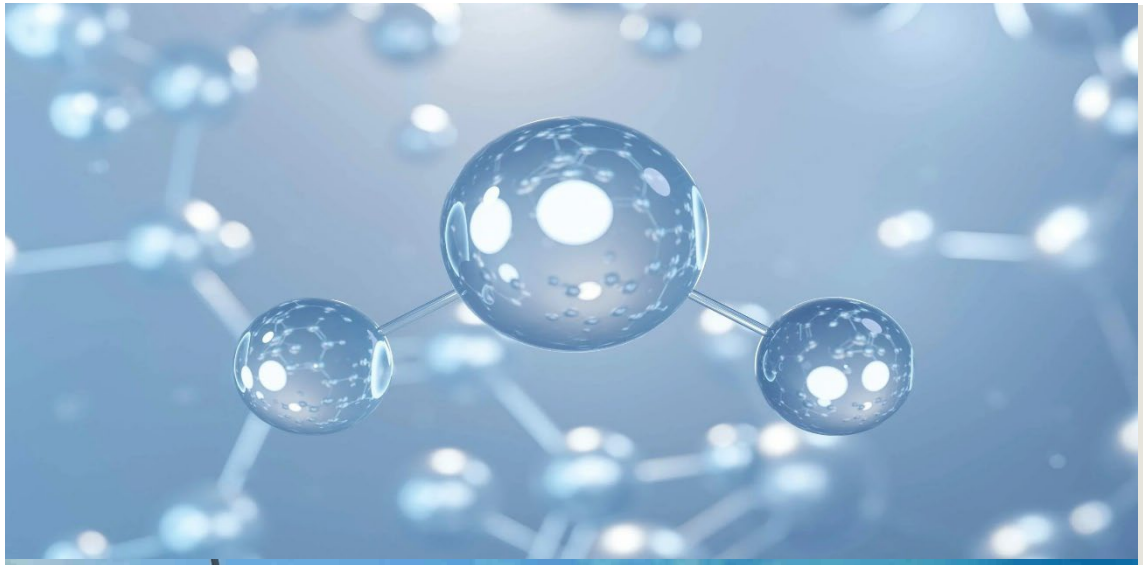

THE IMPACT OF THE ENERGY TRANSITION ON WATER RESOURCES
THE CASE OF GREEN HYDROGEN

MACQUARIE University
SYDNEY·AUSTRALIA

CENRIT
CENTRE FOR ENERGY AND NATURAL RESOURCES INNOVATION AND TRANSFORMATION

SPE-GAIA SEMINAR
13 FEBRUARY 2024

PROFESSOR TINA SOLIMAN-HUNTER
PROFESSOR OF ENERGY AND RESOURCES LAW,
DIRECTOR, CENRIT

Presentation scope

MACQUARIE University
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1. Context: nexus of the energy transition and green hydrogen

2. Hydrogen and renewable energy: likely bed partners ?

3. Water and hydrogen - what's the problem?

Context: The Energy Transformation

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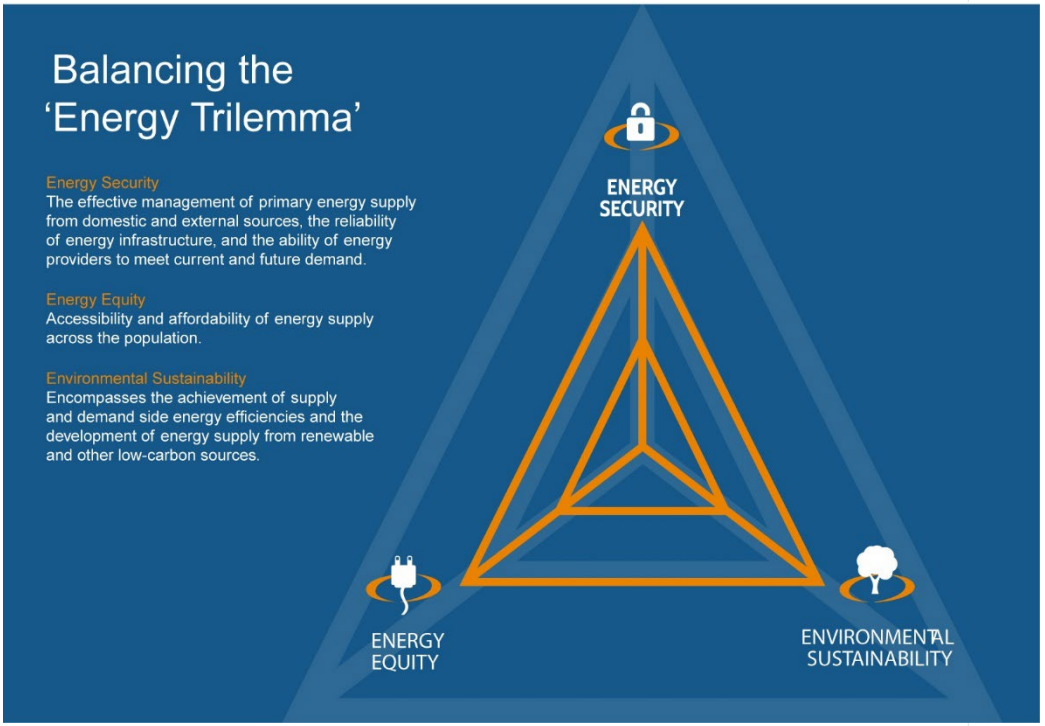

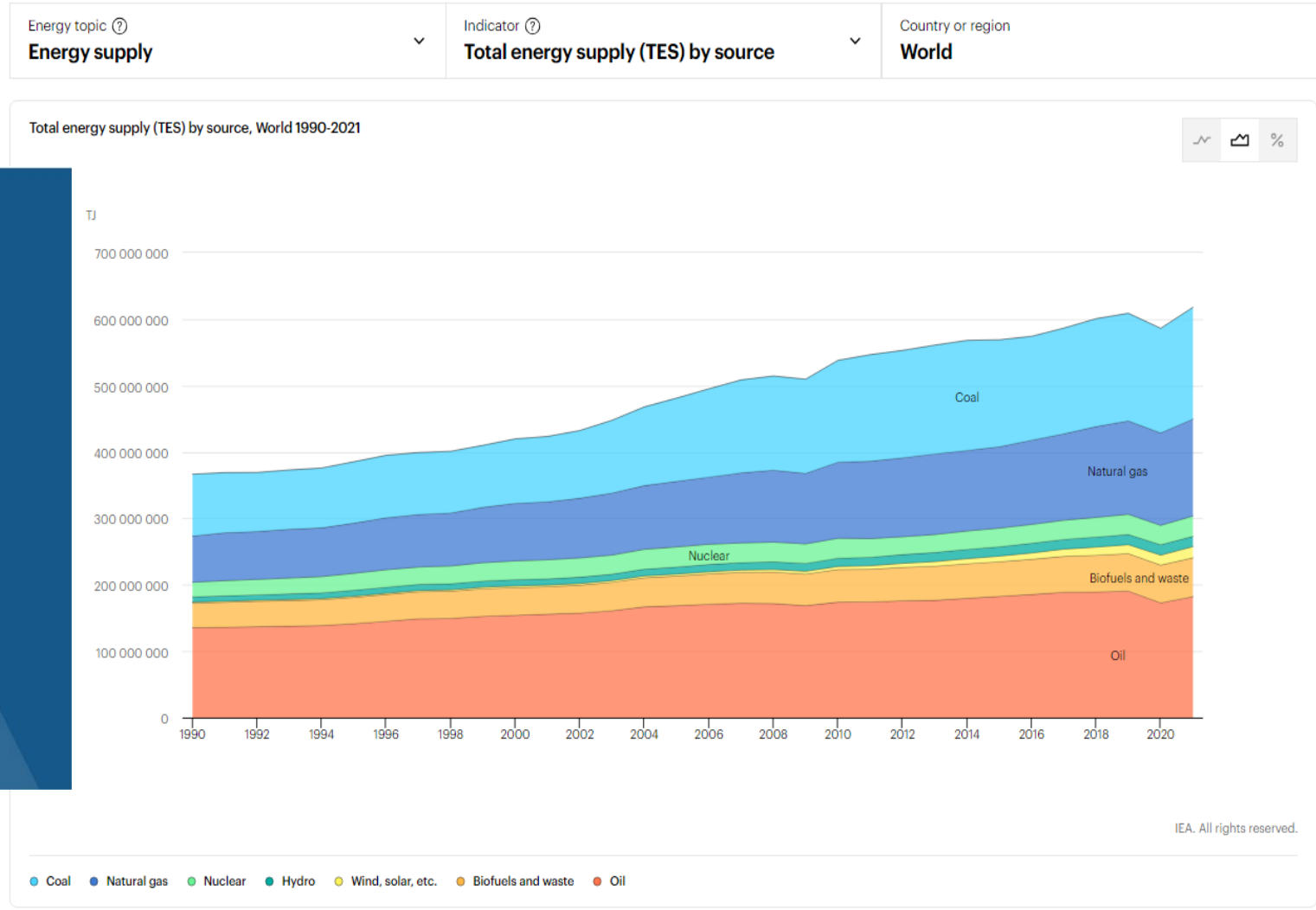

Transforming energy systems- where does hydrogen fit in?

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Table 2.1 Australia's national 2020, 2030 and 2050 energy and climate goals

		2020 and 2021 status	2020	2030	2050
GHG emissions	**GHG emissions versus 2005 (excluding removals)**	-20%	–	-43%	Net Zero
Energy productivity	**Real GDP/primary energy consumption**	+8.5%	–	+40%	–
Renewable energy	**Share of renewable generation capacity in electricity (GWh)**	40 000 or 30%	33 000	82%	–

Notes: GHG = greenhouse gas; GDP = gross domestic product; GWh = gigawatt hour.

IEA, 2023

Figure 4 A power system with both grid and behind-the-meter energy supply

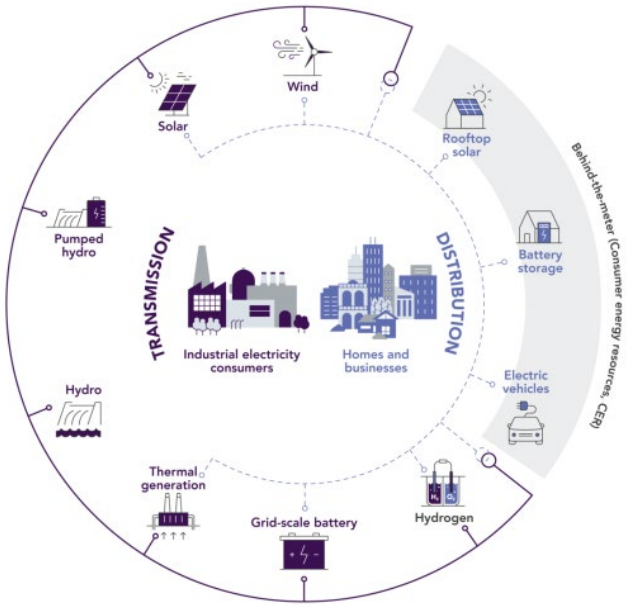
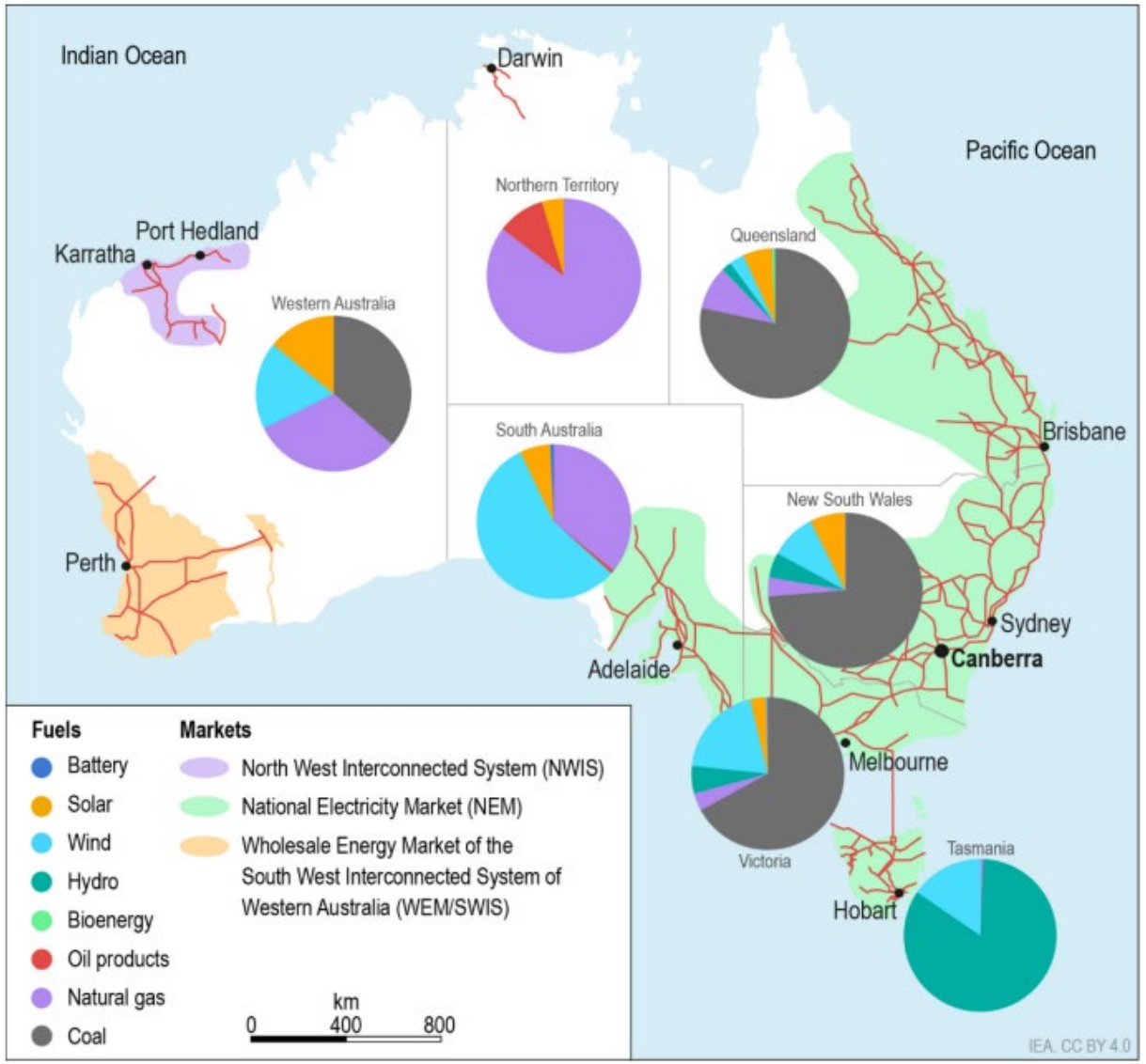
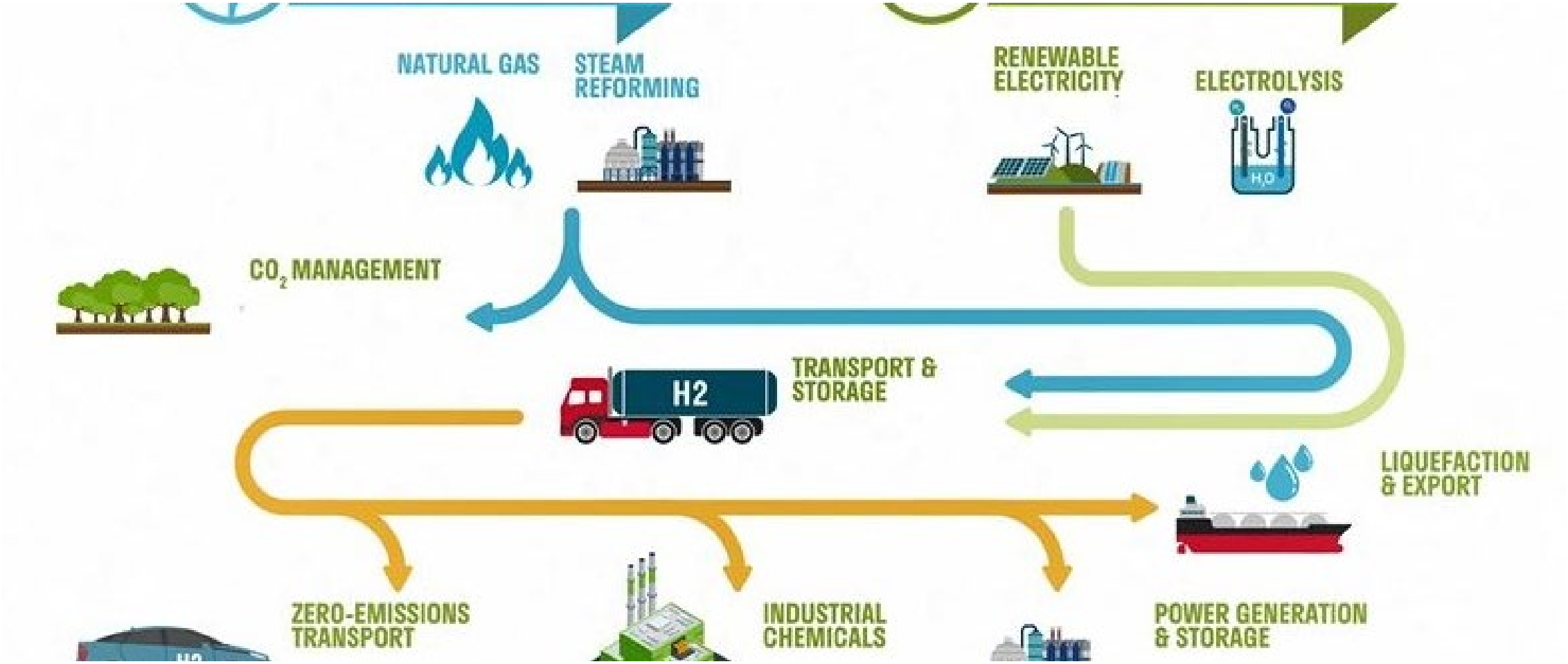


Figure 7.3 Electricity generation mix and power systems in Australia

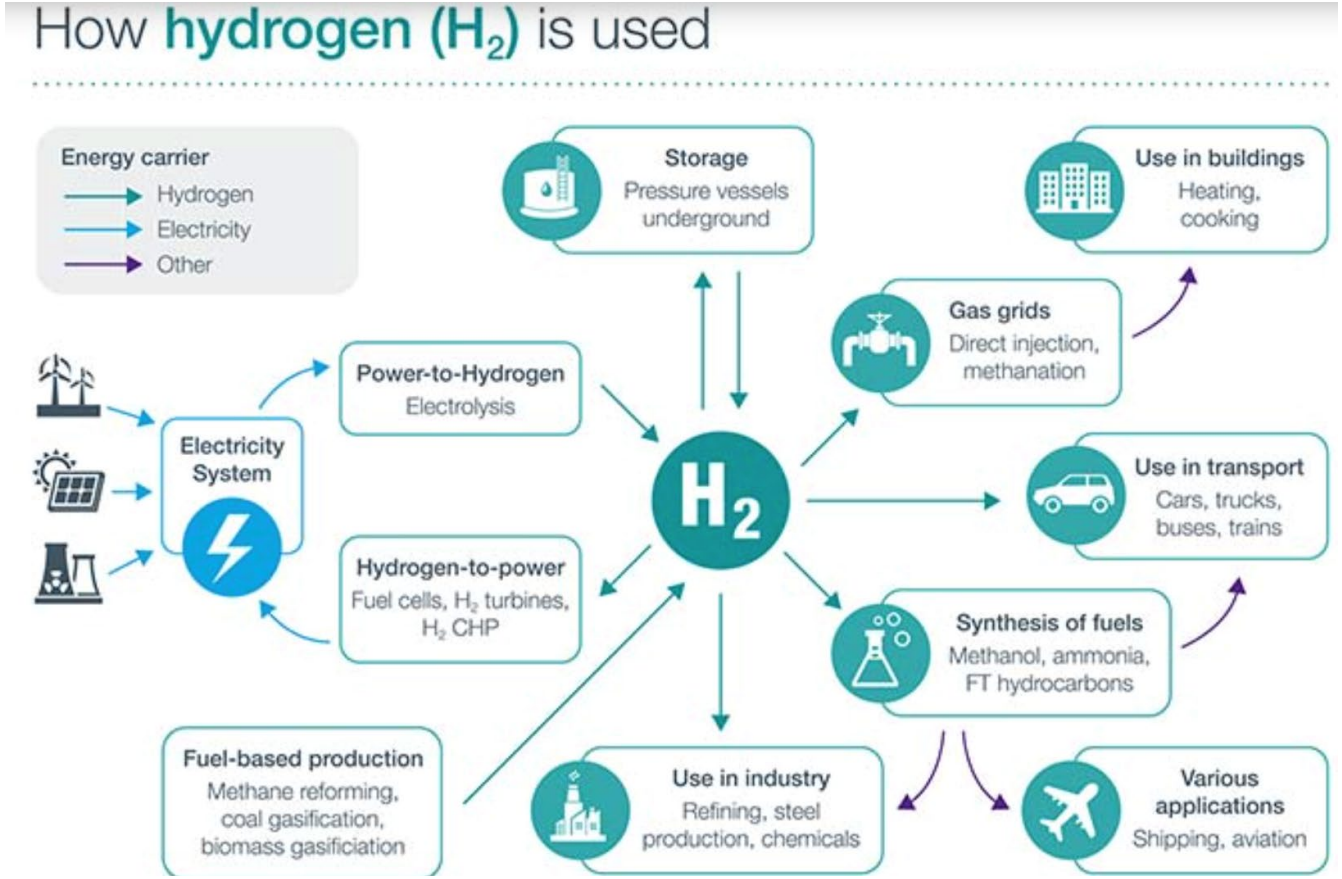


Source: IEA, (2022).

Transforming energy systems- making green hydrogen



Clearly a valuable commodity!



'Make green iron and steel from hydrogen and export them to Europe', EU president tells Mauritania

hydrogeninsight.com • 4 min read

Implications of 'Net-Zero Emissions by 2050' for the Hydrocarbon Industry:

A Case Study of Selected Mature Petroleum Jurisdictions

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Article

OXFORD

Implications of 'net-zero emissions by 2050' for the hydrocarbon industry: a case study of hydrogen in mature petroleum jurisdictions

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ABSTRACT

Climate change, and the need to wean the world off hydrocarbon sources of energy, will have a significant impact on the hydrocarbon industry, an industry worth hundreds of billions of dollars annually, and which has been in existence for over a century. Even though the phasing out of hydrocarbons as an energy source is inevitable, the demise of the hydrocarbon industry is not. This study, demonstrates that the hydrocarbon industry can make a significant contribution as the world transitions to low carbon energy. in this paper, we discuss the role of the hydrocarbon industry in developing a new hydrogen industry, demonstrating how the industry's know how will be vital in the development, construction, and delivery of both blue and green hydrogen to an energy hungry world.

1. INTRODUCTION

Energy, proclaims Lesage and others, is 'one of the most thorny, multi-faceted and daunting policy challenges in today's world.'[1] At its very core, this 'thorny' nature is in part due to the complexities between four deeply intertwined key dimensions of global energy policy as outlined by Goldthau: markets, security, sustainability and development.[2] The development of energy resources has profound implications for law and governance, society and the environment. In particular, the development of hydrocarbons establishes a tri-partite relationship between the state as resource owner and regulator, private corporations as developers, and citizens for whom development of the resource in the national interest[3] may have impacts on land and life.

This research article focuses on the second dimension of energy policy, that of energy security. Elements of energy security in balancing the friction between energy self-reliance domestically and procuring energy exports are increasingly prevalent in global policy discussions. The backdrop of increasing geopolitical tensions, sparked by COVID-19 and followed by the Russian invasion of Ukraine, has seen petroleum prices

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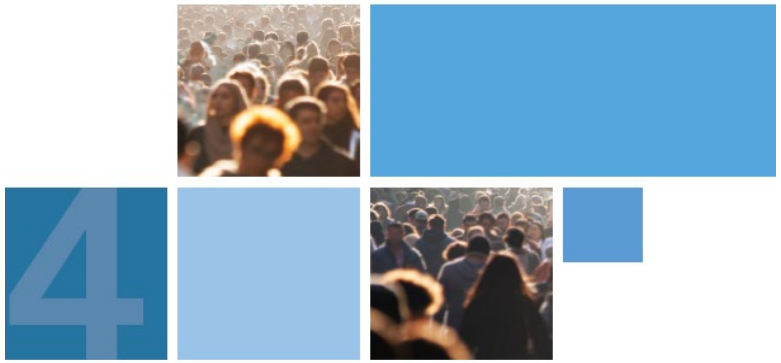
**Jordie Pettit, Australian Renewable Energy Agency, and Masters of Research (MRes) student, Macquarie Law School, Macquarie University.
The authors thank the AIEN for the research grant that made this work possible.

1 Dries Lesage, Thijs Van de Graaf and Kirsten Westphal, *Global Energy Policy in a Multipolar World* (Routledge 2016) 3.
2 Andreas Goldthau, 'Introduction: Key Dimensions of Global Energy Policy' in Andreas Goldthau (ed), *The Handbook of Global Energy Policy* (John Wiley & Sons 2013) 1, 3.
3 United Nations, General Assembly resolution 1803 (XVII) of 14 December 1962, *Permanent sovereignty over natural resources* Adopted by General Assembly Resolution 1803 (XVII) para 1.

Australian Energy Transition Research Plan

REPORT FOUR

Social Engagement Dynamics



ACOLA RESEARCH BRIEFING PAPER

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Hydrogen production in Australia from renewable energy: no doubt green and clean, but is it mean?

Tina Soliman Hunter, Kerryn Brent, Alex Wawryk, Jordie Pettit & Nate Camatta

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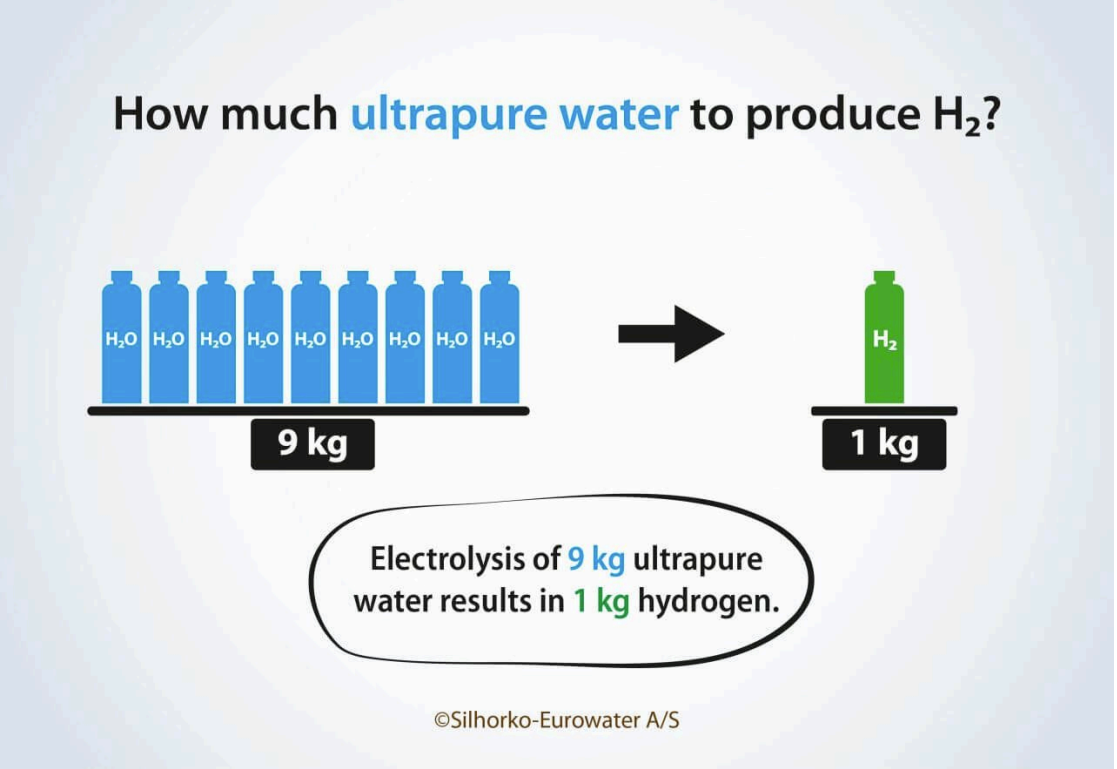
and worthy of research!

We know its green, but is it mean?

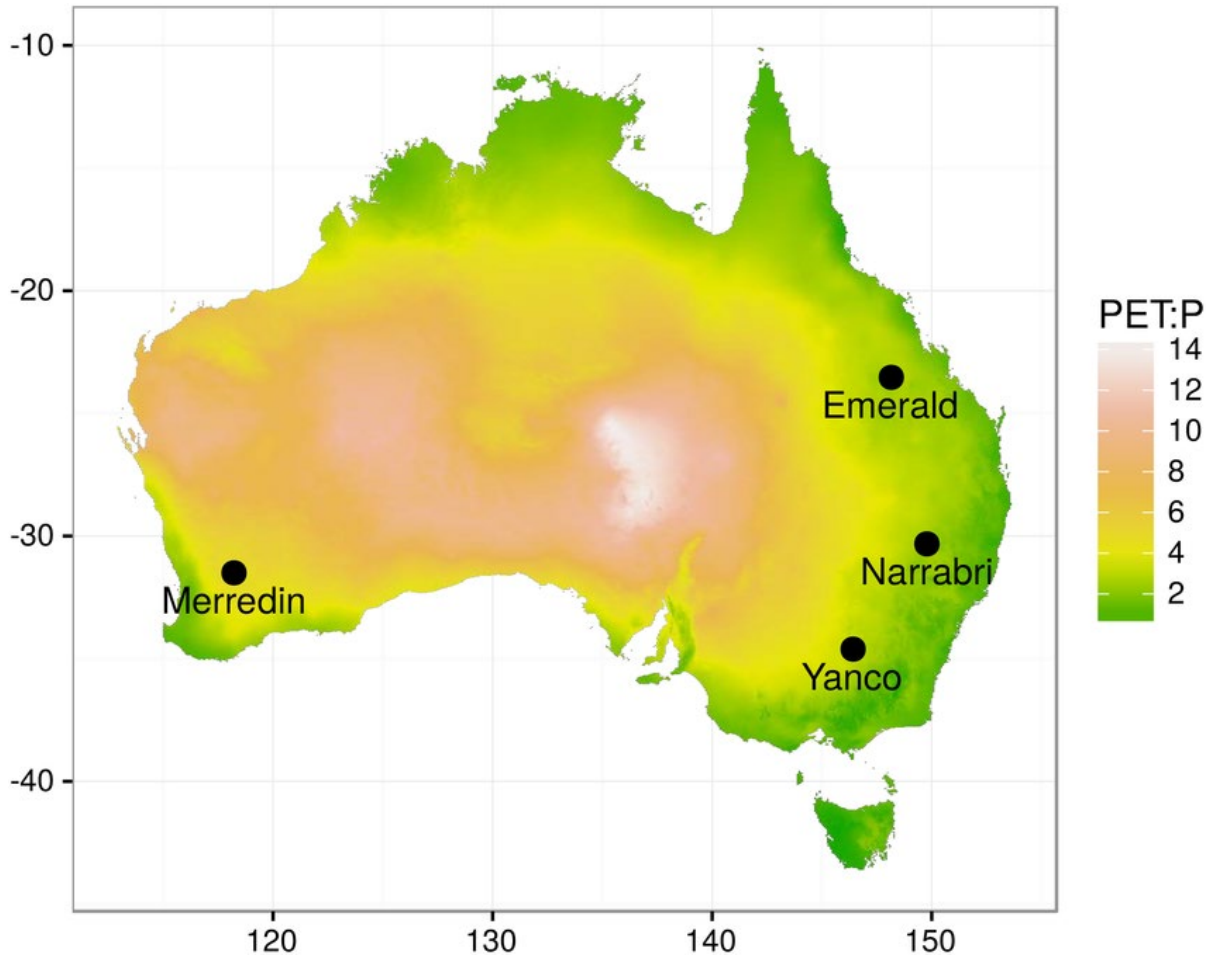
Hydrogen Production	
Energy to create 1 kg H2 @ 100% efficiency (kWh)	33.3
Efficiency of Water Electrolysis (Alkaline process)	67%
Energy Required to Create 1 kg of H2 @ 67% Efficiency (kWh)	49.7
Energy to Compress 1 kg H2 to 691 atmospheres (kWh)	15
Energy Total Required to Create 1 kg of Useable, Pressurized H2 (kWh)	**64.7**
Wholesale Cost of Grid Energy, per MWh	$82
Cost of Energy to Create 1 kg of Useable H2 @ $0.082 per kWh	$5.31
Cost to create 1 kg of H2 using Methane-Steam-Reformation (SMR)	$1.35
Wholesale Energy Cost required to make Electrolysis competitive with SMR	$20.85
Energy Density of 1 kg H2 (kWh)	39.4
Energy Efficiency of H2 production	60.9%
Retail Cost of Hydrogen (on 07/01/2022), per kg	$16.51



According to Lester and others,[85]

replacing the equivalent of Australia's 2019 total Liquified Natural Gas (LNG) exports with hydrogen using renewable hydrogen alone would require 279 GL of water per year, an amount which is less than half of what is currently consumed by the total Australian mining industry.[86]

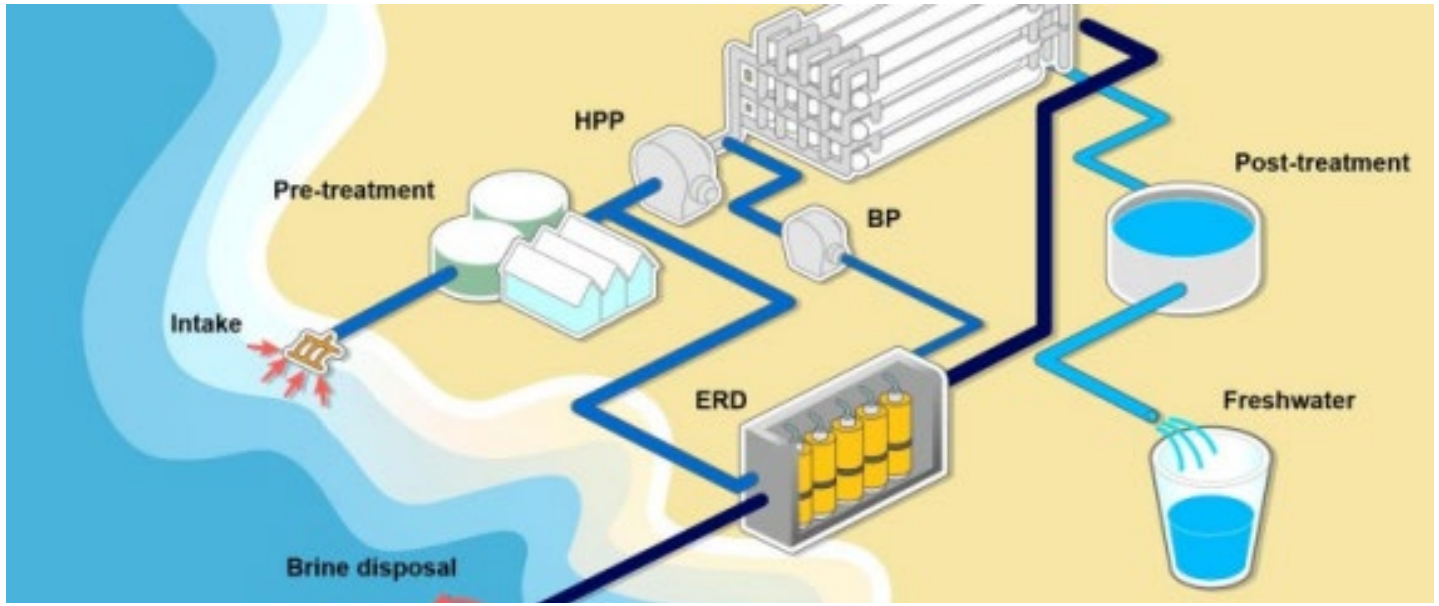
Hydrogen projects and aridity



Water availability and use: only 12% of rainfall flows into rivers (compared to 39% for Europe and 52% for North America).

In 2019–20, 14,270 GL of water was taken for use in Australia, with 67 per cent used for agriculture, 22 per cent for urban use and 11 per cent for industry.

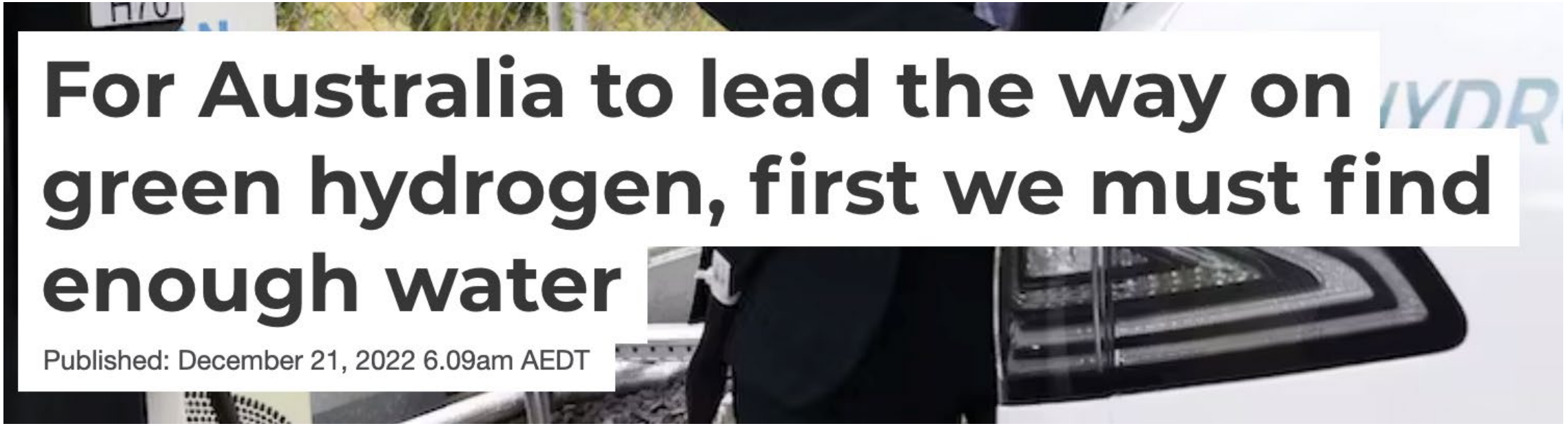
Other water sources – there for the taking?



"Increasingly limited availability of fresh water in Australia is demonstrated in the increased use of desalinated water (up from one per cent in 2018–19 to four per cent in 2021–22), the 11 per cent decrease in water consumption for agricultural use since 2019–19 due to low freshwater availability in the Murray–Darling Basin (MDB)… "

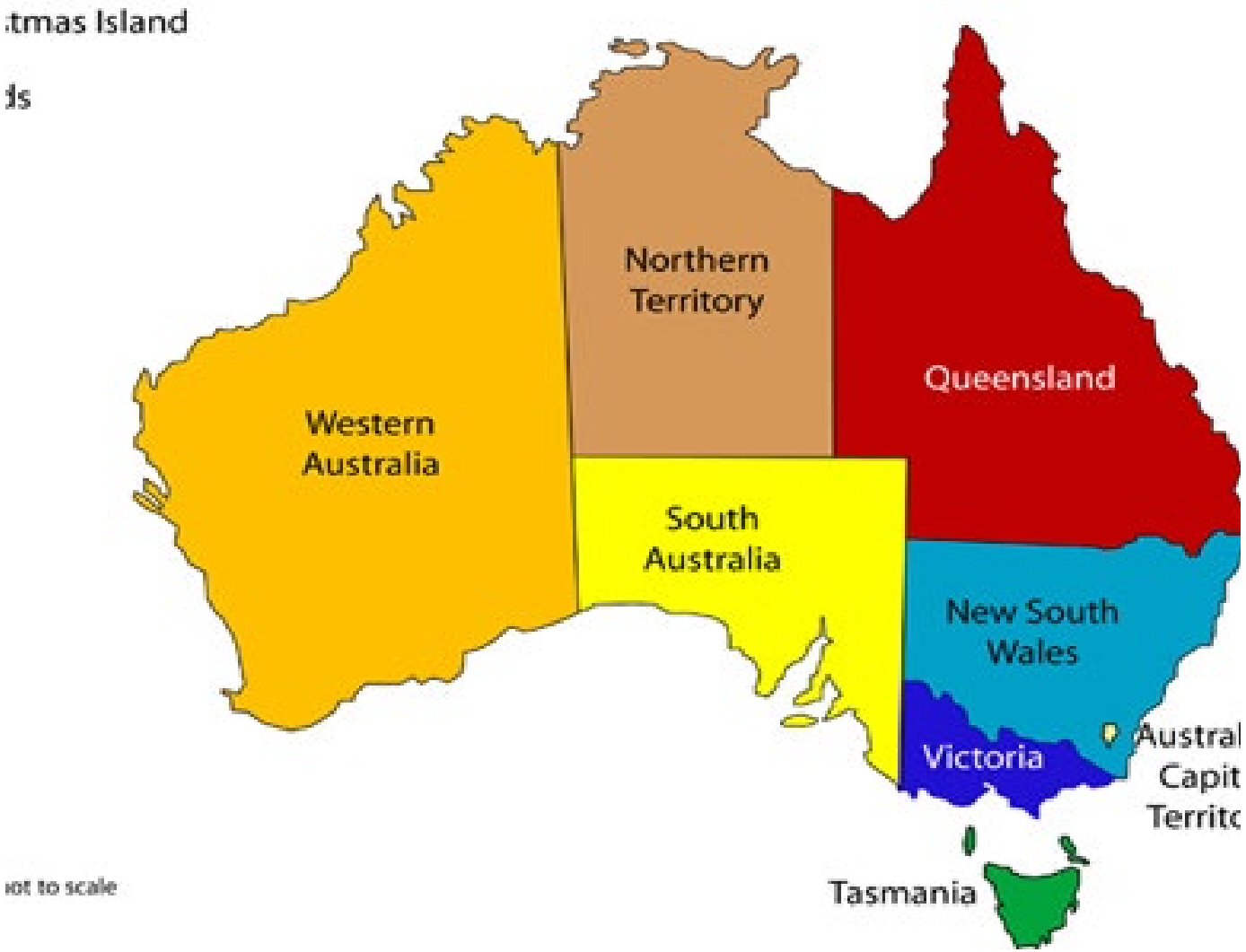
Study of impact of water use

REBECCA E. LESTER AND OTHERS, *WATER REQUIREMENTS FOR USE IN HYDROGEN PRODUCTION IN AUSTRALIA: POTENTIAL PUBLIC POLICY AND INDUSTRY-RELATED ISSUES (*2022) CENTRE FOR REGIONAL AND RURAL FUTURES, DEAKIN UNIVERSITY



"… replacing the equivalent of Australia's 2019 total Liquified Natural Gas (LNG) exports with hydrogen using renewable hydrogen alone would require 279 GL of water per year, an amount which is less than half of what is currently consumed by the total Australian mining industry."

So, can and should the law protect our water ?



WATER USE REGULATION

- State Laws 😬
  - QLD 😱 😱 😱
- Territory laws 😪
- Commonwealth laws
  - EPBCA (MNES) 😂
  - Water allocations esp from Murray and GAB 😱
- NWI 👿


Speak
up!

Professor Tina Soliman Hunter

Director, Centre for Energy and Natural Resources Innovation and Transformation (CENRIT)

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MACQUARIE University
SYDNEY·AUSTRALIA

Thank you!

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