



**Australian Government**  

---

**Chief Scientist**

# Proposal for a national hydrogen strategy

*Presented to COAG Energy Council*

Prepared by the Chief Scientist, Dr Alan Finkel AO, in consultation with senior officials

December 2018

## **INTRODUCTION**

At its 18<sup>th</sup> meeting on 10 August 2018, the COAG Energy Council noted the investment and job opportunities that hydrogen offers in regions across the country. Council agreed the Chief Scientist, in close consultation with officials, would bring back a proposal for the development of a national hydrogen strategy to the December 2018 meeting.

This document fulfils that commitment.

I have set out principles to inform the development of a national strategy; and recommended elements. I have also proposed that Council establish a new Working Group on hydrogen to take the strategy forward. Further, I have suggested three projects that could progress immediately to maintain momentum.

Hydrogen is emerging as a major economic prospect for Australia, but there is a limited window of time to capitalise on this opportunity. A strategy in place by the end of 2019 would enable Australia to define its role in the promising export market and position government and industry to implement the strategy from 2020 onwards. Other countries are positioning as importers and exporters, so now is the time to agree on an optimal way forward.

## **RECOMMENDATIONS**

I recommend COAG Energy Ministers:

*Agree* to issue a Joint Ministerial Statement emphasising the importance of hydrogen to Australia's energy future, noting the progress and contributions to date made by all jurisdictions, and committing to work together to develop a thriving hydrogen industry to the benefit of all Australians.

*Continue* to encourage hydrogen projects in their jurisdictions, whether for production, distribution, export or consumption.

*Agree* to commission a national strategy for hydrogen based on the principles, elements, governance and timing outlined in this paper.

*Agree* to immediately progress three kick-start projects while the strategy is under development:

- Commence work to allow up to 10 per cent hydrogen in the domestic gas network, including the required regulatory changes and implementation of technical standards, in partnership with the Future Fuels CRC.
- Scope potential for building hydrogen refuelling stations in every state and territory, focussed on heavy transport, including the required regulatory changes and implementation of technical standards, in partnership with Hydrogen Mobility Australia's Lighthouse Joint Venture.
- Undertake co-ordinated international outreach to keep building Australia's profile with major trading partners as a potential supplier, not precluding bilateral relationships between individual jurisdictions.

## HYDROGEN – THE VALUE PROPOSITION

Hydrogen presents an opportunity for Australia to lead in the emerging market for low and zero emissions energy, and reap the benefits of early entry into this industry. Global demand for hydrogen is now about 55 million tonnes a year with only 1 million tonnes used for energy. Relatively conservative estimates suggest that global demand for hydrogen for energy is likely to reach more than 8 million tonnes by 2030 and about 35 million tonnes by 2040.<sup>1</sup> (Note that 35 million tonnes of hydrogen has the energy equivalent of 84 million tonnes of LNG, which is more than Australia's current LNG exports.) Japan, South Korea and China are likely to be key markets.

Capitalising on this growing demand for hydrogen could result in an export industry worth \$1.7 billion and which provides 2,800 jobs by 2030 (direct and indirect impact).<sup>2</sup> Most of the jobs created by this new industry are likely to be in regional areas, at sites of hydrogen production, storage and loading for export.

Australia has a number of competitive advantages as a hydrogen exporter:

- Expertise and infrastructure that can be leveraged to develop hydrogen export energy supply chains
- Proximity to markets in Asia and well-established trading relationships
- An abundance of renewable energy and low-cost fossil-fuel resources, the latter with adjacent carbon sequestration sites.

Since I briefed you in August, two international reports have confirmed Australia's potential as a future major hydrogen supplier. The World Energy Council's *International Aspects of a power-to-x roadmap* identified Australia as a 'giant with potential to become a world key player'. The International Energy Agency's *World Energy Outlook* projects that Australia could easily produce 100 million tonnes of oil equivalent of hydrogen, equivalent to 3 per cent of global gas consumption today.

A hydrogen export market will have important domestic spill-over benefits and opportunities for Australia. Hydrogen used as energy storage can contribute to the resilience of our major electricity systems, as well as for long-term energy storage in micro-grid sites, such as remote mine sites.

Clean hydrogen technologies can also help our domestic sectors to decarbonise. Heavy vehicles powered by hydrogen fuel cells, which will have the advantage of long range, rapid refuelling and moderate costs, could meet increasing demand for zero emissions transport. Replacing natural gas with hydrogen could in many cases decarbonise direct combustion at less cost than can electrification. Similarly, a supply of hydrogen from low or zero emissions sources could assist businesses that require hydrogen for industrial processes to decarbonise and expand.

Australian governments are already supporting hydrogen projects, many of which I listed in my briefing to COAG Energy Council in August 2018. Rather than repeat these, I will note just four updates: the West Australian Government's announcement of a renewable hydrogen council

---

<sup>1</sup> Medium hydrogen uptake scenario in: ACIL Allen for ARENA, *Opportunities for Australia from Hydrogen Exports*, 2018.

<sup>2</sup> *Ibid.*

to advise ministers in that state; the Queensland Government's release of a consultation paper on advancing a hydrogen industry; and the Commonwealth Government's \$7.5 million in support for a hydrogen blending trial in NSW and \$22 million in support for hydrogen R&D projects through the Australian Renewable Energy Agency.

## **A GOVERNMENT – INDUSTRY PARTNERSHIP**

Past Australian governments at all levels have helped develop export and local industries through a variety of measures, like negotiating trade agreements, creating Austrade (and its predecessors), underwriting export off-takes, and providing grants and other assistance. But ultimately, a commercial hydrogen industry must be driven by private investment and expertise, from Australian and overseas companies. In my view there are two key areas where government and industry will need to work in partnership.

### **Risk sharing**

It has long been recognised that there are considerable positive spill-over benefits from early-stage innovation, and that these can't always be captured by individual firms. This implies a role for governments in sharing the risk to firms of investing in R&D, demonstrations and pilots.

Grants are one way to do this, and are appropriate for R&D and early stage demonstration. Australian governments at all levels already have and are using the capacity to provide grants to individual researchers and to hydrogen projects. Greater efforts could be made to ensure R&D findings are disseminated and acted on more quickly, and that learnings from early-stage projects are better known. Industry can support R&D, particularly by engaging with the research community to align R&D activity with emerging supply chains and create breakthrough technologies that allow faster scale-up.

As the industry develops, different types of support will be more meaningful. In particular, the significant investment in infrastructure needed to support an export industry is currently difficult to finance in the absence of good information about the projected demand for hydrogen. Governments can develop policy instruments that catalyse these investment decisions – whether this is underwriting domestic demand to create a minimum market size; co-investing in infrastructure, or working with overseas governments to create greater transparency around likely market size. Companies should also consider working in partnership with each other to invest in infrastructure with governments. This would make sure that infrastructure investment is efficient and fully utilised, and minimise first-mover disadvantage.

### **Community engagement and acceptance**

Trust is essential for earning a social licence to operate and ultimate acceptance of a new industry. It will be built through open and transparent decision-making, responding to community concerns, ensuring benefits are shared equitably, and putting in place appropriate standards and regulation. Government and industry will need to work together to ensure that early and ongoing communication and engagement with the broader public is undertaken in an effective and fit-for-purpose manner. Both can learn from the experiences of other emerging industries, such as unconventional gas and wind generation.

Gaining community acceptance will depend heavily on public perceptions of safety, as well as potential benefits of a hydrogen export industry. Governments will need to respond to public perceptions and attitudes. Industry can help by pro-actively ensuring that hydrogen production, logistics and end use are not only technically safe, but accepted by the community as safe.

Governments will need to consider whether existing international standards will work for Australia, or whether bespoke standards will better suit our national needs. Industry can help by proactively identifying where regulation and standards are needed, and sharing information with government to ensure that regulation helps rather than hinders industry development.

**A NATIONAL STRATEGY**

On my recent trip to Japan, I was impressed by the clarity and power of Japan’s national strategy for hydrogen. Its clear targets, its co-ordinated approach between business and government, and its alignment to broader strategic goals left no doubt as to the seriousness of their commitment to hydrogen.

In my report to COAG Energy Council in August, I noted numerous examples of projects already underway to promote the development of a hydrogen industry, in every state and territory and nationally. These projects have been arisen independently of each other. A national hydrogen strategy for Australia could encourage collaboration between these and future activities to accelerate progress and maximise economic benefits, and provide leadership and governance as well as clear timeframes and goals. It would also signal to our potential export partners that Australia is serious about creating good investment conditions and becoming a major world supplier.

**PRINCIPLES TO UNDERPIN A NATIONAL STRATEGY**

The process of developing a national strategy will attract competing views about what is to be done, when, and by whom. To aid in the inevitably difficult choices, I propose the following principles form part of the terms of reference.

<b>Principle</b>	<b>Rationale</b>
<b>Ambition</b>	In light of the highly competitive export environment, to ensure hydrogen plays a strong role in maintaining Australia’s status as an energy export superpower, a national strategy should be bold and ambitious. Policies and measures should allow industry to adapt and improve to keep up with changing markets and span all areas of competitive advantage
<b>Safety and customer focus</b>	Policies and measures should 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 (international and domestic).
<b>Clear goals and objectives</b>	Goals and targets are a proven way of catalysing industry growth. A national strategy and its constituent policies and measures should have clearly articulated goals, communicated succinctly and consistently. These might include an aspirational target price or volume for exports by a certain date. These goals should be clear indicators of success that allow government to step out and let the market take over.

---

<b>Working in partnership</b>	A truly national strategy must be owned by industry and governments and build on the work that has already begun. Policies and measures should rest on an expectation that industry stands to benefit and will contribute. Roles for industry and governments should be clearly articulated.
<b>Technology-neutral</b>	The development of a vibrant hydrogen industry will rely on healthy competition. Noting that each technology will have its own development path and learning curve, as much as possible policies and measures should not favour one technology over another. There should be sufficient scope and support for any hydrogen technology to grow and develop.
<b>Commercial focus</b>	A future hydrogen industry must be economically viable. Policies and measures should show a clear path to a self-sustaining industry.
<b>Benefitting all Australians</b>	Policies and measures should be designed to ensure the benefits of a hydrogen industry are widespread and the costs are minimised. In particular, attention should be paid to minimising negative impacts of an export industry on domestic prices, whether for electricity, gas, fuel or other goods.
<b>Consistent with sustainable environmental management</b>	Policies and measures should include consideration of domestic and global environmental impacts and Australia's international obligations. There should be no substantial negative impact on Australia's greenhouse gas emissions, on water availability, or the environment.

---

## COMPONENTS OF A NATIONAL STRATEGY

### Exports

A national strategy should focus on exports first. The window of opportunity to capture emerging markets in Asia is a small one. Australia has competitive advantages, such as access to infrastructure and large renewable energy potential, but must act swiftly and in a coordinated way to ensure Australia's place in the hydrogen value chain.

Options for developing market infrastructure to underpin bulk exports, including transitioning existing infrastructure should be considered. Assessment of required regulatory changes, both in Australia and as part of international agreements will be required. The strategy should consider support for demonstration projects to assess the feasibility of different bulk carriers; and options to share the risk of infrastructure investment between government and industry.

### Domestic markets

Emergence of a domestic market will rely on consumer decisions. These decisions will be easier, and cheaper, if we build scale via exports first. Nevertheless, we know from the

experience of the energy transition thus far that the future often arrives sooner than expected. A national strategy therefore should consider policies and measures to allow domestic use of hydrogen, for things like decarbonising the gas supply, transport, interacting with electricity systems to improve reliability, and industrial processes.

Increased use of hydrogen for transport may require regulatory changes (both state and federal). A strategy should consider what is needed, as well as assessing refuelling infrastructure needs under different scenarios, the potential for greater use of hydrogen in heavy vehicles and freight, both road and rail.

Hydrogen has the potential to support more reliable and affordable electricity in all areas of Australia; and a national strategy should thoroughly analyse these opportunities. This would include the role of hydrogen as an energy storage medium; and the role of hydrogen production as a potential flexible load or user of curtailed renewable energy and in frequency control ancillary services (FCAS) markets. Hydrogen could also potentially play a role in supporting reliable and affordable renewable energy in remote areas and mini-grids and micro-grids. Regulatory changes may be required; and of course, any measures in this space should consider how to minimise impacts on consumer energy bills.

A national strategy should also examine the potential for industrial use of hydrogen, whether replacing hydrocarbons in industries for chemicals manufacturing, for power generation or to fuel high-temperature heat. The mining sector is one where hydrogen could play an important role.

### **Cross cutting issues**

There are a number of cross-cutting issues that should also be considered. Broad issues of importance to communities include impacts on water availability, safety and environmental impacts, and distributions of benefits and costs. Other cross-cutting issues include safety, R&D and innovation, regulations and standards, origin labelling, improving access to global supply chains, financing, and workforce and managerial skills.

I also note the nascent interest amongst some regions of Australia to move towards becoming 'Hydrogen Cities' – precincts, towns or cities that maximise the integrated use of hydrogen across all sectors to replace petrol, diesel and natural gas as a complement to electrification. The economic and engineering case to pursue this has not been fully explored. Nevertheless, I would encourage individual states and territories to identify potential candidates, and I believe the national strategy should undertake initial work to enable governments to better understand the potential pathways to future adoption of this model.

All of the above should consider international trends and best practices, and the views of experts and key stakeholders including the energy industry, end users, environment and community groups. There should be thorough analysis of costs and benefits, not forgetting other potential benefits like fuel security, regional development, and reducing air pollution and greenhouse gas emissions. Recognising the limited timeframe available to make the most of the hydrogen export opportunity, emphasis should be on moving quickly to implementation and delivery.

### **Kick-start projects**

There is considerable momentum gathering in the nascent Australian hydrogen industry. To sustain this impetus and set the stage for future implementation of a national strategy, I have

also identified, in consultation with officials, three “kick-start” projects that could be progressed immediately while development of the national strategy is under way.

- *Commencing work to allow up to 10 per cent hydrogen in the domestic gas network, both for use in place of natural gas and to provide at-scale storage for hydrogen. Three companies have already announced plans to trial blending hydrogen with natural gas, and the Future Fuels CRC will commence a research program in 2019 to understand the technical, social and safety aspects. Governments could join forces with industry and researchers to begin assessing required regulatory changes and technical standards, informed by practical case studies and high-quality research.*
- *Scope potential for building hydrogen refuelling stations in every state and territory. Fuel cell electric vehicles powered by hydrogen will become available in Australian markets from 2019 onwards, which will create consumer demand for refuelling stations. Both industry and governments need to understand the likely pattern of consumer demand, the regulatory changes required, and whether new technical standards are needed. Beginning this work now, in partnership with industry, will facilitate consumer driven adoption of hydrogen fuelled vehicles.*
- *Undertake co-ordinated international outreach to keep building Australia’s profile with major trading partners as a potential supplier. This activity is already underway through Austrade, several state and territory governments and proactive Australian companies, but could be boosted by enhanced coordination across governments and industry, and given a higher profile through Council endorsement and commitment.*

## **GOVERNANCE**

To ensure close co-ordination and that policies and measures are able to be implemented by the jurisdiction best able to do so, I suggest forming a new Working Group under SCO to develop the strategy, and oversee its implementation. The Working Group should also take forward the implementation of the kick-start projects. I would welcome the opportunity to chair this group.

The Working Group should be supported by a stakeholder advisory panel whose members are senior representatives of the following areas:

- Consumers (large and small)
- Mobility
- Producers ( all sources)
- Gas pipelines and distribution
- Export
- Safety
- Technology (production, logistics, conversion, end use)
- Standards, labelling and regulation

Membership of this group could be drawn from the Hydrogen Strategy Group, which helped me deliver my first briefing to Council on hydrogen. Of course, additional or substitute members may be required to cover the full range of representation.

## STAKEHOLDER CONSULTATION

There will be a very broad range of stakeholders to consult, reflecting the many roles that hydrogen can play in the economy. The following is a non-exhaustive list of groups that I consider the Working Group should consult.

- Commonwealth, State and Territory Ministers, and their departments.
- Local government and regional development organisations
- Consumer representatives and associations
- Infrastructure planning bodies
- Energy market bodies
- Project investors, including government and non-government
- Industry Growth Centres
- Leading academics and researchers related to hydrogen technology and safety and consumer acceptance
- CSIRO
- Resources industry companies and associations
- Energy industry companies and associations
- Transport industry companies and associations
- Individual large energy users
- International bodies, including the Hydrogen Council, the International Energy Agency, Mission Innovation, and the International Partnership for Hydrogen and Fuel Cells in the Economy.

## CONCLUSION

Ministers, this proposal responds to your request for me, working with senior officials, to propose how a national hydrogen strategy could be developed.

If developed and adopted, this strategy will optimise Australia's opportunity to capitalise on all aspects of the expected global growth of hydrogen as an energy carrier.

We have recommended that the strategy be developed by a Working Group rather than an independent panel of experts in order to ensure the development benefits from the deep knowledge of experienced public servants closely guided by their ministers.

We have also recommended some low-risk kick-start projects to maintain the momentum of existing pilot projects and proposals.

Most important are the guiding principles articulated above. It is my belief and my hope that these principles properly capture your expectations and intentions.

Thank you for the opportunity to present this proposal.