Zincara

From strategy to action

Access Arrangement Review
Multinet (MGN)

Public

Prepared for

AUSTRALIAN ENERGY REGULATOR

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Zincara P/L

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1. EXECUTIVE SUMMARY

In June 2022, the Victorian gas distributors submitted its revised Access Arrangement (AA) for its gas distribution systems to the Australian Energy Regulator (AER). The submissions are to cover the period 1July 2023 to 30June 2028. The AER has engaged to Zincara P/L to review some of the elements of the gas distributors' submission. Specifically, Zincara is assessing Multinet's (MGN) hydrogen proposal and its mains replacement program.

The tests used for Zincara's assessments are NGR Division 4 Section 79 for capex and Division 7 Section 91 for opex. As the NGR is for natural gas, we have referred to the Australian Market Operation Commission (AEMC) report to extend the regulatory framework to cover hydrogen and renewable for guidance on the application of our assessment tests.

This report details Zincara's assessment for MGN's hydrogen proposal and its mains replacement program. In coming to our conclusions, we have taken into account the comments made by stakeholders in their submissions.

1.1 HYDROGEN

MGN proposes to introduce a 10% hydrogen and natural gas blend into its network by 2030 and operate a 100% hydrogen network by 2040. This is in line with the Victorian Government commitment to net zero greenhouse gas emission by 2050.

For the next AA period, MGN proposes to commence adapting its Victorian gas network to transport renewable gas. For capex, MGN proposes to carry out a range of activities from replacing network equipment (e.g. pressure reduction stations) which no longer meet the minimum hazardous clearance for hydrogen blend to requalifying welds in the transmission pipelines for hydrogen use.

In relation to operating expenditure, MGN proposes to carry out further assessment on its transmission pipelines for the suitability of transporting hydrogen, document updates and further investigations on the safe and progressive introduction of hydrogen.

MGN's proposed expenditure is shown in the table below.

Table 1-1-1: MGN expenditure for the introduction of hydrogen ($000 real 2021)

	2023/24	2024/25	2025/26	2026/27	2027/28	Total
Capital expenditure	1,669	1,359	2,216	2,216	502	7,962
Operating expenditure	206	126	160	141	-	633

Source: MGN Final Plan_Attachment 9.10(2)_Renewable Gas network Adaptation Plan_Confidential

We concluded that the capex program is required for the introduction of 10% hydrogen. However, the lack of a detailed plan showing how the 10% hydrogen is to be rollout means that there is no demonstrated imperative that the work needs to be commence in the next AA period. We do not consider the capex to be prudent for the next AA period.

In relation to MGN's opex, we also concluded that the range of activities outlined above are required in preparation for the rollout of hydrogen. Like the capex, it is difficult to ascertain the timing of such projects given the lack of detailed rollout plan. We therefore do not consider the work to be prudent for the next AA period.

1.2 MAINS REPLACEMENT PROGRAM

MGN's proposed mains replacement program expenditure is shown in the table below.

Table 1-1-2:Mains replacement program – volumes and expenditure ($million, real 2021)

Mains Replacement	Volume	GSR Response
Capex programs		
Low pressure CI/UPS	704 km	xxxx
Early generation HDPE	86 km	xxxx
Medium pressure - steel	31 km	xxxx
Reactive Service replacement	1731 services	$5.4
Total capex		**$386.0**
Opex programs		
HDPE testing program		$1.0
Reactive mains replacement		$3.7
Total Opex		**$4.7**
Total expenditure		$390.7

(Source: GSR response: Capex Forecast Model)

Low pressure CI/UPS mains

Our analysis of leaks, fractures and water in mains and services incidents show that the remaining low pressure mains are in relatively poor condition and continuing to deteriorate, particularly cast iron, and unprotected steel. We also note that PVC mains are experiencing increasing rates of leaks, with similar levels to unprotected steel. The assessment of leak and fracture rates for each postcode also supports the need for a strong program to continue.

We therefore recommend acceptance of the program as prudent and efficient.

Early generation HDPE mains

The proposed program is to decommission 54.5kms of oldest early generation HDPE kilometres and 27.4km of poor condition steel mains. These medium pressure mains are in xxxx and xxxx and will be replaced with new PE and then the area will be upgraded to high pressure. Our assessment of the leaks and fracture rates of these oldest HDPE mains is that they are in poor condition. Similarly, the steel mains are deteriorating. We therefore concur with the replacement of these gas mains.

Following further explanation of unit rates calculations we are also recommend the efficiency of the cost estimate.

MP steel mains replacement

This program, consisting of two projects, will abandon 20.9 kilometres of steel at the end of its life, as well as 2.4 kilometres of early generation HDPE that is interconnected sporadically in the area. On completion, the two medium pressure island networks will be upgraded to high pressure increasing security of supply with improved capacity. We concluded that the replacement of these aging and poor condition assets is good gas industry practice and prudent in the circumstances.

Similar to the HDPE project above, following further explanation of unit rates calculations we are also recommend the efficiency of the cost estimate.

Reactive service replacement

The reactive service replacement program provides an allocation of capital expenditure to allow for piecemeal replacement of faulty services that are not suitable for repair. The forecast volume reflects the three year average of the current period which has been further discounted due to MGN's assessment of GSR impacts. The unit rates reflect the most recent three year average (2019 to 2021). We therefore recommend acceptance of the costs.

HDPE assessment program (Opex)

MGN propose collecting 20 samples of HDPE per year for analysis by Deakin University. This is part of a joint Victorian gas distribution business research project with the University. We consider that this analysis will broaden the Victorian distribution networks understanding of how their early generation PE assets are performing across the networks and provide further insight as to their potential field life. We therefore recommend acceptance of the program.

Reactive mains replacement (Opex)

The reactive mains replacement program provides an expenditure allocation for the ad hoc replacement of short sections of mains when repair is not possible or cost effective.

During the current period, the AER benchmark was set on the basis of small (typically less than 60m) sections of mains replacement, with the total provision being $1 million. For the forecast period MGN has based its forecast on a three year (2020 to 2022) historical average of ad hoc mains replacements with much longer lengths and an annual average cost of $728k per year, totalling $3.7 million for the period. MGN has also categorised these replacements as Opex, compared to the current period where the expenditure was capitalised.

MGN has explained (IR021) its approach with reactive mains replacements during the current period which is the basis of its forecast for the next AA period. We consider that this approach differs from traditional application of reactive mains replacement. However, we also consider that it does represent a prudent and cost effective approach in these circumstances and therefore recommend approval.

Given the definition of reactive mains replacement, we question whether the last three years replacement is reflective of the future AA period. We are unable to recommend the provision as efficient. However, we suggest that the AER could consider the current provision of $200k per year as a placeholder, until MGN justify the additional expenditure.

On the matter of whether the provision should be capex or opex, we note that MGN's IR021 response indicates that it driven by a desire to align with the AGN SA networks. As this is not a technical issue, we refer the matter to the AER for resolution.

2. INTRODUCTION

2.1 BACKGROUND

In July 2022, Multinet (MGN) submitted it revised Access Arrangement (AA) for its Victorian gas networks for the period 1 July 2023 to 30 June 2028 to the Australian Energy Regulator (AER). To assist in the capital expenditure review, the AER engaged Zincara P/L (Zincara) to advise on the two aspects of the capital expenditure: hydrogen and mains replacement.

2.2 SCOPE

The focus of the review is to provide the AER with a view on whether the capex meets the requirements of the National Gas Rules (NGR) and in particular NGR Division 4 Section 79 for capex and Division 7 Section 91 for opex.

2.3 NATIONAL GAS RULES

Relevant sections of NGR Division 4 Section 79 to determine conforming capital. Section 79 states:

(1) Conforming capital expenditure is capital expenditure that conforms with the following criteria:

(a) the capital expenditure must be such as would be incurred by a prudent service provider acting efficiently, in accordance with accepted good industry practice, to achieve the lowest sustainable cost of providing services; and
(b) the capital expenditure must be justifiable on a ground stated in subrule (2); and
(c) the capital expenditure must be for expenditure that is properly allocated in accordance with the requirements of subrule (6).

National Gas Rules Division 7 to determine operating expenditure. Section 91 (1) states:

"Operating expenditure must be such as would be incurred by a prudent service provider acting efficiently, in accordance with accepted good industry practice, to achieve the lowest sustainable cost of delivering pipeline services."

2.4 DEFINITION FOR PRUDENCE AND EFFICIENCY

As the NGR does not define the prudence, efficiency and good industry practice, Zincara has adopted the following definitions:

"Prudence", means "*caution in managing one's activities to avoid undesirable consequences*[1]*".* Zincara has interpreted this to mean that for the project to be prudent, the decision is made on the basis that it is timely for the project to proceed to rectify ongoing safety and reliability issues.

'Efficiency' means *functioning or producing effectively and with the least waste of effort*[1]*.* This means that the choice of which option to adopt for the project must be made on the basis that the most effective solution has been adopted. The "least amount of effort" refers to the cost of the project and in that context the project must be carried out at market rates.

"Good industry Practice" means that the actions that a prudent operator would adopt in in similar Australian conditions.

2.5 APPROACH

The key steps of our approach are:

- Review the relevant documents provided by MGN in its submission.
- Identify what are strategic objectives of the projects
- Determine whether the most efficient option had been adopted and the appropriateness of the timing of the project.
- Ensure that the estimated cost for the project meets the efficiency test.

Zincara's analysis is based on the MGN's submission and Zincara has assumed the data to be accurate. Zincara has not verified the accuracy or veracity of the data.

[1] Australian Concise Oxford Dictionary

3. HYDROGEN

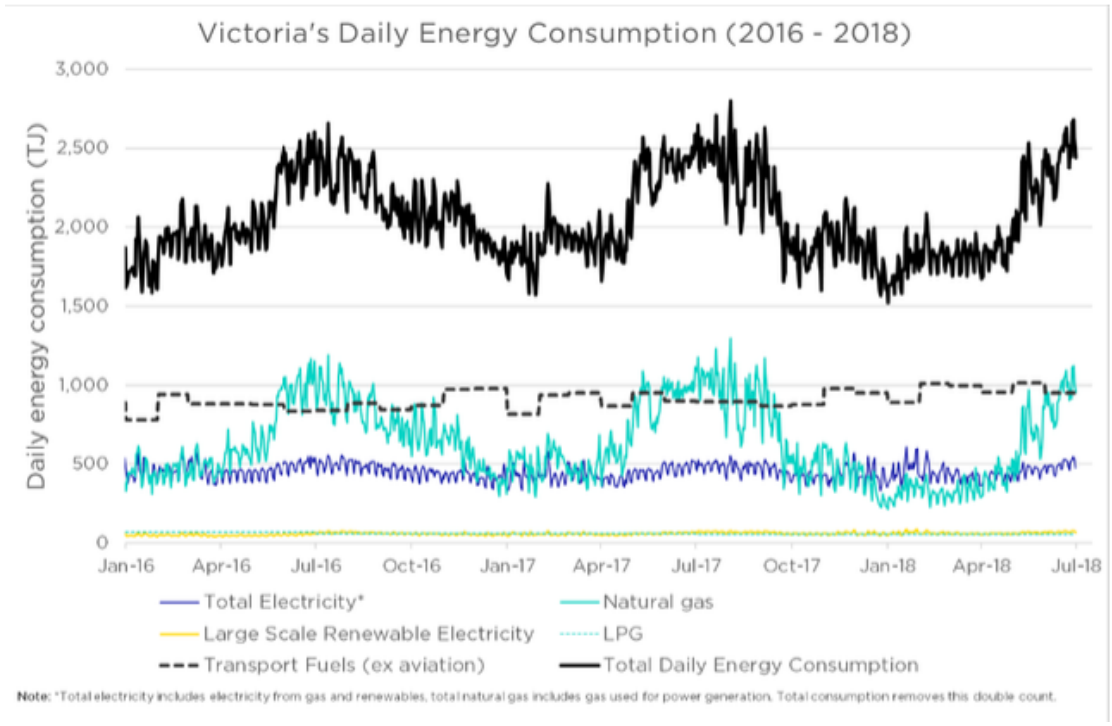
3.1 INTRODUCTION

AGN Victoria, AGN Albury and Multinet are part of Australian Gas Infrastructure Group (AGIG). In Victoria (including Albury Gas Company), AGIG's total networks[2] serve more than 1.5million customers and comprise of 21,667km of pipeline, services and meters. As such, AGIG has set out the same hydrogen rollout strategy for all three companies. For this report, we have presented the strategy as that of Multinet (MGN).

MGN said that the Victorian Government has a timeline to reach net zero greenhouse gas emission by 2050. The Victorian Government has set emissions reduction targets of 28% to 33% by 2025 and 45% to 50% by 2030. MGN believes that renewable gas and gas networks have a role in Australian future energy mix and as such includes Victoria.

MGN advised that research across AGIG operations has shown that customers and the communities want gas in their homes as the preferred fuel for cooking, heating and for its reliability. The Victoria's energy consumption for the winter peak from 2016-2018 shows that gas provided double the energy provided by electricity.

Figure 3-1: Victorian Daily Energy Consumption 2016-18



(Source: MGN Final Plan_Attachment 9.10(1) Figure 2.-1)

Given the energy transition and customer preference, MGN considers that it is important for its networks to be ready to transport renewable gas (e.g. hydrogen).

[2] Multinet Final Plan_Attachment 9.10

3.2 STRATEGY

AGIG has commenced investigation towards a renewable gas future. It advised that it has successfully operated a hydrogen blended networks with hydrogen park in South Australia (HyP SA). It now proposes to expand the operation into Victoria with HyP Murray Valley towns to commence in 2024.

AGIG's key milestone is to accommodate a 10% hydrogen to natural gas blend by 2030 and operate a 100% hydrogen network by 2040. This is in line with the Victorian Government's commitment to net zero greenhouse gas emissions by 2050, with emissions reduction targets of 28% -33% by 2025 and 45% by 2030.

Its next phase is to facilitate 10% hydrogen gas blend by 2030 into its Victorian distribution networks (AGN and Multinet). This will involve targeting sections of its network to incrementally introduce hydrogen as a gas blend with the aim of offering 100% of renewable gas to new housing estate by 2025[3].

Work done on the suitability of the distribution systems to transport hydrogen has shown that in the main, the distribution system is substantially compatible for transporting a blend of natural gas with 10% hydrogen but further work needs to be done for transporting 100%. They include replacement of certain fittings and certain electrical equipment in hazardous locations.

For the 2023/24 to 2027/28 AA period, AGIG proposes to commence adapting both its AGN and MGN networks to transport renewable gas. It considered three options for the introduction of 10% hydrogen blend into the network:

1. Staggered network upgrade focusing proactively on replacing the components in the network in the areas most likely to have hydrogen first.
2. Upgrade network by 2028 focusing on identifying all the components in the network and proactively replacing them in the 2023-28 AA period.
3. No network adaptation and only replacing components as network risks emerges.

For MGN, AGIG adopted option 1 which is to take a staggered approach to replacing its network. The proposed capital and operating costs for MGN network is $9.5mllion.

[3] MGN Final Plan_Attachment 9.10(1)_AGIG Network Adaptation Strategy -Renewable Gas_Public

3.3 CAPITAL AND OPERATING EXPENDITURE

The tables below show the breakdown of the capital and operating expenditure for MGN networks.

Table 3-3-1: MGN Forecast Capex for Hydrogen Adaptation Strategy ($000 Real 2021)

	2023/24	2024/25	2025/26	2026/27	2027/28	Total
Hazardous Area Equipment	857	857	1,714	1,714	-	5,142
Weld Procedures & hardness testing	662	502	502	502	502	2,670
Pipeline Repair Equipment	150	-	-	-	-	150
Total	**1,669**	**1,359**	**2,216**	**2,216**	**502**	**7,962**

(Source: MGN Final Plan_Attachment 9.10(2)_Renewable Gas network Adaptation Plan_Confidential)

Table 3-3-2: MGN Forecast Opex for Hydrogen Adaptation Strategy ($000 Real 2021)

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

(Source: MGN Final Plan_Attachment 9.10(2)_Renewable Gas network Adaptiaton Plan_Confidential)

3.4 CAPITAL PROGRAM

3.4.1 Hazardous Area Equipment

Hydrogen and hydrogen blends require a large minimum hazardous area size in open spaces. Cat II A&B rated equipment will need to be replaced with Cat IIC. MGN operates 241 network facilities (e.g. pressure reduction station) and 314 metering sites (e.g. interval metering sites). All of these sites will be targeted for replacement in the next AA period.

3.4.2 Replace Incompatible Parts

MGN has reviewed all the existing components within the network and sought advice from the manufacturers. All components in the network are found to be compatible with blends of 10% hydrogen and therefore no replacements are required.

3.4.3 Weld Procedures and Weld Hardness Testing

Even though a compatibility review showed that most of the pipelines (>1050kpa) and network steel pipeline (<1,050kpa) can safely transport hydrogen blends or pure hydrogen, MGN has to develop weld procedures for 14 of 17 steel pipelines to ensure their safe operation. MGN is also required to carry out hardness testing of a number of sample welds for each pipeline to show compliance with the hardness limits of ASME B31.12[4].

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.

3.4.4 Pipeline Repair Equipment

MGN indicated that further work is necessary to assess the compatibility of its transmission repair equipment in a hydrogen environment and purchase compatible equipment.

3.5 OPERATING PROGRAM

3.5.1 Transmission pressure pipeline compatibility assessment

MGN said that most of its pipelines have already been assessed for hydrogen compatibility. However, four of the pipelines were excluded due to their scope and complexity. MGN proposes to carry out the assessment of these pipelines in the next period.

3.5.2 Hazardous areas extents

This work is for an engineer to carry out a technical review of MGN's 125 pressure reduction sites to assist in the development of future upgrade or replacement of their asset management plans.

3.5.3 Document updates

MGN said that it needed to upgrade its documentation to comply with the introduction and operation of a hydrogen blend. The range of work covers:

- pipeline associated documentation e.g. pipeline defect assessment;
- an updated SMS for each affected pipeline; and
- updates to the Geospatial Information System to indicate blended hydrogen areas.

MGN proposes to complete the work within the first three years of next AA period to allow safe operations from 2025 onwards when hydrogen will be actively used within the MGN network.

[4] American Society for Mechanical Engineers B31.12 is the standard on hydrogen piping and pipelines. It covers joint (e.g. welding) connecting the piping associated with pressure vessels.

3.5.4 Further assessment or investigation required

MGN propose to carry out further assessment to ensure the safe and progressive introduction and operation of a hydrogen blend into its networks. The range of work includes:

- 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).

3.6 ESTIMATED COSTS

MGN advised that the estimated costs were initially scoped and costed by GPA Engineering. MGN had carried out further investigations with manufacturers on the compatibility of their equipment for transporting hydrogen. MGN had been able to refine the costs further when certain equipment such as the Axial Flow Regulators and the Pietro Florentini regulators were found to be 10% hydrogen compliant, reducing the forecast expenditure by $7.4million.

In addition, MGN had also confined its costs to areas that are going to be receiving gas in the ensuing regulatory period. Through its risk assessment processes, MGN had been able to reduce its capital forecast to the essential works only.

MGN also indicated that to the extent possible, it had estimated the projects using historical costs from similar completed projects. The unit rates that it had used included internal labour, external labour, materials, design, engineering, construction, project management and commissioning costs. A summary of the total costs which include both capex and opex is shown in the table below.

Table 3-3-3: Adaptation Projects Capex and Opex Costs ($'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**

(Source: MGN Final Plan_Attachment 9.10(2)_Renewable Gas network Adaptation Plan_Confidential)

3.7 AEMC REPORT

The tests that we have applied for our analysis is outlined in section 2.3 National Gas Rules (NGR). However, it is noted that the National Gas Rules are for natural gas and not for natural gas substitution. As such, we have referred to report released by the Australian Energy Market Commission (AEMC) for guidance.

The AEMC stated[5] that the objective of the National Gas Law (NGL) is: *"to promote efficient investment in, and efficient operation and use of, natural gas services for the long term interests of consumers of natural gas with respect to price, quality, safety, reliability and security of supply of natural gas"*. As the NGR is made under the NGL and this section is related to hydrogen, we are unable to apply the NGR as tests for our analysis.

However, the AEMC has recommended to Energy Ministers that changes be made to the national gas and retail regulatory frameworks to enable the natural gas sector to evolve using hydrogen and renewable gas to support Australia's emission reduction plans. In its final report (dated 8 September 2022), "Review into extending the regulatory frameworks to hydrogen and renewable gas", the AEMC sets out its recommendations and its draft rules to address the issues that could emerge in the National Gas Rules (NGR) and National Energy Retail Law (NERL) to cover gases and natural gas equivalents that are supplied to consumers.

The AEMC is seeking stakeholders' views on its recommended rule drafting by 13 October 2022.

The relevant section of the report is section 3.5 which covers voluntary transitions to another covered gas. Section 3.5.1 states

If a government does not mandate that a pipeline change to transporting another covered gas, but a service provider elects to do so, then, in the case of a scheme pipeline, the regulator would need to assess the proposal having regard to the expenditure criteria in Part 9 of the NGR. In keeping with these criteria, the regulator would need to consider whether:

- the proposed capital expenditure:
    - satisfies the prudent and efficient test
    - is justifiable on the grounds that either the overall economic value of the expenditure is positive, or the present value of the expected incremental revenue to be generated as a result of the expenditure exceeds the present value of the expenditure.

- the proposed operating expenditure satisfies the prudent and efficient test.

The above requirements are consistent with NGR 79 for capex and NGR 91 for opex.

The report also states that NGR 79(2)(c) also provides for capital expenditure to be justifiable if it is necessary to maintain and improve the safety of services, maintain the integrity of services, comply with a regulatory obligation or requirement, or maintain the service provider's capacity to meet levels of demand for services existing at the time of the capital expenditure. The AEMC has ruled that a voluntary transition to another gas is not expected to be justifiable on any of these grounds.

We acknowledge that the draft rules in the AEMC report have not been accepted. However, as the above draft rules are similar to that of the NGR 79 and 91, we propose to use these rules as tests for our analysis, bearing in mind that the AEMC has ruled that the a voluntary transition to another gas is not expected to justify NGR 79 (c).

[5] AEMC website

3.8 STAKEHOLDERS' SUBMISSIONS

There is a lack of support from the various stakeholders on AGN/MGN proposals to commence adapting their networks to transport 10% hydrogen by 2030. A summary of the comments are provided in the table below.

Table 3-4: Stakeholders' Submissions

Stakeholders	Summary of Responses
Energy Users Group of Australia	Consumers ask to pay for network hydrogen readiness under the guise of safety mains replacement.
Friends of the Earth Melbourne	100% hydrogen is more hype than reality.
Origin Energy	Expenditure to hydrogen readiness is appropriate only to the extent that legislation is introduced supporting the use of hydrogen blend.
Brotherhood of St Lawrence	The Gas Substitution Roadmap is strongly biased towards electrification and the hydrogen hero is unlikely to occur. Hydrogen likely to increase the challenge of electrification. Full cost of hydrogen blend not known. Assumed benefit of the proposal articulated in the National Hydrogen Strategy not demonstrated. Inconsistent with NGR objective or Rule 79. Conflicting priority for hydrogen with demand for industries and reticulation blending. 2040 for 100% hydrogen is a stretch target.
Consolidated submission from Victorian Community Organisations	Conflict with electrification of residential loads. Increase to network price should customers choose to leave the network. Premature in adapting network. No clear plan to transition from gas. Hydrogen development in its early stage and other mode of delivery may not require existing networks. Full cost of upgrades not known for hydrogen blends and 100% hydrogen.
TRAC Partners	NGR does not allow for expenditure to consumers when hydrogen not likely to be commercialised for 10-20 years. R&D expenditure not recoverable in a competitive market. Only expenditure related to commercial and industrial consumers should be allowed.
CCP	Distributors reported consumer strong support for hydrogen readiness expenditure in the stakeholders meetings but stakeholders demonstrated lack of support for AGN/MGN proposals.

(Source: Stakeholders' responses.)

3.9 CONCLUSION

In December 2018, the Council of Australian Government Energy Council[6] set a vision for clean, innovative, safe and competitive hydrogen by 2030. AGIG's key milestone to accommodate a 10% hydrogen to natural gas blend by 2030 and operate a 100% hydrogen network by 2040 is consistent with the overall vision.

In respect to the introduction of the hydrogen blend, our review concluded that MGN's work program shows that the activities are related to ensuring the equipment complies with the relevant safety standards. In addition, we also considered that the procurement of equipment suitable for the hydrogen environment is reasonable.

In relation to its capex cost estimates, MGN provided details in Appendix A of its Renewable Gas Network Adaptation Plan. MGN also advised[7] that its cost estimates are based on the unit cost estimates developed by its consultant, GPA, for the hazardous area equipment replacement. For other estimates, MGN used the current cost rate of pipeline excavation and coat repair for its weld procedures and the current procurement cost of repair equipment. An examination of the information provided has not revealed areas of concern and as such, we consider the costs to be reasonable.

However, we note that the 2030 is a target to have implemented 10% hydrogen. There is no detailed plan to show that how the hydrogen blend is to be rolled out. There is therefore no demonstrated imperative that the adaptation of the network needs to commence in the next AA period or that they need to be carried out before the commencement of the introduction of the hydrogen blend.

AGIG has indicated[8] that in South Australia its first renewable hydrogen blending project – HyP SA is already operational. The project is a 1.25MW electrolyser producing renewable hydrogen for blending with natural gas (up to 5%) and supply to more than 700 existing homes in metropolitan Adelaide. AGIG proposed another hydrogen park for the Victorian Murray Valley towns to commence operation in 2024. Supplying 10% hydrogen to around 40,000 customers is at a different scale to then commence supplying 10% hydrogen to a network with more than 719,000 customers[9]. This further reinforces the need for a plan to demonstrate how the hydrogen blend is to be rolled out and where the hydrogen is to be produced.

In addition, the Gas Substitution Roadmap (GSR) priorities are on electrification and freeing up natural gas for industrial users. Whilst the GSR supports the introduction of hydrogen and biomethane, there is no timeline or details on the rollout of hydrogen blend. This adds to the confusion of what needs to be carried out in the next AA period for the introduction of the hydrogen blend.

It is also noted that stakeholders (discussed in section 3.8) do not support any expenditure in the next AA period for the introduction of a hydrogen blend.

Given the above, we are unable to recommend the capital expenditure as prudent for the next AA period.

[6] Australian National Hydrogen Strategy.
[7] IR021
[8] MGN Final Plan_Attachment 9.10(1)_AGIG Network Adaptation Strategy -Renewable Gas_Public
[9] MGN Vic Final Plan 2023-24 pg 18

On the matter of how this capital expenditure meets the AEMC final report "Review into extending the regulatory frameworks to hydrogen and renewable gas", AGIG has written[10] to the AEMC on the final report. However, it is worth noting that in the report, when a service provider proposes to transport an alternative gas to natural gas, Section 3.5.1 of the report says that the proposal can only be justified when the overall economic value of the expenditure is positive. In this case, Multinet or AGIG have not provided a business case demonstrating this requirement.

In relation to MGN's opex, we consider that the range of activities outlined above are required in preparation for the rollout of hydrogen. Like the capex, it is difficult to ascertain the timing of such projects given the lack of detailed rollout plan.

For the reasons outlined in the discussion on the capex, we are unable to recommend the expenditure as prudent for the next AA period.

[10] IR021

4. MAINS REPLACEMENT

4.1 INTRODUCTION

Multinet Gas Network (MGN) proposed mains replacement program (both capex and opex) for the next regulatory period (2023/24 to 2027/28) is summarised in the following table:

Table 4-4-1: Mains replacement programs ($ million Real 2021)

Mains Replacement	Volume	Final Plan	GSR Response
Capex programs:			
Low pressure CI/UPS	704 km	xxxx	xxxx
Early generation HDPE	86 km	xxxx	xxxx
Medium pressure - steel	31 km	xxxx	xxxx
Reactive Service replacement	1731	xxxx	xxxx
Total capex		**$388.0**	**$386.0**
Opex programs:			
HDPE testing program		1.0	1.0
Reactive mains replacement		3.7	$3.7
Total Opex		**4.7**	**4.7**
Total expenditure		$392.7	$390.7

(Source: Capex Forecast Models: Final Plan and GSR Response)

Following submission of its Final Plan, MGN has undertaken an assessment of the potential impacts of the Victorian Government's Gas Substitution Roadmap (GSR), which has resulted in a range of revisions across capital and operating expenditures. With respect to the Mains Replacement program the impact is minimal with the number of proactive and reactive service replacements slightly reduced to take into account the forecast increase in disconnections for existing customers. In the above table the number of reactive service replacements has reduced from 1,770 to 1,731.

4.1.1 Current regulatory period

During the current period (January 2018 to June 2023) MGN's mains replacement program has:

- Continued replacement of low pressure mains with 530 km completed over the period 2018 to 2021 and another 128 km expected to be completed by end June 2023;
- Targeted replacement of all medium pressure cast iron (MP CI) mains, with 30 km replaced over the period 2018 to 2021 and a further 5 km expected to be replaced in 2022;
- Scheduled replacement of 2.3 km of early generation HDPE mains in 2022.

Note that the level of activity proposed to be completed during the current period is above that approved in the AER Final Decision. For comparison, the following table summarises MGN's revised proposal, submitted in 2017 following the AER Draft Decision, along with the AER Final Decision (2017):

Table 4-4-2: Mains replacement final decision relative to revised proposal (Nov 2017)

Type of replacement	Revised proposal		AER final decision	
Low pressure	531 km	xxxx	531 km	xxxx
Medium pressure cast iron	24 km	xxxx	12 km	xxxx
Early HDPE	40 km	xxxx	-	-
Reactive mains replacement	-	$1.0m	-	$1.0m
Unplanned service renewals	-	$5.7m	-	$5.7m
Total mains replacement	**595 km**	**$217.3m**	**543 km**	**$193.7m**

(Source: AER Final Decision: Attachment 6: section 6.4.2: Table 6.6)

4.1.2 Next regulatory period (2023/24 to 2027/28)[11]

Low pressure mains replacement. MGN estimates that there will be approximately 1,360 kilometres of low pressure mains left in the network by end of June 2023. During the next AA period MGN plans to remove a further 704 km of low pressure mains with the aim of eliminating all CI and UPS mains by 2033. MGN says that the length of mains replacement reflects the rate of replacement achieved during the first four years of the current period.

Early generation HDPE mains replacement. There is approximately 488 km of early generation HDPE mains across the network which MGN says are showing signs of deterioration as they reach the end of their useful life. During the next AA period they propose to target xxxx and xxxx sections of the network that MGN says *"contain the oldest of these mains, with leak rates higher than average. This section of the network is among the oldest in Victoria, containing a combination of different materials and construction types*". They propose to replace approximately 55 km of the early generation HDPE mains. They also propose to replace 27 km of aging MP steel mains and 4 km of newer HDPE (post 1980) that are interspersed with the HDPE, and then upgrade the area to high pressure.

Medium pressure steel mains replacement. MGN says that the xxxx network, comprising two discrete networks, has mains that are in poor condition. They propose to replace 20.9 km of steel and 2.4 km of early generation HDPE that is interconnected sporadically in the area, with new PE mains (24.3 km) over two projects and then upgrade the network to high pressure.

Reactive service replacement. The mains replacement capex program includes provision for replacement of services that fail and are beyond repair. The approximate volume of 354 services per year is based on historical volumes giving a total of 1,770 services. However, this volume has been reduced to 1,731 as a result of MGN's assessment of GSR impacts.

[11] Distribution Mains and Services Strategy: section 1.1; page 4.

Also included in the forecast are two opex programs:

HDPE testing program. MGN proposes to collect samples of early generation HDPE mains for analysis by Deakin University (in conjunction with the other two Victorian gas distribution businesses). The aim is to gain further understanding of the condition and failure mode of these mains and then to use this information to inform the priority order and replacement schedule for the remaining 433 kilometres of early generation polyethylene.

Reactive mains replacement. Provision is made for the reactive replacement of failed mains that are beyond repair.

4.1.3 MGN Network overview

MGN operates a gas distribution network in eastern Melbourne, which consists of 9,575 km of mains operating at high (140 kPa to 515 kPa) , medium (35 kPa to 210 kPa) and low pressures (up to 7 kPa). It also has 78 km of mains operating between 550kPa to 1050kPa.

The network age profile ranges from the late 1880s. Cast iron was prominent up to the late 1960s, steel (both protected and unprotected) was introduced in the early 1950s. PVC and PE were introduced in the early 1970s, with PVC being phased out in the early 1990s. PE is now the prominent material with 98% of mains constructed in the last ten years being PE.

4.2 LOW PRESSURE MAINS REPLACEMENT

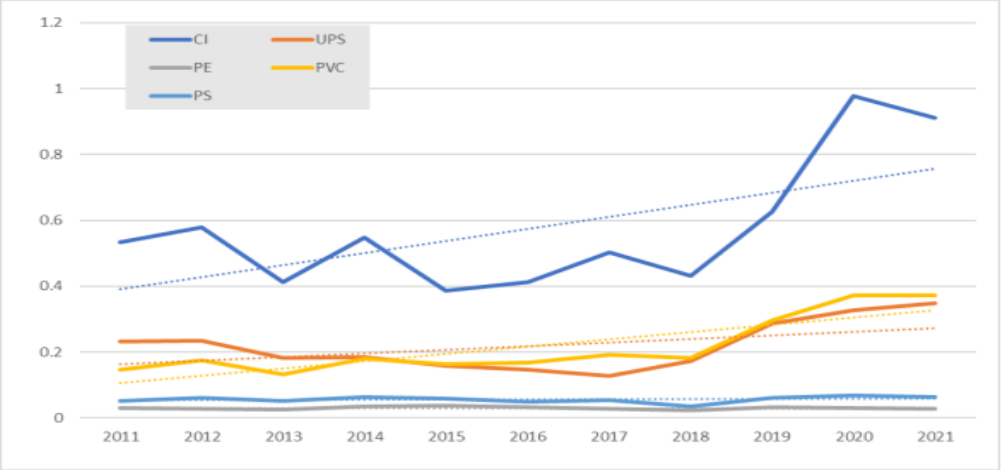
The mains replacement capex program to remove low pressure cast iron (CI) and unprotected steel (UPS) mains commenced in 2003. While the low pressure mains replacement program has a clear focus on cast iron and unprotected steel, it will also result in the replacement of the other low pressure materials which include PVC, protected steel and PE. At the end of 2021[12] there were approximately 819 km of cast iron, 125 km of UPS, 435 km of PVC, 60 km of protected steel and 23 km of PE, giving a total of 1,463 kilometres of low pressure mains. MGN estimates that this will reduce to approximately 1,360 kilometres by end of June 2023.

4.2.1 Asset condition

A key indicator of network condition is the **leak incident rate (LIR)** and is defined as the number of leaks per kilometre. MGN's Distribution Mains and Services Strategy, shows that the low pressure networks have significantly greater level of LIRs with this rate increasing markedly from 2018.

[12] Distribution Mains and Services Strategy: 3.4

Figure 4-1: Distribution mains leak incident rate by material



(Source: Distribution Mains and Services Strategy: Figure 3-6)

The above figure shows leaks[13] per kilometre by material type. This shows that cast iron experiences a relatively higher rate of leaks and is the major contributor to the poor low pressure network condition, followed by unprotected steel and PVC. It is noted that PVC is only found in the low pressure networks. These three material types constitute over 94% of the low pressure network.

With respect to cast iron leakage rate, during the previous AA review (2017) a similar figure showed a reducing trend from 2005 to 2015. This current figure shows a relatively flat trend up to 2018 and then the leak rate increasing to 2020, with 2021 then being a similar rate.

In response to IR020, requesting information relating to the upturn in leak incident rates for cast iron, unprotected steel and PVC since 2018, MGN advised that it is likely driven by a combination of factors:

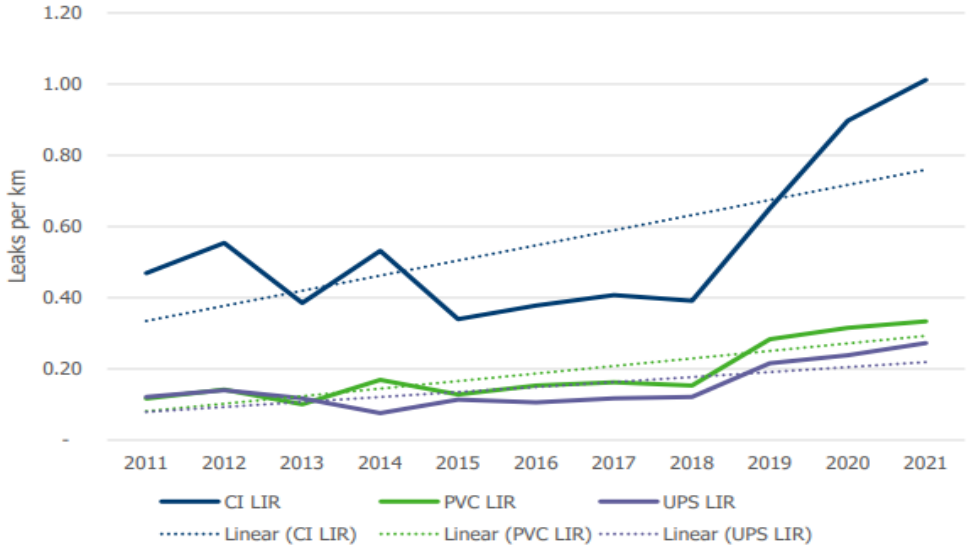
- Remaining low pressure mains are deteriorating at a faster rate than their replacement;
- Greater rainfall and wetter soils contributing to more water ingress and supply interruptions in low pressure mains; and
- Covid lockdowns where more people were at home and walking around their neighbourhood, reporting leaks through public reporting.

MGN also noted in its IR020 response that "*regardless of historic leak rates, a leak incident rate of 0.4-0.6 is 20-30 times the rate of polyethylene materials and represents a significant number of potentially fatal risk events each year across our networks. This has been the driver for the proactive replacement of these mains across Australia for the last two decades*".

While we would anticipate that the remaining old mains are continuing to deteriorate through corrosion faults, joint failures and full pipe fractures, the figure does not provide clarity as to historical asset condition trends for those mains currently remaining in the network. We therefore sought further details from MGN of LIR for those assets. The following figure shows the leak history for those assets remaining in operation. MGN notes that their dataset does not include leaks identified through leak survey and hence the full LIR is understated.

[13] Leaks: public reported or from leakage survey

Figure 4-2: Leak history of remaining low pressure mains (excluding leak survey)

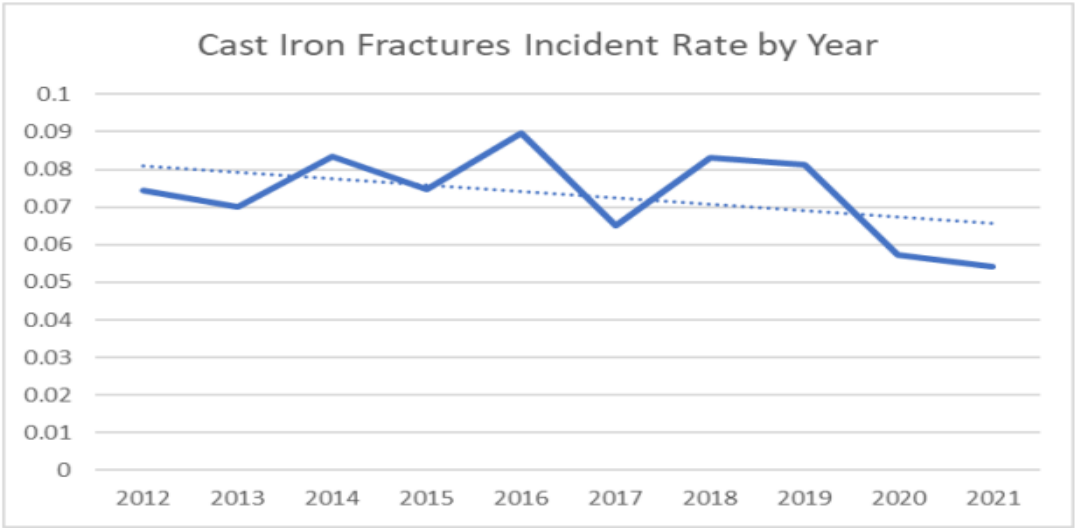


Source: IR009 Q1: Figure 1.

The above figure does confirm that the remaining low pressure assets are continuing to deteriorate, with each of the material types showing increasing trends of the leakage rate, particularly over the last few years.

Another key indicator of asset condition relates to the rate of fractures occurring on the mains. It is particularly important as these failures generally result in a greater release of gas. The following two figures shows **Fracture Incident Rate (FIR)** for cast iron from around 2012, with the latter figure representing FIR specifically of those mains still operational within the low pressure networks:

Figure 4-3: Cast iron fracture incident rate over time



(Source: Distribution Mains and Services Strategy: figure 3-8)

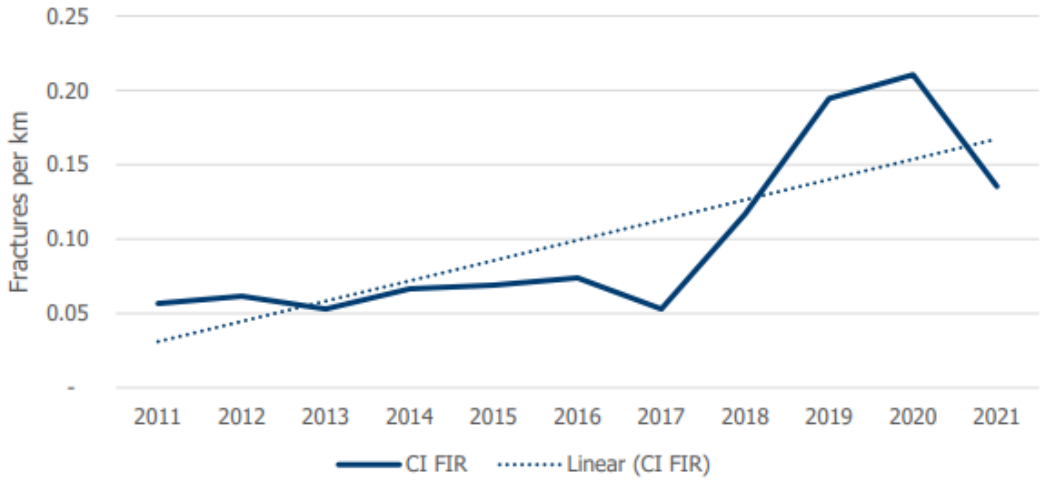
The above figure shows the number of fractures per kilometre of cast iron mains. This is known as the fracture incident rate (FIR). MGN has stated[14] that "*the FIR had been increasing over the 2001 to 2015 period and as a result they switched to a prioritised replacement and*

[14] Distribution Mains and Services Strategy: section 3.4.2

abandonment of areas with a high FIR. The result is reflected in the decreasing FIR over recent years".

Following a request for information specifically relating to the FIR history of remaining cast iron mains MGN has provided the following figure which shows that there is an increasing trend particularly over the last few years, further indicating that remaining mains are continuing to deteriorate .

Figure 4-4: Fracture incident rate on remaining low pressure mains (excluding leak survey)



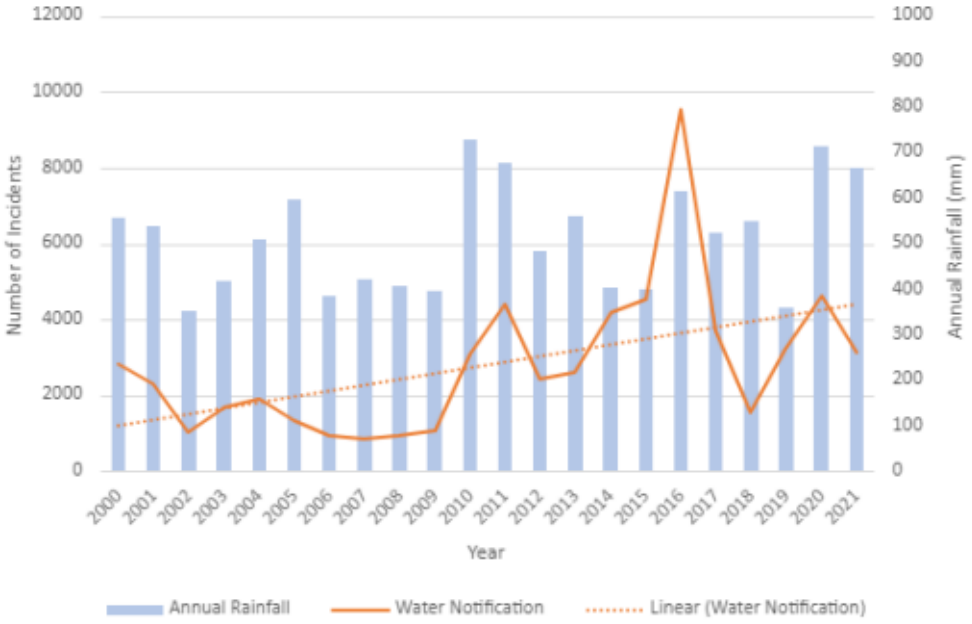
(Source: IR009 Q1: Figure 2)

4.2.2 Supply reliability

For low pressure networks, water in mains and services represents a supply reliability issue. The ingress of groundwater occurs due to breaks, corrosion and porosity and is an indicator that the pipe has reached the end of its useful life. As the water can travel through the mains and into good condition pipes it can be difficult to pinpoint the location of the source.

The number of water in mains and services incidents is largely dependent on weather conditions, however, the maintenance programs associated with "pumping syphons" can reduce the impact and volume of reactive water in mains incidents. The following chart shows water ingress incidents in the low pressure networks.

Figure 4-5: Water ingress incidents on LP pipes-annual rainfall



(Source: Distribution Mains and Services Strategy: Figure 3-12)

4.2.3 Risk Assessment

In its Asset Management Plan[15] MGN notes:

"*The principle driver for the low pressure replacement program is the 'societal risk' posed from the failure of cast iron mains and resulting risk of incidents leading to loss of life or significant property damage. The risk associated with cast iron is quantifiable and it is accepted by both UK and US safety regulators that cast iron is an obsolete material*".

MGN says that its CI/UPS mains are assessed as "High" risk and need to be replaced as soon as reasonably practicable as per AS 4645 requirements. This standard applies to the management of gas distribution networks in Australia and prescribes a risk management approach in accordance with ISO 31000. The risk event associated with these LP CI and UPS mains is a loss of containment leading to build up of gas in a building or other confined space in sufficient volumes to cause explosion if it comes into contact with an ignition source.

MGN considers[16] that by replacing 704 kilometres of CI and UPS mains over the next regulatory period, then they are taking all reasonable measures to remove the risk from the network at an efficient and achievable rate.

MGN said[17] they are committed to removing all low pressure cast iron and unprotected steel from its network by 2033, "*We remain committed to achieving or exceeding this milestone and have reiterated this to Energy Safe Victoria (ESV) throughout the development of this*

[15] Asst Management Plan: section 5.1.1
[16] Distribution Mains and Services Strategy: Appendix A.1.1
[17] Distribution Mains and Services Strategy: section 5.5.1

program for the next AA period". With respect to the remaining program, MGN[18] has indicated that they regularly engage with Energy Safe Victoria on its progress and the development of its ongoing program.

4.2.4 Asset condition analysis

Our analysis of leaks, fractures and water in mains all point to the fact that MGN's old low pressure mains are continuing to deteriorate at a rate that warrants the continuation of a strong mains replacement program over the next AA period. The initial information provided in MGN's Distribution Mains and Services Strategy along with the additional historical data for assets still operating, show that trends for leaks and fractures and water in mains are generally increasing.

In addition, MGN has the largest volume of low pressure mains remaining of the Victorian gas distribution businesses. The following table shows the length of low pressure mains by distribution network in Victoria in 1998 and at the end of 2021. As shown in the table below, MGN had the largest volume of low pressure mains in 1998 and in 2021 has still a considerable amount of low pressure mains remaining.

Table 4-4-3: LP mains – Victorian distribution businesses – length(km) (1998 to 2021)

Business	1998	End 2021	Replaced 1998 - 2021
Multinet	3,473	1,485	1,988
AGN	1,720	138	1,582
AusNet	2,151	361	1,790

(Source: IR004)

It is generally acknowledged that the old cast iron and unprotected steel mains in the low pressure networks pose a societal risk and need to be replaced. Given that the trend for leaks, fractures and water in mains indicate that the 1,360 kilometres of low pressure mains remaining, by end June 2023, are continuing to deteriorate and that MGN has a high percentage of LP mains, we would consider it prudent to continue with a strong mains replacement program.

4.2.5 Justification for replacing 704km low pressure mains

MGN is proposing the replacement of 704 kilometres, covering 32 postcodes with 51 individual projects. While this represents an increase from the current period where MGN expect to complete 658 kilometres (530 kilometres during 2018 to 2021 and a further 128 kilometres by June 2023), it generally aligns with its delivery rate during the earlier years of the current AA period. The proposed program is shown in the following table:

[18] IR004 and IR009 responses

Table 4-4-4: LP mains replacement forecast volumes and expenditure ($000, real 2021)

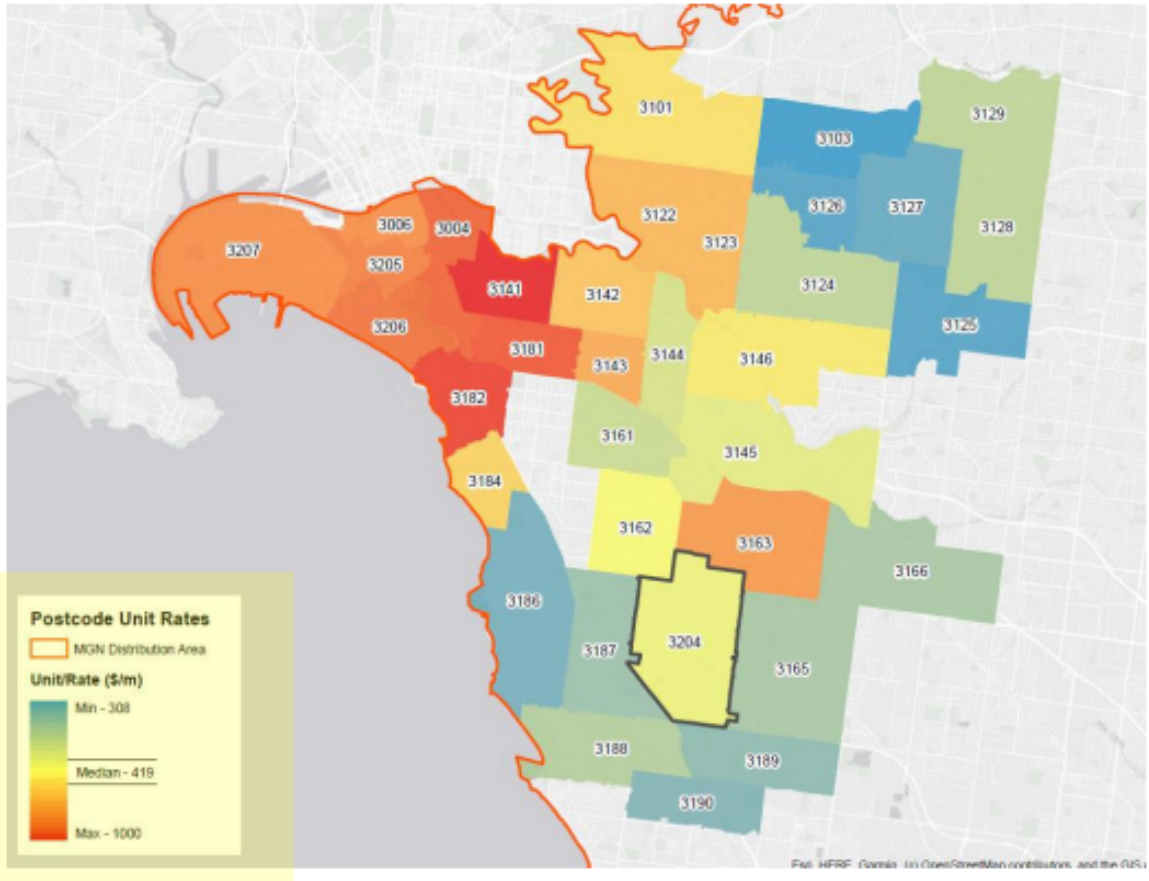
	2023/24	2024/25	2025/26	2026/27	2027/28	Total
Volume (kms)	140	139	141	141	144	704
Capex ($'000)	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx

(Source: GSR Response revisions: capex forecast model)

MGN's low pressure mains replacement program for next AA period is listed by postcode in the Distribution Mains and Services Strategy: Table 5-3. The table lists the postcode, suburb name and volumes to be replaced by year. The summation results in the total program by year for the regulatory period and as shown in the table above.

In response to question[19] from the AER, MGN has noted that its work program comprises a mix of lower and higher complexity areas to avoid a situation where all the high complexity works are at the end of the program while still focusing on areas with relative high cast iron gas main fractures and leaks from the cast iron and unprotected steel network. The following map shows the postcodes included in the mains replacement program for the next AA period, which cover a wide area of the MGN low pressure network:

Figure 4-6: Map of postcodes included in mains replacement program for next AA period



(Source: Distribution Mains and Services Strategy: Figure 5-4)
Note: Postcode 3161 is not included in program for next AA period

A key determinant as to the prudency of MGN's program relates to how the mains replacement program has been prioritised for the next AA period. The AER sought information regarding FIR and LIR for each of the postcodes proposed to be included in the

[19] IR004 response

program. In response[20], MGN outlined its prioritisation process and provided a table of postcodes that included their FIR and LIR over the last six year period (2017 to 2022 YTD).

The following table summarises the volume of mains replacement proposed for the next AA period and the levels of FIR and LIR reported for the postcodes:

Table 4-4-5: Low pressure mains replacement program: FIR and LIR

FIR		**LIR**	
≥0.20	73 km	≥2.0	12 km
≥ 0.10 and <0.2	130 km	≥ 1.0 and <2.0	55 km
≥0.05 and <0.10	276 km	≥0.5 and <1.0	312 km
<0.05	225 km	<0.5	325 km
Total	**704 km**		**704 km**

(Source: IR009: Q7)

Comparing fracture and leak rates to postcode data prepared in 2016, most postcodes now have lower fracture rates but leak rates have increased in the majority of postcodes. We consider that this continuing deterioration supports the need for a strong mains replacement program to continue.

MGN said[21] that "*prioritisation of the replacement of low pressure mains is based on:*

- *Primarily on fracture incident rates related to cast iron mains; and*
- *Secondarily on leak incident rates.*

Incident rates are aggregated at a postcode level and the overall program is prioritised having regard for:

• The availability or provision of high pressure assets;
• Existing and future supply constraints; and
• In general the practice of working inwards from the outer boundary of the low pressure network.

For the 2023/24 to 2027/28 period, the program prioritisation considers sensible staging of work packages so there is appropriate HP supply available to tie the replaced mains in to the surrounding network, and for deliverability, that there is a mix of higher unit rate and lower unit rate jobs each year (with unit rate being a proxy for complexity). There is also consideration of maintaining some geographical spread in the location of work crews who are working concurrently, so as not to introduce further complexities in terms of coordination, traffic management and disruption".

[20] IR009: Q7
[21] IR009: Q7

4.2.6 Low pressure mains replacement expenditure forecast

MGN says that its expenditure forecasting approach is consistent with the current period. The mains replacement program is made up of a number of individual job packages (projects) which are issued for competitive tender by its panel of pre-qualified contractors. There are four companies on the tendering panel[22].

MGN has noted[23] that its actual unit rates incurred for low pressure mains replacement in the current AA period have been below the benchmark in every year. MGN said it is as a result of the introduction of the contestable contractors' panel, which proved successful in reducing unit rates and exceeding volume targets for the current period.

MGN has developed unit rates for each postcode[24]. Further, the Distribution Mains and Services Strategy, Table 5-5 lists for each postcode, the estimation method used to determine the unit rates. MGN says that unit rates are developed using one or more of the following methods, in order of preference:

- Tender process – where works are sufficiently well defined, tenders are issued to its pre-qualified panel of contractors for a firm quotation.
- Historical rates – where a tender process is not practical, MGN rely on actual historical rates for works in the postcode.
- Street walks – where there is no previous works history, assessment is undertaken by street walks, density of the area and other available data.
- Density – MGN undertake postcode density correlation to establish unit rates in similar postcodes based on actual rates.

The unit rates vary significantly across the postcodes from xxxx for postcode 3103 (Balwyn, Balwyn East) up to xxxx for postcode 3141 (Chapel Street north, South Yarra) with the overall average unit rate being xxxx, which is significantly higher than for the current period. The increase reflects the increasing complexity of the projects as the program moves into higher density areas with more services per kilometres and areas requiring a greater level of traffic control, more expensive reinstatement requirements as well as the increasing labour and materials cost impacts.

From our analysis of the unit rate methodology used by MGN which includes a combination of competitive tenders, historical actual rates, density considerations and street walks we consider that the rates have been developed on a reasonable basis to reflect the best estimate of the work that will be undertaken over the next AA period and represent the best forecast possible in the circumstances.

4.2.7 Conclusion

It is recognised that the old cast iron and unprotected steel mains in the low pressure networks pose a societal risk and need to be replaced. Given that the trend for leaks, fractures and water in mains indicate that the 1,360 kilometres of low pressure mains remaining, by end June 2023, are continuing to deteriorate and that MGN has a high percentage of Low

[22] Unit Rates Report: section 4.1 summary.
[23] Unit Rates Report: section 4.2.3
[24] Distribution Mains and Services Strategy Table 5-4.

pressure mains, we would consider it prudent to continue with a strong mains replacement program.

The assessment of leak and fracture rates for each postcode also supports the need for a strong program to continue. On this basis we consider it prudent to continue with similar mains replacement volumes as achieved in recent years. We also consider that the methodology used to develop unit rates for each postcode, based largely on actual and competitive tendering processes can be expected to achieve the most cost effective expenditure forecast and is consistent with that approved by the AER for the current period.

We recommend approval of the MGN's proposed low pressure mains replacement program of 704 kilometres with an expenditure of xxxx.

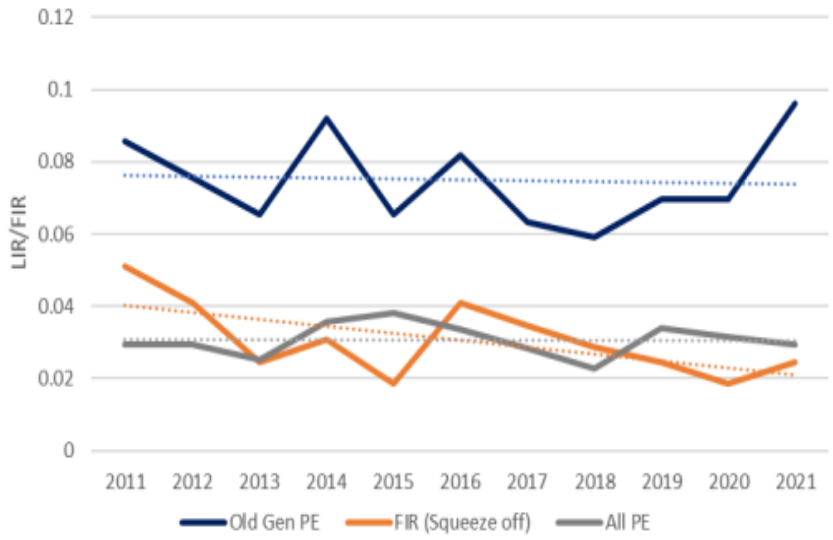
4.3 EARLY GENERATION HDPE MAINS REPLACEMENT

4.3.1 Asset Condition

The majority of the MGN network is now polyethylene (PE) mains, with the newer PE mains showing good asset condition. However, the early generation PE mains (also referred to as high density polyethylene (HDPE)), introduced in the early 1970s, have been shown to be more susceptible to brittle failures because of slow crack growth through the pipe wall. These failures are referred to as fractures or breaks and are typically associated with early squeeze-off procedures. Studies have shown that such failures can occur decades after the squeeze-off has occurred and hence these failures are now becoming more prevalent particularly for mains with the early generation PE material.

MGN[25] has 488 kilometres of early generation HDPE mains which it says were installed before 1980. Of this length approximately 120 kilometres are installed on the medium pressure network, and the majority installed on the high pressure network.

Figure 4-7: PE mains leak and fracture incident rate comparison



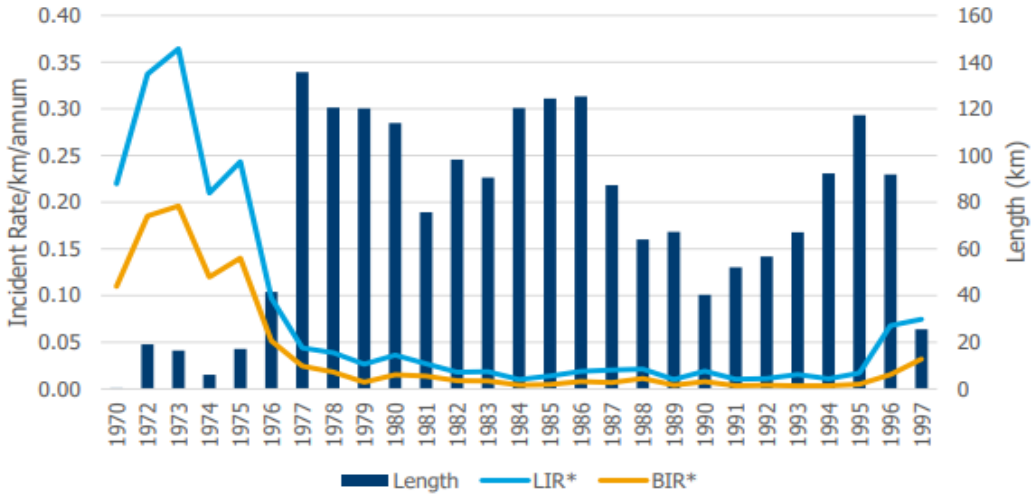
(Source: Distribution Mains and Services Strategy: Figure 3-9)

[25] Distribution Mains and Services Strategy: 5.6.2

MGN says[26] that "*since 2011 the early generation PE network has had an average of 0.079 leaks/km. This is over twice that of the PE network which averaged 0.031 leaks/km for the same period*".

In response to AER (IR009) request for further details of asset condition for early generation HDPE, MGN has provided the following figure showing leak and fracture/break rates by age of main.

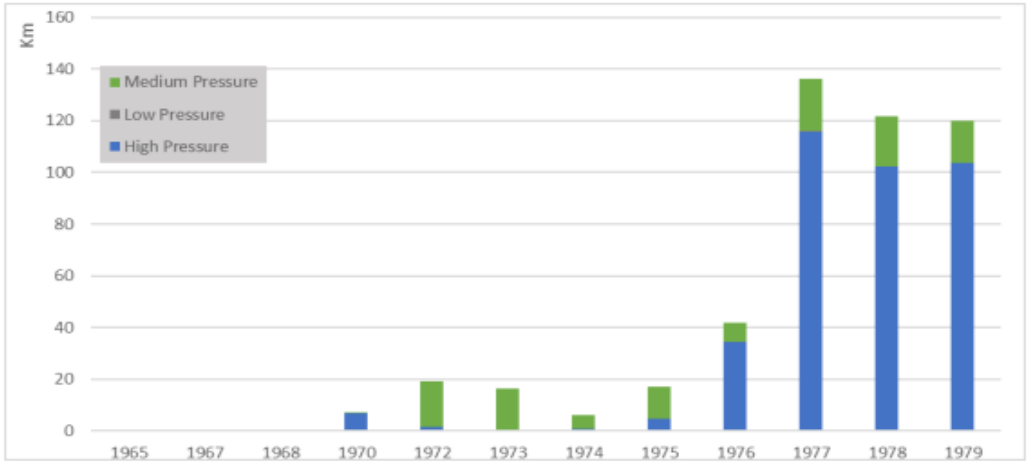
Figure 4-8: Leaks and breaks on early generation PE mains by age (excluding leak survey)



Source: IR009 Q4: Figure 5

The above figure shows that the oldest PE mains have experienced significantly greater incident rates of leaks and fractures than the newer PE mains. The FIR for the oldest PE mains in particular is at a level higher than reported for many of the low pressure mains replacement postcodes.

Figure 4-9: Early generation HDPE volumes by construction year



(Source: Distribution Mains and Services Strategy: Figure 5-6)

The above figure of volumes by pressure and age shows that mains laid in 1972 to 1975 were almost exclusively medium pressure. Comparing the two figures indicates that the old

[26] Distribution Mains and Services Strategy: 5.6.2

medium pressure PE mains have the highest rate of leaks and fractures. This analysis supports the view that the old medium pressure PE mains are likely to be in poorer condition compared to the newer PE mains. MGN says[27] that it is these mains that they are targeting for replacement during the next AA period. Spatial maps included in MGN's Distribution Mains Strategy (section 4.4), dated December 2016, confirm the location of the oldest PE mains being in the xxxx and xxxx area. The maps also show location of leaks and fractures.

In response to IR020, requesting further details to support the priority replacement, MGN has provided the following table which shows leaks and breaks data by postcode for older early generation HDPE.

Table 4-6: Older earlier generation HDPE leaks and breaks by postcode 2000-2021

xxxx	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx
xxxx	xxxx	39.8	169	286	7.68	13.00	0.19	0.33
xxxx	xxxx	0.6	3	3	0.14	0.14	0.23	0.23
xxxx	xxxx	0.5	2	2	0.09	0.09	0.19	0.19
xxxx	xxxx	41.9	76	155	3.45	7.05	0.08	0.17
xxxx	xxxx	2.8	3	8	0.14	0.36	0.05	0.13
xxxx	xxxx m	10.8	8	30	0.36	1.36	0.03	0.13
xxxx	xxxx a	3.3	3	8	0.14	0.36	0.04	0.11
xxxx	xxxx	5.2	6	10	0.27	0.45	0.05	0.09
xxxx	xxxx	1.9	1	3	0.05	0.14	0.02	0.07
xxxx	xxxx	17.4	9	27	0.41	1.23	0.02	0.07
Total		xxxx	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx

Note these postcodes contain small lengths of mains with few failures
(Source: IR020)

The above table shows that xxxx and xxxx areas do have the highest volume and rate of leaks and breaks.

4.3.2 Early generation HDPE mains replacement program

MGN has identified xxxx and xxxx as sections of the network that it says[28] "*contain some of the oldest HDPE mains*". IR020 notes that these areas have mains consisting of thin wall HDPE Class 250 material, which is known to be brittle and subject to replacement programs in other Australian distribution networks.

MGN proposes[29] a program of five discrete projects to decommission 86 kilometres of mains in xxxx and xxxx, replacing them with PE and then upgrading the area to high pressure. The length of mains to be replaced, by material type, are shown in the following table.

[27] IR009 Q4: page 5 and 6
[28] Distribution Mains and Services Strategy: section 1.1.2.
[29] Distribution Mains and Services Strategy: section 5.6.1

Table 4-4-7: Early generation HDPE project-volume to be replaced

Replaced Mains	Length
Early HDPE	xxxx
PE (1980+)	xxxx
MP steel (<80mm)	xxxx
MP steel (>80mm)	xxxx
Total	**86.1 km**

Source: Distribution Mains and Services Strategy: Figure 5-6 and 5-7

The unit rates and component costs are summarised in the following table:

Table 4-4-8: Early generation HDPE project – unit rates and cost ($000, real 2021)

New mains	Unit Rate	Cost
63P10 main	xxxx	xxxx
Upgradable mains (MP – HP)	xxxx	xxxx
125P10 grid main	xxxx	xxxx
Total cost	xxxx	xxxx

(Source: Distribution Mains and Services: section 5.6 and 5.7)

The unit rates were developed using the following methodology:

- 63P10 mains: MGN says[30] this unit rate is an average rate of two estimates prepared by xxxx, an independent estimator pricing[31] and a tendered project.
- Uprating unit rate: is based on past similar tendered projects.
- 125 P10 grid mains: analysis of past gas grid main components of mains renewal.

For the 63P10 mains, MGN have developed a unit rate which they said is "*the average of the* xxxx xxxx *tender prices, and the two independent estimator prices*". However the proposed unit rate was higher any of the three unit rates noted in the Distribution mains and Services Strategy. As a result we sought further information to explain how the unit rate was calculated. MGN's IR021 response clarified that the estimated rates were prepared in 2016 and had not been updated in the Distribution Mains and Services Strategy document to reflect 2021 dollars. MGN also noted in the response that a weighted average should have been applied. While we accept that the estimates need to reflect 2021 pricing it is unclear how the weighted average was to be applied. As a result we recommend acceptance of the unit rate of xxxx as used in the calculation of the project.

However, it is not obvious how these three unit rates have been applied to achieve an even higher "blended" unit rate for the 63P10 mainlaying portion of the projects.

4.3.3 Conclusion

The LIR of 0.079 for early generation HDPE is double that of other PE population, and ten times lower that the cast iron mains. We consider that this rate by itself does not flag a need for priority replacement of the early generation PE. However, as noted in section 4.3.1 above and

[30] Distribution Mains and Services Strategy: section 5.6.3
[31] IR021 Q6 response. Estimates updated to 2021 dollars

examples given in IR009 Q4 response, the oldest PE mains, laid from 1972 to 1975, show LIR of up to 0.35 leaks/km and FIR of up to 0.2 fractures /km. Table 4-6 above, showing leaks and breaks data by postcode also shows that xxxx and xxxx have mains in deteriorated condition and higher than the LIR for the early HDPE population overall.

The HDPE Class 250 mains are not suitable for repair, being thin wall and relatively brittle. Sudden cracking of these medium pressure mains can result in large volumes of gas escaping with the inherit risks associated with such incidents. MGN has noted the replacement program has targeted these "highest risk polyethylene assets" which is supported in our analysis.

With respect to the medium pressure steel mains within the project area, MGN[32] says in its option analysis that the legacy steel is in poor condition and *"as such the pressure cannot be rationalised to high pressure as doing so would result in multiple leaks, asset failure and costly reactive repairs".* MGN's response to IR009 Q5 describes the xxxx assets and provides photographic evidence of mains that supports their view that the mains are in poor condition. Given the proximity of these medium pressure mains to those in xxxx we would expect that they present a similar condition.

Together the old PE mains and steel mains indicate that this medium pressure network is in relatively poor condition. While the key driver is improving safety and security of supply resulting from addressing the level of leaks and fractures associated with these mains, there is also benefit of upgrading the "island" network to high pressure and providing improved supply capacity and enabling the decommissioning of regulator stations.

Based on our review of information provided, including IR009 and IR020 responses, along with our review of MGN's 2016 Distribution Mains Strategy, we consider that replacement of the old medium pressure PE and steel mains represents good gas industry practice. We therefore consider that the replacement program is prudent in the circumstances.

With respect to the cost estimate for the program of projects, we have reviewed the two xxxx estimates and consider them to be well developed, and the third unit rate arising from competitive tender process to be appropriate. Following clarification of the unit rate calculation (IR021) for the 63P10 mainlaying component of the cost estimate, we recommend approval of the program cost estimate as reasonable in the circumstances.

4.4 MP STEEL MAINS REPLACEMENT

MGN said[33] "*the* xxxx *network was built in the 1960s and is haphazard mixture of protected and unprotected steel designed to operate at low or medium pressure. Many of the mechanical fittings and service connections are not adequate to contain high pressure, and cathodic protection in the area has been ineffective, resulting in corrosion. This network was previously a part of the colonial gas network. It is built from an assortment of connections and fittings that are no longer approved for use. Growth in the area means the network should be uprated to high pressure to keep pace with demand, however, the network is unsuitable for pressure above 140 kPa. Each of the* xxxx *networks are isolated from the surrounding networks and are each supplied by single-feed ageing field regulators. Past attempts to raise pressure*

[32] Distribution Mains and Services Strategy: Appendix B (option 3 analysis)
[33] Distribution Mains and Services Strategy: section 5.7

above 140kpa resulted in significant leakage and gas escape, meaning it cannot be interconnected with the surrounding networks in its current state. This network cannot maintain supply if it were lowered to Medium pressure".

This program will replace two isolated aged steel networks. One is a medium pressure network which is surrounded by higher pressure networks and fed by a single field regulator (xxxx). The other is a custom network which operates at 140kpa (xxxx).

In response to the AER request for further information regarding asset condition and justification to support these replacement projects (IR 009 Q5), MGN said that it has progressively uprated and connected MP sections into surrounding HP networks. However, these two remaining areas could not be uprated and interconnected due to "systemic issues with corrosion and fitting leaks". The network cannot maintain supply if it were lowered below 140 kPa. Investigation have concluded that proactive replacement is "*the most effective and efficient way to address the safety and reliability concerns these networks pose*". MGN's response also includes an extensive list of investigations and reactive works undertaken along with a number of photos showing deteriorated asset condition.

The proposed program is to install 24.3 kilometres of new PE mains in xxxx over two projects. The projects will abandon 20.9 kilometres of steel at the end of its life, as well as 2.4 kilometres of early generation HDPE that is interconnected sporadically in the area. Once construction is complete the network will be uprated from medium pressure to high pressure and integrated into the surrounding high pressure networks, increasing security of supply and capacity of the network for current and future customers.

The program mains length laid, unit rates and cost are shown in the following table:

Table 4-4-9: MP steel replacement ($000, real 2021)

New mains	Unit Rate	Length laid (m)	Cost
63P10 main	xxxx	xxxx	xxxx
Upgradable mains (MP – HP)	xxxx	Xxxx	xxxx
125P10 grid main	xxxx	Xxxx	xxxx
Total cost	xxxx	**30,588**	xxxx

(Source: Distribution Mains and Services Strategy: Table 5-7 and 5-8)

The cost estimate unit rates, shown above, were developed using the same methodology as outlined for the early generation HDPE mains replacement program.

The MP steel mains replacement program consists of two projects summarised as follows:

Table 4-4-10: MP steel mains replacement

Project	Year	Mains replaced	Capex
xxxx	2023	xxxx	xxxx
xxxx	2024	xxxx	xxxx
Total		**30.5 km**	xxxx

(Source: Distribution Mains and Services Strategy: section 5.7)

4.4.1 Conclusion

This program, consisting of two projects, will abandon 20.9 kilometres of steel at the end of its life, as well as 2.4 kilometres of early generation HDPE that is interconnected sporadically in the area. On completion the two medium pressure island networks will be upgraded to high pressure increasing security of supply with improved capacity.
Based on our review of the initial and subsequent information provided we consider that the replacement of these aging and poor condition assets is good gas industry practice and prudent in the circumstances.

With respect to the cost estimate for the program of projects and based on our comments in the early generation HDPE section, we recommend that the unit rate of xxxx is efficient in these circumstances.

4.5 REACTIVE SERVICE REPLACEMENT

MGN has over 700,000 inlet services connecting mains to customer meters. A service asset comprises a service pipe, fittings, and metallic upstand with ball valve. The reactive service replacement program provides an allocation of capital expenditure to allow for piecemeal replacement of faulty services that are not suitable for repair. The program excludes service replacement associated with the planned mains replacement program as well as third party damages and customer initiated works.

In response to IR020 requesting further information relating to the trend of an increasing number of reactive service replacements, MGN has advised that medium and high pressure service replacements are the key driver, "*reflecting the age profile and deterioration of these services which are made up of steel and early polyethylene materials*". Low pressure service replacements have also increased since 2018, likely associated with ongoing deterioration of these mains and services, water ingress and repeat interruptions and an increase in public reporting of leaks during the covid lockdowns where more people have been at home and around local neighbourhoods.

Forecast service replacements is based on the historical average volume over the past three years (2019 to 2021), noting that there has been an increasing number of replacements in recent years, to achieve a forecast of 354 services per year or 1,770 for the period.

Following its assessment of GSR impacts, and potentially greater number of disconnections during the next AA period, MGN has reduced the forecast to 1,731 service replacements.

With respect to unit cost, this can be significantly impacted due to the varying costs associated with larger service replacement and geographical location. MGN also noting that high pressure domestic service replacement are more expensive than low pressure service replacements. The information shows that domestic low pressure and domestic high pressure service replacements account for approximately 93% by volume and 84% by cost.

MGN has applied a weighted average of the actual historical costs (which have been the subject of a competitive tender process) to determine the forecast average unit rate of xxxx. Calculation method to determine the forecast unit rate appears to be reasonable.

For comparison with the current period, the AER approved benchmark was xxxx service replacements at a unit rate of xxxx, totalling $6.0 million.

Based on the trend of service replacements, it is reasonable to accept MGN's three year average methodology in terms of volume and expenditure.

Table 4-4-11: Reactive Services replacement ($000, Real 2021)

	Revised Volume	Unit cost	Expenditure
Service replacements	1,731	xxxx	xxxx

(Source: Distribution Mains and Services Strategy: Table 5-12 and GSR revised Capex Model)

The forecast volume reflects the three year average of the current period which has been further discounted due to GSR impacts. Unit rates reflect the current period three year average, which is slightly lower than the AER approved benchmark for the current period. We recommend the volume and expenditure forecast as prudent and efficient.

4.6 HDPE ASSESSMENT PROGRAM

MGN propose collecting 20 samples of HDPE per year for analysis by Deakin University. This is part of a joint Victorian gas distribution business research project with the University. This program aims to provide a better understanding of the condition and failure modes of these mains which MGN will then use to determine the priority order and replacement schedule for the remaining approximately 433 kilometres of early generation HDPE. The samples will be collected across the network with focus on high risk areas and also from the HDPE replacement projects.

In response to question from the AER[34], MGN noted that there is little information regarding the "end of life" for the HDPE 575 mains and more work is required so they can put strategies in place to minimise their risk. Deakin University and Future Fuels CRC have expertise to undertake laboratory testing and to further develop theoretical models, and are NATA approved. Deakin will provide a final report summarising all test results and a high level analysis of trends visible in the data. This will feed into a new mains replacement strategy document. They note risk reduction activities may include a combination of:

- Camera inspections
- Repairing/replacing squeeze-off points
- Clamp design and selection
- Replacement of mains

MGN estimate that this program will cost $0.998 million and will be included in its Operating Expenditure (Opex) forecast. The estimate comprises:

Table 4-4-12: HDPE sampling and testing program – Opex ($2021 real)

Item	Input	Opex
Deakin University (1/3 share)	xxxx	xxxx
HDPE cameras	4 cameras	xxxx
Sample retrievals	100 samples @ xxxx	xxxx
Total Opex		**$998,000**

(Source: Unit Rates Report: section 4.5.2)

[34] IR009: Q6

We consider that this analysis will broaden the distribution networks understanding of how their early generation PE assets are performing across the networks and provide further insight as to their potential field life. As such the study should enable a best practice approach to management and ultimate replacement of these assets. We therefore consider this project to be prudent and efficient and recommend its approval by the AER.

4.7 REACTIVE MAINS REPLACEMENT

Provision is made for the reactive replacement of mains when repair is not possible or cost effective. The work volume and expenditure will vary from year to year and MGN says the primary driver behind these projects was supply faults caused by water ingress into low pressure mains.

During the access arrangement review for the current period, MGN[35] stated "*The program typically covers the replacement of mains sections less than 60m in geographical areas of the gas distribution network, where the planned mains replacement program is not scheduled to take place within the immediate future*".

However, in its current strategy document MGN has listed its reactive mains replacement conducted over the last three years (2020 to 2022), all of which indicate significantly longer lengths being replaced. These range from 160 m up to 1,600 m. Over the eight projects listed the average length of replacement is xxxx at an average cost of xxxx per mains replacement. Over the three year period the average expenditure was xxxx per year, which MGN has applied as its forecast for the next regulatory period giving a total spend of $3.650 million.

During the current period the reactive mains replacement provision approved by the AER was $200k per year, totalling $1.0 million for the AA period.

With a significant discrepancy between what was approved for the current period and works undertaken during the period we sought further information. MGN's response to IR021 said that the works were *"in response to water ingress issues within the LP network and corrosion faults and cathodic protection issues within the MP and HP steel networks*". Initial repairs proved to be unsuccessful and MGN carried out reactive mains replacements with longer lengths to tie into nearby HP mains, "*where supply issues could only be resolved by upgrading to HP*". While we recognise that there needs to be a provision for reactive mains replacement, we question whether the use of the projects listed by MGN appropriately represent reactive mains replacement as previously defined. Therefore, while these projects may be ad-hoc, unplanned mains replacements they do not appear to be "reactive" replacements.

MGN says[36] that it proposes a similar approach in the next AA period to address similar issues. We consider that this approach differs from traditional application the methodology based on three year historical average for expenditure as appropriate but wish to draw the AER's attention to the fact that MGN's proposed reactive mains replacement has provision for much longer ad hoc replacements and as a result significantly higher expenditure provision.

[35] Distribution Mains Strategy: CY2017 – CY2022: section 4.5
[36] IR021 Q7

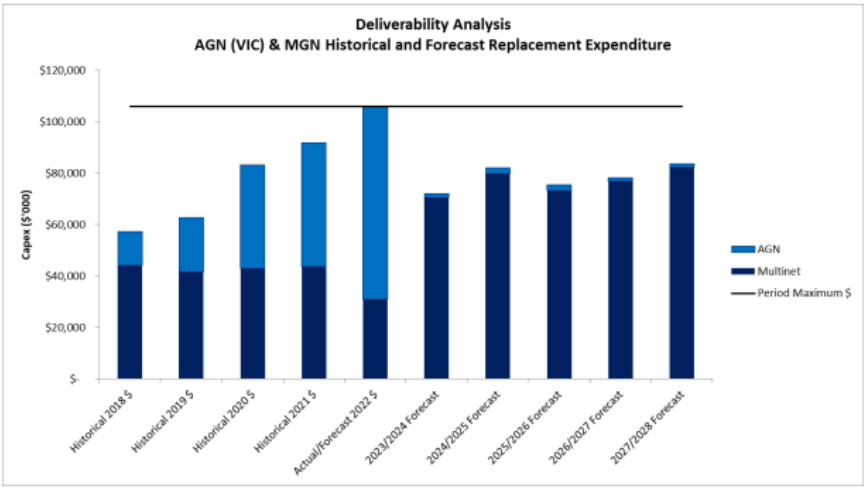
Given the definition of reactive mains replacement, we question whether the last three years replacement is reflective of the future AA period. We are unable to recommend the provision as efficient. However, we also suggest that the AER could consider that it does represent the current provision of $200k per year or $1.0 million as a prudent and cost effective approach in these circumstances and therefore recommend approving a placeholder, until MGN justify the additional expenditure.

We also note the classification of the expenditure is proposed to be changed from historically being capex to Opex. In IR021, MGN notes that it proposes the change so that it is consistent with AGN SA networks. As this is not a technical issue, we refer the matter to the AER for resolution.

4.8 DELIVERY CAPACITY

MGN says[37] that its "*forecast program of mains replacement can be delivered cost effectively and efficiently utilizing the existing AGIG resource base within Victoria*". During the current regulatory period AGN and MGN (both part of AGIG) shared resources to enable AGN to complete its low pressure mains replacement program. The following figure shows the combined expenditure of the two businesses during the current and next periods.

Figure 4-10: AGN and MGN combined expenditure for mains replacement 2018 to 2028



(Source: Distribution Mains and Services Strategy: figure 5-2)

Zincara agrees that this approach should enable MGN's program to be sufficiently resourced for not only the low pressure mains replacement program but also for its other mains replacement projects.

[37] Distribution Mains and Services Strategy: section 5.3

4.9 STAKEHOLDERS' SUBMISSIONS

Submissions received from various stakeholders have recommended [38] that "*mains replacement should not be justified on hydrogen compatibility or augmentation grounds*". Also that the program is not "*fast tracked or expanded with the intention of accommodation of hydrogen blends*". Further they recommend that "*Proposed replacement programs must be supported by clear evidence of the safety risks under which they have been proposed. This should include an evaluation for the entire asset included in the proposal for replacement, i.e., the potential for a smaller program should be considered*".

Report prepared by TRAC partners suggests consideration to "*the AER should test whether MGN has analysed what, if any, additional risks arise if this program were to be extended over a longer period.*"

Another[39] noted "*proposed replacement capital must be for safety reasons, and supported by clear evidence, a business case and consideration of all options*".

We acknowledge the issues and recommendations included in stakeholder submissions and we have endeavoured to address these with our technical assessment of MGN's proposed mains replacement program. In particular our focus has been on whether asset's condition warrants replacement during the next AA period and in this regard we felt it necessary to seek additional information via the AER's information requests. We also considered whether the size of the program was prudent. We also made assessment as to the efficiency of the cost estimates. Our conclusions are summarised below.

4.10 SUMMARY

A summary of MGN capex and opex program are shown in the table below.

Table 4-4-13:Mains replacement program – volumes and expenditure ($million, real 2021)

Mains Replacement	Volume	GSR Response
Capex programs		
Low pressure CI/UPS	704 km	xxxx
Early generation HDPE	86 km	xxxx
Medium pressure - steel	31 km	xxxx
Reactive Service replacement	1731 services	xxxx
Total capex		**$386.0**
Opex programs		
HDPE testing program		$1.0
Reactive mains replacement		$3.7
Total Opex		**$4.7**
Total expenditure		**$390.7**

(Source: GSR response: Capex Forecast Model)

[38] Submission from Brotherhood of St. Laurence
[39] Darebin Climate Action Now

4.10.1 Low pressure mains replacement

Our analysis of leaks, fractures and water in mains and services incidents show that the remaining low pressure mains are in relatively poor condition and continuing to deteriorate, particularly cast iron, and unprotected steel. We also note that PVC mains are experiencing increasing rates of leaks, with similar levels to unprotected steel. The assessment of leak and fracture rates for each postcode also supports the need for a strong program to continue and also provides a basis for prioritising postcodes.

At the end of the current AA period, MGN will have approximately 1,360 kilometres of low pressure mains still operating within its networks compared to relatively small lengths in other Australian distribution businesses. Good industry practice worldwide suggests that a significant mains replacement program is appropriate. In its Asset Management Plan[40] MGN notes:

"*The principle driver for the low pressure replacement program is the 'societal risk' posed from the failure of cast iron mains and resulting risk of incidents leading to loss of life or significant property damage. The risk associated with cast iron is quantifiable and it is accepted by both UK and US safety regulators that cast iron is an obsolete material*".

We consider it prudent to continue with similar mains replacement volumes as achieved in recent years. We also consider that the methodology used to develop unit rates for each postcode, based largely on actual and competitive tendering processes can be expected to achieve the most cost effective expenditure forecast and is consistent with the methodology approved by the AER for the current period.

We recommend approval of MGN's proposed low pressure mains replacement program of 704 kilometres with an expenditure of xxxx.

4.10.2 Early Generation HDPE mains replacement

The proposed program is to decommission 86.1 kilometres of medium pressure mains in xxxx and xxxx, replacing them with new PE and then upgrading the area to high pressure. This includes replacement of 54.5 kilometres of "oldest early generation HDPE mains" and 27.4 kilometres of poor condition steel mains. There is also a relatively small length of PE mains that can be upgraded without replacement.

Our assessment of the leaks and fracture rates of these oldest HDPE mains is that they are in poor condition. Similarly, the steel mains are such that they cannot be upgraded from medium pressure due to their condition. Based on our review of information provided, including IR009 and IR020 responses, we consider that replacement of the old medium pressure PE and steel mains represents good gas industry practice, will enable the area to be upgraded to high pressure and also enables the decommissioning of aging medium and high

[40] Asst Management Plan: section 5.1.1

pressure regulating stations. We therefore consider that the replacement program is prudent in the circumstances.

With respect to the cost estimate for the program of projects, we have reviewed the two xxxx estimates and consider them to be well developed, and the third unit rate arising from competitive tender process to be appropriate. MGN has clarified our query with respect to unit rate calculations for the 63P10 mainlaying component of the cost estimate. As a result we recommend that the unit rate of xxxx is efficient in these circumstances

4.10.3 MP steel mains replacement

This program, consisting of two projects, will abandon 20.9 kilometres of steel at the end of its life, as well as 2.4 kilometres of early generation HDPE that is interconnected sporadically in the area. On completion the two medium pressure island networks will be upgraded to high pressure increasing security of supply with improved capacity.

Based on our review of the initial and subsequent information provided we consider that the replacement of these aging and poor condition assets is good gas industry practice and prudent in the circumstances.

Similar to the HDPE project above, MGN has clarified its calculation of unit rate for the PE mainlaying component of the cost estimate and as a result we recommend that the unit rate of xxxx is efficient in these circumstances.

4.10.4 Reactive service replacement

The reactive service replacement program provides an allocation of capital expenditure to allow for piecemeal replacement of faulty services that are not suitable for repair. The program excludes service replacement associated with the planned mains replacement program as well as third party damages and customer initiated works.

The forecast volume reflects the three year average of the current period which has been further discounted due to MGN's assessment of GSR impacts. The unit rates reflect the most recent three year average (2019 to 2021). The forecast volume and unit rates are both slightly lower than the AER approved benchmark for the current period. We recommend the volume and expenditure forecast as prudent and efficient.

4.10.5 HDPE assessment program (Opex)

MGN propose collecting 20 samples of HDPE per year for analysis by Deakin University. This is part of a joint Victorian gas distribution business research project with the University. This program aims to provide a better understanding of the condition and failure modes of these mains which MGN will then use to determine the priority order and replacement schedule for the remaining approximately 433 kilometres of early generation HDPE. The samples will be collected across the network with focus on high risk areas and also from the HDPE replacement projects.

We consider that this analysis will broaden the Victorian distribution networks understanding of how their early generation PE assets are performing across the networks and provide further insight as to their potential field life. As such the study should enable a best practice approach to management and ultimate replacement of these assets. We therefore consider this project to be prudent and efficient and recommend its approval by the AER.

4.10.6 Reactive mains replacement (Opex)

The reactive mains replacement program provides an expenditure allocation for the ad hoc replacement of short sections of mains when repair is not possible or cost effective. The actual work volume and expenditure varies from year to year and MGN says the primary driver behind these replacements was supply faults caused by water ingress into low pressure mains.

During the current period, the AER benchmark was set on the basis of small (typically less than 60m) sections of mains replacement, with the total provision being $1 million. However, for the forecast period MGN has based its forecast on a three year (2020 to 2022) historical average of ad hoc mains replacements with much longer lengths. MGN has also proposed to categorise these replacements as Opex, compared to the current period where the expenditure was capitalised, to align with AGN's SA networks.

We consider the methodology based on three year historical average for expenditure as appropriate but wish to draw the AER's attention to the fact that MGN's proposed reactive mains replacement has provision for much longer ad hoc replacements and as a result significantly higher expenditure provision. We do however, consider that MGN's approach, as explained in IR021, to address the particular issues is prudent and efficient in these circumstances.

Given the definition of reactive mains replacement, we question whether the last three years replacement is reflective of the future AA period. We are unable to recommend the provision as efficient. However, we suggest that the AER could consider the current provision of $200k per year or $1.0 million as a placeholder, until MGN justify the additional expenditure.

On the matter of whether the provision should be capex or opex, we note that MGN's IR021 response indicates that it is driven by a desire to align with the AGN SA networks. As this is not a technical issue, we refer the matter to the AER for resolution.