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South Australia's clean energy transformation and hydrogen journey

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Department for Energy and Mining



energymining.sa.gov.au



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Introducing South Australia

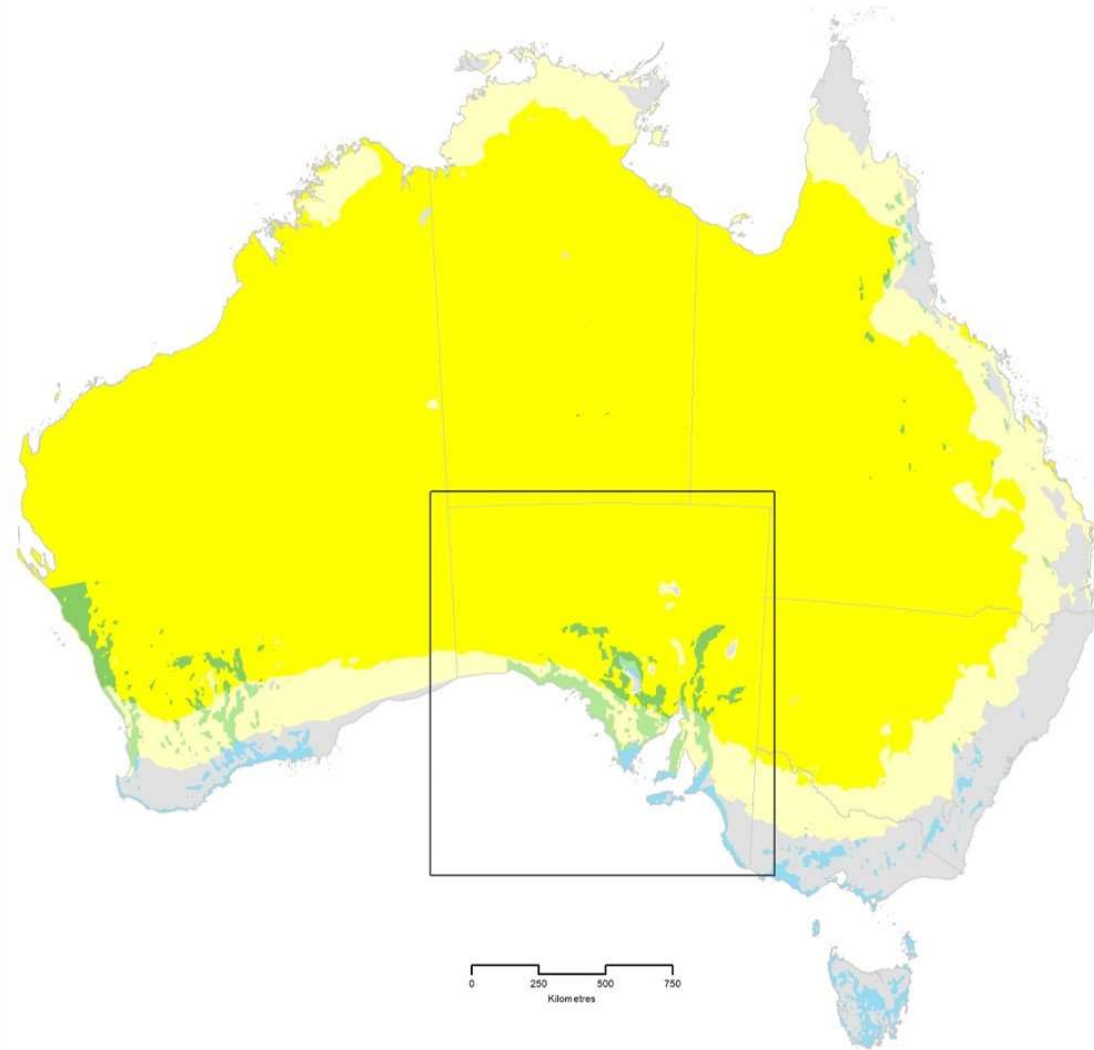
- Total land area of 983,482 square km
- Shares borders with all of the other mainland states
- 1.75 million people in South Australia
- 1.3 million people in Adelaide (capital)
- +9.30hr difference from GMT
- Adelaide regularly listed in the top ten most liveable cities in the world
- Mediterranean climate
 - Adelaide latitude = Cyprus
 - SA-NT border latitude = Luxor, Egypt



A confluence of wind and solar resources

Optimal location for:

-  SOLAR FARM
DNI greater than 23.5 MJ/m²
-  SOLAR FARM
DNI greater than 20.5 MJ/m²
-  WIND FARM
Predicted ave. wind speed above 7.31 m/sec
-  WIND FARM AND/OR SOLAR FARM
Predicted ave. wind speed above 7.31 m/sec
DNI greater than 23.5 MJ/m²
-  WIND FARM AND/OR SOLAR FARM
Predicted ave. wind speed above 7.31 m/sec
DNI greater than 20.5 MJ/m²

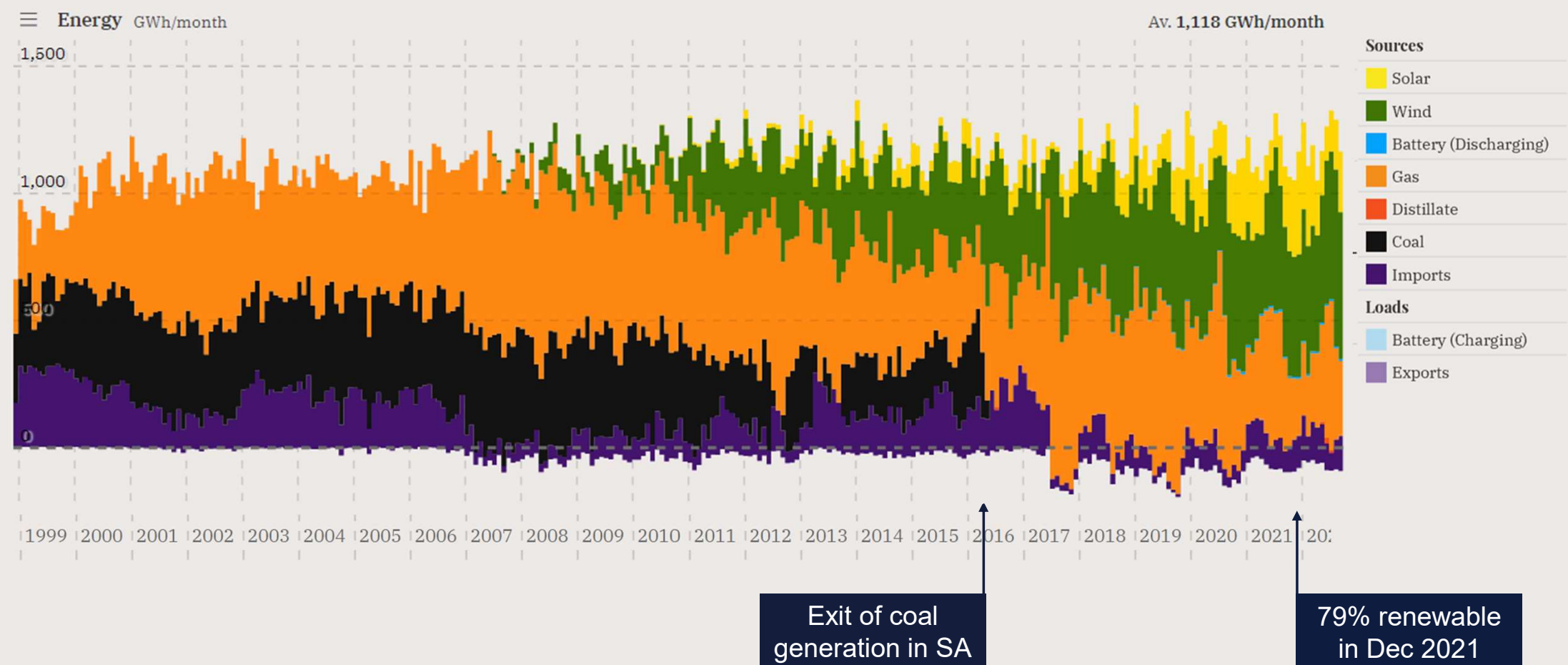


"South Australia is a window to the future for energy system transformation"

Mark Twidell, former Director Energy, Tesla

SA claim to fame #1 – one the world's most rapid transformations to renewable electricity

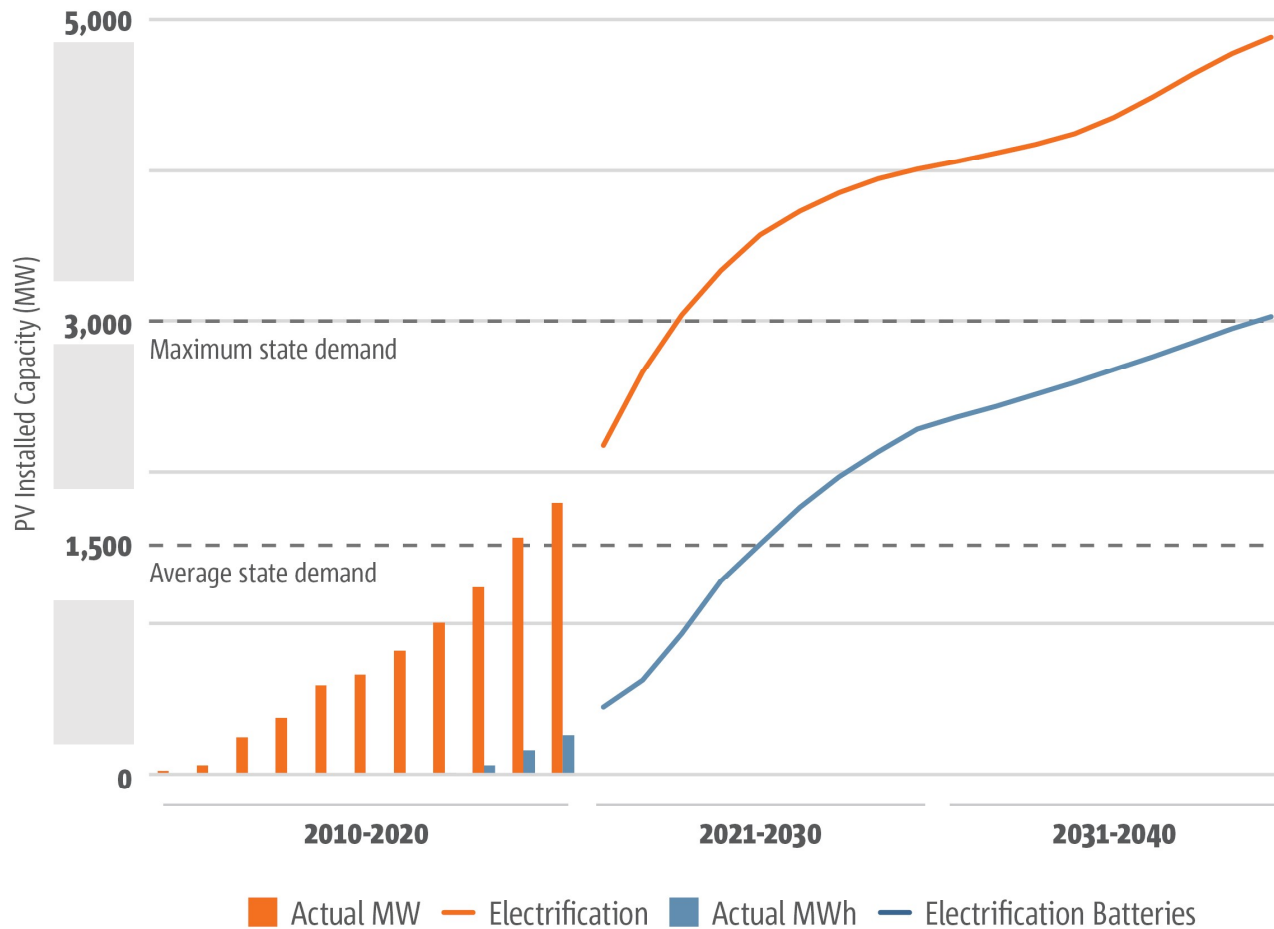
Exited coal generation and <1% ➡ 68% RE p/a in 15 years



Source: www.opennem.org.au

Claim to fame #2 - a world leader in rooftop solar

SA Forecasts AEMO ESOO 2021



~300,000 Rooftop solar systems

>1 in 3 customers, world's highest
State's largest generator
Record growth continues



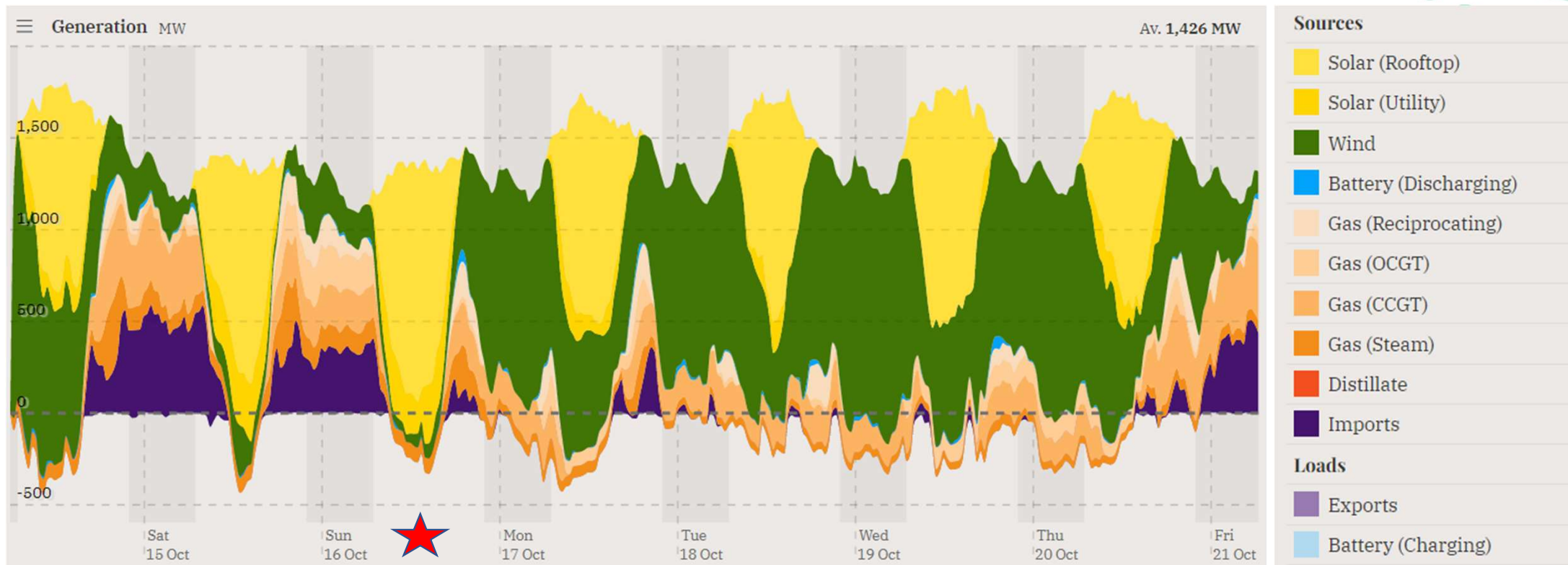
~30,000 Home batteries

9 Virtual Power Plants operating in SA

Source: SAPN

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Claim to fame #3 - Successful integration of world leading share of variable renewables

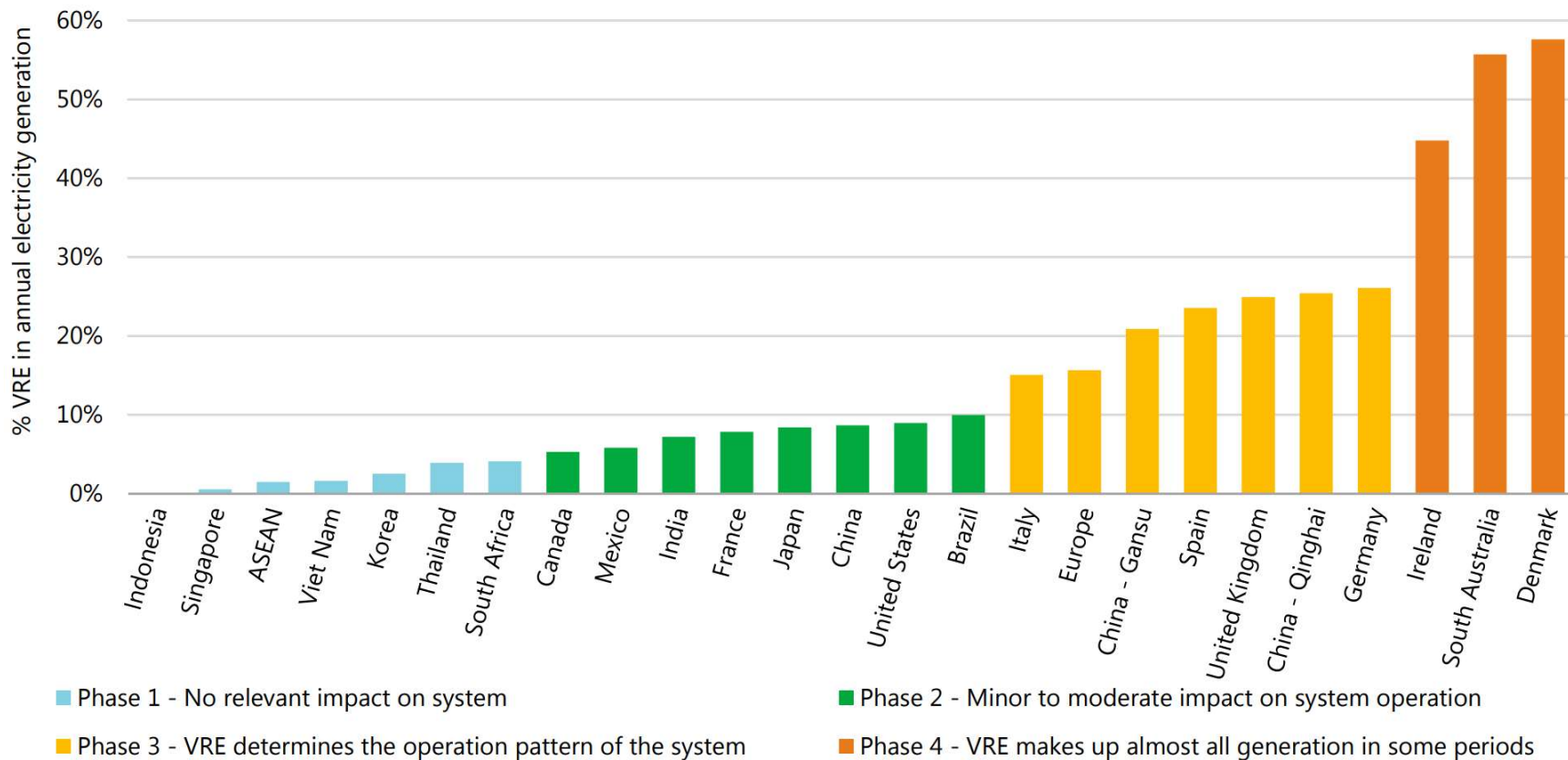


- ★ – Sun 16 Oct 2022 - new minimum operational state demand record of 100MW (after rooftop solar), lowering last year's record by 4MW
- ★ – Sun 16 Oct 2022 - new solar PV generation record of 116.7% of state demand, beating last year's record of 110%
- Wed 14 Sept 2022 4.25am – a new wind generation record of 145% of state demand

Source: www.opennem.org.au

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Neck and neck with Denmark for annual VRE% - 2019 data



Source: IEA, Secure Energy Transitions in the Power Sector, 2021. Note China = The People's Republic of China

Technology has been key... SA has become a test bed

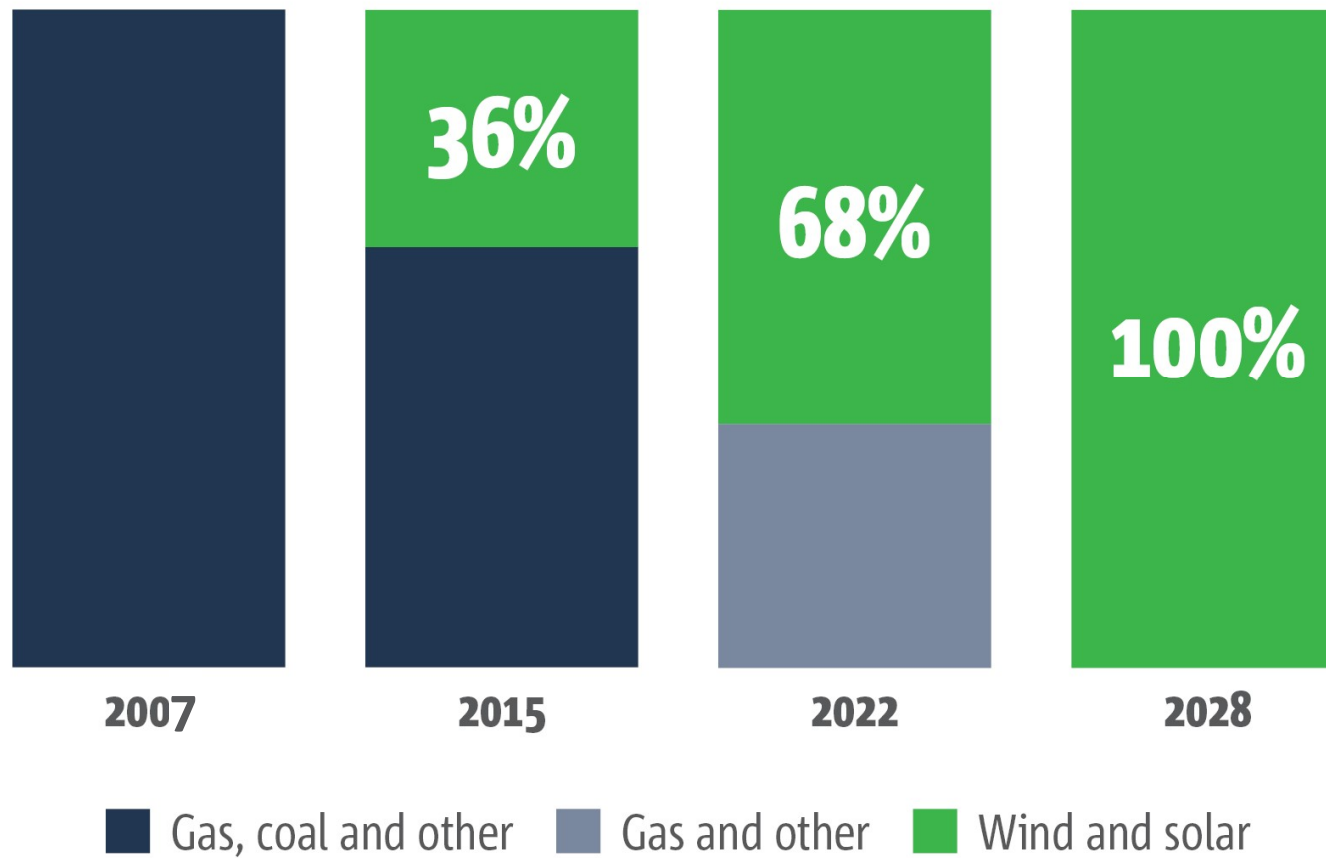
- Grid scale batteries
- Home batteries & VPPs
- Synchronous condensers
- Fast gas



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On track for net 100% renewables by 2030

Demand met by renewables

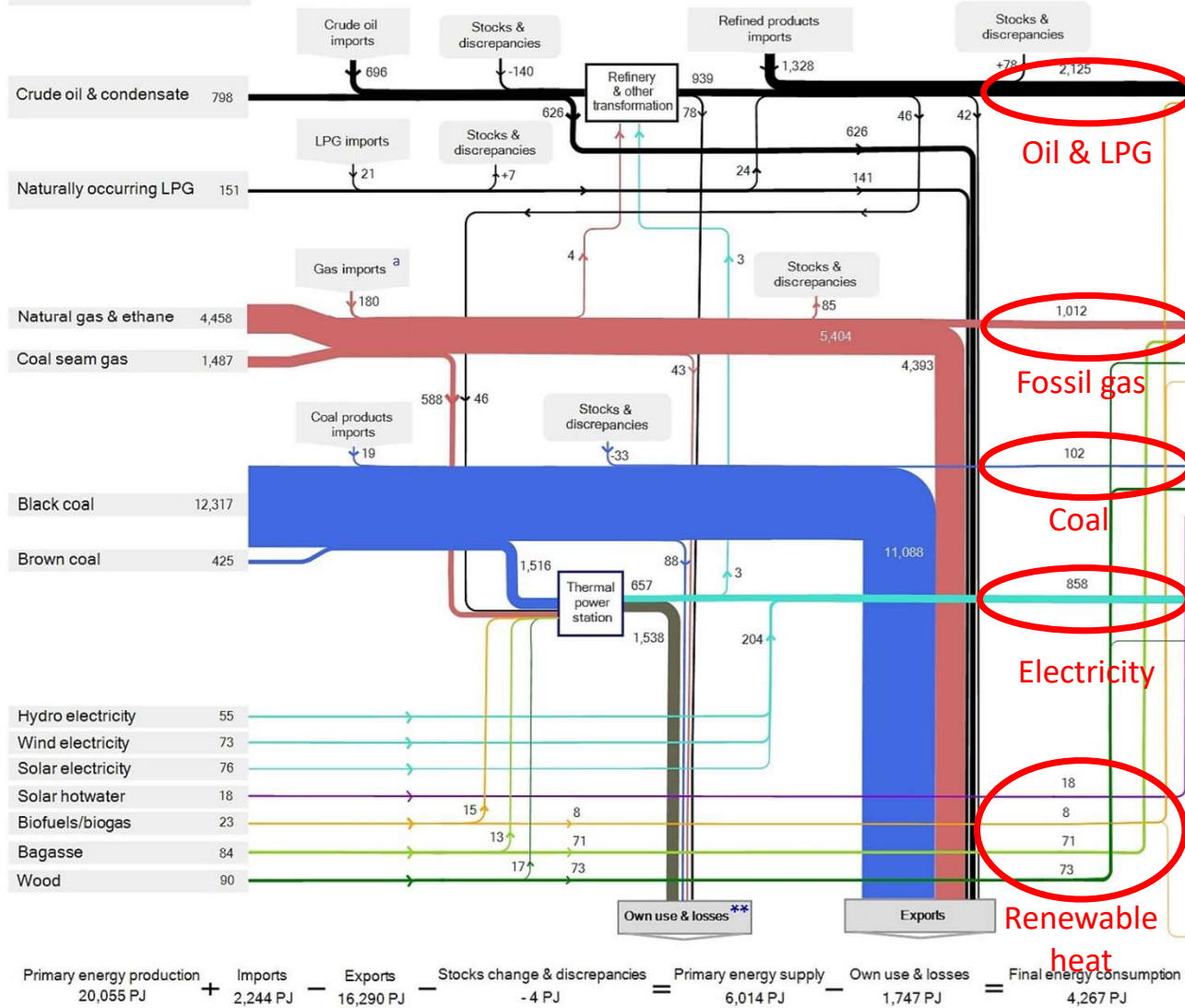


Source: SAPN

Domestic electricity is only part of the energy puzzle, so where to from here?

Australian Energy Flows 2019-20 (Petajoules)

Primary energy production



NOTES: Numbers may not add due to rounding a = Imports from the Joint Petroleum Development Area * Includes LNG plant own use of gas ** Conversion plants own fuel use & losses, and transmission losses

SOURCE: Australian Energy Statistics 2021, Table A and Table F



Australian Government
Department of Industry, Science,
Energy and Resources

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Electrification and hydrogenification can underpin the decarbonisation of the SA economy & low CO₂ exports

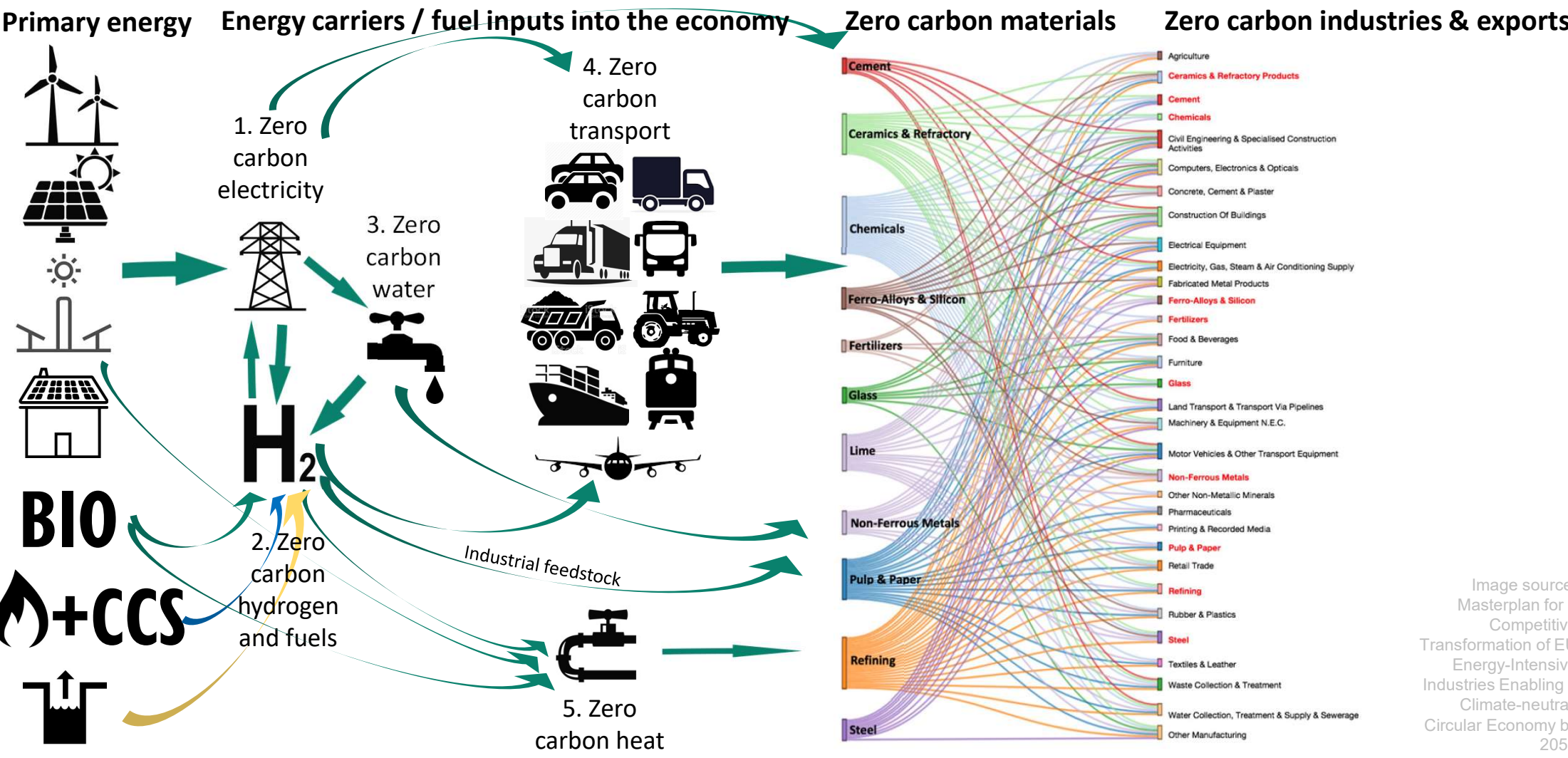
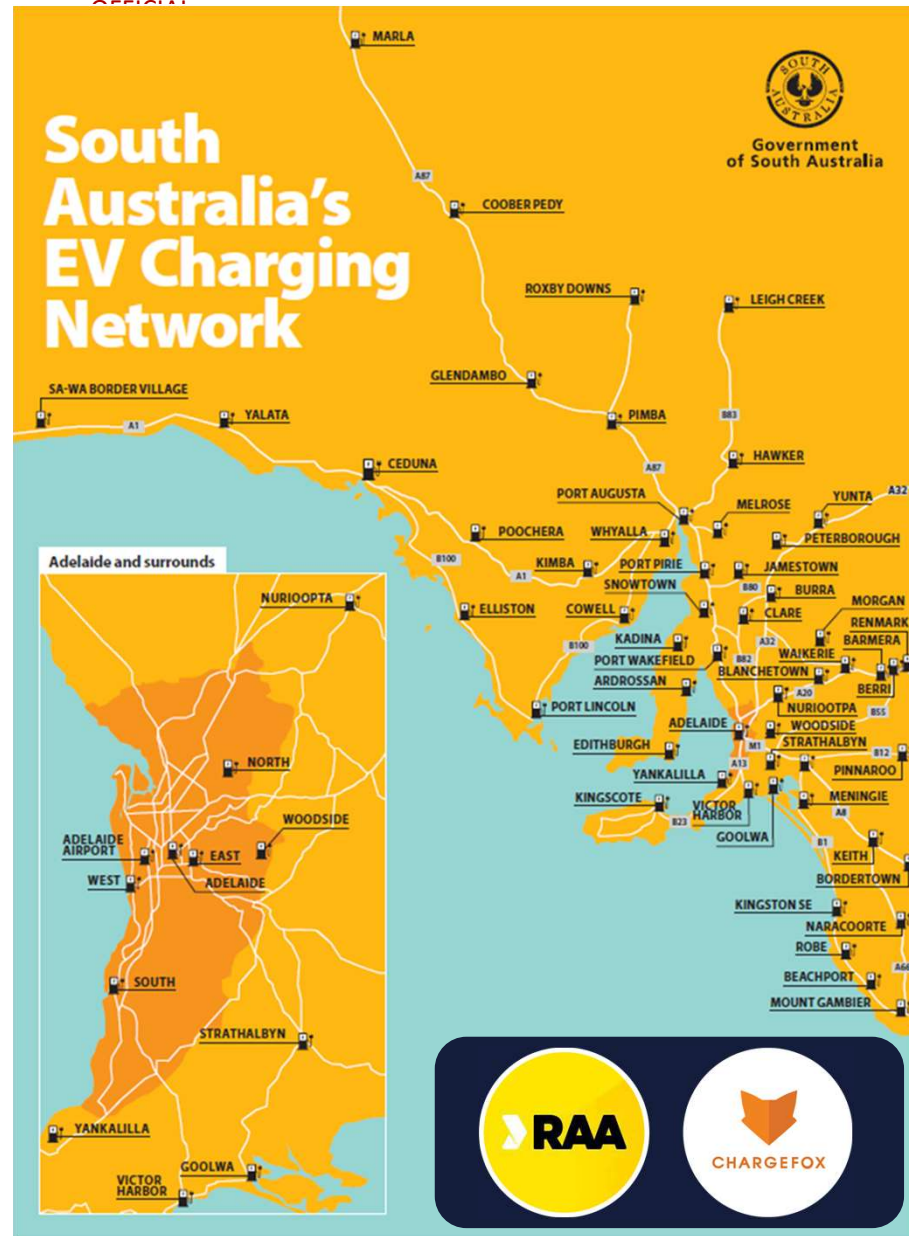


Image source:
Masterplan for a
Competitive
Transformation of EU
Energy-Intensive
Industries Enabling a
Climate-neutral,
Circular Economy by
2050

Electrification - SA's EV program

- SA border to border EV charging network
- 9 smart charging trials
- Repeal of road user charge legislation
- Purchase rebate for EVs
- Registration discount for EV owners
- State Government fleet policy
- Fleet pledge program



52
LOCATIONS

140 SITES

536



NEW RAPID CHARGERS

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Hydrogen is coming, and offers a pathway to decarbonise industry & fuels, & to RE export

Liebreich
Associates

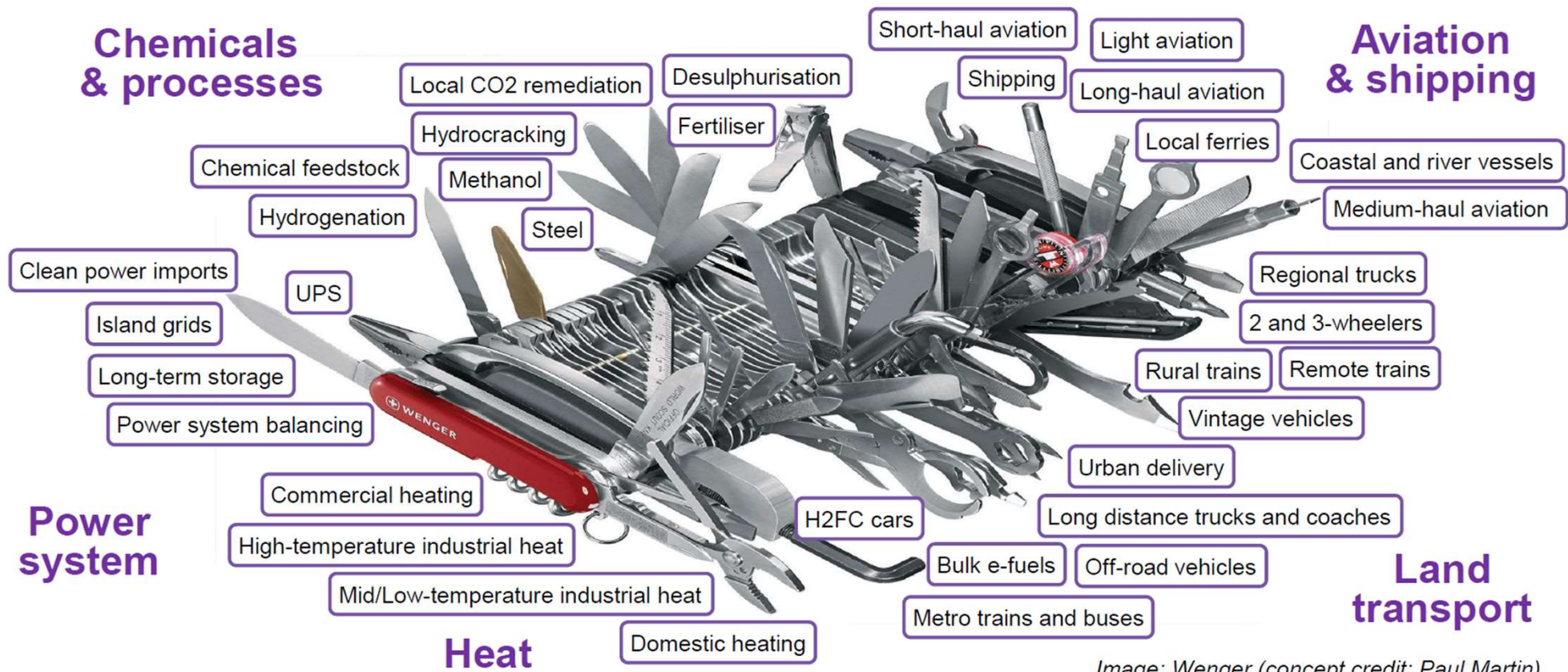


Image: Wenger (concept credit: Paul Martin)

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Liebreich
Associates

Clean Hydrogen Ladder: Competing technologies

Unavoidable

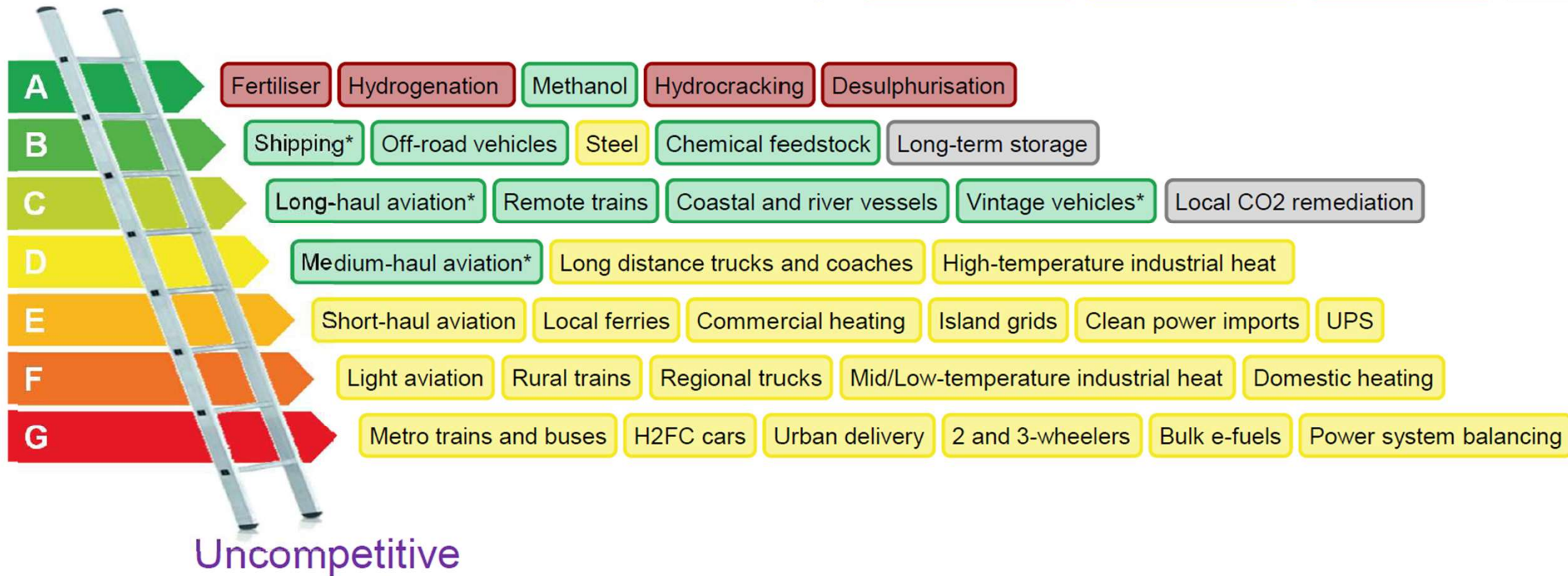
Key:

No real alternative

Electricity/batteries

Biomass/biogas

Other



* Via ammonia or e-fuel rather than H2 gas or liquid

Source: Liebreich Associates (concept credits: Adrian Hiel/Energy Cities & Paul Martin)

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SA's hydrogen journey - Key studies and strategies

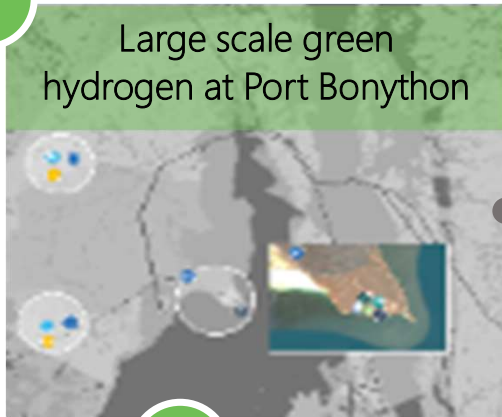


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Multiple prospective export hubs identified via SA's Hydrogen Export Modelling Tool

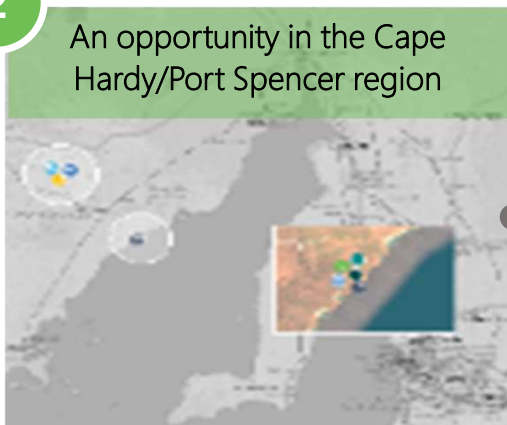
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Large scale green hydrogen at Port Bonython



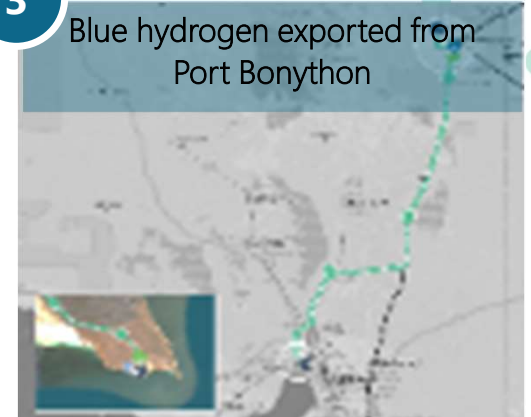
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An opportunity in the Cape Hardy/Port Spencer region



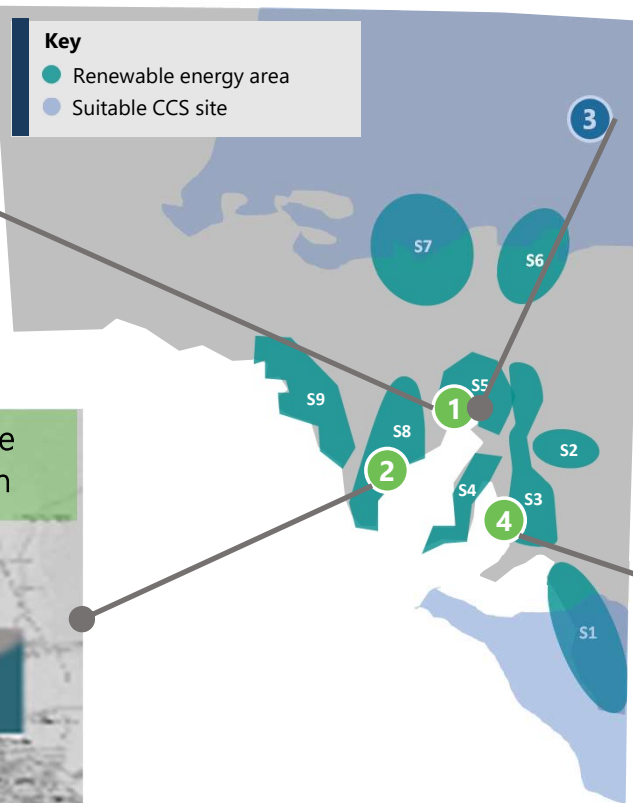
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Blue hydrogen exported from Port Bonython



4

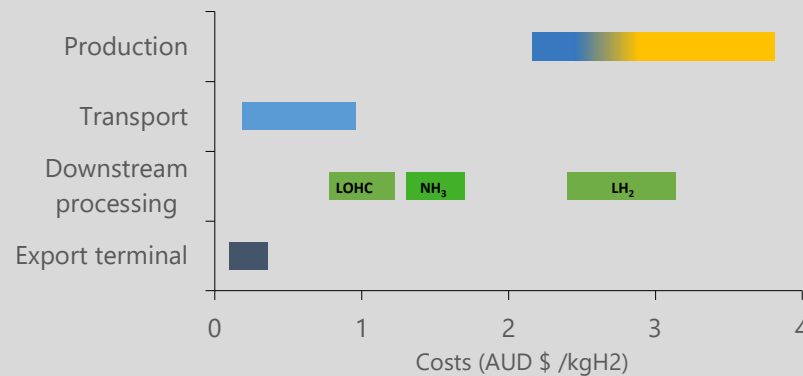
Localised green production at Port Adelaide



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Key supply chain outcomes

FOB outcomes: potential 2030 costs (2020 \$/kgH₂)



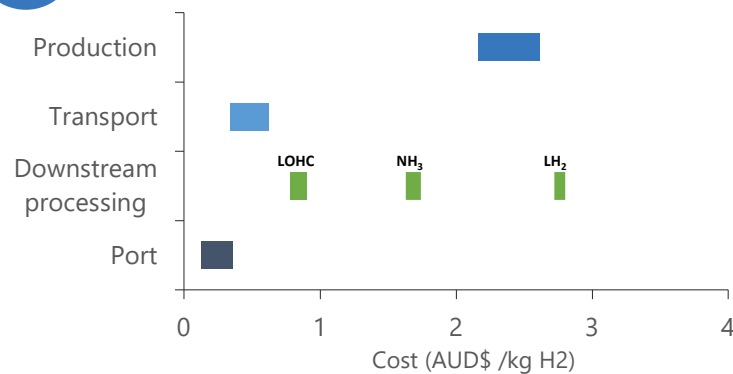
≈ **AUD\$2.5 /kgH₂** estimated average cost of blue hydrogen production (US\$1.66 /kgH₂)



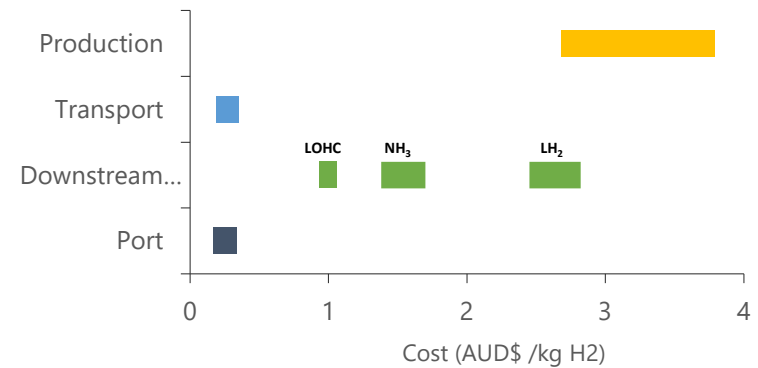
≈ **AUD\$3.5 /kgH₂** estimated average cost of green hydrogen production (US\$2.33 /kgH₂)



Blue from Port Bonython (2030)*








Green from Port Bonython (2030)*



* Potential 2030 costs (2020 \$/kgH₂)* includes upside sensitivities for capex, electricity and water costs, all other figures are presented without sensitivities

Industry projects receiving Government funding

HyPSA (AGIG)	Eyre Peninsula Gateway (H2U)	Hydrogen Superhub (Neoen)	Port Pirie Green Hydrogen (Trafigura)	Moomba Clean Hydrogen (Santos)
				
<ul style="list-style-type: none"> • 1.25MW electrolyser • Gas network injection: 5% blend, 700 homes • Industrial supply: via tube trailer with BOC • \$14.5m project • \$4.9m SA Gov't grant • Operating since mid 2021 	<ul style="list-style-type: none"> • 100MW electrolysis (stage 1) • Planned expansion to 1.5GW electrolysis • Green ammonia production • \$260m (stage 1) • \$4.7m SA Gov't grant and \$7.5m loan • At the FEED stage • MHI invested • Multiple partnerships 	<ul style="list-style-type: none"> • Feasibility study for 50MW electrolysis • \$1m SA Gov't grant • Study completed • Partnerships formed with: <ul style="list-style-type: none"> - ENEOS - Chiyoda & Mitsubishi - Australian Hydrogen Centre 	<ul style="list-style-type: none"> • 440MW electrolysis, developed in 2 stages • Green ammonia production • \$750m project • \$2.5m SA Gov't grant towards FEED • At the FEED stage 	<ul style="list-style-type: none"> • Blue hydrogen production utilising Cooper Basin gas and depleted wells for CCS • \$3m Commonwealth Gov't commitment towards FEED (TBC)

Industry led hydrogen hubs under development

Port Pirie (Trafigura)	Cape Hardy (Iron Road)	Port Adelaide (AGL and partners)
		
<ul style="list-style-type: none"> • 440MW electrolysis, developed in 2 stages • Green ammonia production • \$750m project • \$2.5m SA Gov't grant towards FEED • At the FEED stage 	<ul style="list-style-type: none"> • Iron Road is the developer of the Central Eyre Iron Project and the Cape Hardy (greenfield) port • Iron Road completed market sounding for hydrogen partner(s) in July 2022 and opened EOI in September 2022 	<ul style="list-style-type: none"> • AGL leading detailed feasibility study into green hydrogen production at its Torrens Island Power Station site • Partners include Adbri, Brickworks, Flinders Ports, INPEX Corporation, Osaka Gas Australia, SK ecoplant, Spark Renewables

Hydrogen jobs plan

What

- \$593 million targeting:
 - 250 MWe electrolyser
 - 200 MW power generation fueled by hydrogen
 - hydrogen storage facility

Why

- Accelerate hydrogen industry, capture 1st mover advantage & create new jobs
- Add new large flexible load and 200MW new source of zero carbon firm power generation to lower energy prices for SA customers

HYDROGEN JOBS PLAN

POWERING NEW JOBS
& INDUSTRY



Progress

- Office of Hydrogen Power SA gazetted 19 May 2022 – Attached Office to Department for Energy and Mining
- Appointment and commencement of Chief Executive and recruitment of team
- Completed site shortlisting process within City of Whyalla
- Commissioned detailed energy market analysis
- Market sounding process May to July 2022 – 60 responses
- Tender process to commence later in 2022

HYDROGEN JOBS PLAN

POWERING NEW JOBS
& INDUSTRY



Port Bonython Hydrogen Hub

- State owned site: over 2,000 hectares of available land and 2.4km jetty
- EOI for land closed 1 July 2021
- 7 hydrogen projects shortlisted
- AMP Energy, Fortescue Future Industries, H2U, Neoen/Eneos, Neoen/Chiyoda/Mitsubishi, Origin Energy, Santos
- State awarded \$70m Commonwealth Funding, matched by State and industry for common user infrastructure

Industry led H₂ hubs under development

- Port Pirie
- Cape Hardy
- Port Adelaide



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Northern Water Supply Project

- Detailed business case for a new coastal desalination plant in Spencer Gulf and a new pipeline to service Upper Spencer Gulf and far north of SA
- \$10m Commonwealth Gov't, \$5m SA Gov't
- Project decision due Q2 2023



www.northernwatersupply.sa.gov.au

Dedicated hydrogen legislation

Issues paper released for
proposed *Hydrogen and
Renewable Energy Act*
17 Nov 2022

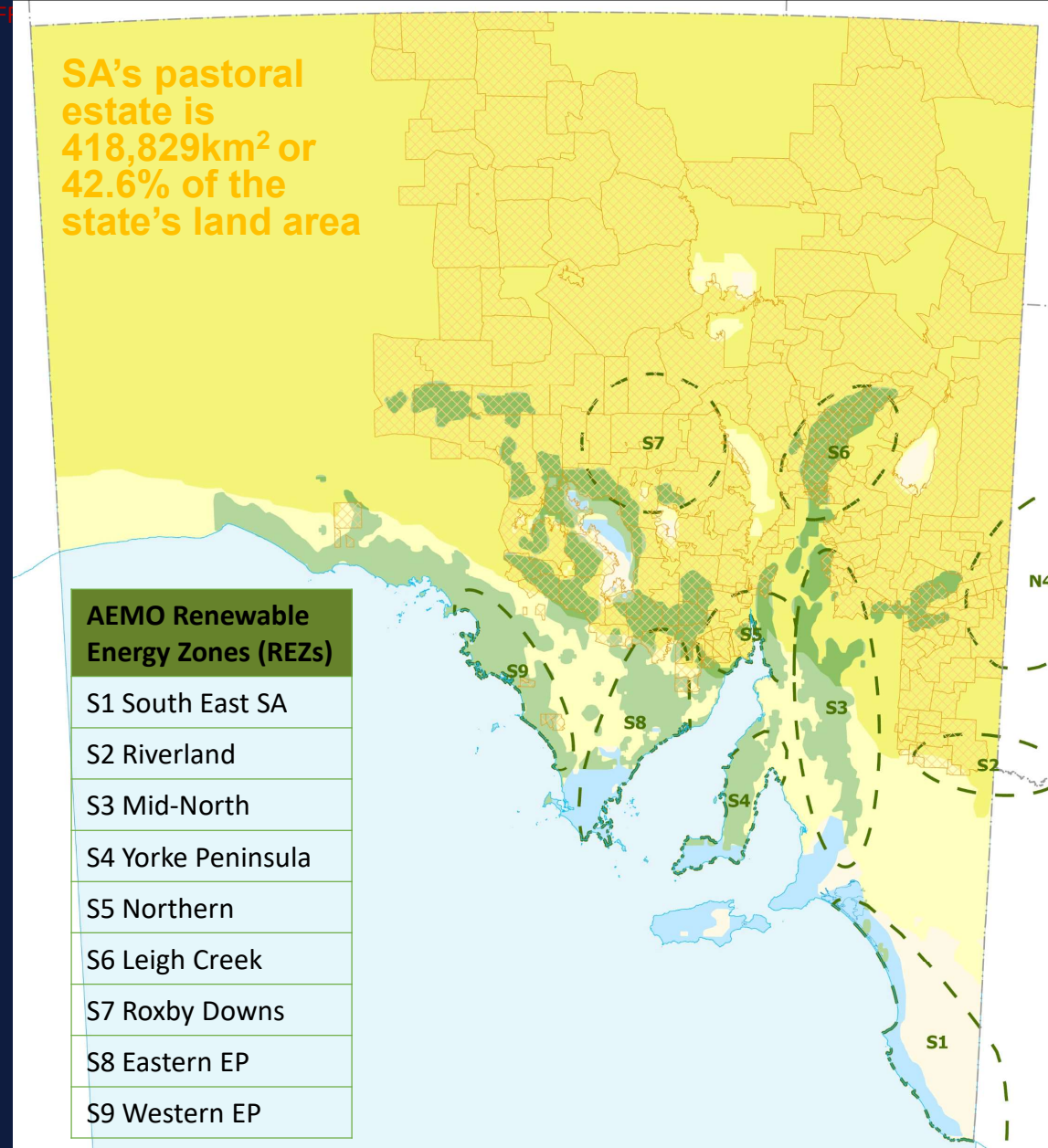
yoursay.sa.gov.au/hre-act

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SA's pastoral
estate is
418,829km² or
42.6% of the
state's land area

AEMO Renewable Energy Zones (REZs)

- S1 South East SA
- S2 Riverland
- S3 Mid-North
- S4 Yorke Peninsula
- S5 Northern
- S6 Leigh Creek
- S7 Roxby Downs
- S8 Eastern EP
- S9 Western EP





South Australia's transformation to a net zero emissions economy and a national and international exporter of clean energy could mean achieving a level of renewable energy that is more than 500% of current local grid demand by 2050.

SA's Climate Change Action Plan, December 2020

The big questions we are starting to ask

- What is SA's potential renewable energy generation capacity?
- How do we share the benefits, especially with our First Nations through this once-in-a-generation opportunity?
- To what extent will the SA community support the responsible unlocking of...
 - GW scale wind and solar, electricity transmission, new industrial water supplies, hydrogen production facilities, hydrogen pipelines, ammonia production facilities, expanded/new port industrial precincts?
- How do we maximise the state economic value and global decarbonisation value of our renewable energy endowment?
- What are the rate limiters / bottlenecks that will need to be overcome in order to unlock the benefits?



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Key hydrogen partnerships & avenues for further collaboration

National



International



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Hydrogen Technology Cluster

- H2H = hub to hub
- Seed funded by National Energy Resources Australia and the South Australian Government
- Covers all of South Australia
- Mission is to deliver hydrogen supply-chain scale in South Australia by
 - enabling hydrogen hubs
 - accelerating the hydrogen ecosystem
 - fostering hydrogen innovation
 - building hydrogen skills, capability and
 - attracting hydrogen



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SA-H2H™ - a growing cluster

www.sah2h.org



Heavy Industries Low Carbon Transition Co-operative Research Centre

- 10 year collaborative research program commencing 21/22
 - \$39m in Commonwealth funding
 - \$175m in industry and university cash and in-kind support
- Goal is to accelerate the decarbonisation of
 - Iron and steel
 - Cement and lime
 - Alumina and aluminium
- Headquartered at the University of Adelaide, with other research partners comprising ANU, Curtin, CSIRO, Swinburne and the University of Newcastle



Program 1 Process Technologies

Streams

- Producing green iron products from magnetite
- Producing green iron products from Pilbara ores
- Green alumina calcination
- Low-carbon lime and cement



Program 2 Cross-cutting Technologies

Streams

- Integrating variable energy sources into industrial processes
- New energy sources: electrification, hydrogen, solar thermal and biomass/waste
- Hybrid technology for multiple energy sources
- Integrated capture and re-use of CO₂ in industrial processes



Program 3 Facilitating Transformation

Streams

- Heavy industry roadmaps and scenario analyses
- Supply chain development and commercialisation pathways
- Community engagement and sustainability leadership
- Technology commercialisation

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HILTCRC

Core partners



Key partners



Affiliate partners



Associate partners





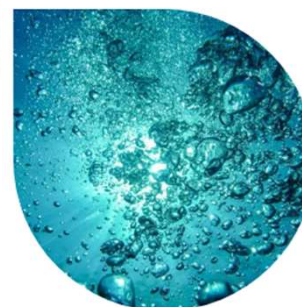
SCALING GREEN HYDROGEN CRC

Scaling Green Hydrogen Cooperative Research Centre

- Proposed bid for the next CRC funding round
- Goal is to drive the rapid expansion of green hydrogen's role in the global economy
- Led by the University of Adelaide, with other University partners comprising CQ, Curtin, Deakin, Griffith, Macquarie, Monash, Newcastle, QUT, Queensland, Swinburne, Sydney, UTS



Program 1: Production and Storage



Program 2: Water



Program 3: Chemicals



Program 4: Mobility



Program 5: Enabling

Learn more

energymining.sa.gov.au

hydrogen.sa.gov.au

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