Hydrogen Outlook

Sumitomo Australia Pty Ltd

March 2022

Sumitomo Australia Pty Ltd

Enriching lives and the world

DECARBONISATION

Commitments to Net-Zero

Governments:

Govt	Net Zero Commitment	Announced
Japan	2050	26 October 2020
Australia	2050	26 October 2021
Queensland	2050	12 October 2021

Companies:

	M/t p.a. Scope 1 Emissions 2019-20	Net Zero Commitments
1. AGL Energy	42.2	2040
2. Energy Australia	17.9	2050
3. Stanwell Corporation	17.1	-
4. Origin Energy	16.0	2050
5. CS Energy	13.2	-
6. Pioneer Sail Holdings (Alinta and Loy Yang)	11.7	2050
7. OzGen Holdings (Intergen)	10.8	-
8. Chevron Australia Holdings	10.2	2050
9. Woodside Petroleum	9.2	2050
10. Inpex Holdings	7.6	2050

Clean Energy Regulator, *'Australia's 10 highest greenhouse gas emitters 2019-20'*

Japan's Energy Imports

Japan is the world's third-largest coal-importing country

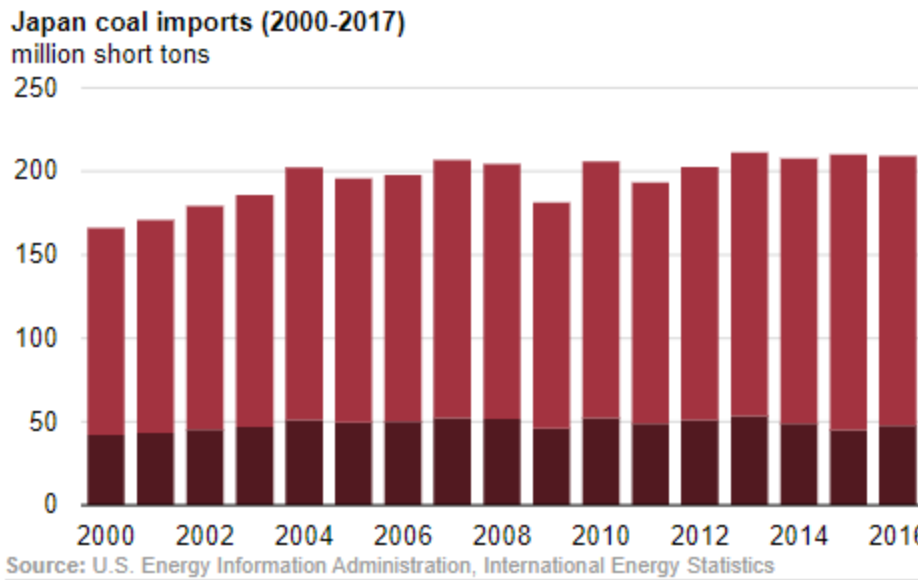
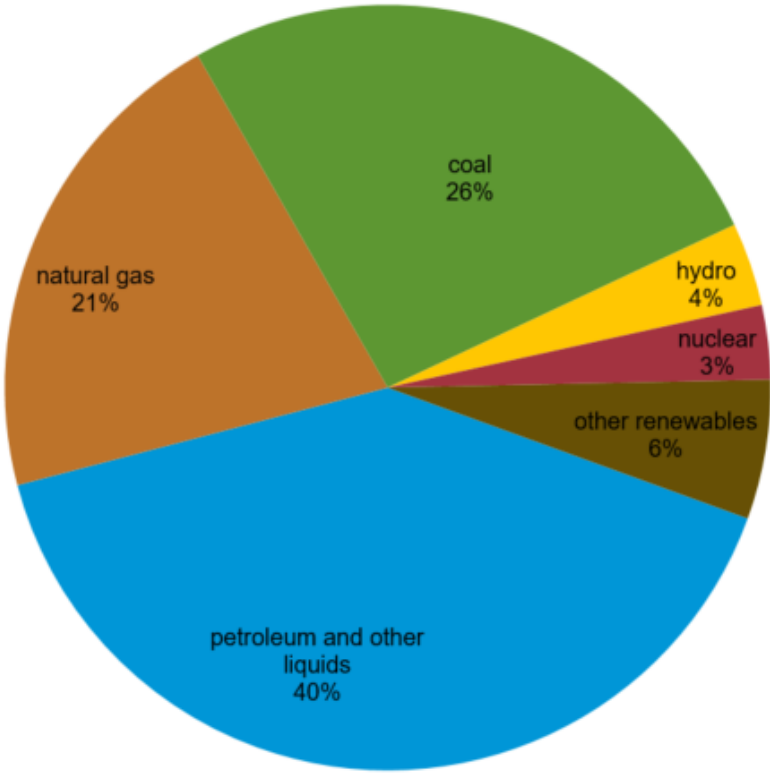
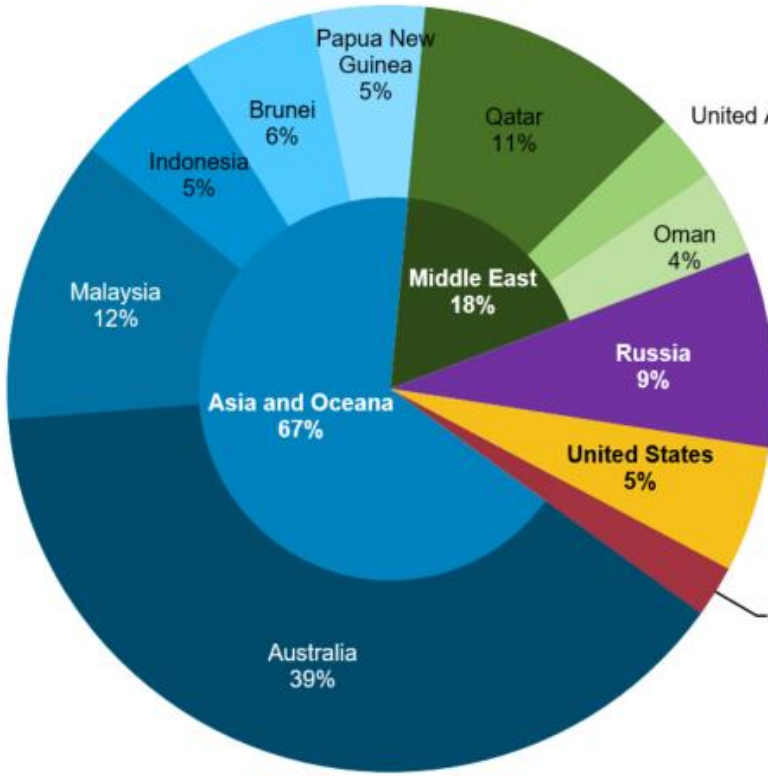


Figure 1. Japan's total energy consumption, 2019



eia Source: *BP Statistical Review of World Energy 2020*

Figure 5. Japan's LNG imports by source, 2019



eia Source: U.S. Energy Information Administration and Global Trade Tracke
Note: Some individual figures do not match the regional total due to round

Clean Energy Regulator, *'Australia's 10 highest greenhouse gas emitters 2019-20'*

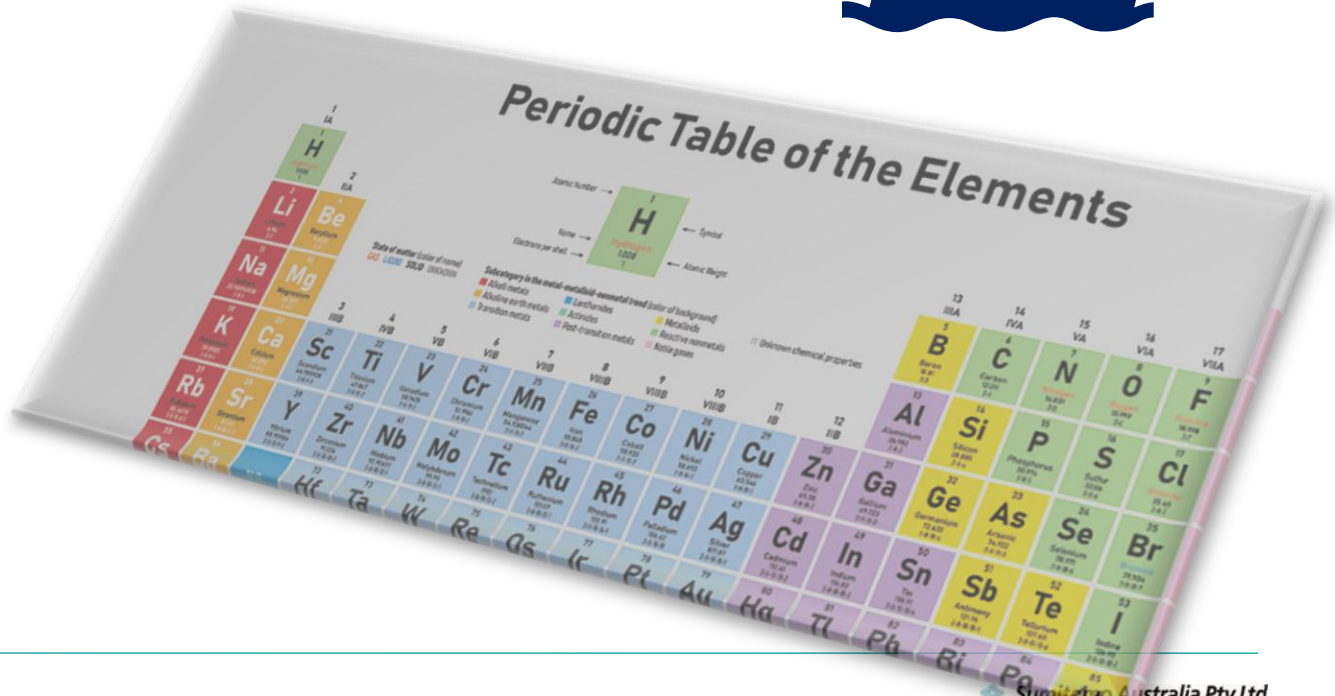
Where does hydrogen come in?

Hydrogen 101:

- No 1 on the Periodic Table
- Atomic Weight: 1.00797
- Gas, odourless, tasteless, highly combustible
- When burned only emission is water
- Combustion Temperature: 2,182°C
- Liquefaction: -253°C
- Energy Density: 120MJ/kg // 33.6 kWh/kg

Transport Vectors:

Methylcyclohexane (MCH)
Ammonia (NH_3)
Liquified Hydrogen



Not all Hydrogen is created equal

The Hydrogen Rainbow

	Terminology	Technology	Feedstock/ Electricity source	GHG footprint*
PRODUCTION VIA ELECTRICITY	Green Hydrogen	Electrolysis	Wind | Solar | Hydro Geothermal | Tidal	Minimal
	Purple/Pink Hydrogen		Nuclear	
	Yellow Hydrogen		Mixed-origin grid energy	Medium
PRODUCTION VIA FOSSIL FUELS	Blue Hydrogen	Natural gas reforming + CCUS / Coal Gasification + CCUS	Natural gas | coal	Low
	Turquoise Hydrogen	Pyrolysis	Natural gas	Solid carbon (by-product)
	Grey Hydrogen	Natural gas reforming		Medium
	Brown Hydrogen	Gasification	Brown coal (lignite)	High
	Black Hydrogen		Black coal	

*GHG footprint given as a general guide but it is accepted that each category can be higher in some cases.

Global Energy Infrastructure *Hydrogen – data telling a story. 30 March 2021*
https://globalenergyinfrastructure.com/articles/2021/03-march/hydrogen-data-telling-a-story/

Offtake by 2030:

Japan
Up to 1,000,000 tpa

South Korea
Up to 3,900,000 tpa

China
Up to 35,000,000 tpa

Applications:

- Power Generation (Established)
- Mobility (Established)
- Logistics
  - Trucks (Developing)
  - Shipping Vessels (Developing)
- Industrial Heat
  - Furnaces (Developing)
  - Kilns (Developing)
  - Calciners (Advanced Development)
- Heavy Industry
  - Mining Vehicles (Developing)

Key Domestic Opportunities & Challenges

Industry:

- Smelters
- Refineries
- Kilns
- Food & Beverage
- Fertilizer Production
- Explosives Production

Transport & Logistics

Injection into gas networks

Challenges

- Economies of scale
- Distribution
- Engineering
- Renewables development
- Electricity System Security
- Water supply
- Governmental Policy
- Technical skills
- Labour shortages

Capacity to produce 1Mtpa: **7,407 MW** of Electrolyser Capacity
55,635 GWh of renewable energy
19 gigalitres of water

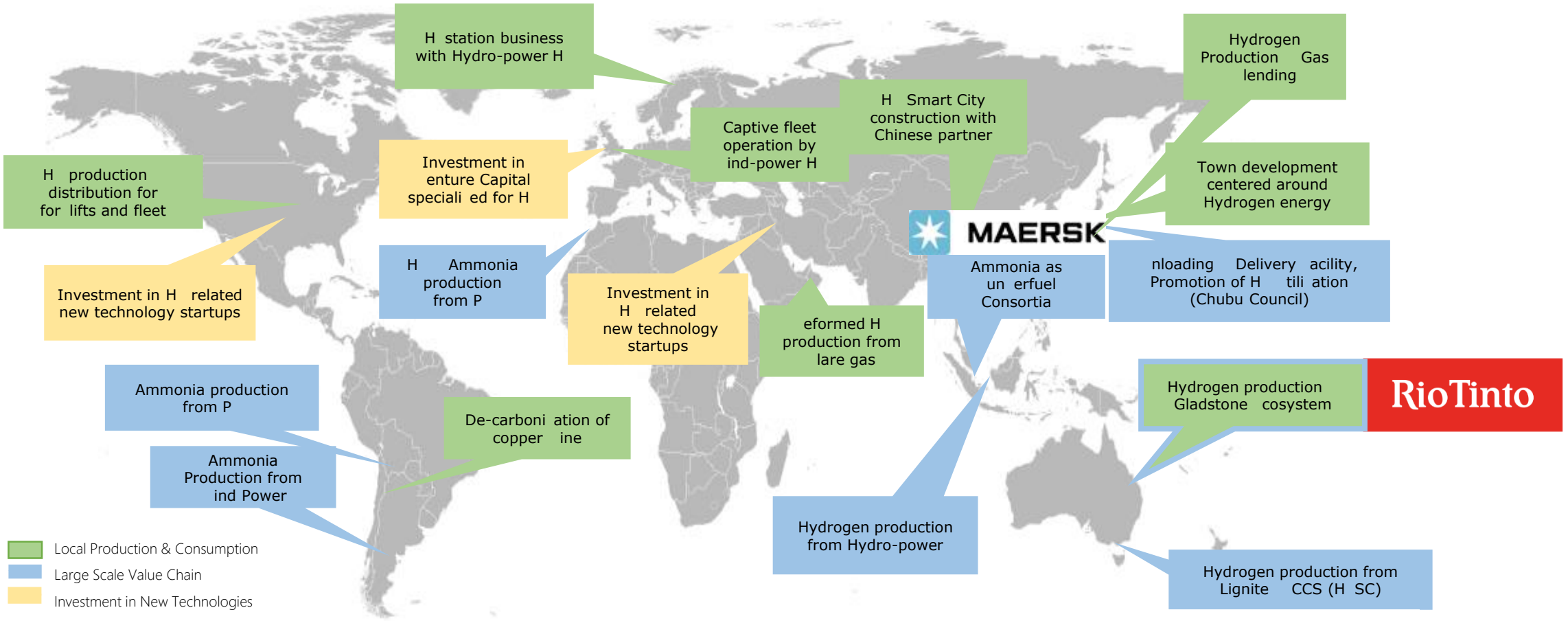
(based on existing electrolyser efficiencies)

Largest Electrolyser In Operation: 1.25MW, HyPark South Australia, Operated by AGIG for gas injection into distribution network

Largest ARENA Funded Electrolyser: 10MW x 3 (ATCO/ENGIE/AGIG) (Perth, Pilbara, Murray Valley Victoria)

How Do You Unlock the Hydrogen Industry: Building the Hydrogen Value Chain

Build your hydrogen credentials



- Local Production & Consumption: Building a distributed hydrogen supply chain in leading Hydrogen countries (Japan, EU, China, Australia)
- Large Scale Value Chain: Building a Mass transport route from mass production in RE cost-competitive areas to Japan and others
- Investment in New Technologies: Gaining access to breakthrough technologies, and applying it to Sumitomo's projects

HESC

Hydrogen Energy Supply Chain (HESC)

Latrobe Valley, Victoria

Kawasaki Powering your potential | POWER Group | Iwatani | Marubeni | agl | HEA | Sumitomo Corporation

VICTORIA | Australian Government

Pilot Phase: 2019-2022

First Production: January 2021

First Cargo: January 2022

5 Japanese Partners, with cooperation and support of Japanese, Aust Federal and Victorian Governments

Gladstone Hydrogen Ecosystem

Bringing together foundational partners

The Courier Mail

Gladstone set to become 'hydrogen capital of the world'

The landmark signing of a memorandum of understanding will see Gladstone exporting hydrogen by 2030.

March 2021

Memorandum of Understanding signed

- Australian Gas Infrastructure Group
- CQUniversity Australia
- Sumitomo Australia Pty Ltd
- Gladstone Regional Council
- Gladstone Ports Corporation — Growth, prosperity, community.
- cleanCO queensland

August 2021

LOI: Hydrogen Calcination Project, Yarwun

- Rio Tinto
- \+
- Sumitomo Australia Pty Ltd

'I don't understand why we are using so much energy to process water and isolate hydrogen, to deliver only a portion of that original energy in the form of hydrogen.

The energy losses don't make sense'

DECARBONISATION