Distributed Gas Resources

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Agenda

1. Carbon emissions & target
2. Why hydrogen
3. Australian activities
4. AEMO Challenges

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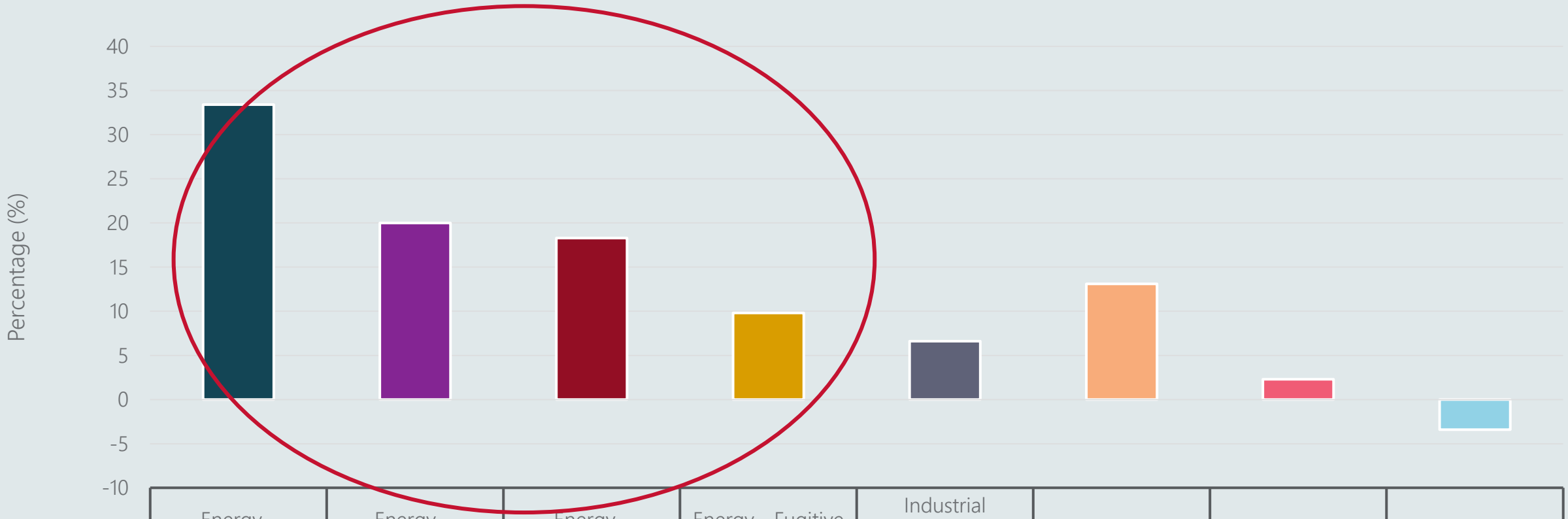
Emissions Target

- Australia has set a target to reduce emissions by 26-28 per cent below 2005 levels by 2030

Emissions Target	Number
Australia's Emissions in 2005	612 MtCO2-e
Australia's Emissions Target in 2020	533 MtCO2-e
Australia's Emissions Target in 2030	441–453 MtCO2-e
Most Australian states have a net-zero target for 2050	

Data sourced from: https://www.pmc.gov.au/sites/default/files/publications/Summary%20Report%20Australias%202030%20Emission%20Reduction%20Target.pdf

Australian National Greenhouse Gas Inventory emissions by sector to June 2020



	Energy - Electricity	Energy - Stationary energy	Energy - Transport	Energy - Fugitive emissions	Industrial processes and product use	Agriculture	Waste	LULUCF
Percentage (%)	33.4	20	18.3	9.8	6.6	13.1	2.3	-3.4

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Data sourced from: https://www.industry.gov.au/data-and-publications/national-greenhouse-gas-inventory-quarterly-updates

Victorian gas usage

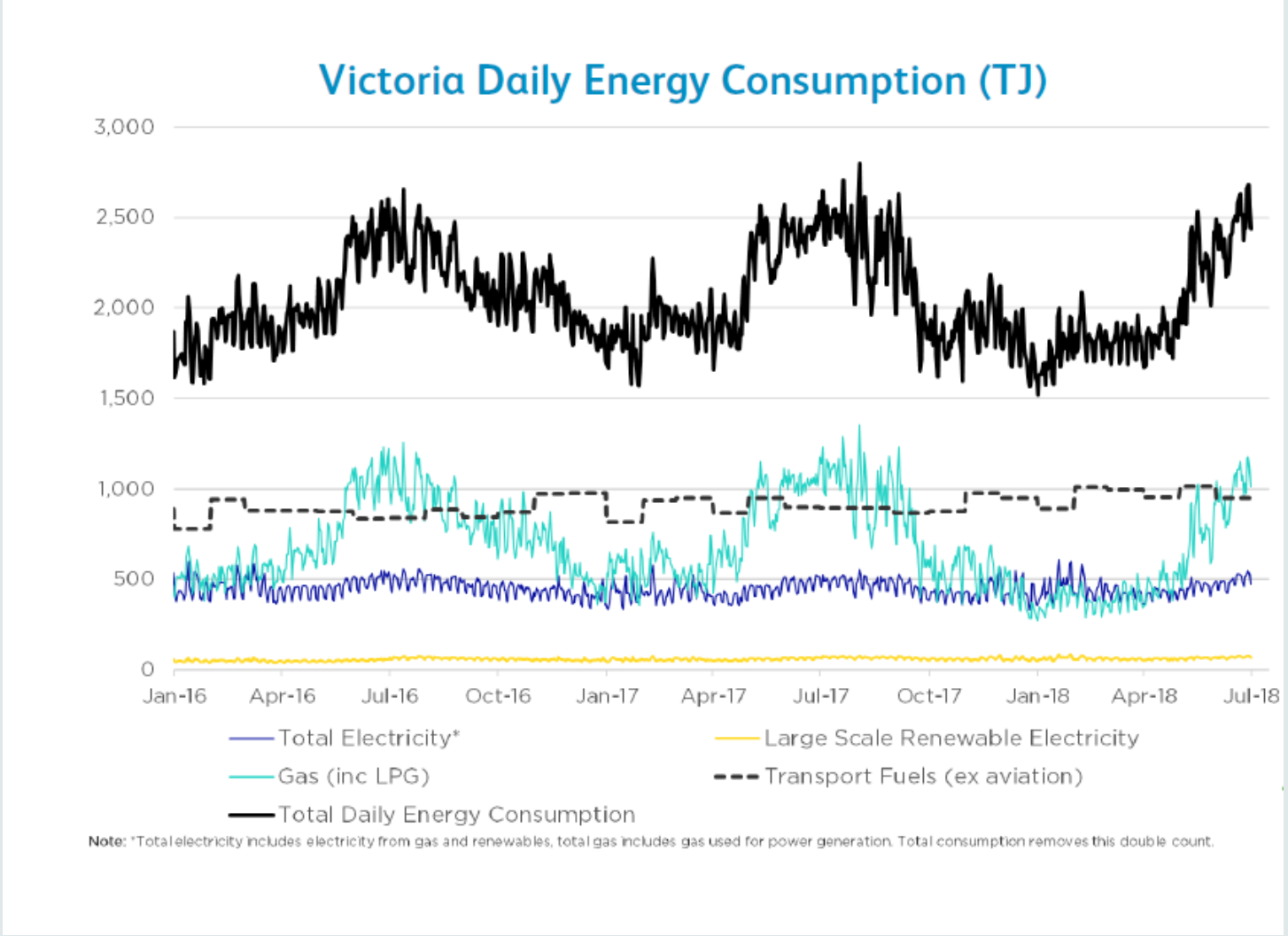
220 PJ of gas consumed in 2020

17 PJ consumed for gas powered generation

203 PJ consumed by residential, commercial and industrial customers

~10 PJ per month in summer & 30 PJ per month in winter

Graph using seasonal electricity vs gas



Graph sourced from AGIG presentation to Australian Domestic Gas Outlook 2021

Options for carbon abatement in energy and transport sectors

- Full electrification
  - Electric Vehicles to reduce transport sector emissions
  - Gas to electric heating (fuel switching) to reduce energy from direct combustion
  - Large increase in electricity consumption
  - Requires large increase in renewable generation, electricity transmission and electricity storage

- Hydrogen conversion
  - Combination of electric vehicles and hydrogen fuel cell vehicles
  - Hydrogen replacing natural gas or blending hydrogen into natural gas to reduce emissions from direct combustion
  - Potential to repurpose some of the existing infrastructure
  - Requires the significant growth of the hydrogen economy

Why Hydrogen

What it is - How you make it - What you can use it for

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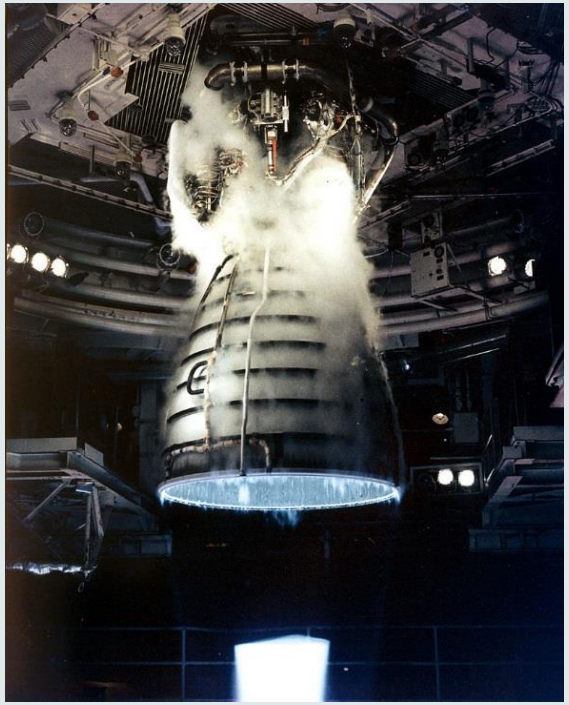
What is hydrogen?

- Hydrogen is not a raw fuel, it must be produced and is classed as an energy carrier.
- It provides a method for energy storage or transportation. Hydrogen energy can be stored as a gas and delivered through existing low pressure natural gas pipelines.
- Hydrogen can also be transported on trucks and in ships when converted to a liquid or other suitable material.
- Distribution of hydrogen is not new – towns gas used in Victoria in the 50's & 60's was ~50% H2
- Hong Kong and Singapore pipeline gas is ~50% H2 today



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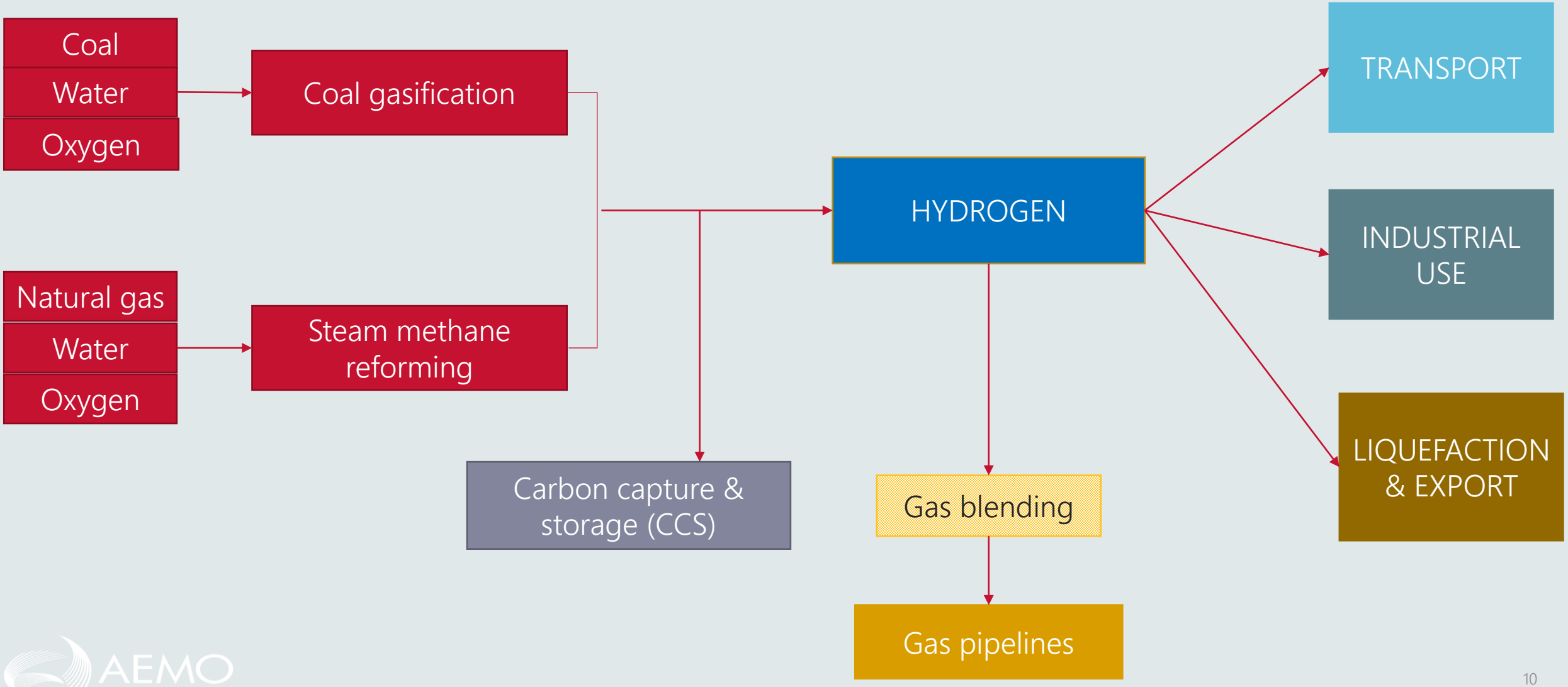
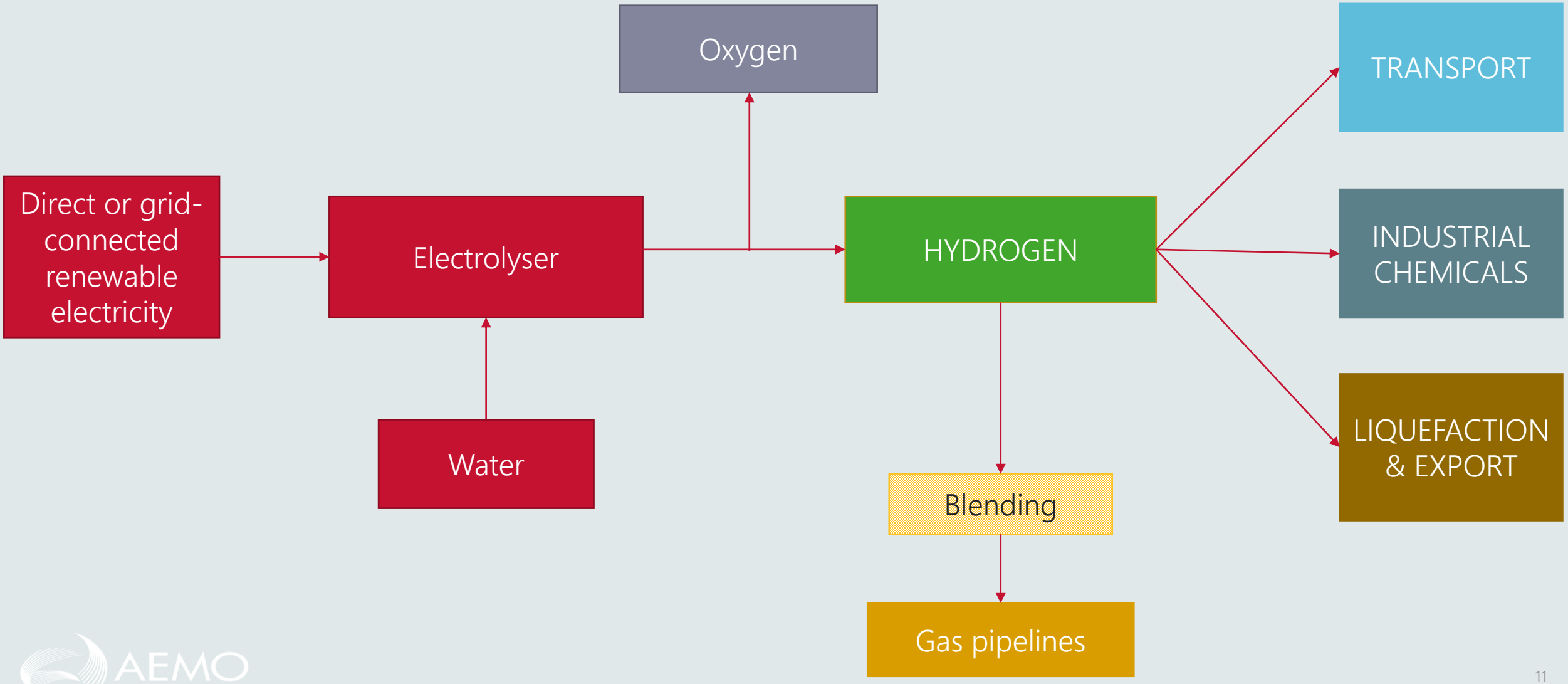
‘Blue’ hydrogen production (CCS Hydrogen)



‘Green’ hydrogen production (Renewable Hydrogen)



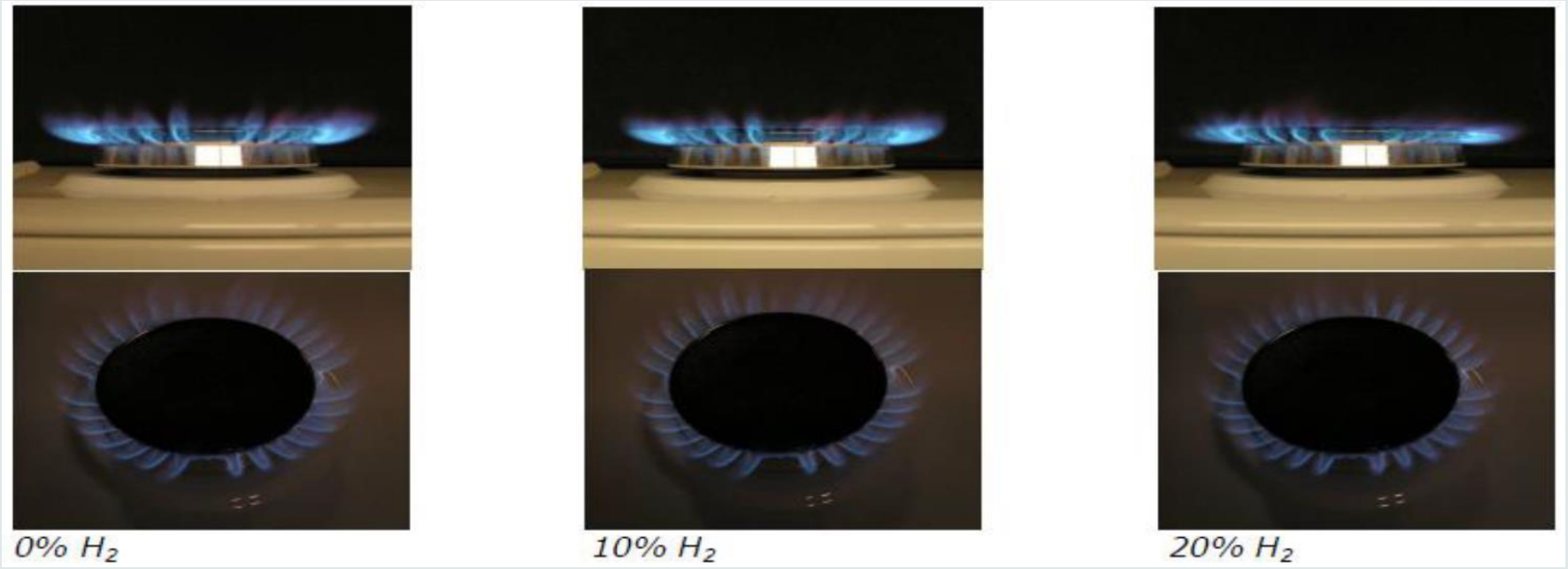
Hydrogen Fuel Cell Vehicles (FCVs)

- FCVs travel 600-800 km on a single tank (5.5 kg) and with hydrogen prices at around $14 per kg, costs approximately $77 per tank
- Refilling time for hydrogen vehicles is approximately 3 minutes
- EV recharge time is typically 4-8 hours, or 75 minutes at a supercharging station.
- Hydrogen Refuelling Stations:
  - Japan 101, Europe 82, USA 39, South Korea 18
  - Australia has a single hydrogen refuelling station in Sydney, Melbourne, Canberra and Adelaide.
- Electric Battery vehicles have difficulty transporting large loads (due to battery weight) creating challenges for buses, trains and trucking. Another difficulty is with high use vehicles such as taxi's.

- 1,000 hydrogen fuel cell trucks just purchased by Switzerland, and USA's major brewer Anheuser-Busch has ordered up to 800 new zero emissions hydrogen-electric trucks from the Nikola Motor Company.
- The first of 14 hydrogen passenger trains commenced operation in Germany during September 2018. The trains operate cheaper than diesel trains with a range of 1,000 km. Letters of intent signed for a further 60 trains.

Appliances

- Current natural gas appliances can function with a natural gas hydrogen blend up to 20%. Hydrogen above this requires a change out of appliances.
- The Future Fuels CRC is currently collaborating with several universities and the Gas Appliances Manufacturers Association of Australia (GAMAA) to test appliances with a hydrogen blend to confirm the suitability.



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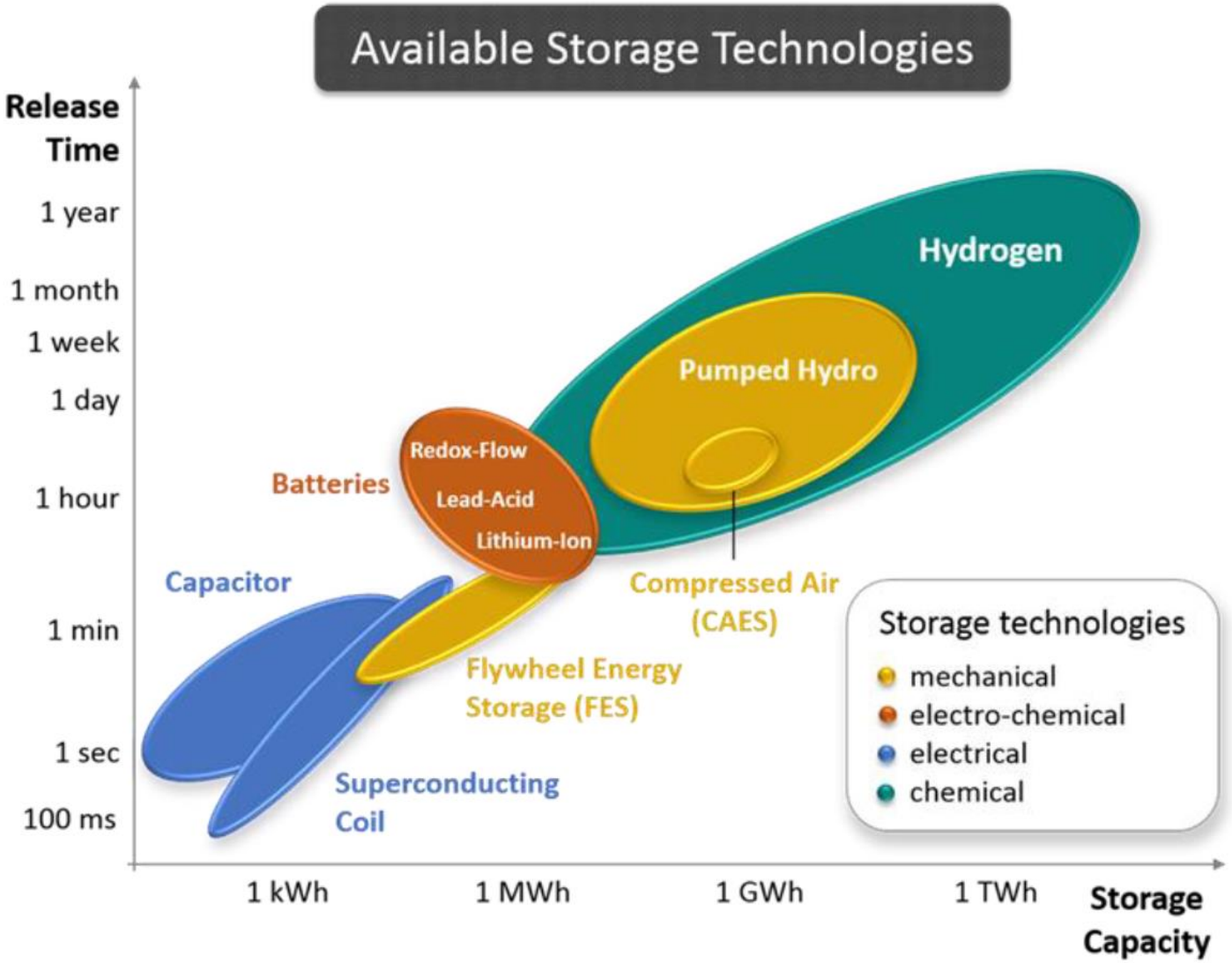
Hydrogen vs. other storage capabilities



Source: Joi Scientific, 2018

Australian Activities

National Hydrogen Strategy

- The COAG Energy Council released the National Hydrogen Strategy in November 2019.
- The Hydrogen Project Team was established in March 2020.

Phase 1 (Foundations and demonstrations)	Phase 2 (Large-scale market activation)
• Advance priority pilots, trials and demonstration projects • Build demonstration scale hydrogen hubs • Assess supply chain infrastructure needs • Develop supply chains for prospective hydrogen hubs	• Scale up projects to support export and domestic needs • Build Australian hydrogen supply chain and large-scale export industry infrastructure • Build and maintain robust and sustainable export and domestic markets and supply chains • Enable competitive domestic markets with explicit public benefits

Focus area in 2020

- In 2020, the National Hydrogen Strategy Team focussed on international collaboration, national coordination, supporting priority industry projects and legislative reviews:

1. Guarantee of Origin Certification scheme
2. Review activities to support use of hydrogen in Australian gas networks (NGL, NGR, regulations, etc)
3. Engaging internationally to build strong trade relationships and set the foundation for Australia to become a key exporter of hydrogen
4. Review of state, territory and Commonwealth hydrogen regulations relevant to hydrogen safety and industry development
5. Support for pilots trials and demonstrations

Hydrogen in Australia

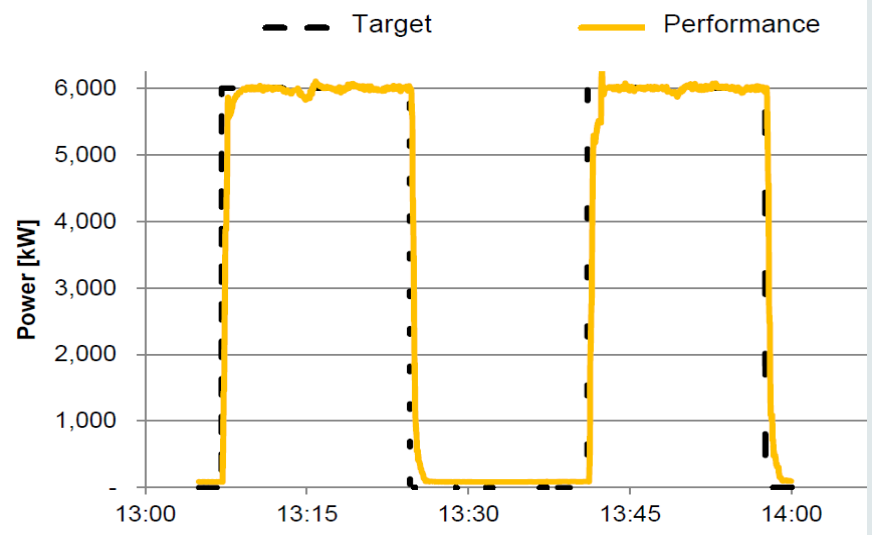
- Hydrogen if produced using low or zero emissions sources can enable decarbonisation across the energy and industry sectors.
- Hydrogen is still an expensive alternative to natural gas but costs are expected to reduce as technology develops and mass production of electrolysers starts – noting that solar has reduced in cost by 99% and the Commonwealth / global target of getting the price of hydrogen down to $2 per kg.
- In April 2019, ARENA opened the $70 million Renewable Hydrogen Deployment Funding Round to help fast track the development of renewable hydrogen in Australia.
  - ARENA shortlisted seven companies in mind-2020 who submitted a full application in January 2021 for the final stage of the Agency's $70 million hydrogen funding round.
  - Among the shortlisted applicants, there are four projects based in Western Australia, and one each in Queensland, Tasmania and Victoria. ARENA aims to support two or three of the shortlisted large scale renewable hydrogen projects.

Existing Australian Hydrogen Projects

- AGIG Hydrogen Park SA
  - Green hydrogen production via electrolyser utilising renewable electricity
  - Blending 5% hydrogen to ~700 natural gas distribution customers
  - Potential to supply hydrogen in transport applications
- Jemena Western Sydney Green Gas Project
  - Green hydrogen production via electrolyser utilising renewable power
  - Blending hydrogen to ~250 homes
  - Potential to supply hydrogen in transport applications
- AGIG Hydrogen Park Gladstone
  - Green hydrogen production
  - Supplying ~770 residential, small commercial and industrial customers
- ATCO WA Clean Energy Hub
  - Fully integrated solar power, battery storage, an electrolyser and a hydrogen fuel cell to provide power to ATCO's Jandakot operational centre and a hybrid display home.
  - Interfaces with third party data including AEMO WEM market data, used to analyse market prices and weather to determine the cheapest source of energy for battery recharge.

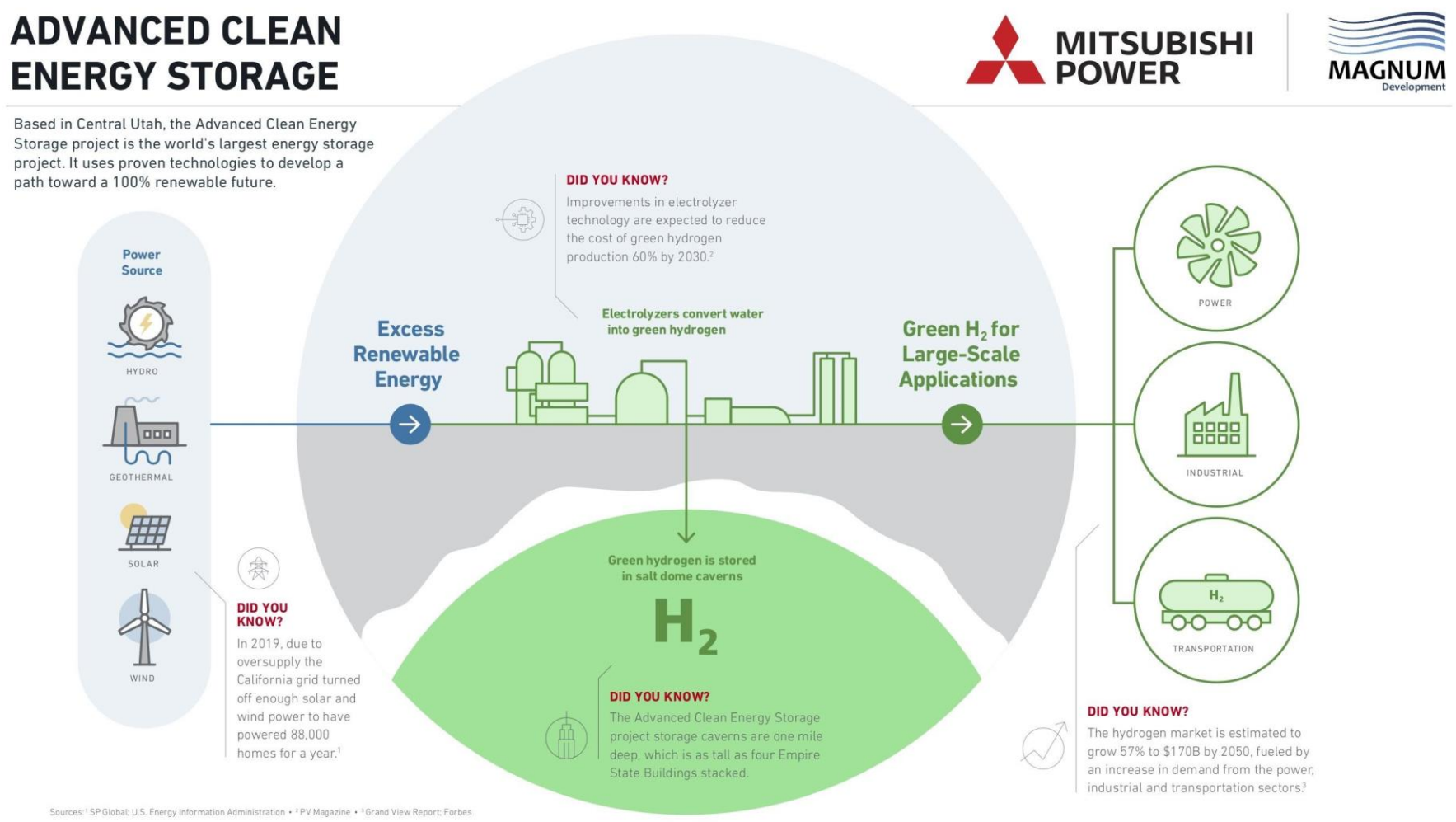
“Energiepark Mainz” Power-to-Gas Project (Germany)

- Commenced operation Q1 2016
- 8 MW wind farm
- 6.3 MW electrolyser
- 1,000 kg H_2 storage (33 MWh)
- Participates in the ancillary market as a large flexible load



Mitsubishi Advanced Clean Energy Storage (ACES) Project – Utah / California

- In March 2020 Mitsubishi Hitachi Power Systems (MHPS) was awarded a contract to supply two M501JAC power trains for the Intermountain Power Plant (IPP) in Utah, to supply electricity to California.
- The plan to sequentially transition from coal, to natural gas and finally to renewable hydrogen in what has been dubbed the "World's Largest Renewable Energy Storage Project".
- This transition will start in 2025, when the turbines will be commercially guaranteed capable of using a mix of 30% hydrogen and 70% natural gas fuel. Between 2025 and 2045, the hydrogen capability will be systematically increased to 100% renewable hydrogen.
- Hydrogen will be stored in underground salt domes/caverns, providing inter-seasonal storage to address California's summer peak electricity demand issues.



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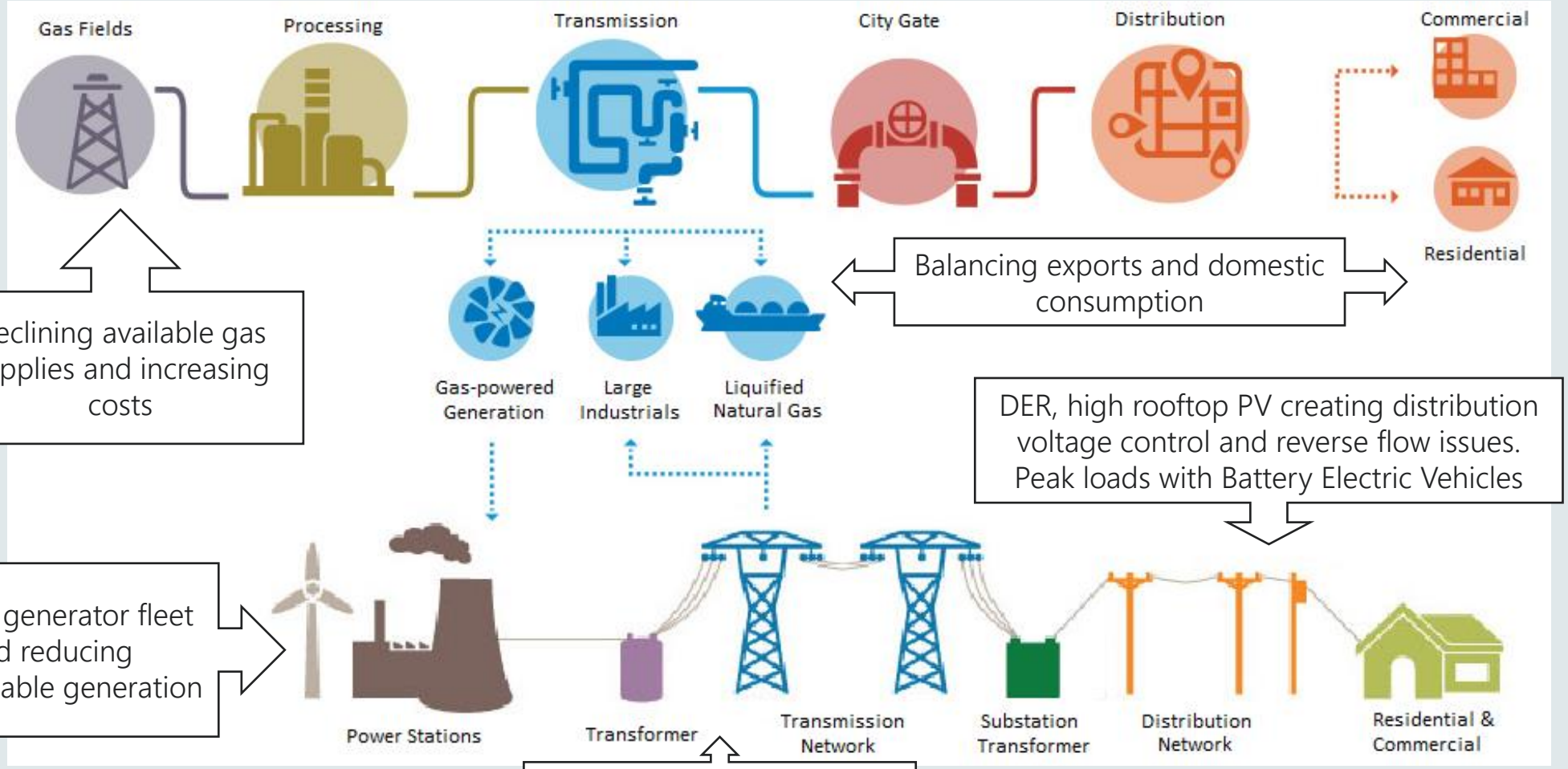
Challenges

Current Energy Challenges



Declining available gas supplies and increasing costs

Balancing exports and domestic consumption

DER, high rooftop PV creating distribution voltage control and reverse flow issues. Peak loads with Battery Electric Vehicles

Ageing generator fleet and reducing dispatchable generation

Inertia & system strength

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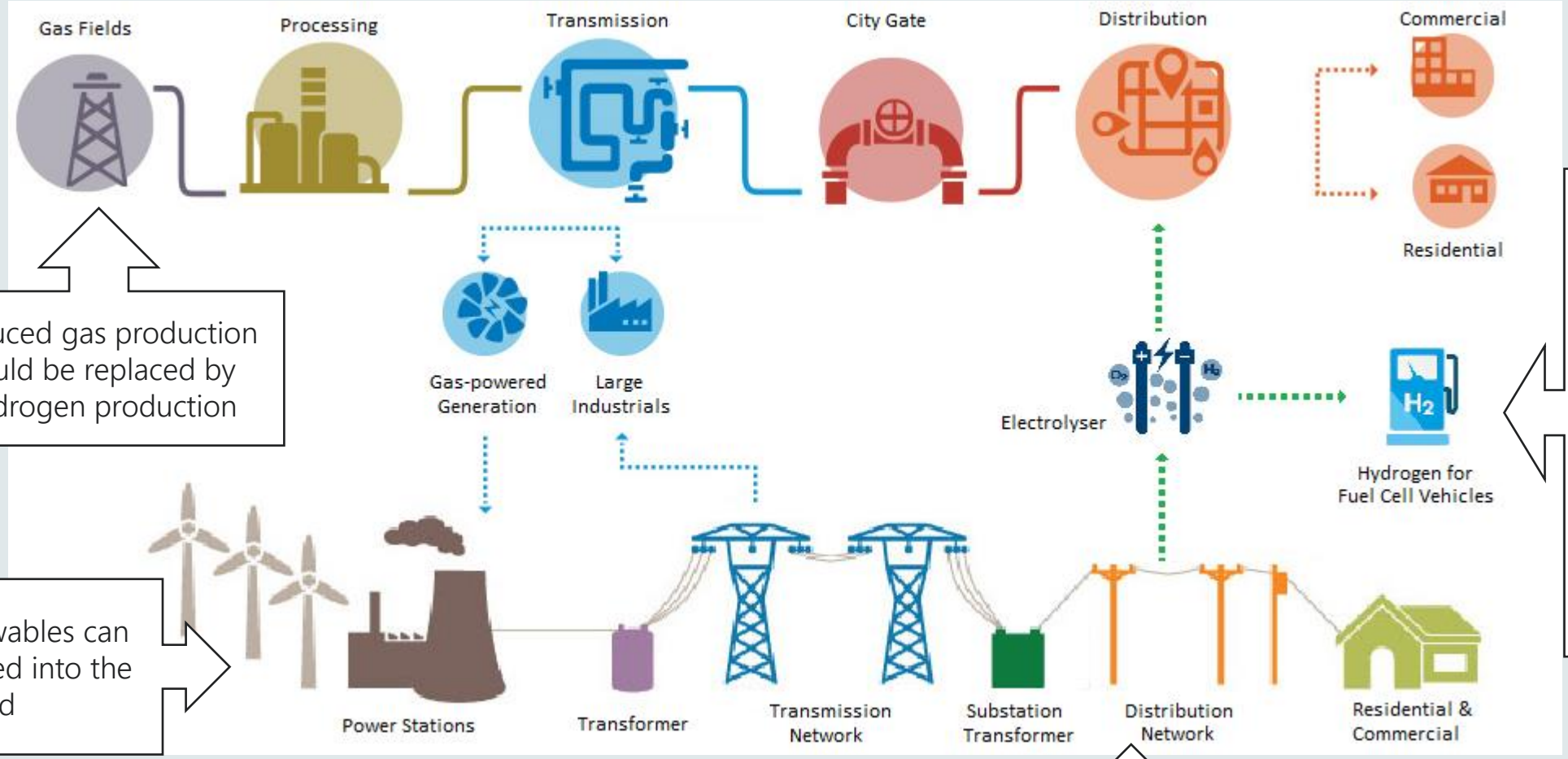
Current Energy Challenges



Reduced gas production could be replaced by hydrogen production

Hydrogen production can occur when renewables are abundant and switch off during low renewable periods. Load following essentially removing some peaks.

More renewables can be integrated into the grid

Large controllable load on distribution network removes reverse flow issues

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Potential Integration Challenges

- NGL and NGR only covers natural gas (methane) and not hydrogen
- STTM market design allows for and includes distribution network connected facilities
- DWGM market design does not contemplate distribution network connected facilities
- AEMO is responsible for the heating value for the Victorian Gas Retail market, current retail design assumes everyone gets the same gas
- NEM connections/registrations as a large controllable load (Potential similarities to batteries)
- NEM operations, how will the electrolysers behave and impact NEM operations, potential participation in demand response schemes, provide ancillary services, etc