28 July 2019

Dr Alan Finkel AO
Chairman, Hydrogen Strategy Group
COAG Energy Council
Australian Government

Our ref:

Your ref:

Dear Dr Finkel,

GHD response to the National Hydrogen Strategy Issues Paper Series

On behalf of GHD, thank you for the opportunity to respond to the National Hydrogen Strategy Issues Paper Series.

We acknowledge there is an exciting and unique opportunity to develop a new clean hydrogen energy export market leveraging Australia's high value renewables resource position to respond to unprecedented momentum and potential growing global demand for hydrogen.

We wish to congratulate the Taskforce for implementing a considered and inclusive consultation format across two phases in March and July 2019.

The Issues Papers provided a clear synopsis of the views and threads emerging for consideration in the development of a hydrogen industry for Australia.

Close collaboration between governments, industry, researchers and communities in the coming year will be of great benefit to us all. We see substantial opportunity for technical and professional services firms, such as GHD, to contribute to shaping a sustainable and thriving new industry of which we can all be proud.

GHD is pleased to present responses to six of the nine issues papers, as follows:

- Issues Paper 1: Hydrogen at scale
- Issues Paper 2: Attracting hydrogen investment
- Issues Paper 3: Developing a hydrogen export industry
- Issues paper 5: Understanding community concerns for safety and the environment
- Issues paper 6: Hydrogen in the gas network
- Issues paper 9: Hydrogen for industrial users

Our collective GHD response has been drawn from various highly-experienced technical consultants from across the oil and gas, hydrogen, power generation, renewables, economics, safety, environmental approvals, and communication and engagement disciplines.

To bring a global perspective, we captured insights from GHD consultants located in our Canadian and United Kingdom operations.

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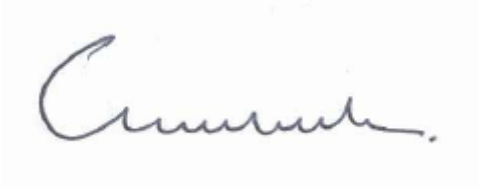
Thank you again for providing the opportunity for us to share our perspectives and contribute to this important policy initiative.

We look forward the release of the final National Hydrogen Strategy later this year.

Regards,



Craig Walkemeyer | A GHD Principal

Australian Market Leader – Energy & Resources

GHD response to National Hydrogen Strategy Issues Papers

Australian Government
Department of Industry, Innovation and Science

COAG Energy Council

GHD

28 July 2019

Issues paper 5: Understanding community concerns for safety and the environment

Consultation Paper 5: Understanding community concerns for safety and environmental impacts

1. **Do existing regulations adequately manage the potential carbon emissions of a large-scale national hydrogen industry?**

   The key to answering this question depends on how the hydrogen is produced in a new facility.

   For example, if it is produced by creating a syngas from a fossil fuel and separating out the hydrogen then in Victoria it is subject to the requirement to receive an approval from EPA Victoria under the EP Act 1970. In determining whether to grant an approval EPA considers best practice, energy efficiency, greenhouse gas emissions and climate change.

   It is anticipated that any commercial scale project would need to include carbon capture and storage to gain environmental approvals and community support. If a future facility was predicted to have >200,000 tCO_2-e of direct emissions, it would currently need to make a referral to determine whether an Environmental Effects Statement is required for the project or an EPBC approval.

   Currently however, again in Victoria, if the hydrogen is created by electrolysis, then the facility would not require approval from EPA (unless it is not sourcing electricity from the grid and is creating its own electricity using fossil fuels on site). This is because there are no direct emissions from the facility.

   Rather, it is like any other large user of electricity. There may be additional emissions created because of the hydrogen facility but these would occur at the source of the electricity generation.

   The source of electricity generation may be regulated by EPA if it consumes fossil fuels to create the electricity but this regulation does not link back to the end user of the produced electricity. The EES referral/EPBC 200,000 tCO_2-e trigger would not apply to the electrolysis facility as the trigger is for direct emissions not using electricity from the grid.

   At a Federal level, if the hydrogen producing facility produces more than 25,000 tCO_2-e of direct emission or consumes electricity equivalent to 25,000 tCO_2-e, it would need to report its emissions under the National Greenhouse and Energy Regulations (NGER). The NGER, however, currently does not limit the amount of emissions from a facility.

   As stated in Issues Paper 5, the safeguard mechanism (SGM) applies to facilities that emit greater than 100,000 tCO_2-e. New facilities predicted to emit greater than 100,000 tCO_2-e will need to apply to the Clean Energy Regulator for a baseline which will be calculated as production amount multiplied by an emission intensity for that product (currently no emission intensities have been set by DoEE).

   If during operation, actual emissions exceed the baseline set then the facility would need to purchase offsets (Australian Carbon Credit Units – currently approximately $15 per tCO_2-e) to bring emissions back down to the set baseline. This would only apply to hydrogen projects using fossil fuels as raw materials as the SGM only applies to direct emissions.

   The SGM does apply to fossil fuel based electricity generators. However, it currently would allow for considerable amounts of electricity to be supplied to hydrogen generators before any penalty was applied.

2. What are the main community concerns about the use of CCS? How can we better manage these concerns and potential CCS projects in regional areas?

Perceptions of Carbon Capture and Storage

The main concerns, and possibly what is driving those concerns, is an overall lack of knowledge about carbon capture utilisation and storage (CCUS) technology and impacts; and that it is perceived to be unproven technology in Australia. This perception is despite the fact that there has been significant Australian effort in developing CCUS through bodies such as the CO2CRC and Global CCS Institute.

A key point made in Issues Paper 5 is that, 'the risks and opportunities for acceptance of hydrogen will change as awareness grows, and as people start seeing the technology emerge in their lives'. The same is true of CCUS – until it is a reality, it may be difficult to change perceptions on a community-wide level without pointing to the runs on the board.

CCUS is fundamental to enabling a commercial-scale coal-hydrogen energy supply chain pathway, unlocking enormous and immediate export opportunities for Australia, while also supporting our existing coal industries to produce clean, low emissions hydrogen – it has the opportunity to be perceived as a win-win.

When speaking to communities or observing media coverage on the issue, the typical threads around concerns involve environmental impacts associated with storage leakage fears – what impact could that have on the marine environment or other natural assets eg. for offshore CCUS, would leakage change the ocean acidity?

There may also be an ideological rejection of CCUS due to some perceiving it as 'propping up' the coal/fossil fuels industry, rather than perceiving it as playing an important role the in decarbonisation of various industries globally.

What can be done to address concerns?

Addressing perception issues would benefit from a three-pronged approach:

1. Develop a credible Australian plan for CCUS based on science and real-world applications and with reasonable times for technical development.
2. A community-wide educational approach using real-world success stories to demonstrate the results, value and benefits that CCS plays in terms of decarbonisation of key industries, and leveraging industry influencers to be an independent voice and act as a powerful advocate.
3. An on-the-ground locally affected (perceived or real) community approach to address localised concerns, building a long-term, trusted relationship over time.

We need to acknowledge that concerns will likely vary depending on location – the concerns of communities such as Golden Beach in Victoria may be very different to communities neighbouring the CTSCo's Surat Basin CCS project.

Additional perceptions research to gain deeper community-wide understanding

It is tempting for industry and Government to make assumptions and conclusions about the real drivers behind CCS concerns. However, the only way to uncover awareness levels and sentiment is to survey a broad cross-section of the community with a representative sample size, supported by qualitative research such as focus groups.

We agree with CSIRO's comment in Issues Paper 5. There is a need to better understand the community-wide concerns with additional and regular primary research to extend on the initial UQ perceptions study findings – once known, Government and industry will be in a better position to collaborate in order to develop the facts to break down the myths.

Once a solid benchmark of awareness and perceptions is understood, this should be re-tested in a longitudinal study. These findings should be shared with industry proponents, as well as Government, in order for there to be a constant shift in our collective communication and engagement approaches – this can not only be an industry proponent responsibility.

Share lessons learned from those on the ground

In addition to market research, insights can be drawn from on-the-ground, real-time community feedback being collected by CCS entities as an invaluable source of knowledge to help shape the right narrative.

Entities at the front line of community interactions on CCS, like CarbonNet in Victoria, are capturing real-time community feedback about the concerns being raised. Appropriately, their approach has been to be visible and available to locals so people can raise concerns directly with technical leaders in the field and receive immediate information to answer concerns. These insights are invaluable to the rest of the industry.

A key challenge will be to maintain this level of constant communication and engagement in the long-term.

Amplifying key messages to build support

- Amplify the narrative around CCS as being the most cost competitive pathway to hydrogen right now – that it has to be a transition/staged approach
- Build a sense of urgency around the need for change to enable to clean energy future, and CCS's role in responding in the immediate term
- Explain why CCS is central to unlocking a decarbonised future for a variety of industries. Rather than communities or interest groups forming up an immediately negative opinion, we need them to be cheerleaders.
- Look at ways to also develop CCU opportunities for local and regional projects.

3. <u>What are the risks about using desalination plants or water recycling facilities to produce water for electrolysis?</u>

In terms of managing water scarcity concerns, the use of desalination plants or recycled water could present enormous benefits. However, there are still some technical challenges to overcome.

Management of brine generated by desalination plants is both a techno-economic and environmental challenge. Thermal brine treatment processes (e.g evaporator crystallisers) are energy intensive and present numerous operational challenges (scaling, water chemistry). The market for by-product salts is also very limited. The more crude methods of brine treatment (salt dams, deep well injection, surface water disposal etc) also present their own ecological risks on top of risks associated with social licence to operate. The existing, large scale, sea water reverse osmosis desalination plants around Australia with brine discharge to ocean provide advanced learnings and solutions for this challenge.

Modern desalination plants are reverse osmosis based, although other membrane technologies (forward osmosis, VSEP, membrane distillation) are being commercialised and may warrant consideration. Thermal distillation units (MSF, MED) are still employed, particularly in the Middle East.

The choice of desalination technology will have an impact on overall energy requirements and lifecycle cost, and lifecycle carbon emissions, for the production of hydrogen and therefore any desalination method should undergo a focused technology selection study.

Australia's experience with existing large-scale sea water desalination provides a solid starting point for the cost and energy impact on the hydrogen industry. There are perhaps even potential synergies to be considered for hydrogen infrastructure relative to these existing assets although the required scales are different.

4. **How can we best balance the water and land use requirements for environmental, agricultural, community and hydrogen production uses?**

There is likely to be substantial community concern regarding water security for the environment, human use, and agriculture if plants are proposed in inland regions to produce hydrogen by electrolysis, particularly given the current drought and climate change projections.

There are strategic land use planning frameworks in each state that provide the opportunity for a range of industries to take place, including hydrogen production. If there are specific locations or regions that are better suited to particular types of hydrogen production (i.e. hydrogen production from fossil fuel compared to hydrolysis), a strategic review could be undertaken to determine whether there is sufficient suitably zoned land available.

Strategic land use planning could also consider the potential issues associated with cumulative impacts due to clusters of developments around nodes that are likely to be particularly attractive for development (this is an issue with other industries).

5. **Hydrogen production projects will require significant project and environmental approvals at the local, state and federal level. What approaches could help to manage these approvals to facilitate industry development while providing suitable environmental and natural resource protections and managing community expectations? When do these approaches need to be in place by?**

One of the key challenges is that it is a new industry in Australia and the planning and environmental approval process for large scale production facilities is yet to be tested in some jurisdictions.

This is unlike other industries, including the fossil fuel and renewable energy sector, where legislation has evolved over time and contains specific provisions to permit and control development.

Planning and environmental approval legislation could be reviewed and amended if necessary to ensure that there is a clearly defined pathway, and perhaps provide a streamlined State-led approval pathway that integrates approval requirements.

Flow charts for planning and environmental approval processes could also be developed so this is clear to proponents as well as the community. This would assist to manage community expectations by identifying key points in the process where they will have an opportunity to provide input.

6. **What are the most important standards and regulations to have in place to ensure a safe hydrogen industry and address the community expectations?**

As noted in Issues Paper 5, community acceptance is strongly linked to perceptions of safety, and those who know more about the properties and uses of hydrogen, are more likely to be supportive. Coupled with highlighting the economic growth and job creation possibilities, this will help with generating better understanding and acceptance.

Based on GHD's community engagement experience on hydrogen projects in Australia, to address concerns and manage community expectations, confirming a clear set of standards (whether they be based on existing or modified for hydrogen) will be important for:

- Hydrogen storage (gas and liquefied)
- Hydrogen transportation (by road)
- Hydrogen gas pipelines
- Hydrogen Liquefaction plants
- Aspects of export terminal design and operations
- Marine shipping routes.

Major Hazard Facility legislation and the associated Safety Case methodology is now mature in all Australia States and Territories and provides a systematic approach to identifying, quantifying and managing risk. Although some hydrogen projects may not trigger MHF thresholds for Scheduled Material storage and use, the methodologies used in the Safety Case preparation are relevant, applicable, well developed and well understood.

The Regulatory Agencies with the requisite skills to review and challenge Safety Cases already exist. Government and industry could choose to apply these methodologies to demonstrate a thorough assessment and understand potential safety impacts from these developments on the community.

The quantified risk assessment approaches used in Safety Cases would enable comparisons of the new hydrogen activities with many other common hazardous activities with which the public is already familiar.

These data and analogies could form a powerful, fact-based community information program and help avert misinformation and misunderstandings occurring that can be difficult to reverse.

GHD foresees a potential challenge is that the above information may emerge too late in the development of the new hydrogen Industry as the requirement for a Safety Case Submission only occurs at the advanced stages of the project execution. Furthermore, many of the smaller pilot and developmental projects may not trigger the MHF Scheduled Material thresholds. Therefore, it is suggested that the national hydrogen strategy should include for these risk assessment activities to be undertaken early in the project phase to help inform policy and the community. This could be achieved, for example, by undertaking the necessary risk quantification for exemplar project configurations.

As highlighted by Hydrogen Mobility Australia in its March submission, if a majority of the environmental and safety aspects associated with the production, distribution, and use of hydrogen can, in fact, be effectively managed through existing regulations, codes and standards, it is of upmost importance that communities are aware of this fact.

Breaking down the fears and normalising hydrogen

Normalising hydrogen applications in our everyday lives could help achieve a shift in safety fears over time. GHD is aware of technology advancements such as work by the University of NSW who developed a hydrogen-fuelled electric bicycle and a domestic-scale BBQ – these small-scale applications could help bring hydrogen applications closer to reality.

7. **As an individual, how would you like to be engaged on hydrogen projects? Which aspects would you like to be kept informed of? Which aspects would you like to be consulted on? Are there any types of issues or challenges that you, or affected communities, would want to be a part of formulating solutions and recommendations?**

Nil response applicable.

8. **What are the best ways of engaging diverse communities in regional and remote areas?**

GHD has worked with government and industry clients to engage regional and rural communities and key agency stakeholders for many years, including in the context of emerging industries, such as the CSG industry.

Key lessons learned to inform the best ways of engaging diverse communities in regional and remote locations include:

Engage the Council: Early involvement by the Local Council in shaping the right approach to engaging their communities is essential – they are a critical voice and have a deep understanding of their community

Acknowledge the diversity of communities: Understanding and acknowledging the differences between each community is key – each will have their own wants and needs in terms of aspirations for their local area – knowing this helps determine what topics or issues are of upmost importance to them and what they will expect to be informed and engaged about

Foster the support of local community opinion leaders as advocates: Regional and remote communities will typically have key opinion leaders/ influencers whom often wear a number of hats eg football club president, fourth generation farmer etc – these people become a primary stakeholder to identify and engage with early and often

Media: The Local newspaper is still a very important source of information – knowing the editor and journalists personally helps to ensure the project team is able to communicate important updates through this platform

Be part of the fabric of that community: Being present and on the ground to develop trust as part of the local community is crucial. – Set up a shop in the main street – be part of the fabric of that town Build trusted relationships: Face-to-face briefings with landholders will be more meaningful and gain better traction in terms of building trust.

Provide independent and scientifically based factual support: Communities are reassured when they can see that key safety and environmental information is not tainted with a potential conflict of interest and when it is delivered in an understandable and relatable form. GHD provided additional suggestions related to this in its answer to Question 6 above.

9. What role could an industry code of conduct play in gaining community support for hydrogen projects? What community engagement principles would you like to see in an industry code of conduct?

Established community engagement and sustainability models

GHD strongly agrees that creating the right framework from the very beginning gives clarity and certainty in terms of what to expect from an emerging hydrogen industry – for the governments funding the projects, for surrounding communities, and for the future industry proponents.

There are a range of established industry best-practice infrastructure sustainability assessment models and community engagement principles that should be leveraged in the development of an overarching industry code of conduct.

International Association of Public Participation (IAP2)

Community engagement practitioners, including GHD, will often develop fit-for-purpose engagement approaches using well-known and widely accepted models like the International Association of Public Participation (IAP2) engagement spectrum. The spectrum provides guidance for the extent to which the public should participate in shaping aspects of project design and implementation, and the appropriate engagement tools.

Infrastructure Sustainability Council of Australia (ISCA)

ISCA has an Infrastructure Sustainability (IS) Rating scheme that facilitates the ratings of infrastructure projects and assets.

The IS Rating scheme is Australia and New Zealand's only rating system for evaluating sustainability across design, construction and operation of infrastructure. IS evaluates the sustainability performance of the quadruple bottom line (Governance, Economic, Environmental and Social) of infrastructure development. This rating scheme could be adopted by industry proponents in order for a proposed project to be assessed on its level of sustainability performance; and provide benchmarks against which to measure each project. This could provide comfort to communities expecting to be impacted by projects in their region.

Developing a hydrogen industry Code of Conduct

GHD has been actively involved in facilitating purposeful and mutually-beneficial community engagement outcomes for over 20 years. In our experience, there is usually inevitable teething problems when industry proponents are unclear about the expectation of their obligations to the communities in which they operate.

As such, GHD believe there are substantial advantages in government leading the way with a code of conduct developed in close collaboration with all levels of government, industry, and the professional infrastructure consulting firms who will inevitably be working on-the-ground and acting as the project ambassadors/representatives.

Finding the right balance will be important – guidelines need to be clear enough to understand the expectation without being too prescriptive and deterring investment.

Engagement principles in a code of conduct should cover topics such as:

- Engaging with Indigenous communities
- Level of public participation - the level of community engagement depending on the phase of work (ie Approvals, Planning, Site Selection, Design, Construction Methods, Operational phase)
- Land access obligations

- Complaints management and escalation procedures
- Decommissioning expectations and legacies
- Local industry participation obligations – local employment and suppliers.

10. <u>What governance structures (such as legislation and regulation) would the federal, state and local governments need to put in place for a large scale hydrogen facility?</u>

Further governance structures would be required where hydrogen production facilities use fossil fuels as the energy source for the hydrogen production, to ensure lifecycle emissions are positively reduced as a result of hydrogen produced.

This could be determined by undertaking a lifecycle analysis of the tCO_2-e produced per kg of hydrogen gas produced, and potentially setting limits on the production of tCO_2-e per kg of hydrogen gas produced. This would further incentivise emission reduction options like carbon capture and storage (CCS). Where hydrogen gas is produced from renewable electricity in electrolysis, this issue is reduced.

Additionally, undertakings from project proponents to purchase Australian Carbon Credit Units (ACCUs) or MWh of renewable energy could be allowed as a means of offsetting the emissions, if fossil fuels are used as the energy source, or while CCS facilities are being developed.

Standards for the requirements for carbon, capture and storage facilities would also needed to be developed to support the use of CCS in these sorts of situation.

It would be advantageous if any rules of these kind where developed on a national level to reduce regulatory risk for project proponents. If a lifecycle analysis approach was proposed, a standardised method to calculating the emissions should be developed. This will ensure consistency between projects. This should be based on the ISO 14040 and ISO 14044 standards. A similar approach has been developed for bioenergy projects, led by the Australian Renewable Energy Agency.

11. <u>What further lessons can we learn from the mining, resources and renewable energy sectors about establishing and maintaining community support?</u>

As an emerging industry, we have the important opportunity to collaborate with governments, project proponents, research institutes and most importantly, communities, to get it right from the very beginning.

Basing our approaches on lessons from oil and gas, mining and other renewable energy sectors, as well as by genuinely acknowledging community concerns of hydrogen project impacts, and working hard to address them in practical and tangible ways, will be key to us developing a sustainable and thriving export market.

Specific approaches and methods which should be considered in order to establish and maintain community support include:

- Explaining why; not just what is happening – bring people on the journey around the pros and cons of transitioning to a clean hydrogen energy future
- Ensure the local benefits are identified and communicated – economic growth, jobs for locals, new skills
- Engage on the solutions – site selection, supporting infrastructure needs, waste and water resources, local impacts during construction
- Engage communities on their preferred engagement and communication channels – tailor those approaches to each community as they will usually have different needs depending

on the local context eg current mining town, in need of economic growth, environmentally-sensitive area, agricultural communities

- Utilise Community Reference Groups appropriately – make them purposeful, have a clear Memorandum of Understanding in place for members to contribute in a meaningful way and avoid wasting people's time
- Utilise Information Sessions carefully – ensure people have access to the right experts and information at the sessions
- Measure the social impacts and social benefit outcomes in a transparent way and report back to communities often
- Be upfront about what happens at the point of decommission – will there by ongoing jobs.

Geologically prospective areas for carbon sequestration include the North West Shelf, where the Gorgon Project is located, and Bass Strait. The Gorgon project will store captured carbon in the Dupuy formation beneath Barrow Island. Chevron recently applied for a licence to operate the carbon sequestration portion of the project; once implemented it will be clear how successful this sequestration installation could be. The Cooper Basin may prove to be another suitable location. Distances from industrial centres are a challenge.

Other carbon sequestration methods include (1) soil sequestration, (2) forest and other vegetation sequestration, (3) ocean sequestration and (4) mineral carbonation. Of these, ocean sequestration and mineral carbonation are the most bound to specific locations, while the first two could be undertaken in various locations around Australia.

4. Technical considerations in transition to clean hydrogen

- **What would a conversion to clean hydrogen look like in your industry, in terms of timing, effect on production, equipment changes?**
- **What existing sites might be suitable to demonstrate industrial use of clean hydrogen?**
- **Does existing equipment in industrial heating applications have the technical capability to handle increased NOx emissions?**

Hydrogen can help tackle various critical energy challenges, as it offers ways to decarbonise a range of sectors where it is difficult to meaningfully reduce emissions any other way – like long-haul transport, chemicals, and iron and steel.

A large number of oil and gas firms are investigating how they can add renewables to its production portfolio and supply chain.

Many existing sites already use hydrogen. The overall mass and energy balance of the process would be significantly affected for sites using reformers to generate the hydrogen where as those receiving hydrogen deliveries or generating hydrogen using electrolysers should be able to make the transition more easily. The applications of hydrogen in industry are diverse and may be broadly split into the following areas:

- Fuel production: product upgrading of oils and intermediary fuels in both conventional and bio refineries
- Synthesis agent for the production of ammonia and ammonia based value chains. These include fertilisers, explosives and a number of intermediary commodity chemicals such as urea and methanol.
- Power Plants: Hydrogen is used a cooling agent for large turbo-generators.
- Manufacturing: Hydrogen is used in a variety of industrial sub-sectors as a reagent, primarily because of its reducing capability. These include glass making, food and beverage production, pharmaceuticals and electronics.

In addition, hydrogen is one of the options for storing energy from renewables.

Hydrogen used as energy storage can contribute to the resilience of our major electricity systems in Australia. Long-term energy storage in micro-grid sites, such as remote mine sites could benefit.

To understand conversion issues, the principal differences in hydrogen versus, for example natural gas, must be understood. The properties of low specific volume, high heating value, high flame speed and temperature, low flame visibility, low molecular weight and low (volumetric) energy density would all contribute to significant changes for a conversion plan.

The molecular properties of hydrogen require specific strategies for the mitigation of risk related to hydrogen embrittlement and leakage, which impacts design and construction of pressure vessels and process piping. Collectively these properties materially affect the way in which safety should be managed on an industrial site.

The oil and gas industry is in the fortunate position where safety and design standards are already in place which can serve to a large extent in a hydrogen industry.

The Toyota Ecopark Hydrogen Demonstration Project is a good example of how a decommissioned site can be put to good use for development of the hydrogen industry. This site used to be a car manufacturing facility, and is now utilised to produce green hydrogen and test storage methods and automobile refuelling. There are more such unused industrial sites around Australia (for example aluminium refineries) that could be put to good use to advance the hydrogen industry through test and demonstration work.

5. Hydrogen safety and regulation for industrial users

- **Are there examples nationally and internationally that illustrate best practice for industrial hydrogen safety regulation and handling expertise?**

There are currently no Australian Standards that deal specifically with hydrogen safety regulation and handling. The International Organization for Standardisation (ISO) body has developed some critical standards that cover various aspects of potential hydrogen supply chains including: basic hydrogen safety (ISO15916), water electrolysis for industrial application (ISO 22734), fuelling stations (ISO 19880), PSA systems for hydrogen purification (ISO 19883) , fuel quality (ISO 14867) and gaseous hydrogen storage (19884) amongst others. The ISO body continues to refine and develop new standards as the industry matures.

It is understood that Standards Australia is engaging the ISO body to request membership for the hydrogen technologies technical committee (ISO/TC 97).

Many of the major international oil refiners could be expected to have mature company standards for hydrogen. Experienced engineering and operating companies, especially ones already in the oil and gas, and in particular the CSG and LNG industry, can assist to develop these standards required for hydrogen production, transport, storage and utilisation.

6. Role for governments in supporting a transition to clean hydrogen

- **Are there any gaps in the existing mechanisms for government support for Australian industry to transition to hydrogen?**

A clear, stable policy that puts a price on CO_2-e emissions linked to Australia's international commitments for emissions reductions in the Paris agreement would provide a firmer foundation to allow industry to start modelling the benefit of transitioning to hydrogen as a fuel source.

The Safeguard Mechanism, which is part of the current National Greenhouse and Energy Reporting and Emissions Reduction Fund legislation, could be used for this purpose if it were to be amended to result in tighter caps in direct scope 1 emissions at a facility level.

Clear policy agreed at a State and Federal level, for the decarbonisation of the electricity sector would lead to greater incentive for the further growth in the use of renewable energy – and potential use of carbon capture and storage for fossil fuel sources, in the generation of electricity. This is clearly required to ensure that our economy wide targets for the emissions reduction under the Paris agreement are met at a reasonable cost.

The support of State Governments is important as is demonstrated by the Victorian Hydrogen Investment Program, the Queensland Government, and now the Western Australian Government industry development fund, which is to be implemented soon.

While Australia has a highly skilled workforce, there is still a gap in skills when it comes to the hydrogen industry. The government could assist to provide a framework for additional education and research and development in the hydrogen industry.

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