



11 November 2022

## Submission: Renewable Hydrogen Target for electricity generation in the South West Interconnected System in Western Australia

The Australian Pipelines and Gas Association (APGA) represents the owners, operators, designers, constructors and service providers of Australia's pipeline infrastructure, connecting natural and renewable gas production to demand centres in cities and other locations across Australia. Offering a wide range of services to gas users, retailers and producers, APGA members ensure the safe and reliable delivery of 28 per cent of the end-use energy consumed in Australia and are at the forefront of Australia's renewable gas industry, helping achieve net-zero as quickly and affordably as possible.

APGA welcomes the opportunity to contribute to the Western Australian Governments' consultation on a proposed Renewable Hydrogen Target for electricity generation in the South Western Interconnected System (SWIS). APGA commends the Western Australian Government for demonstrating national leadership through proposing a renewable hydrogen target, and advises the expansion of the generation-specific, hydrogen specific target to cover all gas users and all renewable gases.

APGA supports a net zero emission future for Australia by 2050<sup>1</sup>. Renewable gases represent a real, technically viable approach to lowest-cost energy decarbonisation in Australia. As set out in Gas Vision 2050<sup>2</sup>, APGA sees renewable gases such as hydrogen and biomethane playing a critical role in decarbonising gas use for both wholesale and retail customers. APGA is the largest industry contributor to the Future Fuels CRC, which has over 80 research projects dedicated to leveraging the value of Australia's gas infrastructure to deliver decarbonised energy to homes, businesses, and industry in Western Australia and nationally.

Western Australia's decarbonisation challenge is not the same as faced elsewhere in the

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power generation to provide dispatchable power for years to come, plus offsets to deliver affordable and reliable net zero electricity.

Hydrogen power generation, supplied through hydrogen pipelines, can initially supplement and may ultimately supplant natural gas power generation in a net zero energy future. Storage of hydrogen in pipelines also offers a realistic and cost-effective storage option for variable renewable energy, especially when compared to battery energy storage systems.

Introducing renewable hydrogen into the energy mix for Western Australia may appear to suffer from low electricity supply chain efficiency. Energy is 'lost' from the point of renewable generation through hydrogen electrolysis, and then through transforming that hydrogen back to electricity. However energy efficiency is only one factor in economic efficiency. When energy storage is taken into consideration, the economic efficiency of the

**APGA supports broadening the Target to consider all renewable gases.**

Renewable gases include renewable forms of methane such as biomethane alongside hydrogen. Biomethane is a mature technology and can deliver carbon-neutral gas today at modelled costs in line with projected 2030 hydrogen costs.<sup>4</sup>

APGA considers that such a scheme could have an even greater positive impact on Western Australia's

that hydrogen pipelines were a cheaper form of energy transport and storage across all modelled scenarios. To determine the cost effectiveness of full renewable energy supply chains however, a broader view of the supply chain is required.

Figure 1 compares rough levelised cost of electricity outcomes for a range of HVAC and hydrogen pipeline scenarios based on data from the GPA Engineering report and simplified energy supply chains. Hydrogen pipelines begin to deliver a lower levelised cost of electricity downstream of hydrogen gas power generation in cases where at least 60% of the energy needed must be stored prior to dispatch to customers<sup>6</sup>. This is due to the low cost of hydrogen storage and not needing to transport and store energy consumed through electrolysis.

Where 100% of energy needs to be stored, all cases considered within the Pipelines vs Powerlines report show hydrogen pipeline transport and storage deliver lower cost outcomes. This scenario would be relevant when considering 100% utility scale solar PV as the VRE supply for electrolysis, in particular where hydrogen power generation is used to cover morning and evening demand peaks. Full expansion of this analysis is available in Attachment A of this submission.

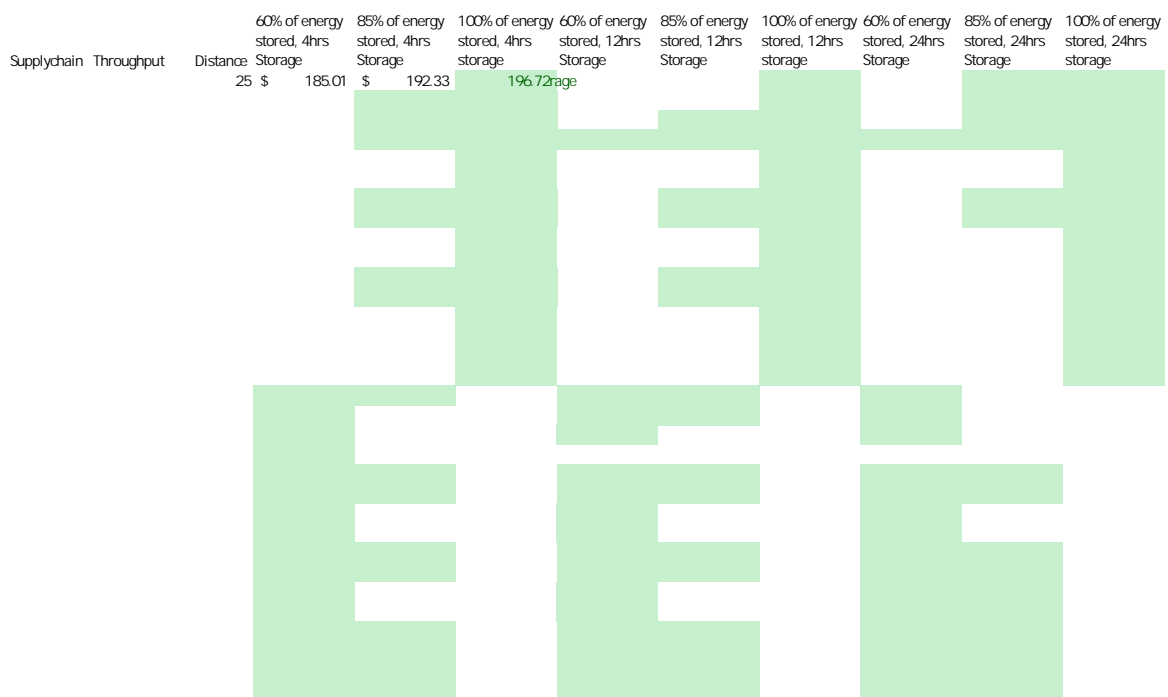


Figure 1: cost of electricity through hydrogen pipelines (including hydrogen pipeline energy storage) and HVAC (with battery energy storage) supply chains.

[https://www.apga.org.au/sites/default/files/uploaded-content/field\\_f\\_content\\_file/pipelines\\_vs\\_powerlines\\_-\\_a\\_technoeconomic\\_analysis\\_in\\_the\\_australian\\_context.pdf](https://www.apga.org.au/sites/default/files/uploaded-content/field_f_content_file/pipelines_vs_powerlines_-_a_technoeconomic_analysis_in_the_australian_context.pdf)

Pipelines vs Powerlines: Appendix 3A and 3B Results Summary

[https://www.apga.org.au/sites/default/files/uploaded-content/field\\_f\\_content\\_file/appendix\\_3a\\_and\\_3b\\_results\\_summary.xlsx](https://www.apga.org.au/sites/default/files/uploaded-content/field_f_content_file/appendix_3a_and_3b_results_summary.xlsx)

<sup>6</sup> A levelised cost of generation without fuel cost of \$50 per MWh for CCGT was assumed from Lazard, 2021, Lazard's levelized cost of energy analysis, Version 15.0,

<https://www.lazard.com/media/451905/lazards-levelized-cost-of-energy-version-150-vf.pdf>

APGA commits to continuing to work with the Western Australian Government to help achieve a least cost net zero energy future for all energy customers and welcomes further engagement on the potential for hydrogen and other renewable gas pipelines to support this outcome. APGA members are already investing in hydrogen infrastructure in Western Australia, and we recommend close consideration of their submissions

To discuss any of the above feedback further, please contact me on +61 422 057 856 or [jmccollum@apga.org.au](mailto:jmccollum@apga.org.au).

Yours sincerely,

A handwritten signature in black ink, appearing to read 'Jordan McCollum', is positioned above a redacted area. The redaction consists of a solid black rectangular box.

JORDAN MCCOLLUM  
National Policy Manager  
Australian Pipelines and Gas Association



## Attachment A: Expansion of analysis for Figure 1

Supplychain	A MWh	B GJ	C cost per GJ	D Efficiency	E Compression	F Throughput	G Distance	H Transport	I Cost	J Cost	K Cost	L Generator	M Generator
Hydrogen	\$ 30.00	\$ 8.33	\$ 3.50	70%	\$ 0.55	10000	25	\$ 0.30	\$ 4.07	\$ 3.88	\$ 3.06	50%	\$ 14.00
Hydrogen	\$ 30.00	\$ 8.33	\$ 3.50	70%	\$ 0.55	10000	100	\$ 1.26	\$ 3.23	\$ 3.55	\$ 3.08	50%	\$ 14.00
Hydrogen	\$ 30.00	\$ 8.33	\$ 3.50	70%	\$ 0.55	10000	250	\$ 2.18	\$ (0.00)	\$ 1.89	\$ 2.05	50%	\$ 14.00
Hydrogen	\$ 30.00	\$ 8.33	\$ 3.50	70%	\$ 0.55	10000	500	\$ 4.64	\$ 6.47	\$ 2.16	\$ 1.08	50%	\$ 14.00
Hydrogen	\$ 30.00	\$ 8.33	\$ 3.50	70%	\$ 0.55	50000	25	\$ 0.12	\$ 2.90	\$ 2.97	\$ 3.28	50%	\$ 14.00
Hydrogen	\$ 30.00	\$ 8.33	\$ 3.50	70%	\$ 0.55	50000	100	\$ 0.48	\$ 2.47	\$ 2.54	\$ 2.56	50%	\$ 14.00
Hydrogen	\$ 30.00	\$ 8.33	\$ 3.50	70%	\$ 0.55	50000	250	\$ 0.89	\$ 1.30	\$ 1.90	\$ 1.89	50%	\$ 14.00
Hydrogen	\$ 30.00	\$ 8.33	\$ 3.50	70%	\$ 0.55	50000	500	\$ 2.16	\$ 0.00	\$ 1.50	\$ 1.54	50%	\$ 14.00
Hydrogen	\$ 30.00	\$ 8.33	\$ 3.50	70%	\$ 0.55	250000	25	\$ 0.05	\$ 2.45	\$ 2.62	\$ 2.66	50%	\$ 14.00
Hydrogen	\$ 30.00	\$ 8.33	\$ 3.50	70%	\$ 0.55	250000	100	\$ 0.22	\$ 1.90	\$ 2.36	\$ 2.43	50%	\$ 14.00
Hydrogen	\$ 30.00	\$ 8.33	\$ 3.50	70%	\$ 0.55	250000	250	\$ 0.46	\$ 1.11	\$ 1.38	\$ 1.79	50%	\$ 14.00
Hydrogen	\$ 30.00	\$ 8.33	\$ 3.50	70%	\$ 0.55	250000	500	\$ 1.14	\$ -	\$ 0.95	\$ 1.32	50%	\$ 14.00
Hydrogen	\$ 30.00	\$ 8.33	\$ 3.50	70%	\$ 0.55	500000	25	\$ 0.04	\$ 2.50	\$ 2.64	\$ 2.54	50%	\$ 14.00
Hydrogen	\$ 30.00	\$ 8.33	\$ 3.50	70%	\$ 0.55	500000	100	\$ 0.16	\$ 1.79	\$ 2.35	\$ 2.46	50%	\$ 14.00
Hydrogen	\$ 30.00	\$ 8.33	\$ 3.50	70%	\$ 0.55	500000	250	\$ 0.33	\$ 1.07	\$ 1.60	\$ 1.78	50%	\$ 14.00
Hydrogen	\$ 30.00	\$ 8.33	\$ 3.50	70%	\$ 0.55	500000	500	\$ 0.83	\$ 0.70	\$ 1.02	\$ 1.58	50%	\$ 14.00
HVAC	\$ 30.00	\$ 8.33	\$ 3.50	70%	\$ 0.55	10000	25	\$ 0.83	\$ 29.23	\$ 29.23	\$ 29.23	50%	\$ 14.00
HVAC	\$ 30.00	\$ 8.33	\$ 3.50	70%	\$ 0.55	10000	100	\$ 3.05	\$ 29.23	\$ 29.23	\$ 29.23	50%	\$ 14.00
HVAC	\$ 30.00	\$ 8.33	\$ 3.50	70%	\$ 0.55	10000	250	\$ 7.99	\$ 29.23	\$ 29.23	\$ 29.23	50%	\$ 14.00
HVAC	\$ 30.00	\$ 8.33	\$ 3.50	70%	\$ 0.55	10000	500	\$ 19.39	\$ 29.23	\$ 29.23	\$ 29.23	50%	\$ 14.00
HVAC	\$ 30.00	\$ 8.33	\$ 3.50	70%	\$ 0.55	50000	25	\$ 0.33	\$ 28.07	\$ 28.07	\$ 28.07	50%	\$ 14.00
HVAC	\$ 30.00	\$ 8.33	\$ 3.50	70%	\$ 0.55	50000	100	\$ 0.93	\$ 28.07	\$ 28.07	\$ 28.07	50%	\$ 14.00
HVAC	\$ 30.00	\$ 8.33	\$ 3.50	70%	\$ 0.55	50000	250	\$ 2.32	\$ 28.07	\$ 28.07	\$ 28.07	50%	\$ 14.00
HVAC	\$ 30.00	\$ 8.33	\$ 3.50	70%	\$ 0.55	50000	500	\$ 4.80	\$ 28.07	\$ 28.07	\$ 28.07	50%	\$ 14.00
HVAC	\$ 30.00	\$ 8.33	\$ 3.50	70%	\$ 0.55	250000	25	\$ 0.12	\$ 26.90	\$ 26.90	\$ 26.90	50%	\$ 14.00
HVAC	\$ 30.00	\$ 8.33	\$ 3.50	70%	\$ 0.55	250000	100	\$ 0.47	\$ 26.90	\$ 26.90	\$ 26.90	50%	\$ 14.00
HVAC	\$ 30.00	\$ 8.33	\$ 3.50	70%	\$ 0.55	250000	250	\$ 1.18	\$ 26.90	\$ 26.90	\$ 26.90	50%	\$ 14.00
HVAC	\$ 30.00	\$ 8.33	\$ 3.50	70%	\$ 0.55	250000	500	\$ 1.99	\$ 26.90	\$ 26.90	\$ 26.90	50%	\$ 14.00

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3.50 70% \$ 0.55 \$ a 2500



## Attachment 2: Submission response template

### Renewable Hydrogen Target – stakeholder feedback template

#### Submission from [Australian Pipelines and Gas Association](#)

This template has been developed to enable stakeholders to provide feedback on the questions posed in the Renewable Hydrogen Target consultation paper.

Energy Policy WA encourage stakeholders to use this template. If you wish to provide additional feedback outside the template, wherever possible please reference the relevant question/section to which your feedback relates.

No.	Question	Feedback
Renewable Hydrogen Target for electricity generation		
1	What are some examples of an objective or objectives that could be used to assess the benefits, costs and impacts of a Renewable Hydrogen Target for electricity generation?	A broader objective of supporting renewable hydrogen uptake across all current gas sector use cases can help to ensure hydrogen uptake delivers least cost emissions reduction through a broader range of market mechanisms.
2	How might other uses of renewable hydrogen be accommodated under a Renewable Hydrogen Target certificate scheme? How might Government otherwise support and/or encourage other use cases for hydrogen?	The Western Australian Government can otherwise support and/or encourage other use cases for hydrogen by introducing a more generic Renewable Hydrogen Target which facilitates uptake of renewable hydrogen for all current gas users.  APGA's order of preference for forms of Renewable Hydrogen Targets is as follows:

No.

Feedback

1. Generic Renewable Hydrogen Target for all gas users plus Renewable Hydrogen Target for electricity generation
2. Generic Renewable Hydrogen Target for all gas users
3. Renewable Hydrogen Target for electricity generation.

Further, as all renewable gases achieve the same net zero emissions ends, APGA also proposes the Renewable Hydrogen Target evolve into a renewable gas agnostic Renewable Gas Target. A key fact to consider relating to this point is that Future Fuels CRC Research indicates that Biomethane can be produces at costs as low as \$2.09 per kilogram hydrogen equivalent today (\$14.70 per GJ), where such pricing is a 2030 hydrogen price target. Please contact the Future Fuels CRC for more detail on biomethane cost research.

We know that gas power generation (GPG) supporting variable renewable electricity (VRn



No.	Question	Feedback
		supply chains can also more energy efficient than electricity supply chains which utilise renewable gas power generation. These are just two reasons behind APGA's preference toward a generic, renewable gas agnostic Renewable Gas Target over generation only or hydrogen- only targets.
4	What role can the infrastructure associated with the production of renewable hydrogen (i.e. renewable electricity generation facilities, electrolysers, transport and storage infrastructure) play in the broader SWS?	APGA engaged GPA Engineering to deliver the Pipelines vs Powerlines study in 2022 <sup>8</sup> . This has demonstrated that pipelines provide a lower cost form of energy transport and storage in comparison to powerlines and other forms of electricity energy storage. Please see APGA's long form submission for commentary on which portions of the Pipelines vs Powerlines case map demonstrate economic viability of hydrogen energy transport and storage for GPG.

**Technical feasibility**

5	To the extent you are able please reflect on some of the technical issues, challenges and considerations in the utilisation of hydrogen in the generation of electricity. To what extent can these technical issues and challenges be overcome? How should this impact on the consideration of a Renewable Hydrogen Target for electricity generation in Western Australia?	As will be highlighted by many, the electricity supply chain from VRE to hydrogen then back to electricity experiences energy efficiency challenges. What is not often
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No.	Question	Feedback
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No.	Question	Feedback
	scheme that would provide a framework to deliver on the objectives or outcomes sought?	
<b>Liabile entities</b>		
8	Is the proposed approach of certification, deemed liability and certificate transfer an efficient and effective way to deliver on the intent of the Renewable Hydrogen Target for electricity generation? Are there alternative approaches which could better deliver on the objectives?	<p>APGA supports the general intent of certification, liability, and certificate transfer.</p> <p>The consultation paper does not specify whether the proposed scheme would be similar to other schemes (such as the Federal Renewable Energy Target), with respect to the intent of the Western Australian Government to purchase some or all certificates at a certain value to support funding of renewable hydrogen through the scheme.</p> <p>If this is the intent of the Western Australian Government, APGA would support this approach. Government purchase of at least some volume of certificates would better facilitate uptake without burdening customers with higher energy bills.</p>
<b>Exemptions</b>		
9	What are the benefits, costs and impacts of an exemptions regime for a Renewable Hydrogen Target for electricity generation?	As noted in the consultation paper, an exemption or partial-exemption scheme such as that which operates for 'Emissions Trade- Exposed Entities' in the Federal Renewable Energy Target may be appropriate to reduce the cost of the scheme to specific consumers.
<b>Non-renewable hydrogen</b>		
<b>Renewable fuels</b>		
10	Should the Renewable Hydrogen Target for electricity generation consider alternative renewable fuels as eligible for the creation of Renewable Hydrogen Electricity Generation Certificate? Why or why not?	Yes. APGA believes that a renewable gas- agnostic approach would be appropriate for both an electricity generation target, as well as a generic target for all gas users. Compared to hydrogen, biomethane offers significant early emissions- reductions opportunities, particularly where methane capture (such as from landfill or wastewater) or production (such as biodigesters)



No.	Question	Feedback
	achieve the objectives of the Renewable Hydrogen Target for electricity generation in the SWS? Why or why not?	
14	To what extent should banking and borrowing of liabilities be permitted under the scheme? What are the benefits and costs of a borrowing mechanism as described in the paragraph above?	APGA agrees with allowing for banking and borrowing of liabilities under the scheme, as long as obligations upon entities is maintained at the end of the target period. As with other certification schemes, banking and borrowing could help to address the time it will take to develop investment proposals and business cases for hydrogen facilities in the event that they delayed mandate approach proposed in APGA's answer to Question 15 below is not taken.

**Scheme commencement and ramp up**

15	<p>How soon do you believe a Renewable Hydrogen Target for electricity generation in the SWS could be feasibly delivered from a technical perspective (i.e. if cost was not a consideration)? Please reflect on your own organisation and/or sector when providing your answer.</p>	<p>While commencement of the scheme should occur as soon as practical, mandated achievement of target levels will need to consider practical project delivery timelines. Such consideration would need to include reasonable timeframes for hydrogen production, pipeline and power station development.</p> <p>APGA notes that once a commercial proposition for energy transport and storage via pipeline has been identified, the process of commercial negotiation, development and subsequent construction of contract carriage pipeline infrastructure generally takes a significantly shorter period than</p>
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No.	Question	Feedback
		<p>the window before which any mandated target would come into effect.</p> <p>The scheme should go live as soon as practical such that any project able to deliver sooner than the projected timeline could commence generation of certificates under the scheme, hence providing a competitive advantage for early project delivery.</p>
16	<p>Similar to the above, how soon do you believe a Renewable Hydrogen Target for electricity generation in the SWS could be feasibly delivered from a commercial or economic perspective (i.e. if cost was a consideration)? Please reflect on your own organisation and/or sector when providing your answer.</p>	
17	<p>Over what period of time do you believe is an appropriate ramp up period for the Renewable Hydrogen Target for electricity generation in the SWS? In providing your answer reflect on the actions your organisation and / or sector would need to take to participate in the scheme.</p>	
<p><b>Hydrogen cost outlook</b></p>		
18	<p>In the short (&lt;5 years), medium (5- 15 years) and long (15+ years) term, where do you expect the cost of production of renewable hydrogen to move from the estimated levels of today? What do you expect to be the drivers of this change?</p>	<p>There are many factors influencing the potential pathway costs for hydrogen production, depending on the nature of the pathway component (in this case, is hydrogen being used directly for energy generation, or is it also being used as energy storage in pipelines). The CSIRO's 2018 National Hydrogen Roadmap has considered this in detail<sup>11</sup>, and the story has already changed in the four years since its publication (especially in the context of high international energy prices). At the time of publication, the levelised cost of hydrogen from electrolysis was modelled as approximately \$2.29- 2.79/kg by 2025, and as focus has shifted away from thermochemical to electrochemical hydrogen</p>

No.	Question	Feedback
		<p>production this has considerably altered the value proposition where there are additional benefits.</p> <p>Over the medium to long term, assuming a market is <del>is</del> <del>ss</del> e <del>hr</del>M <del>wrk</del>rk- a</p>

No.	Question	Feedback
		This opportunity can be enhanced if the Western Australian Government were to support domestic advanced manufacture of hydrogen electrolyzers to mitigate electrolyser cost and medium-term supply chain challenges.
20	How would you expect the levels of hydrogen demand for electricity generation in the SMS to be met at various points in the supply chain? Would you expect a single generator would emerge and provide all certificates?	The event that a single generator emerges to provide all certificates would indicate that the target is too small to facilitate a diverse and competitive hydrogen gas power generation market.
21	Would you expect one very large renewable hydrogen producer, a number of very uneratiūū er, f ere t	