CLOSING THE REGULATORY GAPS AND ADVANCING HYDROGEN INFRASTRUCTURE DEPLOYMENT IN AUSTRALIA

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ABSTRACT

With downward trends in Australian equipment manufacturing, there are increased numbers of overseas designed, manufactured and certified hydrogen systems being introduced into Australia. In parallel there are also opportunities for hydrogen and its carriers to be exported to overseas. Certainty of reputable codes and standards is important to meet regulatory requirements and community safety expectations locally and overseas.

This paper is a progress report of Hydrogen Mobility Australia's (HMA) Technical Committee on mapping the regulatory, codes and standards (RCS) gaps in Australia and establishing a pathway together with Standards Australia, and Commonwealth and State Governments. This paper will discuss the benefits of the pathway covering the areas of:

- Safety – Enable Australia to implement consensual rules to minimise avoidable risks to persons and goods to an acceptable level
- Environment – Ensure protection of the environment from unacceptable damage due to the operation and effects of products, processes and services linked to hydrogen
- Elimination of barriers to trade – Provide consistency between international jurisdictions enabling streamlined entry of hydrogen related equipment from overseas
- Upskilling of Australian industry participants – Gain useful learnings from countries more advanced in their progress in implementing ISO standards and hydrogen sector development

This paper is jointly prepared by representatives of HMA Technical Committee and Department of Energy and Mining, South Australian Government. The paper also highlights the initiatives of Commonwealth and State Governments to advance the hydrogen economy.

1.0 INTRODUCTION

Hydrogen is being recognised globally as having the potential to play a significant role in a future sustainable energy system as a highly versatile energy carrier. The realisation of a hydrogen society built around this clean energy represents a solution to reducing greenhouse gas emissions and the world's reliance upon fossil fuels.

Hydrogen is already produced in Australia for industrial applications in the chemical, power generation, glass, food ammonia and other industries and is safely transported across the country usually in gas cylinders or tube trailers. With hydrogen increasingly being recognised as a clean/green fuel that could

mitigate the impacts of global warming, it has been identified as having the potential to play an important role in the clean energy transition. For example, hydrogen can be produced from carbon-free or carbon-neutral energy sources or from fossil fuels with carbon dioxide capture and storage (sequestration). Thus, the use of hydrogen could alleviate and eventually eliminate greenhouse gas emissions from the energy sector.

Hydrogen opens up access to a broad range of primary energy sources, renewable energy sources (e.g. wind, solar, ocean, and biomass), thus enhancing energy security through increased diversity and less reliance on import of fossil fuel to Australia. Hydrogen and electricity also allow inter-operability and change-ability in balancing centralised and decentralised power, intelligent grids, and power for remote locations.

To be a successful energy carrier as well as for fuel use, hydrogen ought to be economically competitive too, and technological advance and mature via an infrastructure that provides a safe and environmentally acceptable energy system throughout the entire energy source, production, distribution and end-use chain. Hydrogen has been produced and used for commercial and industrial purposes with a good safety record. From a historical perspective hydrogen safety research is however scattered, particularly in Australia, although the hydrogen industry has considerable experience in the safe handling of hydrogen gas in bulk, both in refineries and in chemical plants.

Hydrogen has been widely used in many industrial applications, but not as extensively in the public domain as projected as an energy carrier in 2030 and beyond (which is the timeline outlined by the Australian National Hydrogen Strategy). In those commercial and industrial environments, only well-trained personnel come into contact with and handle hydrogen. When hydrogen becomes more widely used as an energy carrier and fuel, it is expected there will be high demand for laypersons to acquire some level of skill and competency in handling various forms and pressure of hydrogen. The development of skills in the safe handling of hydrogen is key to Australia's ability to compete with overseas markets. RCS will also play a significant role in education and training, thus supporting community acceptance.

In the mobility sector, hydrogen as a transport fuel is being adopted in several countries, including Japan, South Korea, Germany and the UK among others as a solution to the decarbonisation of the sector. The provision of hydrogen refuelling stations is a precondition of the introduction of FCEVs of which Australia currently has two with an additional three stations in progress.

Specific hydrogen standards have been developed overseas for these stations, most notably ISO standards which provide guidance on safety and performance and cover hydrogen production, delivery, compression, storage and fuelling. These ISO standards are yet to be adopted in Australia which has led to some uncertainty for the design and implementation of Australian projects.

Hydrogen, including hydrogen mobility is a growing opportunity for Australia and has been recognised by the recent work of the Chief Scientist and CSIRO. However, to enable both vehicles and infrastructure to be introduced in volume to Australia, certainty of standards is essential.
To progress the necessary standards environment and to enable the effective development of an Australian hydrogen sector, both HMA and the Australian

Government are progressing several initiatives, which are the subject of this paper.

2.0 AUSTRALIAN INITAITVES TO CLOSE THE REGULATORY GAP

Australian Governments (Commonwealth) initiatives

Despite there being no specific hydrogen related legislation in place at this point in time, several policy documents on hydrogen have been developed in Australia in collaboration with research bodies and industry. The first two notable documents were released by the South Australian (SA) Government in 2017 Q2-Q3**.**
http://www.renewablessa.sa.gov.au

- August 2017 SA Green Hydrogen Study
- September 2017 South Australia's Hydrogen Roadmap
- August 2018 ARENA Hydrogen Export Study
- August 2018 Hydrogen Strategy Group briefing paper to COAG Energy Council
- August 2018 CSIRO National Hydrogen Roadmap
- 2019 National Hydrogen Strategy (yet to be released)

An overview of relevant activities to address the hydrogen regulatory gap in Australia are outlined below.

2.1 National Hydrogen Strategy

In December 2018, the Council of Australian Governments (COAG) Energy Council endorsed the development of National Hydrogen Strategy in recognition of the significant jobs and investment opportunities presented by hydrogen and the need for a coordinated approach to take advantage of this golden opportunity.

The National Hydrogen Strategy is being developed with a final document to return to the COAG in December 2019 for approval. A strategy in place by the end of 2019 is intended to enable Australia to define its role in the promising export market and position government and industry to implement the strategy from 2020 onwards.

One of the key principles of the strategy is safety and customer focus with policies and measures to emphasise safety and end-user benefits, in order to earn and maintain strong community acceptance while meeting the price, delivery and source expectations of hydrogen customers.
The development of the strategy has been segmented into five separated work streams, and one overreaching workstream which is called 'cross-cutting issues' and dedicated to regulations, standards, labelling and registration.

The National Hydrogen Strategy covers:

- Developing a hydrogen export industry - Infrastructure requirements (physical & market), regulation for safety and efficiency, inter-country agreements and bulk carriers
- Hydrogen in gas networks - Using hydrogen in the domestic gas network (initially at 10% and the potential for 100%), user and customer impacts,

and safety, metering and standards.

- Hydrogen for transport - Regulatory change assessment, refuelling infrastructure needs studies, assessment of potential for use in heavy vehicle, road and rail fleets and shipping, and standards and safety
- Hydrogen to support electricity systems - Potential of hydrogen to contribute to resilience of electricity markets and assessment of required regulatory changes
- Hydrogen for industrial users - Hydrogen use potential in existing industries and new industries using hydrogen
- Cross-cutting issues - Standards, regulation and labelling, research and innovation, safety and community engagement and governance Hydrogen precincts and cities

The development of the National Hydrogen Strategy is a complex undertaking, in part due to the interconnected nature of hydrogen and so therefore different working groups have been established:

- Australia's Chief Scientist chairs the National Hydrogen Strategy and oversees a stakeholder advisory panel of industry experts
- Six workstreams on various parts of the hydrogen value chain led by federal and state governments
- A 'virtual taskforce' to support the Working Group, its members from the jurisdictions, the regulators, and industry as appropriate.

A broad range of expertise is being contributed to the strategy development, including gas policy, gas safety, energy exports, energy security, law, heavy and light vehicle technology, transport, rail and road policy, the electricity market, technology, heavy industry, environmental impacts, innovation, governance, social acceptance, standards and labelling schemes, stakeholder engagement and communications, and implementation planning.

The Chief Scientist, who is chairing the National Hydrogen Strategy, has established a Hydrogen Strategy Advisory Stakeholders Panel to strengthen industry buy-ins to the strategy and ensure policy keeps pace with industry. HMA is a member of the Stakeholder Advisory Panel and will provide its input into all work streams, including the RCS related program.

2.2 South Australian Government (SAG) initiatives

http://www.renewablessa.sa.gov.au/topic/hydrogen

Hydrogen has been used for many years in South Australia and is only covered in the 'Dangerous Goods Act' as a substance. The Act does not refer to the use of hydrogen as an energy or as a feedstock.

The South Australian Government has recognised that ensuring safety in this new industry is critical to achieving a long-term sustainable industry. The South Australian Government also recognised the numerous challenges in the regulatory regime, therefore they are working towards creating a supportive regulatory environment which ensure regulations, codes and standards are fit for purpose and deliver efficient and cost competitive industry whilst maintaining high standards of safety and facilitating consumer support and associated high adoption rates.

Due to the broad range of possible hydrogen uses it creates complexity and therefore risk in developing RCS that are flexible for future needs and deliver safe outcomes. Therefore, the next step is to develop guidelines for investors and supporting communication strategies to overcome emotive views with trusted evidence for the public.

The South Australian Government supports early investments in hydrogen

In early 2017, the government established the "Renewable Technology Fund" which has provided grants (AU$17 million) and loans (AU$27.5 million) – for four major hydrogen related projects along with several renewable energy focused project initiatives:

1. Australian Gas Infrastructure Group's power-to-gas hydrogen demonstration plant located at the Tonsley Innovation Precinct, which will use renewable electricity to produce hydrogen using a 1.25 MW Siemens electrolyser.
2. H2U's renewable hydrogen and ammonia production facility located near Port Lincoln on the Eyre Peninsula providing grid stability, fertiliser and chemical production (approx. 30MW).
3. Neoen Australia's Hydrogen Superhub planned at Crystal Brook in SA's mid-north, envisioned to be the world's largest co-located wind, solar, battery and hydrogen facility (approx. 50MW).
4. The University of South Australia's demonstration project including hydrogen production, a hydrogen fuel cell, a flow battery, chilled water storage, and ground and roof-mounted solar photovoltaic (PV) cells

The South Australian Government is engaging internationally

- Delegations to ICHS2017, FC Expo February 19, Hydrogen
- Study Tour to Germany March 2019, US Hydrogen Safety Panel meeting April 2019
- North East Asian engagement via Tokyo Office (March 2019+)

- Ministerial delegations to Japan in April 2017 and March 2019, South Korea in Aug 2016 and March 2019
- Hosting inbound delegations
- Hosting the International Conference for Hydrogen Safety (ICHS2019) in Adelaide, 24-26 September 2019

Based on feedback from industry, the South Australian Working Group support is of real value as investors can contact a range of governmental stakeholders by one meeting where project specific issues can be easily clarified. In order to learn from the first movers across Europe, the South Australian Government also became a member of the International Association for Hydrogen Safety.

The South Australian Government is working in collaboration with other Australian jurisdictions and organised a 3-day long hydrogen safety workshop for jurisdictions, research bodies (including universities and associations) and secured a trainer from the US Hydrogen Safety Panel in 2018. The government is also an observer member of Hydrogen Mobility Australia (HMA).

The South Australian Government is supporting research and growing knowledge

- Issued the Green Hydrogen Study (Aug 2017) and the South Australia Hydrogen Roadmap (September 2017)
- Published interactive hydrogen map
- Sponsored the Future Fuels Cooperative Research Centre
- Published Hydrogen Research and Development in South Australia
- Proposed National Hydrogen Centre of Excellence

2.3 Hydrogen Mobility Australia initiatives

https://www.hydrogenmobilityaustralia.com.au/

HMA is a membership-based industry association with a mission to realise a hydrogen society for Australia. Through government advocacy, education and industry engagement, they are working to facilitate the introduction of hydrogen and fuel cell technologies to Australia, including zero emission transport solutions.

The association's membership comprises vehicle and component manufacturers, energy and technology companies, and infrastructure providers with interests across the hydrogen value chain, including hydrogen production, storage, export, power-to-gas, distribution and mobility. Together they recognise the significant opportunity the economy-wide application of hydrogen presents for Australia to decarbonise, diversify the energy mix and create jobs, investment and innovation.
As a hydrogen advocate, HMA's objective is to support the growth of this new energy sector in Australia by specifically:

- Accelerating the commercialisation of new hydrogen and fuel cell technologies by engaging with governments to create a comprehensive policy and regulatory environment
- Providing a forum for effective communication and collaboration of all stakeholders in the hydrogen and energy community across the public and private sectors
- Progressing Australia's shift towards a future hydrogen society built upon clean and renewable energy technologies through advocacy and education

exploiting the expertise, know-how and commercial drive of the HMA members

In 2018, HMA established a Technical Committee, charged with supporting regulators and standards setting bodies with the establishment of regulations, codes and standards (RCS) that ensure the safe generation, storage, transport, dispensing, usage and export of hydrogen.

With international standards harmonisation being one of the key focus areas of this group, the HMA Technical Committee commenced by undertaking a mapping exercise of the current RCS situation for Australia using a supply chain approach and identified various RCS gaps.

The Technical Committee through the gap analysis exercise then reviewed the published ISO standards developed by TC197 – Hydrogen Technologies and has determined that mirroring these standards is the most effective pathway to support the development of an Australian hydrogen sector. With Australia a technology taker for hydrogen technologies, standards mirroring is the preferred approach by HMA and its members.

In 2018, HMA co-hosted a hydrogen standards forum with Standards Australia. This forum provided a clear signal from industry and governments that hydrogen standards adoption was of high importance, and as a result, HMA successfully lobbied Standards Australia to upgrade Australia's participation on ISO Technical Committee 197 – Hydrogen Technologies from observer to participant.

Through the establishment of Standards Australia Committee, ME-093, the process of mirroring existing ISO standards into Australian standards will now take place over the coming years.
HMA has Initiated mirroring TC197 (priorities) given that ME-002 for ISO TC58 already – ME93 was established and the kick off meeting took place on April 10th2019. Various Working Groups are in place.

HMA is now proposing Standards Australia consider the EU model of hydrogen standards adoption re: technical committee and working groups, ISO TC197, ISO TC58, IEC TC105, ISO TC22, etc. Throughout the RCS mapping exercise, HMA also identified numerous Codes from EIGA (European Industrial Gases Association) are applicable to Australia. HMA have made recommendation to Standards Australia to consider to 'harmonise' those relevant codes relating to hydrogen and its use.

3.0 THE PATHWAY AND ITS BENEFITS

While the hydrogen economy in Australia is gaining strong momentum, there are a number of technological and non-technical barriers that need to be addressed. Solving the technological and non-technological challenges of hydrogen production, distribution, storage, transport and provision of the necessary infrastructure, at a competitive cost, requires a national co-ordination, which the National Hydrogen Strategy taskforce and State Governments are acting upon.

With hydrogen becoming an energy carrier which is to be deployed as widely as present-day fossil fuels, RCS are key market enablers. Reflecting this, the

Australian Chief Scientist Dr Finkel has said "… standards are a business's best friend. This truism applies very much to our emerging hydrogen business".

The introduction of hydrogen as a fuel and fuel cell technologies into the Australian market requires the amendment of existing regulations codes and standards or the creation of new ones. HMA's gap analysis revealed that the current Australian Standards publication does not adequately provide the required coverage. The option to 'create new ones' was explored but due to time and resources constraints as well as the need for consistency with international markets, it was found to be impractical. If these aspects of inadequate coverage and time constraints are not appropriately addressed in a timely manner, RCS can become a barrier rather than an enabler. This will hinder the introduction of technology deployment and put community acceptance in jeopardy.

HMA has explored the EU framework and its approach. HMA understands that the EU has been through a similar journey approximately a decade ago. Building a new technical committee on existing ISO and IEC TC structure, EU achieved positive outcomes for the sector, i.e. HarmonHy https://www.harmonhy.com/

HMA then proposed to Standards Australia to establish a new technical committee to primarily function to mirror ISO TC197 and gradually shadow others as per the EU's HarmonHy. Mirror committee ME93 has now been established including various working groups which are connecting to other relevant technical committees within national standards. It is anticipated that various working groups will be in a position to make a recommendation of the list of ISO adoption and drafting of new standards when required.

Why ISO and IEC (not other overseas or regional standards)? and why adoption and not just quote an international standard?

International (ISO and IEC) standards generally reflect the best experience of industry and regulators worldwide and cover conditions in a variety of countries. Australia's obligations under the WTO TBT (World Trade Organisation, Technical Barriers to Trade) Agreement are also supported. In addition, participation in ISO and IEC Technical Committees via Standards Australia is a two-way process. The Australian committee can also contribute to and draft new ISO standards from a unique position from Australian research and development.

The national adoption of ISO is a good indication to standards-users that those standards have been reviewed and endorsed by a Standards Australia technical committee and found to be relevant to the economic efficiency and safety of Australian community. It also indicates that the Standards Australia technical committee has determined that the international standards is used internationally by Australia's trading partners and is not enshrining obsolete or little used technologies or practice.

4.0 CONCLUSION

Australia is in a unique position to take advantage of the global shift to a clean energy future and become a major supplier of hydrogen to the world. Additionally, there are important opportunities for the development of a domestic, safe hydrogen sector to ensure Australia maximises the advantages that will be realised through the trade of hydrogen while enjoying the

decarbonisation and energy security benefits that it provides.

These opportunities have placed greater importance on getting the RCS environment right for Australia and hence the increased level of attention from government and industry in this space. It's an exciting time for Australia and it is now. We are about to embark our hydrogen journey with a 'safety first' approach.

This jointed paper is prepared by the representatives of HMA technical Committee and South Australian Government. We look forward to presenting these initiatives in more detail should this paper be selected by the committee.

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