

A Hydrogen Roadmap for **South Australia**

Accelerating South
Australia's transition to a
clean, safe and sustainable
hydrogen economy.

www.hydrogen.sa.gov.au



Government
of South Australia

“This nation-leading strategy sets out clear pathways to capitalise on our State’s competitive advantages and accelerate South Australia’s transition to a clean, safe and sustainable producer, consumer and exporter of hydrogen.”

Jay Weatherill, Premier of South Australia



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All amounts are shown in Australian Dollars unless otherwise stated.

Hydrogen's role in our clean energy future



Hydrogen is not only the most plentiful element in the universe, but is also the ultimate clean energy fuel.

By embracing a hydrogen economy, our cars, buses, trucks and power stations could soon be emitting H₂O instead of polluting the world with CO₂.

South Australia has led the field in clean-energy generation and the transition of our economy toward a low-carbon future that is required to mitigate the devastating effects of climate change.

Until recently, the focus of our renewable efforts has been to encourage investment in wind and solar as alternatives to fossil fuels.

Through our steadfast commitment to carbon neutrality, South Australia has created the investment landscape for the sort of innovative projects that will help power the 21st Century.

South Australia is in the box seat to leverage its already substantial investment in renewable energy infrastructure to power the burgeoning hydrogen economy.

Just as we have attracted global interest in our renewables sector, we also want to bring to this State international companies that are at the forefront of developing the hydrogen economy.

This Hydrogen Roadmap is a statement of our intent. It will guide the strategic development of this industry in South Australia to fulfil our ambition of becoming a zero-carbon emitting economy.



The Roadmap considers the various options for developing the hydrogen economy – such as future fuel for transport fleets or zero-carbon feedstock for the ammonia and fertiliser industries – that underpin global food production.

In these pages, we also set out the strategic advantages of investing in the hydrogen economy in South Australia and the many projects that can be built around this proven technology.

Hosting major global research and supporting technological advances in the hydrogen economy will also create substantial job and business opportunities in a range of industries, and for decades to come.

By capitalising on the State's competitive advantages, we can accelerate South Australia's transition to a clean, safe and sustainable producer, consumer and exporter of hydrogen.

Hon Jay Weatherill
Premier of South Australia

Hon Tom Koutsantonis MP
Minister for Mineral Resources and Energy
Government of South Australia

The global energy transition

Humanity is in transition toward zero-emissions transportation.

Rapid advances in vehicle technology in the past few years have made it possible to paint a clearer picture of how our transport future will look, with a growing number of cars, trucks, buses and trains all meeting our transportation needs while emitting no harmful emissions into the atmosphere.

Around the world, battery-powered, pure electric vehicles are fast gaining in popularity, while hydrogen fuel cell vehicles that combine rapid refuelling time with long-range travel are now becoming more attainable.

Through intelligent incentives and a holistic approach to policy-making, governments can play a proactive role in driving the take-up of next-generation transport technologies.

I am proud to support the South Australian Government's Hydrogen Roadmap as a visionary first step toward a cleaner, greener future.



Scott Grant
Chief Operating Officer,
Hyundai Motor Company Australia
Member of the Board,
Hydrogen Mobility Australia Ltd

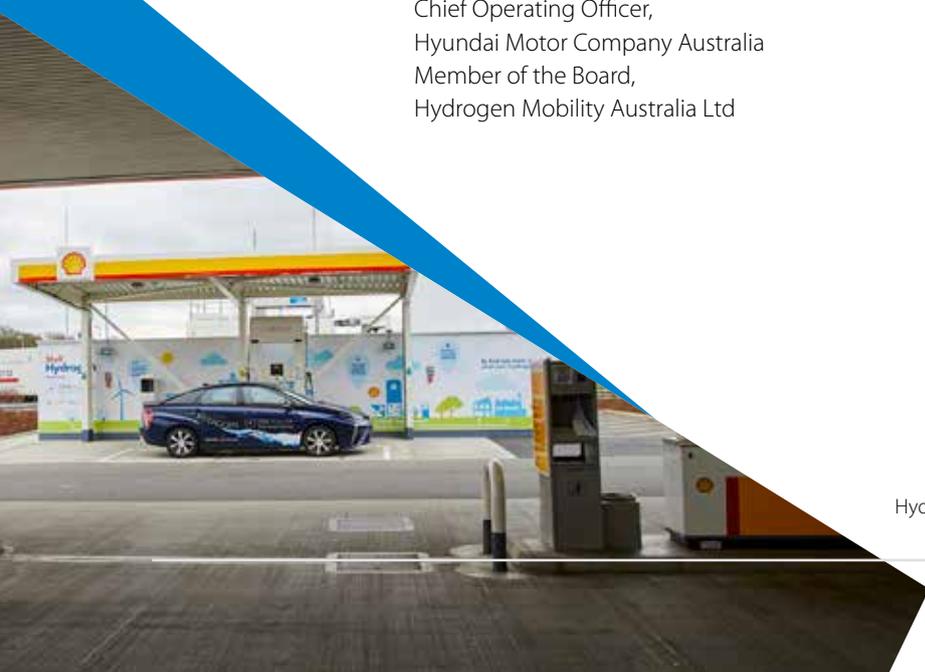
The hydrogen economy has come of age, and the time is right for South Australia to claim a significant stake in the development of this new industry.

Building on its established leadership in solar and wind generation, South Australia can now move towards 100 per cent renewable power, establish a renewable fuel infrastructure for domestic and export markets, and attract new advanced manufacturing jobs in hydrogen infrastructure, fuel cells and supply chain technologies.

The Hydrogen Roadmap developed by the South Australian Government sets a clear agenda and key priorities to guide this transition.



Dr. Attilio Pigneri
CEO, the Hydrogen Utility™
President,
Australian Association for Hydrogen Energy



Hydrogen fuel station, source: ITM Power

Why a Hydrogen Roadmap for South Australia?

South Australia is geographically and technologically well-placed to share in the economic and environmental benefits of the scientific advances that are enabling the production, transportation and use of hydrogen without increasing carbon emissions.

South Australia has several competitive advantages:

Energy focused government

High renewable energy deployment underpinned by world-class wind and solar resources

Existing transport and export infrastructure backed by experienced safety regulators

Proximity and trade relationships into Asia

A diverse range of opportunities for local use of hydrogen

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Hydrogen

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South Australia has a natural endowment of sunshine and prevailing winds that have attracted substantial investment in renewable energy. The power generated by renewable sources has pushed South Australia to the forefront of the transition to a low carbon economy. Developments in the production and transport of hydrogen now make it possible to turn South Australian sun and wind into an export commodity.

Hydrogen is beginning to play a greater role in the global transition to clean, safe and sustainable energy systems by providing an alternative source of energy storage and fuelling bus, train and freight transport fleets. Commercial applications for fertilisers can also help to decarbonise our food-producing agribusiness sector.

The South Australian Government, transport and energy industry leaders and our research institutions recognise an emerging opportunity in the coming decade to accelerate this State's transition to a hydrogen economy so that we can attract the investment required to create a nation-leading hub for the production, use and export of hydrogen.

Seizing the opportunity to take a leadership role in developing a hydrogen economy will deliver against several of South Australia's key strategic objectives

To grow the State's economy by playing to its competitive advantages in renewable energy, mining, tourism, food and wine, health, biomedical research, IT, advanced manufacturing, shipbuilding and defence

To decarbonise the State's economy, targeting zero net carbon emissions by 2050 and the establishment of Adelaide as the world's first carbon neutral city

To achieve 50 per cent of electricity generation from renewable energy sources by 2025 and provide reliable, affordable and clean power into the future for all South Australians

South Australia can play a role in creating a regional economy where public transport fleets here and across Asia can refuel using hydrogen imported from centralised production facilities built in this State. Our own transport fleets will also be able to refuel using hydrogen created by electrolysis plants powered by our expanding renewable energy infrastructure.

To ensure South Australia can leverage its existing competitive advantages as a safe and reliable exporter of gas and generator of renewable energy, a Roadmap is required to guide strategic development of this emerging industry. The Roadmap will also provide a catalyst for attracting international investment and the intellectual property needed to firmly place South Australia at the forefront of the global transition to a safe, clean and sustainable hydrogen industry.

The Roadmap importantly sets out our vision to accelerate South Australia's transition to an Asia-Pacific hub for the production, use and export of hydrogen as part of a safe, clean and sustainable industry.

The South Australian 2017-18 State Budget has already taken the first steps towards accelerating the take-up of hydrogen as an alternative transport fuel with the creation of a \$150 million Renewable Energy Fund that can provide loans and grants to eligible projects including hydrogen storage.

A further \$8.2 million has been allocated to the first stage of the Hydrogen Roadmap that will fund a trial of six hydrogen-fuelled buses on metropolitan public transport routes. The public transport pilot project requires facilities to produce hydrogen, a refuelling station and six or more Adelaide Metro buses specifically designed to run on hydrogen.

The next stages of the Roadmap arise from five action themes set out in this document. Success will be measured through the State's ability to attract the investment and intellectual property required to bring forward the development of a hydrogen economy; the extent that the State can further decarbonise its economy and the increase in our export income generated by overseas sales of locally-produced hydrogen.

By acting now, South Australia can position itself as a global hydrogen producer and exporter as part of a new growth industry that will lower global carbon emissions while generating jobs, investment, export income and business opportunities for our State.



Global energy production and use is undergoing the largest transition it has seen since the start of the industrial revolution, which represents an enormous business opportunity to those with clean energy resources and the courage to forge new industries.

Tony Frencham
Global Director New Energy
WorleyParsons/Advisian



South Australia at a glance



South Australia has set a target of \$10 billion of investment in low carbon energy by 2025



South Australia's renewable energy generation is approaching 50 per cent



Tonsley – Australia's first innovation district – a place of collaboration and commercialisation



South Australia is building the world's largest lithium ion battery under an agreement between Tesla, Neoen and the South Australian Government



Government commitment to establish Adelaide as first carbon-neutral city in the world



GigCity Adelaide provides fast and affordable gigabit internet for start-ups, entrepreneurs and big businesses



Adelaide ranked as the most cost-competitive city in Australia, ahead of Melbourne, in KPMG's 2016 biennial Competitive Alternatives Report



Adelaide's full-time labour costs are 11 per cent below the Australian average

5th

Adelaide ranked as the fifth most liveable city in the world by the Economist Intelligence Unit

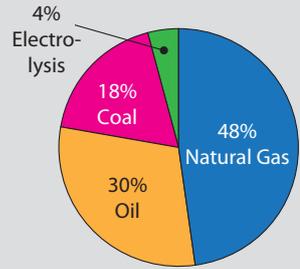


South Australia's 1.7 million population is large enough to facilitate development and growth for businesses

Hydrogen basics

Hydrogen can be produced from a variety of sources

Worldwide Hydrogen Production*

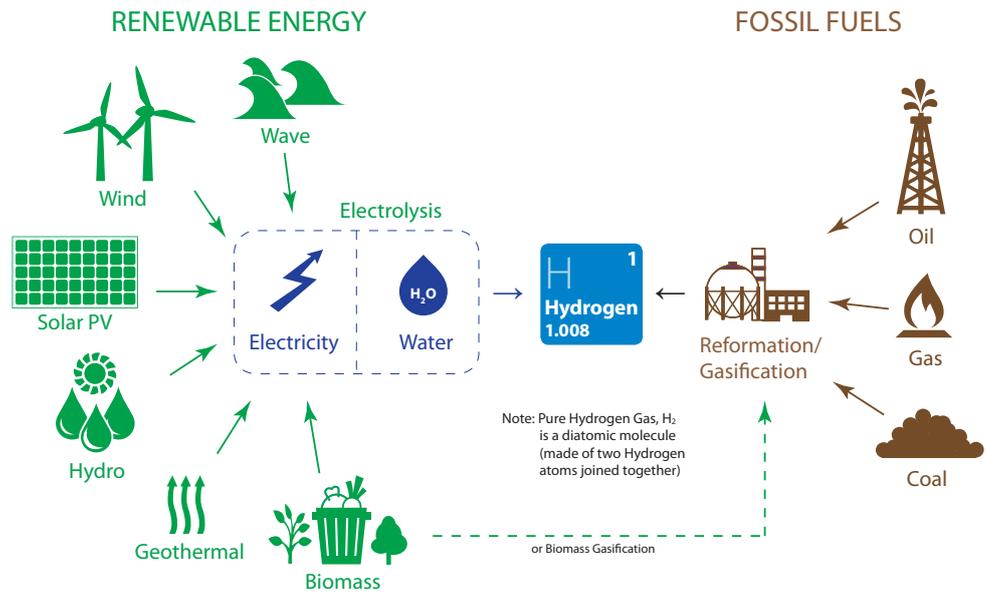


Source: Air Products

Hydrogen production methods

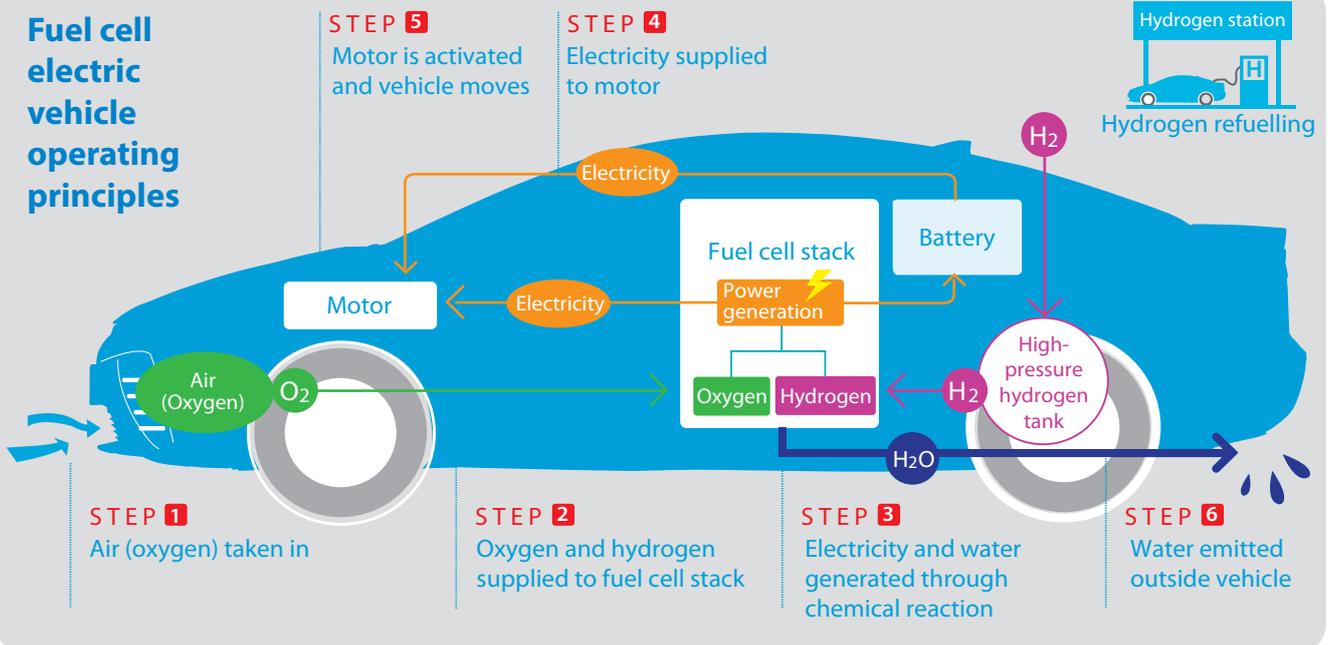
Hydrogen is already produced in large quantities in Australia for industrial applications in the chemical, power generation, glass, food and ammonia industries, amongst others. Hydrogen sold in Australia is mostly made by steam reforming natural gas, but it is also produced by electrolysis.

Hydrogen can be produced from renewable sources such as solar, wind, hydro, tidal, wave and biomass to make electricity which can then be used in an electrolyser to split water (H_2O) into hydrogen and oxygen.



Source: Hydrogen Mobility Australia

Fuel cell electric vehicle operating principles



Source: Toyota

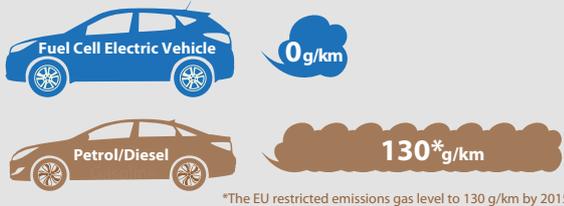
The Hydrogen ecosystem



Source: Linde Group

Advantages of fuel cell electric vehicles

ZERO CO₂ EMISSIONS WHILE DRIVING



A Fuel Cell Electric Vehicle only emits water while driving and is friendlier to the environment by not releasing harmful greenhouse gases.

POLLUTION-FREE WHILE DRIVING



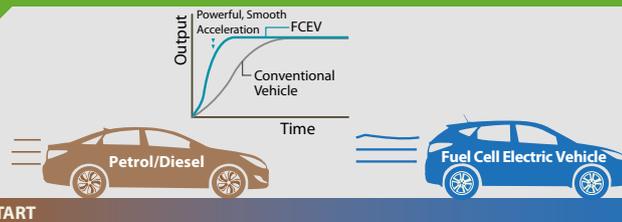
A Fuel Cell Electric Vehicle does not burn Hydrogen, instead a chemical reaction between Hydrogen and Oxygen creates electricity to drive a motor. No harmful pollutants are emitted.

SMOOTH AND QUIET OPERATION



Since a Fuel Cell Electric Vehicle has an electric motor instead of an engine, it makes significantly less noise.

GOOD TAKE-OFF ACCELERATION



Due to the torque characteristics of an electric motor, Fuel Cell Electric Vehicles have significantly more torque for acceleration when taking off.

Source: Hyundai

Hydrogen

Accelerating global momentum



Hydrogen fuel station, source: ITM Power

In March 2017, the UK Government announced a new £23 million fund to accelerate the take up of hydrogen vehicles and boost the creation of hydrogen fuel infrastructure.

In November 2016, during his keynote address at the Zero Emission Bus Conference, London Mayor Sadiq Khan announced that no more diesel double-deckers will be procured in London after 2018 and that all new single-deckers will be zero emission.

In August 2017, Hyundai unveiled its latest hydrogen fuel cell SUV, that will be showcased at the 2018 Winter Olympic Games in PyeongChang, South Korea.

By the 2020 Olympic Games in Tokyo, Japan is targeting 40,000 hydrogen fuel cell cars and 100 buses on the road, 160 hydrogen refuelling stations and 1.4 million residential fuel cells.

In March 2016, the world's first hydrogen powered tram commenced service in Qingdao, China.

In January 2017, representatives from the Australian Maritime Safety Authority and Japan's Transport Ministry signed an agreement regarding the shipping of liquid hydrogen from Australia to Japan as part of a world-first pilot project due to commence in 2020.

In March 2016, the South Korean Government in partnership with Hyundai announced a long-term program to replace 26,000 CNG buses with hydrogen fuel cell buses.

In May 2017, the Commonwealth Government's Australian Renewable Energy Agency (ARENA) announced 'exporting renewable energy' in the form of hydrogen, ammonia or embodied in mineral exports is one of its four new investment priorities.

In March 2017, Alstom successfully performed the first test run at 80 km/h of the world's first hydrogen fuel cell passenger train as part of an extensive test campaign prior to the train going into service in Germany in 2018.

In January 2017, at the World Economic Forum in Davos, 13 leading energy, transport and industrial companies launched the 'Hydrogen Council' - a global initiative to provide a united vision and long-term ambition for using hydrogen. The Council is co-chaired by the chairman of Toyota Motor Corporation and the CEO of Air Liquide.

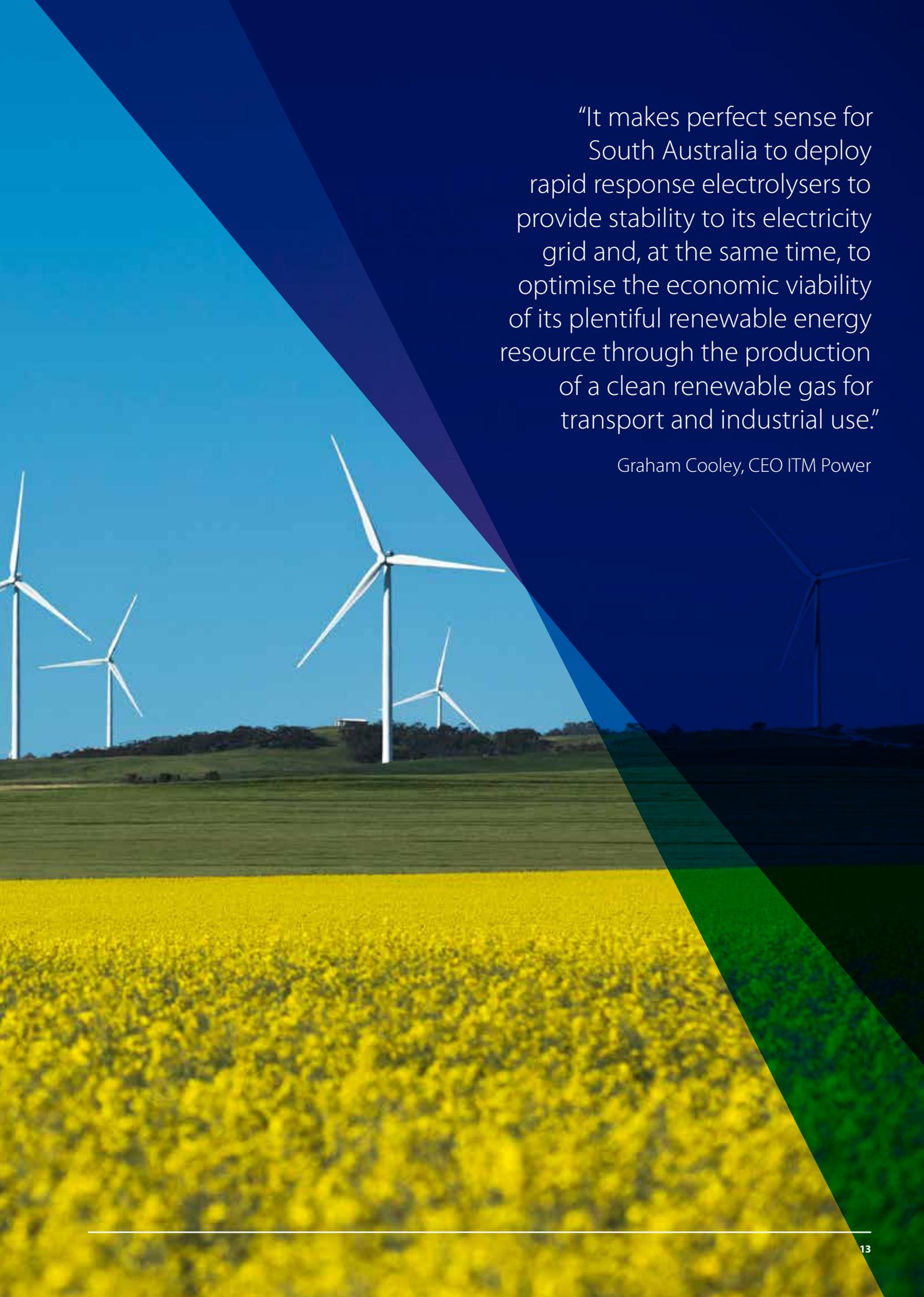
In August 2016, the California Air Resources Board announced that around 1300 new fuel cell electric vehicles had been deployed in California between June of 2016 and April 2017, up from 331 registered in the prior period.

Hydrogen

South Australia's five key competitive advantages



Hornsedale wind farm, South Australia



“It makes perfect sense for South Australia to deploy rapid response electrolysers to provide stability to its electricity grid and, at the same time, to optimise the economic viability of its plentiful renewable energy resource through the production of a clean renewable gas for transport and industrial use.”

Graham Cooley, CEO ITM Power

Energy focused government

South Australia supports a business environment of innovation that welcomes investment in globally-competitive, advanced technologies.

By prioritising both unlocking the full potential of our resources, energy and renewable assets and growth through innovation, the government has assisted the ongoing transformation of the South Australian economy.

Hydrogen offers a further opportunity to build on the substantial progress already made in attracting investment in world-leading renewable energy technologies to this State. Our energy infrastructure and support for advanced and adaptive industries puts South Australia in a strong position to harness the potential of hydrogen as an energy source.

As early as the 1980s, the South Australian Government began collating information about the quality of our renewable resources as the first step toward attracting investors.

A target for increasing the proportion of electricity produced through renewables has been increased from an initial 20 per cent, to 33 per cent and then 50 per cent as each time South Australia reached its clean energy goals ahead of schedule. This success built a foundation for the government's aspiration for Adelaide to become the world's first carbon neutral city.

Our ability to attract investment has not relied solely on our unique endowment of world-class natural wind and solar resources. South Australia has been at the forefront of tailoring our regulatory frameworks to provide clarity and certainty to investors.

South Australia was the first Australian jurisdiction to introduce a feed-in tariff for household roof-top solar panels, which resulted in a sharp uptake of private solar PV installations across the State.

As well as creating a receptive regulatory and strategic planning framework, South Australia has provided leadership as an active participant in the energy economy. Solar panels have been installed on schools and major public buildings such as the Art Gallery, South Australian Museum and the State Library. The government also supported roof-top solar installations at Tonsley, Australia's first innovation district and the Adelaide Showgrounds.

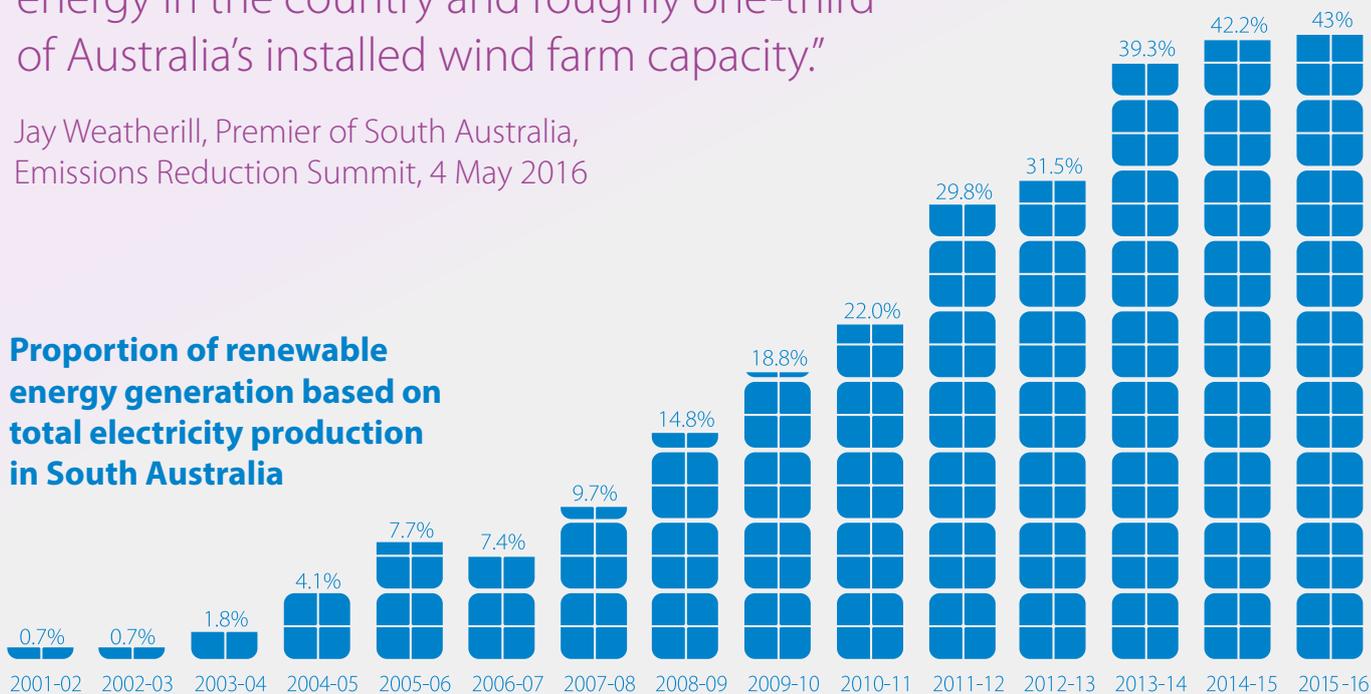
Even with such a progressive track record of attracting investment in wind and solar technology, only a fraction of South Australia's renewable energy potential has been captured. Future growth will rely on new thinking such as hydrogen.



“From virtually a standing start since coming into government in 2002... we now have the highest per capita penetration of solar energy in the country and roughly one-third of Australia’s installed wind farm capacity.”

Jay Weatherill, Premier of South Australia,
Emissions Reduction Summit, 4 May 2016

Proportion of renewable energy generation based on total electricity production in South Australia



50%
OF ELECTRICITY
FROM RENEWABLE
SOURCES
BY **2025**

\$10
BILLION IN
LOW CARBON
GENERATION
BY **2025**

ACHIEVE NET
ZERO
EMISSIONS BY
2050

OUR GREEN
ENERGY
TARGETS

ESTABLISH ADELAIDE
AS THE WORLD'S
FIRST

CARBON NEUTRAL CITY

High renewable energy deployment underpinned by world-class wind and solar resources



Hornsdale wind farm, South Australia

South Australia leads the field in clean-energy generation. In 2015-16, approximately 43 per cent of the state's electricity was generated from renewable sources*, predominantly large scale wind generation and distributed rooftop solar PV. Since this time, increased wind and rooftop solar PV penetration means it is likely that the South Australia's total renewable energy generation will continue to rise and approach South Australia's 50 per cent renewable energy target.

Electrolysers to produce hydrogen offer a highly flexible load that can be ramped up and down to balance electricity supplied from intermittent renewables.

Continued take up of renewable energy technologies is a key component of the South Australian Government's plan to accelerate our transition to a low carbon economy capable of achieving net zero carbon emissions by 2050.

The ongoing transition is backed by targets that by 2025, aim for 50 per cent of the State's electricity production to be sourced from renewable energy and to secure \$10 billion in low carbon investment. Significant headway has already been made on achieving these targets.

The Australian Energy Market Operator's 2015/16 generation statistics show about 43 per cent of the State's total energy is already generated from renewable energy sources. More than 4500 MW of renewable generation capacity at different stages in the development pipeline will be more than enough to close the remaining seven-percentage-point gap in the target.

On the investment front, South Australia has also already attracted about \$7.6 billion in renewable electricity generation to date, the bulk of which is comprised of intermittent wind generation. Foreshadowed investment in SolarReserve's Aurora Solar Thermal Plan near Port Augusta and the world's biggest lithium ion battery at Jamestown being constructed by Tesla and Neoen add to the diversity of investment options currently being pursued in South Australia.

Importantly, the State's six-point Energy Plan sets out a framework to carefully manage the continued transition to a low-carbon economy that provides security, reliability and affordability of South Australia's electricity supply.

Hydrogen offers a compelling solution to many of the energy outcomes being sought by the South Australian Government in the Energy Plan. Its ability to act as a store of renewable energy that can be later reconverted to grid electricity helps to support further growth of the renewable sector in South Australia while its ability to provide ancillary grid services will contribute to power system security.

The State already has a long-standing reputation as a reliable supplier of energy through the development of the Cooper Basin and its supporting infrastructure, including the Port Bonython Processing Facility that exports a variety of products to North Asia. Our existing trading relations and shipping routes allow South Australia to build on its export capacity.

In summary, South Australia has the potential to capitalise on its competitive advantages to position itself as a global hydrogen producer and exporter as part of a new growth industry that will lower global carbon emissions while generating jobs, investment, export income and business opportunities for the State.

**Source: AEMO South Australian Historical Market Information Report August 2016*



RENEWABLE ENERGY STATISTICS

43% Renewable electricity generation in 2015/16*

 At least \$7.6B invested**

WIND STATISTICS

 19 operational wind farms**

 1697 MW of installed capacity**

 Approximately 35% of total electricity generated from wind in South Australia in 2015/16*

SOLAR STATISTICS

 Approximately 1 in 3 South Australian households with rooftop solar PV

 738 MW of installed rooftop solar PV capacity as of April 2017***

 Approximately 7.5% of total electricity generated from rooftop solar PV in South Australia in 2015/16*

FORWARD PIPELINE STATISTICS

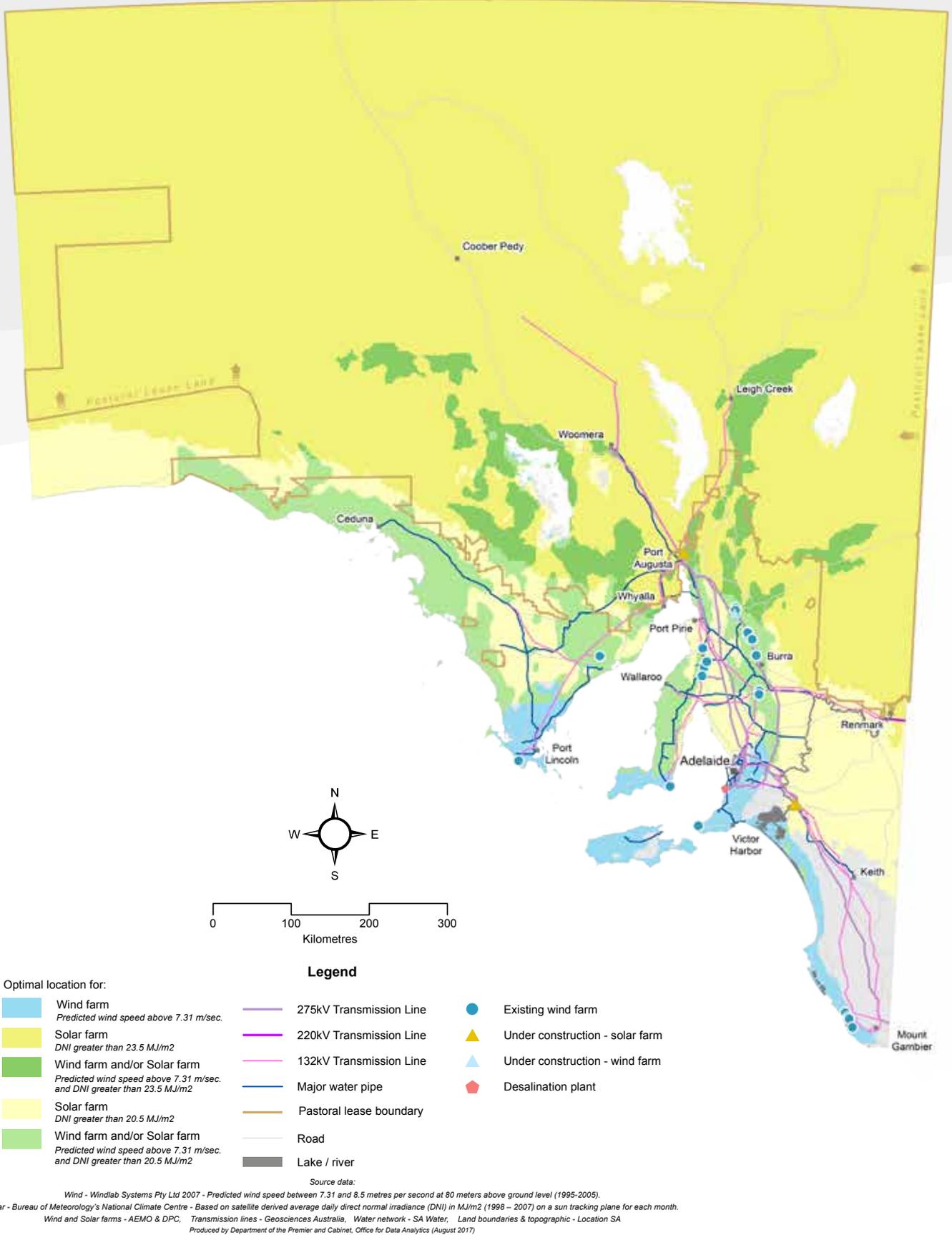
 Over 500 MW of large scale solar PV, wind and storage projects under construction, representing investment of approximately \$1B**

 A further 4300 MW of large scale wind and solar projects and more than 1000 MW of large scale energy storage projects have achieved or are seeking development approval, representing an estimated investment in excess of \$9 billion

*AEMO **Jacobs - as at 30 June 2017 ***Australian PV Institute

Potential for hydrogen production infrastructure sites

Visit www.hydrogen.sa.gov.au to access the link to our Interactive Hydrogen Map.



Existing transport and export infrastructure backed by experienced safety regulators



Port Bonython, South Australia

The development of a hydrogen production and export industry in South Australia will need to be underpinned by robust utilities and transport infrastructure with both capacity and availability at the proposed location of new facilities. The prerequisites for an export-capable hydrogen industry include approved ports capable of handling shipments to the Asia-Pacific region.

The locations of the hydrogen industry facilities and the supporting transport, logistics and utilities infrastructure may be in regional areas, providing potential opportunity to aggregate with the infrastructure development supporting the forecast demands of other economic sectors including the mineral resources and energy sectors.

Experienced regulators with a track record of applying best-practice laws for the handling of liquids and gases also provides South Australia with a competitive advantage in attracting investment in export-capable infrastructure.

South Australia's mineral resources sector, particularly large bulk commodity exports such as magnetite iron ore and copper, require road, rail and port infrastructure to export product to market. Resource projects also have significant demands for water, power and gas and the electricity, gas and pipeline infrastructure to deliver these essential services.

To deliver the objectives of the Roadmap, the State Government has a role in facilitating and scaling the development of transport and utilities infrastructure to incorporate its extension to the hydrogen industry.

Through strategic planning, the government and private sector energy and service providers have already identified utilities, infrastructure corridors, regional transport flows and key major bulk port locations at Whyalla, Cape Hardy and Myponie Point for future multi-user large volume exports.

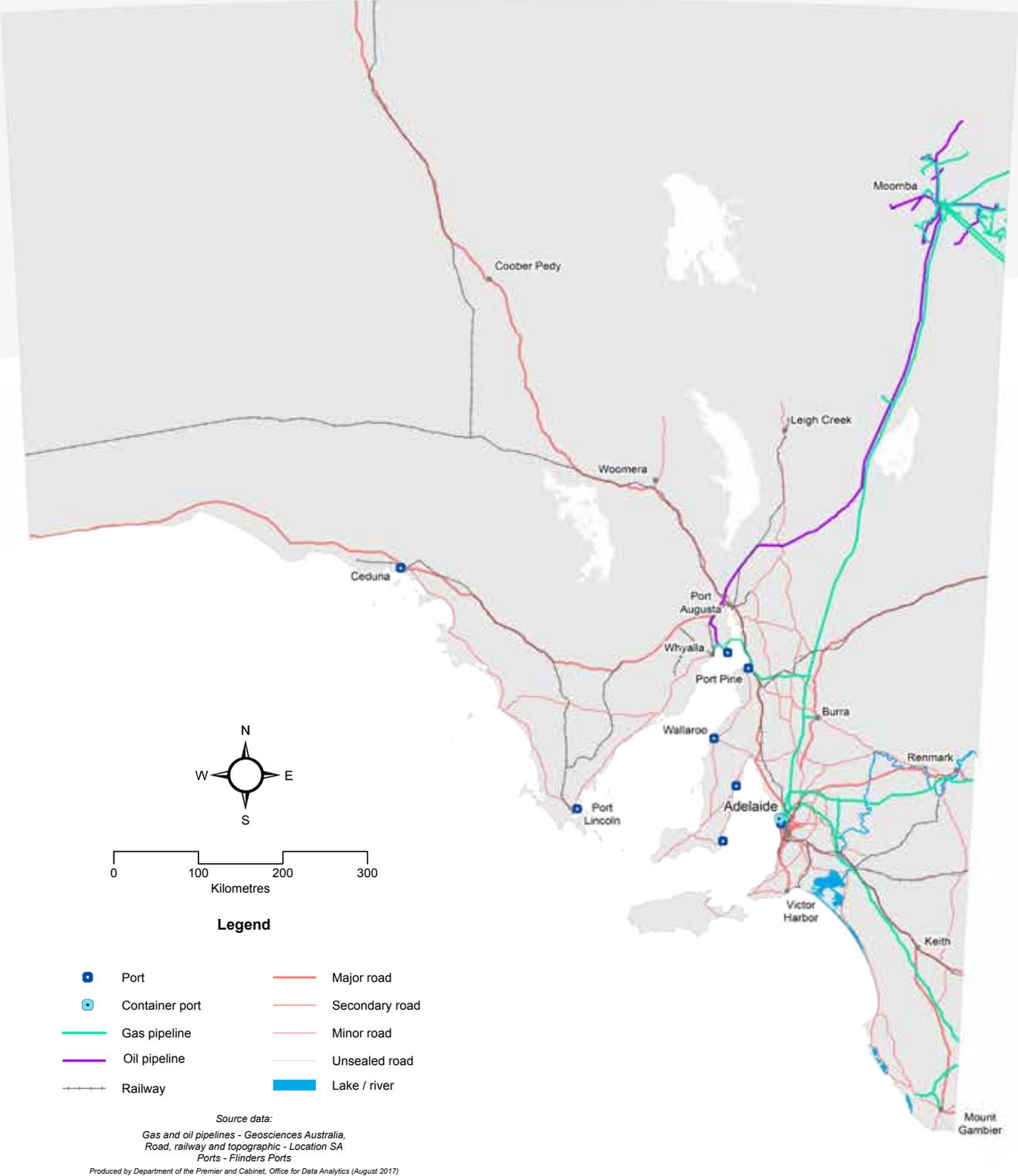
These studies include the Integrated Transport and Land Use Plan, the 50-Year Port Strategy and Electranet studies, that will inform the strategic planning for the hydrogen industry.

The facilitation of investment and developing new supply chain infrastructure across road, rail, water, gas, electricity, ICT and ports to facilitate the growth of a hydrogen industry will further drive economic development and jobs, both in the construction operation and maintenance of the infrastructure. Skills and engineering capacity already developed in this State to support the resources and energy sectors can also play a critical role in growing South Australia's capacity to produce, transport and export hydrogen.

Government has a role to encourage and leverage regional economies of scale that increase the attractiveness of South Australia as an investment destination. Increases in the capacity and capability of the State's supporting infrastructure and utilities will also create a platform for increasing exports to global markets, and have a multiplier effect in new and increasing economic activity.

Transport and utilities infrastructure

Visit www.hydrogen.sa.gov.au to access the link to our Interactive Hydrogen Map.



Proximity and trade relationships into Asia

Toyota and Hyundai hydrogen vehicles
in Victoria Square, South Australia,
source: Hydrogen Mobility Australia
(Photo: Scott Nargar)



Accelerating the development of a hydrogen industry in South Australia will require working in collaboration with some of our key trade partners within the Asia region. Japan and South Korea are already hastening the development of the hydrogen economy for the benefits they bring to their efforts to combat climate change. Opportunities exist for partnerships with like-minded economies such as South Australia.



Our advantage as a strategic partner exists in the proximity of our hydrogen products to these markets and the maturity of our trade relations.

South Australia is a strategic industry hub conveniently at the centre of Australia's road, rail sea and air networks. Our position as an efficient and cost effective gateway to ship exports across Asian markets underpins the desirability of investing in the development of a hydrogen industry in this State.

At the international level, our export trade is supported through Free Trade Agreements including the Japan-Australia Economic Partnership Agreement (JAEPA) and the Korea-Australia Free Trade Agreement (KAFTA). Improved access to these markets bring new opportunities for Australian companies to do business and drive increased two-way trade.

Proximity and market access on their own is not enough. The South Australian Government actively promotes healthy and collaborative growth of Asian partnerships through a focused, strategic and proactive approach to international engagement.

The China Engagement Strategy, South East Asia Strategy and the North East Asia Action Plan have been adopted to assist South Australian businesses and government to work together to build and expand on our trade relations within key Asian markets and promote our image as a clean, green supplier of premium products.

Engagement between South Australia and our Asian neighbours is also enhanced through sister-state relationships that foster harmony and intercultural understanding between our countries.

The South Australian Government's engagement strategies are not transaction focused but also provide support for building cultural and personal relationships. Nurturing respect is a strong and enduring foundation on which to build a trusting relationship that encourages exchanges of intellectual property, skills and capital.

Business missions both inbound and outbound are undertaken on a regular annual basis to foster stronger economic relations with our strategic Asian trading partners. Senior business leaders from a range of industry sectors meet face-to-face with their business peers in Asia through the delivery of these missions and identify opportunities and generate cooperative ventures encouraging investment and innovation to strengthen economic growth across export markets. Similarly, South Australia has a track record of international MOUs in the resources sector that encourage better understanding and knowledge sharing of our regulatory frameworks.

A diverse range of opportunities for local use of hydrogen

Hydrogen is a versatile element and, in addition to being a resourceful fuel and energy carrier, hydrogen has multiple applications across a range of industries. It is used in the manufacture of electronic components providing protection against impurities and oxidation. In the chemical industry, it can be combined with nitrogen to produce ammonia, a base for synthetic fertilisers.

Hydrogen is a reagent in the production of textiles such as nylon and in a number of plastic materials and is essential in the manufacture of glass for flat screens for smart phones and alike. Application of hydrogen can be found in the food industry (margarines), steel manufacture (annealing treatments), across the aeronautical and space industry (as a fuel), and in the oil refining industry to create cleaner fuel by removing naturally occurring sulphur.

Images clockwise from top left:
1. Waterloo wind farm, South Australia
2. H₂ cogen system
3. Nyagan Powerplant, Russia, source: Hydrogenics
4. Source: Linde Group
5. Whyalla, South Australia
6. Source: ITM Power



Grid stabilisation

Grid and micro-grid balancing

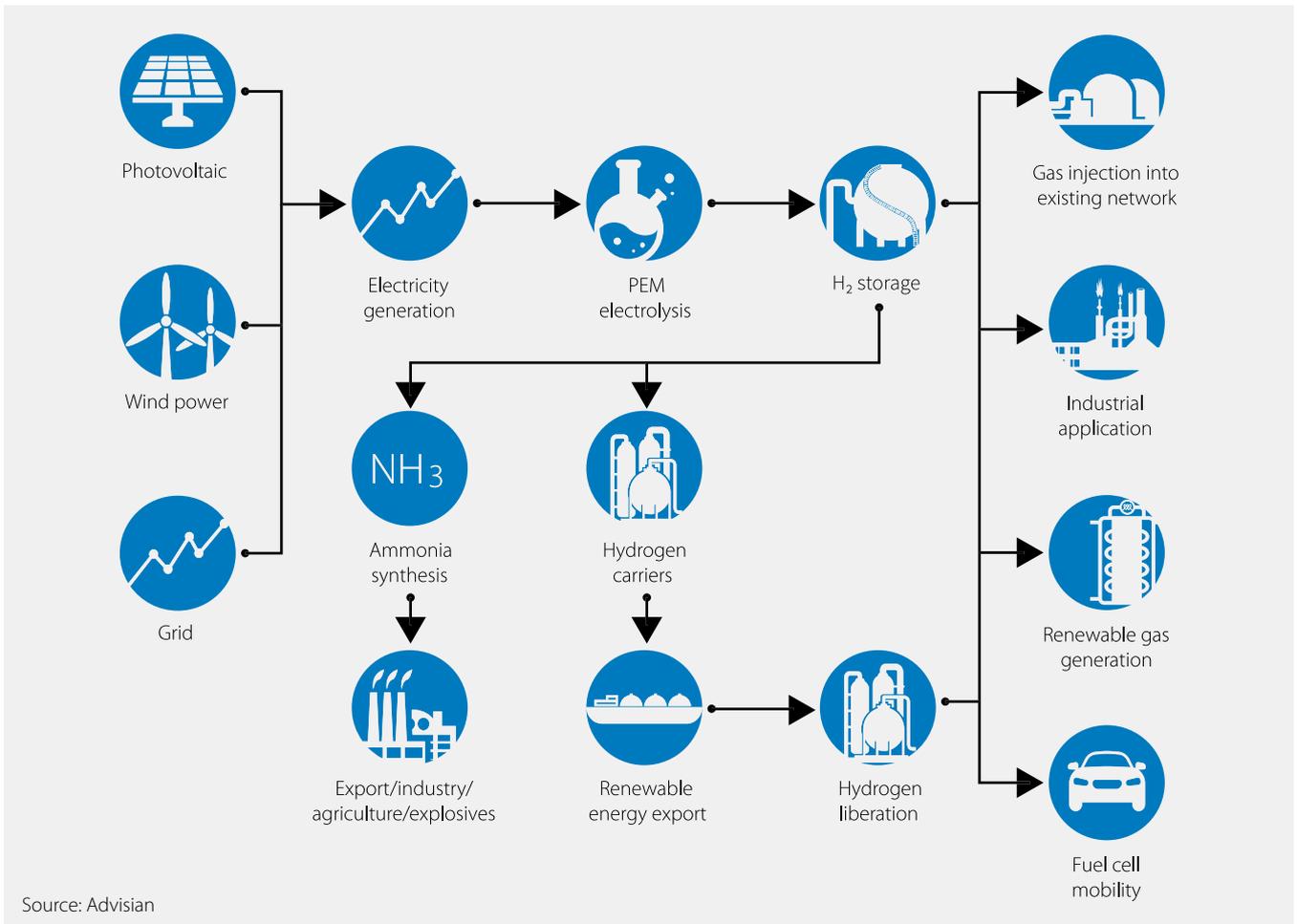


Stationary fuel cells

Remote hydrogen storage and energy generation
Co-generation systems - power and heating



Direct hydrogen gas injection



Source: Advisian



Chemical industry

Ammonia production
Fertilisers for agribusiness
Reagent for textile industry



Heavy industry

Mining
Oil refining
Steel manufacture



Hydrogen powered net zero emission vehicles

South Australia's **Hydrogen Roadmap**



Vision

To accelerate South Australia's transition to a clean, safe and sustainable producer, consumer and exporter of hydrogen.

Objectives

Attract investment in hydrogen production using our renewable energy assets

Accelerate local demand for hydrogen as a low carbon input for transport, energy and industry

Unlock export markets for South Australian-produced hydrogen

Establish South Australia as a testbed for cutting-edge hydrogen technologies

Action themes

1 Support early investments in hydrogen infrastructure

2 Promote and enhance the attractiveness of head office location, equipment distribution and servicing and manufacturing in South Australia

3 Deepen engagement with our key trading partners

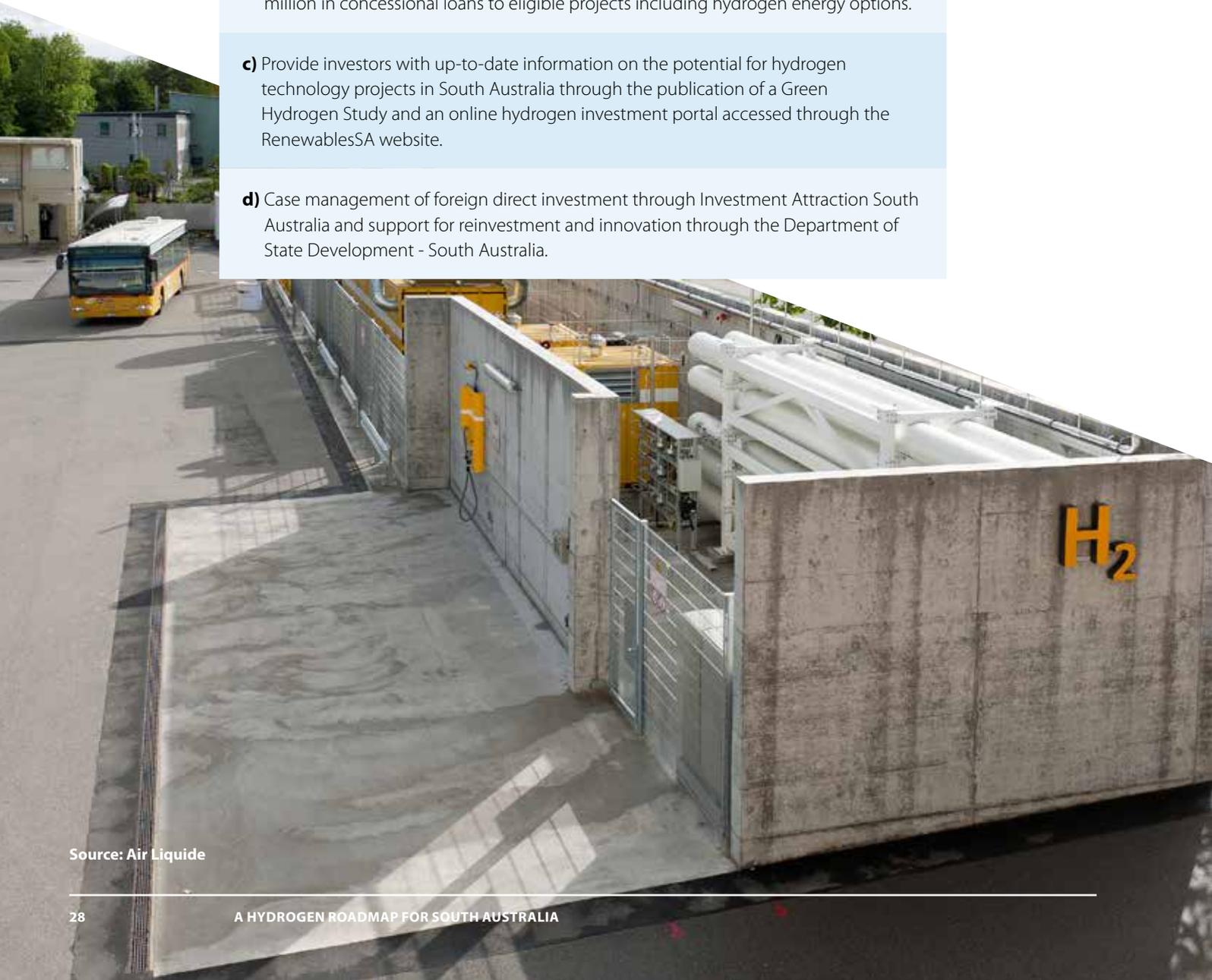
4 Unlock local hydrogen innovation

5 Entrench a best practice regulatory framework for hydrogen production, storage and use

Action theme 1

Support early investment in hydrogen infrastructure

- a)** Use Government leadership and the procurement powers of the State to create demand for hydrogen and incentivise investment in hydrogen production infrastructure. An early mover is the \$8.2 million hydrogen fuel cell bus fleet and refuelling station trial to be conducted by Adelaide Metro.
- b)** Co-investment in demonstration projects comprising hydrogen production and use with the call under the \$150 million Renewable Technology Fund as a first step to incentivising eligible projects. The fund comprises \$75 million in grants and \$75 million in concessional loans to eligible projects including hydrogen energy options.
- c)** Provide investors with up-to-date information on the potential for hydrogen technology projects in South Australia through the publication of a Green Hydrogen Study and an online hydrogen investment portal accessed through the RenewablesSA website.
- d)** Case management of foreign direct investment through Investment Attraction South Australia and support for reinvestment and innovation through the Department of State Development - South Australia.



Source: Air Liquide

Action theme 2

Promote and enhance the attractiveness of head office location, equipment distribution and servicing and manufacturing in South Australia

- a)** Use the \$200 million Future Jobs Fund and its focus on resources and renewable energy to target job creation in the emerging hydrogen sector.
- b)** Encourage automotive industry diversification along the supply chain to include the uptake of hydrogen fuel cell enabled technologies for passenger motor vehicles and heavy commercial fleets such as buses and trucks. South Australia already provides grants to support diversification, transformation and innovation in response to General Motors' decision to cease production of Holden vehicles in Australia.
- c)** Attract international conferences and events on the future development of the hydrogen industry to showcase South Australia's competitive advantages and supportive government policies such as the Hydrogen Roadmap.
- d)** Promote South Australia's supportive environment for business including recent tax and workers' compensation reforms, lower labour costs, Our Energy Plan and access to Government decision-makers. International promotion of South Australia as an investment destination should highlight Adelaide's global reputation as a liveable city that supports innovation.
- e)** South Australia can also provide intensive case management for foreign direct investment in the hydrogen economy through Investment Attraction South Australia, an agency which has a strong track record of supporting international companies to invest and relocate to South Australia.



Source: Hydrogenics

Action Theme 2

Promote and enhance the attractiveness of head office location, equipment distribution and servicing and manufacturing in South Australia

Why South Australia? Investment Attraction

South Australia currently leads the nation in renewable energy generation, which is the primary building block for hydrogen production. Investment Attraction South Australia (IASA) is well positioned to not only support but lead corporations through the ever-changing hydrogen ecosystem.

IASA has established relationships with the proponents developing these renewable energy assets and can aid with establishing cohesive relationships between existing developers and corporations entering the market.

Additionally, IASA will work with prospective proponents by providing a dedicated point of contact for all Hydrogen project requirements and ensuring investors have the best available support to expedite their projects in what to them may be a new experience of investing in an unfamiliar state or country.

IASA can simplify dealings with government and other business partners to streamline pathways to a secure investment and link corporations to new technologies, services and skills that may add value.

South Australia is already home to a proven renewable energy industry ecosystem, therefore moving into the State provides immediate access to a series of complimentary corporations and expedites the opportunity to vertically integrate into the industry.

South Australia offers a range of cost advantages improving the corporate bottom line. In fact, Adelaide was ranked the most cost-competitive city in Australia in KPMG's 2016 biennial Competitive Alternatives Report.

Labour costs in South Australia are 11 per cent below the Australian average making our State a great place to establish a head office and expand. Tax and workers' compensation insurance reforms are also making South Australia the lowest cost jurisdiction in Australia in which to do business.

A well-planned supply of affordable industrial land, linked to strategic infrastructure and transport corridors make South Australia an ideal location for a head office. South Australia's central location provides the ideal gateway into Australia and out to Asian markets beyond through our modern air, sea and rail freight channels.

Our international airport is only 6 kms from the CBD – 15 minutes by taxi and services seven countries direct with 45 flights per week.



invest



South Australia, **naturally rich** with opportunity.

Where in Australia is leading the nation in renewable energy development – the primary building block for hydrogen production?

In South Australia – it's where success starts.



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Government
of South Australia



**SOUTH
AUSTRALIA**

Action theme 3

Deepen relationships with key trading partners

Strong government-to-government relationships, particularly with our Asia-Pacific trading partners, will be key to unlocking export markets as well as attracting inbound investment in hydrogen infrastructure and technology demonstrations, as well as attracting new companies to South Australia.

The South Australian Government is already heavily committed to deepening our international engagement. In 2016, the government hosted trade missions to 13 countries, with the expectation this list would be expanded to 20 countries by the end of 2017.

Hastening the development of our hydrogen economy provides new opportunities for business, trade and research partnerships within the region.

South Australia will take a proactive approach to engaging with our North Asian neighbours to promote the opportunities to invest in the development of hydrogen technologies and the competitive advantages offered by our State's track record in developing low carbon and innovative technologies.

Japan was South Australia's largest export market and fourth largest source of imports in 2016. Petroleum products were ranked the second highest export by value from South Australia. Japan's major imports to South Australia are motor vehicles. This existing two-way trade provides an opportunity to explore how South Australia can continue to meet Japan's energy needs as the country embraces hydrogen fuel cell technology. Similarly, the imports of motor vehicles from leading automakers such as Toyota and Honda create an opportunity for South Australia to reduce its carbon footprint by supporting developments of alternative fuel technologies such as hybrid and hydrogen fuelled vehicles.

South Korea was South Australia's 11th largest export market and sixth largest source of imports. As with Japan, the major imports from South Korea are motor vehicles. Decades of impressive economic growth and industrial modernisation has transformed South Korea into a high-technology industrialised economy. The signing of the Korea-Australia Free Trade Agreement and recent high-profile ministerial visits to Seoul suggest there is significant interest in expanding the existing trade relationship.



Source: SinoHytec Foton



Port Bonython,
South Australia

“If Australia can find a way to export renewable energy then we can build on our coal and gas export businesses and maintain our role well into the future as a regional energy export superpower.”

Jeff Connolly, Chairman and CEO Siemens Australia and New Zealand

Action theme 4

Unlock local hydrogen innovation

South Australia is in a strong position to develop hydrogen technologies with input from local industry, innovators and academics due to the existing innovation ecosystem in the State.



Tonsley innovation district,
South Australia

“Tonsley brings together leading-edge research and education institutions, established businesses and start-ups, business incubators and accelerators as well as government and the wider community to connect and collaborate in Australia’s leading innovation district. Tonsley is also a testbed and showcase for energy technologies supporting the global decarbonisation effort, and hence is the ideal home for hydrogen technology providers looking to establish a presence in Australia.”

Terry Burgess, Member of the South Australian Economic Development Board and Chair of the Tonsley Project Steering Committee

The government acknowledges through its economic priorities that the successful transformation of the South Australian economy depends on our ability to adopt new ways of doing things, using advanced technologies to build globally competitive, high-value firms.

The hydrogen economy is no exception. Capitalising on the four broad pillars of innovation: skills, capital, infrastructure and culture, there is a strong foundation in South Australia for growth of this industry.

The South Australian Government will use its existing funds and support programs to target support for the development of hydrogen technologies. This includes:

- a)** Support for the commercialisation of home-grown technologies through government programs such as the Early Commercialisation Fund.
- b)** Facilitation of research and industry partnerships through programs such as those within the Premier’s Research and Industry Fund and the Future Industries Accelerator.
- c)** Continued encouragement of cluster formations of clean technology and renewable energy expertise at Australia’s first innovation district at Tonsley.
- d)** Connecting leading global hydrogen-related technology and research with local industry and world-leading research capability in South Australia with potential collaborative opportunities.

Through the development of the innovation district at Tonsley, support for innovation and diversification provided by the South Australian Government, creating Australia’s first GigCity and an action plan for prosperity through science, research and innovation, South Australia has created a culture of innovation backed by world-class infrastructure, financing options, and people with skills and international connections.

This ecosystem of creative, innovative and adaptive firms with an ability to work on complex manufacturing and engineering projects is fertile ground for attracting the investment and talent required to develop hydrogen technologies.

Local industry and the research expertise across the South Australian universities continue to forge strong working relationships with many academics working in research centres across the three major universities.

World-leading expertise in renewable energy technologies and the development of a stronger hydrogen economy could also be the catalyst to encourage collaborations with, and attraction of, key opinion leaders to South Australia – not only within academic circles, but industrial leaders as well.

Research innovation within South Australia is also supported significantly by the State Government, by way of several initiatives, such as the Premier’s Research and Industry Fund, the \$150 million Renewable Technology Fund, the \$200 million Future Jobs Fund, the \$10 million Early Commercialisation Fund administered by TechInSA and the \$50 million Venture Capital Fund, managed by BlueSky Venture Capital.

The South Australian Science Council can also play a central role in coordinating engagement across industry and academia. Chaired by South Australia’s Chief Scientist, the Science Council provides high level, independent advice on science policy issues which align with the State’s key strategies.

Furthermore, the GigCity Adelaide program connects businesses within Adelaide’s Innovation Precincts with extremely fast broadband speeds of up to 100 times the national average. Access to affordable high-speed internet can help businesses such as those developing new ideas, products and services in the hydrogen industry to deliver commercial outcomes that benefit the South Australian community and underpin our low carbon future.

Action theme 5

Ensure a strong regulatory framework for hydrogen production, storage and use

South Australia's regulatory approach to hydrogen is to provide fair, predictable and trustworthy regulations that build public trust in industry capability, performance and delivers public safety. Our compliance policy is centred on the prevention of harmful incidents, focuses on sustainability, efficiency of industry and ensures the preservation of our natural resources.

South Australia has been independently assessed as one of the top three resource regulatory regimes in the world for shale and tight gas. Our world-class regulations continue to maintain a global reputation for their simplicity and aim to elicit community trust, investor confidence and provide certainty through legislation that is progressive, transparent, enables flexibility and focuses on outcomes.

South Australia's regulatory environment ensures appropriate consultative processes are in place that involve stakeholders directly affected by regulated activities as well as the public.

Our legislation and regulations are based on the following principles:

- 1. Certainty** - Clear and unambiguous regulatory objectives and expectations for industry to meet
- 2. Openness** - Equitable and competitive access to resources and inclusive communication with stakeholders
- 3. Transparency** - Clear and understandable regulatory decision-making
- 4. Practicality** – Achievable and measurable regulatory objectives
- 5. Flexibility** - Adoption of appropriate and latest technologies to deliver regulatory objectives and meet community expectations
- 6. Efficiency** - Minimise red tape and regulatory inefficiencies

South Australia is committed to simplifying regulations to improve productivity and facilitate economic growth. The State Government has a Simpler Regulation Unit that is responsible for reviewing feedback from business and individuals with a view to updating and improving regulations annually on Simplify Day.

South Australia works closely with other Australian jurisdictions as part of the Council of Australian Governments (COAG) to ensure consistent and prudent regulatory regimes and standards apply to industry and communities across Australia. The South Australian Government is also represented on Australian Standards committees whose work encompasses hydrogen and gas safety.

Regulatory process



Regulation & Legislations

SafeWork SA WHS Act 2012 Dangerous Substances Act 2017	Environmental Protection Agency Environmental Protection Act 1993	Office of Technical Regulator Gas Act 1997 Electricity Act 1996	Environmental, Water and Natural Resources National Resources Management Act 2004	Planning, Transport and Infrastructure Development Act 1993
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Australian Standards (AS/NZS)

International Standards (ISO, NFPA)

Measuring success

Measure 1

Total level of investment in hydrogen-related infrastructure projects and operations in South Australia

Target 1

First of South Australia's hydrogen-powered bus fleet to be operating on Adelaide routes within the next 24 months

1

Measure 2

Overall South Australian production capacity and local access to hydrogen from net zero emission sources

Target 2

By 2025, South Australian motorists should be capable of driving from Ceduna to Mt Gambier in a hydrogen-powered vehicle

2

Measure 3

Volume of export of hydrogen or hydrogen related derivatives from South Australia

Target 3

By 2020, sufficient South Australian production capacity of hydrogen from net zero emission sources to enable the first export shipments in time for the 2020 Tokyo Olympic Games

3

Measure 4

Number of jobs created from Hydrogen Roadmap related projects

Target 4

Hydrogen Roadmap to drive the creation of up to 4200 jobs in research, infrastructure construction and hydrogen production, export and utilisation facilities in South Australia

4

Hydrogen fuel station,
source: Linde Group



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The Hydrogen Roadmap Steering Committee and all the staff across the South Australian Government that have contributed to the development of the Roadmap.



Find out more

South Australia is rich with opportunities, open and ready to do business and to increase its international engagement. Connect with us.

Contact the South Australian Department of the Premier and Cabinet - Low Carbon Economy Unit for further information about the South Australian Hydrogen Roadmap.

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Contact Investment Attraction South Australia for further information on how the agency supports business investment within South Australia.

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