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RENEWABLE GAS DELIVERY STRATEGY

ATCO PLAN 2025-29

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ABBREVIATIONS AND GLOSSARY

Term	Definition
AA	Access arrangement
AEMO	Australian Energy Market Operator
ATCO	ATCO Gas Australia
ALS	Asset Life Strategy
CAPEX	Capital expenditure
Gas meter	Mechanical device (usually) used to measure the volumetric flow rate of gas that passes the device.
GDS	Gas Distribution System
GHG	Greenhouse gas
GIS	Geographic Information System
GJ	Gigajoule (1 Gigajoule = 1,000,000 Joules)
Joule	Joule is a unit of energy and can be represented as different magnitudes: Kilo ($1x10^3$), Mega ($1x10^6$), Giga($1x10^9$), Tera($1x10^{12}$) and Peta ($1x x10^{15}$)
kPa	Kilopascals
OPEX	Operating expenditure
PE	Polyethylene
PVC	Polyvinyl chloride
Strategy	Renewable Gas Delivery Strategy
SCADA	Supervisory control and data acquisition
sm3/hr	Standard cubic meters per hour (either Gas or Air).
SMS	Safety Management Study
Test point	A conveniently located termination point for electrical cables connecting to a buried pipeline. This allows measurement of the pipeline potential and is the principal method of assessing the effectiveness of corrosion protection.
TJ	Terajoule
t CO2-e	Metric tons of carbon dioxide equivalents
UAFG	Unaccounted for gas
WA	Western Australia

EXECUTIVE SUMMARY

ATCO Gas Australia's (ATCO) Renewable Gas Delivery Strategy (Strategy) proposes purchasing renewable gases as replacement UAFG and enabling renewable gases to be transported through the ATCO Gas Distribution System (GDS) during the AA6 period, to assist with greenhouse gas (GHG) emission reduction targets.

ATCO is agnostic as to the renewable gas but considers biomethane and/or renewable hydrogen to be most likely. When purchasing renewable gas as all or a portion of UAFG, the purchasing decision will be based on cost and availability of supply. The portion of UAFG planned to be purchased as renewable gas is up to 20% over the AA6 period, with the remaining 80% to continue to be purchased as natural gas, and this based on increasing blends of renewable gas into the latter years of AA6. Currently, ATCO expects biomethane will be available in the nearer term than renewable hydrogen but expects that there may be limited supplies of biomethane. ATCO therefore assumes it will purchase a combination of renewable gases, depending on what is available and most cost effective at the time. Whilst purchasing renewable gases is ATCO's preferred approach, if there is no or limited renewable gas supply then ATCO would seek to purchase (for surrender) carbon offsets. In terms of renewable gases to be injected and distributed through the network, again ATCO is agnostic as long as the gases are in accordance with the gas distribution laws and this will ultimately depend on availability of supply, customer demand and the ability of the network to safely accept the renewable gas.

The purpose of this Strategy is to ready our network to receive renewable gas with the aim of:

- reducing the GHG impact of our fugitive methane emissions,
- reducing the emissions intensity of energy transported through the network; and
- allowing gas consumers and retailers access to the GDS for renewable gases.

The key strategic outcomes of this strategy include:

- The planned investments have a positive economic and environmental value to deliver a reduction in net emissions (Scope 1) through the introduction of renewable gases.
- ATCO's investment in renewable gases achieves emission reduction targets (of ATCO, its customers and the WA and Australian governments).
- ATCO will invest in a number of programs including 6 gate injection points over the AA6 period to enable the introduction of renewable gas into the GDS
- ATCO's strategic alignment to Australian government obligations and the ATCO Gas Sustainability Strategy ensures the investments are prudent and credible
- ATCO has started and continues to invest in climate change actions including the decarbonisation of the GDS into AA6 to achieve 2030 targets.

ATCO's primary source of Scope 1 GHG emissions is fugitive emissions from the GDS. To date, ATCO has progressed the reduction of these emissions by identifying and repairing leaks in the GDS and thus reducing fugitive emissions. ATCO will continue its activities in reducing fugitive emissions, and this is detailed in our *UAFG Strategy and Forecast*.

ATCO has identified a complementary method of further reducing net GHG emissions and the emissions intensity of the energy delivered through the GDS, by replacing the fugitive emissions with renewable gas rather than with natural gas as is the current practice.

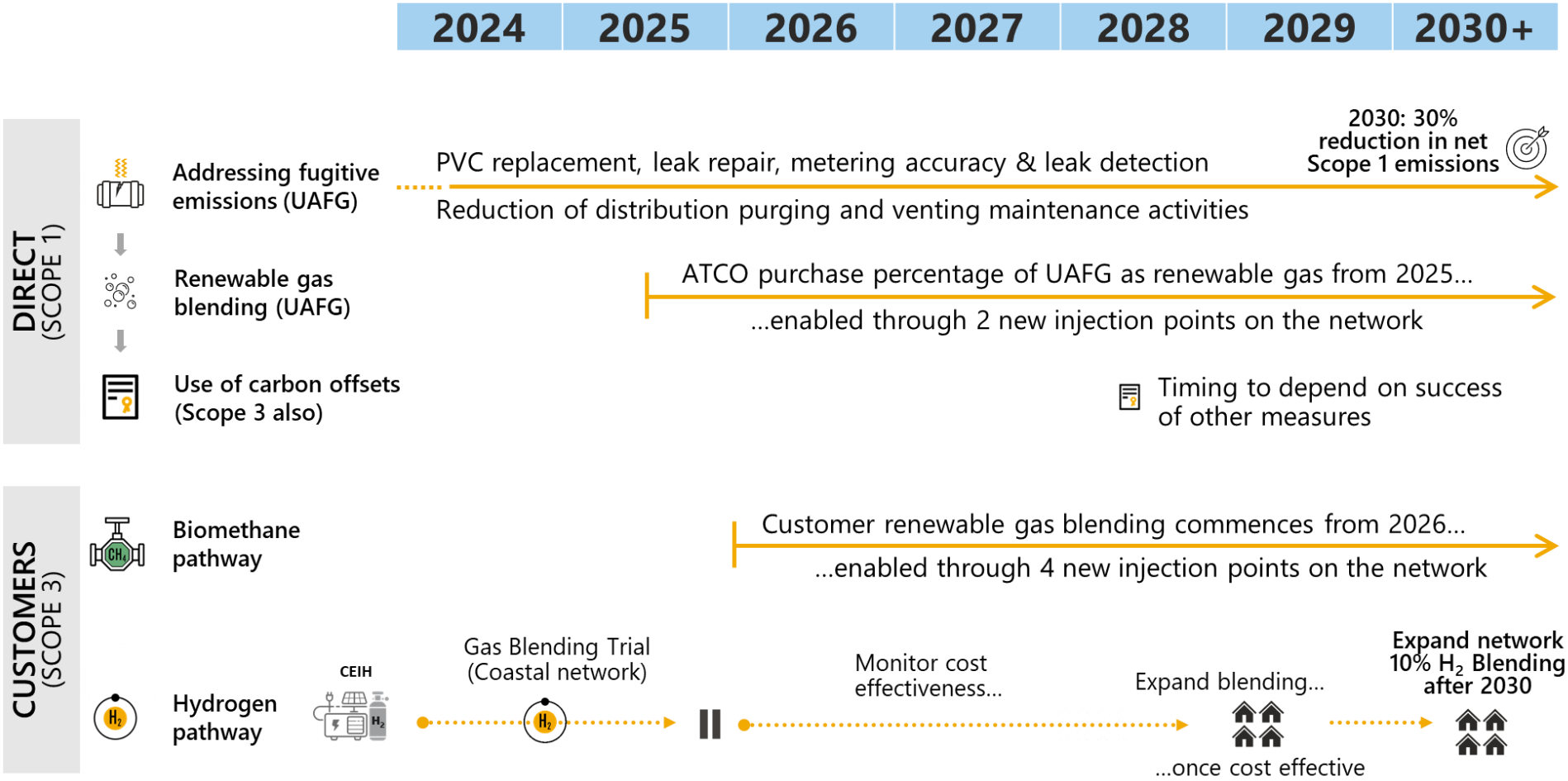
ATCO's scope 3 emissions occur when gas consumers use the natural gas delivered through the GDS. Reduction of the emissions intensity of the energy delivered through the GDS will reduce these emissions and, as we outline, is in-line with community expectations. By ensuring the GDS can transport renewable gases, ATCO can reduce its Scope 3 emissions that contributes to the reduction of end-users' GHG emissions thereby supporting its customers to meet their own emissions reduction targets and requirements.

An overall summary of the plan for achieving the Strategy is outlined in Figure 1 below:

This Strategy has been informed by, and strongly aligns to, State and Commonwealth Government Policies (including the Commonwealth Government's National Emissions Reduction Targets), the ATCO Sustainability Strategy, ATCO Corporate ESG targets and has strong consumer support.

With the introduction of renewable gases across the GDS, ATCO must play a role within the community to provide education, safety awareness, in-depth consultation and engagement activities. ATCO will aim to seek genuine and authentic engagement with all stakeholders, based on transparency, accessibility and inclusiveness.

Figure 1: The overall plan for achieving the Strategy



1. INTRODUCTION

1.1 Purpose

ATCO Gas Australia's (ATCO) Renewable Gas Delivery Strategy (Strategy) proposes a program of works to be carried out during the AA6 period to purchase renewable gas as replacement UAFG and enable renewable gases to be transported through the ATCO GDS, to assist with GHG emission reduction targets.

The Strategy outlines:

- how investment in renewable gases and readying the GDS for renewable gases can achieve emission reduction targets (of ATCO, its customers and the WA and Australian governments).
- the investments ATCO is proposing including any upgrades, modifications and changes required to the network which build on the work ATCO has already completed.
- why the investment is prudent and efficient including what are the drivers behind the proposed investments.
- when the investments will be made during the period between 2025 to 2029 and beyond.

Whilst a key aspect to ATCO's decarbonisation plans, this Strategy does not go into detail about how ATCO will reduce UAFG. This is dealt with in the UAFG Strategy.

1.2 Background and Context

The ATCO Renewable Gas Deliverability Strategy (and associated plans) outlines ATCO's commitment to confronting the challenges posed by climate change through proactive, sustainable, and collaborative measures. By prioritising renewable gas, engaging the community, investing in adaptive infrastructure, and utilising data-driven insights, ATCO aims to secure a more sustainable and resilient future and contribute to global efforts for mitigating climate change.

ATCO has already commenced its renewable energy journey by creating a world class Clean Energy Innovation Hub (CEIH) in Jandakot and is currently conducting a hydrogen blending trial to 2,700 homes in the Cockburn area.

Further detail around the background and context to this Strategy is set out in Appendix A.

1.3 Strategic Alignment

To support the efforts of Federal and State governments to tackle climate change and reduce emissions (2030 and 2050 emissions reduction targets), and to meet its own and customers' emissions reduction targets (including mandatory obligations under the Safeguard Mechanism for ATCO's large customers), this Strategy outlines the role that the GDS will play to enable decarbonisation and support the energy transition.

The Strategy is aligned with ATCO's Global Environmental, Social, and Governance (ESG) targets[1] and the ATCO Gas Australia Sustainability Strategy[2].

1.3.1 ATCO Gas Australia Sustainability Strategy

We are focused on reducing our scope 1 and 2 emissions, in line with ATCO Group priorities, State and Federal targets. Our long-term vision of being net zero by 2050 is supported by realistic and actionable 2030 emission reduction targets, with a focus on reducing the occurrence and climate-related impacts of fugitive emissions from the GDS. Our strategic outcomes include:

- Reduce scope 1 and 2 emissions
- Maintain compliance with mandatory reporting frameworks
- Influence our scope 3 emissions in our upstream supply chain

This strategy supports the targets in the ATCO Sustainability Strategy, specifically:

- Net emissions (scope 1) reduced to 30% below 2020 levels by 2030

The ATCO Sustainability Strategy presents a summary of the actions to meet this target by 2030 including:

- Develop new renewable gas injection points for blending of renewable gas into the gas distribution network.
- Determine a system for accurately measuring delivered energy in a system with a disparate and dynamic hydrogen-methane blend.
- Test the workability of introducing zero-emission fuels into the network by testing customers' receptiveness, including identifying technical and social prerequisites for acceptance.
- Engage with end-use industry (e.g., appliance manufacturers, industrial energy users) to proactively prepare them for hydrogen and biomethane blends).

This Strategy provides the background, detailed actions and the technical detail to ensure that ATCO can deliver on climate action.

1.3.2 Regulatory Landscape and Changing Legislation

This Strategy has been informed by, and strongly aligns to, the Commonwealth Government's National Emissions Reduction Targets**.** The Strategy directly supports the achievement of National 2030 emissions reduction and 2050 net-zero emissions targets, through ATCO's commitment to reduce its net emissions (Scope 1) by 30% by 2030 from 2020 levels via addressing its UAFG emissions. In addition, ATCO is committed to reducing Scope 3 emissions by 2030, through a reduction of the emissions intensity of the GDS by ensuring renewable gases can be transported through the network.

This Strategy also directly supports the following:

[1] ATCO Global – 'Strategic ESG 2030 targets' (2022)
[2] ATCO Gas Australia – Sustainability Strategy (2023)

- **WA Emissions Reductions Targets:** The Strategy directly supports the WA Government's target to reduce public sector emissions by 80% by 2030 compared to 2020 levels and achieve net-zero GHG emissions state-wide by 2050. Through the transition of the GDS to renewable gas, ATCO will reduce its own Scope 1 emissions and support the reduction in end-user emissions (which include WA Government agencies) across the system.
- **Safeguard Mechanism Reforms[3]:** The Strategy directly supports the reduction of emission baselines predictably and gradually on a trajectory consistent with achieving net zero by 2050 by sourcing renewable net carbon reducing fuels to offset emissions and displace carbon emitting fuels for end-users. This will contribute to the gradual decarbonisation of ATCO's industrial sector end-users that fall under the Mechanism.
- **National Gas Law (NGL)[4]:** The Strategy directly supports recently proposed reforms to extend the national gas regulatory framework to accommodate renewable gases into gas networks. By purchasing renewable hydrogen and/or biomethane to replace a portion of its UAFG, ATCO will become a key off-taker from renewable gas producers, thereby supporting investment in innovative projects designed to reduce emissions in the gas networks.
- **National Energy Objectives (NEO) amendment[5]:** Energy Ministers have approved an update to the national energy objectives which embeds emissions reduction as part of the long-term interests of energy consumers. When implemented, this will provide greater clarity to Australia's energy market bodies, including WA's Economic Regulation Authority (**ERA**), to consider emissions reduction in undertaking their functions. This Strategy supports achievement of the emissions reduction objective within the NEO.
- **Closure of all WA Government-owned coal generator units by 2029:** The Strategy directly supports the transition to renewable energy, lower-emissions technologies in the energy sector by ensuring natural gas supply remains throughout the transition and that an increasing proportion of that gas comes from renewable gases over time.
- **WA Renewable Hydrogen Roadmap[6]:** The Strategy directly supports the adoption of up to 10% renewable hydrogen blended gas across Western Australia's gas pipelines and networks. ATCO will focus on trialling and implementing hydrogen blending across dedicated sections of the system to enable a long-term transition of the entire GDS to a 10% renewable hydrogen blend.

1.4 Key Stakeholders

Key Stakeholders are those with an interest in the outcome of ATCO's Renewable Gas Delivery Plans. Table 1 provides a list and the main interest of key stakeholders related to this Strategy.

Table 1: List of Key Stakeholders related to the Plans outlined in this Strategy

Stakeholder	Main Interest
Customers	Gas consumers are the ultimate stakeholder across the network footprint. They include residential, commercial, and industrial users that are served through ATCO's distribution networks. They want a safe, reliable supply at a reasonable price.

[3] Australian Government – Safeguard Mechanism Reforms (2023)
[4] Australian Energy Market Commission – Review into extending the regulatory frameworks to hydrogen and renewable gases (2022)
[5] Australian Government – National Energy Laws Amendment (Emissions Reduction Objectives) Bill 2023 (2023)
[6] WA Government – Western Australian Renewable Hydrogen Roadmap (2020)

Stakeholder	Main Interest
Retailers	Retailers own the gas that is distributed by ATCO and have the contracted delivery responsibility with end-consumers. They want to understand ATCO's investment plans, ability to respond to faults (and to provide them information), and approach to connecting new customers.
Economic Regulation Authority	ATCO is subject to regulatory scrutiny to assess, amongst other things, whether network investments are efficient and prudent.
Department of Mines, Industry Regulation and Safety (DMIRS) – Building and Energy Division	Building and Energy is responsible for the technical and safety regulation of the GDS. This includes administering gas technical and safety legislation and setting and enforcing minimum safety standards for gas networks.
WA Communities	It is important that ATCO consults effectively with the communities that host ATCO assets, and who may be affected by network performance. Engaging with them during planning of activities, to better understand potential risks and mitigate these as far as practicable.
Staff	ATCO staff are also stakeholders. Ensuring that they have appropriate skills is an essential element of managing the safety and reliability of assets.
Other Stakeholders	Other stakeholders with an interest in ATCO's asset management approaches include government ministries, financial institutions, the media, and other industry bodies.

1.4.1 Consumer support

Research conducted by ATCO has led to several important insights, summarised below, which are a driver for this Strategy:

- End-users value the **affordability and reliability** of natural gas.
- End-users like using gas in their homes, and it is often a **preferred fuel** for cooking and heating.
- End-users show strong **support for more sustainable gas** and see ATCO as central to delivering such outcomes over time.
- End-users show a **willingness-to-pay for renewable gas** to be distributed through ATCO's system. The amount that consumers are willing to pay increases with the percentage of renewable gas. In our survey, consumers were willing to pay 12% more on average for 15% renewable gas and 20% more for 50% renewable gas.
- Overall, residents surveyed showed a **strong preference for renewable gases**, are particularly interested in being educated about renewable gases including hydrogen blending and its integration with the current gas infrastructure, as well as its environmental impacts and benefits.

Though the type of gas consumed, and overall demand levels may change over time, our research suggests it is reasonable to assume gas services (natural or renewable) will remain relevant in WA for the foreseeable future. These survey results have contributed to the drivers behind ATCO's proposed investment in renewable gases under the AA6.

Further detail can be found at Appendix B.

2. ATCO'S TRANSITION STRATEGY TO DECARBONISE THE GDS

2.1 Renewable gases – biomethane and hydrogen

ATCO's strategy involves the purchase of renewable gas as replacement UAFG (section 2.2 below) and ensuring the GDS can accept and transport renewable gases to meet customer demand and achieve emissions reduction objectives (section 1.3).

Where referring to renewable gases, ATCO considers biomethane and renewable hydrogen or both to be the most likely renewable alternative to natural gas within the next 10 years[7]. ATCO is agnostic to which of these renewable gases is utilised in meeting this Strategy.

2.1.1 Availability and cost

ATCO's current assessment and expectation is that biomethane will be available and more cost effective in a shorter timeframe than renewable hydrogen. However, it considers there will be limitations to the supply of biomethane such as producer constraints or not enough feedstock. As such ATCO expects that it will need to purchase a combination of biomethane and renewable hydrogen depending on the timing availability, supply levels and cost. ATCO may also need to purchase carbon offsets for a period if renewable gases are not yet available (although this is not the preferred approach).

ATCO will continue to assess the supply availability and cost of renewable gases during the 2025 to 2029 period (and beyond) and will make any purchasing decisions based on availability and cost of supply of these renewable gases.

The availability and cost of supply will impact customers' demand for renewable gas and the need for the GDS to be able to accept and distribute these required amounts of renewable gases. ATCO therefore needs to ensure that the GDS can accept and distribute renewable gas as determined by expected customer demand.

2.1.2 Additional infrastructure required

Whether biomethane and/or renewable hydrogen is purchased as replacement UAFG and required to be distributed to meet customer demand, additional injection points will be required.

Two injection points are required to enable ATCO to commence purchasing renewable gas as UAFG replacement, and four injection points are required to be built to enable renewable gases to be injected and distributed through the GDS to meet expected customer demand.

2.1.3 Timing and delivery plan for gate injection points

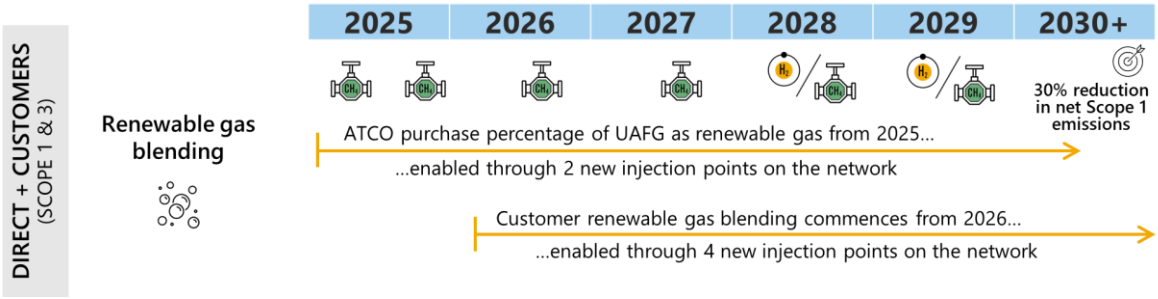
The two injection points for UAFG are forecast to be built in 2025, to allow ATCO to commence purchasing renewable gas as UAFG replacement as soon as there is sufficient supply. One injection point is required to be built in each of the remaining AA6 period years (2026 – 2029) to enable

[7] For further information on these renewable gases see Appendix C

renewable gases to be injected and distributed through the GDS to meet expected customer demand.

Figure 2 below shows ATCO's timing and delivery plan for the required gate injection points.

Figure 2: Renewable Gas blending timeline and delivery



2.2 UAFG: Reducing the impact of our fugitive emissions

Unaccounted for gas (**UAFG**) is the difference between system inputs and system outputs. Some UAFG is attributable to actual physical losses during distribution and are known as 'fugitive emissions'[8]. This is the primary source of ATCO's Scope 1 emissions. The remaining UAFG are non-actual losses, but attributable to inaccurate meter readings or other reporting issues. Non-actual losses are not Scope 1 emissions for the purposes of NGER reporting.

UAFG accounts for nearly all of ATCO's Scope 1 emissions. During the AA6 period, ATCO will meet its net emissions (Scope 1) reduction target by:

- Reducing the losses in the system through a range of technical improvements. These activities are covered in ATCO's UAFG Strategy and Forecast and are not covered further here.[9]
- Replacing all or a portion of UAFG with renewable gas instead of natural gas (or purchasing offsets if renewable gas is not yet available or there is insufficient supply).

ATCO is responsible for reporting and replacing energy lost in the GDS. As a participant in the Gas Retail Market, ATCO and other participants provide data to AEMO who utilises the Gas Retail Market Procedures (WA) to calculate UAFG. Once calculated, ATCO currently replaces UAFG by purchasing natural gas.

However, utilising natural gas as a replacement of UAFG has no benefit in reducing emissions within the GDS. Instead, ATCO can seek to address a portion of UAFG emissions by replacing all or a portion of its UAFG with renewable gases. ATCO is agnostic to the renewable gas it purchases and this will be dictated by availability and cost. Further detail regarding biomethane and renewable hydrogen is set out at Appendix C. Whilst not the preferred approach, if there is insufficient supply of renewable gas for ATCO's UAFG replacement needs, ATCO would seek to purchase and surrender Australian Carbon Credit Units (ACCUs).

[8] Fugitive emissions are a category of Scope 1 emissions: section 1.3, National Greenhouse and Energy Reporting (Measurement) Determination 2008 (Cth)

[9] Measures that can be implemented to reduce the amount of UAFG, include metering improvements to improve reporting accuracy, improved leak detection systems, and pipe replacement to reduce losses. Whilst these improvements are essential in reducing ATCO's emissions, they are described in the UAFG Strategy document and are not within the scope of this document.

In addition to the cost of purchasing renewable gas, ATCO has considered the additional infrastructure and other requirements to inject and transport the renewable gas that would be needed before ATCO can start purchasing renewable gas as replacement UAFG.

As explained further in Appendix F, no changes would be required to ATCO's systems or upgrades to the network for the introduction of biomethane and/or renewable hydrogen into the network for UAFG replacement. This is because:

- biomethane[10]has the same characteristics as natural gas; and
- whilst hydrogen has different properties to natural gas[11], only small portions of hydrogen would be injected (less than 2%) and these percentages have already been tested by ATCO (see Appendix F for the work ATCO has already completed prior to AA6) and has been approved by the safety regulator.

The only additional infrastructure that would be required for biomethane and/or renewable hydrogen to be purchased as replacement UAFG, is gate injection point(s). Injection points would be required to allow the relevant volume of renewable gas to be injected into the network for distribution. As discussed, ATCO considers two injection points are necessary to inject the volume of renewable gas required for UAFG replacement.

Whilst these additional infrastructure requirements are not needed if ATCO were to instead purchase and surrender ACCUs to offset its UAFG emissions, the use of offsets is generally not as effective in reducing or offsetting emissions and is not the preferred approach.

Whilst the purchase of renewable gas and/or offsets would help to reduce or offset emissions related to UAFG, they would also increase the total delivered cost. The most cost-effective solution can be determined by comparing the forecast cost of renewable gas and associated additional infrastructure required against the forecast cost of natural gas plus ACCUs during the same period. This cost comparison should be considered in light of the preferability of using renewable gas over offsets, to achieve a cost-benefit analysis.

ATCO has performed a preliminary cost-benefit analysis across these scenarios to help determine the optimal pathway to replace UAFG. This analysis currently indicates that biomethane is the most cost-effective renewable gas for UAFG replacement. However, the cost-benefit analysis will be reviewed prior to purchase to determine the availability and cost of renewable gases and ensure that the most cost-effective source of UAFG replacement is procured given ATCO is agnostic to the renewable gas purchased.

ATCO's resultant UAFG replacement strategy for AA6 is to utilise the knowledge and lessons learnt from the biomethane and hydrogen plants in WA and NSW, including the work ATCO has already carried out in this regard as set out in Appendix F, to procure a cost effective, safe, reliable, and sustainable delivery of renewable gases into the GDS.

The key actions ATCO will undertake to achieve this are:

1. Outline plan to enable renewable gases to be injected into the GDS – Currently underway.
2. Review UAFG contract termination date – Confirmed 31/12/24.
3. Market investigation to source renewable gases to replace UAFG – Currently underway.

[10] For further detail on biomethane, refer to Appendix C.1
[11] For further information on hydrogen, refer to Appendix C.2.

4. Determine and document requirements for biomethane quality – Currently underway utilising interconnection agreements, Australian Standard 4564 and system specific requirements.
5. Review optimum locations across the system for renewable gas injection points – Determined.
6. Contact experienced constructors of biomethane and renewable hydrogen facilities – Currently underway.
7. Validate design of biomethane production facilities to ensure that quality and quantity is acceptable – Review of existing designs underway.
8. Determine costs and verify acceptance of cost with business for gas procurement – currently underway with tender to Retailers.
9. Set up contracts to procure renewable gases for UAFG offset via Retailers – Currently in progress.
10. Design and build 2 gate point delivery stations – during AA6.

The selection process and the detailed cost benefit analysis for the UAFG replacement options is provided in Appendix D and Appendix E.

2.3 Renewable Gases: Distributing renewable gases through the GDS

Distributing renewable gases through the GDS would reduce the emissions intensity of the GDS and require only minimal changes to the network and existing systems (where blends of hydrogen are less than 10% by volume).

ATCO's objective is to reduce the emissions intensity of the energy delivered through its GDS and support market demand for emissions reduction for end users by providing delivery of renewable gases.

As described in the Customer Satisfaction Surveys, gas consumers expect ATCO to help enable emissions reductions for our end-users (our Scope 3 emissions form part of their Scope 1 emissions). ATCO will do this by installing up to four renewable gas receiving gate stations to enable up to 400 TJ per year of available supply in the next AA period. The gate stations will be built progressively in response to demand from producers, retailers and end-users for renewable gas distribution services.

In support of ATCO's objective to reduce the emissions intensity of energy supplied in a cost-effective manner, a cost comparison for emissions reduction via conversion to full electrification or via procurement of carbon credits verses renewable gas procurement, is being conducted – similar to the cost/benefit analysis conducted by ATCO for UAFG replacement.

Renewable gas blending: Whilst sourcing biomethane and/or renewable hydrogen for UAFG replacement, ATCO will discuss options for suppliers to expand production and delivery of biomethane/renewable hydrogen to gas-consumers (other than ATCO) to support ATCO's Scope 3 reduction objectives.

Hydrogen blending: In consultation with the Technical Regulator and Building and Energy, and by utilising the knowledge and lessons learnt from ATCO's hydrogen injection facility within the Clean Energy Innovation Hub at Jandakot and its existing blending trial (see Appendix A.5), ATCO

plans to increase the percentage of renewable hydrogen that is blended into a section of the GDS from 2% to 5% to 10%. ATCO also plans to optimise and modularise the existing working designs as templates for the new gate injection points.

Key actions to ensure the GDS is able to accept and distribute renewable gases are:

1. Optimise existing plant to achieve a reliable delivery of renewable gas into the existing natural gas supply across the GDS.
2. Review the designs to determine if modern technologies can be incorporated to improve safety, energy consumption, and reduction in labour interactions.
3. Create a modular design from the existing design to optimise space required to install the infrastructure, to standardise parts and manufacturing costs.
4. Review optimum locations across the system for blending renewable gas with existing gases, taking into consideration the system design and end user gas specification requirements.
5. Create detailed cost estimations through a combination of procurement actions including: request for information, request for quote, material cost and lead time from standard design.
6. Develop business case for delivery of renewable gas blending facilities.

New gate injection points: In summary, ATCO will construct and operate 4 new gate injection points to support renewable gas injection into the GDS from producers and support market demand. This is in addition to the two gates to be used to support UAFG replacement with biomethane (as outlined above).

In conducting this analysis, ATCO has calculated the levelised abatement cost of purchasing renewable gas compared to carbon offsets. This will allow ATCO to assess customer intent/demand for renewable gases to address their own emissions reduction targets and assist ATCO's assessment of whether customers are likely to purchase offsets or renewable gas and the amount of demand for renewable gas to be distributed through the GDS. This will further allow ATCO to assess gas consumers' willingness to pay for the required infrastructure and ensure that ATCO's expenditure is in the long-term interests of the consumers Further analysis is provided in Appendix G.

2.4 Long-term transition planning: 100% Hydrogen Distribution Model

ATCO is exploring the possibility of a 100% hydrogen distribution model as part of its long-term transition planning. This section sets out ATCO's longer term plan to demonstrate the feasibility of transitioning the network to 100% hydrogen. This is outside the AA6 period and is provided here for information.

ATCO are proposing to validate the 100% hydrogen distribution model at a suburb scale, by proposing the development of a portion of the GDS that will be compatible with 100% hydrogen gas supply. To achieve this, there are a number of significant investigations that will need be conducted, including:

- Community consultation and awareness
- Industry training

- Safety control assessments
- Facility designs
- System compatibility for 100% Hydrogen
- Hazardous area assessments
- System operations and maintenance system reviews, modifications, and training
- Energy regulatory requirement modifications
- Safety regulator requirement modifications
- Producer and retailer agreements.

ATCO will commence early investigations into a 100% hydrogen distribution model from 2025. From 2030 ATCO will action the bulk of the modifications required for a hydrogen distribution model as this is when we expect to increase blending at greater than 10% hydrogen by volume levels.

3. FORECAST EXPENDITURE

3.1 Renewable gas gate injection points

Utilising similar designs to ATCO's hydrogen blending skid at Jandakot, the proposed renewable gas gate injection points will enable supply from producers into the GDS. [redacted]

Table 2: Estimated gate injection point cost

Asset	Cost	Note
Gate injection point	[redacted]	Without telemetry and Land
Land	[redacted]	
Telemetry	[redacted]	Separate project for control system monitoring and notifications to operational personnel
TOTAL	**$2.5 M**	**High-level estimate based on existing infrastructure costs**

As shown in Table 2, total CAPEX is currently estimated at $2.5M per gate injection point. The average OPEX for maintaining and servicing each station is estimated to be $112.5k per annum. These are high-level estimates subject to detailed design and costing.

3.2 Renewable Gases (Scope 1 and Scope 3)

The roll out of renewable gas injection points, 6 in total, will commence in 2025. The following table details the planned roll out schedule to 2030 across Scope 1 and 3 injection points.

Table 3: Renewable gas injection points, 2025-2030 rollout schedule and forecast cost

ACTIVITY	2025	2026	2027	2028	2029	TOTAL
Number of injection points (Scope 1 - cumulative)	2	2	2	2	2	2
Number of injection points (Scope 3 - cumulative)	0	1	2	3	4	4
Capital Expenditure	$5.0	$2.5	$2.5	$2.5	$2.5	$15.0
O&M Expenditure	$0.2	$0.3	$0.4	$0.5	$0.7	$2.1

These are high-level estimates subject to detailed design and costing and submission for approval utilising ATCO's existing project governance systems. The business cases will refer to this document for the basis of approval.

3.3 System validation projects

To support the introduction of renewable gases across the GDS, the following system validation projects with estimated budgets are proposed for the AA6 regulatory period:

- **Desktop assessment [redacted]:** Desktop review of the GDS to identify equipment incompatible with 10% hydrogen blends and assessment of meter type and suburb. This will inform the meter replacement program and determine preferred suburbs for blending.
- **Hazardous area re-assessment drawings ([redacted]:** Existing hazardous area assessments, facility compound sizes and exclusion zones are based on environmental conditions, physical locations, and properties of natural gas. To support the introduction of renewable hydrogen, new hazardous area assessments will need to be conducted. The resultant adjustments to hazardous area zones, and replacement or relocation of infrastructure will also need to be conducted. This project is the first step for conducting the re-assessments and providing drawings for the facilities. This project will provide a basis for hazardous zones for infrastructure to be installed immediately and prior to the implementation of hydrogen to reduce future amendment costs.
- **Desktop Equipment Hazardous area assessments [redacted]:** Desktop assessment to ensure system hazardous areas are compatible with varying proportions of hydrogen. Note, it is probable that some equipment including meters may have to be replaced from enclosed spaces with the requirement for installing additional venting. However, delivery of remediation works, and associated costs is expected to be out of scope for the AA6 period.
- **Meter replacement program [redacted]**: Replacement of non-compliant meters, as conducted for ATCO's blending project, across the wider GDS. It is estimated that 3,467 meters will need to be replaced based on learnings from ATCO's blending project (ratio of compliant to non-compliant meters applied to the GDS). Note, it has been assumed that the cost to replace each meter is equivalent to the current meter replacement program. This project is expected to span the duration of the AA6 period.
- **Desktop feasibility study [redacted]:** Feasibility study for the capability of the network to distribute increasing hydrogen blends from 10% to higher proportions, eventually reaching a transition to 100% hydrogen. This project will help to inform the requirements for a transition to 100% hydrogen being distributed across the GDS.

- **Weld procedure review [redacted]:** Review associated modifications to welding procedures for hydrogen blends and 100% hydrogen. With the introduction of hydrogen blends and 100% hydrogen, existing weld procedures and weld inspection requirements developed for natural gas will need to be adapted. This includes procedures for new piping, repairs, and maintenance within existing operating piping based on physical locations and gas properties. Note, contractors will be engaged to qualify the new procedures. This project is expected to be implemented in 2023/2024.
- **Safety case amendments [redacted]:** The existing System Distribution Safety Case has been developed for natural gas, with an additional Safety Case already developed for the existing blend system with a 2% maximum blend ratio. Any adjustment in blend ratio (e.g., to 5% and again to 10%), any new system area (e.g., new renewable blend area) will require amendments to the safety case and resubmission for approval. The estimated cost for this project is based on seven amendments at $200k per amendment, including an amendment for blend ratio increase at ATCO's existing Jandakot facility, six amendments for new renewable blend systems.
- **Energy regulator reporting amendments ($TBC):** Due to the introduction of renewable gas and associated higher heating value (HHV) changes, gate injection point locations, billing systems and reporting to AEMO will need to be adjusted via the Network Management Information System (NMIS). This project will review, scope, and implement changes to the existing NMIS to address these changes.
- **System modelling amendments ($TBC):** The proposed addition of gas injection points will alter the flow of gases through the system, and the change to HHV will require new billing zones to be defined. To validate the billing zones or the consequence areas of these changes, new modelling tools will need to be implemented. This project will review, scope, and implement changes to the existing Synergy modelling system to address these changes.
- **Display home appliances [redacted]:** To demonstrate the options available to end-users, ATCO will utilise the existing hybrid home to install 100% hydrogen compatible residential appliances. The estimated cost for this project includes procurement of appliances, confirmation of certifications/approvals for use in Australia, and installation within the display home.
- **Sustainability reporting system [redacted]:** Governmental and National Greenhouse and Energy Reporting (NGER) framework requirements to report on environmental strategy deliverables. This project will deliver a solution to collate required environmental inputs and reports in the format required by various agencies with ongoing operational support.
- **Security of Critical Infrastructure (SOCI) Act assessment ($TBC):** A review and implementation of SOCI control requirements for the new infrastructure proposed.
- **Additional system control and monitoring systems [redacted]:** As the facilities implemented at Jandakot are replicated across the system, additional system control and monitoring systems will need to be developed and operated. This project allows for the development and ongoing operations of these systems.

3.4 Community Consultation

The proposed renewable gas community consultation and communications plan is a phased level of investment that will mirror the proposed system projects requirements and milestones. Additional details of the proposed community consultation activities are provided in Appendix I.

With the introduction of renewable gases across the GDS, ATCO must play a role within the community to provide education, safety awareness, in-depth consultation and engagement activities.

ATCO will aim to seek genuine and authentic engagement with all stakeholders, based on transparency, accessibility and inclusiveness. We aim to achieve this through:

- Providing honest, transparent, consistent and timely information regarding our renewable gas transition journey through above the line media.
- Educating the community around the future of the ATCO GDS and the transition to renewable gases, to increase awareness and understanding.
- Identifying and engaging in proactive community consultation with impacted areas around the potential benefits and implications of renewable gas blending.
- Raising awareness of key renewable gas safety messages to accompany our Natural Gas Safety Engagement public campaign.
- Developing a mix of additional consultation activities that allow us to reach most end-users.

3.5 Excluded Estimates

The following projects have been excluded from the AA6 period as the works are not required until the AA7 regulatory period:

- **Desktop assessment [redacted]:** Desktop assessment of the GDS to determine compatibility of equipment with 100% hydrogen. Similar to the assessment across all materials and equipment conducted based on 10% blends, this study will validate similar studies from other utilities (e.g., GPA for Jemena) to determine equipment and materials that would be required for conversion to blends higher than 10% or 100% Hydrogen. This project was removed from the AA6 period as timing indicates that this would more prudently be conducted in the AA7 period.
- **Desktop assessment [redacted]:** Desktop assessment of replacement programs to exchange equipment to enable 100% hydrogen. This would involve collaboration across the Technical Assessment and Asset Services team to coordinate the optimal replacement strategies for the equipment identified as incompatible with high hydrogen blends. This project was removed from the AA6 period as timing indicates that this would more prudently be conducted in the AA7 period.
- **Meter replacement program ($not calculated):** Project to ensure the system is compliant with a 100% hydrogen transition. This could include replacing existing meters with ultrasonics and associated power supply. Further research needs be conducted to understand the utilisation of 100% hydrogen (e.g., community fuel cells).
- **Valve replacement program [redacted]:** Project to ensure the system is compliant with a 100% hydrogen transition, based on life replacement schedules for the valves. All steel valves would likely need to be changed on the 1900kPa system. The project cost assumes 300 valves to be placed at [redacted] per valve, with works spread over 25 years. This project was removed from the AA6 period as timing indicates that this would more prudently be conducted in the AA7 period and beyond.

- **Seal replacement program** [redacted] Project to ensure the system is compliant with a 100% hydrogen transition, including regulators, filters, gaskets, valve stems, and other equipment. The project cost assumes work would be conducted during major facility maintenance, and assumes 3,500 sites (500 HPRs, 1,000 MPRs, and 2,000 other sites) at [redacted] per site spread over 25 years. This project was removed from the AA6 period as timing indicates that this would more prudently be conducted in the AA7 period and beyond.

3.6 Cost Summary

Table 4: Proposed Costs

ACTIVITY	2025	2026	2027	2028	2029	TOTAL
Number of injection points (Scope 1 - cumulative)	2	2	2	2	2	2
Number of injection points (Scope 3 - cumulative)	0	1	2	3	4	4
Capital Expenditure	$5.0m	$2.5m	$2.5m	$2.5m	$2.5m	$15.0m
O&M Expenditure	$0.2	$0.3	$0.4	$0.5	$0.7m	$2.1m
System Validation Capex	$0.12m	$0.12m	$0.12m	$0.12m	$0.12m	$0.6m
System Validation Opex	$0.3m	$0.3m	$0.3m	$0.3m	$0.3m	$2.4m
Community Consultation	$0.9m	$0.8m	$0.8m	$0.8m	$0.8m	$4.1m
TOTEX						**$24.2m**

Refer to Appendix H for a summary of these program costs.

4. REFERENCES

Supporting Documents	• ATCO Global – 'Strategic ESG 2030 targets' (2022) • ATCO Gas Australia – Sustainability Strategy (2023) • Australian Government – Safeguard Mechanism Reforms (2023) • Australian Energy Market Commission – Review into extending the regulatory frameworks to hydrogen and renewable gases (2022) • WA Government – Western Australian Renewable Hydrogen Roadmap (2020) • ATCO Gas Australia Gas Distribution Safety Case • Unaccounted for Gas Strategy and Forecast • Gas Statement of Opportunities 2022 (WA) • National Inventory Report 2021 • Australia's Bioenergy Roadmap Report
Legislation and Standards	• Climate Change Bill 2022 • Australian Government – National Energy Laws Amendment (Emissions Reduction Objectives) Bill 2023 (2023) • National Greenhouse and Energy Reporting (Measurement) Determination 2008 (Cth)

5. DOCUMENT APPROVAL

	Title and Name
Author:	Commercial Lead - Ghazal Avijegon

	Title	Name	Signature	Date
Reviewer:	Manager Portfolio Governance and Expenditure Strategy	Kelvin Grace	Kelvin Grace	30-Oct-23
Approver:	General Manager Renewable Fuels	Jim Richardson	Jim Richardson	30-Oct-23

6. DOCUMENT HISTORY

Rev	Date	Amended By	Reason for Change
0	31/05/2023	Ghazal Avijegon	New Document

APPENDIX A. BACKGROUND AND CONTEXT

ATCO owns and operates pipelines in the Mid-West and South-West Gas Distribution System and in Kalgoorlie and Albany. Our networks safely transport gas from the transmission pipelines to over 800,000 homes and business in Western Australia.

A.1 Australia's Commitment

Australia's climate change policy environment has been intensely debated and scrutinised in recent years. The election of a new Federal Government in May 2022 resulted in Australia adopting stronger emissions reduction targets. Through the *Climate Change Act 2022*, Australia has committed to reducing greenhouse gas (GHG) emissions by 43% below 2005 levels by 2030, and net-zero emissions by 2050[12].

Furthermore, the Federal Government will utilise its Safeguard Mechanism policy to lower emissions from Australia's largest emitters. The policy will set a total cap on emissions for all facilities covered by the scheme and progressively lower allowable emissions over time.

Each Australian state has stated or made a commitment to reach net zero by 2050, or earlier. In addition to Australia's 2030 emissions reduction target of 43 per cent below 2005 levels, each state has also set interim emissions reduction targets by 2030. Western Australia (WA) has adopted climate targets aligned with the Federal Government's commitments. By the end of 2023, the WA State Government will introduce legislation committing to reduce Government emissions by 80% below 2020 levels by 2030.

Current research and investigations point to renewable gas as a potentially long-term substitute for natural gas to reduce emissions. In line with this, Energy Ministers and the AEMC have proposed amendments to existing legislation to accommodate regulatory and economic considerations for the introduction of renewable gas into the gas network.

A.2 Regulating emissions

Australia's long-term strategy and domestic actions are underpinned by rigorous emissions monitoring and accountability systems, including the National Greenhouse and Energy Reporting (NGER) scheme and the Safeguard Mechanism. ATCO currently reports its emissions under both of these systems.

NGER is a comprehensive framework designed to track and report on national GHG emissions. Established under the National Greenhouse and Energy Reporting Act 2007 it is a critical component of Australia's commitment to addressing climate change and meeting its international obligations. NGER requires certain corporations and facilities to report their GHG emissions, energy consumption and production data to the government. NGER threshold for GHG emissions include 50,000 tonnes of Scope 1 & 2 emissions in CO_2-e per year and production and consumption greater than 200 TJ/year. It includes the disclosure of 'covered emissions', which include fugitive emissions and direct emissions from fuel combustion, waste disposal, and industrial processes. The reported data is used to compile Australia's National Greenhouse Accounts, which provide a comprehensive picture of the country's emissions profile.

[12] Parliament of Australia (2022), "Climate Change Bill 2022", available at: https://www.aph.gov.au/Parliamentary_Business/Bills_Legislation/Bills_Search_Results/Result?bId=r6885.

The Safeguard mechanism is a regulatory framework to limit GHG emissions from large industrial facilities with a threshold of greater than or equal to 100 kilotonnes CO_2-e per year. It requires Australia's largest greenhouse gas emitters to keep their net emissions below a limit that will be reduced over time. It does this by setting legislated limits - known as baselines - on the GHG emissions of facilities and these baselines will decline, predictably and gradually, on a trajectory consistent with achieving Australia's emission reduction targets of 43% below 2005 levels by 2030 and net zero by 2050. The Safeguard Mechanism commenced in 2016 and was reformed in 2023 to ensure that covered facilities contribute to meeting these targets as the world moves to net zero.

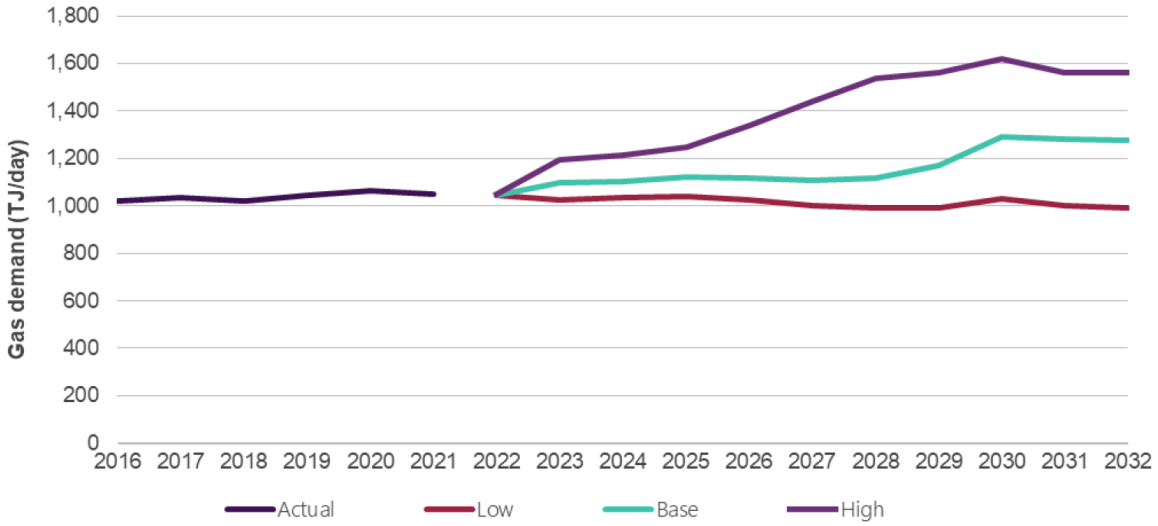
Whilst ATCO is and will continue to be within the NGER threshold, and therefore must report under the scheme, its current forecasts estimate its emissions will remain below the Safeguard Mechanism threshold for the duration of the AA6 period.

A.3 Role of gas in Western Australia

The biggest contributors to WA's emissions, and those that will be impacted most by more stringent emissions targets, are the energy, mining, and manufacturing industries[13]. The direct combustion of fuel in these industries accounts for about 33% of total emissions.

There is much to suggest that gas will continue to play a significant role in the future energy mix in WA. Figure 3 demonstrates the ongoing future role of gas in WA.

Figure 3: WA Domestic gas demand – actual data from 2016 to 2021 and forecast under growth scenarios from 2022 to 203214



A.4 ATCO's decarbonisation plans

ATCO is well positioned to support the decarbonisation and energy transition. The GDS could be used to transport renewable and lower-emission gases to deliver cleaner energy to consumers. In collaboration with the electricity sector, the GDS could also act as an energy storage system to alleviate the issue of intermittent supply from renewable electricity generation. To achieve these

[13] WA Government - Shaping Western Australia's Low-Carbon Future (Dec 2021)

[14] Source: AEMO, https://aemo.com.au/-/media/files/gas/national_planning_and_forecasting/wa_gsoo/2022/2022-wa-gas-statement-of-opportunities.pdf?la=en

aspirations and targets, timely and long-term investments in infrastructure and processes, along with effective collaboration between key stakeholders, will be required.

Given the expected role of gas in the transition to net-zero, reducing the emissions intensity of the GDS will be vital to meet mandated and voluntary decarbonisation commitments for ATCO and its stakeholders.

There are several ways ATCO could seek to decarbonise the GDS:

- Optimising pipeline infrastructure to minimize unaccounted for gas (**UAFG**) by reducing leaks and deploying advanced leak detection technologies will be essential to reducing Scope 1 emissions.
- Purchasing renewable gas to replace UAFG to help address our Scope 1 and Scope 3 emissions.
- Ensuring the network can transport renewable gases, like biomethane and hydrogen, to address our Scope 1 and Scope 3 emissions.
- Other tools such as carbon capture and storage (**CCS**) and emissions offsetting via carbon credits can also be used, though these tend to be more expensive and less effective pathways to decarbonisation.

For ATCO to play its part in responsibly transitioning the GDS and reducing Scope 1, Scope 2, and Scope 3 emissions, any decarbonisation initiatives to be implemented must also meet its overarching objectives of: **Safety, Affordability, Reliability, and Sustainability.** Specifically, it is important for ATCO to create a smooth pathway in terms of a cost-effective and a timely solution for emissions reduction for consumers.

All emission reduction plans outlined below have therefore been assessed and prioritised in such a way that only those with the highest potential for emissions reduction, achieved safely, delivered in the shortest time frame and at the least cost have been put forward.

A.5 Current and Completed Activities for ATCO

This section outlines the work that ATCO has already completed on its path to enabling the GDS to distribute renewable gases. The work already conducted resulting in a reduction in further investment and knowledge gathering.

A.5.1 Compatibility testing: Clean Energy Innovation Hub and Hydrogen Blending Trial

ATCO has already commenced its renewable energy journey by creating a world class Clean Energy Innovation Hub[15] (CEIH) in Jandakot since 2019 and conducting a hydrogen blending trial[16] to 2,700 homes in the Cockburn area.

The CEIH (refer Figure 4) is a great demonstration of solar, battery, and renewable hydrogen production through electrolysis, conducting industrial scale trials of renewable hydrogen blending

[15] This Project received funding from ARENA as part of ARENA's Advancing Renewables Program. The views expressed herein are not necessarily the views of the Australian Government, and the Australian Government does not accept responsibility for any information or advice contained herein.

[16] This blending project receives funding from the Renewable Hydrogen Fund as part of the Western Australia Government's Renewable Hydrogen Strategy. The views expressed herein are not necessarily the views of the Western Australian Government, and the WA Government does not accept responsibility for any information or advice contained herein.

scenarios. The latest iteration of the CEIH demonstrates the technical feasibility of renewable hydrogen production and blending technology in a Western Australian context.

It is important to emphasise that hydrogen is already safely produced and distributed in Australia. Blends of up to 20% have been safely supplied and used at ATCO's Jandakot depot for approximately 2 years, and we have been safely transporting hydrogen through a portion of the GDS at a blend of 2% without significant system modification to selected end-users since December 2022.

Through its hydrogen blending trial, ATCO will demonstrate that hydrogen blends of up to 10% are compatible for the materials and equipment on its GDS - subject to safety regulatory approval. From its blending trial, ATCO has found that the only item of non-compatibility with these hydrogen blends were a small percentage of meters. Of the 2700 meters within the trial area, 12 were required to be replaced, which was conducted prior to the introduction of the hydrogen-blended supply. All other elements were desktop assessed and then verified with field leak testing to confirm the safety and integrity of our system. End-user appliance compatibility was also assessed, with an independent national body conducting safety testing.

The success of this blending trial underpins further research and business cases, which can pave the way for commercial production or further distributed generation and injection locations. For example, the CEIH project provides a basis for regulators in implementing safety, environmental, and other regulation specifically for hydrogen.

Figure 4: Clean Energy Innovation Hub in Jandakot

A.5.2 Piping replacement

The GDS needs to be renewable gas ready. As described in Appendix F above, the majority of ATCO's distribution mains where renewable gases are to be distributed are made up of PVC and polyethylene (PE) pipes, which are capable of supporting hydrogen. All known cast iron and other unprotected metallic mains have been replaced with new PE pipes.

A.5.3 Other hydrogen projects

ATCO has also invested to demonstrate other uses of hydrogen that may drive different uses of the GDS into the future, as outlined below.

A.5.3.1 Demonstrations: Hybrid Home

Initially developed to showcase the utility of natural gas in a residential setting, this facility as shown in Figure 5 has provided evidence of how blends of hydrogen and natural gas can be used in a home. ATCO plans to further enhance this facility to demonstrate 100% hydrogen appliances and energy usage.

Figure 5: Hybrid Home at the ATCO Jandakot facility

A.5.3.2 Demonstrations: Hydrogen Refuelling Station[17]

In Western Australia, in conjunction with Fortescue Future Industries (FFI), ATCO developed the Hydrogen Refuelling Station (**HRS**), which builds on the success of the CEIH to enable the refuelling of hydrogen fuel cell powered passenger vehicles. This HRS (as shown in Figure 6) provides evidence of hydrogen fuel cell technology to reduce transportation emissions.

Figure 6: Hydrogen Refueller at ATCO's Jandakot facility

[17] This Project receives funding from the WA Government's Renewable Hydrogen Fund as part of the WA Government's Renewable Hydrogen Strategy. The views expressed herein are not necessarily the views of the Western Australian Government, and the WA Government does not accept responsibility for any information or advice contained herein.

A.5.4 Other compatibility testing

ATCO has been working with Energy Networks Australia and the Future Fuels CRC to undertake an assessment of asset compatibility with hydrogen and consider the changes that are required to prepare assets and operational processes for hydrogen injection. Third-party experts such as GPA have conducted surveys of similar assets in other states, which considered four key areas of piping compatibility, component compatibility, operational issues, and downstream considerations. Their assessment concluded that the current equipment in the gas distribution system is compatible with a 10% hydrogen blend with only minor modifications to some parts of the system. This also reflects our own assessments of the Western Australian gas system.

A.6 Key pillars of ATCO's decarbonisation

There are six pillars to ATCO's decarbonisation plan, with each pillar tackling one or more emissions categories:

- **Scope 1 emissions** are those resulting from the operation of the business. These include gas usage but are mostly related to UAFG losses from the system. ATCO plans to reduce these emissions by reducing UAFG (refer to the UAFG Strategy) and switching to renewable gas for UAFG replacement (refer to this document).
- **Scope 2 emissions** are from grid generated electrical supply to business operations. ATCO plans to reduce these emissions by supplying its operations with renewable electricity. Please refer to ATCO's Sustainability Strategy for further information on operational emissions.
- **Scope 3 emissions** are from end-user consumption of the gas products ATCO delivers through its distribution system and are determined by the gas type. ATCO plans to reduce these emissions by enabling the introduction of renewable gases into the GDS.

Figure 7 showcases ATCO's decarbonisation key pillars for 2030 and beyond. ATCO started the decarbonisation journey by taking actions to reduce the amount of UAFG by improving metering and leak surveys of the system as well as ongoing piping replacement programs. In parallel with this UAFG reduction plan, partially replacing UAFG with net zero fuel is another near- term emission reduction plan for ATCO. Having access to renewable electricity as well as increasing the energy efficiency of the system is an ongoing plan. Gaining 100% zero emission is beyond the AA6 program.

Figure 7: Key pillars of ATCO's decarbonisation

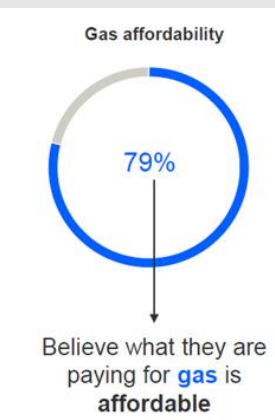
APPENDIX B. CONSUMER SENTIMENT

Research continues across ATCO operations to better understand our end-users and the communities in which we operate. This work has led to several important insights, as set out further below.

B.1 Affordability & reliability

Consumers are keen to continue to use gas as part of the energy system due to its relative affordability. Majority of customers surveyed (79%) believe the price they pay for natural gas is not beyond their means. Satisfaction levels are also very high (>80% over the last 12 months), with many end-users having never experienced an interruption in supply.

Figure 8: End-users' perception of gas affordability



Do you believe what you are paying for natural gas is affordable?

	Metro	Nett: Regional	Bunbury	Busselton	Geraldton	18-24	25-39	35-44	42-54	55-64	65+	Income - $1 – $51,999	Income - $52,000 – $103,999	Income - $104,000 – $207,999	Income - + $208,000	I rent the household I live in
Yes	79%	82%	74%	87%	87%	70%	83%	72%	74%	86%	84%	78%	79%	82%	76%	72%
No	21%	18%	26%	13%	13%	30%	17%	28%	26%	14%	16%	22%	21%	18%	24%	28%

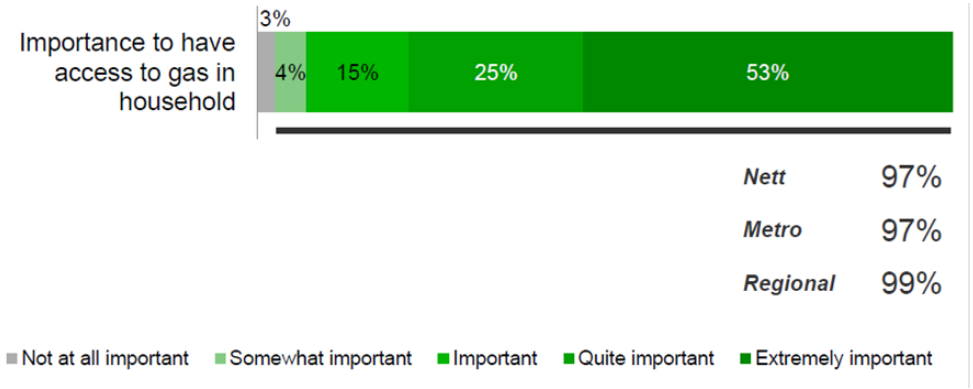
Residents aged 18-24 (70%) have the lowest level of perceived gas affordability compared to the older age groups, closely followed by renters (72%). Gas affordability is highest in Busselton (87%), Geraldton (87%) and Residents aged 55-64 (85%). Perception of affordability slightly increases as Residents' income increases before decreasing at the above $208,000 income households.

Affordability does not imply gas is a superior product on a like-for-like basis

B.2 Preferred fuel

In a recent survey, as shown below, more than half of ATCO's end-users surveyed (53%) consider access to gas as "extremely important" in their household and up to 97% of our end-users surveyed believe gas to be important. The response to the survey was even more positive towards gas when considering our regional end-users. Only 3% do not consider access to gas in their household as "important".

Figure 9: Survey results of the importance of gas in the household



B.3 Sustainability support

Residents surveyed expect ATCO to lead the change in WA towards a more sustainable future and demonstrate strong support for ATCO's Sustainability Projects Program, with 94% of residents considering it important.

More than half of the residents surveyed (54%), believe that 'Gas from Renewable Sources' should be the top priority among the Program investments that are personally relevant to them. The key reasons for this were: "better for the environment" (43%), "sustainability" (28%), and "combat climate change" (15%).

Figure 10: Preference ranking for outcome

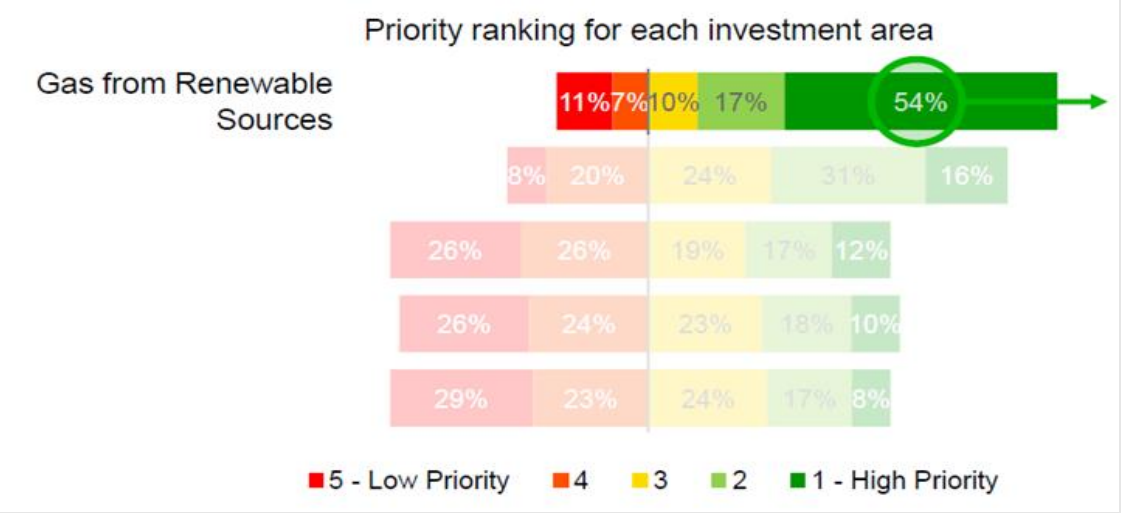
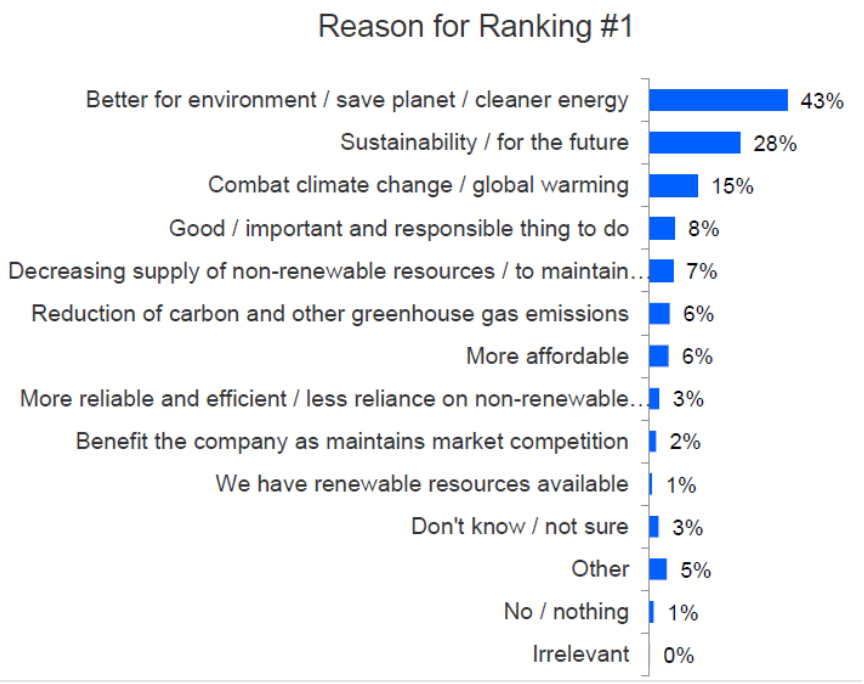


Figure 11: Reason for preference ranking



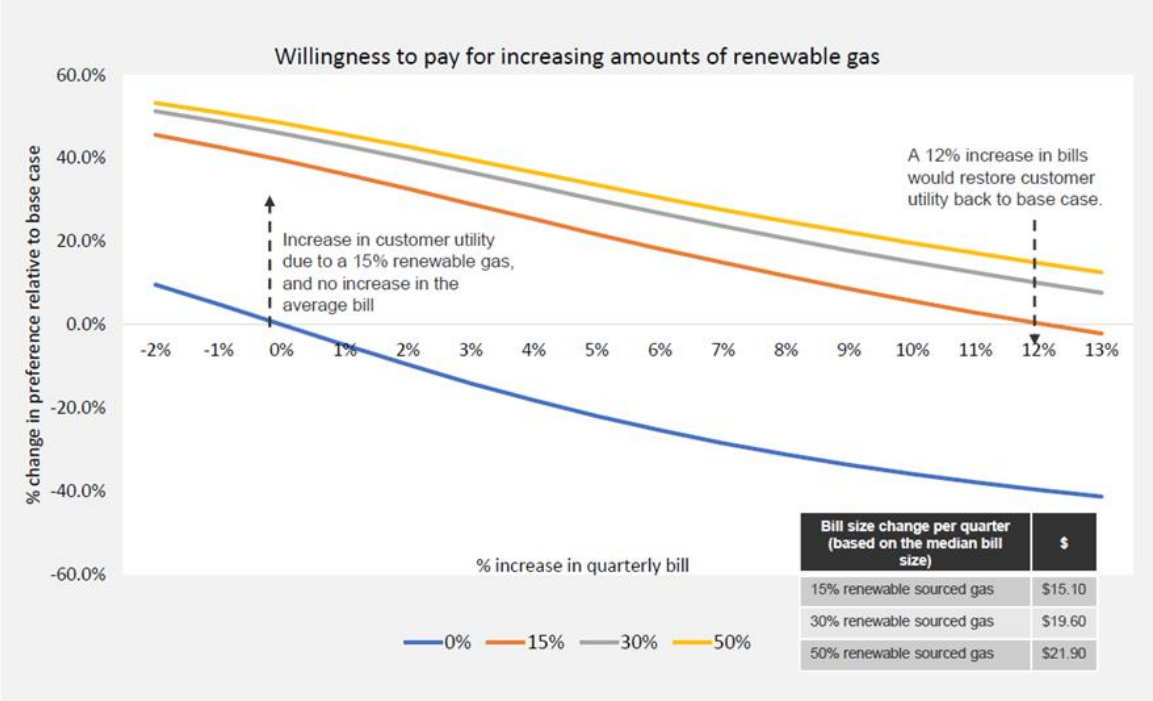
Overall, residents surveyed show a strong preference for net-zero renewable gases, are particularly interested in being educated about renewable gases including hydrogen blending and its integration with the current gas infrastructure, as well as its environmental impacts and benefits.

This feedback forms part of the drivers for ATCO's proposed investment in renewable gases during the AA6 period.

B.4 Willingness to pay for renewable gas.

The chart below shows the end-user willingness to pay a premium for renewable gases instead of natural gas. The blue line simply shows end-user sensitivity to bill size, as the % of renewable gas is set to zero (the same as the base case). The orange line shows that preference for a new alternative that supplies 15% of gas from renewable sources while keeping bill size constant would shift preference share by 39.6% to the new alternative, relative to the base case. This reflects the higher utility that end-users gain from this improvement in service.

Figure 12: Willingness to pay (WTP) for renewable gas



However, if ATCO were to charge more for delivering this service, the utility would reduce as shown by the downward-sloping line. Maximum willingness to pay for the 15% renewable gas scenario is given by the point at which the orange line crosses the x-axis (horizontal/ bottom line). That is, a 12% increase in average quarterly bills combined with a 15% renewable gas scenario will make end-users (on average) indifferent between selecting the changing scenario and the base case. For a 30% renewable gas scenario (grey line), maximum willingness to pay equates to approximately 17% increase in quarterly bills. End-users would be willing to pay, on average, a maximum bill increase of 20% for 50% for renewable gas scenarios. Overall, there is a high willingness-to-pay for renewable gas to be distributed through ATCO's system.

APPENDIX C. RENEWABLE GASES

C.1 Biomethane

Biomethane is generated from upgrading biogas. Biogas is a term used for gases that are produced by the biological processing of waste materials from different sources, including livestock, wastewater and organic matter. In waste treatment facilities, organic waste is separated from non-organic waste and minced before being injected into a process vessel with bacteria. The bacteria break down the organic material into biomass waste and biogas. The biogas is then further treated and separated into its constituent parts of biomethane, carbon dioxide, hydrogen sulphide and others.

Biomethane is deemed to be a net-zero carbon emissions gas based on the assumption that untreated organic matter would break down naturally with bacteria and release the biogases into the environment. Considering that carbon emissions from unconsumed (i.e., unburnt) methane are significantly higher than from consumed methane, capturing the biomethane portion of the biogas provides a substantial benefit in emissions reduction.

The replacement of natural gas with biomethane does not require significant changes or upgrades to the gas distribution system (subject to quality checks to ensure it is equivalent to existing gas sources) because it shares the same characteristics. Given the existing systems for design, construction, operation, maintenance, inspection, emergency response and training are all based on natural gas, the only modification required is the provision of gate injection point(s) for the supply of biomethane.

C.2 Renewable hydrogen

Hydrogen is an alternative net-zero carbon emissions gas. It can be produced in several ways, but renewable hydrogen is produced via electrolysis (splitting water into hydrogen and oxygen) using renewable electricity. Hydrogen can then be utilised by fuel cells to provide electrical energy on demand or stored and distributed through the GDS. When referring to hydrogen as a renewable gas throughout this Strategy, ATCO is referring to renewable hydrogen.

However, hydrogen has its own characteristics that differ in many ways from natural gas; these include its lower volumetric energy density, being a much smaller molecule, having a wider flammability range, and lower ignition energy. These critical differences need to be taken into consideration when blending hydrogen into any gas distribution system. The primary considerations and changes required to the system include confirmation that relevant materials and equipment as well as gas fitting techniques within the GDS are compatible with percentages of hydrogen.

Unlike biomethane, hydrogen has the added benefits of location and production scale flexibility, which can be more easily aligned with end-user demand and power supply constraints. For example, any excess electricity generated from wind or solar energy can be converted to hydrogen and stored in the gas system to be used when there is insufficient electricity capacity from renewable sources, helping to minimise any unmanageable fluctuations in the electricity grid.

APPENDIX D. SELECTION PROCESS FOR UAFG REPLACEMENT OPTIONS

This provides further detail on ATCO's process for selecting the UAFG replacement option.

D.1 Forecasting gas market

These forecasts are based on various discussions with retailers and other key stakeholders based on current market conditions. Although these are our current predictions, we expect by May 2024 we will have updated pricing since we are currently in the tender process for UAFG replacement from retailers for natural and renewable gas as well as ACCUs.

D.2 Selecting a UAFG replacement option

In selecting a UAFG replacement option, ATCO's objective was to procure the available, cost-effective renewable gas to achieve our emission targets. Cost- effectiveness is when renewable gases become cost- comparable with natural gas and ACCUs. In the simplest terms, this meant comparing the forecast price of natural gas during the AA6 period and additional cost of purchasing ACCU's (for surrender), to the forecast price of renewable gas supply and associated additional infrastructure costs over the same period.

D.2.1 Baseline

Based on current forecasts, the purchase price of 100% natural gas for UAFG replacement with no emissions off-setting (Baseline) is the lowest cost compared to purchasing either natural gas plus ACCUs or purchasing a combination of natural gas and a percentage of renewable gases to achieve emissions reduction targets. However, procurement of natural gas alone does not deliver any emissions reductions or offsets.

D.2.2 Scenario 1: Off-setting with ACCUs

As observed in the chart below, renewable gas options are not expected to reach parity with the baseline until 2029. In the absence of renewable gas, ATCO could purchase ACCUs to help offset

emissions in support of its 30% reduction of net emissions (Scope 1) target. However, this results in a material increase in the overall purchase price of gas for UAFG replacement. Even if ACCUs are purchased only in 2029, the last year of the AA6 period and last year before the emission targets are to be achieved, a big jump in the total UAFG purchase price is observed and exceeds the price of the natural gas and renewable gas blend scenarios.

D.2.3 Scenario 2: Off-setting with renewable gases

The above assessment considers the forward price of renewable gases per year. These costs have been utilised in the cost-benefit modelling as inputs and do not take into account the additional infrastructure needed to allow for their injection into ATCO's GDS. This capital expenditure and associated operating costs need to be considered to accurately reflect the levelised abatement cost and is presented in Appendix E.

D.2.4 Selected scenario: Scenario 2

Given ATCO's UAFG off-setting objective to determine the lowest net present cost project able to deliver the highest abatement volume (i.e., the project with the lowest levelized abatement cost), Scenario 2 has been progressed for the AA6 period.

In progressing this option, ATCO is agnostic to the type of gas used to replace UAFG, subject to that gas achieving the emissions reduction requirements at the lowest levelised abatement cost whilst being available.

Based on the ATCO modelling, the purchase of biomethane was found to be more cost-effective. This is because cost competitiveness of renewable hydrogen is unlikely to occur before 2030[18]. Therefore, replacing 2% of UAFG (by energy units) in the AA6 period with renewable hydrogen by 2028 (3% by 2029) and the remaining 28% with biomethane is not as cost-effective as 30% biomethane.

[18] https://arena.gov.au/knowledge-bank/australias-bioenergy-roadmap-report/

Whilst ATCO found the purchase of biomethane to be the most cost effective, ATCO is agnostic to the renewable gas and which renewable gas is purchased will depend on availability and cost of supply at the time of purchase.

APPENDIX E. COST BENEFIT ANALYSIS FOR UAFG REPLACEMENT OPTIONS

This section outlines a cost-benefit analysis for the UAFG replacement options:

E.1 Scenario 1: Offsetting with ACCUs

UAFG is estimated annually and the carbon footprint in tCO_2-e is estimated using the following formula provided by the NGER framework:

Method 3-natural gas distribution:[19]

$$Ejp = Sp \times \%UAGp \times 0.373 \times Cjp$$

Where:

- Ejp is the fugitive emissions (other than emissions that are flared) of gas type (j) that result from natural gas distribution through a system of pipeline with sales of gas in a State or Territory (p) during the year, measured in CO_2-e tonnes.
    - This emission fraction is currently 0.55. The Update Determination updates the emission fraction to 0.373 to align with the factor used in Australia's National Inventory[20]
- Sp is the total sales during the year from the pipeline system in a State or Territory (p), measured in terajoules.
- $\%UAGp$ is relative to the amount of gas issued annually by gas utilities to that system.
- Cjp is the natural gas composition factor for gas type (j) for the natural gas supplied from the pipeline system in a State or Territory (p), measured in CO_2-e tonnes per terajoule.

Table 5 below shows the UAFG forecast for the AA6 regulatory period based on ATCO's 2023 UAFG Strategy.

Table 5: UAFG (TJ) forecast for AA6 period

Forecast	2025	2026	2027	2028	2029
UAFG (TJ)	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]

As per Figure 15 below, the forecasted price of natural gas is taken as $11 per gigajoule ($11/GJ)[21] with an anticipated rise in purchase price during the AA6 regulatory period. This price of $11/GJ is determined from feedback provided from retailers for the typical volumes of UAFG replacement. This also aligns with the current historical daily gas trading spot price.

[19] National Greenhouse and Energy Reporting (Measurement) Determination 2008, available at: https://www.legislation.gov.au/Details/F2022C00737

[20] Department of Climate Change, Energy, the Environment and Water (2023) "National Inventory Report 2021" Volume 1. Available at: https://www.dcceew.gov.au/climate-change/publications/national-inventory-report-2021

[21] https://www.gastrading.com.au/spot-market/historical-prices-and-volume/forecast-vs-actual]

Figure 15: Historical daily gas trading spot prices in WA[22]

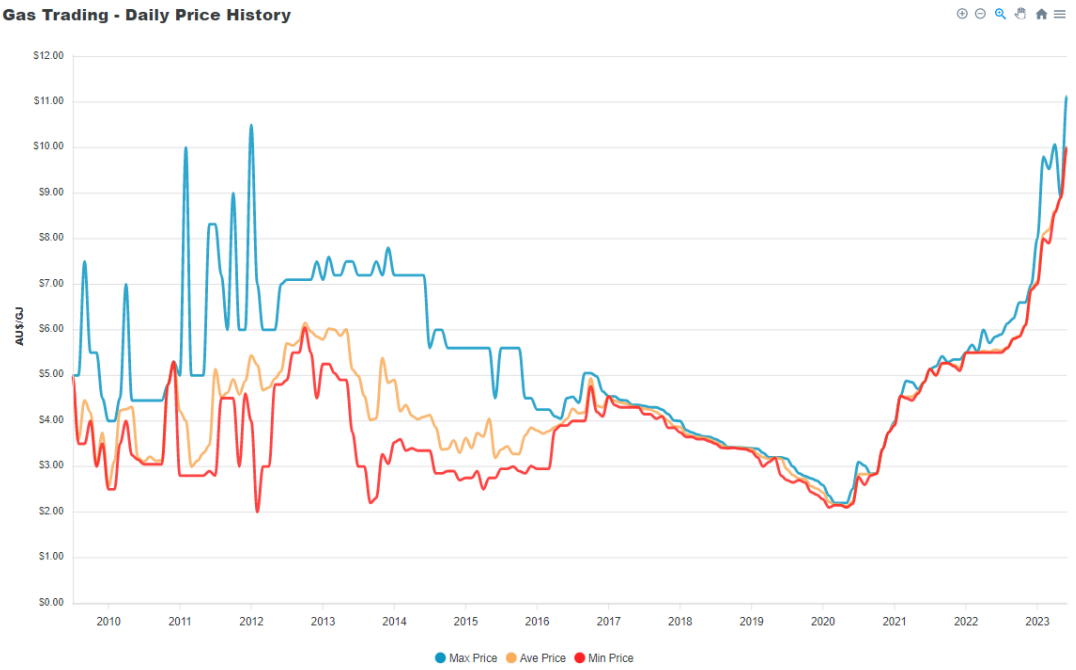
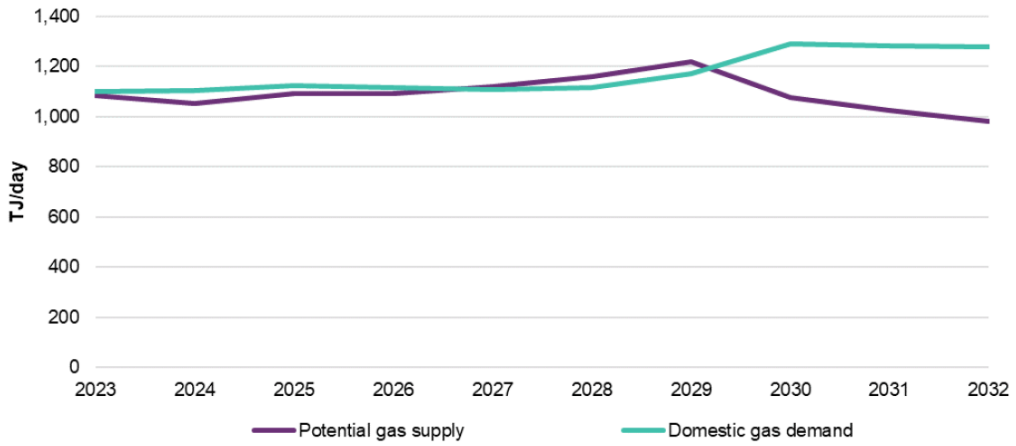


Figure 16 shows AEMO's base case forecast of gas supply demand balance from 2023 to 2032 for the WA market. AEMO expects supply and demand in the WA gas market to remain tight throughout the AA6 regulatory period, with demand expected to exceed supply by the end of this period. Although supply is expected to marginally exceed demand with start of production from Scarborough by mid-2027, demand is forecasted to outstrip supply due to the expected shut-down of coal-fired power plants in the SWIS from 2030 which will result in increased gas demand.

Figure 16: WA base scenario forecast supply demand balance, 2023 to 2032[23]



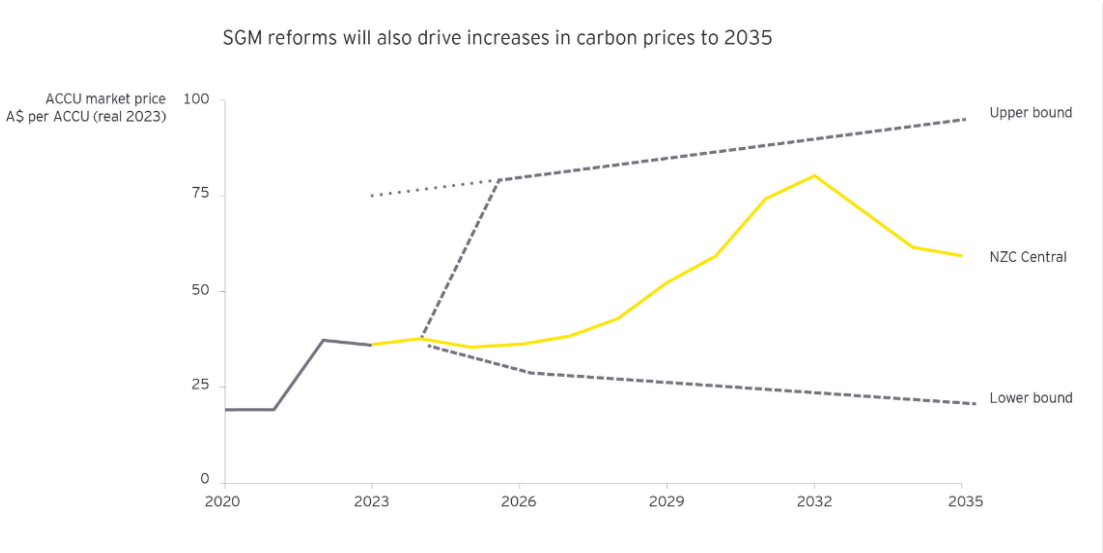
The inability for gas supply to meet demand is expected to increase the price of natural gas, making renewable gas a more competitive option for ATCO. ATCO's calculations are based on the above

22 The chart compares the actual average price and monthly quantity to the Scheduled for sale values. The chart demonstrates the reliability of the gas Trading Spot Market (Supplied: Gas Trading Australia).

23 https://aemo.com.au/-/media/files/gas/national_planning_and_forecasting/wa_gsoo/2022/2022-wa-gas-statement-of-opportunities.pdf?la=en

forecast of demand-supply scenario where the natural gas price in 2025 (start of AA6 period) is estimated to be $11/GJ for the years 2025-26, increasing to ~12/GJ during 2027-28 and reaching to $14/GJ by 2029. The forecasted purchase cost of ACCU, as shown in Figure 17 below, has also been considered. ACCUs are currently being traded at ~$30 and are expected to reach $50 by 2029.

Figure 17: Forecast of Australian Carbon Credit Units till 2035[24]



The cost of supplying natural gas and purchasing ACCUs is used as a baseline for comparing this scenario with alternative scenarios for emissions reduction.

E.2 Scenario 2: Offsetting with renewable gases

ATCO is agnostic to the type of renewable gas used to replace UAFG, subject to that gas achieving the emissions reduction requirements. To determine the optimal solution, available supply, timing of delivery and cost effectiveness of the renewable gas as well as infrastructure cost and operating cost associated with utilising renewable gas has been considered. For estimating the cost of projects involving renewable gases, it is important to include the capital cost of the required infrastructure as well as incremental operating cost.

ATCO's investigations into production facility capacities through system modelling have indicated that to replace the relevant portion of UAFG with renewable gas whilst achieving the reliability requirements requires two (2) additional gate injection points to be constructed and operated.

The total cost for the two gate injection points will be the cost of the infrastructure (including land tenure), which will be split over the expected UAFG contract period of 5-years, with the associated OPEX for gate injection points.

Whilst ATCO is agnostic to the renewable gas, the timeframe to enable injection and distribution of biomethane is thought to be significantly shorter than hydrogen. This is because injection and distribution of hydrogen above the current limit of 2% blend requires:

1. Additional safety case modification

[24] Hatfield-Dodds, S., Boulus, P. (2023) "Why the Safeguard Mechanism supports steep reductions in emissions and steep rises in carbon prices – with a possible sting". Available at: https://www.ey.com/en_au/sustainability/australias-safeguard-mechanism-and-the-transition-to-net-zero

2. Piping and isolation modifications to segregate from rest of system.
3. Additional time due to availability of hydrogen generation equipment (electrolysers)
4. Power supply at cost effective value and associated supply agreements
5. Water source and disposal agreements
6. Time to complete desktop system investigations for material and equipment compatibility.
7. Time to effectively deliver community communications.

ATCO assumes that biomethane can be supplied for ~$14 per GJ in 2025 and with the price decreasing as forecasted. Although biomethane production is mature overseas and the cost is expected to remain constant, the commercial application increases in Australia might help to reduce costs as the industry grows[25.]

Based on ATCO's modelling, purchasing biomethane would be more effective long-term for UAFG replacement than purchasing natural gas and offsetting with ACCUs (scenario 1) as the absence of emission costs makes biomethane a more compliant and cost-effective option.

However, biomethane has limited feedstock. Due to the expected restrictions in availability over the longer term, renewable hydrogen is also considered.

If the price of purchasing renewable hydrogen is compatible with biomethane supply, and supply is reliable and sustainable, ATCO may also purchase renewable hydrogen for UAFG replacement. The delivery cost of renewable hydrogen will likely decrease over time with increased production volumes. Production volumes will increase with increase in demand. Assuming significant growth in the hydrogen industry due to growing market demand for utilising renewable gases, there is a high chance that biomethane and renewable hydrogen may reach similar levels of cost-competitiveness. Whilst purchasing renewable hydrogen provided a cost benefit over Scenario 1, it was not as cost-effective as purchasing biomethane.

As cost competitiveness for renewable hydrogen is unlikely to happen before 2030[26], ATCO's emissions reduction scenarios assume a portion of the 30% reduction of net emissions (scope 1) will be achieved by replacing natural gas with biomethane for the first three years of the AA6 period. From 2028, there is a higher chance of purchasing renewable hydrogen for UAFG. In the event that renewable gas is not available, including for the initial years of the AA6 period, ATCO would purchase (and surrender) ACCUs.

[25] ARENA (2023) "Australia's Bioenergy Roadmap Report" available at: https://arena.gov.au/knowledge-bank/australias-bioenergy-roadmap-report/
[26] ibid

APPENDIX F. NETWORK COMPATIBILITY

This section describes the key findings of the GPA compatibility report and the key actions that ATCO must take to facilitate the introduction of renewable gas into the GDS. The GPA compatibility report conducted assessments of distribution network assets including materials and equipment, as well as design standards and integrity management processes for suitability for hydrogen blends. Due to the consistency in design, integrity management, materials and equipment across distribution networks in Australia, this report is equally relevant for the GDS.

F.1 Engineering design and integrity management

F.1.1 Pipelines (>1900 kPa)

The GPA compatibility review suggests that most of ATCO's pipelines with design factors below 0.3 can safely be used to transport hydrogen blends or pure hydrogen. Through engineering calculations, it was found they have effective resistance to fracture and fatigue at the relevant operating conditions, and that the original pipeline hydrotest still provides a margin of safety after hydrogen embrittlement.

In service live welding may be possible on ATCO pipelines containing hydrogen. Existing weld procedures will not be appropriate and must be re-qualified where there is 100% Hydrogen being transported. Weld procedures for hot works on pipelines with blends of Hydrogen and methane to 20% to be confirmed and based on pressure. Refer to DNV study.

New hydrogen pipeline design should be completed as per AS2885 with additional guidance from ASME B31.12 as the most mature hydrogen pipeline design standard available.

Actions:

1. Hydrogen injection projects utilising ATCO pipelines that have not yet been assessed should perform hydrogen compatibility review as early as possible in the scoping stage of the project.
2. Create weld procedures as required.
3. Consider guidance from ASME B31.12 during new pipeline construction.

F.1.2 System piping (<1900 kPa)

F.1.2.1 Piping

The distribution system has a large range of materials across four pressure categories. A recent study (ref. AGIG) identified some materials such as steel, copper and plastic pipe that are suitable for hydrogen service at 10% and 100%.

ATCO believe the majority of our system is ready for blends of methane and Hydrogen up to 10%.

F.1.2.2 Joint types

For 10% hydrogen blend there is no need to change the joint type in the system, for a 100% hydrogen system most welded, flanged and threaded steel connections, and welded and glued plastic pipe connections are suitable, however, ongoing research has suggested that some

mechanical joint types with a narrow leak path (including Gibault & perfection joints used for the water industry) may have unacceptable leak rates at 100% hydrogen (other than flared-type tubing connections (e.g. Swagelok and similar copper pipe connection types) These valves require further investigation to confirm if the types of elastomers used to create seals is acceptable.

It should be noted that ATCO have utilised mechanical joints for PVC connections throughout the system.

In service live welding may be possible on ATCO distribution piping containing hydrogen. Existing weld procedures for steel welding will need to be validated but may not be appropriate and may need to be re-qualified.

Actions:

1. Perform further investigation into the suitability of certain mechanical joints.
2. Create weld procedures as required.

F.1.3 Meters

Since hydrogen has a lower volumetric energy density compared natural gas, a higher volumetric flow rate is required in the system to deliver the same amount of energy. The existing volumetric gas meters in ATCO's distribution systems will see a reduction in capacity to deliver energy to the end-user. For 10% blends, this reduction is minor and within the margin of typical over-specification of current installations.

For 100% hydrogen, the volumetric flow rate increases by a multiple of three, the equivalent of the difference between a standard domestic meter (e.g., AL1000 meter). Installing an AL1000 meter at each domestic end-user is not feasible due to its size and cost.

New-to-market small ultrasonic and other flow-based meters are a promising alternative. Some domestic meters are being marketed that are compatible with both natural gas and hydrogen at the respectively required volumetric flow rates. This type of meter raises the possibility of being installed when supply is natural gas and then not requiring a change out when 100% Hydrogen is supplied.

F.1.4 Hazardous area equipment

Due to the lower ignition energy of hydrogen when compared to natural gas, electrical equipment installed within hazardous areas must be rated to a higher level than is required for natural gas. In summary:

- 100% natural gas requires a category IIA equipment.
- At 9% hydrogen / 91% natural gas blend, the category changes to IIB
- Category IIC is required at blends above 43% hydrogen / 57% natural gas

An initial review of several ATCO pressure reduction stations has shown the majority of equipment (~90%) installed across the Western Australian systems is already category IIC.

Actions:

1. Any new hazardous area equipment purchased should be cat IIC to prepare for eventual 10% & 100% hydrogen scenario.

2. Review and update hazardous area dossiers as part of hydrogen projects.
3. Review and update hazardous area extents as part of hydrogen projects.
4. All new hazardous area equipment installed during normal maintenance or new projects to be category IIC.
5. Assessment of Hazardous areas from existing designs to 100% hydrogen should be conducted. From a highlevel check, horizontal distances should remain the same, vertical distances increase, greater controls will be needed for checking environment prior to entry to boxes, pits, compounds.

F.1.5 System component compatibility

The introduction of hydrogen poses embrittlement concerns for certain metals and has the potential to change the material properties of certain elastomers. While the impact of hydrogen has not yet been fully tested, Table 6 summarises materials that should be avoided for hydrogen service until further research confirms compatibility. Please refer to the GPA Component Compatibility report for more detail.

Table 6: Material incompatibility with hydrogen

Material	Reason	Plan to address
High strength steels, high carbon steels, tool steels and similar	Increased susceptibility to hydrogen embrittlement.	Restrict injection points to locations where high strength steels are not utilised. API 5L grade X52 and greater should be avoided.
Martensitic stainless steel, and precipitation hardened stainless steel	Increased susceptibility to hydrogen embrittlement.	Verify that martensitic Stainless steels are not utilised on system. Note: 304, 316 and 316L stainless steel are austenitic steels
Nickel alloys E.g. Inconel, Monel, Hastelloy C-276	These are not generally considered suitable, but may safely be used at low stress levels, subject to engineering confirmation.	Equipment validation required
Titanium	Some grades have lower performance. These need to be confirmed individually.	Equipment validation required. Not utilised as piping material.
Natural rubber	Performance reduces in hydrogen.	Equipment validation required
Silicone	Performance reduces in hydrogen.	Equipment validation required
Fluorosilicone	Performance reduces in hydrogen.	Equipment validation required
Butadiene-Styrene SBR, Butadiene-Acrylonitrile NBR	Potential performance reduction – more investigation required.	Equipment validation required – used throughout the system
Epichlorohydrin CH	Potential performance reduction – more investigation required.	Equipment validation required
Ethylene-propylene EPDM	Potential performance reduction – more investigation required.	Equipment validation required – used throughout the system
Polyoxymethylene / Polyacetyl POM	Potential performance reduction – more investigation required.	Equipment validation required

Table 7 below lists the system equipment and the probability of level of modification required for two different blending ratios (10% vs 100% blending)

Table 7: System modification required for different hydrogen blends

Area	Description	10% Hydrogen	100% Hydrogen
System Performance	System capacity	M	H
Materials Compatibility	High pressure steel pipelines (primary, trunk and pipeline)	M	H
	Low pressure steel pipelines	L	L
	Pipelines under integrity management	H	H
	Pipelines subject to cyclic loading	H	H
	Other steel equipment	M	M
	Polyethylene and Poly Vinyl-chloride pipelines	L	U
	Elastomers	M	U
Equipment	Flow meters	M	H
	Manual valves	L	M
	Control valves and regulators	M	H
	Heaters – gas fired	M	L
	Heaters – electrical	L	L
	Gas chromatographs	M	H
	Instrument gas systems	L	L
	Gas detectors	L	H
	Station/facility pipework	L	M
	Filters	L	M
Safety	SCADA system	M	M
	Hazardous areas	L	H
	Odorant	L	U
	Safety and Operating Plan	M	H
	Pipeline Safety Management Study	M	H
	Gas detectors (personal)	L	H
	Emergency response plan	L	M
Operation and maintenance	Prohibition of in-service welding	M	U
	Blowdown facilities	L	H
Key			
Risk Impact	**Description**		
M	Medium impact – Minor or partial modifications are expected		
H	High impact – Major modifications are expected		

Area	Description	10% Hydrogen	100% Hydrogen
U	Unknown, further information is required, by means of analysis or research		
L	Low Impact – Low probability of modifications required		

F.1.6 Metal components

One of the challenges with a hydrogen system is embrittlement of some metals that, leading to a reduction in tolerance to crack like defects and an acceleration of fatigue failure. According to GPA's investigations, components with parts made from copper alloys, most aluminium alloys, and stable austenitic stainless steels are suitable for 10% and 100% hydrogen service.

Other metals with poor performance, such as cast irons, high strength carbon steels (e.g. chrome-moly), martensitic stainless steels and nickel alloys may also not be suitable, and the following recommendations apply:

- Components with bodies or pressure containing parts made from martensitic stainless steel or nickel alloys are not suitable for any level of hydrogen service;
- Components with cast iron bodies should only be used up to a maximum pressure of 7 kPa in 10% and 100% hydrogen service, in the absence of any other supporting data; and
- Components that contain materials for which no data has been identified should be replaced unless the manufacturer can endorse its performance in hydrogen.

Actions:

1. Replace incompatible components prior to Hydrogen blending.
2. Update purchase process to include hydrogen compatibility assessment.
3. Refer to Technical Services studies and material approval documentation for Hydrogen blends.

F.1.7 Plastic (elastomer) component parts

The hydrogen effect on properties for many plastic materials is not currently quantified or reliably predicted. While commonly used Viton and PTFE are hydrogen compatible, very widely used NBR (Buna- N) often underperforms in hydrogen (depending on the brand). There are also many instances of Acetal, EPDM and some other elastomers that may have reduced performance in hydrogen. Across all of these materials, however, the reduced performance is not expected to result in spontaneous failure of the component. The materials are generally used internally in valves and regulators as seals, gaskets, diaphragms and occasionally bearing materials. As a result, replacing the components containing these materials is not considered essential; instead, risk assessment of seal leakage and close monitoring of performance and failure rates are advised.

Actions:

1. Review report from performance research through FFCRC into elastomer compatibility.
2. Check high quality spare parts are specified for pressure reduction stations.
3. Update purchase process to include hydrogen compatibility assessment.

4. Confirm compatibility of transmission and distribution pipeline repair components (Plidco & other sealing devices).

F.1.8 Further research

Some system component areas require further compatibility research prior to deciding whether to retain or replace the affected equipment. These include:

1. Elastomers – further work is required to quantify the impact of hydrogen on operational performance of elastomers, noting that elastomers in natural gas also have a finite life.

2. Risk mitigation can be undertaken through a program of increased inspection and maintenance, particularly at lower percentages of renewable gas entering the distribution system in the first 5 years.

F.2 Planning

F.2.1 System capacity planning

For ATCO it is crucial to manage the capacity of a distribution system to avoid end-user supply issues due to low pressures within the system. System capacity models have been produced for ATCO's systems to investigate the impact hydrogen will have on system capacity.

Hydrogen has a reduced higher heating value (HHV) of 12.1 MJ/m^3 when compared to natural gas ~38.4 MJ/m^3. However, this reduction in HHV is significantly overcome due to hydrogen's lower viscosity and specific gravity in comparison to natural gas, which enables a higher flow rate and lower corresponding pressure loss. The result is a relatively modest loss in capacity (2% loss for a 10% hydrogen blending and ~12% reduction in 100% hydrogen system) Further modelling needs to be performed to confirm any capacity concerns for services connecting end-users to the system mains.

Actions:

1. The current system planning process should be expanded to include hydrogen related models at 10% blend now so that appropriate system upgrades can be designed in time to facilitate hydrogen blending.
2. Complete capacity assessment of small diameter services.
3. Assessment of flow delivery reduction due to electrification

F.2.2 Hazardous areas

Compared to natural gas, hydrogen and hydrogen blends will require a larger minimum hazardous area size in open spaces (note actual size commonly includes significant upwards rounding, so might not change). In enclosed spaces, such as valve pits, the hazardous area is simply designated as the entire pit.

Since hydrogen has a lower ignition energy compared to natural gas and it is a very small molecule therefore changes to the equipment group is required due to the reduced ignition energy compared to natural gas. This also impacts 10% hydrogen blends.

- For 10% hydrogen, hazardous area extents may increase by about 10%, which may require changes at the higher-pressure facilities, but this is likely to fall within rounding for most facilities. Equipment group, for the limited compositions that have been analysed, increases from IIA to IIB at around 9% hydrogen. If an item of equipment is numerous in the network, the first action for this equipment would be to seek to re-certify it, rather than replacing it.
- For 100% hydrogen, hazardous area extents increase by a multiple of about three, using typical classification methodologies, which may require facility modifications if the existing area was close to a property boundary. Equipment group increases to IIC, which will require replacement of more components. Assessment of existing hazardous areas is required to determine which ones will require physical changes on site.
- Investigation into typically hazardous areas equipment installed in gas networks has found that it is typically category IIC.

Actions:

1. Any new hazardous area equipment purchased should be cat IIC to prepare for eventual 10% & 100% hydrogen scenario.
2. Review and update hazardous area dossiers as part of hydrogen projects.
3. Review and update hazardous area extents as part of hydrogen projects.
4. Replace incorrect category equipment as part of hydrogen projects.
5. New facilities to be designed and specified assuming 100% hydrogen for hazardous area requirements.

F.2.3 Pressure regulating stations.

To convert a natural gas system to a hydrogen distribution system with the same energy throughput, we will need to take into account the requirements for higher flow velocity to compensate for the differences in the volumetric energy density between the two gases. These changes may be negligible for 10% hydrogen blending but more work will be needed for 100% hydrogen. High velocity may increase the risk of erosion, vibration and noise. This work may include regulator station modelling to understand impact of high velocity on current design norms.

Actions:

1. Assess flow velocity, vibration and noise impacts at regulating stations as part of hydrogen projects and upgrade design of stations as required.
2. New facilities to includes a 100% Hydrogen design assessment during the design process.
3. Review energy throughput based on electrification and or additional storage requirements.

F.2.4 Work practices

Table 8 below lists the effects of hydrogen blending on the GDS that need to be considered particularly for 100% hydrogen services.

Table 8: Effects of hydrogen blending on the gas distribution system

Difference in gas properties between hydrogen and natural gas	Consequence that may affect system operations
Reduced energy density	Higher volumetric flowrates throughout the distribution system to match the current energy capacity
Higher volumetric flow rates	increases size of leak clouds, increased noise
Reduced ignition energy	Increases probability of ignition
Increased flame speed	Higher explosive forces
Higher buoyancy	Faster dispersion in open area
Negative Joule-Thomson coefficient at ambient conditions	Differences in thermal behaviour and thus material selection requirements

The two most important aspects to consider are leak management and piping and pipeline repairs.

Existing studies and investigations have confirmed that minimal changes are required to existing infrastructure for 10% hydrogen blending. However, since hydrogen is a very small molecule, the risk of leakage and potential ignition in a 100% hydrogen gas system is increased compared to existing ignited release risk for a natural gas pipeline. Therefore, the following actions are required for a 100% hydrogen gas system:

- Leak testing should be conducted using gas molecules that are similar size or smaller than hydrogen (helium or hydrogen), hence using normal air for leak testing is not acceptable.
- Use of certain mechanical joints for PVC coupling that are used for some repairs to plastic pipes should be discontinued. Further investigation is required to confirm the replacement of mechanical joints in the system.
- The existing steel welding procedures will need to be reviewed for both 10% as well as 100% hydrogen blending.
- It is possible that certain elastomers may experience degradation of performance in presence of hydrogen. This needs further monitoring and investigation to confirm performance reliability in presence of hydrogen.
- Pressure testing acceptance criteria may need to be tightened to ensure unaccountable allowable leak valves are suitable to Hydrogen.

Action:

1. Review leak management plans considering reactive measures to place less value on the absence of ignition sources; and increase of proactive leak control measures.
2. Perform further investigation into the suitability of certain mechanical joints.
3. Create weld procedures as required.
4. Confirm compatibility of transmission pipeline repair components (e.g. Plidco & Smith Clamps).

F.2.5 Documentation

The following documents require updating with the changes outlined in this document to ensure ongoing management of the gas assets is conducted appropriately.

- Pipeline documentation
- Design guidelines
- Procurement specifications

F.3 Asset management considerations

Taking into account the system compatibility assessment and our incremental approach to introducing renewable gas, Table 9 outlines the key asset management considerations for our gas distribution systems.

Table 9: Asset management considerations for the ATCO gas distribution systems

Asset management activity	Summary
Capex works	Biomethane facility gate injection points Hydrogen facility gate injection points System adaption projects as defined below

System capacity planning will assess proposed augmentations for the introduction of 10% hydrogen blend and if projects are required to brought forward into the next 5 years, or if risk can be mitigated. Table 10 provides a list of Hazardous Area equipment and further compliance activities required.

Table 10: Hazardous area equipment and further compliance activities for Hydrogen blending

Hazardous area equipment	Update the hazardous area dossiers and extents, adjust infrastructure for compliance to 10% hydrogen blend
Pressure regulating stations (HPR/MPR/Meter sets)	Confirm that no further work required for 10% hydrogen blend – all equipment is compatible
Steel pipelines – weld procedures	Confirm weld procedures are suitable for 10% Hydrogen blends
Steel pipelines - weld hardness testing	Perform Weld Hardness testing on steel pipelines in readiness for hydrogen blends
System incompatible parts	Replace incompatible components prior to the introduction of Hydrogen
Meters	Replace known incompatible meters.
Pipeline Repair Equipment	Assess compatibility of distribution pipeline repair equipment and replace with Hydrogen ready equipment.
Operational activities	Revise procedures and work instructions as required
Transmission Pipeline compatibility assessment	Assess remaining licensed pipelines for compatibility with hydrogen blends
Hazardous areas extents	Assess hydrogen area extents
Document updates	Update documents to reflect changing product, for example pipeline defect assessments, SMS reviews, GIS blended area identification, pressure testing acceptance criteria

Hazardous area equipment	Update the hazardous area dossiers and extents, adjust infrastructure for compliance to 10% hydrogen blend
Further assessment or investigation required	Allocation for studies to ensure a safe transition to increasing hydrogen. Review of asset condition and feedback from end-users
Service capacity review	Not required for 10% hydrogen

These asset management considerations form the basis of required network amendment changes for renewable gas into our system. The amount of work required to address these considerations will vary by location, however, we consider the volume of proactive asset replacement to achieve full hydrogen compatibility will be a small proportion of the total asset base and is predominantly a one-off cost.

All the solutions proposed within the Strategy are deemed to be:

- A conservative and phased level of investment reflective of the locations that hydrogen will enter the system in the next five years;
- Reducing the risk to an acceptable level; and
- Aligned with ATCO's goal of achieving 30% reduction in net emissions (Scope 1) by 2030, and to facilitate the transport of decarbonised gas within our Western Australian distribution systems.

APPENDIX G. LEVELISED ABATEMENT ANALYSIS

Levelised cost of carbon abatement measures how much CO_2-equivalent can be reduced by a specific investment or policy, taking into account relevant factors related to the type and size of project. It calculates how much an investment costs on the basis of dollars per ton of emissions reduced. Levelised abatement analysis provides insight into the highest value for emission reduction.

The input assumptions into this analysis include:

- 100 TJ of natural gas to be abated in a gas distribution system, which is equivalent to the approximate throughput of x1 gate injection point
- Emissions abated (tonnes CO_2-e) based on the NGER scheme (Division 3.3.8—Natural gas distribution) calculated to be 15,259 tCO_2-e/year
    - Based on 100 TJ, 37.3% of this is fugitive emissions as outlined in Appendix E
    - Combined constant of 409.1 tonnes CO2-e / TJ (includes fugitive methane and CO_2)
- Capital expenditure for x1 gate injection point (this includes the basic cost estimate of locating, building and commissioning) (estimated to be $2.5M)
- Operational expenditure for x1 gate injection point over the life of the analysis (e.g., 10 years) (estimated to be $112,500 per year)
- Incremental biomethane to natural gas price on a $ per tCO_2-e basis
- Australian Carbon Credit Unit (ACCU)Cost (assume flat $50)

Using the basis of x1 gate injection point the Levelised Abatement Costs for a single gate injection point which can enable 100TJ biomethane injection into the GDS, compared to offsetting 100TJ of natural gas by purchasing and surrendering carbon credits each year over the expected life of the injection point.

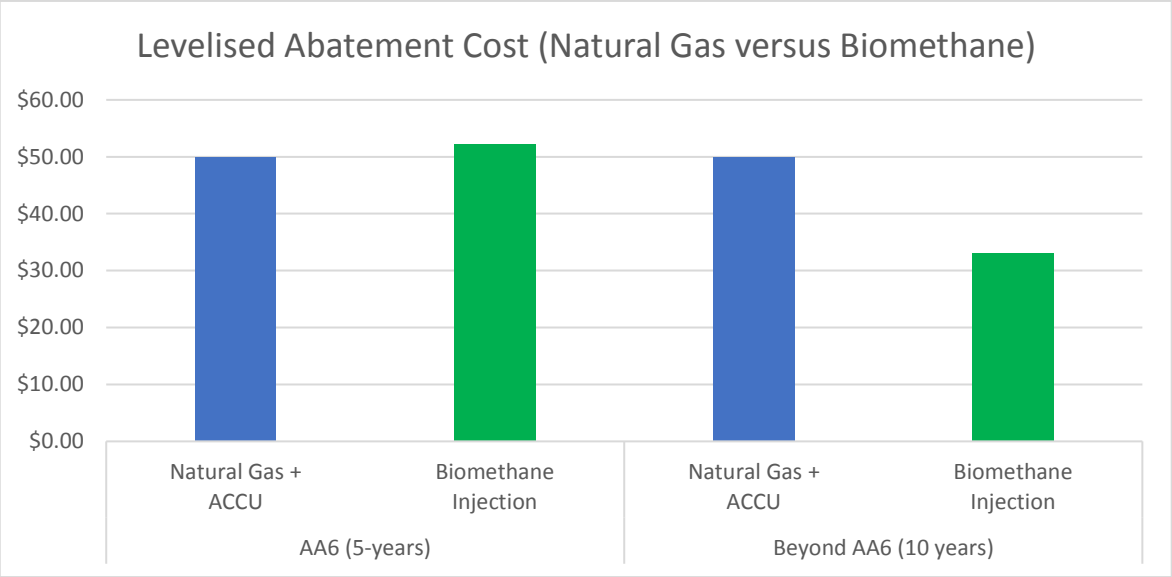
The purpose of this assessment is to measure how much CO_2 can be reduced by a specific investment or policy, considering relevant factors related to geography and specific asset. It calculates how much an investment or policy costs based on dollars per ton of emissions reduced.

As shown in the figure below, the cost of biomethane is expected to drop below the cost of natural gas with offsets by 2030 (which is beyond the AA6 period).

Based on the simple analysis, using biomethane has better long term value compared to using natural gas plus ACCUs. Therefore, investment made for gate injection points in the AA6 period are in the long-term interests of consumers.

In addition, whilst the price of purchasing renewable hydrogen currently is higher than natural gas and biomethane, it is expected that the price will continue to reduce as the hydrogen industry matures and that some portion of natural gas will be displaced with renewable hydrogen by end of AA6 and beyond.

Figure 18: Levelised Abatement Cost



As shown in Figure 18 analysis confirms that the total cost of projects that deliver 30% reduction in net emissions (Scope 1) through the introduction of renewable gases to the system is the most cost-effective option and is also the more sustainable approach to reducing emissions. The renewable projects offer the lowest cost for abating 100 tCO2-e when assessed over 10 years and longer.

[redacted]

Table 11: Project related costs from 2024 to 2029

Project	Total Value ($ real 2022)	Project Duration (years)	Capex per annum ($ real 2022)	Opex per annum ($ real 2022)
Major Projects				
Renewable gas gate injection points - UAFG 2 sites	$6,012,500	2	$2,500,000	$112,500
Renewable gas gate injection points - up to 4 sites	$11,125,000	4	$2,500,000	$112,500
[redacted]				
[redacted]	[redacted]	[redacted]		[redacted]
[redacted]	[redacted]	[redacted]		[redacted]
[redacted]	[redacted]	[redacted]		[redacted]
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[redacted]	[redacted]	[redacted]	[redacted]	[redacted]

APPENDIX I. COMMUNITY CONSULTATION PLAN

This Draft Community Consultation Plan (the **Plan**) provides an overview of essential community and stakeholder consultation, engagement and communication activities associated with the Strategy solutions.

ATCO is committed to providing all stakeholder and community groups with factual and transparent information, engaging with and listening to all stakeholder groups while ensuring consultation and collaboration with all interested parties. The Plan will be finalised in line with the ERA final decisions and regularly reviewed/updated over the 5-year access arrangement period.

I.1 Scope

This Plan applies to the proposed introduction of renewable gases into the network over the AA6 period.

Community Consultation, as applied within the Strategy, is an all-encompassing term and includes local communities, landowners, neighbours, Indigenous peoples and groups, interest groups, Government, regulatory bodies and the general public.

I.2 Objective

This Plan aims to establish community and stakeholder consultation and engagement as a part of the Strategy, aiming to seek genuine and authentic engagement with all stakeholders based on transparency, accessibility and inclusiveness. We aim to achieve this through the following:

- Providing honest, transparent, consistent and timely information regarding our renewable gas transition journey through above-the-line media
- Educating the community about the future of the ATCO GDS and our transition to renewables, thus increasing awareness and understanding
- Identifying and engaging in proactive community consultation with impacted areas around the potential benefits and implications of renewable gas blending
- Raising awareness of critical renewable gas safety messages to accompany our Natural Gas Safety Engagement public campaign
- Developing a mix of additional consultation activities that allow us to reach most end-users

By providing clear and timely communication and engagement with all stakeholder groups, ATCO aims to:

- Raise the level of public education around renewable gas and the potential benefits within the distribution network
- Ensure consistent safety awareness around the different renewable gas blends within communities
- Obtain a level of stakeholder and community support to enable ATCO to expand renewable gas projects within the WA communities.
- Support and demonstrate the vital role of the ATCO GDS in the decarbonisation of WA

- Demonstrate our ability to provide the community with their choice of energy while meeting our overarching objectives: Safe, Affordable, Reliable, and Sustainable.

I.3 Our expertise

ATCO has significant experience in community and stakeholder consultation, engagement and communication. It undertakes detailed 'Voice of the Customer' listening related to its gas network and delivers effective engagement surrounding various infrastructure and innovation projects.

Key insights in the WA stakeholders from the AA6 Vo6 include:

- Residents deemed gas essential in households, with 97% of residents acknowledging its importance, being considered an affordable energy source in comparison with electricity
- Most Residents prefer gas as an energy source for cooking, heating, and hot water, and given the choice, they will use natural gas over electricity for these uses cases.
- There is strong support for the Sustainability Projects program, with 94% of Residents considering it important.
- Residents are particularly interested in being educated about hydrogen blending, its integration with the current gas infrastructure, and its environmental impacts and benefits.
- Customers strongly prefer gas sourced from renewable sources, with the highest preference level at 15%. This is the most preferred investment area for the AA6 program.
- There is an expectation for ATCO to educate customers on their plans to achieve net zero, specifically regarding their planned investments in new technologies.
- The majority of Residents need more information before they're fully confident in hydrogen/biomethane blending.

ATCO recognises the value of broader community and stakeholder engagement outside the directly impacted areas as essential to education and awareness.

I.4 Consultation approach

Our approach to community and stakeholder consultation, engagement and communications for the Strategy will span the 5-year Access Arrangement period – including general community communications, safety messaging, awareness and localised individual project (injection point) community consultation.

The development and delivery of project consultation will represent the community consultation budget's most significant expenditure and resource requirements.

I.4.1 Community Profile

Understanding the composition and values of a community is an essential step in ensuring that stakeholder engagement activities are undertaken in a culturally appropriate manner and considers the needs of those in the community.

Once the locations of the six ATCO gate injection points, additional infrastructure, and associated projects (by external producers) are determined – extensive research and mapping will be undertaken for the individual community profiles to understand the most appropriate

consultation and engagement activities. Our approach will provide frequent opportunities to interact with the community while ensuring direct and two-way communication channels exist.

I.4.2 Principles of Engagement

ATCO recognises the value of community and stakeholder engagement as essential to long-term business planning. It is critical to achieve positive outcomes for both the community and network while continuing our social license to operate.

Stakeholder engagement will be integrated into all critical activities for the Strategy and aligned with current community engagement methodologies, as detailed below:

	INFORM	CONSULT	INVOLVE	COLLABORATE
External Participation	One-way communication. Balanced and objective information around services or events that will happen or have happened	Two-way communication that creates opportunities for all stakeholders to contribute feedback and inform decision making	Community participation through facilitated processes that occur prior to decision making allowing issues and concerns to be considered	Stakeholder partnership in critical aspects of decision making, including identification of preferred solutions
Tactical Tools	▪ Letters ▪ Website ▪ Social Media ▪ Adverts ▪ Factsheets ▪ Flyers ▪ Digital Campaigns	▪ Community Information Sessions ▪ Public Comment Forums ▪ Public Meetings ▪ Surveys ▪ Formalised Meetings	▪ Community Workshops ▪ Survey and Research groups	▪ Strategic Plans ▪ Impacted Stakeholder workshops
Stakeholder Roles	**Community** - Listen **Organisation** - Inform	**Community** - Contribute **Organisation** - Provide open channels for communication	**Community** - Participate **Organisation** - Provide accessible processes for participation	**Community & Impacted Stakeholders** - Partner **Organisation** - Provide accessible activities for partnership and decision making

I.4.3 Identification of Stakeholders

Stakeholders for each project will be mapped, categorised and profiled according to their type. Table 12 provides an example of stakeholder mapping and the different stakeholders engaged.

Table 12: Example of stakeholder mapping

General Public	Local Council	Local Community
Business	Asset/Infrastructure owners	Indigenous groups
Industry Groups	Developers	Elected representatives
Media	Regulatory Authorities	

I.4.4 Stakeholder Engagement Methods

Early engagement with all stakeholders and the wider public provides a strong foundation for genuine relationships characterised by trust, mutual understanding and cooperation. Better relationships lead to better outcomes for communities, stakeholders and the environment.

The program of engagement, consultation and communication with all stakeholders will be undertaken using the following activities:

- Direct Project Community Consultation
- Safety & Education
- Supporting Material
- Resourcing Support

Tactical methodologies include, but are not limited to;

- Establishment of a specific website relating to the Strategy containing the most up-to-date information and contact details.
- Fact sheets and Strategy collateral provided on an ongoing basis to stakeholders and via the website.
- Meetings with targeted stakeholders to demonstrate Strategy value and understand initial interest and/or concerns.
- Public notification of upcoming gate station projects
- Conduct face-to-face focus groups, which will include some residents of the proposed areas, to measure community attitudes toward blending renewable gas into the network
- Face-to-face individual discussions and meetings with directly affect community members within proposed locations
- Mailbox drop, emails, direct mail to stakeholders, landowners, neighbours, and community groups.
- Phone calls directly between landowners or occupiers and ATCO representatives.
- Regular meetings with the project area council Mayors and key planning members
- Regular updates to state and federally elected members.
- Renewable Gas Awareness and Safety Communications

Key renewable gas messages through the use of above-the-line media with the objective of education and awareness around new gases and subsequent safety. Media includes metro and country areas to ensure awareness in all regions ATCO operate. We will constantly optimise the approach and the messaging to market, which includes an 'always on' safety component. This approach mirrors our current Gas Safety work within the public space.

- Targeted research by an independent third party to better understand community sentiment on Renewable Gas, both positive and negative, to act as a baseline metric to measure against through the lifecycle of the RDS.
- Media and digital presence.
- Targeted stakeholder awareness campaigns
- Public display and Q&A opportunities held in conjunction with Industry events
- Community information day events where applicable.

Ongoing, regular updates will be provided to all stakeholder groups to give feedback on the project's progress, findings from various assessments and stakeholder feedback. Periodic additional public forums will take place, specifically in the form of community open days.

As the Strategy progresses, ATCO will continue directly engaging with all stakeholders; however, adjust the frequency and intensity to reflect the increased awareness and education levels within each stakeholder group.

I.4.5 Promotion of community consultation opportunities

When promoting specific community consultation events, various channels will be used to ensure the affected area is well aware of the opportunity to ask questions and provide feedback. The community open days are a good example of these opportunities. Typical promotion of these events include:

- Editorial and advertising in local newspapers, both printed and online;
- Mailbox drop of information flyer four weeks prior and then two weeks before the sessions
- Online advertising via Facebook with targeted, boosted campaigns; and
- On ATCO's website: details are provided in an e-newsletter to all who subscribe.

I.4.6 Consultation Schedule

The Community Consultation plan schedule will be developed to align with the logical stages and milestones of the Strategy. The frequency, intensity and methods of engagement, consultation and communication over each year (for the period of AA6) will be adjusted based on the types of information to be communicated and the required level of impact on the different stakeholder groups.

ATCO will continue to build our understanding of the stakeholder and community values and expectations around renewable gas throughout the five years.

I.5 BUDGET OVERVIEW

The proposed OPEX expenditure will be broken into the following activities for yearly spending.

- Direct Project Community Consultation - 35%
- Safety & Education – 28%
- Supporting Material & Research – 12%
- Resourcing Support – 25%

Developing and delivering high-quality community consultation, engagement, and communication is essential for successful project outcomes of the Strategy. This community consultation Plan will provide the framework to enable education and information flow to the WA community about the changing landscape of the GDS and the benefits of a renewable gas industry. Our stakeholders seek engagement and communication that raises awareness and education around renewable gas that will equip them for decision-making around their future energy mix.

ATCO believes through our community consultation and engagement strategy; the WA community will fully engage with and support the emerging renewable gas industry.