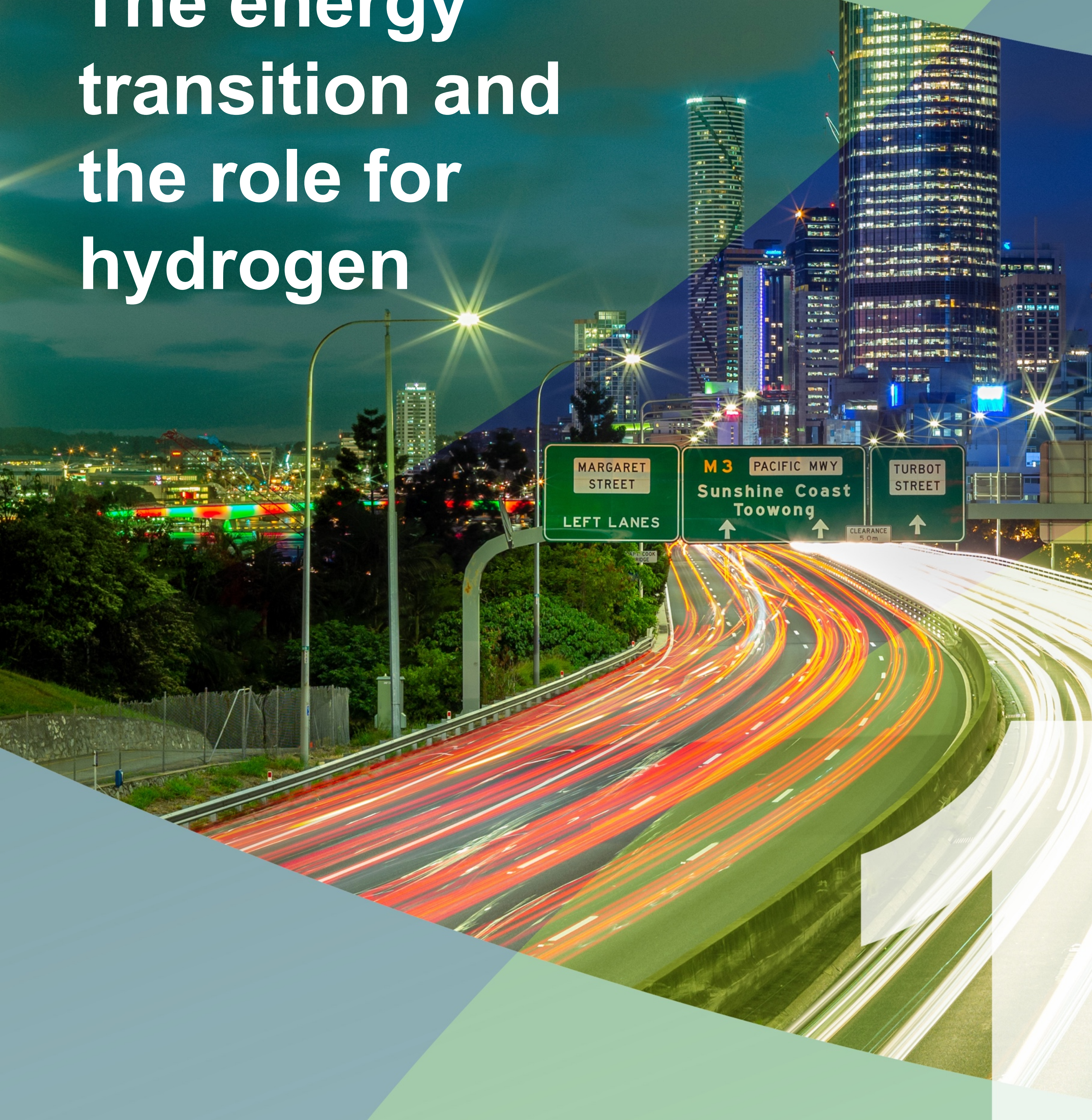
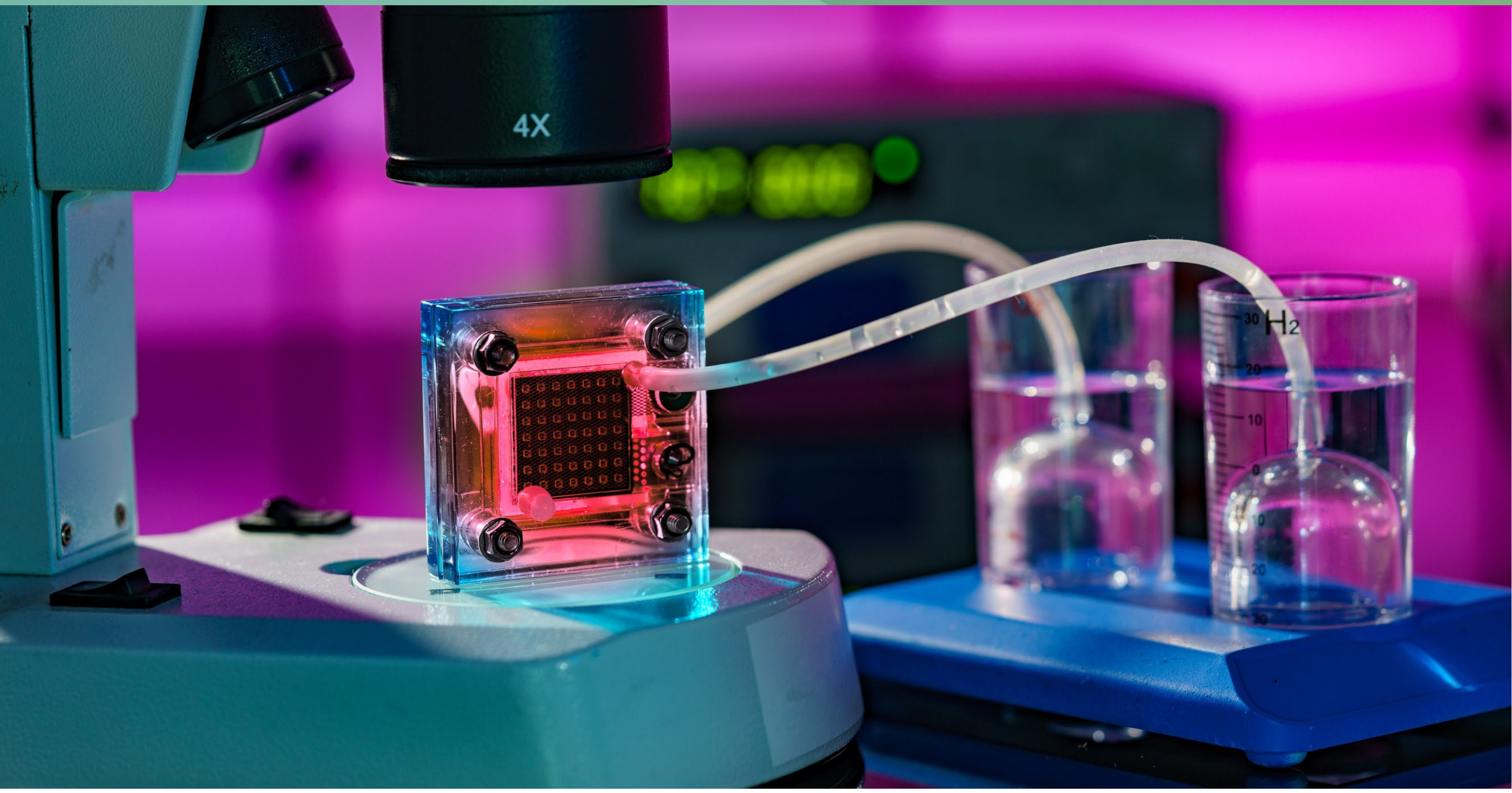
AUSTRALIAN HYDROGEN COUNCIL

The energy transition and the role for hydrogen





We have an enormous opportunity in this country to create a vibrant hydrogen industry, both for domestic use and for export. Australia has the renewable energy resources, the technical skills, and the track record with international partners to become a global hydrogen leader.

We are already seeing significant investment from local and international businesses, and the National Hydrogen Strategy[1] and jurisdictional announcements have signalled the value that the Australian Government and states and territories see in the developing industry. Work for the National Hydrogen Strategy estimated potential benefits to Australia could be as high as A$26 billion a year in additional GDP and 16,900 new jobs by 2050.[2]

The objectives of the National Hydrogen Strategy – and in 2020, the 'H2 under $2' target set in the Government's Low Emissions Technology Statement[3] – are considerable. They require a further significant demonstration of government commitment to implementation and market development.

Meeting Australia's stated hydrogen objectives requires strong national leadership to plan, collaborate and communicate with partners and stakeholders. Government must drive and lead the creation of the clean hydrogen industry. With the world moving to net zero, there is no real alternative.

1 COAG Energy Council (2019).
2 Deloitte (2019), page 1.
3 Australian Government Department of Industry, Science, Energy and Resources (2020).

1.1 Global commitment to decarbonisation is accelerating

The need to decarbonise the global economy is becoming widely accepted, and pledges to achieve net zero emissions by 2050 or soon thereafter are growing in number. Communities, companies and countries are announcing their support to eliminate carbon emissions and limit climate change. Predictions of global warming are being increasingly validated by measurable changes in the world's climate. Scepticism about complex climate models has become muted and marginal. The evidence is validating the science.

Further, investors are increasingly recognising that they have both an ethical and fiduciary duty to play an active role in transitioning to a decarbonised economy. The global financial system is already valuing the risk. There may be different views on when and how fossil fuels will demonstrably decline; however, markets are responding *now*:

> *Energy transition risk is often viewed as a long-term risk, the impacts of which will not be felt for decades to come. However, this view is an imprecise presentation of reality. This is because although completion of transition might take decades, the increased uncertainty around the transition impacts the energy markets on a much shorter time scale than the transition itself.*[4]

With a quarter of equity markets and half of corporate bond markets said to be 'carbon entangled', the global financial system is vulnerable to the energy transition.[5] This has also been noted by the Reserve Bank of Australia, which stated in October 2020 that climate change exposes the financial system "to risks that will rise over time and, if not addressed, could become considerable".[6] These risks explicitly include transition risks.

Based on a survey of institutional investors, researchers from the Oxford Institute for Energy Studies found that uncertainty about the energy transition had, in fact, already started to alter the risk preferences of investors in fossil fuels, with these investors "demanding higher hurdle rates in order to invest in coal and long cycle oil projects", which:

> *extends the payback period of discounted investment costs into a more uncertain future part of the energy transition period and thus dis-incentivises investment in long cycle projects. It also concentrates upstream investment around short-term projects with shorter payback periods.*[7]

1.1.1 Our fossil fuel trading partners are likely to withdraw over time

As countries look to deliver on the emissions reduction targets of the Paris Agreement by incorporating cleaner fuels into their energy mix, the decline in demand for fossil fuels such as coal and natural gas threatens the Australian resources sector. There will also be increasing pressure for metals to be mined and extracted in a way that minimises carbon emissions.

While the short to medium-term outlook for Australian coal and natural gas exports remains optimistic, the long-term threat posed by decarbonisation commitments across the world must not be ignored if Australia is to ensure its continued economic success.

And the 'long term' may be closer than once thought. Carbon Tracker argues "It is in the interest of fossil fuel importers to move to a Paris compliant world as quickly as they can",[8] meaning that Europe, China and India will tend to progress to renewables faster.

4 Fattouh, Poudineh and West (2019), page 1.
5 Bond, Vaughan and Benham (2020), page 4.
6 Reserve Bank of Australia (2020), page 43.
7 Fattouh et al. (2019), page 1.
8 Bond et al. (2020), page 42.

A recent Reserve Bank of Australia paper states:

To date, the decline in renewable energy costs has been faster than expected. Should this trend continue, the substitution away from thermal coal and towards renewable energy sources would also be faster. In addition, if countries increase their commitments to reducing emissions, there would be an even faster transition. In the IEA's 'Sustainable Development' scenario (in which countries implement policies that the IEA suggests are comparatively more aligned with the Paris Agreement), coal's share in the electricity generation mix would decline from around 40 per cent currently to around 5 per cent in 2040.[9]

The export of hydrogen and its derivatives provides Australia not only with an economic growth opportunity, but a way to evolve the resources and mining sectors and provide economic resilience in a decarbonising world. Hydrogen also provides tangible opportunities for Australia to decarbonise its domestic energy system, including power generation, manufacturing and transport.

Australia is particularly well-positioned to play a key role in the hydrogen export market with its abundant renewable resources, existing bilateral trade relationships with Japan, Korea and China and low sovereign risk.

9 Cunningham, Van Uffelen, and Chambers (2019).

However, the window of opportunity will not exist forever. Competing hydrogen producers across the globe seek a share of the international market and are scaling up hydrogen production in their respective countries to supply the Japan, Korea and China markets as soon as 2025.[10] These competitors include Brunei, Qatar, UAE and Norway, and in the longer-term, market entrants such as the United States, Brazil, Chile and New Zealand.

Many of these countries have similar strengths to Australia, including abundant renewable resources, access to low cost gas for blue hydrogen production, carbon capture and storage capabilities, large areas of land for solar installations, and proximity to key hydrogen export markets.

1.1.2 Market experts say Australia will go first

Australia is not only affected in its export markets – the transition is well-progressed domestically, at least for electricity. In its Integrated System Plan for 2020, the Australian Energy Market Operator (AEMO) stated that Australia is experiencing “what is acknowledged to be the world’s fastest energy transition”.[11]

The pace of transition is also affecting AEMO’s own projections: last year AEMO was noting that by 2035 there might be periods where renewables would meet nearly 90 per cent of demand,[12] but by August 2021 this view changed to 100 per cent of customer demand that could be met by renewables by 2025.[13]

This would seem to indicate that there is a need to engage in longer-term planning from a policy perspective, so that Australia can exit from fossil fuels in an orderly way; that is, to avoid a loss of supply security and to maintain affordability for electricity consumers.

AEMO notes that, depending on the scenario, the National Electricity Market will also “need 6-19 GW of new flexible, utility-scale dispatchable resources to firm up the inherently variable resources”.[14] This includes ‘deep’ storage[15] for ‘droughts’ of variable renewable energy and seasonal smoothing. Figure 1 shows how inter-seasonal smoothing would work.

What this means is that there is both a need and an opportunity for new energy storage to match the domestic electricity transition.

10 ACIL Allen consulting (for ARENA) (2018), Opportunities for Australia from Hydrogen Exports, page 15.
11 AEMO (2020), page 8. See also Farmer (2020).
12 AEMO (2020), page 18, see also Tilly (2021).
13 AEMO (2021).
14 AEMO (2020), page 50.
15 AEMO defines three broad types of storage in this context:
- shallow storage: for capacity ramping and to provide FCAS services that make the system more stable (e.g., VPP batteries and 2-hourgrid connected batteries);
- medium storage: for intra-day shifting (e.g., 4-hour batteries, 6 - 12 hour pumped hydro); and
- deep storage: for VRE ‘droughts’ and seasonal smoothing.

1.2 Hydrogen has a vital role in future energy systems

Hydrogen provides the versatility required by future energy systems in a carbon constrained world. With its long-term energy storage potential, and the potential for electrolysers to become large dispatchable loads which can be turned on or off as required, hydrogen is the perfect complement for variable renewable electricity and batteries. Hydrogen also has the unique potential to be shipped and traded globally as a zero-carbon fuel, in both liquefied form and in chemical variants (such as ammonia).

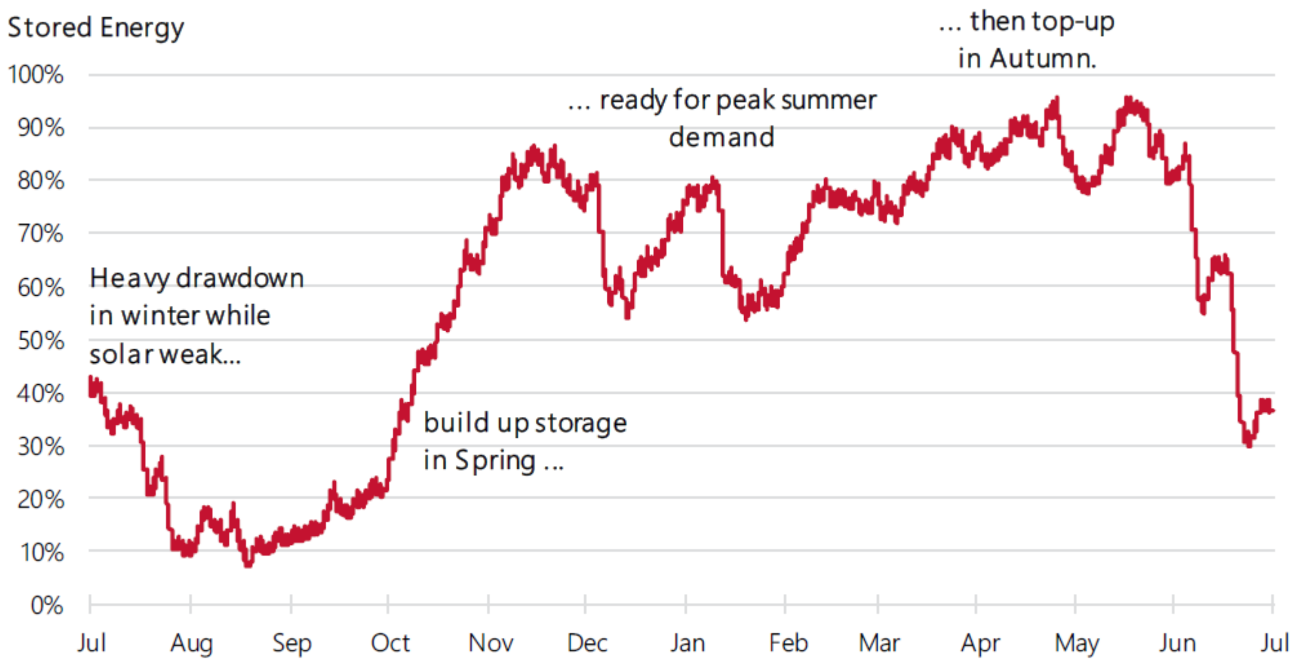


Figure 1: Deep storage balances energy loads throughout the year, 2034-35, SOURCE: AEMO, 2020, p. 52.

The 2015 Paris Agreement was the first global compact to seek national commitments to carbon neutrality, to avoid dangerous climate change. The effect is to require targets for electricity decarbonisation to shift from partial to total, and for decarbonisation efforts to extend to sectors in which abatement is more difficult than in electricity, such as land, sea and air transport, mineral processing, chemical manufacturing and agriculture.

The Paris Agreement has effectively made hydrogen an essential element of decarbonisation plans. Prior to Paris, national policies appeared to assume that partial decarbonisation targets would be achieved with greater energy self-sufficiency, particularly in renewables. However, the Paris goal of full decarbonisation puts self-sufficiency out of reach for countries with limited clean energy resources and large populations.

There will also be geopolitical consequences from the energy transition that will need to be accommodated. The International Renewable Energy Agency (IRENA)[16] refers to this as a 'democratising effect' – driven by the fundamental physical differences between fossil fuels and renewable technologies in how they are produced and at what scale.[17] This will fundamentally change the long-term value of global energy markets as different countries explore their alternatives and opportunities for self-sufficiency.

16 IRENA (2019), page 23.
17 For example, renewables are not as geographically concentrated as fossil fuels, reducing the importance of current energy 'choke points'. Renewables are also largely inexhaustible and harder to disrupt than fossil fuels. Renewables are also deployable at 'almost any scale' and are compatible with decentralised energy production and use.

1.3 Structure of this paper

This paper sets out some recommendations for next steps in policy to support a 'no regrets' net zero and hydrogen policy.

Chapter 2 describes the scale of assets and infrastructure required to meet Australia's hydrogen objectives, finding that the task ahead will need whole-of-economy planning that addresses multiple hydrogen production, delivery and use pathways, and encourages co-location of projects. In this chapter we argue that policy and funding should prioritise the demand side, and demand for harder to abate applications with opportunities to build scale should take precedence.

Chapter 3 explores the need to consider how we can reuse existing gas infrastructure to get to scale, noting that we need to be careful to plan for the economic lives of assets already in the ground to support energy affordability for consumers. Hydrogen also creates 'sector coupling' opportunities, where planners and project proponents can choose between electricity and gas infrastructure for different purposes. With the scale required to 'move molecules' or 'move electrons' in producing hydrogen, both gas and electricity infrastructure will need to be in play.

We also address the relatively easy way that demand can be stimulated by implementing a 10 per cent target for hydrogen to be blended into the natural gas system.

Chapter 4 is about a key demand to be served, and one that we suggest is no regrets: heavy road transport. Diesel is already close to price parity with hydrogen, and heavy transport is also hard to abate with electricity and batteries. The problem with this market is that the refuelling infrastructure isn't in place and the vehicles are not yet in the country. In this chapter we recommend a programme of heavy and lighter truck (and bus) trials that will start the necessary refuelling backbone. The trials will also provide data to build transport operator confidence in the costs per kilometre for truck and bus purchases.

Chapter 5 is about the second key set of markets for demand: manufacturing products that already use hydrogen as a feedstock or fuel, and the use of hydrogen in new markets that can grow Australia's manufacturing capabilities. The markets identified here are iron and steel, ammonia, methanol, and alumina and aluminium. Steel is an ambitious future use for hydrogen but has promise that needs to be explored fully. Ammonia and methanol are already produced from hydrogen, with each also presenting great promise for larger scale production and export as low-carbon fuels,particularly for shipping.

AUSTRALIAN HYDROGEN COUNCIL

References

AEMO (2020) *2020 Integrated System Plan for the National Electricity Market*, July, https://aemo.com.au/-/media/files/major-publications/isp/2020/final-2020-integrated-system-plan.pdf?la=en.

AEMO (2021) 'Reliability outlook positive as energy transition accelerates', media release, 31 August, https://aemo.com.au/newsroom/media-release/2021-esoo.

Australian Government Department of Industry, Science, Energy and Resources (2019) 'The Australian resources sector - significance and opportunities', in *Australia's National Resources Statement*, February, https://www.industry.gov.au/data-and-publications/australias-national-resources-statement/the-australian-resources-sector-significance-and-opportunities

Australian Government Department of Industry, Science, Energy and Resources (2020) *Technology Investment Roadmap: First Low Emissions Technology Statement 2020*, 22 September, https://www.industry.gov.au/data-and-publications/technology-investment-roadmap-first-low-emissions-technology-statement-2020.

ACIL Allen consulting (for ARENA) (2018) *Opportunities for Australia from Hydrogen Exports*, https://arena.gov.au/knowledge-bank/opportunities-for-australia-from-hydrogen-exports/.

Bond, K., Vaughan, E. and H. Benham (2020) *Decline and Fall: The size and vulnerability of the fossil fuel system*, Carbon Tracker, 4 June, https://carbontracker.org/reports/decline-and-fall/

Burchardt, J., Herhold, P., Päivärinta, J. and S. Schönberger (2020) 'Have We Passed Peak Demand for Fossil Fuels?', BCG, https://www.bcg.com/en-au/publications/2020/have-we-passed-peak-demand-for-fossil-fuels.

COAG Energy Council (2019) *Australia's national hydrogen strategy*, November, https://www.industry.gov.au/sites/default/files/2019-11/australias-national-hydrogen-strategy.pdf.

Cunningham, M., Van Uffelen, L., and M. Chambers (2019) 'The Changing Global Market for Australian Coal', *RBA Bulletin*, September, Reserve Bank of Australia, https://www.rba.gov.au/publications/bulletin/2019/sep/the-changing-global-market-for-australian-coal.html.

Deloitte (2019) *Australian and global hydrogen demand growth scenario analysis*; COAG Energy Council – National Hydrogen Strategy Taskforce, November, https://energyministers.gov.au/sites/prod.energycouncil/files/publications/documents/nhs-australian-and-global-hydrogen-demand-growth-scenario-analysis-report-2019_1.pdf.

Farmer, M. (2020) '"Fastest energy transition" for Australia after renewables ramp-up', *PowerTechnology*, 25 August, https://www.power-technology.com/features/australia-energy-transition-analysis-coal-decline-solar-wind-project-pipeline-energy-markets-aemo-globaldata/.

Fattouh, B., Poudineh, R. and R. West (2019) *Energy Transition, Uncertainty, and the Implications of Change in the Risk Preferences of Fossil Fuels Investors*, Oxford Energy Insight: 45, The Oxford Institute for Energy Studies, University of Oxford, January, https://www.oxfordenergy.org/publications/energy-transition-uncertainty-implications-change-risk-preferences-fossil-fuels-investors/

IRENA (2019) *A New World: The Geopolitics of the Energy Transformation*, the Global Commission on the Geopolitics of Energy Transformation, https://irena.org/publications/2019/Jan/A-New-World-The-Geopolitics-of-the-Energy-Transformation

Office of the Chief Economist (2020) *Resources and Energy Quarterly*, Department of Industry, Science, Energy and Resources, September, https://www.industry.gov.au/data-and-publications/resources-and-energy-quarterly-september-2020

Reserve Bank of Australia (2020) *Financial Stability Review*, 8 October 2020, https://www.rba.gov.au/publications/fsr/2020/oct/pdf/financial-stability-review-2020-10.pdf.

Tilly, M. (2021) 'AEMO says renewables growth "well ahead" of greenest forecast', *Energy News Bulletin*, 10 May.