REVIEW OF THE NATIONAL HYDROGEN STRATEGY | CONSULTATION

Australian Petroleum Production and Exploration Association | 25 August 2023

The Australian Petroleum Production and Exploration Association (APPEA) welcomes the opportunity to provide input and recommendations into the review of Australia's *National Hydrogen Strategy*.

APPEA strongly recommends a technology-neutral, emissions-intensity focused approach to low-carbon hydrogen (LCH) development in Australia. LCH produced from natural gas with CCUS is the lowest cost and most technologically advanced pathway to LCH, delivering significantly more emissions reductions per dollar today. A technology-neutral, emissions-intensity focused approach that includes LCH from natural gas with CCUS will enable more hydrogen to be produced sooner and at a lower cost, supporting growth in LCH demand and the development of a domestic LCH industry. Progressing a range of LCH pathways diversifies supply chains, leverages a greater range of existing skills and infrastructure, manages risks and complements broader climate change mitigation efforts in Australia.

The oil and gas sector is central to the development of LCH globally and in Australia, including both renewable-based hydrogen and LCH produced from natural gas with CCUS. The strength of Australia's oil and gas sector, combined with world class renewable energy, natural gas and CO_2 storage resources gives Australia a comparative advantage across multiple LCH pathways.

To meet the strategic objectives outlined for the National Hydrogen Strategy, APPEA recommends the strategy should:

- **Take a technology-neutral, emissions-intensity focused approach to LCH development in Australia** that maximises emissions reductions across the economy and economic outcomes for all Australians.
- **Outline a clear, technology-neutral policy framework for LCH deployment**, including establishing a process for determining emissions intensity thresholds for the Guarantee of Origin scheme.
- **Explore synergies between sectors and technologies, as well as within regional industrial zones –** in line with the concept of Net Zero Zones[1] – to optimise LCH scale up and infrastructure development in Australia.
- **Prioritise least-cost LCH production and the establishment of a stable long-term policy, legal, regulatory and fiscal framework for LCH** to facilitate investment in an LCH industry in Australia.
- **Develop a pathway for LCH development that minimises cost-of-living impacts and maximises economic benefits**, in order to maintain community support.
- **Leverage Australia's abundant natural gas reserves, infrastructure and skills to fast-track large scale LCH production in Australia** from natural gas with CCUS, which in turn will support the roll-out of all LCH pathways as costs come down and production scales up.
- **Align Australia's energy exports with the energy needs and capacity of partner counties**, recognising that international customers will prioritise the least-cost and most reliable LCH suppliers to support their net zero transformation.

APPEA and its members welcome the opportunity to provide input into the development of the National Hydrogen Strategy issues and look forward to inputting further as the strategy develops.

The Australian oil and gas sector's contribution to the economy and to reaching net zero is outlined in Annex 1.

[1] APPEA A review of Net Zero Energy and Industrial Zones – Preliminary Report

CONTENTS

A technology-neutral approach is critical to low-carbon hydrogen development

APPEA strongly recommends a technology-neutral, emissions-intensity focused approach to low-carbon hydrogen (LCH) development in Australia. A technology-neutral approach to LCH development in Australia decreases the cost and timeframes for scale up and increases the volume of LCH produced and the emissions reductions achieved. This increases LCH demand and speeds up the roll-out of hydrogen infrastructure, fast-tracking Australia's development as a global hydrogen leader. A technology-neutral approach to LCH development is the best way of realising the Strategic Objectives of the National Hydrogen Strategy:

- Strategic Objective 1: Australia is on the path to be a global hydrogen leader by 2030.
- Strategic Objective 2: Enable domestic decarbonisation through the development of the hydrogen industry; and
- Strategic Objective 3: Ensure economic benefit for all Australians through the development of the hydrogen industry.

International analysis is clear – all LCH pathways have a role to play in reaching net zero. Analysis from the International Energy Agency (IEA), the Intergovernmental Panel on Climate Change (IPCC) as well as the Commonwealth Scientific and Industrial Research Organisation (CSIRO) and others, is clear: all LCH pathways – including renewable-based hydrogen and LCH produced from natural gas with carbon capture, utilisation and storage (CCUS) – have a role to play in the development of a LCH industry and in reaching net zero. While the balance between pathways will change from region to region, and over time based on factors such as costs and resource availability, all pathways need to be considered.

LCH produced from natural gas with CCUS is the lowest cost and most technologically advanced pathway to LCH, delivering significantly more emissions reductions per dollar today. LCH from natural gas with CCUS is expected to be two to six times cheaper than renewable-based hydrogen per kilogram of LCH produced today[2,3] – meaning up to six times more emissions reductions per dollar today depending on the emissions intensity of the LCH produced. Further, natural gas with CCUS is the most technologically advanced and widely deployed pathway to LCH, meaning it has the ability to scale up faster in the near-term, to facilitate other low-carbon hydrogen pathways as they scale up and costs come down. The IEA estimates around 650,000 tonnes of LCH is currently produced each year of which 92% is produced from natural gas with CCUS, 5% is produced from bioenergy, with the remaining 3% produced from renewables, including wind and solar.[4]

A technology-neutral, emissions-intensity focused approach can be expected to enable more hydrogen to be produced, and at a lower cost, supporting growth in LCH demand and the development of a domestic LCH industry. Key to the development of a LCH sector in Australia is the fostering of LCH demand and the roll-out of hydrogen infrastructure, in parallel with the development of LCH supply. The most technologically advanced and lowest-cost pathways to LCH production must be prioritised to decrease the cost and maximise the volume of LCH produced and to minimise barriers to entry for manufacturers and industry looking to utilise LCH. Maximising the volume and minimising costs will in-turn maximise the generation of LCH demand, as well as the skills and supply chain infrastructure that will be developed.

The development of LCH from natural gas with CCUS supports the development of CO_2 transport and storage infrastructure which can be leveraged to support the decarbonisation of other existing facilities and hard-to-abate industries where LCH is not a decarbonisation pathway, such as cement production.

[2] CSIRO National Hydrogen Roadmap
[3] IEA CCUS in Clean Energy Transitions
[4] IEA World Energy Outlook 2022

The development of shared CO_2 transport and storage infrastructure can also underpin the deployment of CO_2 removal – negative emissions – technologies such as direct air CO_2 capture (DACC) and bioenergy with CCUS (BECCS).

The oil and gas sector is central to the development of LCH globally, including both renewable-based hydrogen and LCH produced from natural gas with CCUS. The oil and gas sector is one of the primary producers and users of hydrogen today and will be a critical demand centre for LCH going forward. The oil and gas sector also has the technical and commercial skills and experience necessary to scale up and commercialise LCH production. The IEA highlight that 80% of all large-scale renewable-based hydrogen projects today are being developed by the oil and gas industry or with the oil and gas industry as the off-taker.[5] The oil and gas sector is also central to the development of LCH from natural gas with CCUS, both from a gas production perspective as well as being the industry with the experience in developing and deploying CCUS.

World class renewable energy, natural gas and CO_2 storage resources gives Australia a comparative advantage across multiple low-carbon hydrogen pathways. Australia stands to benefit from the complementarity and synergies between renewable-based hydrogen and LCH produced from natural gas with CCUS, to optimise the development of a LCH industry in Australia, provided a technology neutral approach is pursued.

Enabling decarbonisation through the development of a clean hydrogen industry

The National Hydrogen Strategy should focus on outlining a clear, technology-neutral policy framework for LCH deployment, including establishing a process for determining emissions intensity thresholds for the Guarantee of Origin scheme. The National Hydrogen Strategy should establish a strategic foundation for maximising emissions reductions from LCH in Australia and in the region while also maximising benefits for Australians, without picking winners or favouring one sector over another. As part of establishing this level playing field, it will be critical to advance the technology-neutral LCH Guarantee of Origin scheme, including developing transparent, evidence-based emissions intensity thresholds for the classification of hydrogen, noting that these thresholds should be developed in close consultation with industry and other stakeholders. Further, should the government look to establish or expand incentive schemes to support the roll-out and uptake of LCH, such schemes should be economy-wide and technology-neutral.

Taking a narrow approach to LCH development, that excludes viable production pathways, presents a barrier to LCH scale-up and may impact broader climate mitigation policy outcomes. Central to the development of a LCH industry in Australia is the reduction in emissions – in Australia and abroad – and delivering benefits to Australia from the development of a new LCH industry. These pillars must therefore be the focus of LCH policy development in Australia – establishing a framework focused on emissions reductions and economic outcomes. In contrast, narrowing the technologies and fuels to be considered for LCH development in Australia will only reduce the emissions reductions that will be achieved and decrease the benefits that LCH can deliver to Australians.

Further activating hydrogen and related industries in Australia

Exploring synergies between sectors and technologies, as well as within regional industrial zones, will help establish an optimised approach to LCH development in Australia. LCH is one part of the decarbonisation puzzle but no technology alone with be sufficient to get to net zero. In conjunction with LCH, other key building blocks of net zero include renewable energy, natural gas and CCUS. Not only will all these technologies be necessary for reaching net zero but in many instanced multiple building blocks will be needed in a single facility. For example, for a liquified natural gas (LNG) plant, CCUS will be needed to address reservoir CO_2 with electrification using renewables being used to

[5] IEA World Energy Outlook 2022

provide an important proportion of on-site power needs. For the compression needed to liquify the natural gas, a range of options could be considered including gas turbines with CCUS, LCH powered turbines, or electrification. It is likely that many other industrial sectors will have a similar need for a range of emissions reductions technologies. Similarly, the scale up of LCH is inherently linked to renewable energy production, gas production and CCUS and therefore LCH development will be significantly easier in regions where these technologies are being scaled up at the same time and shared infrastructure can be established. The National Hydrogen Strategy should consider the synergies between technologies and sectors and the regions where LCH uptake is most likely in order to optimise the development of a LCH industry in Australia. To inform this integrated and collaborative approach to emissions reductions, including LCH deployment, APPEA has developed the concept of Net Zero Zones.

Net Zero Zones can help scale up LCH across Australia and minimize the costs of the transformation to net zero by leveraging the synergies between LCH, renewables, natural gas, and CCUS.[6] Nine energy and industrial regions around Australia comprise 92% of all emissions covered by the Safeguard Mechanism as well as 98% of all large power generation emissions. The majority of emissions sources in these regions and across Australia require the same four net zero technology building blocks to reduce their emissions: LCH, natural gas, renewable energy and CCUS. In many instances, manufacturing and industrial facilities are going to need to rely on shared emissions reductions infrastructure to meet their climate mitigation targets and Net Zero Zones are a framework for considering and prioritizing this infrastructure.

The establishment of Net Zero Zones based around the four net zero building blocks and shared infrastructure can help scale up LCH in these regions by leveraging technological, sectoral and regional synergies, while also providing a range of benefits to support the equitable and efficient transformation to a net zero economy:

- reducing the costs and timelines for reaching net zero
- powering regional manufacturing and industry – creating and protecting regional jobs
- underpinning net zero critical mineral production and processing
- leveraging existing infrastructure
- creating a magnet for regional net zero investment
- providing focal points for streamlined government approvals and environmental permitting
- establishing the foundations for net zero energy and industrial exports and imports.

A technology-neutral approach to LCH development mitigates supply chain risks and leverages a greater range of existing human and infrastructure capacity. Picking technological winners risks exacerbating supply chain constraints and making other climate change mitigation policy outcomes harder to achieve. For example, development of an LCH industry that is exclusively developed around renewable energy-based LCH, increases demand for renewable energy technologies – in competition with the electricity sector – and puts additional pressure on renewable energy permitting processes, community engagement, deployment schedules and supply chains that are already facing challenges in meeting 2030 renewable electricity generation targets. In contrast, a technology neutral LCH strategy diversifies supply chains and brings a broader range of sectors, technology providers and regulators into the LCH development process, increasing the capacity of the economy to deliver LCH at scale. By diversifying the LCH supply chains there is also the opportunity to draw on a wider pool of existing skills and experience as well as existing infrastructure, including from the oil and gas industry.

[6] APPEA A review of Net Zero Energy and Industrial Zones – Preliminary Report

Sector-specific targets and approaches reduce the flexibility of LCH deployment and disregards potential synergies between sectors and regionally. Establishing a technical and economic evidence-based understanding of LCH potential by sector is a critical element of a National Hydrogen Strategy. This analysis, complemented by a review of regional potential supply and demand and will inform a broader, economy-wide assessment of LCH potential in Australia. However, LCH policy will be most efficient when it is not ring-fenced to specific LCH supply pathways or specific sectoral demand. The establishment of sector strategies, or sector targets, overlooks the synergies between sectors and limits the flexibility of LCH supplier and off-takers to find economies of scale, which is likely to have a detrimental impact on the roll-out of LCH in Australia. Similarly, technology-specific targets more generally – such as LCH targets – risk forcing higher-cost abatement technologies into the market in place of lower-cost options, thereby increasing the cost of economy-wide climate change mitigation.

Maximising investment in Australia's hydrogen industry

A technology-neutral approach to LCH that prioritises least-cost emissions reductions is central to attracting investment in LCH development. All LCH pathway represent an increased cost of energy when compared with current energy carriers – gas, oil, electricity – as well as compared to conventional hydrogen production. This commercial cost gap presents a major barrier to LCH investment today. Minimising this cost gap is therefore critical to the scale-up of LCH across the economy. Today, LCH produced using natural gas with CCUS represents the lowest-cost and most technically advanced pathway to LCH. LCH from natural gas with CCUS therefore presents the lowest commercial cost gap today. This is reflected in the fact that the overwhelming majority of LCH today is produced from natural gas with CCUS.

Long-term LCH investment confidence will hinge on long-term policy and fiscal certainty and the knowledge that the terms and conditions in which large capital investments are made today won't be changed in the future in a way that compromises the commercial viability of the investment. Commercial LCH projects are large and capital intensive and will entail long payback periods for investors. For investors to commit this capital, they must have confidence that the policy, legal, regulatory and fiscal context in which the project is established – which provides for the return necessary to justify the investment – are broadly stable and predictable for the duration of the project's commercial life. If investors do not have this confidence, they will either require higher prices for the LCH produced – to reduce the payback period and mitigate risk – or will locate their project elsewhere in the world where they can get the investment certainty they require. To provide this confidence to LCH investors and to minimise the sovereign risk of investing in Australia the government must establish a stable policy, legal, regulatory and fiscal environment, not just in the energy sector, but across the economy.

Interventionist policies such as domestic price caps and reservation policies will only reduce investment confidence in LCH production and reduce LCH supply. Instead, LCH policies that incentivise the market to increase overall supply to satisfy both domestic and export markets should be developed. It is widely established that price caps and other such interventions serve only to limit investment in supply which over the longer-term drives up prices and leads to shortages. Instead, government should focus on developing LCH policy that establishes a competitive LCH market that provides the long-term market signals to bring on new supply sufficient to meet ongoing demand.

Developing a hydrogen industry to benefit all Australians

A least-cost approach to emissions reductions, that minimises cost-of-living impacts on Australians and maximises economic outcomes, is critical to maintaining community support for the transformation to net zero – LCH must be developed within this context. The transformation of the economy to net zero represents a significant challenge for Australia and is going to entail significant changes in the way we run our economy, with trade-offs needing to be made. To ensure community support for this process,

government and industry must demonstrate that every effort is being made to minimise the impacts on the lives of all Australians, including minimising the cost of the net zero transformation and maximising the economic opportunities. Taking any approach other than the least-cost approach risks undermining this support. It is therefore essential that LCH is looked at against the backdrop of the overall net zero transformation and the full portfolio of emissions reductions technologies. Should lower-cost LCH pathways be excluded in favour of higher-cost pathways, it risks jeopardising public support for the roll-out of LCH and the transition to net zero more broadly.

Scaling up the infrastructure needed for a hydrogen industry

Abundant gas reserves and production infrastructure in combination with repurposed end-of-production gas infrastructure for CO_2 transport and storage provide Australia with the opportunity to fast-track large scale LCH production. Australia's natural gas infrastructure can be leveraged for the establishment of a LCH sector, including both LCH from natural gas with CCUS as well as renewable-based LCH. Australia has abundant natural gas reserves and extensive natural gas infrastructure that can produce and deliver the gas needed create hydrogen – today, as much as 650,000 tonnes of hydrogen are produced in Australia each year from natural gas.[7] In addition, efforts are already underway to repurpose gas production and transport infrastructure – where gas production has ceased – for the development of large-scale CCUS. This combination of operational and end-of-production natural gas infrastructure can underpin the development of least-cost LCH production from natural gas with CCUS. In-turn this can support the build up of hydrogen demand and hydrogen infrastructure for domestic use and for exports, which can be leveraged by renewable-based LCH and other LCH pathways as their costs come down and production scales up.

Shared hydrogen infrastructure – linking multiple suppliers with multiple LCH users – will be the most efficient way to deliver LCH at scale. Future-proofing early investments in hydrogen infrastructure to allow them to be extended and expanded to accommodate new LCH production facilities as well as industrial LCH users will be important to avoid creating future bottlenecks to the LCH scale-up. Similarly, the National Hydrogen Strategy needs to be integrated and aligned with the broader energy and industrial planning to ensure an optimised approach to infrastructure is developed, including LCH infrastructure. The National Hydrogen Strategy must be aligned with the Future Gas Strategy – with LCH being considered as a key potential demand centre for gas – and to the six proposed Net Zero Sector Plans to ensure supply and demand are aligned and the necessary infrastructure is put in place for all the elements of a LCH industry and of a future net zero economy.

Establishing a competitive hydrogen export industry

International LCH customers will seek out the least-cost and most reliable suppliers to support their net zero transformation. Countries and regions around the world are competing to scale up their LCH industries, with an eye on future international trade of LCH and LCH-derived products. By taking a technology-neutral approach, key energy market players are looking to reduce the cost of LCH and associated products and maximise the volume of LCH produced, increasing their international competitiveness – the production of low-emissions steel and ammonia from higher-cost hydrogen will result in higher-cost steel and ammonia than that produced using lower-cost LCH pathways. The United States' Inflation Reduction Act provides up to US$3/kg of hydrogen produced based on the emissions intensity of the hydrogen produced, without excluding any LCH pathways. Countries in the Middle East are expected to be some of the lowest-cost LCH producers globally – with hydrogen from natural gas with CCUS able to be produced at a cost of as low as US$1/kg today.[8] Similarly, LCH customers are prioritising emissions reductions and costs over technology pathway. The United Arab Emirates have

[7] Advisian 2021, *Australian hydrogen market study – Sector analysis summary*
[8] IEA The Future of Hydrogen – Seizing today's opportunities

already supplied LCH cargos produced form natural gas with CCUS to Japan.[9] The first shipment of hydrogen from Australia to Japan was produced from coal, which has been followed up with an investment of $2.35 billion in the production of LCH from coal with CCUS. For Australia to maximise its competitive advantage and compete globally for the future LCH market, a technology-neutral approach to LCH that incorporates all LCH production pathways will be critical. Exporting the lowest cost LCH possible will also increase the role of LCH in the region – making LCH accessible to a broader number of countries and customers – and in-turn maximising emissions reductions beyond Australia's borders.

Australia's energy exports must align with the needs and capacity of partner counties and take a staged approach to LCH exports. LCH carries with it a cost premium when used domestically, and this premium is only increased when considering LCH exports. This cost premium is exacerbated further by the technical challenges of shipping liquid hydrogen and the likely need for the addition of intermediary steps – such as converting the hydrogen into ammonia – to facilitate transport. In addition, demand for LCH imports is currently embryonic and will take time to develop, as LCH-based facilities are developed at scale. Accordingly, the integration of LCH into these economics will take time and continued export of conventional fuels – including LNG – will be necessary to keep the lights on. Australia's energy exports must evolve with the needs of exporting countries.

To reconcile the gradual increase in LCH demand in importing countries with the large-scale "chunky" nature of LCH export facilities an integrated LNG/LCH strategy should be considered. This could involve the continued export of LNG to supply both existing natural gas demand as well as LCH production in the importing country based on natural gas with CCUS. Should the recipient countries not have the geology to store CO_2, it could be shipped back to Australia for storage in association with Australian CCUS projects. By producing LCH in-country, energy importing economies can utilise existing LNG infrastructure and supply chains to scale up LCH production in-line with the growth in LCH demand and the roll-out of hydrogen infrastructure. Once demand grows sufficiently and the technologies associated with hydrogen transport mature and costs come down, consideration can be given to complementing LNG exports with direct LCH exports. This approach allows LNG exports to act as an enabler to LCH scale-up in partner counties.

APPEA and its members welcome the opportunity to provide input into the development of the National Hydrogen Strategy issues and look forward to inputting further as the strategy develops.

Yours sincerely,

S McCulloch

Samantha McCulloch
Chief Executive

[9] www.japantimes.co.jp/news/2021/08/19/business/corporate-business/uae-blue-ammonia-japan

ANNEX 1: The Australian upstream oil and gas industry

The Australian oil and gas industry has invested well over $400 billion in the Australian economy undertaking exploration and developing natural gas production, transport, liquefaction and export facilities over the last decade.

This investment will deliver returns for Australia for decades to come, through increased gas supply for Australian customers, export revenue, jobs, and in payments to governments in royalties and taxes – nearly $65 billion[10] in payments have been made to government over the last decade.

LNG is now Australia's second largest export commodity after iron ore, with export revenue of more than $91 billion in 2022-23.[11] As well as providing a significant return to the Australian economy, this LNG export industry is also a key enabler of domestic gas supply.

The oil and gas industry supports 80,000 jobs directly and indirectly in Australia and hundreds of thousands more in manufacturing.

Investment in new gas supply for the east coast market is critical to the ongoing functioning of a stable, reliable electricity market and affordable domestic gas supply while the broader energy market transitions through the closure of coal-fired power generators, the construction and grid connection of new renewable projects and the implementation of storage or peaking capacity to firm renewables.[12]

The industry is pivotal to reaching net zero, supporting the transition away from coal, providing the firm dispatchable energy required to unlock our renewable energy potential, and powering Australian industries across the economy. The industry is also central to delivering step-change technologies including CCUS and low-carbon hydrogen.

[10] See Media Release: Oil and gas industry helps bankroll public services despite pandemic challenge | APPEA and Historical-Summary-2019-20.pdf (appea.com.au) for more information. Over and above this, Australia's LNG exporters are set to almost triple their financial contribution to the public this financial year, forecasted to pay an extra $9 billion to federal and state governments. New preliminary forecasts released in October 2022 revealed the gas export sector is estimated to pay around $13 billion during 2022-23 – up from $4.8 billion forecast for last financial year (see Media Release: LNG exporters forecast to pay extra $9 billion to governments as tax and royalty collections almost triple | APPEA for more information).

[11] See Office of the Chief Economist - Resources and Energy Quarterly - September 2022 (industry.gov.au) for more information.

[12] For example, the Australian Energy Market Operator's (AEMO) recent *2022 Integrated System Plan* (available at AEMO | 2022 Integrated System Plan (ISP)) confirmed the long and enduring value of natural gas partnering with renewables with the report finding (page 57): *"Peaking gas-fired generators will play a crucial role as significant coal-fired generation retires, as an on-demand fuel source during extended periods of low VRE output, and to provide power system services for grid security and stability and High renewable output and high demand – gas is needed to meet the demand peaks just after sunset, and to keep going through the night to cover wind variability."* See Media Release: 'Crucial' role for gas powering electricity grid for decades: AEMO report | APPEA for more information.