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150 YEARS

Institute For Sustainability, Energy And Resources

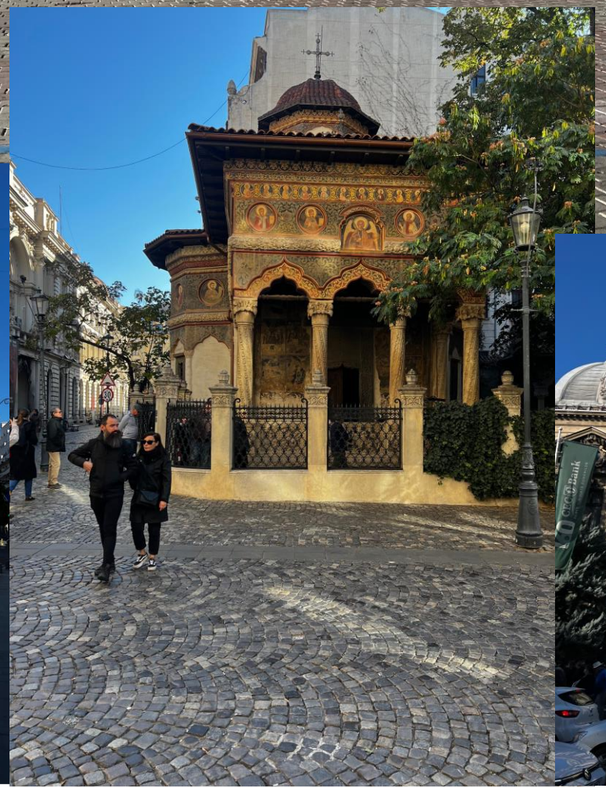
Advances in Hydrogen research for a sustainable future: South Australia as a Hydrogen, Metals, and Minerals Leader: Challenges and Opportunities

EnergIntell 2024 Keynote address

Professor Christian Doonan
State of South Australia Future Industry Making Fellow in Hydrogen

(With slides also provided with thanks by Professor Michael Goodsite (Pro Vice-Chanellor (Research Operations and Commercialisation and Mr. Sam Crafter, CEO of Office of Hydrogen Power South Australia)

make history.



The University of Adelaide

- Member of the prestigious Group of Eight (Go8)
- Consistently ranked in the top 1% of the world's univ
- 82nd in QS World University Rankings (2025)
- 111th in Times Higher Education World Rankings
- 157th in Academic Ranking of World Universities
- On January 1st 2026 will become *Adelaide University* though amalgamation with The University of South Australia

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TORRES STRAIT
Melville I
Bathurst I
DARWIN
TIMOR SEA
ARNHEM LAND
Groote Eylandt
GULF OF CARPENTARIA
Weipa
CAPE YORK PENINSULA
CORAL SEA
Wyndham
Katherine
KIMBERLEY
Mt Ord 937
Derby
Broome
Halls Creek
INDIAN OCEAN
NORTHERN TERRITORY
Victoria R
Tennant Creek
GREAT SANDY DESERT
Port Hedland
Karratha
De Grey R
L Mackay
PILBARA
Mt Meharry 1251
Tom Price
Newman
GIBSON DESERT
L Disappointment
WESTERN AUSTRALIA
L Macleod
Carnarvon
Gascoyne R
Meekatharra
GREAT VICTORIA DESERT
Mount Magnet
L Barlee
Geraldton
Leonora
Kalgoorlie-Boulder
NULLARBOR PLAIN
PERTH
Northam
Rockingham
Merredin
Norseman
Corrigin
Ravensthorpe
Bunbury
Wagin
Esperance
Margaret River
Manjimup
Albany
GREAT AUSTRALIAN BIGHT
SOUTHERN OCEAN
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Kilometres
Mt Zeil 1531
Alice Springs
Finke R
SIMPSON DESERT
Uluru 867
Mt Woodroffe 1439
Oodnadatta
Cooper C
L Eyre
L Torrens
L Gairdner
Ceduna
Whyalla
Port Augusta
Woomera
Broken Hill
ADELAIDE
Kangaroo I
Port Lincoln
Murray Bridge
Renmark
Mildura
Naracoorte
Bendigo
Mount Gambier
Ballarat
MELBOURNE
Warrnambool
Geelong
Traralgon
Mount Kosciuszko 2228
Bega
Wagga Wagga
Goulburn
SYDNEY
Wollongong
CANBERRA
Orange
Dubbo
Tamworth
Bourke
Moree
Maitland
Newcastle
Port Macquarie
Coffs Harbour
Lismore
Gold Coast
BRISBANE
Toowoomba
Charleville
Longreach
Emerald
Rockhampton
Gladstone
Bundaberg
Fraser I
Maryborough
Mackay
Townsville
Charters Towers
Mount Isa
Cairns
Bartle Frere 1622
GREAT DIVIDING RANGE
GREAT BARRIER REEF
SOUTH PACIFIC OCEAN
Tropic of Capricorn
Lord Howe I
King I
BASS STRAIT
Flinders I
TASMAN SEA
Burnie
Devonport
Launceston
Mt Ossa 1617
HOBART
SKM LA10789.19


Penfolds
Penfolds
Penfolds

Large land mass – low population density

Located at the end of global supply chain

Positioned rapidly growing South East Asian economies and China

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Australia as an energy powerhouse

Australian energy production by fuel type

Fuel type	2019-20		Average annual growth	
	PJ	Share (%)	2019-20 (%)	10 years (%)
Black coal	12,316.8	61.4	-2.2	3.2
Brown coal	425.4	2.1	-4.3	-5.9
Natural gas	5,944.9	29.6	7.9	11.3
Oil and NGL	798.4	4.0	18.0	-1.9
LPG	151.0	0.8	47.8	5.9
Renewables	418.8	2.1	4.6	4.0
Total	**20,055.3**	**100.0**	**1.7**	**4.4**

Consumption
6,500 PJ/year

Imports
2,500 PJ/year

Exports
16,000 PJ/year

Source: Department of Industry, Science, Energy and Resources (2021) *Australian Energy Statistics,* Table J

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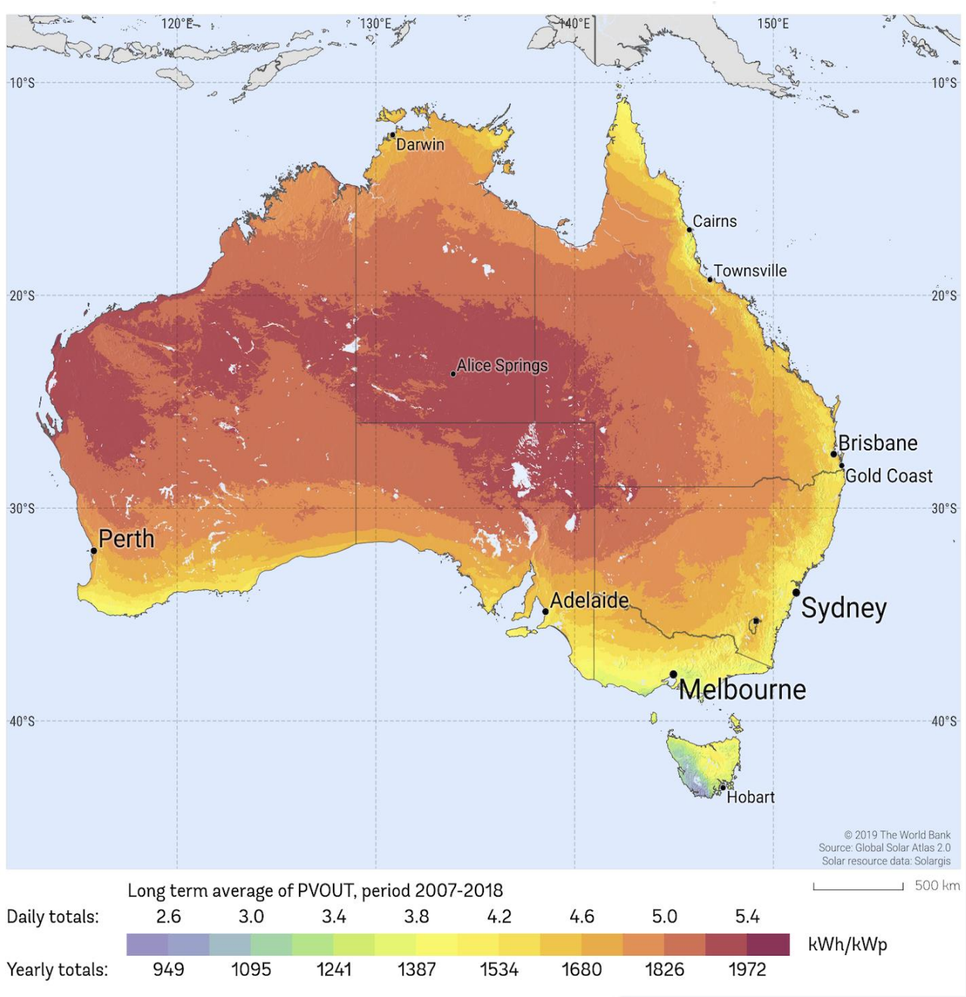
High Capacity for solar (and wind)

- Energy Transition high capacity for solar *and* wind
- Challenge integrating renewable energy zones with existing grid (land size)



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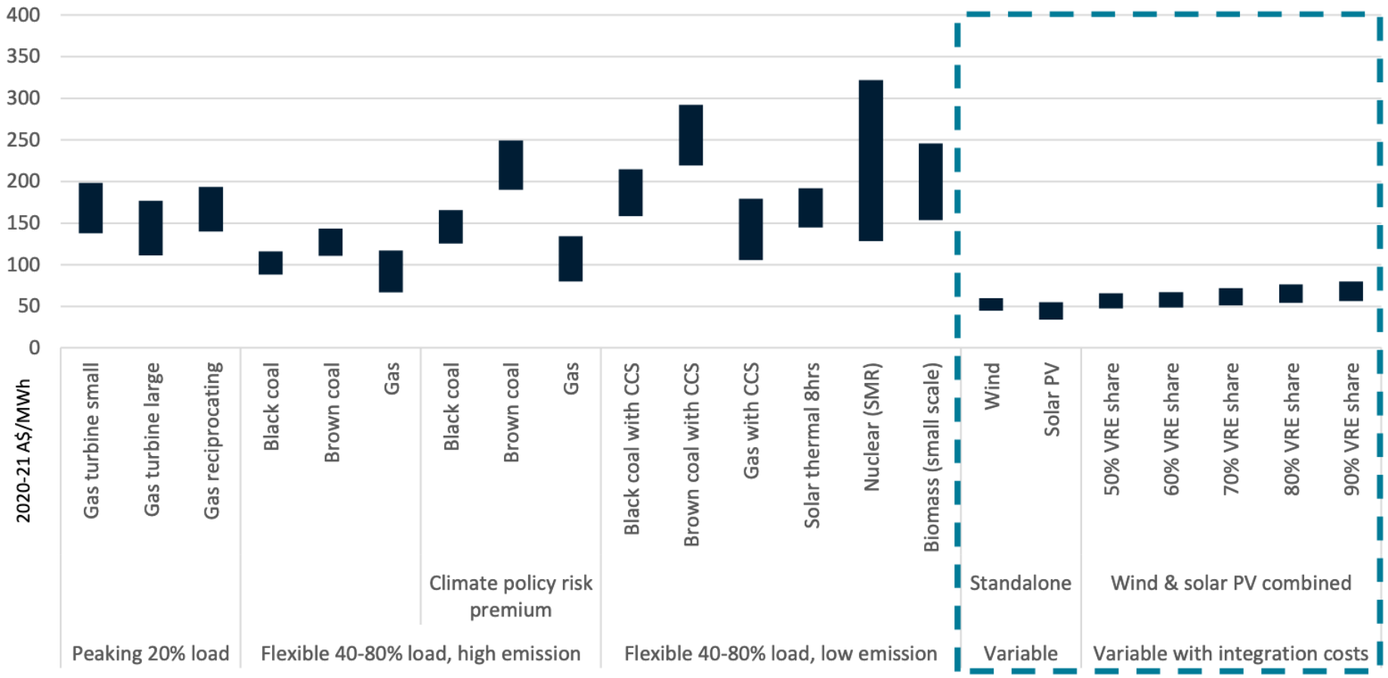
Solar PV and wind energy are the lowest cost electricity



ES Figure 0-1 Calculated LCOE by technology and category for 2030

Cheap renewables will drive:

- Decarbonisation of our grid
- Mass electrification
- Green hydrogen and derivatives

GenCost 2020-21 Final Report, CSIRO

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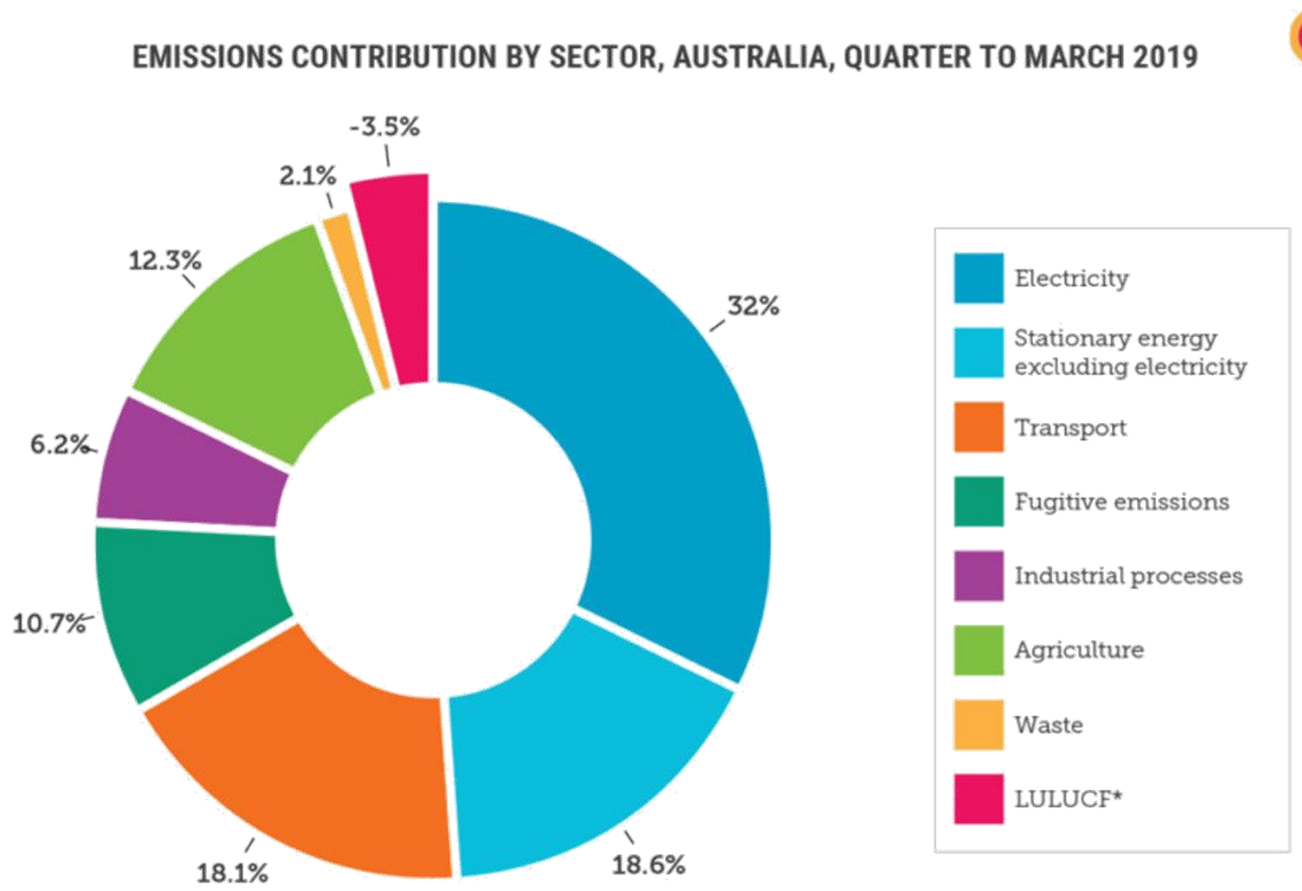
Australia's emissions



* LULUCF refers to land use, land use change and forestry emissions
Source: Adapted from Australian Government, 2019.

Not all carbon emissions can be eliminated by direct electrification

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A Heterogeneous Future Energy Landscape?

- Global energy economy has based on fossil fuels (Coal, Oil and Gas)
- High energy density (volumetric and gravimetric), (relatively) easy to extract and transport
- Transitioning from fossil fuels challenges – trade? Regionally based solutions? Centralized vs Distributed

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You are here. What are the opportunities?

Low population density (even for Australia!)

Rich solar and wind capacity

Extensive mineral deposits copper

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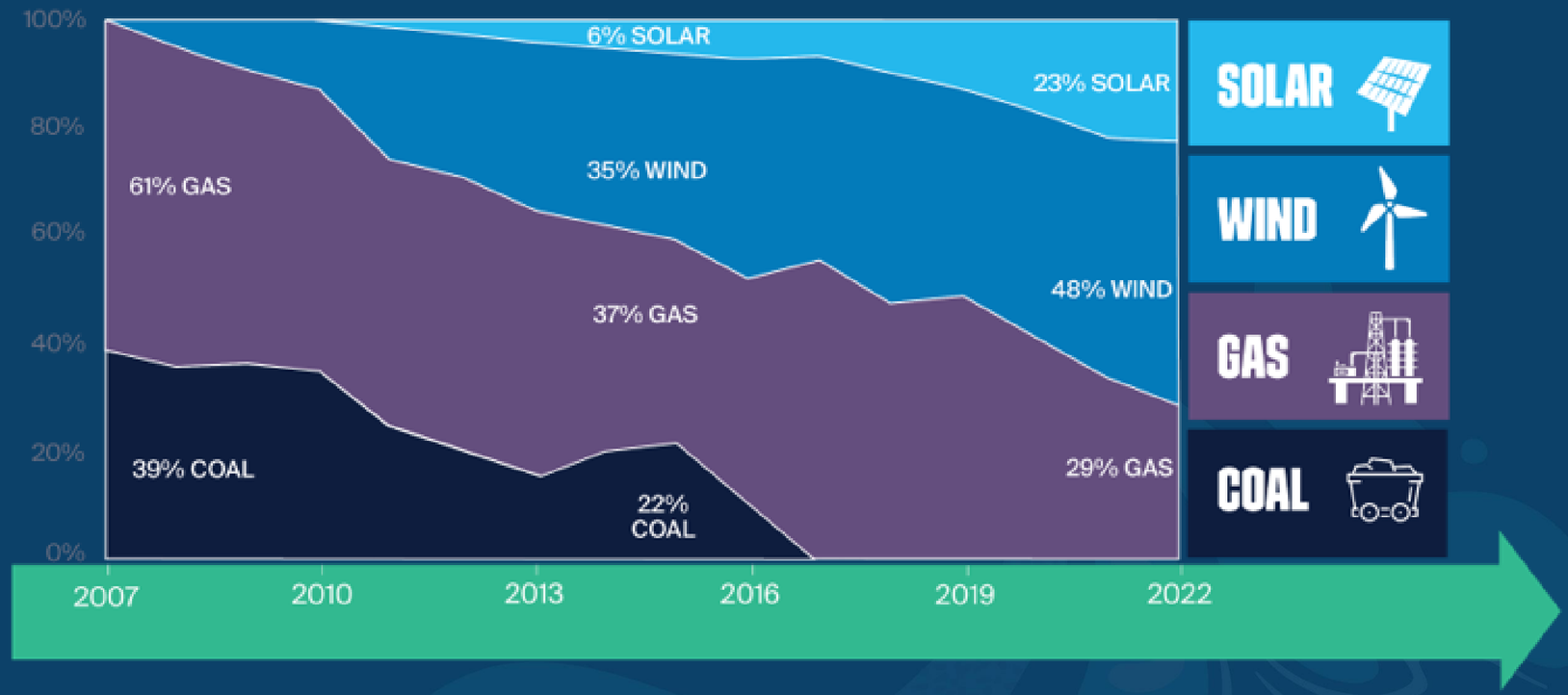
South Australia: a global leader in renewable energy

- Over 70% renewable energy transition in 15 years
- Over 40% of homes have rooftop solar
- Australia's largest operational hydrogen electrolyser



On track for 100% renewables by 2030

ohpsa.sa.gov.au

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South Australia: a global leader in renewable energy

- Over 70% renewable energy transition in 15 years
- Over 40% of homes have rooftop solar
- Australia's largest operational hydrogen electrolyser

2017 installed the worlds first 'big battery' 100 – 150MW (increase to GW capacity (approved projects))

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South Australia as a Hydrogen Leader:

- ✓ Aim to enhance South Australia's grid security, through new dispatchable generation
- ✓ Proving green hydrogen production and generation technology at scale
- ✓ Helping to unlock a pipeline of renewable energy developments and associated manufacturing opportunities
- ✓ Catalysing other hydrogen projects in development, including export focused projects
- ✓ Supporting research and Innovation
- ✓ Creating greater complexity in our economy - greening resources and realising energy security

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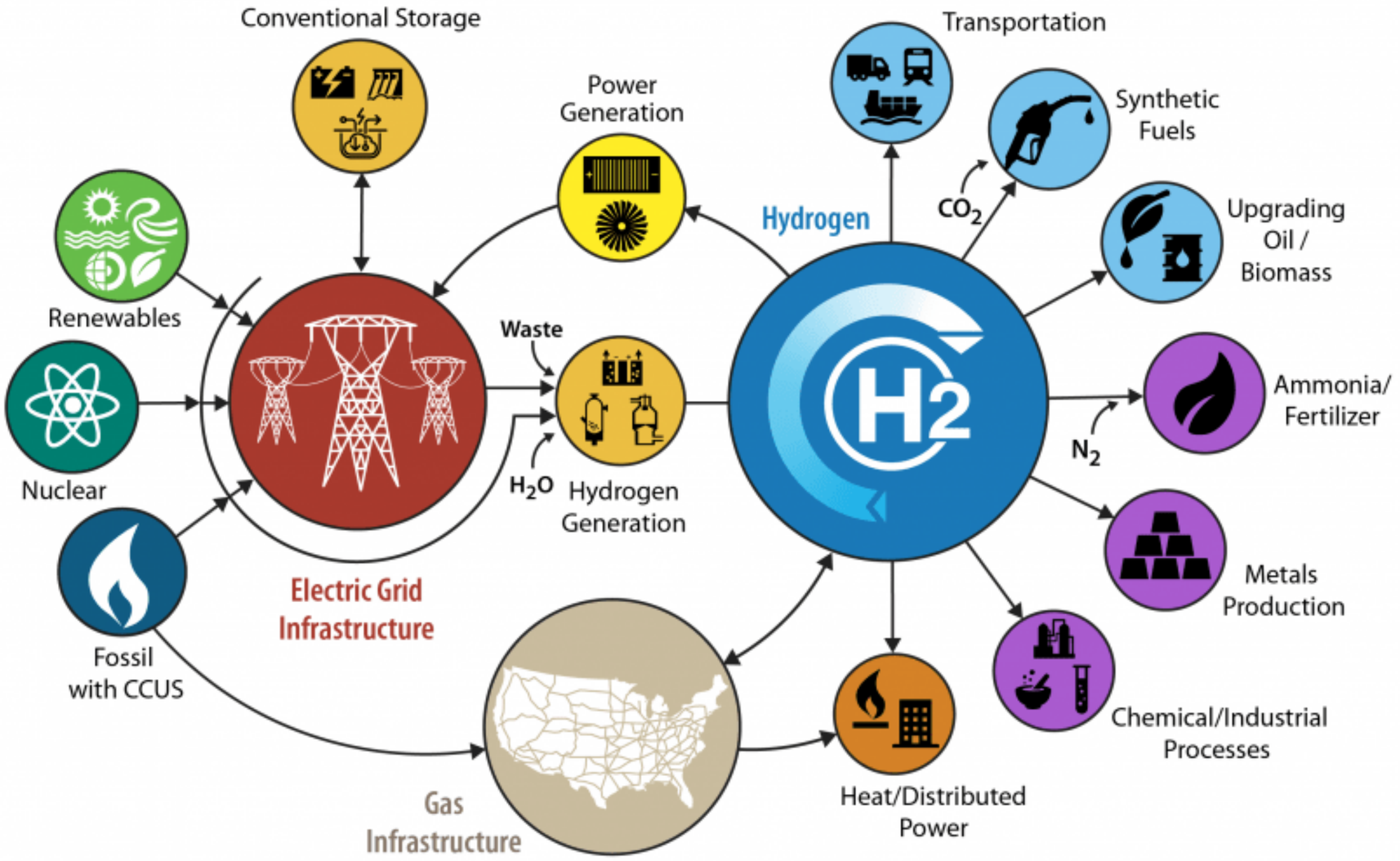
A case for Green Hydrogen



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Green Hydrogen Economy - Where are we?

- Generation – Technological uncertainty (electrolyser, methane pyrolysis, gold hydrogen)
- Resources (electricity, water)
- Offtake (export, chemical industry, fuel, steel)
- Social License (safety, acceptance of new technology)
- Certification
- Workforce

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Research and Energy Security

- Advances our knowledge and leads to the development of new game-changing technologies
- Informs and underpins evidence-based policy decisions

- Example: Research on alternative energy sources, like hydrogen and renewables, helps nations reduce dependence on volatile fossil fuel markets and avoid energy crises linked to global events

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Research Priority Areas

1. Production & Storage	2. Water	3. Chemicals	4. Mobility	5. Enabling
				

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1. Production & Storage

Focus on integration of green hydrogen with the electricity sector, covering scalable energy technologies, electrolysis, models for distributed vs centralised production, and storage options.

Example research initiatives:

- Renewable energy-based production technologies
- Distributed vs centralised models
- Shared infrastructure
- Electrolyser CAPEX and OPEX reductions
- Balance of plant development
- Business case for local manufacturing
- Storage technologies and options
- Emerging production technologies

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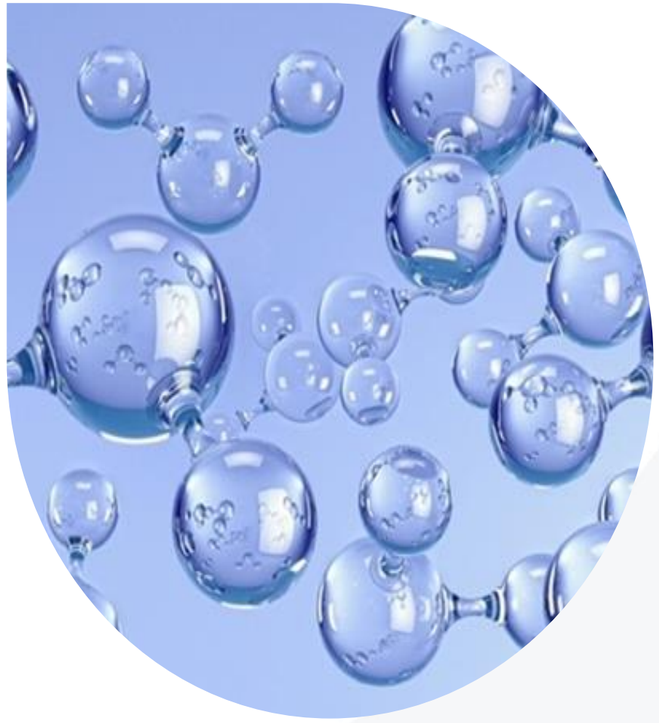
2. Water

Focus on decoupling fresh water resources from hydrogen production through electrolysis via desalination, recycled water networks, waste water, sea water, air capture or other methods.

Example research initiatives:

- Technologies for alternative water sourcing
- Shared infrastructure and models
- Beneficial co-products and co-location
- Integrated planning



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3. Chemicals

Focus on new and efficient processes for hydrogen derived commodity chemicals and fuels.

Example research initiatives:

- Green hydrogen derived or refined fuels (such as sustainable aviation fuel)
- Green hydrogen derived chemicals (such as methanol)
- Green ammonia and fertilisers
- Technologies and models for distributed production

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4. Mobility

Focus on achieving zero emission shipping, aviation, rail, buses and trucks in Australia and internationally.

Example research initiatives:

- Refuelling systems for shipping, aviation, rail, buses and trucks
- Multi-user and shared infrastructure
- Fuel cell technologies

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5. Enabling

Focus on best practice processes and systems to support the growing sector and deliver shared value.

Example focus areas:

- Safety, regulations, and standards
- Sustainable financial and techno-economic models
- Beyond social licence - mutually valuable partnerships with First Nations and other communities
- A talented and skilled workforce
- A sovereign and innovative supply chain
- Addressing United Nations' Sustainable Development Goals

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H_2 Economy

Developing and expanding the H_2 economy will require technological solutions to

storage, *transport & separation*

Technology solutions are required that will benefit all participants

Summary

- A Heterogeneous future
- (green) Hydrogen will be part of the energy mix
- Research is essential – don’t allow perfect to be the enemy of good

Hydrogen and the research and innovation around it are essential to 'getting to green energy'.

We must meet demand sustainably and are collaboratively innovating for impact in South Australia. Join us!

Prof. Michael Goodsite

Thanks to H.E. Ambassador Safta and Professor Radoi for your kind invitation to speak, I look forward to continuing to build collaboration.

Christian.Doonan@adelaide.edu.au

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