – the level of efficiency depends on the site we are working on, the type of asset being replaced, and whether the site gas supply can be isolated. Ideally if we were carrying out 3 separate replacements (crossing asset types) on a single site, we would look to do all the work at the same time to minimise mobilisation and demobilisation cost for instance. At this time, we are still in the process of identifying when we are able to carry out specific interventions on specific sites. Therefore, it would not have been appropriate to build efficiency savings into individual unit costs, but we will look to make efficiencies during RIIO-GD3 where programme management can facilitate.

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

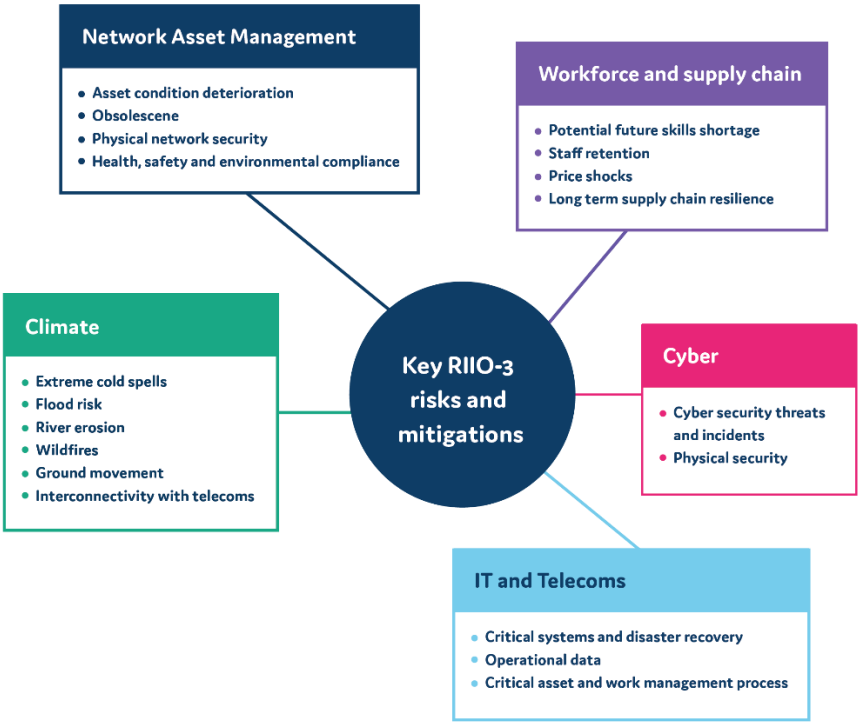

Figure 8 RIIO-GD3 key risks and mitigations

10.6. Outputs Included in RIIO-GD2 plans

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