Report Summary

RP1.1-03

Learning from 19 plans to advance hydrogen from across the globe

July 2019

Background

Hydrogen, as the International Energy Agency (IEA 2019) notes, has experienced a number of 'false dawns' - in the 1970s, 1990s and early 2000s - which subsequently faded. However, this time there is reason to think that hydrogen will play a substantial role in the global energy system. The most important factor driving this renewed focus is the ability of hydrogen to support deep carbon abatement by assisting in those sectors where abatement with non-carbon electricity has so far proven difficult. Hydrogen can also address poor urban air quality, energy security, and provides a good means of shifting energy supply between regions and between seasons.

In response to these changed conditions many countries, states and even cities have developed hydrogen strategies while various interest groups have developed industry roadmaps which fulfil a similar role.

This report summarises 19 hydrogen strategies and aims to help readers understand how nations, regions and industries are thinking about opportunities to become involved in this emerging industry. Its prime purpose is to act as a resource to assist those involved in long-term energy policy planning in Australia including those involved in the development of Australia's hydrogen strategy.

Planned roles for hydrogen in the energy system

The various strategies see a range of different end-uses for hydrogen, with the relative focus reflecting local constraints and opportunities; these are summarised below.

Key end-uses for hydrogen identified in strategies

	<20% hydrogen in existing gas distribution and transmission pipelines[a]	100% hydrogen in existing gas distribution and transmission pipelines[a]	Long-term store of energy	Industrial heat	Industrial feedstock	Electricity generation	Household heating	Combined heat and power generators	Manufacture of fuel cell vehicles	Use of H2 for heavy vehicle transport	Use of H2 for small passenger vehicles	Hydrogen production for export
Brunei												✓✓
China					✓					✓✓	✓✓	✓✓
European Union (Hydrogen Roadmap Europe)	✓[b]	✓✓[b]	✓	✓✓	✓✓	✓	✓✓	✓✓		✓		
European Union (Decarbonisation strategy) [c]	✓[c]	✓✓[c]	✓	✓✓[c]	✓✓	✓	✓✓[c]			✓✓	✓	
France	✓				✓✓					✓✓	✓	
Germany (power-to-gas)		✓✓[d]					✓✓	✓✓				
Japan	✓	✓	✓			✓	✓	✓✓	✓✓	✓✓	✓✓	
Netherlands	✓✓	✓✓				✓	✓			✓	✓	
Northern Netherlands	✓✓	✓✓	✓	✓	✓✓	✓	✓✓			✓	✓	
Norway										✓✓	✓✓	✓✓
Republic of Korea		✓✓		✓	✓			✓✓	✓✓	✓✓	✓✓	
United Kingdom	✓	✓✓		✓✓	✓		✓✓			✓✓	✓	
UK - Leeds (gas network)	✓	✓✓	✓				✓✓			✓	✓	
UK – London		✓					✓	✓✓		✓✓	✓✓	
UK – Northern England	✓	✓✓	✓	✓		✓	✓✓	✓				
United States of America						✓✓				✓✓	✓✓	
California			✓							✓✓	✓	

Notes: ✓✓ = primary use case assumed in strategy; ✓ = secondary use case assumed in strategy. These assessments of relative focus are necessarily subjective and reflect the focus of policy as outlined in the strategy document(s).

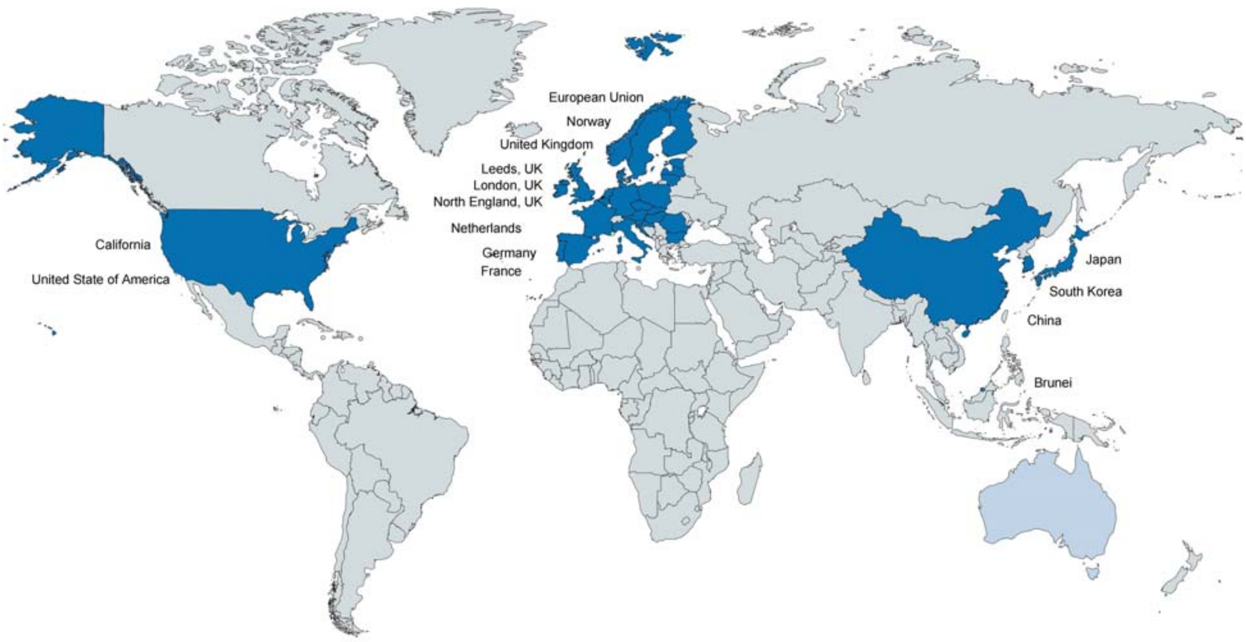
(a) hydrogen concentration by volume rather than by energy.

(b) Targeted approach is blended to 5 to 15% by volume up to 2030, with transmission to a full H_2 gas network between 2030 and 2050.

(c) Hydrogen (or 'e-fuels' derived from green hydrogen and 0 net GHG emission sources of carbon) only has a substantial role in 'high hydrogen' and 'e-fuel' scenarios. In other scenarios hydrogen would not be used in the gas distribution network, with the gas distribution network shut down and energy transmission (and localised uses derived from it such as industrial heat and household heating) fully electrified. In these other scenarios the role for hydrogen would be focused on industrial feedstock and transportation (particularly heavy transport).

(d) As synthetic methane or other 'e-fuels' derived from green hydrogen and 0 net GHG sources of carbon.

Countries, states and cities that have developed hydrogen strategies:



Implications and recommendations for industry

The key take-away findings from the review of national hydrogen strategies and roadmaps, which are particularly relevant to those who are involved in developing the National Hydrogen Strategy (NHS), include:

- There is considerable international interest in rapidly deploying hydrogen technologies over the next several decades to reduce carbon emissions, which could give rise to export opportunities for countries with a comparative advantage in producing hydrogen.
- There is considerable uncertainty regarding how quickly hydrogen and competing technologies will develop in terms of their effectiveness and cost efficiency. Such uncertainty needs to be taken into account in formulating a strategy, either by taking a technological neutral or flexible approach, or not overcommitting down particular pathways.
- Strategies should clearly identify the goals they are seeking to achieve, and targeting activity at any barriers to achieving those goals.
- The scale of activities and resourcing needs to be commensurate with the targets of the strategy.
- Hydrogen strategies should be built upon areas of comparative advantage in terms of production and use.
- Hydrogen strategies should also reflect the broader international environment, for example by drawing on hydrogen strategies in other countries.
- The logistics of the transition to hydrogen should be a core focus of the NHS.
- The scale of activities should reflect the scale of the transition being targeted.
- Access to low cost, low GHG intensity electricity is likely to be critical to the potential for a hydrogen export trade into the medium term as potential importers are targeting low GHG intensity hydrogen in the medium term. Availability of suitable geological features for CCS is also likely to be an important cost driver.
- International collaboration on standards for technology is potentially important not just for those countries that have comparative advantages in the development of the technology but also for potential users of the technologies developed.
- International collaboration is also likely to be necessary on ways to measure and certify the GHG intensity of hydrogen supplies for end users.

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