Pacific Hydrogen Strategy

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Presented by Iain MacGill, based on the work of the UNSW team, and particularly Dr Rahman Daiyan and Dr M. Haider Ali Khan

UNSW SYDNEY

Australian Government
Department of Climate Change, Energy, the Environment and Water

GlobH2E
ARC Industrial Transformation Training Centre for the Global Hydrogen Economy

IRENA
International Renewable Energy Agency

USP
THE UNIVERSITY OF THE SOUTH PACIFIC

Pacific Community
Communauté du Pacifique

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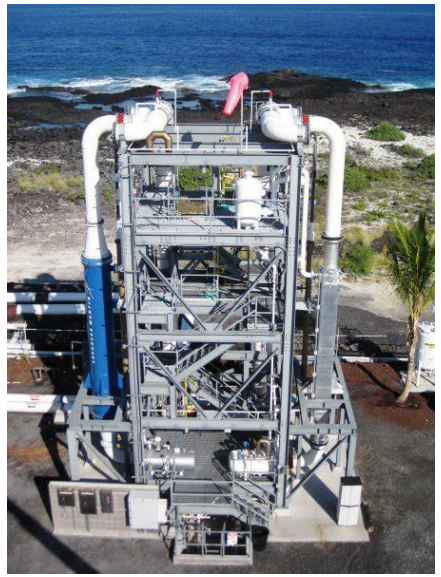
A key planning, *deployment and operational* challenge:
assessing promising but still emerging energy technologies for the Pacific

- New technologies
  - Hydrogen and its derivatives
  - Ocean Energy options
- Established technologies with expanded roles
  - High level PV integration into island grids
  - Battery Energy Storage Systems
  - Off-shore wind
- New variations on existing technologies
  - Floating PV
  - Enhanced geothermal technologies
  - New biomass technologies



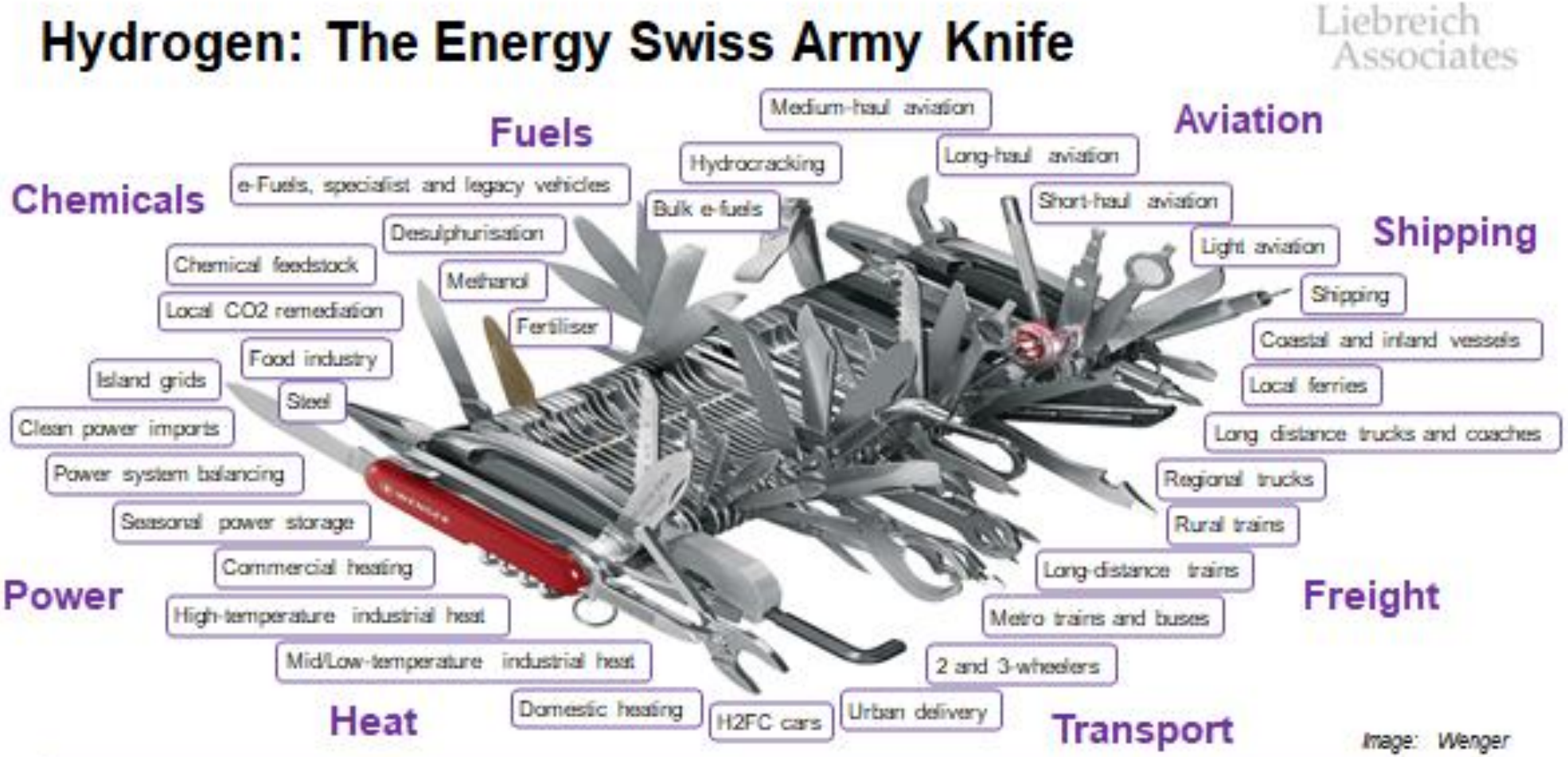
Deployment of new technologies in the region
– *leading edge* versus *bleeding edge*

Leading Edge vs. Bleeding Edge

- Bleeding Edge: When failure occurs because an organization tries to be too far out on the technological leading edge
  - Time-Warner's Pathfinder portal
- Leading Edge: Let competitors test the new technology first

- Possible strategies to manage technology risks
  - Regionally relevant R&D and demonstration
  - Readiness assessments
  - Pilot projects
  - Ongoing Independent expert review and assistance for the region
  - **Tools that can help us assess the potential role of these technologies while minimizing risks and regret**
  - **Technology roadmapping**

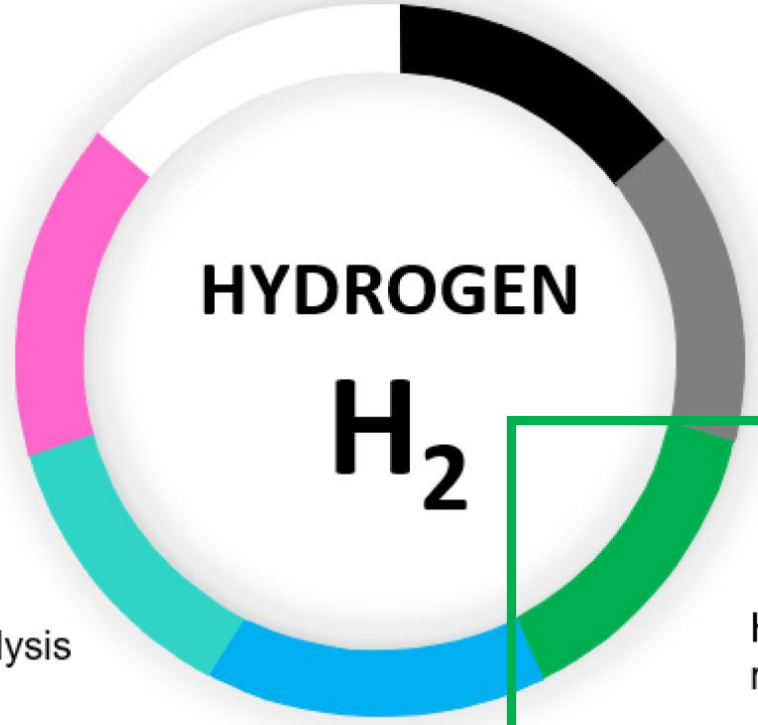
Hydrogen can do just about everything ….
but what does it do better than other options?



Why the different colors of hydrogen … *and which will sellers want to sell, buyers want to buy?*

Naturally ocurring

Coal gasification



Nuclear power

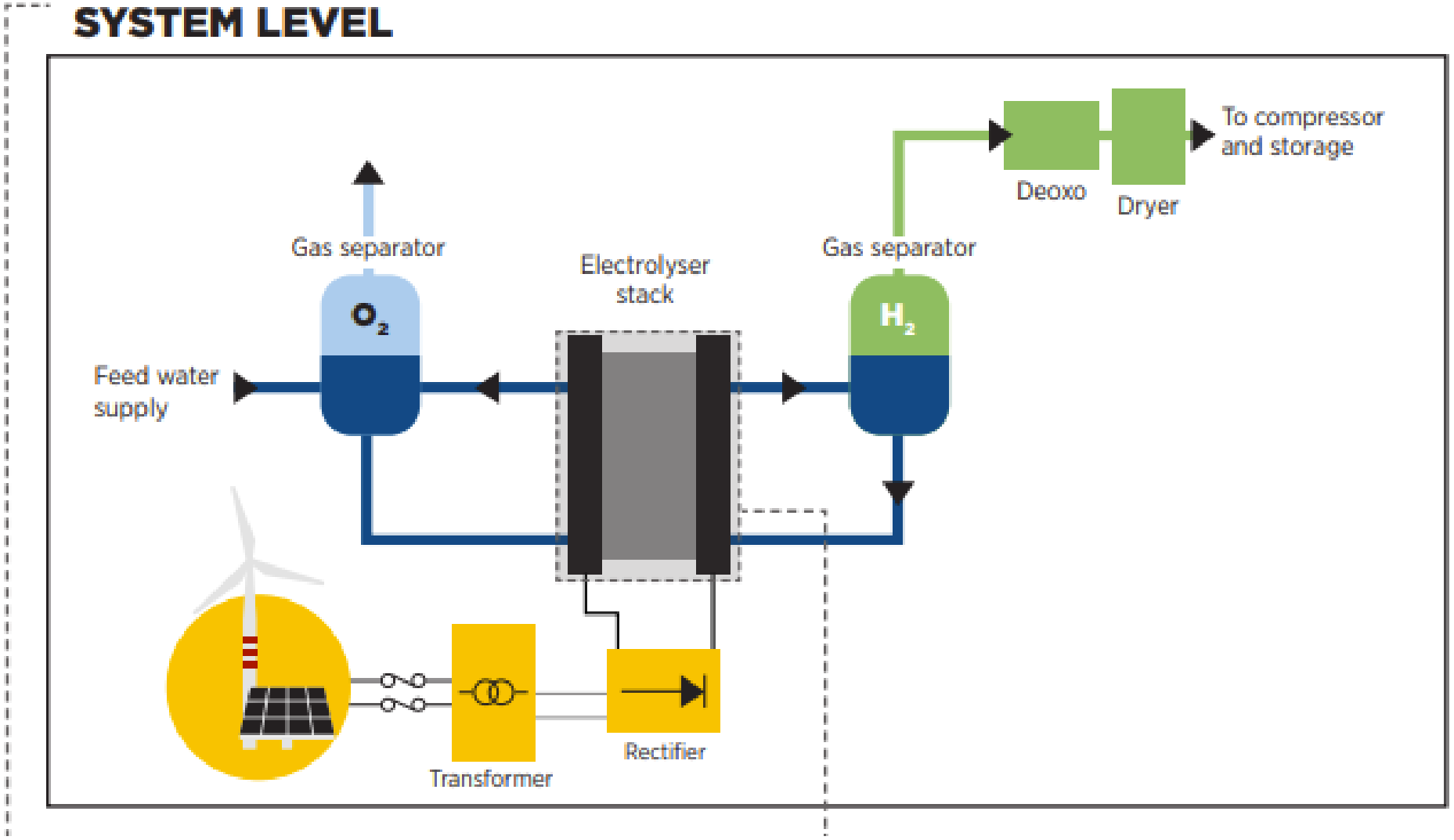
From fossil fuels

Methane pyrolysis

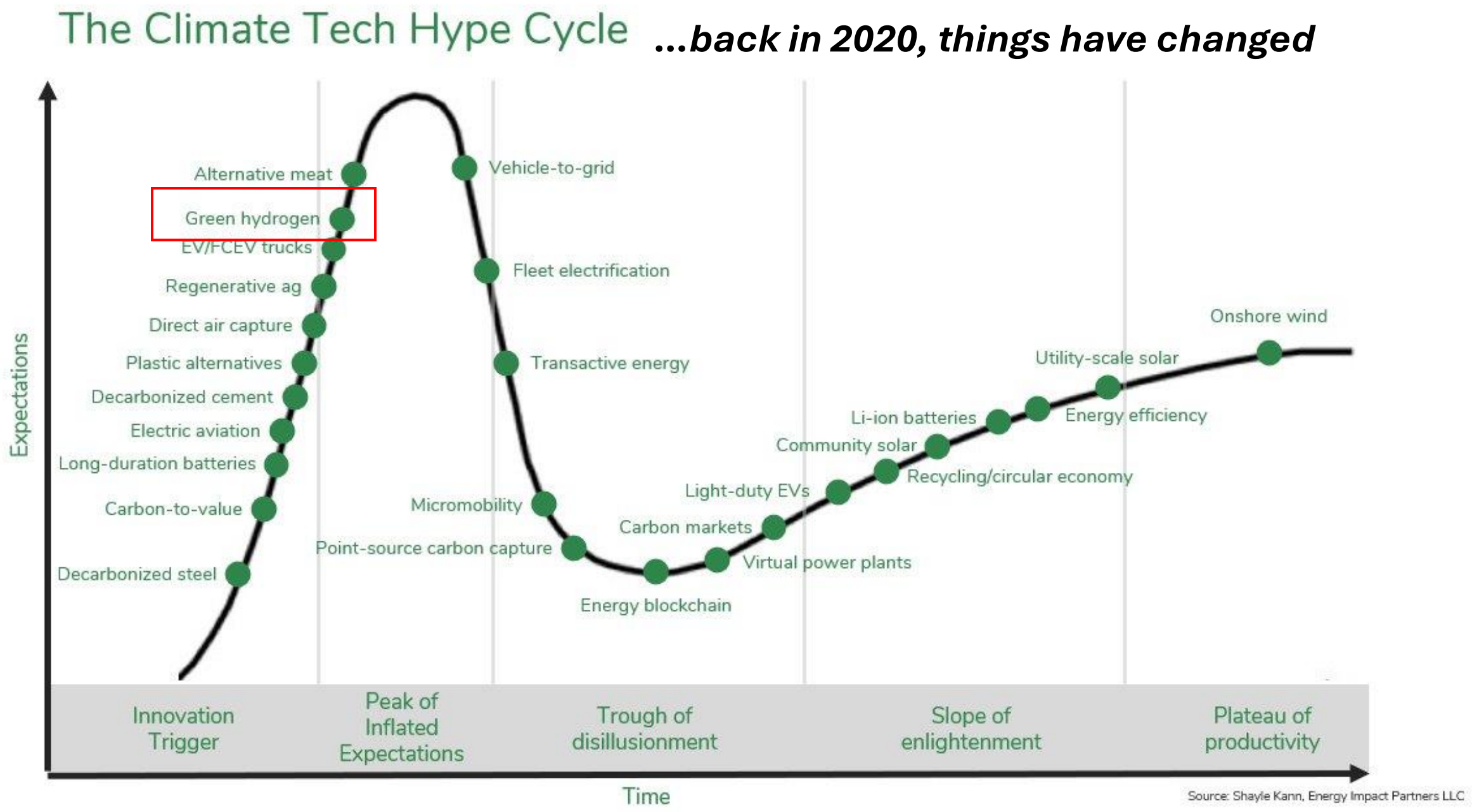
Natural gas with carbon capture

Hydrolysis with renewable power

Green / renewable hydrogen from electrolysers the only sustainable option in the longer term



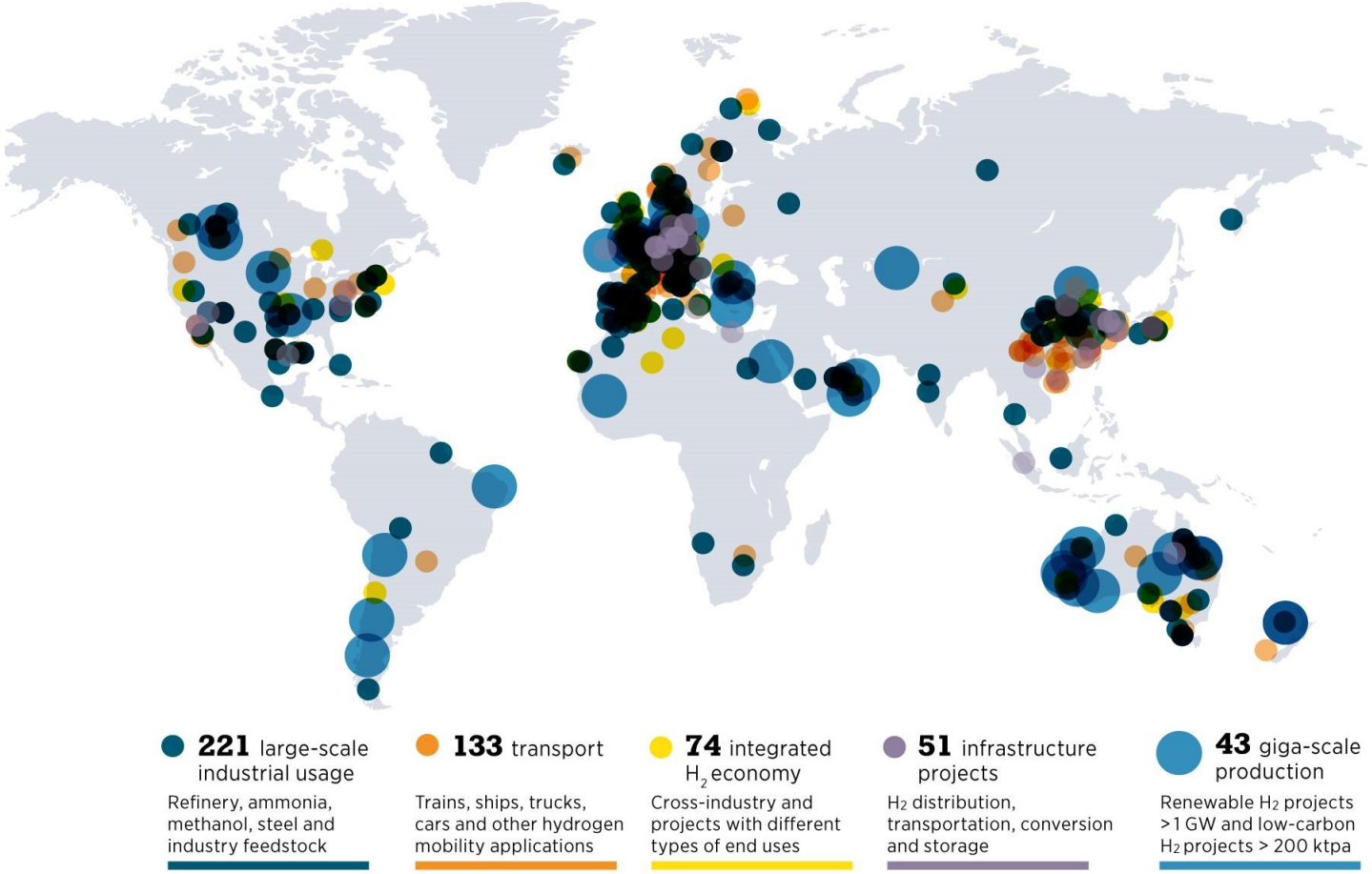
Where are on the renewable hydrogen hype cycle?



Clean Hydrogen

now past peak hype, an opportunity to establish *renewable hydrogen's* potential contribution to clean energy transition

Growing global interest in major hydrogen and derivative projects…. *although still only relatively limited progress on FID and deployment to date*



Current pacific project proposals?

Hydrogen Production in Papua New Guinea

- Two agreements between Fortescue Future Industries and Papua New Guinea signed in 2020 and 2021 enabled feasibility studies on up to 18 hydropower and geothermal projects in the country, including a hydro project along the Purari River on the nation's southern coast.
- These projects would provide renewable hydrogen to TotalEnergies' Papua LNG project.
- However, Fortescue has not provided any updates on the projects since December 2021 when it said a pre-feasibility study was well advanced.

Figure: The Papua LNG project.

Reference: https://www.reuters.com/business/energy/totalenergies-may-buy-green-power-fortescue-papua-new-guinea-regulator-2022-12-08/

HDF Project in Fiji

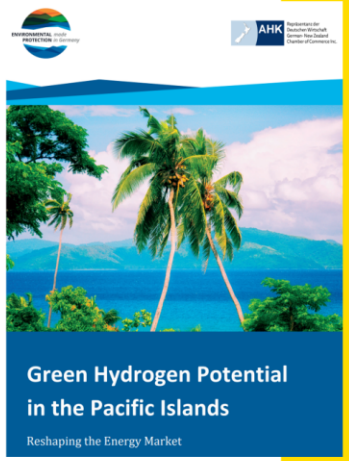
- The HDF Energy Australia team is currently developing a green hydrogen project on Fiji's Viti Levu island.
- The plant could generate 6 MWe of electricity during the day and evening, and 1.5 MWe throughout the night.
- HDF develops, finances, builds and operates multimegawatt industrial power generation infrastructures.
- HDF marketed the Renewstable® power plants, which capture intermittent renewable energy and store it massively in the form of hydrogen. HDF Energy currently has around ten Renewstable® projects in the advanced development phase in several countries.

Figure: Concept images of the solar PV farm and the hydrogen generation, storage, and fuel cell facilities.

Reference: https://www.hydrogenpower-fiji.com/

Pacific Green Hydrogen Project

- The German New Zealand Chamber of Commerce's (GNZCC) regional responsibility includes seven countries in the Pacific – Fiji, Samoa, Tonga, Cook Islands, Kiribati, Niue, and Tuvalu.
- Roles of the GNZCC include:
  - Business Intelligence
  - Consulting Services for Market Entry
  - Sourcing for Business Partnerships
  - International Trade Fair Participation
- The Pacific Green Hydrogen Project aims to connect small-to-medium German enterprises that manufacture hydrogen technologies for an off-grid application in the Pacific Islands.
- Excess energy from renewable energy plants is stored in the form of hydrogen and oxygen by electrolysis. This green hydrogen can be used to generate electricity with the help of a fuel cell.



Reference: https://neuseeland.ahk.de/en/services/projects/pacific-green-hydrogen-project

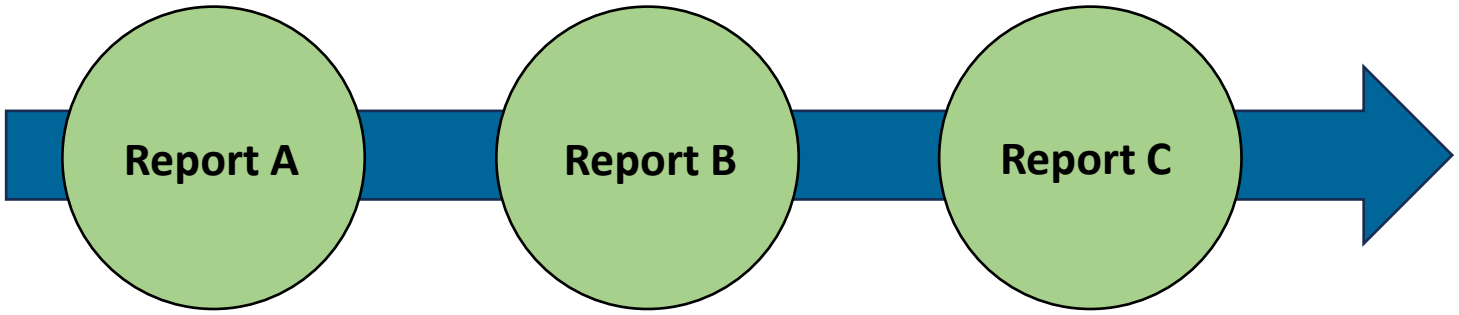
Renewable H_2 to Palau

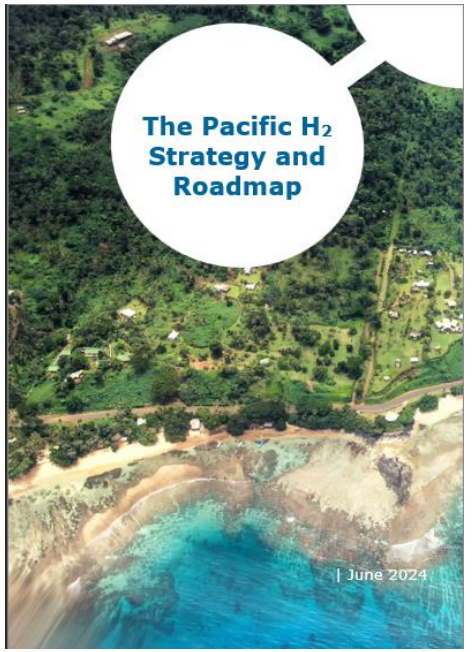
- Queensland-produced renewable hydrogen will be exported to the Republic of Palau from 2023 as part of a collaboration between Sojitz Corporation, Nippon Engineering Consultants and CS Energy.
- The project will assess the potential of renewable hydrogen for use in fuel cells and marine vessels in Palau to reduce its reliance on fossil fuels and has received subsidies from Japan's Ministry of the Environment.
- Renewable hydrogen for the project will be supplied from CS Energy's Kogan Renewable Hydrogen Demonstration Plant, which will be built on the Western Downs and produce renewable hydrogen from behind-the-meter solar energy.

Figure: Kogan renewable hydrogen plant (1 MW electrolyser, 2 MW solar PV farm).

Reference: https://www.csenergy.com.au/news/queensland-renewable-hydrogen-to-power-pacific-islands-demonstration-project

Approach





The Pacific H_2 Strategy and Roadmap

UNSW SYDNEY · IRENA International Renewable Energy Agency · USP The University of the South Pacific · Pacific Community Communauté du Pacifique · Australian Government Department of Climate Change, Energy, the Environment and Water

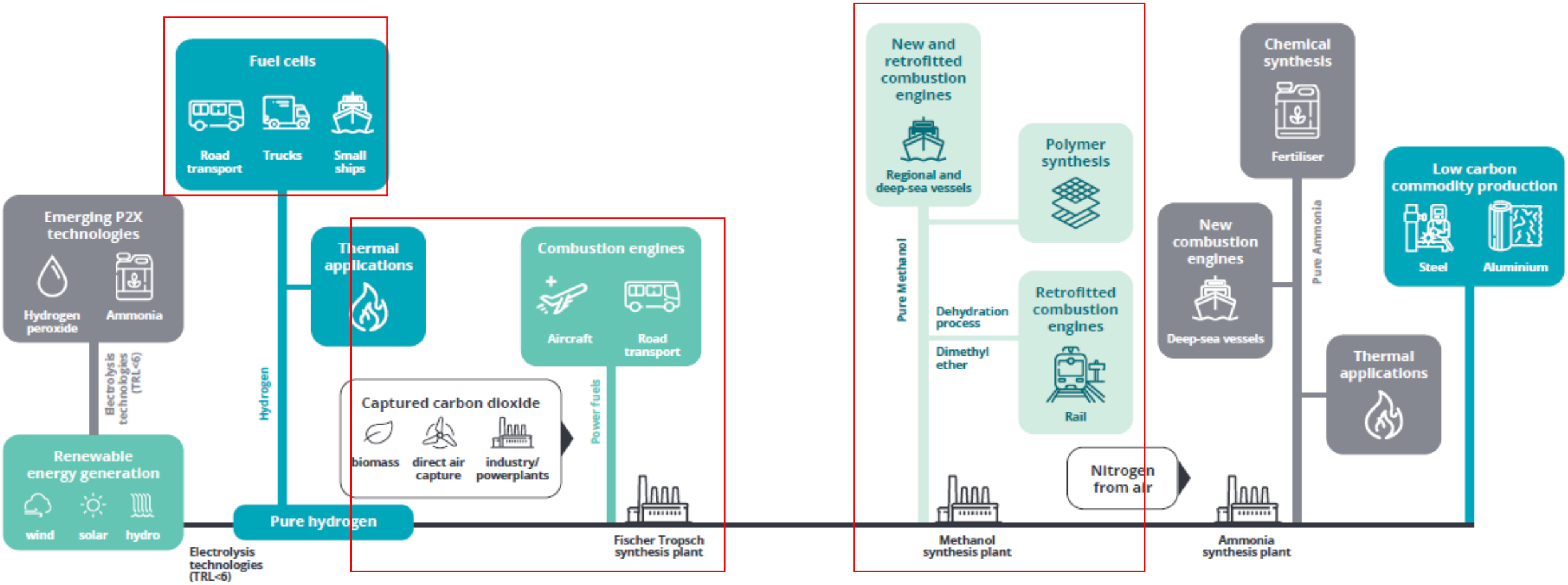
With ongoing support, engagement, and consultancy from regional and international stakeholders

First Q: What are the key roles for hydrogen?

A: Assist in sectors otherwise hard to decarbonize

Next Q: Is it h2 or an h2 derivative that we really need?

A: It depends (intended use, other factors)



Hydrogen and Derivatives: Key Potential Application Areas in the PICTs

- P2X technologies can be used to **generate green chemicals and fuels.**
- Pure **hydrogen or its carriers** can play the following key roles of:
  1. Closing the decarbonisation gap in power generation.
  2. Displacement of fossil fuels for mobility.

Application	Hydrogen	Methanol	Ammonia	Renewable Diesel	SAF
Seasonal power storage	✓			✓	
Power Generation	✓			✓	
Land mobility fuel	✓	✓		✓	
Maritime fuel		✓	✓	✓	
Aviation fuel					✓

FIGURE: RELEVANT P2X FUELS AND THEIR APPLICATION AREAS.

- *Key tradeoff – lose more energy and spend more money to get easier to use (even drop-in) fuels for existing infrastructure*

Where are the Potential Production Hubs: Resource Availability

PICT	Solar potential	Wind potential	Biomass potential	Land availability	Potential role
Fiji					▪ Production and net export hub
Samoa					▪ Production and net export hub
Vanuatu					▪ Production and net export hub
Solomon Is					▪ Production and net export hub
PNG					▪ Production and net export hub
New Caledonia					▪ Production and net export hub
Kiribati					▪ Net importer
FSM					▪ Net importer
Tonga					▪ Net importer
Cook Islands					▪ Net importer
RMI					▪ Net importer
Tuvalu					▪ Net importer
Nauru					▪ Net importer

High
Average
Low

FIGURE: OUTLOOK OF A POTENTIAL COLLABORATED H_2 ECONOMY IN THE PICTS BASED ON RESOURCE AVAILABILITY AND PICT PROXIMITY.

End-Use Applications in the region

- Assessment of end-use technologies for hydrogen and derivatives in the Pacific for key metrics.
- **SAF, methanol and renewable diesel emerge as an economically and technically viable opportunity for mobility.**
- Niche opportunities for **ammonia** use as a means of maritime fuel and fertiliser generation exist, however constrained by low TRL and low demand.
- **Hydrogen** could see use in fuel cell power generation systems that can be used to operate critical infrastructure (like remote hospitals, communication networks etc.), that would require a reliable power supply.

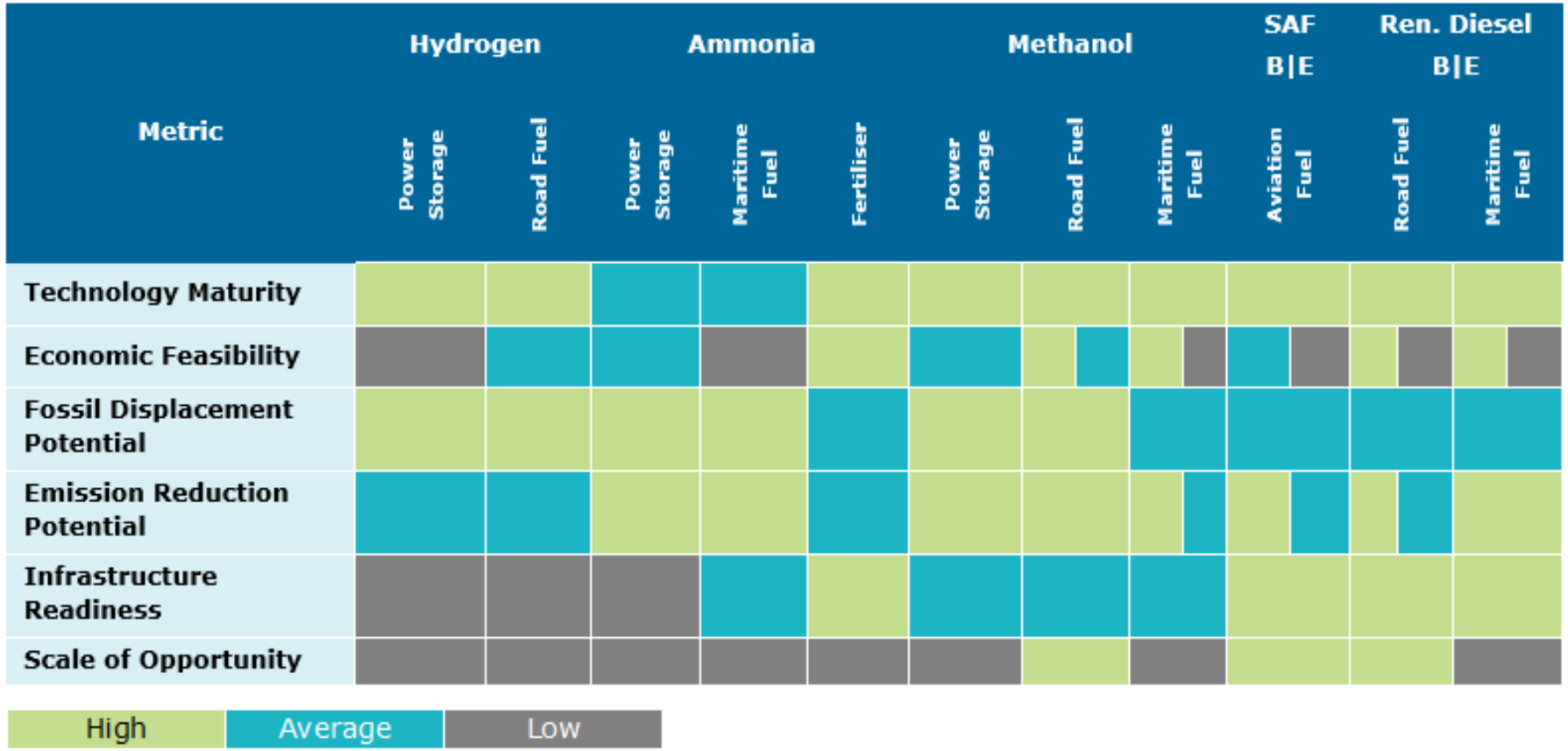


FIGURE: PERFORMANCE MATRIX FOR HYDROGEN AND DERIVATIVES END-USE APPLICATIONS.
NOTE: B = BIOGENIC PATHWAY, E = ELECTROLYTIC PATHWAY.

Identifying Early Markets in the Pacific

- **Renewable Diesel and SAF** offer the best options as drop-in replacements for current infrastructure
- **Methanol** blending potential for transport but would require repurposing and retrofitting of engines/infrastructure.
- Maritime is a key sector: **Renewable diesel** can be used domestically, option to scale up **methanol and ammonia** for bunkering fuels over time with development of regional green corridors.
- **Hydrogen and methanol** for seasonal power storage and in off grid sites, potential for heavy duty transport and specialised equipment.

- **Key takeaway message:** e-fuels (hydrogen, ammonia, e-saf and e-methanol) are likely to play a complementary role, with direct electrification and biofuels (SAF, methanol, and renewable diesel) doing the heavy lifting. Maritime and aviation are likely to be the key market and long-term market.

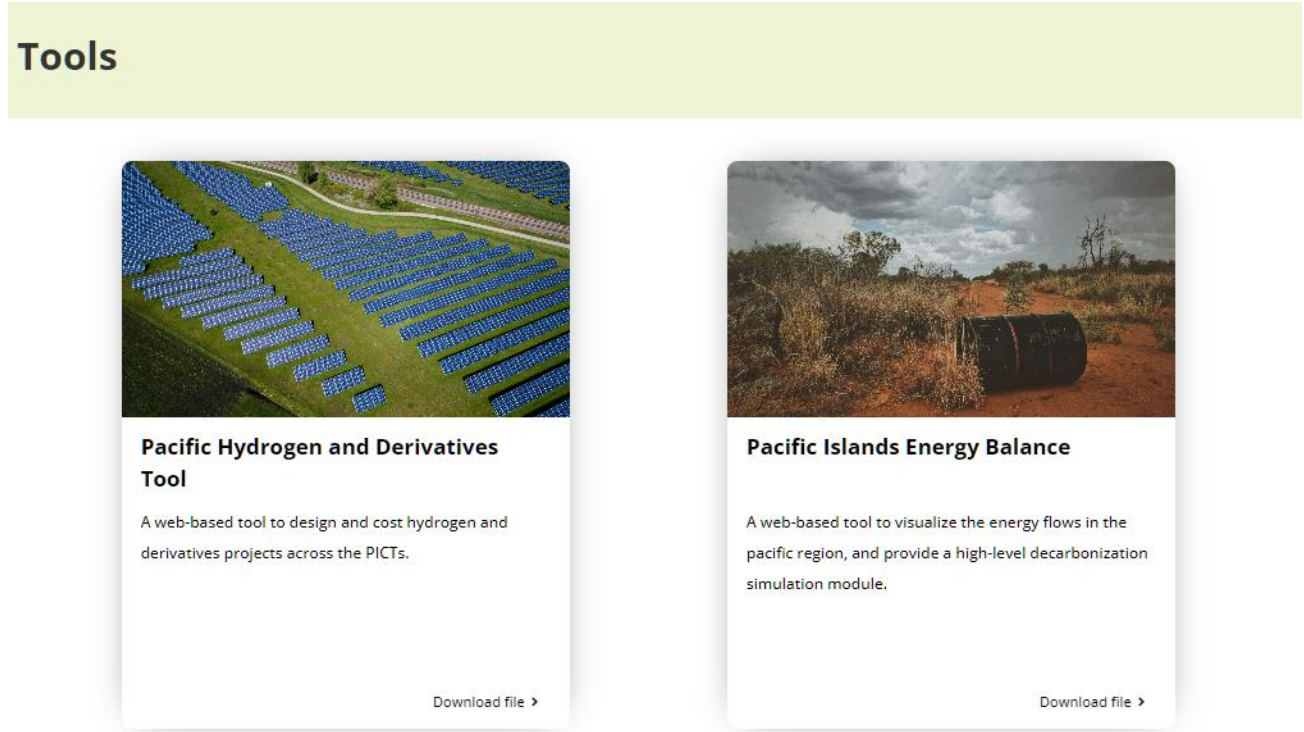
Challenges – Next Steps for mapping a hydrogen roadmap for the region

- **General Understanding of H_2 and Derivatives:** Our reports, masterclasses, and tools are designed to help regional understanding and capacity building.
- **Realistic Target setting, Feedstock Availability, and Allocation**: A need to understand and promote that H_2 and derivatives are not the only solution and will compete with other options for both feedstock (water, renewables and biomass), economics (capital investment) and land.
- **Economics:** All these processes are capital intensive – e.g., a 1 MW electrolyser (500 kg a day of H_2) would cost between USD 500k to 1.8 million. In addition, the turnaround times of these facilities (ammonia, methanol and biofuels) at scale are 3 to 4 years so that's capital locked in for a significant time.
- **Infrastructure Readiness:** Biofuels have a significant opportunity to be used in as drop in replacement fuels – but why has there been little progress across the Pacific to implement these. Is it a production and distribution problem or an end use problem (social acceptance ?).
- **Risks:** Technical risks in terms of safety and compliance. SAF and RD are synthetic replacements and can leverage existing understanding and capabilities. Hydrogen, ammonia and methanol on the other hand will require infrastructural changes and new skills in the region.

Contacts and Resources

All available resources are currently on the project website:

- Reports A, B, C
- Hydrogen Strategy Draft
- Online Open-Source Costing Tools
- Online Knowledge Hub and lectures
- Events in the Pacific
- Online masterclasses
- In-person workshops



You can use the contact information available to contact us if required

Link to Website:
http://pacifich2strategy.com/