Multinet Gas Networks

Attachment 9.10 (2)

Renewable Gas Network Adaptation Plan – MGN Victoria

Final Plan 2023/24 – 2027/28

July 2022

Multinet Gas Networks

Renewable Gas Network Adaptation Plan – MGN Victoria

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Head of Asset Development	Robert Davis		June 2022

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Title	Name	Signature	Date
Head of Network Strategy & Planning	Troy Praag		June 2022

Approved by

Title	Name	Signature	Date
EGM – Network Operations	Mark Beech		June 2022

Table of contents

1. Program of works – 2023/24 to 2027/28

1.1. Program overview

MGN proposes to spend $8.6 million (total capital and operating expenditure) to ensure its gas distribution networks are ready for the introduction of renewable gas.

The capital and operating expenditure (capex and opex) program has been developed in accordance with the AGIG Network Adaptation Strategy – Renewable Gas AGIG-SP-0001, with the objective of adapting the MGN natural gas distribution network to transport renewable gas in a manner that is:

- a conservative and phased level of investment, consistent with achieving the lowest sustainable cost of transitioning to hydrogen and hydrogen blends;
- reflective of the locations that hydrogen will enter the network in the next five years;
- reducing the risk to an acceptable level; and
- aligned with the network vision of facilitating 10% renewable gas by 2030, and to facilitate the transport of fully decarbonised gas within our Victorian distribution networks (AGN and MGN) by no later than 2050, with 2040 identified as a stretch target.

Note hydrogen-ready replacements being conducted as part of ongoing asset replacement strategies such as the mains or regulator replacement programs are not included in this Renewable Gas Network Adaptation Plan. This plan relates to proactive replacement of components outside of scheduled end-of-life replacement/upgrade.

Table 1-1 provides a breakdown of capex from 2023/24 to 2027/28 by program for the MGN network.

Table 1-1: MGN renewable gas network adaptation forecast capex $'000 real 2021

Title	2023/24	2024/25	2025/26	2026/27	2027/28	Total
Hazardous area equipment	857	857	1714	1714	-	5,142
Replace incompatible parts	-	-	-	-	-	-
Weld procedures & weld hardness testing	662	502	502	502	502	2,670
Pipeline repair equipment	150	-	-	-	-	150
	1,669	**1,359**	**2,216**	**2,216**	**502**	**7,962**

Table 1-2 provides a breakdown of opex from 2023/24 to 2027/28 by program for the MGN network.

Table 1-2: MGN renewable gas network adaptation forecast opex $'000 real 2021

Title	2023/24	2024/25	2025/26	2026/27	2027/28	Total
TP compatibility assessment	80	-	-	-	-	80
Hazardous areas extents	25	25	-	-	-	50
Document updates	30	30	19	-	-	79
Further assessment or investigation required	71	71	141	141	-	424
	206	**126**	**160**	**141**	-	**633**

1.2. Risk assessment

Risk management is a constant cycle of identification, analysis, treatment, monitoring, reporting and then back to identification (as illustrated in Figure 1-1). When considering risk and determining the appropriate mitigation activities, we seek to balance the risk outcome with our delivery capabilities and cost implications. Consistent with stakeholder expectations, safety and reliability of supply are our highest priorities.

Figure 1-1: Risk management principles

Our risk assessment approach focuses on understanding the potential severity of failure events associated with each asset and the likelihood that the event will occur. Based on these two key inputs, the risk assessment and derived risk rating then guides the actions required to reduce or manage the risk to an acceptable level.

Our risk management framework is based on:

- AS/NZS ISO 31000 Risk Management – Principles and Guidelines,
- AS 2885 Pipelines-Gas and Liquid Petroleum; and
- AS/NZS 4645 Gas Distribution Network Management.

The Gas Act 1997 and Gas Regulations 2012, through their incorporation of AS/NZS 4645 and the Work Health and Safety Act 2012, place a regulatory obligation and requirement on us to reduce risks rated high or extreme to low or negligible as soon as possible (immediately if extreme). If it is not possible to reduce the risk to low or negligible, then we must reduce the risk to as low as reasonably practicable (ALARP).

When assessing risk for the purpose of investment decisions, rather than analysing all conceivable risks associated with an asset, we look at a credible, primary risk event to test the level of investment required. Where an risk event has an overall risk rating of moderate or higher, we will undertake investment to reduce the risk.

Seven consequence categories are considered for each type of risk:

1. **Health & safety** – injuries or illness of a temporary or permanent nature, or death, to employees and contractors or members of the public
2. **Environment** (including heritage) – impact on the surroundings in which the asset operates, including natural, built and Aboriginal cultural heritage, soil, water, vegetation, fauna, air and their interrelationships
3. **Operational capability** – disruption in the daily operations and/or the provision of services/supply, impacting customers
4. **People** – impact on engagement, capability or size of our workforce
5. **Compliance** – the impact from non-compliance with operating licences, legal, regulatory, contractual obligations, debt financing covenants or reporting / disclosure requirements
6. **Reputation & customer** – impact on stakeholders' opinion of AGN, including personnel, customers, investors, security holders, regulators and the community
7. **Financial** – financial impact on AGN, measured on a cumulative basis

Note that risk is not the sole determinant of what investment is required in our network. Many other factors such as growth, cost, efficiency, sustainability and the future of the network are also considered when we develop engineering solutions. The risk management framework provides a valuable tool to manage our assets, and prioritise our works program, however, it is not designed to provide a binary (yes/no) trigger for investment.

The risk event being considered is that hydrogen is injected into the network without infrastructure adaptation, with two main consequences that would eventuate:

8. Loss of supply to >10,000 customer due to the failure of a high-pressure regulating site where the hydrogen has caused the elastomer and/or the metal to fail. This results in high risk levels in Operations, Reputation & Customer, and Finance
9. Potential loss of license due to breaching of the Safety Case, whereby all reasonable risks have not been managed. The results in a high risk under the Compliance category.

The moderate Health & Safety and People risk is due to potential for an explosion in a hazardous area caused by equipment not being upgraded for the purposes of operating in a hydrogen blend environment. This explosion may result in an employee receiving hospital treatment. The moderate risk is not considered ALARP.

Table 1-3: Risk rating – untreated risk

Untreated risk	Health & Safety	Environ-ment	Operations	People	Compliance	Rep & Customer	Finance	Risk
Likelihood	Unlikely	Unlikely	Occasional	Unlikely	Occasional	Occasional	Occasional	High
Consequence	Significant	Minor	Major	Significant	Major	Significant	Major	
Risk Level	Moderate	Low	High	Moderate	High	High	High	

1.3. Customer and stakeholder engagement

AGIG is committed to operating the network in a manner that is consistent with the long-term interests of our customers. To facilitate this, AGIG conducts regular stakeholder engagement to understand and respond to the priorities of our customers and stakeholders. Feedback from stakeholders is built into our asset management considerations and is an important input when developing and reviewing our expenditure programs.

As discussed in the Network Adaptation Strategy, decarbonisation of the energy sector and a preference among stakeholders for renewable gas is the subject of ongoing discussion and research. For example, the Renewable Hydrogen Industry Development Plan 2021 sets a blueprint for how the Victorian Government supports the growth of the emerging renewable gas sector. Extracts from the report state:

"We have a vision for renewable hydrogen to be a part of our economy and the transition to a net zero emission future"

"Victoria has the most extensive gas main network in Australia and uses a significant amount of natural gas. Renewable hydrogen could become a low carbon substitute for natural gas, either through gas blending or complete replacement in the long term"

Further, in recent Victorian customer engagement workshops, key findings were:

- Clean energy and reducing carbon emissions is an imperative for the majority of customers.
- 87% of customers view climate change and reducing carbon emissions as important or very important.
- 89% of customers support AGN's proposed approach to preparing our networks for renewable gas.

Based on this feedback, it is clear our gas distribution networks will have an important role to play in Victoria's energy transition, and that customers still value gas services. We will therefore continue to pursue prudent and efficient ways to get our networks ready for renewable gas, and aim to do so without materially impacting customers' bills.

1.4. Program breakdown

This section provides a breakdown of our proactive, staggered approach to network adaptation, which we believe is the most efficient transition path to renewable gas transportation.

1.4.1. Hazardous area equipment

Compared to natural gas, hydrogen and hydrogen blends require a larger minimum hazardous area size in open spaces. Hydrogen will require a change to the equipment group, due to the reduced ignition energy compared to natural gas. This solution involves replacing Cat. II A & B rated equipment with Cat. IIC, hydrogen ready equipment.

MGN operates 241 network facilities with hazardous areas (such as pressure reduction sites) and 314 metering facilities with hazardous areas (such as interval metering sites). All sites shall be incrementally upgraded for hydrogen compatibility during the next AA period.

1.4.2. Replace incompatible parts

Hydrogen can cause embrittlement of some metals, leading to a reduction in tolerance to crack-like defects and an acceleration of fatigue failure. We have identified that components with parts made from copper alloys, most aluminium alloys, and stable austenitic stainless steels are suitable for 10% and 100% hydrogen service. Other metals with poor performance such as cast irons, high strength carbon steels (e.g. chrome-moly), martensitic stainless steels and nickel alloys also may not be compatible with hydrogen.

MGN has reviewed all the existing components within the network and following due diligence investigations with manufacturers that found that all components are compatible with blends of 10% hydrogen and therefore no replacements are required.

1.4.3. Weld procedures and weld hardness testing

A compatibility review found that most of AGIG's pipelines (>1,050kPa) with design factors below .04 and Network steel piping (<1,050kPa) can safely be used to transport hydrogen blends or pure hydrogen. However, existing weld procedures will not be appropriate and must be re-qualified.

We must develop weld procedures for 14 of 17 steel pipelines identified in Table 1-4 below, to ensure the safe operation of our steel pipelines. We must also undertake hardness testing for a random sample of welds in each pipeline, to show compliance with the hardness limits of ASME B31.12.

Three pipelines have been excluded, as these pipelines have been assessed as less likely to be required for hydrogen service during the upcoming AA period.

The weld hardness testing project is relatively balanced across the AA period. There is a peak in activity in 2025 to provide early access to data and to help balance the work profile with the 2024 activity peak in weld procedures, thereby making efficient use of the resources available.

Table 1-4: Steel pipelines requiring new weld procedures and weld hardness testing

Pipeline/Section name	License number	Identified for AA period
Dandenong - West Melbourne (Ring Main Dandenong to Templestowe)	PL40	Yes
Murrumbeena - Highett	PL56	Yes
Ringwood - Vermont	PL28	Yes
Dandenong - Edithvale	PL33	Yes
Dandenong (Aust F'glass)	PL47	Yes
Dandenong (Dandenong - Hallam Valley Road)	PL47	Yes
Croydon - Mooroolbark	PL77	Yes
Ringwood – Lilydale (Stages 1-5) (Ringwood to Croydon)	PL51	Yes
Mooroolbark - Lilydale	PL100	Yes

Pipeline/Section name	License number	Identified for AA period
Yarra Glen to Lilydale City Gate (LCG)	PL276	-
Lilydale Pipeline – LCG to Lilydale	PL276	Yes
Rowville - Ferntree Gully	PL142	Yes
South Melbourne - Brooklyn MG Offtakes (APA T33)	PL205	Yes
Dandenong - West Melbourne MG Offtakes (APA T16)	PL209	Yes
Packenham-Wollert MG Offtake (APA T61)	PL210	Yes
South Gippsland Pipeline	PL261	-
Lang Lang (Offtake)	PL265	-

1.4.4. Pipeline repair equipment

Further work is required to assess compatibility of transmission pipeline repairs undertaken with Plidco & Smith Clamps and purchase compatible equipment. This project will be delivered during the first two years of the AA period, as the information will assist in developing forward looking upgrade or replacement asset management plans.

1.4.5. Transmission pressure pipeline compatibility assessment

Most of MGN transmission pressure pipelines have already been assessed for hydrogen compatibility as part of the Australian Hydrogen Centre (AHC) technical assessment. Several pipelines were excluded from the AHC's scope due to their complexity, however they still require suitable assessment prior to the introduction of hydrogen. For MGN this impacts four pipelines, which are identified in the table below.

Table 1-5: Transmission pressure pipelines requiring hydrogen compatibility assessments

Pipeline name / Section Name	Pipeline license	Identified for AA period
Pakenham-Wollert Offtake	PL210	Yes
South Gippsland Pipeline	PL261	Yes
Lang Lang CG Connection	PL265	Yes
Lilydale Pipeline - Yarra Glen to LCG	PL276	Yes

This project is being delivered during in the first two years of the next AA period, as the information will assist in developing forward looking upgrade or replacement asset management plans.

1.4.6. Hazardous areas extents

We must conduct a technical review of 125 Pressure Reduction Sites. This work will require a qualified engineer to review each site and provide recommendations to the business. This activity is prioritised for first two years of the next AA period, as the information will assist in developing forward looking upgrade or replacement asset management plans

1.4.7. Document updates

We must ensure documentation complies with the introduction and operation of a hydrogen blend. For MGN , the following types of documentation have been identified:

- pipeline associated documentation, for example procedure 9066, pipeline defect assessment;
- an updated SMS for each affected pipeline;
- updates to the Geospatial Information System to indicate blended hydrogen areas.

The project shall be completed within first three years of the period to allow safe operations from 2025 onwards, when hydrogen will be actively used within the MGN network.

1.4.8. Further assessment or investigation required

Further assessments are required to ensure the safe and progressive introduction and operation of a hydrogen blend into gas networks. For MGN the following areas have been identified as requiring further assessment:

- assess cast iron components currently in use >7kP for use with hydrogen;
- perform risk assessments on possible loss of isolation for all components containing nickel alloys, any untested aluminium alloy or elastomers;
- review capacity of 125 pressure regulating stations; and
- investigate mechanical joint compatibility and performance in the MGN network (<1050kPa).

This activity is phased to align with the 'replace incompatible parts' project to optimise the available workforce. The project increases over the period to balance the overall portfolio of works and to ensure that efficiencies and learnings are applied as the program progresses.

1.5. Options analysis

The following options have been identified to address the risk associated with the introduction of Hydrogen into the network without network adaptation being undertaken.

- **Option 1 – Staggered approach** – Upgrade components in strategic locations of the MGN network ready for a 10% hydrogen blend by 2028, and continue ongoing research into the safe transition of increasing renewable gas volumes ($8.3 million)
- **Option 2 – Upgrade network by 2028 –** Upgrade components all across the MGN network ready for a 10% hydrogen blend by 2028, and continue ongoing research into the safe transition of increasing renewable gas volumes ($8.9 million)
- **Option 3 – No network adaptation** – Inject hydrogen into the network without network adaptation investment. Continue ongoing research into the safe transition to renewable gas ($0.6 million)

A further option was also considered to make strategic locations of MGN's network 100% hydrogen blend ready by 2028. Although this option would best position MGN to facilitate transition to decarbonised energy in Victoria and help the Government achieve its emissions reduction targets, we considered there were too many unknowns in the cost estimation model to be able to develop a reasonable estimate.

We will continue to investigate the costs, benefits and technical implications of transitioning to 100% hydrogen, however we feel it is more prudent and efficient to prepare the entire network for 100% renewable gas over a longer timeframe, and these initial projects represent a proactive and conservative approach at this stage in the transition journey.

Table 1-6: Option analysis – scope summary

Program	Option 1	Option 2	Option 3
Hazardous area equipment	Program Included	Program Included	N/A
Replace incompatible parts	N/A	N/A	N/A
Weld procedures and weld hardness testing	14 of the 17 identified steel pipelines	17 of the 17 identified steel pipelines	N/A
Further assessment or investigation	Program Included	Program included	N/A
Transmission pipeline (TP) compatibility assessment	Program included in all options		
Hazardous areas extents	Program included in all options		
Document updates	Program included in all options		
Further assessment or investigation required	Program included in all options		
Capex	8,005	8,275	-
Opex	633	633	633
Totex	**8,638**	**8,908**	**633**

1.5.1. Option 1 – Staggered network upgrade

Under Option 1, rather than attempt to proactively replace all components, we will take a more strategic approach, focusing on those parts of the network most likely to have hydrogen introduced first. For example, the priority is to blend into the Melbourne metro area and therefore regional parts of the network such as South Gippsland have been excluded.

Option 1 therefore represents a more conservative work program than Option 2, with a reduction in the number of assets replaced, welds tested and hazardous areas assessed.

Cost assessment

Table 1-7 provides a breakdown of forecast capex for Option 1.

Table 1-7: Forecast capex – Option 2 $'000 real 2021

Option 1	2023/24	2024/25	2025/26	2026/27	2027/28	Total
Hazardous area equipment	857	857	1714	1714	-	5,142
Replace incompatible parts	-	-	-	-	-	-
Weld procedures & weld hardness testing	662	502	502	502	502	2,670
Further assessment or investigation	150	-	-	-	-	150
	1,669	**1,359**	**2,216**	**2,216**	**502**	**7,962**

Table 1-8 provides a breakdown of forecast opex for Option 1.

Table 1-8: Forecast opex – Option 1 $'000 real 2021

Option 1	2023/24	2024/25	2025/26	2026/27	2027/28	Total
TP compatibility assessment	80	-	-	-	-	80
Hazardous areas extents	25	25	-	-	-	50
Document updates	30	30	19	-	-	79
Further assessment or investigation	71	71	141	141	-	424
Total	**206**	**126**	**160**	**141**	**-**	**633**

Risk assessment

Under Option 1, the sections of the network that will receive hydrogen first will be made compatible, therefore the likelihood of the identified loss of supply and compliance risk events occurring reduces to rare. This results in an overall risk assessment of low.

Table 1-9: Risk assessment – Option 1

Option 1	Health & Safety	Environ-ment	Operations	People	Compliance	Rep & Customer	Finance	Risk
Likelihood	Rare	Rare	Rare	Rare	Rare	Rare	Rare	Low
Consequence	Significant	Minor	Major	Significant	Major	Significant	Major	
Risk Level	Negligible	Negligible	Low	Negligible	Low	Low	Low	

Alignment with vision objectives

Table 1-10 shows how Option 1 aligns with our vision objectives.

Table 1-10: Alignment with vision – Option 1

Vision objective	Alignment
Delivering for Customers – Public Safety	Y
Delivering for Customers – Reliability	Y
Delivering for Customers – Customer Service	Y
A Good Employer – Health and Safety	Y
A Good Employer – Employee Engagement	-
A Good Employer – Skills Development	-
Sustainably Cost Efficient – Working within Industry Benchmarks	Y
Sustainably Cost Efficient – Delivering Profitable Growth	-
Sustainably Cost Efficient – Environmentally and Socially Responsible	Y

Option 1 would align with our objectives of *Delivering for Customers* and *a Good Employer* as it enables the safe introduction of a hydrogen blend into the network without putting employees or the public at risk.

This option would also align with our objective to be S*ustainably Cost Efficient* as although the whole network must be adapted in the longer term, the priority is to focus on those areas expected to receive hydrogen in the current period. This makes for a modest, prudent and efficient work program. The project will also allow us to increase our understanding of hydrogen and renewable gas in the network, informing future plans and allowing us to identify operational efficiencies going forward.

1.5.2. Option 2 – Upgrade network by 2028

Under Option 2 we will identify all components that require proactive replacement in order to be compatible with a 10% hydrogen blend, and aim to replace them all during the next AA period (2023/24 to 2027/28). This includes replacing non-hydrogen ready equipment in hazardous areas, replacing incompatible parts (certain metallic valves and regulators), and testing weld hardness and procedures.

This project would be a very similar program to Option 1 as MGN's infrastructure is predominantly in the metropolitan area, which is the focus of the transition, however the program would include extra work related to pipelines that would not be likely to see hydrogen during the next 5 year period.

Option 2 would also include opex to continue assessing hazardous area extents, updating key documentation to reflect renewable gas asset management, and assessing hydrogen compatibility with transmission pressure pipelines.

Cost assessment

Table 1-11 provides a breakdown of forecast capex for Option 2.

Table 1-11: Forecast capex – Option 2 $'000 real 2021

Option 2	2023/24	2024/25	2025/26	2026/27	2027/28	Total
Hazardous area equipment	864	865	1,728	1,728	-	5,185

Replace incompatible parts	-	-	-	-	-	-
Weld procedures & weld hardness testing	662	502	502	502	502	2,670
Further assessment or investigation	150	-	-	-	-	150
Total	**1,730**	**1,421**	**2,284**	**2,284**	**556**	**8,275**

Table 1-12 provides a breakdown of forecast opex for Option 2.

Table 1-12: Forecast opex – Option 2 $'000 real 2021

Option 2	2023/24	2024/25	2025/26	2026/27	2027/28	Total
TP compatibility assessment	80	-	-	-	-	80
Hazardous areas extents	25	25	-	-	-	50
Document updates	30	30	19	-	-	79
Further assessment or investigation	71	71	141	141	-	424
Total	**206**	**126**	**160**	**141**	**-**	**633**

Risk assessment

Under Option 2, all network components would be compatible with hydrogen, therefore the likelihood of the identified loss of supply and compliance risk events occurring reduces to rare. This results in an overall risk assessment of low.

Table 1-13: Risk assessment – Option 2

Option 2	Health & Safety	Environ-ment	Operations	People	Compliance	Rep & Customer	Finance	Risk
Likelihood	Rare	Rare	Rare	Rare	Rare	Rare	Rare	Low
Consequence	Significant	Minor	Major	Significant	Major	Significant	Major	
Risk Level	Negligible	Negligible	Low	Negligible	Low	Low	Low	

Alignment with vision objectives

Table 1-14 shows how Option 2 aligns with our vision objectives.

Table 1-14: Alignment with vision – Option 1

Vision objective	Alignment
Delivering for Customers – Public Safety	Y
Delivering for Customers – Reliability	Y
Delivering for Customers – Customer Service	Y
A Good Employer – Health and Safety	Y

Vision objective	Alignment
A Good Employer – Employee Engagement	-
A Good Employer – Skills Development	-
Sustainably Cost Efficient – Working within Industry Benchmarks	N
Sustainably Cost Efficient – Delivering Profitable Growth	-
Sustainably Cost Efficient – Environmentally and Socially Responsible	Y

Option 2 would align with our objectives of *Delivering for Customers* and *a Good Employer* as it enables the safe introduction of a hydrogen blend into the network without put employees or the public at risk.

This option would not align with our objective to be S*ustainably Cost Efficient* as the solution, although required in the longer term, is not fully optimised. A hydrogen blend will be introduced throughout the entire network in the future, however, this is not likely to occur until after 2028 and therefore it is not necessary to proactively address all assets within the next AA period.

1.5.3. Option 3 – No network adaptation

Option 3 involves the injection of hydrogen into the MGN network without undertaking proactive replacement to undertake compatibility risk. As discussed in the Network Adaptation Strategy, the vast majority of our network is already, in theory, compatible with a hydrogen blend of up to 10%. It is therefore reasonable to consider the possibility of introducing hydrogen without the proactive replacement, instead of waiting for all assets to reach end of life before replacing them with hydrogen compatible components. As and when network risks emerge, they would be managed reactively.

However, it is important to highlight the lack of practical experience and application of hydrogen blending in an ageing gas distribution network. There are many unknowns with regard to the chemical and technical impact of hydrogen on our network. Once hydrogen impacts on one type of asset and results in operational failures, for example elastomers failing on pressure reduction sites, it is very likely that further failures will occur on all similar assets in a short period of time. This may result in significantly escalating reactive responses to incidents and loss of supply events.

Failed MGN infrastructure would be replaced with hydrogen ready assets.

This option would make the network non-compliant with Hazardous Area requirements.

Cost assessment

There are no upfront capital costs associated with this option. The network would be injected with a 10% blend without any proactive hydrogen ready asset replacement being conducted.

Work to research the safe transition to renewable gas would continue, resulting in opex costs of around $0.6 million as per Options 1 and 2.

We highlight that in the event of asset failure, the cost of emergency works and call out would be high, with reactive works typically costing 3-5 times more than proactive works. There would also be significant financial penalties associated with loss of supply incidents and non-compliances.

Risk assessment

The risk outcome under Option 3 would be the essentially same as the untreated risk, as no action would be taken to proactively replace non compatible assets and mitigate the current risk posed by hydrogen injection.

Table 1-15: Risk rating – Option 3

Option 3	Health & Safety	Environ-ment	Operations	People	Compliance	Rep & Customer	Finance	Risk
Likelihood	Unlikely	Unlikely	Occasional	Unlikely	Occasional	Occasional	Occasional	High
Consequence	Significant	Minor	Major	Significant	Major	Significant	Major	
Risk Level	Moderate	Low	High	Moderate	High	High	High	

Option 3 is not consistent with the requirements of our Safety Case, risk management framework, and does not meet the tests of a prudent asset manager/network business. Ultimately, the network business could lose its operating license as the risks escalate over time.

Alignment with vision objectives

Table 1-16 shows how Option 3 aligns with our vision objectives.

Table 1-16: Alignment with vision – Option 3

Vision objective	Alignment
Delivering for Customers – Public Safety	N
Delivering for Customers – Reliability	N
Delivering for Customers – Customer Service	N
A Good Employer – Health and Safety	N
A Good Employer – Employee Engagement	-
A Good Employer – Skills Development	-
Sustainably Cost Efficient – Working within Industry Benchmarks	N
Sustainably Cost Efficient – Delivering Profitable Growth	-
Sustainably Cost Efficient – Environmentally and Socially Responsible	N

Option 3 would not align with any of our objectives. It would not deliver against the service, safety and decarbonisation expectations of our customers and stakeholders.

Introducing hydrogen without undertaking the necessary component upgrades exposes our employees and contractors to unnecessary hazards, placing them at risk of serious harm. It is therefore not consistent with being a good employer.

While the upfront capital costs would be lower than Option 1 and 2, the higher costs of reactive works and the potential for significant financial penalties means Option 3 is not sustainably cost efficient.

1.5.4. Summary of costs and benefits

Table 1-17 presents a summary of how each option compares in terms of the estimated cost, the residual risk rating, and alignment with our vision objectives.

Table 1-17: Comparison of options

Option	Estimated cost ($ million)	Treated residual risk rating	Alignment with vision objectives
Option 1	8.6	Low	Aligns with *Delivering for Customers* and *Sustainably Cost Efficient*
Option 2	8.9	Low	Aligns with *Delivering for Customers* but not *Sustainably Cost Efficient*
Option 3	0.6	High	Does not align with *Delivering for Customers, A Good Employer* or *Sustainably Cost Efficient*

1.5.5. Recommended option

Option 1 is the recommended option. This solution involves the adaptation of strategically targeted areas of the network, whilst simultaneously undertaking necessary works for future hydrogen blending.

1.6. Estimating efficient costs

The work programs that form the hydrogen network adaptation program were initially scoped and costed by external experts GPA Engineering as part of the AHC's wide ranging review into network compatibility with hydrogen. The expert report has been distilled down to applicable AGIG networks to develop network specific scopes and costs.

Further investigations have been undertaken with manufacturers to determine hydrogen compatibility of components initially identified as lacking information to support compatibility. This subsequent research has successfully identified that key infrastructure within the initial cost build up no longer requires further investment. For example, Axial Flow Regulators & Pietro Fiorentini regulators were found to be 10% hydrogen compliant, which reduced the forecast expenditure by $7.4 million.

Further refinement of the forecast expenditure was made by identifying and excluding costs for sections of the network that were unlikely to receive blended hydrogen in the upcoming regulatory period.

Through risk assessment processes, we have determined that many of the operational risks can be managed through additional monitoring practices and research projects, thereby reducing capital forecast investments to only those that are essential. The specific scope and volumes for each network business has been developed from the GPA reports, considered against the Network Adaptation Strategy, which has informed the specific projects.

Excluded from cost estimates are the minor incremental changes to procurement practices and design activities to accommodate future hydrogen blends in the network. These costs have been absorbed into forward looking unit rates specific to those assets and strategies.

To the extent possible, the costs derived for these programs have been estimated based on historical costs incurred in completing similar projects.

To achieve efficiency in design, engineering and project management, projects in the program are bundled together as a package for efficient use or resources. By way of example the incompatible parts project is phased to match the further investigation required project as engineering resources can complete the two in conjunction, with these efficiencies accounted for in the forecast.

Projects are phased across multiple years to achieve the optimal outcome for the business and customers in terms of asset utilization, risk reduction, timing of the works and resource availability. Projects that are critical to developing knowledge and facilitating any hydrogen blend (regardless of percentage by volume) are prioritised in the earlier years of the period.

The unit rates used for all projects managed within this program of work include the internal labour, external labour, materials, design, engineering, construction, project management and commissioning costs forecast.

Historical projects in this strategy have typically achieved a labour to material split of 40:60 percent. This breakdown is then applied to the forecast below.

Table 1-18: Cost breakdown, AGN Victoria hydrogen adaptation $'000 real 2021

	2023/24	2024/25	2025/26	2026/27	2027/28	Total
Labour	750	594	950	943	201	**3,438**
Materials	1,125	891	1,426	1,414	301	**5,157**
Total	**1,875**	**1,485**	**2,376**	**2,357**	**502**	**8,595**

As with all capex programs, only capital actually incurred to adapt the network to renewable gas and hydrogen will be added to the regulated asset base (RAB) and recovered via regulated tariffs. We will endeavour to outperform the forecast where possible and ensure the incremental expenditure to get the network ready to deliver renewable gas reflects the lowest sustainable cost to consumers.

More detailed cost estimates are provided in Appendix A and Appendix B.

1.6.1. Consistency with the National Gas Rules

In developing these forecasts, we have had regard to Rule 79, Rule 74 and Rule 91 of the NGR. With regard to all projects, and as a prudent asset manager, we give careful consideration to whether capex is conforming from a number of perspectives before committing to capital investment.

NGR 79(1)

The proposed solution is prudent, efficient, consistent with accepted good industry practice and will achieve the lowest sustainable cost of delivering pipeline services:

- **Prudent** – The expenditure is necessary in order to ensure that the ongoing integrity of the network is maintained with the introduction of hydrogen and to reduce the risk of major gas escapes that could impact public safety and reliability of supply.

  Adapting our network in a way that mitigates foreseeable risks is consistent with our Safety Case and accepted industry practice. Hydrogen transportation is not new and the steps we are taking are known to address the risk associated with hydrogen in pipes. Several practicable options have been considered to address the risk. The proposed expenditure is therefore consistent with that which would be incurred by a prudent service provider.

- **Efficient** – The forecast expenditure is based on rates applied in similar projects and a detailed scope of work verified by an experienced third-party engineering consultant. Undertaking this project with a staged approach, focusing those parts of the network that will receive hydrogen first (rather than embarking on network-wide asset replacement), will help us inform the scope and cost of the forward works program as blends of hydrogen increase over time, while lessening revenue impact on customers in the next period.

- **Consistent with accepted and good industry practice** – We are constantly reviewing the network risks in line with the Safety Case and are taking steps to mitigate likely issues that will result from the introduction of hydrogen. Renewable gas and associated technologies are being pursued by stakeholders, and are part of the decarbonisation agenda being developed by the Australian Commonwealth and State Governments. It is therefore good practice to ensure our network is ready to support this.

- **To achieve the lowest sustainable cost of delivering pipeline services** – The proposed expenditure is necessary to facilitate the early stages of hydrogen introduction into the network. Failure to do so would result in additional expenditure being incurred to reactively augmenting the network over a short, unmanageable timeframe. The project is therefore consistent with the objective of achieving the lowest sustainable cost of delivering services. The project will also enable us to inform and manage the future requirements of increasing hydrogen blends more efficiently. Fully understanding the effect of hydrogen blends on our assets, and taking a proactive approach, will allow us to operate the assets for as long as is safe and practicable, achieving the lowest sustainable cost of providing pipeline services.

NGR 79(2)

The proposed capex is justifiable under NGR 79(2)(c)(i) and 79(2)(c)(ii), as it is necessary to maintain the safety and integrity of services. Introduction of hydrogen into the distribution system without upgrading incompatible parts will likely resulting in asset failure, with the potential for significant safety and/or supply events.

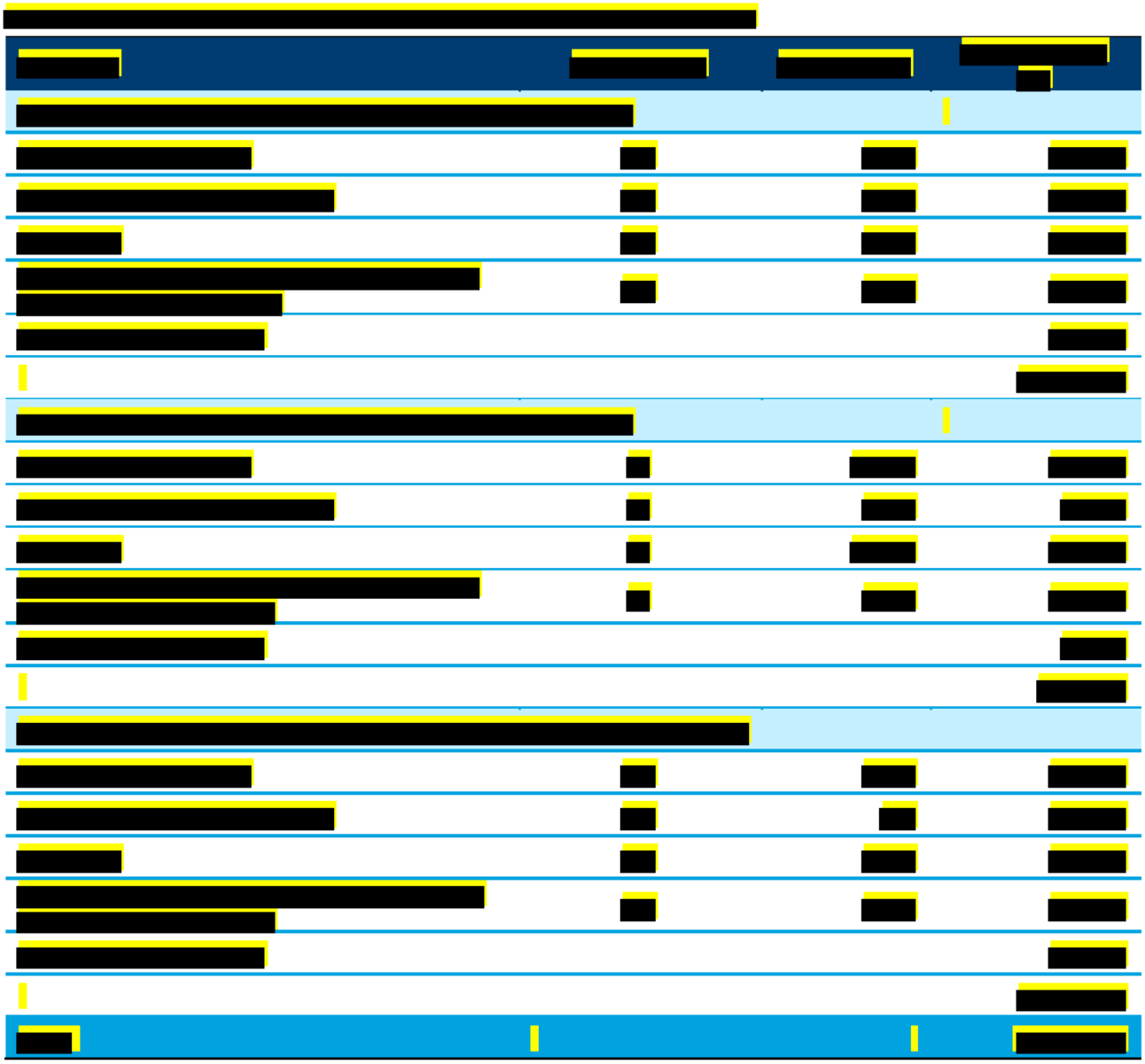
NGR 74

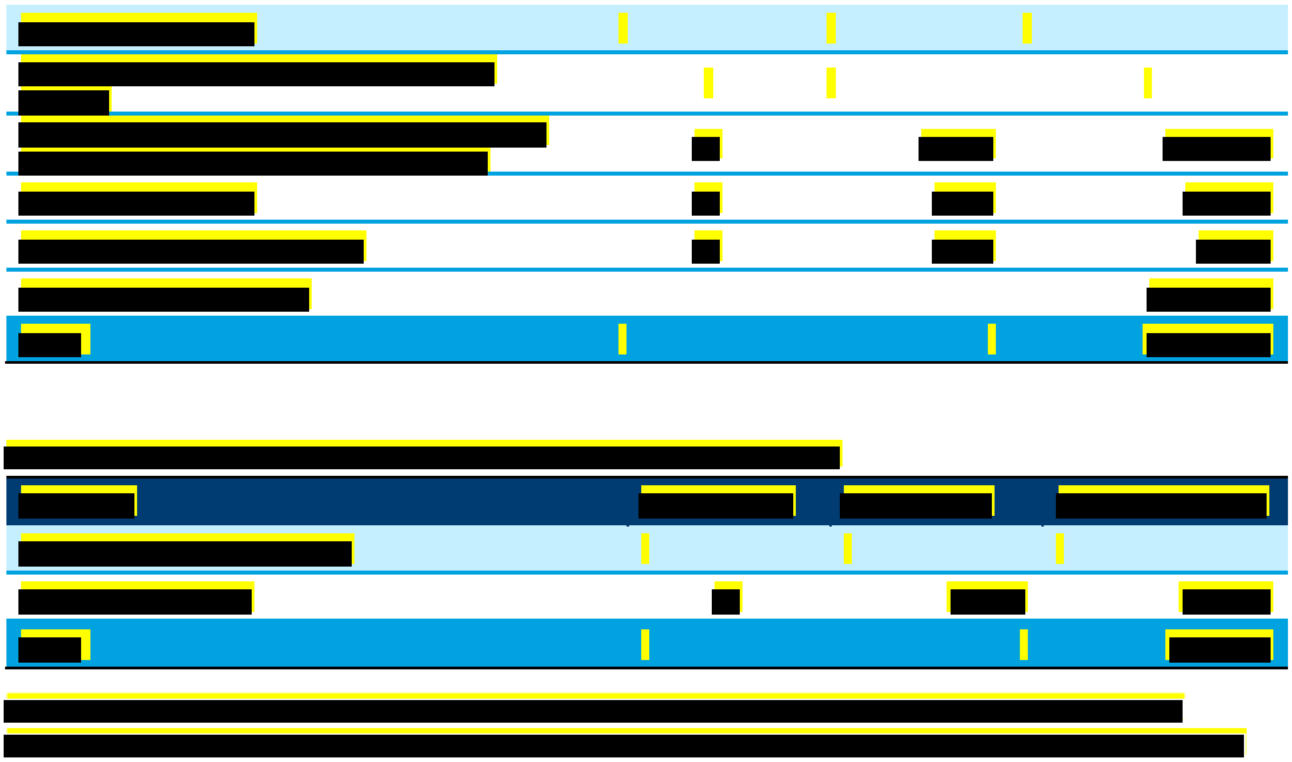
The forecast costs have been arrived at on a reasonable basis by following realistic assumptions of costs, informed by independent engineering advice and experience in other jurisdictions. Rates are comparable with the market and the scope of the project is limited to only what is critical for the next access arrangement period, with a view to informing more accurate forecasts in future periods. We therefore consider the costs estimates represent the best forecast possible in the circumstances.

NGR 91

The proposed operating expenditure is required to undertake the necessary renewable gas research and studies to ensure the transition to renewable gas can occur in a safe and affordable manner. These are consistent with costs that would be incurred by a prudent service provider acting efficiently to achieve the lowest sustainable cost of service.

Appendix A Detailed capex estimates





Appendix B Detailed opex estimates

Appendix C Comparison of risk assessments for each option

Untreated risk	Health & Safety	Environ-ment	Operations	People	Compliance	Rep & Customer	Finance	Risk
Likelihood	Unlikely	Unlikely	Occasional	Unlikely	Occasional	Occasional	Occasional	High
Consequence	Significant	Minor	Major	Significant	Major	Significant	Major	
Risk Level	Moderate	Low	High	Moderate	High	High	High	

Option 1	Health & Safety	Environ-ment	Operations	People	Compliance	Rep & Customer	Finance	Risk
Likelihood	Rare	Rare	Rare	Rare	Rare	Rare	Rare	Low
Consequence	Significant	Minor	Major	Significant	Major	Significant	Major	
Risk Level	Negligible	Negligible	Low	Negligible	Low	Low	Low	

Option 2	Health & Safety	Environ-ment	Operations	People	Compliance	Rep & Customer	Finance	Risk
Likelihood	Rare	Rare	Rare	Rare	Rare	Rare	Rare	Low
Consequence	Significant	Minor	Major	Significant	Major	Significant	Major	
Risk Level	Negligible	Negligible	Low	Negligible	Low	Low	Low	

Option 3	Health & Safety	Environ-ment	Operations	People	Compliance	Rep & Customer	Finance	Risk
Likelihood	Unlikely	Unlikely	Occasional	Unlikely	Occasional	Occasional	Occasional	High
Consequence	Significant	Minor	Major	Significant	Major	Significant	Major	
Risk Level	Moderate	Low	High	Moderate	High	High	High	