Zincara

From strategy to action

AER Access Arrangement 2017

AGN

Prepared for

AUSTRALIAN ENERGY REGULATOR

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1. EXECUTIVE SUMMARY

The AER has engaged Zincara to provide technical advice on a number of matters related to the AGN's capital expenditure. They include:

- Augmentation
- Connection
- Mains Replacement
- Other Capex
- Meter Replacement
- SCADA

In carrying out the review, Zincara has taken into consideration the requirements of the National Gas Law and the National Gas Rules. Zincara's approach was to review the submission provided by AGN and responses provided by AGN resulting from clarification sought by the AER.

The results of the assessment are discussed below.

1.1 AUGMENTATION

AGN proposes an augmentation capex of $28 million for the next AA period. Details of the capital expenditure are shown in the table below.

Table 1: Augmentation Projects ($million, 2017, direct)

Augmentation	2018	2019	2020	2021	2022	Total
Dandenong – Crib Point	3.7	6.9	3.5	-	-	14.0
Cranbourne HP	0.9	1.2	3.3	1.7	1.7	8.8
City Gate and CTM upgrades	0.5	0.5	0.4	0.8	0.4	2.4
Other	0.7	0.8	0.3	1.0	-	2.8
Total	**5.7**	**9.3**	**7.4**	**3.5**	**2.1**	**28.0**

(Source: AAI: Table 8.10)
Note: Totals may not add up due to rounding error.

Zincara has reviewed the scope of the project, its timing and its justification.

Dandenong – Crib Point Pipeline (DCP)
The project involves the construction of the last stage of the duplication of the DCP. The 4km x DN450 steel pipeline is required due to the increased gas demand in the area and will also assist in mitigating any risk associated with the pigging of the pipeline.

Cranbourne HP
The project consists of nine gas mains augmentation projects ranging from small to relatively large new mains and new city gate stations. The projects are required to meet the expected load growth in the area.

City Gates and CTM Upgrades
This project involves the upgrade of the Berwick, Lindrum Road and Sale city gates. The upgrades are required to address the excessive noise from the city gates and also the increasing gas demand.

Others
This section consists of small projects ranging from small pipeline duplications to upgrading the corrosion protection units. Most of the works are in regional Victoria.

Sale City Gate Inlet Pressure Reduction
While not included in AGN's AAI and hence the Augmentation Projects Table 1 above, AGN advised that it received a letter from the Australian Energy Market Operator (AEMO) (dated November 2016) regarding the reduction in connection pressure for Sale. A business case was subsequently provided to the AER in March 2017. The project involves the partial duplication of the existing main along the South Gippsland Highway. The cost estimate is $5.776 million ($2016). Following review of the business case, Zincara considers the augmentation project to be prudent and, based on the approach used in developing the cost estimates, the project costs efficient.

Conclusion
AGN had provided business cases for all projects which included details of the cost estimates. Zincara has reviewed the business cases (including Sale City Gate Inlet Pressure Reduction) and considers the projects to be prudent and efficient.

1.2 CONNECTIONS

AGN is proposing connection capex of $174.3 million for the next AA period. Details of the capital expenditure are shown in the table below.

Table 2: Connection Capex Forecast ($million, 2017, direct)

AGN – Connections	2018	2019	2020	2021	2022	Total
Growth Forecast	35.0	34.2	34.5	35.1	35.6	174.3

(Source: AAI: Table 8.5)
Note: Totals may not add up due to rounding error.

The growth forecast capex is made up of the number of connections multiplied by the unit cost of mains, services and meters for each customer class. The connections volume

forecast has been carried out by Core Energy as part of the overall demand forecast, which was not part of Zincara's brief. Zincara's review is therefore focused on unit costs.

In addition, AGN provided details of the costs in its Capex model in 2016 dollars instead of 2017 dollars. As such, Zincara had carried out its analysis based on 2016 dollars.

As part of the review, Zincara has also reviewed the new service provider contracts that AGN has entered into.

Conclusion
Zincara has accepted the new service provider contracts as they were entered into through a tendering process.

Based on its analysis, Zincara is recommending the following unit costs as efficient.

Table 3: Summary of Recommended Unit Costs ($2016)

Connections		AGN Forecast	Comment
New Mains	New Estate	$[redacted]/m	Recommended
	Existing Home	$[redacted]/m	Recommended
	I&C	$[redacted]/m	Recommended $[redacted]/m ($880k reduction)
New Service	New Home	$[redacted]/service	Recommended
	Multi-User	$[redacted]/service	Recommended
	Existing Home	$[redacted]/service	Recommended $[redacted]/service ($374k reduction)
	I&C	$[redacted]/service	Recommended
New Meter	Domestic	$[redacted]/meter	Recommended $[redacted]/meter ($1,723k reduction)
	I&C	$[redacted]/meter	Recommended $[redacted] (reduction of $1,564k).

(Source: Attachment 8.4: Capex Model and Zincara's analysis)

1.3 MAINS REPLACEMENT

AGN is proposing a mains replacement capex of $154 million over the next AA period. This program will complete AGN's mains replacement program of its low pressure system which includes the Melbourne CBD. The program also includes other mains that AGN has determined are at risk. The table below shows the details of the program.

Table 4: Mains Replacement Forecast ($million, 2017, direct)

Mains Replacement	Volume	2018	2019	2020	2021	2022	Total
CBD Block replacement	25.3km	6.1	6.1	6.1	6.3	6.4	31.1
CBD Trunk replacement	1.6km	-	2.0	2.0	-	-	3.9
General Trunk replacement	10.2km	2.1	2.1	2.1	1.6	0.3	8.3
Decommissioned Trunk	32.4km	1.3	1.3	1.3	1.3	-	5.1
Block replacement (HDICS)	178.5km	20.3	20.3	20.3	20.3	-	81.3

Block replacement (LDS)	36.9km	3.4	3.4	3.4	3.4	-	13.5
HDPE replacement	10km	1.1	1.1	1.1	1.1	1.1	5.6
Piecemeal replacement	2.0km	0.3	0.3	0.3	0.3	0.3	1.1
Services replacement	-	0.8	0.8	0.8	0.8	0.8	0.8
Total Mains Replacement	**296.8km**	**35.4**	**37.4**	**37.4**	**35.0**	**8.6**	**153.7**

(Source: AAI: Table 8.4 (Capex); DMSIP: Table 8.3 (Volumes))
Note: Totals may not add up due to rounding error.

Zincara analysed the following aspect of this project:

- Failure mode;
- Volume to be replaced;
- Prioritisation;
- Delivery capacity; and
- Unit rate

Conclusion

AGN has used a combination of qualitative and quantitative assessment, including a cost impact analysis, to determine which mains should be replaced within the next AA period. Its risk analysis is well detailed in its Distribution Mains and Services Integrity Plan (DMSIP).

Failure Analysis. AGN's DMSIP outlines its leak performance for the various categories of mains and services across its networks. Zincara has reviewed the risk analysis and leakage performance for each mains category and finds that AGN's methodology and approach is reasonable.

Early Generation (HDPE 575) have shown a propensity for slow crack growth. AGN has over 3,000 kilometres of this early generation PE in its network. While no significant incidents have occurred within its Victorian networks, AGN has experienced some catastrophic failures in its South Australian networks. As part of a study that has been initiated with Deakin University, AGN propose to replace 7 kilometres of mains that have reached 50 years old and 3 kilometres (<35 years old) as a sampling program across its networks. From a risk and failure perspective, Zincara has reservation about the replacement about the replacement of the 10 kilometres. However, based on the uncertainty of the failure mechanism for these mains, the volume in its networks, and the level of research study proposed (already initiated), Zincara recommends accepting this project as prudent.

General Block Replacement – LDS / HDICS. Following a request from the AER regarding any recent new contracts, AGN advised that it has awarded contracts in February 2017 for:

- General Block – High Density Inner City Suburbs (HDICS); and
- General Block – Low Density Suburbs (LDS).

These categories cover 215 kilometres (72%) of mains replacement. The new contracts for both these categories have resulted in reduced unit rates and reduced capex of $6.2 million ($2016 direct). In terms of unit rate analysis, these recently tendered contracts reflect current market tested rates and therefore would be considered as efficient. For the

purposes of this review, Zincara wishes to highlight the above change but for consistency, has relied upon the information contained in the DMSIP and Unit Rates Forecast documents, rather than using these updated unit rates.

CBD Block Replacement. As part of its planning for the CBD mains replacement program, AGN has sought indicative tenders for four of the 16 areas covering the CBD block replacement program. Averaging the submitted unit rates for each of the four areas and then averaging the sum of these, AGN calculates the contractor component of the unit rates as $[redacted]/m. Zincara agrees with AGN's approach and methodology, however, in analysing the tendered prices, Zincara noted that for three of the areas there is one indicative tender price that could be considered as an outlier (significantly higher (>30%) than the other prices). As part of a sensitivity analysis, and as would be expected in a pre-award analysis, if these "high" unit rates are removed the remaining rates result in the overall unit rate reducing to $[redacted]/m. Adding provision for unscoped variations, materials and internal project management (per Unit Rate Forecast: Table 4.7) then the total unit rate is $[redacted], compared with AGN estimated rate of $[redacted]/m, a reduction of $[redacted]/m. Applying this unit rate to the volume of 25.3 kilometres then capex reduction would be $3.8 million. If these indicative tenders were representative of what to expect during the formal tender and award process then the lower unit rate would be considered as efficient, compared with AGN's forecast unit rate.

Zincara accepts that AGN's methodology in developing unit rates for mains replacement is reasonable and largely based on recent competitive tendering or historic unit rates for work of a similar type. On the basis of its analysis Zincara agrees the AGN's unit rates are reasonable and efficient, except as noted in this Conclusion.

1.4 OTHER CAPEX

The Other Capex category consists of miscellaneous projects that do not fit into the above categories. The projects that Zincara has reviewed are set out in the following table.

Table 5: Other Asset Projects ($000, 2016, direct)

Other Assets	2018	2019	2020	2021	2022	Total
Transmission pipeline modifications	354	2,224	7,320	3,240	486	13,623
Bushfire Preparedness	636	600	582	564	564	2,947
I&C Meter Set Refurbishment	587	762	946	762	762	3,820
Plant & Equipment Upgrade	764	764	764	764	764	3,818

(Source: Business cases – V83; V62; V79; V05)
Note: Totals may not add up due to rounding error.

Zincara has analysed each project separately and its conclusions are set out below.

Analysis

Transmission Pipeline Modification for In-line Inspections

AGN proposes to modify the following two transmission pressure pipelines to enable the use of in-line inspection tools:

- Dandenong to Frankston pipeline
- North Melbourne to Fairfield pipeline

Conclusion

AGN has prepared a detailed business case for this project. This has included a background description of the two pipelines and the issues relating to its ability to demonstrate structural integrity of the pipelines. It described the two principle methods for demonstrating structural integrity of a pipeline and provided a risk assessment where it has assessed the untreated risk as "High". AGN then considered four options and cost / benefit analysis, concluding with an NPV analysis which shows that the modifications of the pipelines to enable ILI inspections as the most cost effective, and with a residual risk reduced to Moderate.

The NPV analysis shows the preferred option as being the most cost effective of the options considered. Importantly, Zincara is of the view that the modification of the pipelines to enable in-line inspections is good industry practice. As such, Zincara considers the project to be prudent.

A detailed cost estimate breakdown was included in the business case for the Dandenong to Frankston pipeline. AGN advises that it proposes that material and contractor costs will be obtained through a competitive process. In relation to the North Melbourne to Fairfield pipeline, Zincara believes that there is an oversight by AGN in not providing a detailed cost. However, for the reasons discussed above, Zincara believes the project to be also efficient.

In addition, Zincara also considers that the overall project should be carried out in this AA period as the risk is rated as "High", which would require risk treatment action to bring the risk to as low as reasonably practicable in a manner that balance cost and risk.

Bushfire Preparedness

The bushfire preparedness project is to install Thermal Safety Devices (TSDs) in all new services (upstream of the meter control valve) and retrofit in existing services (downstream of the meter control valve) in bushfire prone areas.

Conclusion

The technical solution proposed by AGN, compared to its earlier proposal during the last AA period review, provides a very similar risk benefit at a greatly reduced cost. AGN has also stated that it has the capability to complete this project during the next AA period.

Given AGN's policy approach concerning the changed requirements for other aspects of connection materials e.g. meter brackets, and its risk assessment relating to bushfires, Zincara considers that AGN could have already included the TSD for any new connections in Extreme Bushfire Zones. With its minimal cost of about $[redacted] per connection and low number of connections (around 400 per year), this would add only $[redacted] per year to the residential connections program. There was no information in the business case to suggest whether this has already been implemented.

AGN has not included any historic information as to the number of incidents where its assets have been damaged by bushfires and where they have directly contributed to damage of other property or people, in addition to that caused by the bushfire. Also AGN has not provided any information where the CFA or Victorian Royal Commission recommendations require / or recommend the fitting of the TSD for all homes within the designated "Extreme Fire Zone".

However, Zincara acknowledges that a similar program has been approved by the AER for AGN's South Australian networks. Given this precedent and the history of bushfires in Victoria, Zincara believes that the fitting of TSDs in extreme fire zone areas should be accepted as prudent.

In addition, Zincara also considers that AGN's approach in determining the number of TSDs to be retrofitted is reasonable and also that they should be included as part of any new connection in the extreme fire zone areas.

With respect to the expenditure, Zincara acknowledges that the proposed technical specification is pragmatic and significantly reduces the required capex from that submitted for the current AA period in 2012. On this basis, Zincara considers the program to be prudent and cost efficient.

I&C Meter Set Refurbishment Program

AGN has approximately 3,250 I&C meter sets. While the meters are changed on a 10-year basis, the meter assembly remains in place, with some installations over 40 years old. AGN has now determined that external condition of many I&C meter sets is now reaching a level where touch painting is no longer sufficient.

AGN proposes that a full repainting (on-site complete grit basting and extensive repainting) will enable most of the meter sets to be restored to a sustainable condition.

Conclusion

In principle, Zincara finds that AGN's proposed recoating program provides a cost effective solution, minimising the risk of corrosion leaks and/or component failure, from the meter set. Given that AGN has an ongoing maintenance program, Zincara believes that the deterioration of the paint on the meter sets should have been identified previously and it is therefore unclear why AGN has only now decided to initiate a recoating program.

However, Zincara acknowledges that as it stands the condition of the meter sets have deteriorated and the proposed program along with the "ongoing sustainment option" shows a strategy to manage the condition of these assets into the future. On this basis, Zincara considers that the proposed program, including the "front end" volume, is prudent and based on its review of AGN's unit rates, Zincara also considers that the costs are efficient.

Plant and Equipment

AGN says that keeping plant, operational tools and equipment up to date, fit for purpose and in line with advancements in technology is necessary not only to perform required tasks by minimising occupational, health and safety risk and health and safety risks to the public.

AGN therefore proposes to replenish its small tools, plant and equipment.

Conclusion

Zincara considers it prudent to ensure tools, plant and equipment are fit for purpose and well maintained. Also that it is good practice to consider new technologies during the procurement process so that productivity can be maximised. Zincara considers good industry practice would ensure that the tools, plant and equipment are well serviced and maintained to maximise their fit for purpose life.

On this basis, in reviewing the current period expenditure and comparing with the AER approved capex, Zincara considers that continuation of the AER approved annual average would provide sufficient capex to ensure tools, plant and equipment are fit for purpose and replaced cost efficiently and with due consideration of cost/benefit analysis.

Resulting annual capex would be $0.650 million ($2016) with a total of $3.250 million ($2016) over the next AA period a reduction of $0.568 million ($2016) compared to AGN's proposal.

1.5 METER REPLACEMENT

The following table shows AGN's proposed capex for Meter Replacement.

Table 6: Meter Replacement ($million, 2017, direct)

Meter Replacement	2018	2019	2020	2021	2022	Total
Residential Capex	5.2	5.2	5.2	2.7	2.7	20.8
Commercial Capex	2.5	2.5	2.5	2.5	2.5	12.4
Total Program	**7.7**	**7.7**	**7.7**	**5.2**	**5.2**	**33.2**

(Source: AAI: Table 8.8)
Note: Totals may not add up due to rounding error.

Zincara has carried out a volume and unit cost analysis on the meter replacement capex.

Conclusion

AGN's Meter Replacement Plan and Unit Rates Forecast documents provide a good level of detail, explaining its approach and assumptions in development its forecast volumes and unit rates for the next AA period's meter replacement program.

In 2016, AGN entered into new contracts with its field contractors and suppliers, based on a competitively tendered process. Zincara notes that AGN's selection of a state wide gasfitting contractor rather than a larger number of smaller contractors may be reflected in the increased labour rate shown in 2016 for the domestic meter change program.

Zincara considers that AGN's methodology is based on good industry practice and its forecast estimates are well developed. On this basis, and the fact that contracts have been recently competitively tendered, Zincara considers that the meter replacement program is prudent and cost efficient.

1.6 SCADA

AGN's SCADA program consists of two projects:

- SCADA – end of life replacement – upgrade of pressure, temperature transmitters and associated switches due to non-conformance with Australian Standards or age.

- Field regulator and fringe points – SCADA monitoring equipment to be installed on the sites that currently do not have monitoring equipment (Capex V08).

The costs of the projects are shown in the table below.

Table 7: SCADA Project Cost ($000, 2016, direct)

	2018	2019	2020	2021	2022	Total
End of Life Replacement	99.5	99.5	99.5	99.5	-	398.3
Field regulator and fringe points	147.7	136.1	136.1	150.6	139	709.5
Total	**247.2**	**235.6**	**235.6**	**250.4**	**139**	**1,107.8**

(Source: Attachment 8.6 - Business Cases –December 2016 Business Case V07 and V08)
Note: Totals may not add up due to rounding error.

Zincara reviewed the options been considered in AGN's business case.

Conclusion

End of Life Replacement

Zincara recognises that it is important to ensure that the equipment meet the current electrical safety standards as such, considers the program to continue to replace the equipment reasonable. Zincara therefore considers this project to be prudent.

In relation to the cost, Zincara has examined the material and unit cost details and believes that the material cost to be reasonable. The labour cost is within the range that you would expect but at the high end of the range. Based on that, Zincara recommends accepting the cost as efficient.

Field Regulator and Fringe Points

Zincara is aware that the gas industry is moving towards its network having monitoring equipment to ensure that it is able to respond to emergencies as a result of loss of gas

supply quickly and also to gather data for its network planning process. AGN's proposal to continue with its program of installing network monitoring equipment is consistent with industry practice. As a result, Zincara considers this project to be prudent.

In relation to the cost, Zincara has reviewed the material and labour costs and considers them to be reasonable. Zincara therefore considers the cost to be efficient.

2. INTRODUCTION

2.1 BACKGROUND

In December 2016, the Australian Energy Regulator (AER) received AGN's revision to its Access Arrangement for the period 2018-2022. To assist in the review of the capital expenditure, the AER engaged Zincara P/L (Zincara) to advise it on some aspects of the forecast capital expenditure. In particular, the AER sought advice on the following topics:

- Augmentation
- Connections
- Mains Replacement
- Meter Management
- Other Costs
- SCADA

In providing the advice, Zincara had to take the following factors into account:

- the efficiency and prudence of the size, scope and timing of the AGN's proposed capital expenditure (capex) allowances;

- the justification for each project or area of forecast capex ;

- the relationship of the capex allowances to the respective drivers of capex, and the efficiency and prudence of AGN's proposed capex allowances in relation to these drivers;

- the efficiency and prudence of the service provider's proposed capex allowances in relation to capex–opex (operating costs) interactions and potential trade-offs; and

- the appropriateness of the AGN's methods for determining its proposed capex allowances, including whether the forecasts were arrived at on a reasonable basis and represent the best forecast or estimate possible in the circumstances.

2.2 DEFINITION FOR PRUDENCE AND EFFICIENCY

Zincara has used the following definitions in its analysis:

"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.

[1] Australian Concise Oxford Dictionary

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

2.3 APPROACH

Zincara has carried out a desktop review on the material provided by AGN and has assumed that the data provided is accurate. Zincara has not verified the accuracy or veracity of the data.

In carrying out this assessment, Zincara has adopted the following approach:

- Analyse the information provided in the Access Arrangement Information, Asset Management Plan and other supporting Plans and responses to AER's information requests (refer Appendix A);
- Determine what the strategic objectives of each project are;
- Consider whether the most efficient option has been adopted and the appropriateness of the timing of the project;
- Ensure that the estimated cost for the project meets the efficiency test; and
- Consider whether there are opportunities for trade-off between capex and opex

2.4 COST REPORTING

All costs shown in this report are in real 2017 dollars unless otherwise stated. Any reference to direct cost means that the cost includes escalation for labour but does not include overheads.

3. AUGMENTATION

3.1 INTRODUCTION

AGN is proposing augmentation capex of $28 million over the next AA period.

Note: AGN states[2] that it has excluded costs associated with the Morwell to Tramway Rd pipeline from its forecasts as it is contingent on an ESV decision regarding the condition of the pipeline (for completeness, a business case has been included in attachment 8.6). The decision is expected by mid-2017, so AGN will advise the need for this project at the time of the revised AA proposal.

Table 8: Augmentation Projects ($million, 2017, direct)

Augmentation	2018	2019	2020	2021	2022	Total
Dandenong – Crib Point	3.7	6.9	3.5	-	-	14.0
Cranbourne HP	0.9	1.2	3.3	1.7	1.7	8.8
City Gate and CTM upgrades	0.5	0.5	0.4	0.8	0.4	2.4
Other	0.7	0.8	0.3	1.0	-	2.8
Total	**5.7**	**9.3**	**7.4**	**3.5**	**2.1**	**28.0**

(Source: AAI: Table 8.10);
Note: Totals may not add up due to rounding error.

AGN has also received a letter from the Australian Energy Market Operator (AEMO) (dated November 2016) regarding the reduction in connection pressure for Sale. A business case has recently been provided to the AER and has been reviewed by Zincara in this paper. The cost estimate is $5.776 million ($2016), but has not been included in the summary table above, to maintain consistency with AAI Table 8.10.

3.2 DANDENONG CRIB POINT (DCP) PIPELINE AUGMENTATION

Proposal: Complete the duplication of the DCP pipeline[3] by constructing a 4km x DN450 steel TP pipeline from Abbotts Road the Dandenong City Gate.

Table 9: Dandenong Crib Point Pipeline Augmentation Cost: ($000, 2016, direct)

Capex	2018	2019	2020	2021	2022	Total
Project – V23	3,595	6,784	3,392			13,771

(Source: Business Case V23: Table 1.8)

[2] AAI - Final Plan – section 8.6.5
[3] AGN - Final Plan Attachment 8.6 – Business Cases – Capex V23

This project will complete the duplication of the transmission pipeline between Dandenong and Robinsons Road. The DCP is the primary supply to several high pressure networks in the Mornington Peninsula supplying gas to over 100,000 consumers. The full duplication project has been constructed in stages over the last 10 years.

AGN's business case explores a range of options including "do nothing during the next AA period", "implementing demand management" (such as restricting additional connections and turn off during peak periods) and three design and construction scenarios. AGN advises that the proposed option was deferred during the current AA period "*….pending confirmation that growth in demand will decrement the pressure in the pipeline to the point that safety and reliability of supply is affected*".

Reference material: AGN has fully responded to AER's questions arising from the preliminary review and provided the following supporting information:

- AER-AGN-IR #2 – Augmentation. Responses to the seven questions raised by AER.
- Network capacity review (TP44 Dandenong-Crib Point and TP43 Dandenong-Frankston). Includes network performance and modelling. Also includes winter test results.
- Derivation of meter growth forecast (Attachment B).
- Tale of three pigs (Attachment C). Reports of pigging failures.
- Cost estimate details and basis (Attachment D).

AGN's business case indicates ongoing growth of 1,100 to 1,600 domestic connections per year. The lower figure is based on forecast associated with precinct structure plans and forecast.id reports. The higher figure arises from historic connections growth being experienced over the last five years. AGN has assumed the lower level of connections in its capacity modelling, which shows that the pipeline minimum pressure would fall below 1,050kPa by winter 2020 at the Dunns Road TP/HP regulator, which supplies gas to over 14,000 consumers in the Mornington and Mount Martha area (1,062kPa in 2019, 1,031kPa in 2020 and 995kPa in 2021). The 5 year historic connection rate (1,600 pa) would reach minimum pressures one year earlier (1,062kPa in 2019, 1,031kPa in 2020 and 982kPa in 2021).

The TP/HP regulators are designed based on a minimum upstream pressure (typically 1050 kPa) to maintain a nominal 450kPa to the downstream HP networks.

AGN has applied a penetration rate of 85% and provided supporting information in IR #2 (Q5). The penetration rate has varied between 84% and 96% over the last five years and AGN selected the lower rate which is also consistent with the average across the network areas in 2016.

The business case outlines key drivers, risk assessment and cost-benefit analysis of each option.

AGN advises that three coating surveys have been conducted since 1999 with the results included in its response IR #2: question 3. The number of defects reported has increased at each survey. Further information is contained within business case V54 (DCP – Refurbishment).

With completion of the duplication works AGN proposes to undertake an in-line inspection program of the existing DCP pipeline (refer capex business case V54). AGN has noted the risk of undertaking this work while the DCP is the single supply for the peninsula. In response to AER's question 4, regarding any reports of pigging incidents, AGN has provided a report of three incidents. As the DCP has not yet been pigged there was no reportable incident for this pipeline.

3.2.1 Cost Breakdown Analysis

The business case includes a cost estimate by each component of materials, labour, miscellaneous items and management. Cost estimates are provided for the three route options. Additional cost breakdown detailed supporting information has been provided in response IR #2 (attachment D).

In response to AER's question regarding the basis of the management cost of 9.2%, AGN has provided additional details[4]. The management cost is the average of the three previous sections of this duplication project ranging from 8.9% to 9.5%. AGN notes that it will engage external contracted specialist personnel for the multi-year project, which is included within the management costs.

3.2.2 Conclusion

Following further review of the additional information provided in response to AER's questions (IR #2), there are no further issues arising with respect to the business case. The level of detail provided by AGN with the initial AAI submission and in response to AER's questions has been extensive. Given the above analysis, Zincara considers the augmentation project to be prudent and, based on the approach used in developing the cost estimates, the project costs are efficient.

3.3 H07 CRANBOURNE

Proposal: Program of augmentation works[5] (nine separate mains augmentation projects) ranging from small to relatively large new mains, to new gate stations aligned with expected future residential developments.

Table 10: Cranbourne Augmentation Cost: ($000, 2016, direct)

Capex	2018	2019	2020	2021	2022	Total
Gate Stations						

[4] (refer: IR #2: question 7 response)
[5] AGN - Final Plan Attachment 8.6 – Business Cases – Capex V28

Clyde North	426					426
Clyde North	426					426
Clyde North					1,432	1,432
Mains						
Botanic Ridge	43					43
Clyde North		495				495
Cranbourne East/Clyde North		248				248
Clyde North		186				186
Langwarrin			305			305
Langwarrin / Cranbourne Sth Stage 1			1,516			1,516
Langwarrin / Cranbourne Sth Stage 2				1,646		1,646
Clyde North – Soldiers Road				1,301		1,301
Clyde North-Berwick Cranbourne Rd					175	175
Cranbourne East / Clyde North					568	568
Project – V28	**895**	**929**	**1,821**	**2,947**	**2,175**	**8,767**

(Source: Table 1.6: Staged Network Augmentation)
Note: Totals may not add up due to rounding error.

AGN has prepared a detailed business case (Capex V28) covering a program of augmentation projects across the Cranbourne HP network. AGN advises [6] that "…..*The overall augmentation has been broken down into a sequence of a number of key augmentation projects, most of which can be constructed independently of the others*". The timing of projects is based on expected future residential growth with the flexibility to be re-sequenced in line with actual land development.

AGN's IR #3 response including associated attachments provides additional information:

- AGN #3 response
- attachment C: Network Capacity Report
- attachment D: Connections growth
- attachment G: Pressure chart Modelling results (with and without reinforcement)
- attachment H: Cost estimates

The Cranbourne HP network supplies gas to the broader Cranbourne area located on the south-eastern fringe of Melbourne and is one of the fastest growing residential zones within AGN's network reach. It was recently reported to be "…the country's largest and second-fastest expanding suburb..." (ref: domain.com.au).

The network supports approximately 30,000 residential customers and six major industrial commercial customers. The five-year average net customer growth from 2011 to 2015 is about 1,756 per year.

[6] Business Case V28: section 1.6.3, page 207

The basis of future demand criteria/assumptions:

- Average annual projected growth in dwellings within the Cranbourne network from forecast.id reports (annual average over period 2016 – 2022). AGN's response (IR #3: Q2, associated attachment C: Network Capacity Report, and attachment D: forecast connection growth details) shows meter connections of 1,700 per year. The network capacity report in turn relied upon data sourced from the forecast forecast.id reports and Precinct Structure Plans (list provided in IR #3: Q3) with plans available upon request;

- Penetration rate of 80% (initially around 80% and increasing to around 99% over time) pattern observed in more developed areas (per Table 1.3). AGN's response for basis of the penetration rate (refer IR #3: Q3) provides a table 4, showing actual connections over five years which ranges from 80% to 99%, with AGN using the lower rate of 80% for modelling;

- Average demand for tariff V of 0.9 m^3/hour, with actual averages of up to 1.2 m^3/hour. AGN's response (refer IR #3: Q4) provides table 5 which lists the new and old areas average MHQ consumption per customer.

AGN has considered a range of options in its business case. It explores a range of options including "do nothing during the next AA period" (Option 1), "implementing demand management" (such as restricting additional connections and turn off during peak periods) (Option 2), staged augmentation of the network (Option 3) and defer augmentation into the following regulatory period (Option 4).

AGN proposes that Options 1, 2 and 4 are not feasible given its regulatory obligations maintain a safe and reliable supply of gas to consumers.

AGN has provided a table of Cranbourne Network minimum pressures (see Table 1.4), which lists a number of locations and their respective minimum pressures from 2017 to 2023, without augmentation works. The table also includes the number of customers impacted by <140kPa and also the number of customers where gas pressure is modelled to drop to zero.

Table 11: Cranbourne Network Minimum Pressure - number of customers impacted

Number of customers	2017	2018	2019	2020	2021	2022	2023
Customers <140kPa	0	0	700	4,500	10,000	15,000	21,000
Customers nil gas	0	0	100	500	1,500	7,000	16,600

(Source Table 1.4 Cranbourne Network Minimum Pressure)

AGN's response (IR #3) includes the "H07 Cranbourne network capacity report" and winter test results, which provides further details of modelling that show these outcomes.

AGN has provided IR #3: attachment G: "Model results-Cranbourne" to show the interaction between local network pressures and each proposed augmentation project. In particular, AGN has provided summary charts of each area which model the pressures from 2016 to 2023. These charts show "no reinforcement" and "with reinforcement" graphs and indicates

where minimum pressures fall below 140kPa in each area, these all occur during the 2018-2022 period.

3.3.1 Cost Breakdown Analysis

AGN advises[7] that given the nature of most of these augmentation projects, materials and labour are generally based on the price achieved for comparable works, or based on the unit rate achieved as the result of a competitive tender. Detailed cost estimates are provided in Appendix C. AGN's response (IR #3: Q9) provides further details of cost estimates for the two Clyde North CTM projects scheduled for 2018 and initially totalling $852,000 (per AGN Final Plan). Cost estimates have been based on the new city gate in Pakenham. AGN's response states that the city gates will now total $1.126 million ($2016), rather than estimate of $852,000 included in the Final Plan (an additional $274,491).

3.3.2 Conclusion

Revised cost for two Clyde North CTMs. In its information response #3, AGN noted that it has revised cost estimates for the two Clyde Road CTMs as shown in the following table:

Table 12: Detailed Cost Breakdown of Clyde North CTMs ($000, 2016, direct)

Revised Gate Station projects	2018	2019	2020	2021	2022	Total
Clyde North (increase from $426 to $563)	137	-	-	-	-	137
Clyde North (increase from $426 to $563)	137	-	-	-	-	137
Net increase:	**274**	**-**	**-**	**-**	**-**	**274**

(Source: AGN response IR #3 Table 9 states increased estimate to $563,000 from $426,000)

Given the above analysis, Zincara considers the augmentation project to be prudent and, based on the approach used in developing the cost estimates, that the project costs are efficient.

3.4 GATE STATION REBUILDS

Proposal: Upgrade the Berwick, Lindrum Road and Sale gate stations[8].

Table 13: Augmentation of Gas Stations Cost: ($000, 2016, direct)

Capex – V13	2018	2019	2020	2021	2022	Total
Berwick City Gate	449	449	-	-	-	898
Lindrum Rd Field Regulator	-	-	344	344	-	688
Sale City Gate	-	-	-	399	399	798
Total	**449**	**449**	**344**	**743**	**399**	**2,384**

(Source: Business Case V13); Note: Totals may not add up due to rounding error.

[7] Business Case V28: section 1.8.4.
[8] AGN - Final Plan Attachment 8.6 – Business Cases – Capex V13

AGN states[9] that three sites are approaching capacity and requiring upgrade, as identified as part of the regular facility review process or as operating conditions change.

3.4.1 Berwick City Gate

Constructed in 1977, inlet MAOP is 6,890kPa and outlet MAOP is 515kPa. This city gate supplies 20,000 customers and currently subject to excessive gas flow leading to high gas velocities in the pipework. APA's Engineering standard specifies a velocity limit of 30m/s with current calculated maximum gas velocity of 110m/s. The high velocity results in excessive noise and an Occupational Noise Assessment of the site shows noise within the enclosure peaking above the limits of the EPA. Upgrade will include larger pipework and quieter regulators.

3.4.2 Lindrum Road (Frankston) Field Regulator

Constructed in 1973, inlet MAOP is 1,920kPa and outlet MAOP is 515kPa. This city gate supplies 6,000 customers. AGN states that excessive pressure losses within pipework at the field regulator have resulted in insufficient pressure at the regulator inlet to adequately maintain supply at the network fringes. Larger pipework and regulators need to be installed to provide sufficient capacity.

Following a request from the AER for further explanation of the pressure losses and the impact on supply, AGN's response (IR #11) provided a range of details. Flow calculations have demonstrated that at peak demand conditions, high gas velocities (around 50% higher than design limits), excessive flow rates (around 60% higher than design limits) and pressure losses (around three times the design limits) are being experienced, as summarised in the following table.

Table 14: Lindrum Road Regulator Station Flow and Demand Calculations

	Design Limits	Current Peak Demand	2017 Forecast Peak Demand	2030 Forecast Peak Demand
Inlet Pressure (kPa)	1,050	1,050	1,050	1,050
Nominal Outlet Pressure (kPa)	450	450	450	450
Flow Rate (sm^3/hr)	6,000	10,000	10,065	10,888
Pressure Loss on Outlet Pipework (kPa)	5.6	15	15.9	18.6
Regulator Velocity (m/second)	60	97	98	105

(Source: AGN response IR #11: Table 3)

As a result of these high velocities, flow rates and pressure losses, the regulator station is affected by the design capacity being exceeded, excessive vibration and greater noise levels.

[9] Business Case V13: section 1.3, page 133

3.4.3 Sale City Gate

Constructed in 1969, inlet MAOP is 6,890kPa and outlet MAOP is 4,800kPa. This city gate supplies 9,000 customers. AEMO[10] has advised AGN that the minimum inlet pressure for Sale needs to be reduced to 4,500kPa. At the revised minimum inlet pressure, work is required to ensure sufficient flow capacity of the gate station to meet existing downstream demand. AGN advises that current flow capacity of the gate station is not sufficient to ensure downstream network fringe pressures remain above the design minimum.

3.4.4 Risk Assessment

The business case includes a risk assessment and AGN states that the untreated risk has been determined as "high" because of health and safety and compliance related issues. Following upgrade the residual risk will fall to "negligible".

3.4.5 Options Considered

AGN's business case considers three options: "Do nothing", "Maintain current configuration of the network", and "Upgrade the three gate stations", with AGN proposing the upgrade option. For each option AGN considers the cost/benefit analysis, which Zincara has reviewed and agrees that the proposed option is reasonable and the most prudent.

AGN states[11] that, with no bypass, each of the gate stations will need to be replaced with new regulating stations, installed in parallel. The existing regulator stations will then be removed. Due to the higher potential for noise complaints, the Berwick city gate will be prioritised first.

3.4.6 Cost Breakdown Analysis

The business case included detailed cost estimates for each of the station upgrades. AGN states[12] that they have been "*….prepared for individual items based on the actual incurred costs of comparable projects recently completed, including the Cobram city gate, Melrose Drive field regulator upgrades and the city gate installation at Thewlis Rd, Pakenham. These projects were significant upgrades or new construction of gate stations and were completed during the current AA period. This shows that the 3 proposed upgrades can be completed in a similar timeframe to the recently completed work*".

Following a request from the AER for further clarification of costs, in particular labour hours, shown in the detailed estimates, AGN's response (IR #11 and IR #13) provided analysis of hours for each of the upgrades. AGN clarified that each of the projects will be delivered over a 16 week period, with the number of people involved being 15 indirect labour, 5 indirect labour supervisors and 5 APA supervisors, each working about 4 weeks over the period.

[10] Final Plan attachment 8.10 – letter from AEMO
[11] Business Case V13: section 1.5.3, page 136
[12] Business Case V13: section 1.7.3, page 139

3.4.7 Conclusion

The level of detail provided by AGN with the initial AAI submission, Business Case (V13) and in response to AER's questions has been comprehensive and enabled Zincara to fully review the augmentation proposal. Given the above analysis, Zincara considers the augmentation project to be prudent and, based on the approach and level of detail used in developing the cost estimates, that the project costs are efficient.

3.5 OTHER

3.5.1 H85 Echuca

Proposal: Duplicate a 1,000m section of the polyethylene trunk main (DN180 PE) supplying Echuca and provide a 250m interconnection (DN63 PE main) of the network in Moama.

Table 15: Echuca Augmentation Cost: ($000, 2016, direct)

Capex	2018	2019	2020	2021	2022	Total
Moama - interconnect	-	-	48	-	-	48
Echuca - duplication	-	-	-	443	-	443
Total	**-**	**-**	**-**	**-**	**-**	**491**

(Source: Business Case V18)

The network supplies approximately 7,000 residential customers and eight major industrial and commercial customers. The gate station is located 4km south of Echuca township and also supplies Moama.

AGN states that the five year average net meter connections from 2011 to 2015 are about 140 per year, with the ten year average of around 200 connections per year. AGN has used the 5 year average for future growth projections, with no new tariff D load.

AGN has assumed average demand for tariff V is 0.76 m^3/hr (actual averages vary up to 1.0 m^3/hr in some parts of the network).

AGN's network modelling, using the above assumptions, shows that fringe minimum pressures will be 140kPa (2020), 128kPa (2021) and 113kPa (2022). Completion of the interconnect will improve pressures, but modelling shows they will fall again in 2022 to 131kPa. Following completion of the duplication the minimum pressures will be 186kPa.

AGN's risk analysis shows risk of a gas outage is moderate, reducing to low following completion of this project.

3.5.1.1 Cost Breakdown Analysis

The business case includes a detailed cost estimate, built up from first principles.

3.5.1.2 Conclusion

The level of detail provided by AGN in the Business Case (V18) including assessment of demand, project options with cost/benefit analysis and the detailed cost estimate has been comprehensive and enabled Zincara to fully review the augmentation proposal. Given the above analysis, Zincara considers the augmentation project to be prudent and, based on the approach and level of detail used in developing the cost estimates, that the project costs are efficient.

3.5.2 Dandenong to Crib Point Pipeline – Refurbishment

Proposal: Refurbish the final CPU anode bed, locate the inspection tool launcher at Dandenong and the receiver at Crib Point and conduct an ILI following the DCP duplication project (V23)[13].

Table 16: Dandenong to Crib Point Pipeline – Refurbishment: ($000, 2016, direct)

Project (V54)	2018	2019	2020	2021	2022	Total
Inspection tool traps installation	392	651	-	-	-	1,043
ILI Run	-	-	-	555	-	555
Repair / Validation	-	-	-	-	590	590
CPU anode bed refurbishment	54	-	-	-	-	54
Total	446	651	-	555	590	2,242
Capex (split)	**446**	**651**	**-**	**555**	**-**	**1,652**
Opex (split)	-	-	-	-	590	590

(Source: V54 business case: Table 1.8 and 1.9). Note: also Opex of $590 (no step change required)

The Dandenong to Crib Point pipeline (DCP) was originally constructed in 1966 and supplies over 100,000 customers on the Mornington Peninsula. The DCP has a design life of 80 years and limited construction records are available to assess the quality of construction. AGN states[14] that there are a number of construction issues such as inadequate backfill and poor coating adhesion due to high longitudinal weld seam reinforcement, resulting in a large number of severe coating defects. While the CP system should prevent corrosion, inspection of the pipeline steel condition is required to confirm this.

In the business case, table 1.4, provides a summary of the number of coating defects and while there are an increasing number of coating anomalies being detected, there is currently no emerging corrosion problem for the sites examined.

In the current AA review, the AER[15] approved an allowance of $6.341 million ($2011 real) for AGN to establish the baseline condition and carry out a refurbishment program to maintain the ongoing integrity of the 39km DCP (ref: business case V04: Refurbishment of DCP). AGN

[13] AGN - Final Plan Attachment 8.6 – Business Cases – Capex V54
[14] Business Case: section 1.3, page 229
[15] AER Final Decision, part 2 attachments, March 2013, page 94

says[16] that there are three refurbishment works components of this project to be completed during the next AA:

- Refurbishment of the final CPU. Unlike the other two CPUs which have been refurbished, this unit had been deferred because it only recently was showing signs of decreased performance.

- Alterations to allow ILI Runs. Risk assessment determined that there was a significant residual risk with ILI of the section of pipeline upstream of where the current pipeline duplication commences, with the potential for the tool to become stuck.

- ILI of the pipeline with subsequent repairs or validations.

AGN states[17] that the risk profile of the DCP has changed over time with industrial encroachment in the north and urban encroachment in the south around Hastings. AGN has provided details of its risk assessment in the business case.

AGN considered four options:

- Do nothing
- Locating the inspection tool launcher at Dandenong and receiver at Crib Point
- Locating the inspection tool launcher where the current duplication commences at Abbotts Road, with the receiver at Crib Point. This would involve an initial ILI run followed by another ILI run once the final duplication is completed (per V23).
- Recoat the pipeline. Recoat all accessible sections of the pipeline.

The second option was calculated as being the most cost effective.

3.5.2.1 Cost Breakdown Analysis

The business case (refer section 1.3.1, page 231) states that the final cost estimate for the total refurbishment program is approximately 60% of the original estimate. AGN states that it expects to spend $2.1 million ($2016 real) prior to the next AA period. The business case Table 1.4 shows details of costs being spent during the current AA. AGN's business case Appendix C provides a detailed cost estimate of the works involved with the inspection tool trap installation, CPU replacement, ILI run, and Data validation and pipeline repair.

3.5.2.2 Conclusion

The AER approved an allowance of $6.341 million ($2011 real) for AGN to establish the baseline condition and carry out a refurbishment program to maintain the ongoing integrity of the 39 km DCP (ref: business case V04: Refurbishment of DCP; and AER Final Decision, part 2 attachments, March 2013, page 94). It expects to spend $2.1 million ($2016, real)

[16] Business Case V54: section 1.3.1.1, page 232
[17] Business Case V54: section 1.3, page 229

during this current AA period and propose further capex of $1.652 million ($2016 real) to complete the works during the next AA (2018-2022). The overall project capex is significantly below that approved for the current AA period. An Opex amount of $590,000 ($2016 real) for repair/validation will also be spent, but no step change required.

The comprehensive level of detail provided by AGN in the Business Case (V54) including background information, condition assessment, project options with cost/benefit analysis and the detailed cost estimate has enabled Zincara to fully review the augmentation proposal. Given the fact that this project had been approved for the current AA period and the forecast total cost now being about 60% of the original estimate and based on the above analysis, Zincara considers the augmentation project to be prudent and, with the level of detail used in developing the cost estimate, that the project costs are efficient.

3.5.3 H70 Moe

Proposal: Duplicate sections of existing steel and PE mains (total 420m)[18].

Table 17: Moe Augmentation Cost: ($000, 2016, direct)

Project (V102)	2018	2019	2020	2021	2022	Total
360m x DN180 PE Railway Crescent	129	-	-	-	-	129
60m x DN150 Steel Narracan Drive	98.5	-	-	-	-	98.5
Total	**227.5**	**-**	**-**	**-**	**-**	**227.5**

(Source: Business case V102: Table 1.8)

The Moe HP network supplies over 7,000 residential customers in Moe and Newborough in the La Trobe Valley. The trunk main supplying Newborough area is a single DN100 steel main with limited further capacity to supply ongoing developments.

Net connections over the last five years average 62 per year, with 10 year average being the same. AGN forecast future growth of 62 per year. No tariff D load is assumed. Average demand is 0.76 m^3/hr, which is in line with regional average demand.

AGN's network modelling has confirmed that ongoing residential growth will reduce pressures below the minimum required, highlighting the need to duplicate the existing trunk main at two locations. Minimum network pressures are shown in Table 1.4 and show that in Guy St, Newborough, fringe pressures will fall from 145kPa (2016), 136kPa (2017), 126kPa (2018) and 116kPa (2019), without reinforcement. Following augmentation in 2018, minimum pressure has been modelled to be 176kPa, and it is noted that further augmentation is likely to be required during the following AA period.

Options considered include:

- Accept increasing risk of supply loss
- Control/limit additional load
- Network augmentation, including a number of alternative duplications

[18] AGN - Final Plan Attachment 8.6 – Business Cases – Capex V102

3.5.3.1 Cost Breakdown Analysis

A detailed cost estimate of both components of the augmentation is provided in the business case, appendix C.

3.5.3.2 Conclusion

The level of detail provided by AGN in the Business Case (V102) including assessment of demand, fringe pressures based on network modelling, project options with cost/benefit analysis and the detailed cost estimate has been comprehensive and enabled Zincara to fully review the augmentation proposal. Given the above analysis, Zincara considers the augmentation project to be prudent and, based on the approach and level of detail used in developing the cost estimates, that the project costs are efficient.

3.5.4 H79 Wallan

Proposal: Augment the network by installing 160m DN63 PE and 200m DN150 steel main[19].

Table 18: Wallan Augmentation Cost: ($000, 2016, direct)

Project (V103)	2018	2019	2020	2021	2022	Total
80m x DN63 PE – King Street	67.4	-	-	-	-	67.4
80m x DN63 PE – Franklin Close	-	67.4	-	-	-	67.4
200m x DN150 Steel - duplication	-	-	353	-	-	353
Total	**67.4**	**67.4**	**-**	**-**	**-**	**487.8**

(Source: Business case V103: Table 1.6)

The Wallan HP network supplies over 4,000 residential customers in Wallan and is part of the northern growth corridor. Net connections over the last five years average 237 per year. AGN forecast future growth of 200 per year. No tariff D load is assumed. Average demand is 1.1 m^3/hr, which is in line with regional average demand. Penetration rate has been assessed as 91% (active connection to completed homes in the area).

AGN's network modelling has confirmed that ongoing residential growth will reduce pressures below the minimum required, highlighting the need to duplicate the existing trunk main supplying the Wallan township. Minimum network pressures are shown in Table 1.4 and show that fringe pressures will fall from 156kPa (2017), 129kPa (2018) and 98kPa (2019), without reinforcement. Following augmentation in 2018, minimum pressure has been modelled to be 142kPa, increasing to 145kPa in 2019 and increasing further to 180kPa in 2020 following the trunk main duplication.

Cost/Benefit analysis has been undertaken for each of the following options:

- Accept increasing risk of supply loss

[19] AGN - Final Plan Attachment 8.6 – Business Cases – Capex V103

- Control/limit additional load
- Network augmentation
- Network augmentation via a number of interconnections totalling 870m
- Defer augmentation

3.5.4.1 Cost Breakdown Analysis

A detailed cost estimate of both components of the augmentation is provided in the business case, Appendix C.

3.5.4.2 Conclusion

The level of detail provided by AGN in the Business Case (V103) including assessment of demand, fringe pressures based on network modelling, project options with cost/benefit analysis and the detailed cost estimate has enabled Zincara to fully review the augmentation proposal. Given the above analysis, Zincara considers the augmentation project to be prudent and, based on the approach and level of detail used in developing the cost estimates, that the project costs are efficient.

3.6 SALE CITY GATE INLET PRESSURE REDUCTION

Proposal: Construction of a new DN150 steel main duplicating the existing main for 4.7km from the outlet of the Sale City Gate[20].

Table 19: Sale Augmentation Cost: ($000, 2016, direct)

Capex	2018	2019	2020	2021	2022	Total
Project – V106	3,206	2,570	-	-	-	5,776

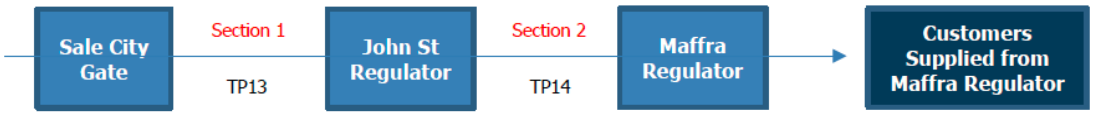
(Source: Business Case V106: Table 1.7)

The Sale City Gate (SCG) serves the communities of Sale and Maffra. The Australian Energy Market Operator (AEMO) has advised AGN[21] that due to changing hourly demand profiles in Victoria, the 5000kPa minimum inlet pressure at the SCG can no longer be maintained. As a result AGN is required to operate the SCG and downstream transmission system with a reduced contractual minimum inlet pressure at the SCG of 4,500kPa. This reduction in pressure will reduce the capacity of the SCG to supply the downstream networks and result in AGN being unable to maintain the required minimum pressure at Maffra.

The TP pipeline supplying Sale and Maffra has two separate sections, each with their own maximum allowable operating pressure (MAOP), licence number and normal operating pressure. The two sections are separated by the John St regulator, as shown below.

[20] AGN - Business Case – Capex V106
[21] Final Plan attachment 8.10: AEMO letter to AGN, dated 21 November 2016

Figure 1: Sale to Maffra TP System Configuration



(Source: Business Case V106: Figure 1)

This configuration means maintaining supply to customers at Maffra depends directly on the inlet pressure into the John St regulator, which in turn is dependent on the inlet pressure into the SCG. AGN has undertaken unsteady state network modelling to determine the performance of the system under a range of scenarios. This modelling shows that an inlet pressure reduction (of 500kPa) to 4,500kPa at SCG would result in a loss of supply at Maffra under design load conditions. Modelling also assesses three potential augmentation lengths on their ability to match the inlet pressure at the John St regulator under the current system configuration. This shows that the potential augmentation length of 4.7km maintains the current minimum pressure compared with the two other scenarios (one being shorter augmentation and the other longer).

The key drivers and assumptions for the project include:

- The pressure reduction is built-in
- Current performance is the benchmark performance.
- Customers will be immediately adversely impacted
- Mains duplication from Sale CG is the most cost effective solution, compared with investment required to provide additional linepack on the LMP, which is the main pipeline supply for Victoria.

AGN considered four options to address the capacity issues resulting from AEMO's instruction:

- Option 1: accept the 500kPa reduction, with no matching reinforcement downstream
- Option 2: control the amount of load on the network through demand management
- Option 3: duplication of 4.7km of the Sale City Gate to Sale pipeline
- Option 4: defer augmentation into the next AA period

Under option 1, AGN could not ensure that minimum pressure is maintained through its network.

With option 2, AGN would limit consumption during peak periods in order to maintain pressures in the network.

Option 3, involves the duplication of 4.7km of DN150 steel TP main, duplicating the existing main along the South Gippsland Highway from the outlet of the SCG to the vicinity of Seaspray Road. This option is the most consistent with maintaining the current inlet pressure at the John St regulator, following the pressure reduction at the SCG as required by AEMO.

Work on the duplication would commence in 2018 and be complete by the end of 2019. AGN says that this is the earliest timeframe without adversely impacting other capital projects currently underway.

Option 4, would defer the augmentation into the next AA period. However, AGN could not ensure that minimum pressure is maintained through its network. During a peak demand period the system design minimum pressures will be breached and it is forecast that there will be loss of supply at Maffra. This option does not address any short term risks and as a result the risk would remain until augmentation work is completed in 2024. The cost saving under this option is insignificant compared to the ongoing risks

On the basis of its analysis, Zincara finds that duplication option is the most prudent.

3.6.1 Cost Breakdown Analysis

AGN has developed its cost estimate using comparable works completed elsewhere in the network. The labour costs are based on the unit rate achieved as a result of competitive tender between external contractors and for specialist services the estimate is derived from the cost of due diligence for similar projects. AGN has included a detailed cost estimate in its business case.

3.6.2 Conclusion

Following review of the various elements of the business case, Zincara considers the augmentation project to be prudent and, based on the approach used in developing the cost estimates, the project costs are efficient.

4. CONNECTIONS

4.1 INTRODUCTION

AGN is proposing Connections capex of $174.3 million over the next AA period.

Table 20: Connections Capex Forecast ($million, 2017, direct)

AGN - Connections	2018	2019	2020	2021	2022	Total
Growth Forecast	35.0	34.2	34.5	35.1	35.6	174.3

(Source: AAI: Table 8.5)
Note: Totals may not add up due to rounding error.

Table 21: Connections Capex ($million, 2016, direct)

	2018	2019	2020	2021	2022	Total
Mains	9.54	9.33	9.43	9.57	9.71	47.57
Services	18.54	18.03	18.25	18.55	18.84	92.21
Meters	6.24	6.14	6.20	6.28	6.36	31.21
Total	**34.31**	**33.50**	**33.88**	**34.39**	**34.91**	**170.99**

(Source: Attachment 8.4: Capex Model)
Note: Totals may not add up due to rounding error.

With respect to I&C – tariff D (contract) Connections, Zincara did not find any mention in the Connection section of the AAI documents, Capex model, or the Unit Rates documents regarding the large I&C (Tariff D) contract Connections.

Marketing forecasts an additional 61 connection per year, totalling 303 for the period. At an estimated average unit rate of $[redacted] per connection (mains, service and meter), then additional capex is approximately $[redacted] million ($2016, direct), which has been included within residential connection volumes.

4.2 CONNECTIONS CAPEX FORECAST METHODOLOGY

AGN says[22] that, where possible, it has applied the same approach to that accepted by the AER for South Australia, including basing the forecast capex on either:

- The most recent tender/contract information available which reflects the market-tested costs that will be incurred over the next AA period (and adjusted for any variations to the scope of work where relevant to the forecast period), or

- Where tender or contract information is not available, or in situations where the categories of expenditure involve low volumes of work, are subject to a high degree of variability or it is difficult to derive meaningful assumptions on the mix of work to be

[22] Unit Rates Forecast: section 1.2, page 1

carried out, the unit rates have been based on a weighted average historic unit rate measured over a three year period.

- Bottom-up approach, where neither tender submissions, awarded contracts nor historic actual costs are available, unit rates have been developed using a bottom-up forecasting approach based on management estimates.

For connections, AGN has mainly used historic actuals (a three-year weighted average (2014-16) unit rate in forecasting its proposed unit rates, given that its current mains and service laying contract commenced [redacted]. For domestic connections AGN has applied the rates within the new meter and gasfitting contracts which were entered into in [redacted].

4.3 SERVICE PROVIDERS

AGN has used a competitive tender process in awarding contracts covering the labour and materials components required for connections, such as mainlaying and servicelaying, gasfitting (installation of meters) and meter suppliers. The contracts' duration and unit rates are key inputs to AGN's unit rates forecast.

Mainlaying and Servicelaying. Following a competitive tender process AGN entered into Mainlaying and Servicelaying contracts with a panel of approximately [redacted] contractors across a number of regions, in [redacted]. These contracts cover all of the contract labour related costs associated with laying these different types of mains. The contracts include a provision that [redacted]. The contracts have [redacted].

Gasfitting. Gasfitting services for domestic meter installation services contract was entered into with [redacted].

Domestic Meters. A new national contract was entered into with a range of meter suppliers in [redacted].

4.4 DEMAND FORECAST

AGN engaged Core Energy[23] to develop forecasts of gas consumption and customer numbers over the forecast period. AGN states that the methodology applied is consistent with that recently approved by the AER for South Australia. Zincara notes that the volume forecasts are being reviewed separately by the AER.

The number of new residential connections over the next AA period has been based on forecasts from the Housing Industry Association (HIA), and for Albury connection growth was projected using historic trends. In Victoria, the HIA new dwelling forecast is strong currently, followed by a slowing of construction activity through to 2019 and then recovery towards the end of the forecast period.

Residential net customer growth is forecast to be 2.0% per year, which is lower than the historic growth rate of 2.4%. This is due to the slowing of new dwelling construction over the next AA period. Commercial customer connections are forecast to be 0.6% per year over the next AA period, which is the same growth rate that has occurred over the past five years.

[23] AAI: section 13

Industrial demand is forecast to marginally increase by 0.1% per year over the next AA period, which is less than the historic eight-year trend decline of -1.7% per year (impacted by the closure of two of the largest customers in 2012 and 2013 which accounted for nearly 20% of the industrial load).

Table 22: Volume of Connections

	2018	2019	2020	2021	2022	Total
New Estate	12,241	11,866	12,016	12,225	12,433	60,781
Existing Home	836	811	821	835	849	4,153
Multi-User	675	654	661	673	684	3,348
I&C (V)	357	359	361	362	364	1,804

(Source: Attachment 8.8 Capex Model: Growth Capex Volumes). Additional connections due to marketing (303) are included above. Note: In the above table, AGN assumes one Multi-User connection has 4 customer meters.

4.5 MARKETING STRATEGY

AGN is proposing an expanded marketing program [24] and forecasts 303 additional connections for new and existing homes (293 Victoria and 10 Albury). The three gas distributors will coordinate marketing activities in the next AA period, enabling AGN to expand its marketing into the Melbourne metropolitan area. AGN has made a post model adjustment to the connections and demand forecast to reflect the increases expected from the program.

4.6 UNIT RATES FORECAST AND ANALYSIS

For Connections forecast AGN has prepared a summary of component unit rates, which include labour and materials (ref: attachment 8.4: Unit Rates Forecast):

Table 23: Component Unit Rates

Growth Capex		Unit Rate	Forecasting Approach
New Mains	New Estate	$[redacted]/m	Historic actuals (3-yr weighted avg 2014-16)
	Existing Home	$[redacted]/m	Historic actuals (3-yr weighted avg 2014-16)
	I&C	$[redacted]/m	Historic actuals (3-yr weighted avg 2014-16)
New Service	New Home	$[redacted]/service	Historic actuals (3-yr weighted avg 2014-16)
	Multi-User	$[redacted]/service	Historic actuals (3-yr weighted avg 2014-16)
	Existing Home	$[redacted]/service	Historic actuals (3-yr weighted avg 2014-16)
	I&C	$[redacted]/service	Historic actuals (3-yr weighted avg 2014-16)
New Meter	Domestic	$[redacted]/meter	Actual rates for [redacted] – new contract
	I&C	$[redacted]/meter	Historic actuals (3-yr weighted avg 2014-16)

(Source: Attachment 8.4 - Unit Rates Forecast: Table 1.2).

[24] AAI 7.6.2.2

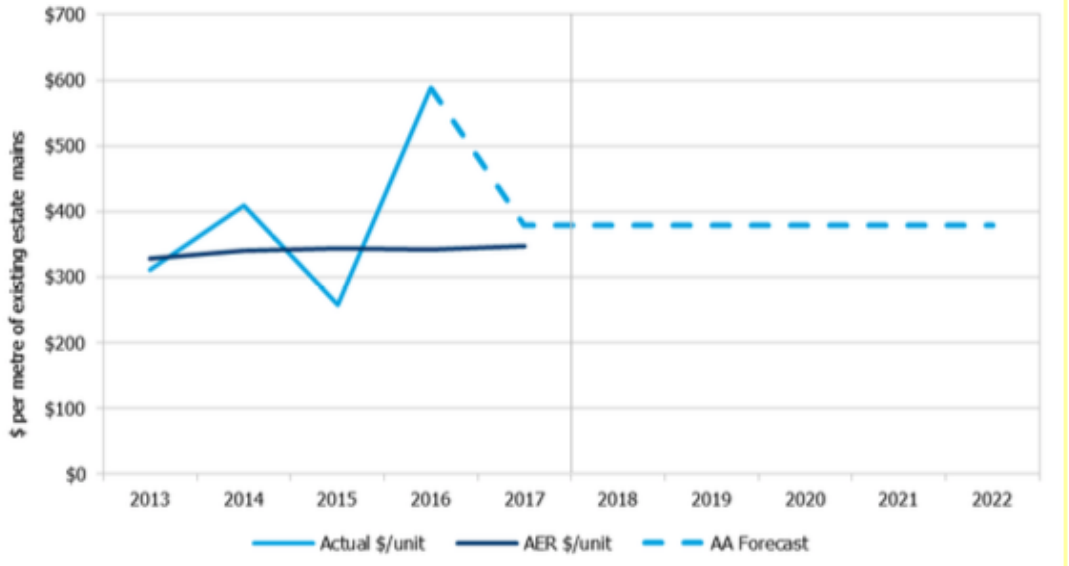
AGN[25] describes a number of upward pressures on its mainlaying and servicelaying activities, however has decided to forecast using the historic three-year weighted average unit rates, which it views as a conservative approach.

New Estate Mains: The work involves gas supply and reticulation mains in new residential greenfield estate developments and is typically part of common trenching with other utilities' assets, thereby providing a cost efficient outcome. The work is quite generic and any variability typically only occurs with ground conditions. The northern growth corridor of Melbourne being quite rocky compared with the southwestern areas. The three year weighted average forecast unit rate of $[redacted]/m is [redacted] the AER approved rate in the current AA period. In response to AER questions, AGN has also provided weighted average costs for 2011-2013, which shows that the proposed unit rate is [redacted] than average rates during that period. The unit rate appears reasonably determined.

Existing Homes Mains: The work involves main laying in existing (brownfield) areas and is subject to a high degree of variability due to the range of locations and conditions, as shown in the Unit Rates Forecast, figure 2.2. AGN states that the forecast three-year weighted average unit rate is [redacted] the AER approved rate in the current AA period, [redacted]. The actual rates in 2015 and 2016 were much lower due to regional activities. AGN forecast that a reduction in regional works and an increase in inner suburbs will reflect the application of the three-year actual weighted average as the forecast. AGN states that this is consistent with its approach in South Australia which was approved by the AER. In response to AER questions, AGN provided weighted average costs for 2011-2013, which shows that the proposed unit rate is [redacted] than the average for that period. Based on the review of unit rates over 2011-13 and 2014-16 the proposed unit rate appears reasonably determined.

I&C Mains: The work involves laying of mains to boundaries of I&C premises. The figure below shows that the unit rates for the work have fluctuated over the last six years (2010-2016). This reflects the high level of variability for each connection.

Figure 2: I&C New Mains Unit Rates ($2016)



(Source: Unit Rate Forecast Figure 2.3)

[25] Unit Rates Forecast: section 2.1.1.2

AGN has used the latest three-year average as its forecast unit of $[redacted]/m. The forecast unit rate is [redacted] the AER approved rate in the current AA period. AGN advised that this variability with connections in inner suburbs is set to continue. Zincara recognises that the cost for I&C mains could vary considerably due to the location and size of the mains to be constructed. As such, Zincara believes that taking a longer period will give a more representative sample of the variability assuming that there are no outliers. As AGN had provided six years of data, Zincara has taken the six-year average as the representative cost. The six-year average gives a unit rate of $[redacted].

Zincara considers the unit cost of $[redacted] as the efficient cost.

New Home Services: This work involves laying services to new homes in greenfield or brownfield conditions. While the type of work is relatively stable, it can be impacted by ground condition (e.g. rock versus clay) and the extent of urban infill (brownfield) which can involve traffic management and reinstatement works. AGN states that during the current AA period that has been a greater number of services being laid in rocky ground conditions (northern growth corridor) resulting in actual capex being [redacted] The northern growth corridor is expected to continue as a significant growth area, as is the southeast corridor, so the three-year weighted average represents a reasonable forecast. In response to AER questions (IR #1), AGN provided 2011-13 weighted average unit rates which match that for 2014-16. AGN's response (IR #1) also stated that more recent actual data for 2016 reflects [redacted] compared to that submitted in the AAI, supporting the ongoing impact of the northern corridor ground conditions.

Given the fact that the 2011-2013 unit rates are also quite similar to the rates experienced in 2014-16, the unit rate appears reasonably determined.

Existing Home Services: This work involves laying services to existing homes (brownfield conditions). Volume is relatively low (around 830 per year) and quite variable depending on location. The 2011-13 average is [redacted] than 2014-16 average, with AGN stating that it is laying more services in inner suburban locations and it expects this trend to continue into the next AA period. The proposed unit rate is [redacted]r than that approved by the AER for the current period and is highly influenced [redacted] Given the variability of the unit cost, Zincara considers that taking the average over a longer period than three years would give a better representative average. As AGN has provided six years of data, Zincara has taken the average over the six year period. The six-year average unit rate (2011-16) is $[redacted] over the forecast period*.*

Zincara considers the average cost of $[redacted]/service to be the efficient cost.

Multi-User Services: Low volume (around 670 per year) and quite variable. The three-year weighted average is [redacted] than approved by the AER for the current period. The proposed unit rate appears reasonably determined.

I&C Services: Low volume (around 360 per year) and quite variable. In response (IR #1), AGN states that updated data [redacted] The forecast unit rate is [redacted] than approved by the AER for the current period. However, given the fact that the unit rates during each of 2013 – 2016 are similar, the forecast unit rate appears reasonably determined.

New Domestic Meters: AGN has used [redacted] unit cost as the forecast unit cost of $[redacted]/meter. The forecast unit cost is [redacted] than the benchmark approved by the AER for the current AA period. AGN says[26] that this is because in the current AA period it had installed [redacted]. The table below provides details of the historical rates and the forecast unit cost.

Table 24: **New Domestic Meters Forecast Unit Rates ($2016, direct)**

	Historic Rates				Forecast Unit Rate
	2014	**2015**	**2016**	**3-yr Average**	
Contractor Rates	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Materia/Other Rates	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Actual ($/unit)	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Volume (units)	14,376	15,443	15,892		

(Source: Unit Rates Forecast: table 2.11)

AGN also stated that it had entered into a new meter purchase contract [redacted]. A new gasfitting contract was entered into in [redacted]. AGN says that it had applied the rates contained within these contracts in forecasting the proposed unit rate of $[redacted].

From Table 24, Zincara notes that the contractor's unit rate has stayed constant for the period 2014-2016. AGN has used this unit rate for its forecast contractor's rate, which would imply that there is no impact on the unit rate from the new gas-fitting contract. In the case of the material cost, Table 24 shows that the material cost has fluctuated considerably in the three years 2014-2016 due to [redacted]. Zincara therefore believes that a more reflective material cost for the forecast period should be the average of the three years 2014-2016. The average would have also allowed for a component of the material cost to be affected by the new meter contact.

Zincara therefore considers an efficient cost for installing new meters is $[redacted].

New I&C Meters: Low volume (around 360 per year) and quite variable. AGN states[27] that connections over the last few years are [redacted] approved by the AER which it forecasts to continue, resulting in a rate which is [redacted] than approved for current AA period. I&C metering installations can vary in complexity due to the range of sizes that need to be installed and the locations. AGN state that the work is carried out by a mixture of internal staff and contractors depending on the scale of the job. The work is not subject to a competitive tender, although materials are procured through a competitive process. Additional information provided by AGN shows that the average unit rate for the three-year period 2011-13 is $[redacted], compared with the 2014-2016 weighted average of [redacted].

Given the variability, Zincara believes that a longer period would give a more representative sample. As there is only six years of data, Zincara has used this data to calculate the unit

[26] Unit Rate Forecast: section 2.3.2.5, page 21
[27] Unit Rates Forecast: section 2.3.3.3, page 23

rate. However, it has not included the 2011 data as the unit cost was considered to be too low and as such treated as an outlier.

The calculated average unit rate is $[redacted], or $xxx lower than AGN's forecast unit rate. Applying this to the volume of 1,804 would result in [redacted]. Zincara considers the efficient unit rate to the calculated unit rate of $[redacted].

Table 25: New I&C Meters Forecast Unit Rates ($2016, direct)

	Historic Rates				Forecast Unit Rate
	2014	2015	2016	3-yr Average	
Contractor Rates	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Materia/Other Rates	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Actual ($/unit)	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Volume (units)	273	272	313	-	-

(Source: Unit Rates Forecast: table 2.12)

4.7 BENCHMARK ANALYSIS

The following table represents the calculation of total connection unit rates, based on information contained within the Capex Forecast Model (attachment 8.8). Data relates to direct cost only and 2016 dollars. Note that this is slightly different to customer numbers due to the assumption in the capex model that multi-user connections have four gas meters.

Mains. The capex model shows metres of main per connection type. In each case we have used to Victorian data (Albury being slightly different, but also with relatively small volumes). For Multi-User we have assumed a metre length for mains, which calculates around [redacted], however, the capex model doesn't provide any length for this connection type.

Services. The capex model states the assumption of [redacted] per multi-User.

Meters. One meter per connection, except for Multi-User, which assumes [redacted].

Table 26: Connections Analysis Average Unit Rates ($2016, direct)

Unit rate analysis:	Mains	Service	Meter(s)	Total
New Estate	[redacted]	[redacted]	[redacted]	[redacted]
Existing Home	[redacted]	[redacted]	[redacted]	[redacted]
Multi-User	[redacted]	[redacted]	[redacted]	[redacted]
I&C (V)	[redacted]	[redacted]	[redacted]	[redacted]

(Source: Zincara tables within this report). * estimate only; ** assumes [redacted] per connection

Residential Connection Unit Rate. Consolidating new estate, existing home and multi-user unit rates with respective volumes and then dividing by total residential connections calculates a residential unit rate of approximately $[redacted] ($2016, direct). By way of a benchmark comparison, with the other two Victorian Distribution businesses, all three have

relatively similar forecast unit rates for residential connections. Due to the variety of contracting arrangements across the businesses, only AGN provided information that enabled a further breakdown of residential connections into new estate, existing home, and multi-user.

I&C (V) connection unit rate. AGN and AusNet Services have similar forecast unit rates, while Multinet's rate is significantly lower. There was also significant variation across the businesses for mains, services and meters, which may reflect the variation in size and location of I&C (tariff V) connections.

4.8 CONCLUSION

Volume Forecast. AGN has engaged Core Energy to develop forecasts for customer numbers, and state that the methodology applied is consistent with that recently approved by the AER for South Australia. Zincara has been advised that the AER has made other arrangements to review AGN's forecast and methodology.

Unit Rates. Based on the analysis in Section 4.6 and 4.7, Zincara is recommending the majority of the unit costs but has also recommended that some unit costs be adjusted as shown in the table below.

Table 27: Summary of Analysis

Connections		AGN Forecast	Comment
New Mains	New Estate	$[redacted]/m	Recommended
	Existing Home	$[redacted]/m	Recommended
	I&C	$[redacted]/m	Recommended [redacted]
New Service	New Home	$[redacted]/service	Recommended
	Multi-User	$[redacted]/service	Recommended
	Existing Home	$[redacted]/service	Recommended [redacted]
	I&C	$[redacted]/service	Recommended
New Meter	Domestic	$[redacted]/meter	Recommended [redacted]
	I&C	$[redacted]/meter	Recommended [redacted].

(Source: Attachment 8.4: Table 1.2)

Marketing Capex. AGN has proposed a nominal 303 additional residential connections with capex of $[redacted] million ($2016 direct), which is incorporated within the volume forecasts. As this marketing capex is discretionary, it is noted that the decision regarding approval would be included in the AER's review of the Opex.

I&C (tariff D) Connections. Zincara did not find any mention in the Connection section of the AAI documents, Capex model, or the Unit Rates documents regarding the large I&C contract Connections, so it cannot make any recommendations for this connection type.

5. MAINS REPLACEMENT

5.1 INTRODUCTION

AGN is proposing Mains Replacement capex of $154 million over the next AA period, with an estimated 297 kilometres replaced or abandoned, as outlined in the following table. As a result this will complete its mains replacement program, resulting in the replacement (and upgrade) of the low pressure network, including the Melbourne CBD. In addition it proposes to replace other mains determined to be at risk.

Table 28: Mains Replacement Forecast ($million, 2017, direct)

Mains Replacement	Volume	2018	2019	2020	2021	2022	Total
CBD Block replacement	25.3km	6.1	6.1	6.1	6.3	6.4	31.1
CBD Trunk replacement	1.6km	-	2.0	2.0	-	-	3.9
General Trunk replacement	10.2km	2.1	2.1	2.1	1.6	0.3	8.3
Decommissioned Trunk	32.4km	1.3	1.3	1.3	1.3	-	5.1
Block replacement (HDICS)	178.5km	20.3	20.3	20.3	20.3	-	81.3
Block replacement (LDS)	36.9km	3.4	3.4	3.4	3.4	-	13.5
HDPE replacement	10km	1.1	1.1	1.1	1.1	1.1	5.6
Piecemeal replacement	2.0km	0.3	0.3	0.3	0.3	0.3	1.1
Services replacement	-	0.8	0.8	0.8	0.8	0.8	0.8
Total Mains Replacement	**296.8km**	**35.4**	**37.4**	**37.4**	**35.0**	**8.6**	**153.7**

(Source: AAI: Table 8.4 (Capex); DMSIP: Table 8.3 (Volumes))
Note: Totals may not add up due to rounding error.

AGN advised[28] that it has spent $18 million less than that approved by the AER on mains replacement over the current AA period, while being on track to deliver the approved volume of 696 kilometres, as a result of completing less complex areas than initially anticipated. This includes 508 kilometres replaced by the end of 2015, and a total of 188 kilometres forecast to be completed during 2016 and 2017.

Unless noted otherwise, references noted in this section of the report relate to AGN's Distribution Mains & Services integrity Plan (DMSIP).

Using a combination of qualitative and quantitative assessment, including cost impact analysis, AGN propose that 285 kilometres of highest risk mains be replaced or abandoned in the next AA period. The amount is comprised of:

- Cast iron / unprotected steel mains – 132 kilometres
- PVC mains – 110 kilometres
- HDPE (575) – 10 kilometres
- Decommission / abandon trunk mains – 32 kilometres of Cast iron and unprotected steel

[28] AAI: section 8.3, page 77

A further 12 kilometres of trunk main construction is also proposed to support the existing HP network as it is extended, giving a total mains replacement program of 297 kilometres {(252 kilometres (replace) + 32 kilometres (abandon) + 12 kilometres (construct)}, compared with 696 kilometres of main replaced during current AA period.

AGN has engaged with Energy Safe Victoria (ESV) on its Distribution Mains Services Integrity Plan (DMSIP). In a letter to AGN, ESV[29] stated *"….ESV supports the proposed mains and services replacement program outlined in AGN's DMSIP, being the replacement of 297km of CI, UPS, PVC and HDPE mains."* Further details are provided later in this paper.

The following table presents a summary of AGN's proposed program, showing length, capex and unit rates for each of the categories of mains replacement.

Table 29: Mains Replacement Forecast ($million, 2016, direct)

Category	Program	Length (km)	Capex ($M)	Unit Rate $/m
1	CBD – Block (CI/UPS)	25.3	30.5	[redacted]
2	CBD – Trunk	1.6	3.9	[redacted]
3	HDICS / LDS - Trunk	10.2	8.2	[redacted]
4	Trunk - decommission	32.4	5.0	[redacted]
5	CI/UPS HDICS	94.2	42.1	[redacted]
6	CI/UPS LDS	10.9	3.9	[redacted]
7	PVC HDICS	85	38.1	[redacted]
8	PVC LDS	25	9.0	[redacted]
9	HDPE 575 sampling program	3	1.6	[redacted]
10	HDPE 575 50yr old replacement	7	3.8	[redacted]
11	Piecemeal	2	1.1	[redacted]
	Total length and cost	**297**	**147.2**	**-**

(Source: DMSIP: Table 8.1; Table 10.1)
Note: Totals may not add up due to rounding error.

5.2 FORTHCOMING ACCESS ARRANGEMENT PERIOD – 2018-2022

5.2.1 Failure Analysis

AGN notes that its key integrity indicators include (DMSIP: 4.2):

- Leaks
- Cracks or breaks – a sub-category of leaks
- Water in mains
- Unaccounted for gas (UAFG)

[29] Final Plan Attachment 8.9: Letter from ESV, dated 20 December 2016

All things being equal, increasing trends in these indicators are usually a sign of deterioration in the condition/integrity of the network.

Leaks and Cracks

AGN states[30] that cast iron, unprotected steel and PVC mains account for over 68% of mains leaks over the last ten years, despite representing only about 4% of the distribution network. The impact of the mains replacement program is reflected in an improving trend since 2010, with over 330 kilometres of cast iron mains replaced over the last four years.

With respect to leak and crack rates the following table shows that cast iron, unprotected steel and PVC mains are significantly higher than that of steel or PE and considered to pose the greatest public risk.

Table 30: Leak Rate by Material (FY2015)

Material	Length	Mains Leaks	Leaks/km	Mains Cracks	Cracks/km
Cast iron	226	516	2.28	55	0.24
PVC	228	58	0.25	29	0.13
UPS	21	139	6.7	0	0
Steel	2,860	131	0.05	0	0
PE	6,995	188	0.03	86	0.013

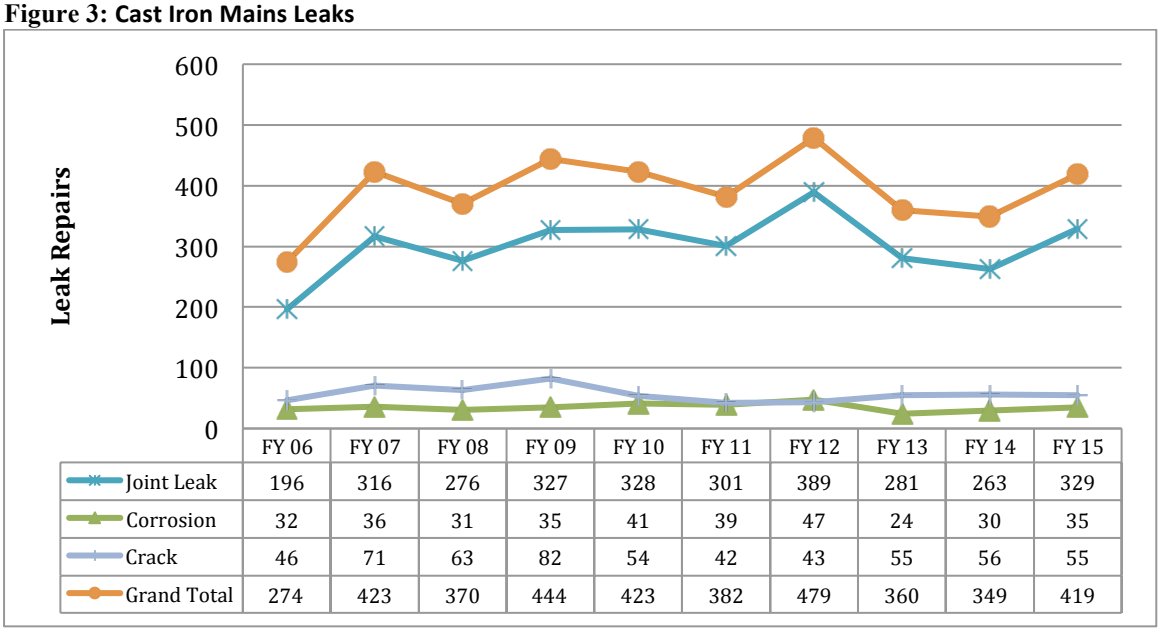
(Source: DMSIP: Table 4.2)

Cast Iron Mains. The leak and crack rate for cast iron mains is far greater than for most other material types. Joint leaks account for a majority of leaks (approximately 78%) over the last five years, with cracks accounting for approximately 13%. These two leak types represent the highest modes of failure in these mains. While AGN has mainly been maintaining these rates through its operations and mains replacement programs, Zincara would expect that the rates would increase if the mains replacement program were deferred to any great extent.

The oldest cast iron mains in AGN's network are in the Melbourne CBD, where population density and proximity to building results in relatively higher public risk. For the CBD, AGN shows that the annual leak rate is about 2.5 leaks/km and the annual crack rate is about 0.2 cracks/km, with both experiencing an increasing trend from 2013.

[30] DMSIP: section 4.2.1, page 27

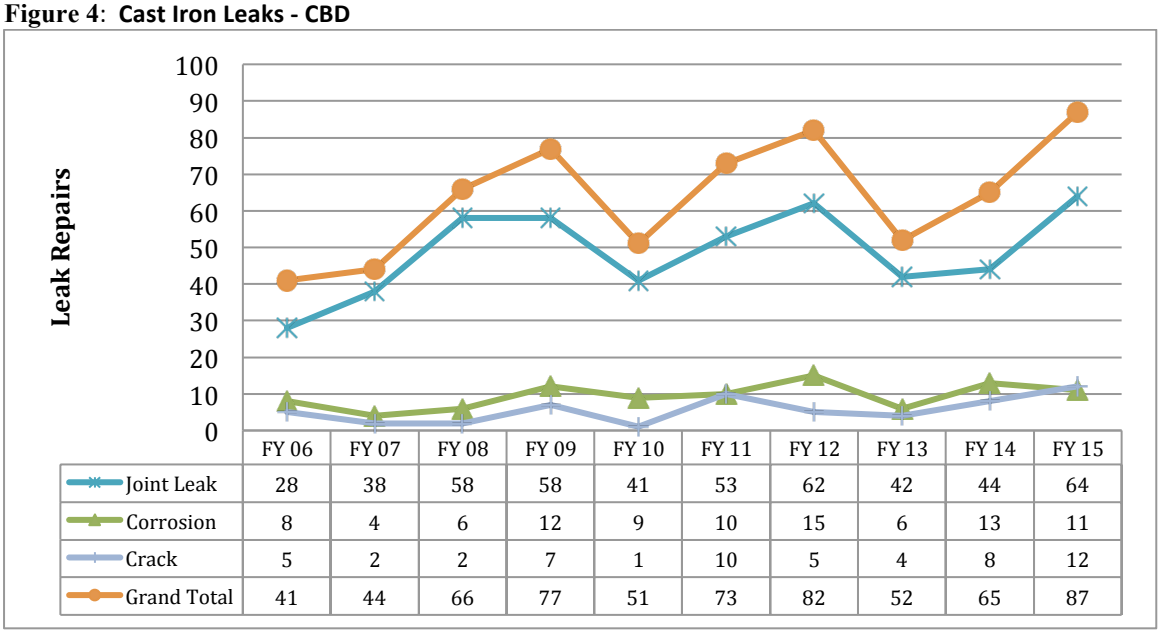
Figure 3: Cast Iron Mains Leaks



	FY 06	FY 07	FY 08	FY 09	FY 10	FY 11	FY 12	FY 13	FY 14	FY 15
Joint Leak	196	316	276	327	328	301	389	281	263	329
Corrosion	32	36	31	35	41	39	47	24	30	35
Crack	46	71	63	82	54	42	43	55	56	55
Grand Total	274	423	370	444	423	382	479	360	349	419

(Source: DMSIP: Figure 4.3)

Figure 4: Cast Iron Leaks - CBD



	FY 06	FY 07	FY 08	FY 09	FY 10	FY 11	FY 12	FY 13	FY 14	FY 15
Joint Leak	28	38	58	58	41	53	62	42	44	64
Corrosion	8	4	6	12	9	10	15	6	13	11
Crack	5	2	2	7	1	10	5	4	8	12
Grand Total	41	44	66	77	51	73	82	52	65	87

(Source: DMSIP: Figure 4.4)

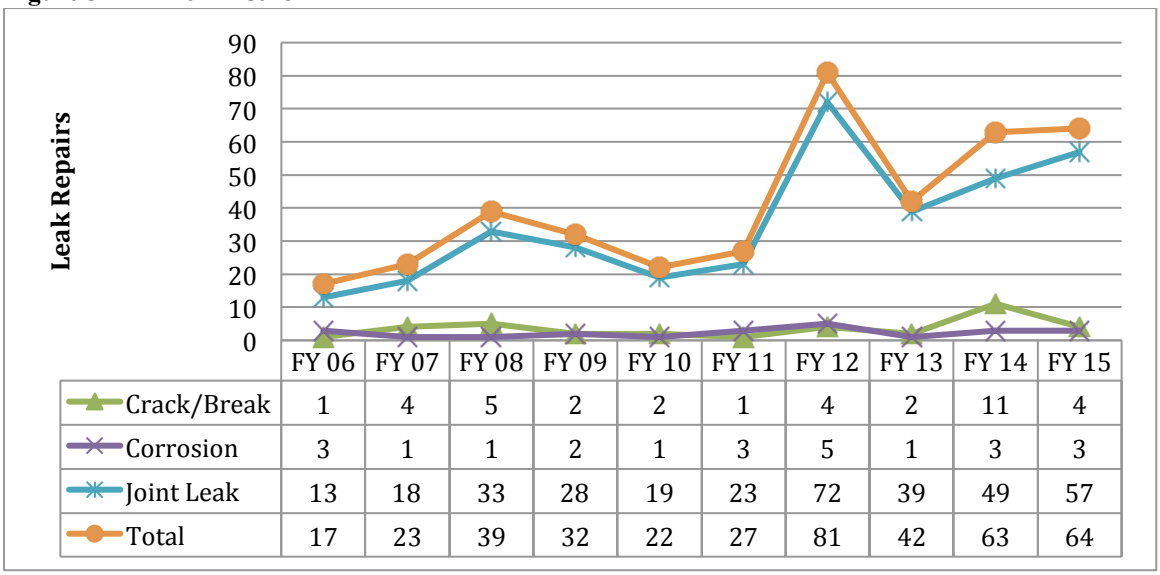
Unprotected Steel Mains. These mains have no cathodic protection and as such are susceptible to corrosion. AGN notes[31] that often, response to failures reveal extensive corrosion which requires piecemeal replacement as the extent of corrosion is beyond repair. While the volume of leak failures is around 40 per year, with a low volume of these mains currently in service (21 kilometres) the resulting annual leak rate is 6.7/km, which is the highest of all materials in the network. With the number of leaks exhibiting an increasing trend, Zincara agrees that these mains need to be replaced.

[31] DMSIP: section 4.2.3, page 30

PVC Mains. These mains are typically interspersed throughout the LP cast iron network, being used as part of piecemeal cast iron replacement programs in the 1970s and 1980s. These mains can have brittle failures and become brittle with age making repairs and connections difficult. AGN's data shows that there are about 55 leaks per year, with joint failures showing an increasing trend and cracks remaining relatively stable. Overall leak failures are exhibiting an increasing trend.

MP Trunk Mains. There are about 32 kilometres of medium pressure cast iron and unprotected steel trunk mains in the network, providing the primary supply to the LP network. As the LP network is replaced, the majority of these mains will be made redundant and abandoned. Some mains will be replaced by HP trunk mains, to support the extension of the HP network as it replaces the LP network. The number of joint leaks on these mains has increased from around 13 in 2006 to 60 in 2015, with an increasing trend. Corrosion and crack leak failure have been relatively stable and is a small number by comparison to joint leaks. These mains are typically located in major roads and near significant infrastructure, making repairs very problematic with significant disruption to the community.

Figure 5: MP Trunk Leaks



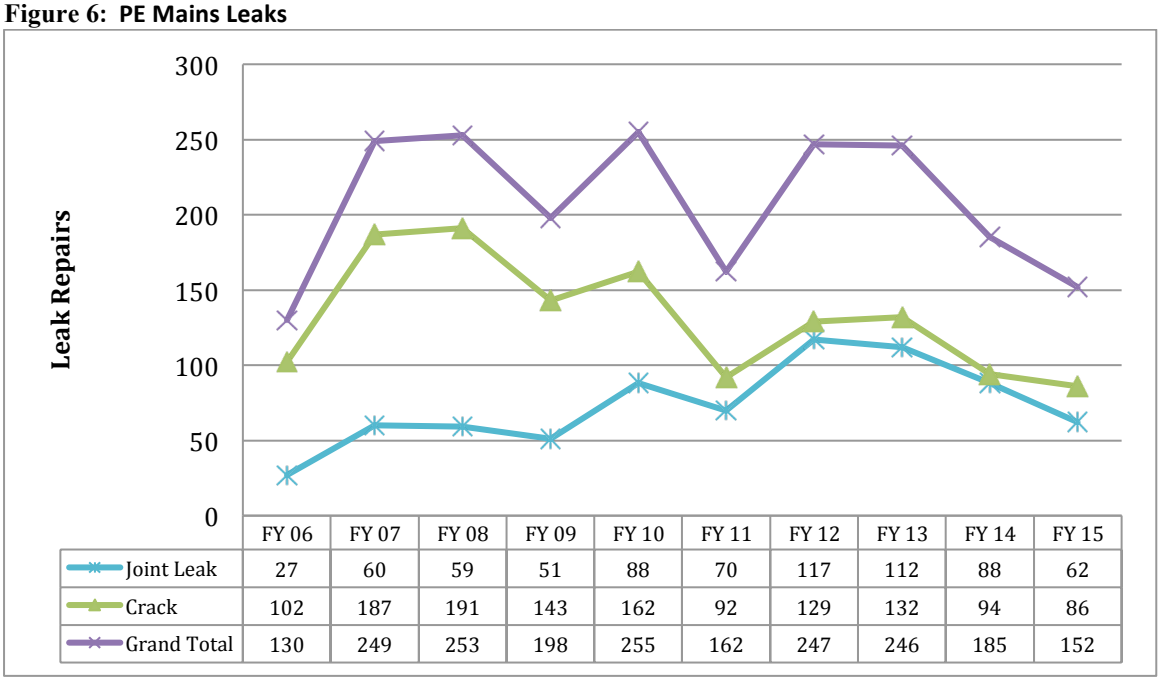
	FY 06	FY 07	FY 08	FY 09	FY 10	FY 11	FY 12	FY 13	FY 14	FY 15
Crack/Break	1	4	5	2	2	1	4	2	11	4
Corrosion	3	1	1	2	1	3	5	1	3	3
Joint Leak	13	18	33	28	19	23	72	39	49	57
Total	17	23	39	32	22	27	81	42	63	64

(Source: DMSIP: Figure 4.7)

PE Mains. HDPE 575 was used from late 1970s to the late 1990s and superseded by MDPE (PE80) from the late 1990s. A few years ago that was superseded by HDPE 100. Overall the annual leak rate for PE mains is about 0.03 leaks/km, with the annual crack rate of about 0.02/km. AGN reports[32] that "catastrophic failures" of HDPE 575 mains in its South Australian network has shown that this material does have a propensity for slow crack growth at sites where it has been subjected to local stress, particularly from past squeeze-offs. HDPE has been shown to degrade over time becoming increasingly brittle. From its investigations AGN states[33] that *"It is considered that once the material reaches about 50 years of age it can become highly susceptible to cracking. The time to "brittle" failure can be significantly reduced as a result of squeeze-off damage."*

[32] DMSIP; section 4.2.6, page 33
[33] DMSIP: section 4.2.6, page 33

Figure 6: PE Mains Leaks

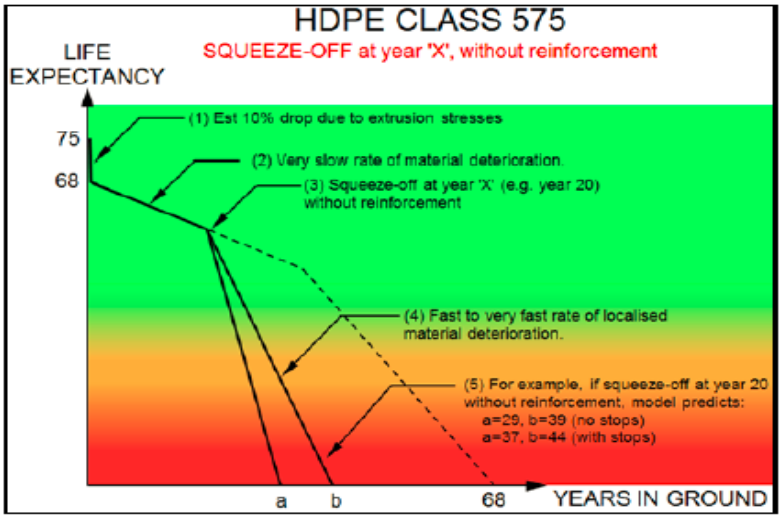


	FY 06	FY 07	FY 08	FY 09	FY 10	FY 11	FY 12	FY 13	FY 14	FY 15
Joint Leak	27	60	59	51	88	70	117	112	88	62
Crack	102	187	191	143	162	92	129	132	94	86
Grand Total	130	249	253	198	255	162	247	246	185	152

(Source: DMSIP: Figure 4.8)

AGN provided the following figure to illustrate how the time to failure reduces significantly where squeeze-off damage has occurred. In the figure, the "dotted line" to 68 years is the life expectancy "*achievable in ideal conditions, where no squeeze-off has occurred.*" The age "a" represents the impact of a fast rate of localised material deterioration (e.g. where squeeze-off has occurred without using stops on the squeeze-off tool), and "b" represents the impact on life expectancy where the squeeze-off tool includes stops to reduce the extent of the squeeze-off.

Figure 7: HDPE Class 575 Behaviour Model



(Source: DMSIP: Figure 4.10)

About 3,000 kilometres of HDPE 575 was laid in AGN's Victorian networks during the 1970s and 1980s. Over the next 15 years, a significant quantity of HDPE 575 mains will reach 50 years of age. There are 597 kilometres of HDPE 575 mains in the network that are more

than 35 years old and risk rated as "intermediate". Of concern is the 7 kilometres of HDPE 575 that will reach 50 year life in the next AA period.

As there is considerable uncertainty surrounding the risk posed by these mains in Victoria, AGN proposes the replacement of 7 kilometres of the oldest HDPE 575 (>35 years old) so it can investigate the condition and material properties of these mains in order to better understand the likelihood of failure. As part of its investigations AGN also propose replacement of 3 kilometres of main less than 35 years old from across its Victorian networks. Analysis and review of the samples provided will be undertaken by a Deakin University research team under the auspices of the Energy Pipelines Cooperative Research Centre (EPCRC) project. The project, "Cracking in Polyethylene Pipelines" has been initiated with Deakin University by AGN's Victorian Asset Manager. The aims of the project are outlined in AGN's DMSIP section 7.2.3.

From a risk perspective and its failure analysis of information provided in AGN's submission, Zincara does not believe that the replacement of 10km of this early generation PE is justified as efficient at this time. However, based on the uncertainty of the failure mechanism for these mains, the volume in its networks, and the level of research study proposed (already initiated), Zincara finds that this sampling program is reasonable and prudent.

Steel Mains. AGN says that there is some emerging evidence to suggest that the oldest mains in this category, coated with coal tar enamel, may be starting to lose coating cohesion. There are 1,389 kilometres of this mains type in service, operating at high pressure. As the cathodic protection difficulties are a leading indicator of condition deterioration, this is now being investigated by AGN via targeted leak survey and detailed reporting of leak fixes on affected assets.

Services. These generally consist of material of the same vintage of the gas main to which they are connected. Hence AGN makes no distinction between mains and services when assessing useful life or risk. AGN has noted an increase in steel service leaks over 2015 suggesting there may be an emerging corrosion issue with protected steel pipes in the seaside suburbs of the Mornington Peninsula.

Gas in Building Incidents. AGN advises that there has been a decrease in the number of these incidents since 2010. Historically, these incidents have occurred near cast iron and unprotected steel mains. The significant reduction since 2010 has been attributed to the cast iron and unprotected steel mains replacement program.

Water in Main Incidents. The number of water in main incidents are influenced by the amount of rain that falls and the level of ground movement associated with clay soils as they swell and contract. AGN says that a high number of water in main incidents is indicative of mains reaching the end of their useful life. Following a sharp rise in incidents during 2011 associated with the breaking of the drought, subsequent wet winters have experienced a declining trend with a 68% reduction attributed to the mains replacement program.

Conclusion. Based on its failure analysis and review of AGN's risk analysis, Zincara agrees that AGN's methodologies appropriately identify mains requiring attention for replacement. In reviewing AGN's proposals with respect to its early generation HDPE 575 mains, Zincara finds that its failure analysis does not justify replacement of the 10 kilometres of main as efficient at this time. However, the basis of the replacement is to enable AGN to better understand the ongoing condition of these mains and likelihood of failure. Having also

initiated a research study with Deakin University, and the fact that AGN has about 3,000 kilometres of these mains, Zincara finds that this sampling program is reasonable and prudent and therefore recommends its approval.

5.2.2 Volume

AGN says[34] that it has used a combination of qualitative and quantitative assessment, including a cost impact analysis, to determine which mains and associated volumes should be replaced within the next AA period.

Risk Assessment.

AGN's risk assessment process has identified five categories of mains with a rating of "high" (250 kilometres), three categories of mains have been rated "intermediate" (641 kilometres) and three categories rated as "low" (6,738 kilometres). No mains were rated as "extreme" or "negligible" risk.

"High" risk. For mains rated as high risk, AGN states that replacement is the only treatment that can reduce the risk to "Low". While continuing mitigation activities such as leak surveys, pressure monitoring and odorisation can help manage the risk until mains replacement can occur, they alone will not reduce the risk to low, as required by AS/NZS 4645 and the Safety Case. Therefore it is planned to replace all cast iron, unprotected steel and PVC mains located in the high density inner city suburbs (HDICS) (250 kilometres) during the next AA period.

"Intermediate" risk. Treatment of mains rated as intermediate risk will vary depending on the particular characteristics of the mains. AGN propose that 25 kilometres of PVC in the lower density suburbs will be replaced as part of the CI/UPS replacement program. Intermediate risk mains in the CBD will be managed during the next AA period until they become redundant as a result of gas supply to the CBD being transferred to the HP system.

HPDE (575) mains aged greater than 35 years are risk rated as "Intermediate". There are 597 kilometres more than 35 years old, but there is insufficient data to fully assess their condition. There have not been any major incidents in Victoria to date, but South Australia's experience (3 major gas in building explosions) suggests that this material has a propensity for cracking and sudden failure. Therefore AGN propose a sample program of 3 kilometres across the network, and also a further 7 kilometres based on end of technical life (estimated to be 50 years), for investigation and analysis as to the most efficient replacement profile for the remaining assets. A research study has been initiated with Deakin University.

Mains rated at "Low" risk do not require any risk treatment other than monitoring.

Mains Replacement Options Analysis. AGN has considered a range of options for mains replacement and risk mitigation over the next five years. For each option, AGN has considered the cost impact to customers, deliverability, and whether the activities will be effective in reducing the consequence of the risk event or the likelihood of the risk event.

[34] DMSIP: section 6 and 7

Table 31: Cost and Risk Outcomes of Scenarios ($million, 2016, direct)

Scenario	Km replaced	Risk Rating end 2018-22	Capex
Replace all high risk CI and UPS	177	High	[redacted]
Replace all high risk CI, UPS, plus PVC in HDICS	262	Intermediate	[redacted]
Replace all high risk and all intermediate PVC mains (all CI, UPS and PVC mains)	299	Intermediate	[redacted]
Replace all high risk mains and intermediate PVC mains in LDS (i.e. excludes PVC mains in CBD)	287	Intermediate	[redacted]
Replace all high and intermediate risk mains (CI, UPS, PVC plus HDPE>35yrs old)	896	Low	[redacted]
Preferred Option: replace all high risk and achieve ALARP or low for all other mains	297	Intermediate (ALARP)	[redacted]

(Source: DMSIP: Table 2)

AGN considers, on balance, that its preferred option represents a prudent and efficient level of replacement, with the estimated cost of the program reflecting the lowest cost of achieving the risk reduction required by AS/NZS 4645. It believes that it can mitigate the risk associated with the remaining 599km of mains by continuing regular leak surveys, monitoring odorant levels and expediently responding to and repairing leaks when they occur. This approach is in line with that supported by Energy Safe Victoria (refer Letter from ESV dated December 2016 and outlined later in this review).

In AGN's DMSIP, section 7, each asset category has a risk rating with treatment options considered. AGN's DMSIP (table 7.7) provides a summary list of each mains category, including the kilometres in service, its risk rating, risk treatment approach and kilometres to be removed during the next AA period. Zincara has reviewed AGN's approach and agrees that it is well developed and reasonable.

Summary of Volume.

As a result of its failure analysis, risk assessment and proposed risk treatment, AGN proposes to undertake replacement or decommissioning of the following mains over the next AA period:

- 177 kilometres of Cast Iron and Unprotected Steel:
    - 25 kilometres in the CBD
    - 44 kilometres of trunk mains (32 kilometres will be decommissioned and replaced with 12 kilometres of new or inserted trunk main
    - 96 kilometres in high density inner city suburbs
    - 11 kilometres in lower density suburbs
- 110 kilometres of PVC mains:
    - 85 kilometres in high density inner city suburbs
    - 25 kilometres in lower density suburbs

- 10 kilometres of HDPE 575:
    - 3 kilometres as part of a sampling program
    - 7 kilometres where the mains are older than 50 years

5.2.3 Prioritisation

AGN says that to optimise the risk reduction, the areas are prioritised based on the highest crack rate. It is noted that the sequence of replacement may require lower risk areas to be replaced to ensure the HP network can be extended effectively or in circumstances to take advantage of third party works where it is cost effective to do so.

Trunk Mains. A majority (32 kilometres) of the residual cast iron and unprotected steel Trunk mains will be decommissioned after the LP networks they supply are replaced. About 12 kilometres of new trunk main is required to augment the supply to areas that have been inserted and upgraded to high pressure. These mains are generally in different locations to the existing MP cast iron and unprotected steel trunk mains to optimise supply across the HP network.

Melbourne CBD. AGN has developed a replacement strategy for the Melbourne CBD. This strategy is based on insertion where possible. AGN says that it has been planning for a staged replacement program, detailing the scope and sequence of work, for some time. The CBD strategy focuses on replacement of cast iron and unprotected steel mains, leaving about 12 kilometres of PVC and 7 kilometres of cathodically protected steel mains operating at low pressure. The steel mains were rated as low risk so no further intervention is required. The CBD PVC mains, while rated as intermediate risk, have been assessed as ALARP (ref: DMSIP: section 7), with replacement to be deferred, as in the longer term these mains are expected to be redundant. The replacement of the Melbourne CBD is expected to span the 5 years of the next AA because of construction constraints that apply to working in a high density, business critical location. In response to a question from the AER regarding CBD mains replacement (IR #14), AGN advised that the rail tunnelling and associated activities would have a negligible impact on its program over the next AA period.

Non-CBD Mains Replacement. Prioritisation for replacing cast iron, unprotected steel and PVC in non-CBD suburbs is based on addressing first the suburbs where the highest crack and leak rates have been identified. In the following table, the lower the total rank score, the higher the replacement priority. The actual sequence and timing of replacement will depend on the detailed design and follow logical areas based on network configuration and proximity to existing HP network infrastructure.

Table 32: Mains Replacement Suburb Ranking

Suburb category	Suburb	Crack Rate	Leak Rate	Crack Rank	Leak Rank	Rank Score	Overall Rank
HDICS	Northcote	0.4	2	1	3	4	1
HDICS	North Melbourne	0.3	1.3	2	5	7	2
HDICS	Fitzroy North	0.3	1.4	4	4	8	3
HDICS	Carlton	0.3	1.1	3	7	10	4

HDICS	Preston	0.2	2.5	9	1	10	4
HDICS	Richmond	0.2	2.1	8	2	10	4
HDICS	Fitzroy	0.3	1.1	6	6	12	7
HDICS	West Melbourne	0.2	1.1	7	8	15	8
LDS	Ivanhoe	0.3	0.6	5	12	17	10
HDICS	Parkville	0.2	1	10	9	19	11
HDICS	East Melbourne	0.1	0.9	12	10	22	12
HDICS	Clifton Hill	0.1	0.9	14	11	25	13
LDS	Ivanhoe East	0.1	0.3	11	14	25	13
HDICS	Carlton North	0.1	0.5	13	13	26	15
LDS	Eaglemont	0	0.1	15	15	30	16
HDICS	West Melbourne	0.2	1.1	7	8	15	8

(Source: DMSIP: Table 8.2)

Piecemeal Replacement. Some reactive piecemeal replacement will be required to address urgent leakage problems or localised cases of water ingress. Short lengths (less than 100 metres) are typically replaced on a size for size direct basis using direct burial, rather than insertion. The piecemeal replacements are typically related to LP cast iron, unprotected steel and PVC materials where the first response to a leak identifies a main in poor condition with replacement considered a more effective and efficient solution than repair. In its Unit Rates Forecast paper, AGN states that "*very little piecemeal replacement has been completed over the last three years, with no work undertaken in 2015*", but has forecast a nominal 500m per year. However, in contrast, AGN's DMSIP (ref: 4.2.3) notes that for unprotected steel "*these mains are typically more than forty years old with the first response to a leak invariably revealing extensive corrosion that in many cases cannot be repaired and as such 'piecemeal' replacement is the only option.*"

Zincara notes these apparently conflicting comments, however, based on its experience expects that there would be a number of piecemeal replacements each year and on that basis recommends the nominal amount of 500m per year as reasonable.

Service Replacement. There are cases where services need to be renewed on a standalone piecemeal basis, such as when leaks arise or damage occur on the service and inspection reveals that the service is heavily corroded or in such poor condition that repairs are not viable.

Summary Schedule. AGN has prepared the following mains replacement schedule and a delivery schedule (refer: DMSIP: Figure 8.3)

Table 33: Mains Replacement Summary – Volume (km)

Category	2018	2019	2020	2021	2022	Total
CBD Block replacement	5	5	5	5.1	5.2	25.3
CBD Trunk replacement	-	0.8	0.8	-	-	1.6
General Trunk replacement	2.6	2.6	2.6	2	0.4	10.2
Decommissioned Trunk replacement	8.1	8.1	8.1	8.1	-	32.4
HDICS Block replacement	44.6	44.6	44.6	44.6	-	178.5
LDS Block replacement	9.2	9.2	9.2	9.2	-	36.9
HDPE replacement (HDPE 575 sampling)	2	1	-	-	-	3
HDPE 575 >50 year replacement	-	1	2	2	2	7
Piecemeal replacement	0.5	0.5	0.5	0.5	-	2.0

(Source: DMSIP: Table 8.3)

Following a review of AGN's prioritisation methodology, Zincara finds that it is reasonable.

5.2.4 Delivery Capability

(Ref: DMSIP: section 9)

The mains replacement program of 297 kilometres is substantially less than the 696 kilometres replaced during current AA. AGN says that the majority of work is subject to competitive tender with successful contractors delivering to unit rates established during the tender process. These tenders are issued up to 18 months in advance. This has ensured that the planning, budgeting, negotiation and execution cycles are aligned to ensure a cost efficient program.

AGN uses a prequalified contractor panel, which was established in [redacted] The current agreement expires in [redacted] and AGN advises that [redacted].

AGN also has an internal crew available as required, to ensure that a level of hands on experience with the complexity, health, safety and environmental requirements of block mains replacement is available.

Major block renewal programs outside the CBD will be delivered during the first four years of the next AA period. The CBD will be a major project with the concept design being completed and issued as an initial tender in 2016. An additional 12 month round of design, planning, stakeholder engagement and tendering during 2017 has been incorporated into the schedule, to ensure the program can be optimised, accounting for constraints and other capital works being undertaken within the CBD. The proposed program averages around 125 metres of mains replacement per week, and given AGN's past performance and experience, the delivery risk is considered low.

Given, AGN's performance with mains replacement during the current AA period and its planning and lead time approach, along with the fact that the next AA period's program is

greatly reduced compared with the current period, Zincara believes that AGN can deliver its program as planned.

5.2.5 Unit Rates Analysis

Development of unit cost uses a mix of:

- Historical information (recent tenders and actual historic unit rates for the particular suburb or a similar suburb)
- Assessment of the extent and reasons for variations to past costs
- New tender information for particular scope of works

This approach is consistent with that used by AGN to develop cost estimates in respect to the South Australian mains replacement program.

Material costs are based on average unit rates for the last 3 years. Additionally, AGN has applied a 5% uplift to capture internal project management costs, based on average actual costs for mains replacement over the same period. Zincara agrees that this approach is reasonable.

AGN has prepared a Unit Rates Forecast document, along with Supporting Information 1 to show the detailed analysis it has undertaken in developing the unit rates for each of the categories. Zincara has reviewed this information and provides analysis below.

AGN's approach to development of unit rates varies depending on the category of work to be undertaken (refer: Unit Rates Forecast: section 4) and is outlined below.

General Block Replacement – LDS / HDICS. Forecast v*olume: 215 kilometres; Average forecast unit rate:* [redacted]. Forecasting approach is to base the unit rates on recent tender information where this is available and on historic actuals where recent market testing has not occurred. Where no work has been undertaken then the rate is based on work undertaken in similar suburbs and varied for any known changes in scope. The work covers 215 kilometres of mains replacement across LDS and HDICS. AGN considers the actual unit rates for this category that have been incurred over the last three years. AGN calculates that the average unit rate for this category will increase for the next period with over 80% of the work in the HDICS areas.

In addition it says that some of the smaller contractors will drop off the panel due to the increasing complexity of the work and locations. These areas contain more multi-user sites and properties with meter rooms (which may need some upgrading). There are also some replacements in narrow bluestone laneways that have special heritage management requirements. Once contractor costs are determined, AGN then adds a unit rate for materials based on an approximate three year average (2014 – September 2016), finally adding a 5% uplift for internal project management costs, which has been based on average actual costs for mains replacement over the same period as for materials.

Zincara has reviewed the information provided by AGN, including the DMSIP, Unit Rate Forecast and Supporting Information 1 (unit rate analysis) and finds that the approach is reasonable and the information provided is detailed.

As a result of the above approach, AGN has developed unit rates for each suburb. Table 4.4 (Attachment 8.4: Unit Rates Forecast document) lists the suburbs covered by this category, their location type, length of replacement, forecast total capex and unit rate, along with the method of forecasting applied. AGN has also undertaken a reasonableness analysis for the forecast unit rate, considering the median value of all tenders for each stage. It has also applied a sensitivity analysis in arriving at its recommended unit rate of $[redacted] /m (LDS) and $[redacted] /m (HDICS).

In addition to analysing AGN's approach and the provided information as noted above, further information was sought by the AER regarding any new mains replacement contracts (IR #14: Question 2). In its response, AGN confirmed that it had into new contracts for:

- General Block – High Density Inner City Suburbs (HDICS); and
- General Block – Low Density Suburbs (LDS).

Table 34: Impact of New Contracts - Volume, Unit Rates and Capex ($million, 2016, direct)

Category	Volume	Plan Unit Rate	Revised Unit Rate	Capex Variance
Block replacement (HDICS)	178.5km	[redacted]	[redacted]	[redacted]
Block replacement (LDS)	36.9km	[redacted]	[redacted]	[redacted]
Total mains replacement	**215.4km**	[redacted]		[redacted]

(Source: IR #14:Q2)

With [redacted] unit rates, these contracts result in a [redacted] capex of $[redacted] million ($2016 direct). In terms of unit rate analysis, these recently tendered contracts reflect current market tested rates and therefore would be considered as efficient. For the purposes of this review, Zincara highlights the above change, but has relied upon the information contained in the DMSIP and Unit Rates Forecast documents, rather than using these updated unit rates.

AGN notes that CDB East and North are the outer fringe areas of Melbourne CBD and it is estimated that the work involved in delivering mains replacements in these areas is more complex than the HDICS but less complex than the CBD proper. As such, these areas are included in this category with adjustments to recognise the additional complexities. Actual unit rates in [redacted] have been used as the basis for calculation with a further provision to allow for after-hours work that will be required.

CBD Block Replacement. *Forecast volume: 25 kilometres; Average forecast unit rate: $[redacted]/m.* Forecasting approach is to base the unit rates on indicative tenders for a sample of four CBD sections to be undertaken. Approximately 25 kilometres of block replacement is forecast. Work in the CBD is complicated by high levels of congestion, working restrictions, the requirement to reinstate completely the sealed areas each day/night, upgrading existing meter locations to modern standards, business interruption issues and increased coordination with a large number of stakeholders.

AGN has split the CBD into 16 sections which will be tendered to a panel of pre-qualified contractors. Indicative tender prices have been received from the [redacted] contractors qualified for complex mains replacement work such as the CBD. Tenders covered four CBD areas (totalling 10.5 kilometres) for planning purposes and the average unit rate has been used to forecast the contractor unit rate, refer Supporting Information 1. Using these initial tendered unit prices, AGN has developed the forecast using a bottom-up approach because of the nature of the work in the CBD. As a result the forecast unit rate is estimated to be $[redacted]/m.

With respect to the indicative tenders, used in developing AGN's unit rate for the CBD replacement program the contractor component of the unit rates is $[redacted]/m. Zincara agrees with AGN's approach and methodology, however, in analysing the tendered prices, Zincara noted that [redacted]). As part of a sensitivity analysis, and as would be expected in a pre-award analysis, [redacted] Adding provision for unscoped variations, materials and internal project management (per Unit Rate Forecast: Table 4.7) then the total unit rate is $[redacted]. If these indicative tenders were representative of what to expect during the formal tender and award process then the [redacted] unit rate would be considered as efficient, compared with AGN's forecast unit rate.

CBD Trunk Replacement. *Forecast volume: 2 kilometres; Forecast unit rate: $[redacted]/m.* Forecasting approach is to base the unit rates on indicative tenders. This program involves the replacement of large diameter cast iron and unprotected steel feeder trunk mains within the Melbourne CBD network. The work is to be undertaken in [redacted] in the CBD, which is particularly complex. There are no historic replacement activities for this category, so AGN has used a bottom-up approach based on receiving indicative pricing from one of its contractors, using open cut method. In addition, a provision of 5% for unscoped variations and 5% for other internal management costs, along with materials results in a unit rate of $[redacted]/m. Approximately 2km is expected to be replaced. Zincara agrees with AGN's estimating methodology and the utilisation of an indicative contractor price.

General Trunk Replacement. *Forecast volume: 10 kilometres; Forecast unit rate: $[redacted]/m.* Unit rate based on bottom-up approach, as the scope of work is materially different to what was carried out historically or where there is no recent historic cost which can be referenced. Requires detailed construction works, which involves the replacement of large diameter cast iron and unprotected steel feeder trunk mains. Replacement generally involves inserting large diameter PE, but can also require open cut works. There was only one such replacement during the current AA period, compared with 10km expected to be delivered during to next AA period.

An estimated unit rate has been adopted due to the lack historic mains that can be used as a comparative basis. The estimate at summarised in Unit rates forecast Table 4.9 and includes components that are able to be estimated from other works (e.g. Excavation work, cut & wrap, insertion and backfill & reinstatement). Zincara agrees with AGN's estimating methodology and the considerations necessary for this specialist mains replacement.

Decommissioned Trunk Replacement. *Forecast volume: 32 kilometres; Forecast unit rate: $[redacted]/m.* Unit rate has been calculated using a bottom-up approach, similar to General

Trunk replacement. Where a replacement main is not deemed necessary due to the availability of new or existing HP infrastructure the old main may be abandoned. The timing of these works is typically subject to the completion of cast iron and unprotected steel block replacement program. The unit rate is relatively low based on excavations and sealing of pipe ends every 50metres when the trunk is abandoned. Zincara agrees with AGN's estimating methodology (bottom-up) and the components necessary for this work.

Piecemeal Replacement. *Forecast piecemeal mains volume: 2 kilometres; Forecast HDPE (sampling): 3 kilometres; Forecast HDPE (>35 year replacement): 7 kilometres; Forecast unit rate: $[redacted]/m.* AGN has included HDPE (sampling program) and HDPE (>35 year replacement) within this category in addition to piecemeal replacement, on the basis that the techniques are similar. Under this category the unit rate is based on historical costs associated with two individual jobs undertaken in 2013 and 2014. In its Unit Rates Forecast paper, AGN states that "*very little piecemeal replacement has been completed over the last three years, with no work undertaken in 2015*", but has forecast a nominal 500 metres per year. However, in contrast, AGN's DMSIP (ref: 4.2.3) notes that for unprotected steel "*these mains are typically more than forty years old with the first response to a leak invariably revealing extensive corrosion that in many cases cannot be repaired and as such 'piecemeal' replacement is the only option.*"

Zincara notes these apparently conflicting comments, however, based on its experience expects that there would be a number of piecemeal replacements each year and on that basis recommends the nominal amount of 500 metres per year as reasonable.

With respect to the HPDE activities Zincara accepts that the estimating methodology and cost estimates appear reasonable.

Piecemeal Services Replacement. *Forecast unit rate: $[redacted]/service*. AGN has applied a 3-year weighted average. This category covers instances where services need to be renewed on a stand-alone basis, due to the condition of the service making repair not viable.

Zincara accepts that AGN's methodology in developing unit rates for mains replacement is reasonable and largely based on recent competitive tendering or historic unit rates for work of a similar type. On the basis of this analysis Zincara agrees the AGN's unit rates are reasonable and efficient, except as noted above, which are referred to the AER for its consideration.

5.2.6 Energy Safe Victoria – Letter to AGN

AGN has engaged with Energy Safe Victoria (ESV) on its Distribution Mains Services Integrity Plan (DMSIP). In a letter to AGN[35], ESV stated *"ESV is satisfied that AGN has its development of the DMSIP:*

- *proposed a mains and services replacement program, which has been developed and prioritised via appropriate risk-based analysis;*

[35] ESV letter to AGN, dated 20 December 2016

- *assessed the condition of assets and risks associated with mains and services, utilising the qualitative risk assessment framework in accordance with the appropriate standards, being AS/NZS 4645 and AS 2885:1;*

- *utilised asset integrity performance indicators and data, such as leak rate analysis, to demonstrate that CI/UPS and PVC mains (which represent only 4% of the distribution network) account for almost 70% of the mains leaks;*

- *clearly and appropriately assessed and ranked CI, UPS mains and PVC mains as "high risk";*
- *identified appropriate options to mitigate the risks associated with CI, UPS mains and PVC mains and has clearly demonstrated that the most effective way of reducing the risk is to replace all CI, UPS and PVC mains; and*

- *indicated that AGN will continue to maintain rapid leak rate response, conduct scheduled leakage surveys, monitor odorant levels and maintain operating pressures as low as possible as a way to monitor ongoing integrity issues.*

On this basis, ESV supports the proposed mains and services replacement program outlined in AGN's DMSIP, being the replacement of 297lm of CI, UPS, PVC and HDPE mains."

In its letter, ESV also listed a number of indicators and arrangements to be included in AGN's revised Safety Case, including its mains replacement summary (DMSIP: Table 8.3) which shows the volumes of each category of mains replacement over the 2018-22 AA period, noting that *"….any further change in the planned number of mains replaced would require a revised safety case to be submitted to ESV pursuant to section 45 of the Gas Safety Act 1997, which would then need to be accepted by ESV."*

ESV also stated *"Any failure by AGN to meet the targets of the mains and services replacement program may constitute a failure to comply with the accepted safety case as per section 44 of the Gas Safety Act 1997."*

5.3 CONCLUSION

AGN has used a combination of qualitative and quantitative assessment, including a cost impact analysis, to determine which mains should be replaced within the next AA period. Its risk analysis is well detailed in its Distribution Mains and Services Integrity Plan (DMSIP).

Failure Analysis. AGN's DMSIP outlines its leak performance for the various categories of mains and services across its networks. Zincara has reviewed the risk analysis and leakage performance for each mains category and finds that AGN's methodology and approach is reasonable, with details of Zincara's analysis provided in the relevant sections above.

Early Generation (HDPE 575) have shown a propensity for slow crack growth. AGN has over 3,000 kilometres of this early generation PE in its network. While no significant incidents have occurred within its Victorian networks, AGN has experienced some catastrophic failures in its South Australian networks. As part of a study that has been initiated with Deakin University, AGN propose to replace 7 kilometres of mains that have reached 50 years old and 3 kilometres (<35 years old) as a sampling program across its networks. From a risk and failure perspective, Zincara has reservation about the replacement about the

replacement of the 10kilometers. However, based on the uncertainty of the failure mechanism for these mains, the volume in its networks, and the level of research study proposed (already initiated), Zincara recommends accepting this project as prudent.

General Block Replacement – LDS / HDICS. Following a request from the AER regarding any recent new contracts, AGN advised that it has awarded contracts in February 2017 for:

- General Block – High Density Inner City Suburbs (HDICS); and
- General Block – Low Density Suburbs (LDS).

These categories cover 215 kilometres (72%) of mains replacement. [redacted]. In terms of unit rate analysis, these recently tendered contracts reflect current market tested rates and therefore would be considered as efficient. For the purposes of this review, Zincara wishes to highlight the above change but for consistency, has relied upon the information contained in the DMSIP and Unit Rates Forecast documents, rather than using these updated unit rates.

CBD Block Replacement. As part of its planning for the CBD mains replacement program, AGN has sought indicative tenders for four of the 16 areas covering the CBD block replacement program. Averaging the submitted unit rates for each of the four areas and then averaging the sum of these, AGN calculates the contractor component of the unit rates as $[redacted]/m. Zincara agrees with AGN's approach and methodology, however, in analysing the tendered prices, Zincara noted that [redacted]. As part of a sensitivity analysis, and as would be expected in a pre-award analysis, if [redacted]. Adding provision for unscoped variations, materials and internal project management (per Unit Rate Forecast: Table 4.7) then the total unit rate is $[redacted], compared with AGN estimated rate of [redacted]. Applying this unit rate to the volume of 25.3 kilometres then capex reduction would be $[redacted] million. If these indicative tenders were representative of what to expect during the formal tender and award process then the lower unit rate would be considered as efficient, compared with AGN's forecast unit rate.

Zincara accepts that AGN's methodology in developing unit rates for mains replacement is reasonable and largely based on recent competitive tendering or historic unit rates for work of a similar type. On the basis of its analysis Zincara agrees the AGN's unit rates are reasonable and efficient, except as noted in this Conclusion.

6. OTHER CAPEX

6.1 INTRODUCTION

The following table shows AGN's proposed capex for specific projects in the "Other Costs" category.

Table 35: Other Assets Projects ($000, 2016, direct)

Other Assets	2018	2019	2020	2021	2022	Total
Transmission pipeline modifications	354	2,224	7,320	3,240	486	13,623
Bushfire Preparedness	636	600	582	564	564	2,947
I&C Meter Set Refurbishment	587	762	946	762	762	3,820
Plant & Equipment Upgrade	764	764	764	764	764	3,818

(Source: Business cases – V83; V62; V79; V05)
Note: Totals may not add up due to rounding error.

AGN proposes the following projects during the next AA period:

- **Transmission pipeline modifications.** Modifications to the Dandenong to Frankston pipeline and the North Melbourne to Fairfield pipeline, enabling use of in-line inspection tools.

- **Bushfire Preparedness.** Install Thermal Safety Devices (TSDs) in all new services (upstream of the meter control valve) and retrofit in existing services (downstream of the meter control valve) in bushfire prone areas.

- **I&C Meter Set Refurbishment.** Repaint 732 I&C meter sets.

- **Plant & Equipment Upgrade.** Purchase of small tools, plant and equipment.

For each of the projects AGN has developed a detailed business case, which has enabled Zincara to review the proposals and undertake its analysis of the issues and the cost estimates in making conclusions as to their prudence and cost efficiency.

6.2 TRANSMISSION PIPELINE MODIFICATION FOR IN-LINE INSPECTIONS

AGN proposes to modify the following two transmission pressure pipelines to enable the use of in-line inspection tools:

- Dandenong to Frankston pipeline
- North Melbourne to Fairfield pipeline

Table 36: Transmission Pipeline Modifications (V83) - Capex ($000, 2016, direct).

Project V83	2018	2019	2020	2021	2022	Total
Dandenong to Frankston	354	1,957	4,992	683	-	7,986
North Melbourne to Fairfield	-	267	2,327	2,721	650	5,965
Total cost	**354**	**2,224**	**7,320**	**3,404**	**650**	**13,952**
Capex split	354	2,224	7,320	3,240	486	13,623
Opex split	-	-	-	164	164	329

(Source: Business case V83: Table 1.7 & 1.8)
Note: Totals may not add up due to rounding error.

AGN's Dandenong to Frankston (24.0 kilometres) and North Melbourne to Fairfield (11.1 kilometres) transmission pipelines were constructed in 1962 and 1971 respectively. These pipelines are located within road reserves that traverse through suburban or industrial areas, which are more sensitive to failure than pipelines in rural regions. Neither pipeline was constructed to accommodate in-line inspection tools (ILI), and both are coated with coal tar enamel, which is showing signs of increasing deterioration.

Demonstrating structural integrity of the pipeline is crucial for verifying that the pipeline is safe to operate, and is required for compliance with the current Australian Standard AS2885-2012. There are two principle methods for demonstrating structural integrity of a pipeline:

- indirectly measure the pipeline coating for faults in the cathodic protection current and conduct direct examination (exposing the pipeline, removing coating, cleaning the steel and examining and measuring any defects present) at identified faults to inspect for steel deterioration; or

- indirectly measure the thickness and condition of the pipeline steel by ILI and verify results by direct examination.

Indirect measurement of coating faults. This is typically conducted by taking surface measurements of electrical current which escapes through coating faults. Direct examination by excavation is then conducted on a mandatory basis for coating faults of a certain size, with other sites considered candidates for excavation based on AS2885.1-2012 Location Classification, CP and previous direct examination history. There are also sections of the pipeline that cannot be inspected by this method (e.g. under railway lines). These account for about 4.7% of the Dandenong to Frankston pipeline and 8.5% for the North Melbourne to Fairfield pipeline.

APA policies, developed to ensure compliance with Australian Standards, require "mandatory" excavations to inspect the coating condition and underlying pipe steel, when DCVG survey voltage gradient is above a threshold value. Further, defects in a range below this threshold are considered as "candidate" for excavation.

AGN's business case provides a summary table of the results of these surveys[36], noting that both pipelines have a significantly higher coating fault rate per kilometre than other AGN

[36] (refer: Business Case: Table 1.3)

pipelines in its Victoria/Albury networks. The results show that the total number and severity of the faults are increasing significantly for both pipelines.

In-Line Inspection. This method involves inserting an intelligent pigging tool into the pipeline, which takes measurements of the pipeline steel condition as it is propelled by the natural gas through the pipeline. This method has a high probability of detecting steel defects within a high degree of accuracy along the pipeline length, enabling a more effective targeted repair program and significantly reduces the risk of a pipeline defect degrading to failure point. The latest revision of AS2885.3-2012 (Clause 6.6) requires that consideration be given to modifying pipelines to permit inspection by ILI when they are not capable of accommodating an ILI tool. This method of inspection is considered good industry practice for demonstrating pipeline structural integrity.

AGN and other pipeline operators have modified existing pipelines to accommodate ILI where they were not originally constructed for these tools, and this type of modification has previously been approved by the AER, considering the investment for these modifications to be prudent and consistent with good industry practice.

AGN's Dandenong to Crib Point Pipeline is currently undergoing modifications to accommodate ILI, with the condition of that pipeline at the time of the AER approval being consistent with these two pipelines.

6.2.1 Risk Assessment

AGN has undertaken a risk assessment, noting that the principle risk is related to a failure of the pipeline as a result of corrosion or deterioration of a pipeline defect, which could result in a significant release of gas. This could potentially impact the safety of residents and industries in close proximity to the pipeline and could also potentially result in a major leak and disruption to supply to large numbers of consumers. AGN's assessment shows the overall untreated risk as "High", because the health and safety, operational, reputational and financial risks are high (ref: Business Case: Table 1.4).

Zincara agrees that the overall untreated risk rating of High is appropriate for these pipelines, particularly given their location and risk to operational supply to up to 45,000 consumers in the case of Dandenong to Frankston pipeline and 50,000 customers in the case of the North Melbourne to Fairfield pipeline, from a worst case failure event.

6.2.2 Options Considered

AGN has assessed four options to mitigate the risks associated with these pipelines. Hydrostatic testing was not considered as it is considered impractical for operational pipelines.

Option 1: Do nothing. Under this option, AGN would continue regular DCVG surveys and subsequent inspection of the pipeline by direct assessment at mandatory coating faults. This option does not address the untreated risk. Operational costs would continue and are expected to increase as additional faults are detected. In addition, sections of the pipelines would remain inaccessible for coating inspection and excavations. AGN would have limited means of demonstrating continued pipeline integrity, which could ultimately limit the operational life of the pipeline.

Option 2: Modification of pipelines to accommodate ILI tools. The second option is the basis of this business case. AGN describes the components of the works including engineering investigation and physical proving of pipeline features, land negotiation, fabrication of pig launchers and receivers, modifications to the pipeline (e.g. valves), regulatory approvals, on site construction, performing an ILI inspection. The business case shows the cost of the works for each pipeline, which Zincara discusses later in this review. The benefits of the option include, a significant reduction in the likelihood of a pipeline failure, accurate inspection data enabling more efficiently and effectively addressing and repairing high risk areas of the pipelines, and enable AGN to demonstrate pipeline compliance and baseline data for assessing pipeline extension. This option will also reduce the residual risk to "Moderate".

Option 3: Recoat pipelines. This option is to recoat all accessible sections of the pipelines. This option would require significant excavation of the majority of the pipeline, removal of existing coatings, inspection of the pipeline, repair defects and recoat the pipeline using modern coating and reinstatement. The modern coating will enable the risk of pipeline failures to be greatly reduced. Inaccessible sections of the pipeline would not be recoated but the overall risk on the pipeline would be reduced as the length of pipeline exposed to the vintage coating is decreased. The cost of this work is very high for both pipelines [redacted]. While the likelihood of a failure event is reduced, there is no reduction in residual risk.

Option 4: Additional dig-ups. This option is to conduct additional excavations on the pipelines to include all mandatory and half of the candidate sites. This provides a larger sample size of potential corrosion sites, however, will only marginally decrease the risk of unidentified corrosion developing on the pipelines. Residual risk ranking remains at high.

Table 37: Cost/benefit analysis results and residual risk rating

Option	NPV ($000, 2016)	Residual Risk Rating
1. Do nothing	[redacted]	High
2. Modifications to pipelines	[redacted]	Moderate
3. Recoat pipelines	[redacted]	High
4. Additional dig-ups	[redacted]	High

(Source: Business Case: Table 1.6; Appendix C)

The NPV analysis shows that option 2 (Modifications to the pipelines) is the least cost and most cost effective way to reduce the risk associated with corrosion and deterioration of pipelines and achieves a reasonable balance between residual risk and cost. Following a request for further information from the AER, AGN provided its NPV and options analysis. Zincara has reviewed the analysis and finds that it is reasonable.

In regard to the timing of the project, Zincara concurs that the project should be carried out this AA period as the pipelines have a risk rating of "High" and need risk treatment action to bring the risk to Low or ALARP.

6.2.3 Forecast Cost and Analysis

The summary costing including the capex and opex split for the two projects is summarised in Table 2, above.

In the business case, V83, AGN provided a detailed cost estimate for the Dandenong to Frankston pipeline modifications. However, the business case does not include a detailed costing for North Melbourne to Fairfield pipeline.

The detailed cost breakdown shows, for each line item, the unit rate, number of units and comments providing the basis of the estimation. AGN has developed component costs using comparable projects that have been recently completed, and which have mainly been competitively tendered. These projects include Wandong city gate, Melrose Drive field regulator, Tumut Valley Pipeline, Amcor pipeline decommissioning and Donnybrook city gate. AGN had also estimates used for business case V54 "Refurbishment of the Dandenong to Crib Point pipeline". AGN also indicated that it proposes that to seek competitive tender for the material and contractor costs.

With respect to Opex, AGN does not anticipate any step change is required.

The cost estimate for Dandenong to Frankston pipeline is summarised below:

Table 38: Cost estimate summary ($000, 2016, direct)

Item	Cost	Basis of estimate
Engineering investigation	[redacted]	SA business case, internal project manager labour rate
Pig Trap installation	[redacted]	Wandong actual, Cobram city gate, Donnybrook quote, labour tender
Valve replacement	[redacted]	Wandong, internal labour rates, Donnybrook quote, labour contracts
Offtake replacement	[redacted]	Internal labour, labour maintenance contracts, labour tender
ILI run	[redacted]	Estimate 2 runs as different tools, TVP actuals/estimates
Verification excavations	[redacted]	SA business case, recent inspection invoices
Total	[redacted]	**Capex: $7,822; Opex: $164**

(Source: Business Case: Appendix D)

Given the project is only in its concept stage, Zincara believes that the methodology used by AGN is consistent with industry practice. Further refinement of the estimate can only be carried out after the project has been approved and has undergone a FEED[37] study. As such, Zincara considers that the cost is the best estimate possible and therefore efficient.

In relation to the North Melbourne to Fairfield pipeline, AGN has not provided a detailed cost estimate. Zincara believes that it is an oversight from AGN. In all the projects that Zincara has reviewed, AGN has provided significant details that enable Zincara to make a decision on the project prudence and efficiency. In addition, as discussed above, Zincara considers the estimation methodology for the Dandenong to Frankston pipeline has

[37] FEED study stands for Front End Engineering Design study which involves the design of the project concept. At this stage, the risks of the project are identified and the cost estimates are prepared with a higher level of accuracy.

produced an efficient outcome. Zincara sees no reason why AGN would not use the same methodology for estimating the cost for the North Melbourne to Fairfield pipeline. Furthermore, as shown in Table 36, the project cost for this pipeline is less than that of the Dandenong to Frankston pipeline with a similar scope. Given these reasons, Zincara believes the cost for the North Melbourne to Fairfield pipeline would be efficient.

6.2.4 Delivery

AGN is proposing four stages for each project and will also stagger the two projects by one year to enable effective use of resources. The timing provides for:

- Year 1 – Engineering investigation and physical proving
- Year 2 – Pig Trap installation
- Year 3 – Valve installation
- Year 4 – ILI run and validation / repair excavations

6.2.5 Conclusion

AGN has prepared a detailed business case for this project. This has included a background description of the two pipelines and the issues relating to its ability to demonstrate structural integrity of the pipelines. It described the two principle methods for demonstrating structural integrity of a pipeline and provided a risk assessment where it has assessed the untreated risk as "High". AGN then considered four options and cost / benefit analysis, concluding with an NPV analysis which shows that the modifications of the pipelines to enable ILI inspections as the most cost effective, and with a residual risk reduced to Moderate.

The NPV analysis shows the preferred option as being the most cost effective of the options considered. Importantly, Zincara is of the view that the modification of the pipelines to enable ILI inspections is good industry practice. As such, Zincara considers the project to be prudent.

A detailed cost estimate breakdown was included in the business case for the Dandenong to Frankston pipeline. AGN advises that it proposes that material and contractor costs will be obtained through a competitive process. In relation to the North Melbourne to Fairfield pipeline, Zincara believes that there is an oversight by AGN in not providing a detailed cost. However, for the reasons discussed above, Zincara believes the project to be also efficient.

In addition, Zincara also considers that the overall project should be carried out in this AA period as the risk is rated as "High", which would require risk treatment action to bring the risk to as low as reasonably practicable in a manner that balance cost and risk.

6.3 BUSHFIRE PREPARADNESS

The bushfire preparedness project is to install Thermal Safety Devices (TSDs) in all new services (upstream of the meter control valve) and retrofit in existing services (downstream of the meter control valve) in bushfire prone areas.

Table 39: Bushfire Preparedness (V62) – Volume, Unit Cost and Capex ($000, 2016, direct)

Project V62	2018	2019	2020	2021	2022	Total
New Connections						
Volume	340	340	340	340	340	1,700
Unit Cost	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	
Existing Connections						
Volume	4,120	4,120	4,120	4,120	4,120	20,600
Unit Cost	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	
Total cost	**$636**	**$600**	**$582**	**$564**	**$564**	**$2,947**

(Source: Business case V62: Table 1.5)
Note: Totals may not add up due to rounding error.

Following the Victorian Bushfire Royal Commission, arising from the "Black Saturday" bushfires in 2009, AGN considered it prudent to gain an understanding of the potential future risk and evaluate options for risk mitigation through the installation of Thermal Safety Devices (TSDs) in each service inlet in bushfire prone areas.

A TSD is a passive thermal device for protection of combustible gas pipes and fittings in extreme heat situations such as bushfires. The device prevents the escape of gas from a gas service when its temperature reaches 100^{o} Celsius.

In the last AA review for the 2013-2017 AA period, AGN proposed to fit the TSD on the inlet side (upstream) of the meter control valve. This proposal was not accepted by the AER on the basis of "*the absence of specific legislative requirements to either install thermal safety devices in new installations or to retrofit to existing installations and the absence of specific recommendations from the Victorian Bushfire Royal Commission. Further the AER has no evidence retrofitting these thermal safety devices reflects good industry practice.*"[38] The AER has however recently accepted a similar proposal by AGN for the AA period 2016/17 – 2021/22 for its South Australian networks to install TSDs using a different installation configuration, which makes it more economical.

AGN's business case considers applying the same technical specifications as those approved for the South Australian network and presents an alternative to the one submitted for its Victorian networks five years ago.

Specifically, this proposal proposes fitting the TSD downstream of the meter control valve for existing installations, thereby eliminating the need for excavation and stopping gas supply in order to fit the TSD. At the same time, the work can then be performed by a single gasfitter rather than a two man crew. This results in a significantly lower cost with only a marginally higher residual risk, compared with fitting the TSD upstream of the control valve.

For new installations in bushfire prone areas, AGN propose to fit the TSD as part of its standard requirement. In this case the TSD would be fitted upstream of the meter control valve with the cost impact only being the cost of the TSD itself.

[38] AER AA Draft Decision, Envestra Ltd, 2013-17, Part 2 Attachments, p. 134.

In order to determine the volume of installations that could be impacted, AGN sought information from the Country Fire Authority of Victoria, which provided data showing its "Extreme Fire Zone" boundaries across Victoria. AGN has applied this data across its networks and estimated that approximately 20,600 properties are located in a bushfire prone area. In addition, AGN has estimated that there would be an additional 340 new connections per year in these areas (based on annual growth of 1.7% which is consistent with forecasts developed by Core Energy). The total volume is therefore 22,300 TSDs.

6.3.1 Risk Assessment

AGN's primary driver for this project is the risk that AGN's networks may contribute to property damage and/or personal injury and/or fatality in the event of a bushfire, if any of the components of a meter set are damaged and cause an uncontrolled gas release. It has undertaken a risk assessment, concluding that the untreated risk rating is "High" with the highest risk categories being health & safety (employees, contractors, firefighters and residents); environmental (devastating nature of fires and their effect on flora and fauna); reputational (given the significant attention that bushfires attract, particularly if AGN assets are seen as contributing to fire damage).

AGN has not included any historic information as to the number of incidents where its assets have been damaged by bushfires and where they have directly contributed to damage of property or people. Also AGN has not provided any information where the CFA or Royal Commission recommendations require / or recommend the fitting of the TSD for all homes within the designated "Extreme Fire Zone".

6.3.2 Options Considered

AGN has assessed three options that it identified to deal with the risks posed by its networks in bushfire prone areas.

Option1: Do nothing. Under this option, no action would be taken to address the potential for uncontrolled releases due to bushfires damaging gas infrastructure. There are no upfront costs with this option, but risks are ongoing. AGN advised that none of its regional customers supported this approach in its stakeholder workshops.

Option 2: Install TSDs in all new services and retrofit in existing services upstream of the meter control valve in bushfire prone areas. This option is the same as presented to the AER five years ago. AGN says that it reduces the residual risk to Moderate, however the cost is significant, given the work effort required to retrofit the TSDs upstream of the meter control valve.

Option 3: Install TSDs in all new services upstream of the meter control valve and retrofit in existing services downstream of the meter control valve in bushfire prone areas. AGN considers that this option to be a more cost effective solution by fitting the TSD downstream of the gas control valve. As a consequence, isolation of the service pipe is not required and hence, rather than requiring a two man crew with excavating equipment, this work can be completed by a single gasfitter with the use of hand tools. The only downside is the potential for a very small gas escape if the meter control valve's internal seals are damaged during a bushfire, but even if that did occur the amount of gas ignited would be so small that it is unlikely to contribute meaningfully to the bushfire damage. It is still proposed that for

new installations the TSD would be installed upstream of the meter control valve and the cost impact is only that of the TSD itself.

Table 40: Summary of cost/benefit analysis

Option	Benefits	Cost/Risks
1.	Avoids upfront capex	No improvement in risk components
2.	Reduces risk components	$[redacted] million ($2016)
3.	Reduces risk components similar to option 2 but protection is marginally less	$2.947 million ($2016)

(Source: Business Case: Table 1.4)

Option 3 was selected because AGN considered that it is the most cost effective way to reduce the risk across the network in a manner that achieves a reasonable balance between residual risk and cost, consistent with Australian Standard AS4645. AGN notes that this option is also in keeping with the option that the AER approved for South Australia.

Delivery capability. AGN has confirmed with the changeover contractor that it will be able to mobilise resources required to meet the proposed volume.

6.3.3 Forecast Cost and Analysis

AGN has provided the detailed cost estimate for the preferred option which has been estimated on the basis of the following assumptions:

- Materials – the cost of the TSD is based on a quote from the supplier.
- Labour – costs have been based on a simple average of Meter Refix rate across the Victorian regions of the gasfitting contract that has been established through a competitive tender.
- Forecast volumes – based on data provided by the CFA and also the forecast growth for new connections.

Total volumes, unit costs and capex for the next AA period are shown in Table 5 above.

6.3.4 Conclusion

The technical solution proposed by AGN, compared to its earlier proposal during the last AA period review, provides a very similar risk benefit at a greatly reduced cost. AGN has also stated that it has the capability to complete this project during the next AA period.

Given AGN's policy approach concerning the changed requirements for other aspects of connection materials e.g. meter brackets, and its risk assessment relating to bushfires, Zincara considers that AGN could have already included the TSD for any new connections in Extreme Bushfire Zones. With its minimal cost of about $[redacted] per connection and low number of connections (around 400 per year), this would add only $[redacted] per year to the residential connections program. There was no information in the business case to suggest whether this has already been implemented.

AGN has not included any historic information as to the number of incidents where its assets have been damaged by bushfires and where they have directly contributed to damage of other property or people, in addition to that caused by the bushfire. Also AGN has not provided any information where the CFA or Victorian Royal Commission recommendations require / or recommend the fitting of the TSD for all homes within the designated "Extreme Fire Zone".

However, Zincara acknowledges that a similar program has been approved by the AER for AGN's South Australian networks. Given this precedent and the history of bushfires in Victoria, Zincara believes that the fitting of TSDs in extreme fire zone areas should be accepted as prudent.

In addition, Zincara also considers that AGN's approach in determining the number of TSDs to be retrofitted is reasonable and also that they should be included as part of any new connection in the extreme fire zone areas.

With respect to the expenditure, Zincara acknowledges that the proposed technical specification is pragmatic and significantly reduces the required capex from that submitted for the current AA period in 2012. On this basis, Zincara considers the program to be prudent and cost efficient.

6.4 I&C METER SET REFURBISHMENT PROGRAM

This program is focused on repainting 732 I&C meter sets.

Table 41: Project Cost Estimate ($000, 2016, direct)

I&C Meter Set repaint (V79)	2018	2019	2020	2021	2022	Total
Volume/year	111	146	183	146	146	732
Average Capital Cost / Site	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Total Capex	**$587**	**$762**	**$946**	**$762**	**$762**	**$3,820**

(Source: Business Case V79: Table 1.6)
Note: Totals may not add up due to rounding error.

AGN has approximately 3,250 I&C meter sets. While the meters are changed on a 10-year basis, the meter assembly remains in place, with some installations over 40 years old.

The preventative maintenance for these larger meter sets involves mechanical and instrumentation checks on a 6 monthly or 12 monthly basis, focussing mainly on the operation of the meter set. The maintenance also includes a visual inspection for damage and corrosion. AGN advises that paint on steel components serves as the main protection against corrosion. Their current maintenance includes localised cleaning and paint touch up where there is peeling or de-laminated paint, which AGN says "*has generally maintained the coating in a fit for purpose state.*"

AGN has now determined that "*the external condition of many I&C meter sets is now reaching a level where touch up painting is no longer sufficient to effectively maintain*

corrosion protection coating" and significant corrosion has been observed on a number of meter sets.

AGN proposes that a full repainting (on-site complete grit basting and extensive repainting) will enable most of the meter sets to be restored to a sustainable condition.

6.4.1 Risk Assessment

The business case includes a risk assessment, which rates the untreated risk as Moderate. Based on good industry practice, Zincara would anticipate that an effective preventative maintenance program, with six or twelve month inspection frequency, would identify meter sets with poor corrosion or coating, and action would be taken to correct the defect, including full grit blasting and recoating, thereby mitigating the risks.

6.4.2 Options Considered

AGN's business case has outlined four options:

- Option 1: Continue current practices to apply touch-up where required and replace components and meters sets if they fail.

- Option 2: Implement a program to comprehensively re-paint I&C meter sets located outdoors at 1,952 locations over four AA periods, with the 732 Group 1 sites being repainted during the next AA period, then continuing over multiple AA periods. AGN says that the selection of these specific meter sets would be subject to assessment of actual condition. Reduces residual risk to Low.

- Option 3: Replace the piping and refurbish components at 325 meter sets every five years. The volume is based on AGN's capacity to replace the meter sets. Residual risk remains as Moderate.

- Option 4: Combining elements of Option 2 and Option 3, this option would be structured to repaint the majority of meter sets as per option 2. Further, where the condition of meter sets is identified as a risk of causing failure, those meter sets would be replaced. AGN has assumed a ratio of approximately 1 in 9 based on data recently collected, regarding the condition of meter sets. As a result this option proposes replacement of 81 meter sets in each AA period and repainting the remainder. Reduces residual risk to Low.

Zincara notes that AGN has assumed 1 in 9 meter sets would be replaced based on risk (per Option 4), but Option 2 assumes that repainting would be appropriate, with both options reducing the residual risk to Low. The NPV analysis shows that Option 2 is the most cost effective of the feasible options.

AGN's proposed solution is to carry out option 2, which will involve repainting all 1,950 meter sets of 40scm/hr and greater, that are located outdoors. This program will be implemented over four AA periods (per "Options Considered", while "proposed solution" says five AA periods, and "description of project" says 15-20 years). The program shows "*more than half the meter sets to be repainted in the first two AA periods to target the oldest*

and highest risk meter sets, with work reducing to a sustainment level over the following periods."

6.4.3 Volume

AGN has identified approximately 1,952 sites as potentially requiring re-painting or replacement over the next 15-20 years, which is the estimated number of large open air meter sets (delivering a minimum 40scm/hr). These have been grouped as follows:

- Group one: 732 meter sets assessed as highest risk, typically older or located in corrosive environments.
- Group two: 610 meter sets assessed as moderate to high risk, typically similar location and age to group one meters, but in better condition.
- Group three: 488 meter sets assessed as moderate risk, typically newer installations, located in less corrosive environments.
- Group four: 122 meter sets, assessed as moderate to low risk, typically new or near new units.

AGN's business case did not provide details as to how the numbers have been identified, for example, whether they have been based on a physical condition assessment. However, AGN does say "*over the reminder of the current AA period, AGN maintenance staff will collect information on I&C meter sets located outdoors in the course of their usual duties. This information will be used to assess the condition of these meter sets to better facilitate prioritising the work according to the risk*." In order to clarify the basis of determining the volume of I&C meter sets requiring recoating, the AER requested additional information, which was provided by AGN (IR #18). AGN says that it has now collected asset condition data from over 215 sites of which 84 sites (39%) require recoating. Zincara acknowledges that this additional information supports the volumes estimated in the business case.

AGN has also considered its ongoing program of recoating to achieve a sustainable level of work, as outlined in the following table.

Table 42: Refurbishment Program with Ongoing Sustainment Option (number of sites)

	AAP Start Year										
Group	**2018**	**2023**	**2028**	**2033**	**2038**	**2043**	**2048**	**2053**	**2058**	**2063**	**2068**
1	732			122	122	122	122	122	122	122	122
2		610			122	122	122	122	122		122
3			488			122	122	122	122		122
4				122			61	61			
Total	**732**	**610**	**488**	**244**	**244**	**366**	**427**	**527**	**366**	**122**	**366**
	Refurbishment phase										
				Sustainment phase							

(Source: Business Case: Figure 1.3)

AGN's proposal for refurbishment is to "front end" the program to address the highest risk sites at the earliest opportunity. Zincara considers this approach to be prudent.

6.4.4 Cost Analysis

AGN's business case includes a detailed cost breakdown of the four options. With respect to the proposed option 2, the cost breakdown shows internal labour and contractor costs. The contractor costs are an average of minimum and maximum cost per site. The contractor costs are based on recently completed work and existing contract prices. In addition to the unit costs per site, provision has been made for a project manager utilised for 12 weeks per year. AGN has spread the manager's cost across the volume of sites being forecast for the year, resulting in some variation in unit cost from one year to the next. Zincara has reviewed the cost breakdown and finds the approach is efficient.

6.4.5 Conclusion

In principle, Zincara finds that AGN's proposed recoating program provides a cost effective solution, minimising the risk of corrosion leaks and/or component failure, from the meter set. Given that AGN has an ongoing maintenance program, Zincara believes that the deterioration of the paint on the meter sets should have been identified previously and it is therefore unclear why AGN has only now decided to initiate a recoating program.

However, Zincara acknowledges that as it stands the condition of the meter sets have deteriorated and the proposed program along with the "ongoing sustainment option" shows a strategy to manage the condition of these assets into the future. On this basis, Zincara considers that the proposed program, including the "front end" volume, is prudent and based on its review of AGN's unit rates, Zincara also considers that the costs are efficient.

6.5 PLANT AND EQUIPMENT

This proposal is for the purchase of small tools, plant and equipment.

Table 43: Project Cost Estimate ($000, 2016, direct)

Plant & Equipment (V05)	2018	2019	2020	2021	2022	Total
Materials	764	764	764	764	764	3,818

(Source: Business Case V05: Table 1.6)

Keeping plant, operational tools and equipment up to date, fit for purpose and in line with advancements in technology is necessary not only to perform required tasks but also to maintain the integrity of the network and maintain the safety of the networks by minimising occupational, health and safety risk and health and safety risks to the public.

The type of equipment and tools necessary to adequately perform work on the networks ranges from general excavation equipment to specialised gas detection equipment. Examples of equipment procured during the current AA period include:

- Gas detectors
- Flammable storage units
- Wire cages for storage of meters
- Pressure gauges
- Pipe cutters
- Polyethylene stop off and drilling machines
- Instruments and tools for use on the SCADA system
- General hand tools

The AER's last determination for AGN's Victorian networks approved an allowance of $2.965 million ($2011) for the current AA period with an average of $0.664 million ($2016) per year. The following table shows the approved and actual expenditure during the current period.

Table 44: Plant & Equipment Current AA period ($000, 2016, direct)

Plant & Equipment	2013	2014	2015	Annual Average
Approved	664	664	664	664
Actual	1,268	629	393	764

(Source: Plant & Equipment business case - V05: section 1.3 and Table1.3)

As the table shows the average actual expenditure over the last three years has been $0.764 million ($2016), with 2013 being much higher.

6.5.1 Risk Assessment

AGN has included a risk assessment in the business case. While the untreated risk rating is shown as "High", Zincara considers that good industry practice in terms of maintenance of tools, plant and equipment would significantly mitigate the risks included in AGN's assessment.

6.5.2 Options Considered

AGN has considered two options:

Option 1: Do Nothing - use the existing tools, plant and equipment until each item is no longer able to be used due to obsolescence, breakdown or loss of function. With this option, replacement would be reactive generally at increased costs. There is likely to be a loss of productivity through the use of poorly maintained tools and equipment and while they are not available due to failure.

Option 2: Continued purchase of small tools, plant and equipment, to provide fit for purpose tools and equipment to install, repair and maintain the natural gas assets. As existing tools and equipment age, they require replacement in accordance with good industry practice. The rate of replacement cannot be determined accurately as it depends on the degree of use, harshness of service, technological obsolescence etc. Historical

expenditure is commonly used to guide estimates of future expenditure. AGN has applied a 3 year average to determine the proposed forecast capex.

AGN has selected Option 2 on the basis that it is the most cost effective way of managing the safety related risks associated with tools, plant and equipment. As shown in Table 10 above, the average annual allowance would be $0.764 million ($2016) which is the three year average of the current AA period, and was the same methodology that was accepted by the AER for the South Australian Access Arrangement.

6.5.3 Conclusion

Zincara considers it prudent to ensure tools, plant and equipment are fit for purpose and well maintained. Also that it is good practice to consider new technologies during the procurement process so that productivity can be maximised. Zincara considers good industry practice would ensure that the tools, plant and equipment are well serviced and maintained to maximise their fit for purpose life.

On this basis, in reviewing the current period expenditure and comparing with the AER approved capex, Zincara considers that continuation of the AER approved annual average would provide sufficient capex to ensure tools, plant and equipment are fit for purpose and replaced cost efficiently and with due consideration of cost/benefit analysis.

Resulting annual capex would be $0.650 million ($2016) with a total of $3.250 million ($2016) over the next AA period a reduction of $0.568 million ($2016) compared to AGN's proposal.

7. METER REPLACEMENT

7.1 INTRODUCTION

The following table shows AGN's proposed capex for Meter Replacement.

Table 45: Meter Replacement ($million, 2017, direct)

Meter Replacement	2018	2019	2020	2021	2022	Total
Residential Capex	5.2	5.2	5.2	2.7	2.7	20.8
Commercial Capex	2.5	2.5	2.5	2.5	2.5	12.4
Total Program	**7.7**	**7.7**	**7.7**	**5.2**	**5.2**	**33.2**

(Source: AAI: Table 8.8)

AGN's meter replacement approach includes the following key elements:

- Minimise the level of inter-year variability by "smoothing" the volume of meter to be replaced each year;
- Maximise the use of refurbished meters;
- Use testing facilities and contractors that have been selected through a competitive tender process.

AGN's proposed program forecasts the following volumes (smoothed) along with its unit rates for the next AA period.

Table 46: Meter Replacement Volume (smoothed) and Unit Rates ($2017, direct)

Meter Replacement	2018	2019	2020	2021	2022	Total
Residential						
Volume	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Unit Rates	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Commercial						
Volume	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Unit Rates	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]

(Source: Meter Replacement Plan: Table: 5.8)

7.2 VOLUME ANALYSIS

AGN forecasts the volume of meters to be replaced as part of its meter replacement program, using the following steps[39]:

Step 1. Forecast the number of PMCs for meters sized up to and including 25 m^3 per hour, using the following four elements:

- Initial in-service testing. AGN assumes the testing of the meter family occurs in the fifth year of service, with sample size in accordance with Table 1 of AS 4944. For the next AA period AGN forecasts [redacted] meters.

- Field Life Extension (FLE) testing. Given the variable nature of meter performance AGN has noted its assumptions in estimating the number of meters required to be removed for FLE testing. Using these assumptions AGN estimates that [redacted] meters will be removed for FLE testing.

- Meters requiring replacement after failing FLE testing. Similar to the previous step, AGN has noted its assumptions in estimating the number of meters that may fail the FLE testing and required to be removed as part of the meter replacement program. In this case AGN estimates [redacted] meters.

- Reactive replacements of defective meters. Finally, there are meters that become defective and require replacement. AGN has applied its historical levels in estimating [redacted] meters to be replaced per year, or [redacted] for the period.

- The total number of domestic meters forecast to be replaced during the next AA period is therefore forecast to be [redacted]. This is approximately 6% higher than the current period, which can be attributed to the increased number of meters currently in service.

Step 2. Forecast the number of PMCs for meters greater than 25m^3 per hour. AGN has applied the standard life of these meters as set out in the Victorian Gas Distribution System Code (GDSC), which is 15 years. These meters cover the installation period 2003 to 2007 and total [redacted] meters. It is noted that this volume is around double the volume replaced during the current period. Again this reflects the significant growth that occurred during that time ([redacted] versus [redacted] connections during 1998 to 2002).

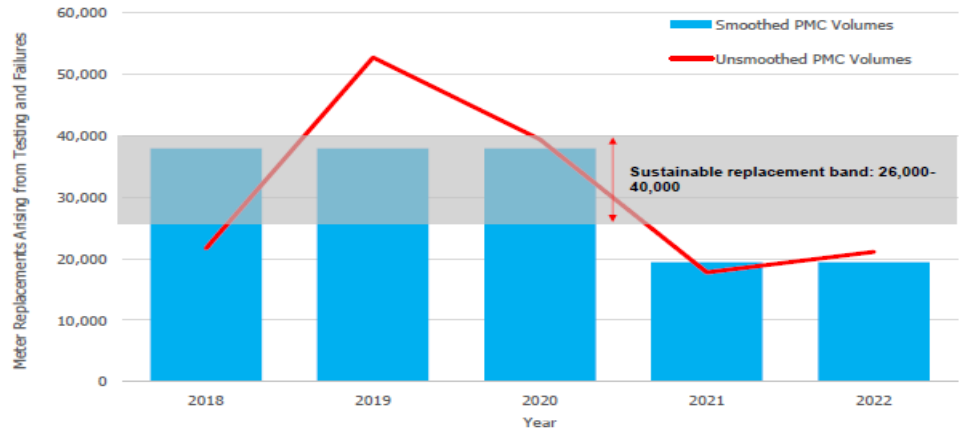
Estimating meter replacement is subject to a wide range of inputs and cannot be accurately determined until the actual meter testing results are known. However, Zincara has reviewed the approach taken by AGN and considers that it has assessed each element methodically and developed the total replacement program based on its experience, historical results and good industry practice. On this basis, Zincara considers that AGN's determined volumes are prudent.

Step 3. Minimise the degree of inter-year variability. Having forecast the volume of meters to be replaced each year, and subject to the constraints posed by its regulatory obligations, AGN proposes to "smooth" the replacement profile over the next AA period. AGN says that it is more cost efficient to achieve a more even replacement program, particularly with respect to the impact on availability of resources, planning effort and meter availability. By contrast, smoothing can only be achieved by bringing forward meter replacements, so as to

[39] Attachment 8.3: Meter Replacement Plan: section 5

ensure compliance with the regulatory obligations such as the GDSC, the NSW Regulation (relating to AGN's NSW meters), AS 4944 and the National Measurement Act. To avoid excessive reduction of in-service life, smoothing is constrained. Analysing its yearly program AGN has proposed to smooth the years 2018 – 2020 and 2021 – 2022. The following figure shows the smoothed versus unsmoothed meter replacement profile, including its sustainable volume replacement band, which enables its most cost effective utilisation of its internal and external resources.

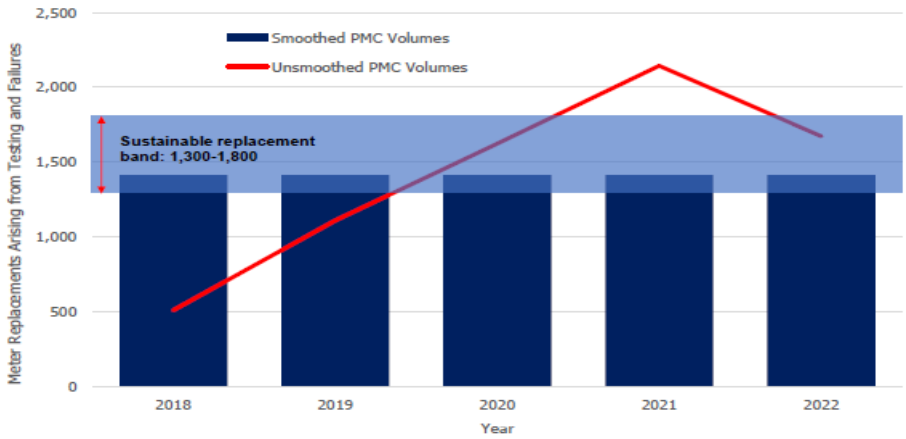
Figure 1: Smoothed v Unsmoothed Domestic Meter Replacement Profile



(Source: Meter Replacement Plan: Figure 5.3)

For meters greater than 25m^3 per hour, AGN's annual replacement program ranges from [redacted] to [redacted]. As the peak occurs later in the next AA period, AGN has used a five year average smoothing profile. The following figure shows the smoothed versus unsmoothed profile. It also shows AGN's sustainable replacement band.

Figure 2: Smoothed v Unsmoothed >25m^3 per hour Meter Replacement Profile



(Source: Meter Replacement Plan: Figure 5.5)

In Zincara's experience, it has been common industry practice to smooth the meter replacement profile, where there is a wide range of annual volumes, in order to balance available planning and field resources and also the capacity of meter suppliers.

7.3 UNIT RATES ANALYSIS

For AGN a key element of the unit rates are the contracts that it has in place. It advises that new meter and labour contracts were awarded during 2016:

- Meters. A new national contract was awarded to meter suppliers, [redacted]; and

- Labour. A new contract covering gasfitting services for domestic meter changes was awarded to [redacted].

With respect to I&C meter changes, this work is predominantly carried out by a mixture of APA internal staff and contractors depending on the scale of the work, with I&C meters acquired through a competitive tender process.

In developing its unit rates, AGN has applied different approaches for its domestic and greater than 25m^3 per hour meter replacement programs, as outlined below.

7.3.1 Domestic Unit Rates

The following table shows the actual unit rates that have been incurred during the current AA period, the three year weighted average and proposed forecast unit rates.

Table 47: Domestic Unit Rates ($2016, direct)

	2014	2015	2016	3-yr weighted average	Forecast
Contractor Rates	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Material/Other Rates	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Total Unit Rate	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]

(Source: Unit Rates Forecast: Table 3.2)

AGN has applied the [redacted] unit rates for labour and materials on the basis that they have been [redacted]. AGN note that the use of [redacted] rates is consistent with the approach that was used in the South Australian AA, which was approved by the AER.

Zincara notes that the contractor rates have changed significantly between 2015 and 2016. Comparing the 3-year weighted average with the forecast labour rate shows an increase of over [redacted]%. Following a request from the AER for further information, AGN (IR #1: 8) provided a table showing the various unit rates included [redacted] across the regions and by time of day. Planned meter changes during business hours were very consistent for the metropolitan regions [redacted]. However, [redacted]. Zincara considers that the labour unit rate change [redacted] impact on the domestic meter change program. However, while there has been a change in approach to AGN's contracting, the [redacted] was subject to a competitive tender process.

For materials, AGN has [redacted] unit rate, based on [redacted]. This unit rate is in the range of the historical rates and is reasonable.

Refurbished meters. As part of its replacement program, AGN uses refurbished meters, which it says reduces the cost of replacement meters. AGN says that refurbished meters are 35% cheaper than new meters and "*even when the difference between the life of a refurbished and new meter (i.e. 19 years versus 24 years) is taken into account the refurbished meters are 19% cheaper than new meters*." (ref: Meter Replacement Plan: section 4.3). AGN says there is a limit to the availability of refurbished meters of around 25,000 per year from the supplier. Any replacement program in excess of that volume will require the purchase of new meters.

Based on its experience, Zincara considers the use of refurbished meters has been a long standing industry practice and has the benefit of reducing expenditure, at least in the short to medium term. (It is noted that one of the Victorian businesses has elected to use only new meters, with its NPV analysis suggesting that it is cost effective to do so, at least in the longer term).

7.3.2 Meters > 25m3 Unit Rates

Similar to domestic meters, AGN also uses refurbished meters for its greater than $25m^3$ per hour meter group.

Table 48: Meters > $25m^3$ Unit Rates ($2016, direct)

	2014	2015	2016	3-yr weighted average	Forecast
Contractor Rates	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Meterial/Other Rates	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Total Unit Rate	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]

(Source: Unit Rates Forecast: Table 3.3)

AGN has applied the 3-year weighted average for the forecast unit rate, based on the relatively low volumes and the variability of the meter types. It is also consistent with the approach used in the recent South Australian AA, which was approved by the AER.

Assessing the historical labour and materials unit rates, Zincara considers that the 3-year weighted average is reasonable for the wide range of meter types covered by this program.

7.4 CONCLUSION

AGN's Meter Replacement Plan and Unit Rates Forecast documents provide a good level of detail, explaining its approach and assumptions in development its forecast volumes and unit rates for the next AA period's meter replacement program.

[redacted]. Zincara notes that AGN's selection of [redacted] for the domestic meter change program.

Zincara considers that AGN's methodology is based on good industry practice and its forecast estimates are well developed. On this basis, and the fact that contracts have been recently competitively tendered, Zincara considers that the meter replacement program is prudent and cost efficient.

8. SCADA

8.1 INTRODUCTION

AGN's SCADA program consists of two projects:

- SCADA – end of life replacement – upgrade of pressure, temperature transmitters and associated switches due to non-conformance with Australian Standards or age.

- Field regulator and fringe points – SCADA monitoring equipment to be installed on the sites that currently do not have monitoring equipment (Capex V08).

The costs of the projects are shown in the table below.

Table 49: SCADA Project Cost ($000, 2016, direct)

	2018	2019	2020	2021	2022	Total
End of Life Replacement	99.5	99.5	99.5	99.5	-	398.3
Field regulator and fringe points	147.7	136.1	136.1	150.6	139	709.5
Total	**247.2**	**235.6**	**235.6**	**250.4**	**139**	**1,107.8**

(Source: Attachment 8.6 - Business Cases –December 2016 Business Case V07 and V08).
Note: Totals may not add up due to rounding error.

Zincara's analysis and conclusions are detailed in the sections below.

8.2 SCADA – END OF LIFE REPLACEMENT

AGN has commenced replacing degraded and non-compliant instrumentation associated with RTU in the current AA period. AGN advised that the replacement will address the following:

- Upgrade of pressure and temperature transmitters, slam shut switches and pit entry security switches conforming to the relevant parts of AS/NZS 60079.

- Upgrade of junction boxes and electrical rewiring to comply with AS/NZS3000:2007 Australian/New Zealand Wiring rules for Hazardous Area.

- Real time SCADA monitoring of regulator supply pressures which provides a "health" check of these facilities, allowing timely diagnosis and rectification of equipment performance issues before problems arise.

- Conformance to industry standards for electrical equipment in hazardous area installations.

- Continued compliance by AGN with its regulatory obligation in the Gas Distribution System Code (Code) to use all reasonable endeavors to ensure minimum prescribed pressures are maintained at gas delivery points.

This project was approved for the current AA period, however, it was not completed due to operational issues. In the current AA period, AGN installed 24 units and in the forecast period, it proposes to install another 24.

In its business case, AGN says that it had considered two options:

Option 1 – Do Nothing

This means that AGN will stop replacing the degraded SCADA equipment at regional sites. AGN will continue to monitor these sites on a yearly basis as part of the current preventative maintenance program.

Option 2 – Replacement Program

This option will see the ongoing program for replacing pressure and temperature transmitter components, limit switches and security switches to enhance SCADA for regional and metropolitan networks.

AGN has decided on option 2 as part of the ongoing program as it increases the safety for the maintenance staff and ensures the units are continuing to operate effectively. The costs of the program are shown in the table below.

Table 50: SCADA – End of Life Replacement ($000, 2016, direct)

	2018	2019	2020	2021	2022	Total
Volume	6	6	6	6	-	24
Unit Cost	16.59	16.59	16.59	16.59	-	-
Total	**99.5**	**99.5**	**99.5**	**99.5**	**-**	**398.3**

(Source: Attachment 8.6 - Business Cases –December 2016 Business Case V07)
Note: Totals may not add up due to rounding error.

The business plan also provided a detailed cost estimate per site which is summarised in the table below.

Table 51: Detail Unit Cost Estimate ($2016, direct)

	Cost
Material	[redacted]
Labour	[redacted]
Total	**15,370**

(Source: Attachment 8.6 - Business Cases –December 2016 Business Case V07)

AGN has estimated that 58% of the sites are in the regional areas and as such requires overnight accommodation for the technicians. Based on that, AGN has estimated the average cost per site as $16,595.

8.2.1 Conclusion

Zincara recognises that it is important to ensure that the equipment meet the current electrical safety standards as such, considers the program to continue to replace the equipment reasonable. Zincara therefore considers this project to be prudent.

In relation to the cost, Zincara has examined the material and unit cost details and believes that the material cost to be reasonable. The labour cost to be within the range that you would expect but at the high end of the range. Based on that, Zincara recommends accepting the cost as efficient.

8.3 FIELD REGULATOR AND FRINGE POINT V08

AGN has identified 63 field regulators and network fringe sites in the Victorian and Albury networks that do not have SCADA monitoring equipment. AGN proposes to install 30 sites with the monitoring equipment in the next AA period and continue the program to install 33 monitoring equipment in the following AA period.

AGN says that the inability to remotely monitor pressures at these sites limits its ability to provide timely response to emergencies and unplanned supply interruptions. Having real time monitoring also means that it is able to provide real time data and history of performance, which will help to optimise its network planning, and augmentation. Improvements in communication technology (wireless) also made the monitoring of distant sites easier to achieve and more cost effective.

In addition, AGN also indicated that having real time monitoring equipment also means that it is able to ensure that it is complying with the Victorian Gas Distribution System Code (GDSC). The GDSC requires that the gas distributor uses reasonable endeavour to maintain pressures in the distribution supply points.

AGN had considered two options:

Option 1 Do Nothing

This option essentially means that AGN will continue to operate as it is currently and retains the same risk of slower response to supply interruptions and lack of real time data for network planning purposes.

Option 2 Continue with installing SCADA monitoring facilities

This option continues with AGN's current practice of installing SCADA monitoring equipment in sites which do not have the equipment. The criteria for selecting the sites include:

- Area of high growth;

- Area where augmentation may be required in the future;
- Significant area where is no remote monitoring capability (e.g. large country towns); and
- Network supply points where is currently no remote monitoring capability.

AGN decided on option 2.

The cost of installing the equipment is shown in the table below.

Table 52: Installation of SCADA Monitoring Equipment Costs ($000, 2016, direct)

	2018	2019	2020	2021	2022	Total
Volume (metro)	1	5	5	0	4	15
Unit Cost (metro)	22.2	22.2	22.2	22.2	22.2	-
Volume (regional)	5	1	1	6	2	15
Unit Cost (regional)	25.1	25.1	25.1	25.1	25.1	-
Total	**147.7**	**136.1**	**136.1**	**150.6**	**139**	**709.5**

(Source: Attachment 8.6 - Business Cases –December 2016 Business Case V08)

Details of the unit cost of installations are shown in the table below.

Table 53: Detail Unit Cost Estimate ($2016, direct)

	AC Power	Solar Power
Material	xx,xxx	xx,xxx
Labour	x,xxx	x,xxx
Total Estimated Cost	xx,xxx	xx,xxx

(Source: Attachment 8.6 - Business Cases –December 2016 Business Case V08)

AGN says that 40% or 12 of its 30 sites require solar power due to the unavailability of mains supply. Taking that into account, the average cost per site is $22,200.

8.3.1 Conclusion

Zincara is aware that the gas industry is moving towards its network having monitoring equipment to ensure that it is able to respond to emergencies as a result of loss of gas supply quickly and also to gather data for its network planning process. AGN's proposal to continue with its program of installing network monitoring equipment is consistent with industry practice. As a result, Zincara considers this project to be prudent.

In relation to the cost, Zincara has reviewed the material and labour costs and considers them to be reasonable. Zincara therefore considers the cost to be efficient.

Appendix E

References

Access Arrangement Information
Attachment 8.2: Distribution Mains & Services Integrity Plan
Attachment 8.3: Meter Replacement Plan
Attachment 8.4: Unit Rates Forecast
Attachment 8.4: Supporting Information 1: Regulatory Unit Rate Analysis
Attachment 8.4: Supporting Information 3: Melbourne CBD Map
Attachment 8.8: Capex model
Attachment 8.9: Letter from Energy Safe Victoria
Attachment 8.10: Letter from AEMO - Sale Minimum Connection Pressure
Business Cases – Augmentation projects
Business Case – V05 – Plant and Equipment Upgrade
Business Case – V62 – Bushfire Preparedness
Business Case – V79 – I&C Meter Set Refurbishment Program
Business Case – V83 – Transmission Pipeline Modification for In-Line Inspections
Final Plan Attachment 8.6 – Business Cases – Capex V18
Responses to questions from the AER
Attachment 8.5 – Business Cases – December 2016 Business Case V07 and V08