

Response to the

COAG Energy Council Hydrogen Working Group: National Hydrogen Strategy

Request for information – Discussion Paper



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Response to the National Hydrogen Strategy Discussion Paper

The Australian Academy of Technology and Engineering (the Academy¹) welcomes the opportunity to provide a response to the COAG Energy Council's National Hydrogen Strategy Discussion Paper.

Key messages:

- If hydrogen is to play a significant long term role in reducing emissions it should be produced using electrolysis powered by renewable energy resources.
- A clear policy and regulatory environment is needed, as well as initial financial incentives from governments.
 - The Academy recommends continued government support for innovation and the commercialisation of hydrogen-associated technology through grants and support for innovation funds.
- Australia needs to adopt a strategic national approach to hydrogen. Without such a framework the hydrogen industry will struggle to become commercially viable, including for export markets.
 - The Academy recommends that any hydrogen production, use or export in Australia should be accompanied by the introduction of clear, appropriate regulatory frameworks and standards to ensure minimal environmental impact and encourage community acceptance.

1. What do you think are the two or three most significant recent developments in hydrogen?

The Academy recognises that several developments have combined to reignite global interest in hydrogen as an energy carrier including:

1. The growing urgency to address climate change by reducing greenhouse gas emissions. This is providing global demand for zero emissions hydrogen energy, which is regarded as an important means of reducing overall emissions.
2. Recognition that hydrogen may have a competitive future as an energy source beyond that as a hydrogenation source. This has highlighted the opportunity for Australian hydrogen exports to offset any decline in our conventional energy exports that may emerge as the world increasingly seeks to decarbonise energy production and use.
3. Significant investment in identifying reliable and sustainable hydrogen supply chains and growing investment in hydrogen end-use technologies is creating demand for hydrogen and related technologies.

2. What are the most important safety issues to consider in producing, handling and using hydrogen in Australia?

The Academy has identified four areas where safety will be critical in producing, handling and using hydrogen in Australia:

1. Maintenance of high pressure and low temperature conditions for storage and transportation of hydrogen.
2. Better leak detection of small leaks of hydrogen gas from equipment, vessels, pipes, flanges and joints.
3. If hydrogen is to be mixed with methane (beyond around 10-15 per cent) for domestic use, three technical issues arise:

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- Burner heads with smaller apertures must be retrofitted to all appliances to account for the way hydrogen burns in comparison to methane.
- At concentrations above a certain point, hydrogen gas can cause metal embrittlement, the consequences for the remnant life of the nation's pipeline infrastructure must be fully understood before its gas supply is enriched with larger proportions of hydrogen.
- A suitable method of rendering the flame visible must be developed.

3. What environmental and community impacts should we examine?

Currently, hydrogen can be produced via two pathways:

1. A thermochemical reaction using a fossil source (natural gas or coal)
 - Without sequestration of the carbon dioxide, this production method would negate the environmental advantages of using hydrogen as an energy source. Storage of the resultant carbon dioxide will add to the cost of the process.
 - Safe disposal of the carbon dioxide generated will be critical for community acceptance of the technology.
2. Electrolysis, a process of splitting water molecules into hydrogen and oxygen using electricity
 - If the electricity required is generated using fossil fuels then greenhouse gas emissions will again be an issue.
 - If renewable energy is used for the electrolysis process the entire production process would have zero emissions.
 - Using renewables for the electrolysis process also provides other benefits, such as using the hydrogen to store excess energy produced by intermittent renewable sources.

Hydrogen production, use or export should be accompanied by the introduction of clear, appropriate regulatory frameworks and standards to ensure minimal environmental impact and encourage community acceptance.

4. How can Australia influence and accelerate the development of a global market for hydrogen?

Australia has a number of significant competitive advantages in the production and export of hydrogen, which positions Australia in a key position to influence and accelerate the development of a global market. Australia's competitive advantages include its stable political environment, which is receptive to foreign investment, and its resources, such as:

- Access to a skilled technical workforce, essential to the development and operation of the required supply chain infrastructure.
- Large amounts of low cost, flat land suitable for the generation of electricity from solar PV and wind for the electrolysis of water into hydrogen. Much of this land is remote from population centres and without existing competing land uses, thereby reducing socio-environmental-economic impacts.
- Excellent and extensive solar and wind resources. There are also large scale undeveloped tidal power resources in north-west Australia.
- Existing energy export facilities, supporting infrastructure and reserved land. For example land currently set aside in north-west Western Australia and central Queensland for building additional LNG terminals could instead be used to develop hydrogen production and export.

In order for Australia to influence the developing hydrogen export market, the Academy recommends that the Government:

- Financially support joint research and development for cheaper, more robust fuel cells, including R&D to reduce or eliminate the use of precious metal catalysts.
- Develop a clear regulatory framework for the production, storage and transport of hydrogen that will encourage investment in Australian sited projects.
- Ensure a reliable large-scale source of competitively priced hydrogen available on the world market and demonstrate the feasibility of hydrogen export systems.

5. What are the top two or three factors required for a successful hydrogen export industry?

A successful hydrogen export industry will require access to research and development (R&D), finance, access to resources and transparent, effective and efficient regulation.

1. Further R&D is needed to drive the significant cost reductions needed for hydrogen to become a competitive export industry for Australia, for example:
 - For electrolysis: large quantities of low cost electricity generation using renewable energy resources, such as solar and wind. If continuous production of hydrogen was needed, this would require energy storage facilities for intermittent renewable energy sources.
 - Development of economically viable hydrogen storage and transport technologies.
2. Availability of low interest rate capital funds and associated equity for hydrogen production.
3. Access to resources such as:
 - The raw materials to competitively generate the energy required for the conversion of hydrogen-containing feedstock such as water.
 - Suitable land for hydrogen production and storage, which is flat, cheap, has no conflicting existing land uses and is in close proximity to export facilities.
4. Regulation:
 - Australia requires a clear and supportive regulatory framework for the production, storage and transport of hydrogen that will encourage investment in Australian sited projects.
 - Stable political environment with bi-partisan agreement on energy policy.

6. What are the top two or three opportunities for the use of clean hydrogen in Australia?

There are three strong opportunities for the use of clean hydrogen in Australia:

1. As an energy storage medium for excess renewable energy
 - By using excess renewable energy to create hydrogen, which can be stored and used to generate electricity on demand or to extend natural gas supplies.
2. In fuel cell electric vehicles as a zero-emission transport fuel, particularly in heavy freight transport, public transport and coastal shipping.
 - As hydrogen refuelling stations become more common, the private transport sector could become an important source of hydrogen demand.
3. As a feedstock in chemicals and plastics industries such as hydrogenation.

The Academy recommends that the Government support and promote technological innovation in order to identify further opportunities for the use of clean hydrogen in Australia.

7. What are the main barriers to the use of hydrogen in Australia?

The Academy has identified two main barriers to the use of hydrogen in Australia:

1. Availability of economically viable technologies for the production, storage, transport and use of hydrogen in industry, transport and domestic applications.
 - Production of hydrogen via a thermochemical route would result in greenhouse gas emissions.
 - If the cost of carbon capture and storage (CCS) were included, the economic viability of hydrogen production would be reduced.
 - Electrolysis is a mature technology and while there is on-going technology development, a significant cost reduction for the electrolysis process is unlikely. Cost reductions are more likely to flow from economies of scale and 'learning by doing'.
 - Purified water for electrolysis is a finite resource in Australia, although we understand that there have been some recent developments in using sea water for hydrogen production.
 - If hydrogen is produced continuously the cost of storing energy generated from renewables would need to be included.
2. Local issues such as the establishment of a suitable and efficient network for the distribution of hydrogen to end users may also be a logistical requirement to be overcome. Placing 100 per cent hydrogen into existing gas networks would be costly because user equipment and pipelines would need to be modified or specially designed.

8. What are some examples where a strategic national approach could lower costs and shorten timelines for developing a clean hydrogen industry?

It is unlikely that much progress toward an Australian hydrogen economy will be made without a strategic national approach toward the following areas:

1. Government subsidies, export incentives, a national regulatory framework and tax incentives for investment in, and use of, hydrogen-related technology. This includes support for funds such as the Northern Australia Infrastructure Fund (NAIF) and the Australian Renewable Energy Agency (ARENA) which enable the nation building projects that will help address key issues such as transport and infrastructure, and continued support for energy innovation through National Energy Resources Australia (NERA).
2. Access to a substantial supply of low cost renewable electricity production, to be achieved by:
 - Provision of incentives including an appropriate electricity market framework that encourages investment in renewable energy, for example efficient hydro-electric pumped storage schemes.
 - A national electricity transmission grid across Australia to enable the efficient transmission of electricity from Australia's lowest cost renewable energy generation to the locations producing and exporting hydrogen.
 - Strategic development of energy storage technology and facilities to store renewable energy if continuous production of hydrogen is required.
3. Development of a centre of excellence for education and R&D of hydrogen production and export technologies.
 - The centre should be able to pull together existing R&D expertise and tap into opportunities for international collaboration.
 - Encourage the building of a national hydrogen supply infrastructure.

9. What are Australia's key technology, regulatory and business strengths and weaknesses in the development of a clean hydrogen industry?

The response to question 4 includes some of Australia's competitive advantages for hydrogen production and export to help supply global demand for hydrogen.

Australia also has all the key energy and technological strengths to develop a clean hydrogen industry, and has a strong background in the fast take-up of new technology.

- We are one of the global leaders in the integration of high levels of intermittent renewable generation, which could allow application of knowledge to using renewable energy as a source in electrolysis.
- We have proven expertise and experience working in remote areas with power systems, construction and operation of large industrial undertakings, including associated technical, social, workforce and operational challenges. These are skills that will be useful if hydrogen production and export facilities, or energy generation facilities, are located in remote areas.
- A key business strength is Australia's support for start-up and pilot projects, such as renewable energy from solar, which should be applied to the hydrogen industry.

Australia's key weakness is the lack of a national policy framework for energy, including hydrogen. Without such a framework it is unclear how the hydrogen industry will become commercially viable. Strong hydrogen technology standards tailored for Australian conditions across production, storage and usage are also required.

10. What workforce skills will need to be developed to support a growing clean hydrogen industry?

A new hydrogen industry will require a workforce with technical skills related to production, storage, transport, distribution and use of hydrogen as an energy source, which should be roughly translatable or adaptable from other fuel and resource industries. Specialist skills such as cryogenics and high-pressure technology should be made available in higher degree courses, with the private sector supporting hydrogen-related course content.

Future industries will develop once hydrogen is available to use as an energy source, and for these to grow, the workforce will need fundamental science and engineering knowledge. Further support should be provided for STEM education in schools, and for STEM teacher training, to ensure cutting edge technologies are explored in classrooms (such as the Academy's school STEM program on renewable energy).



11. What areas in hydrogen research, development and deployment need attention in Australia? Where are the gaps in our knowledge?

Areas of Australia's hydrogen research, development, and education needed to facilitate a hydrogen production and export industry include:

1. Detailed technical and economic modelling of a hydrogen industry, including its costs, benefits and implications.
2. Integration of much higher penetrations of large-scale renewable generation and large-scale storage schemes to ensure affordable, continuous, reliable and sustainable electricity supplies to hydrogen production and export facilities.
3. Investigation into planning, design, construction and operation of hydrogen production and export facilities to:
 - Eliminate or reduce the use of precious metal catalysts in fuel cells.
 - Find alternatives to high pressure storage systems, such as the conversion of hydrogen to or from ammonia and the use of ammonia (liquid) as a hydrogen storage and transport method.
 - Enable efficient shipping of liquid hydrogen to minimise energy usage and hydrogen losses.
4. Develop measures to help ensure the safety of hydrogen. Such as the detection of hydrogen leaks from pipes and storage facilities, as well as measures to improve flame visibility when burning hydrogen.