United Nations Asia Pacific Forum for Sustainable Development ESCAP Expert Working Group: Hydrogen Opportunity in Asia Pacific

Presented by David Cavanagh Integrated Energy
March 2023

Agenda and Objectives: Show how renewable energy and hydrogen can offer Asia Pacific sustainable economic solution

- Agenda:
- 1035 Introduction to Integrated Energy and our perspective on learning from Australia for Asia Pacific
  - Hydrogen Overview - video 5 min
  - Standards and Safety
- Economic Applications & Case studies
- Capability building eg Hydrogen Awareness, Zero Emission Transport (EV/H2), Smart Operations
- Hydrogen Standards Development
- Green Hydrogen wind solar production and distribution chain with road transport eg Hydrogen West
- Green Hydrogen solar production and distribution with road transport eg Hume Highway, Bluewater
- Decarbonisation Roadmap and Business Case for Resource Company eg Mount Gibson Mining
- Reflections from a recent journey through SE Asia
- 1100 Q and A – How can hydrogen support the energy transition?
- What are the principal tradeoffs to be mitigated?

  Which technologies are bridging technologies vs long term solutions?

  How can green hydrogen be adopted as an energy medium in synergy with these technologies?

- Key message:
  - Hydrogen with renewable energy offers a safe, sustainable, economic solution for Asia Pacific today
  - We are here to help you on this journey

Welcome

Education

- M.B.B.S. (Medicine), University of Western Australia (1984)
- B.Eng (Mechanical), University of Western Australia (1985-1990)

Memberships

- Engineers Australia: Member (Eng Exec Nominee), Hydrogen Society of Australia: Corporate Member
- Working Committee Member, Standards Australia ME-093 Hydrogen Technologies (Hydrogen Mobility) and ISO TC 197/WG 24
- Chairman, Connecting Green Hydrogen Asia Pacific International Conference
- Australian Attendee UN COP27
- UN selected Expert for UN ESCAP

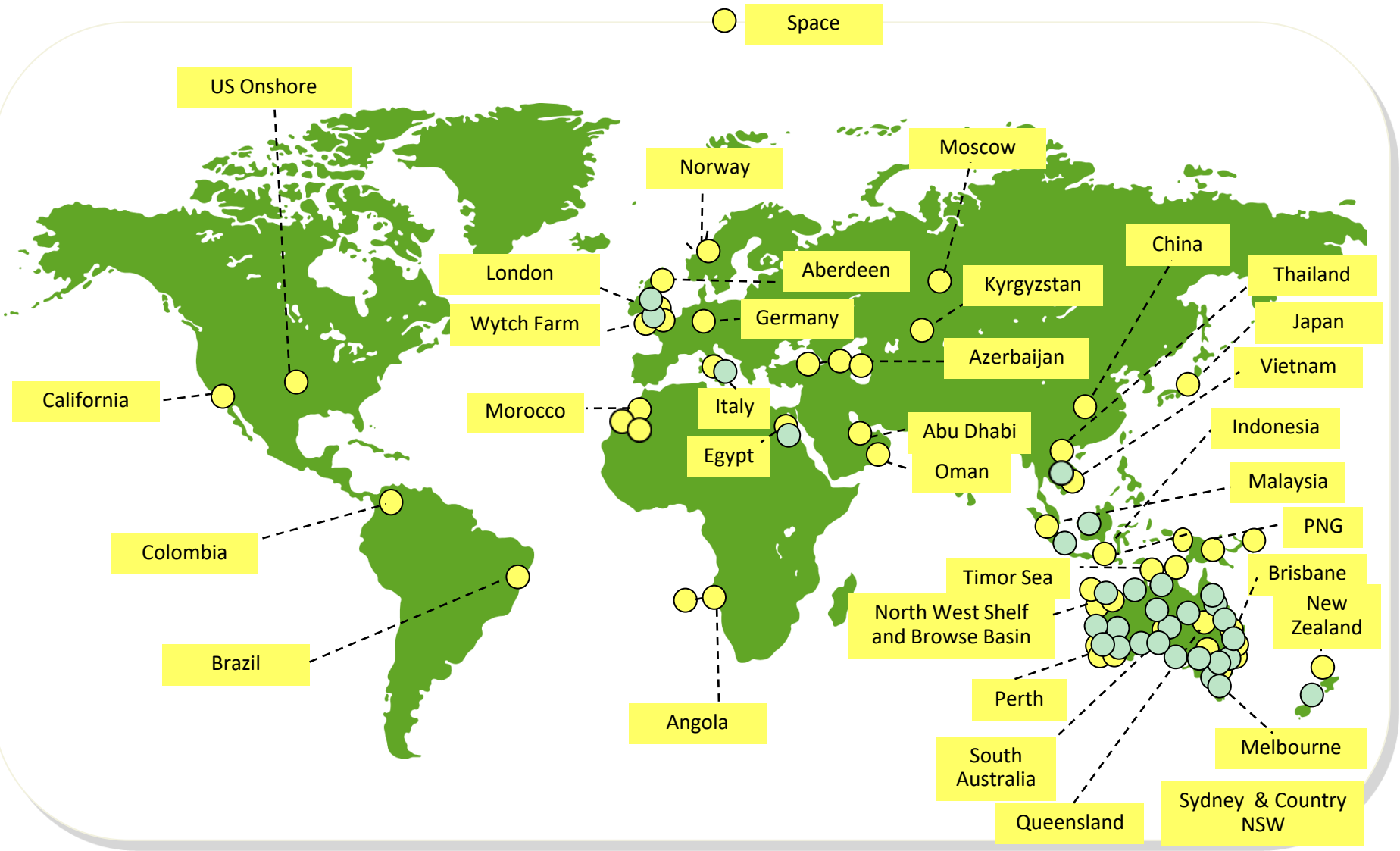
David Cavanagh is Chief Hydrogen Officer of Hydrogen West and Hydrogen East, and founder and owner of Integrated Energy. Integrated Energy is a renewables, resources and energy consulting group with experience in twenty countries around the world.

David is a recognised expert in hydrogen, as an author of Australian standards for Hydrogen Mobility on land, air and sea, and represents Australia on International Hydrogen Standards Committee ISO 197/WG 24.

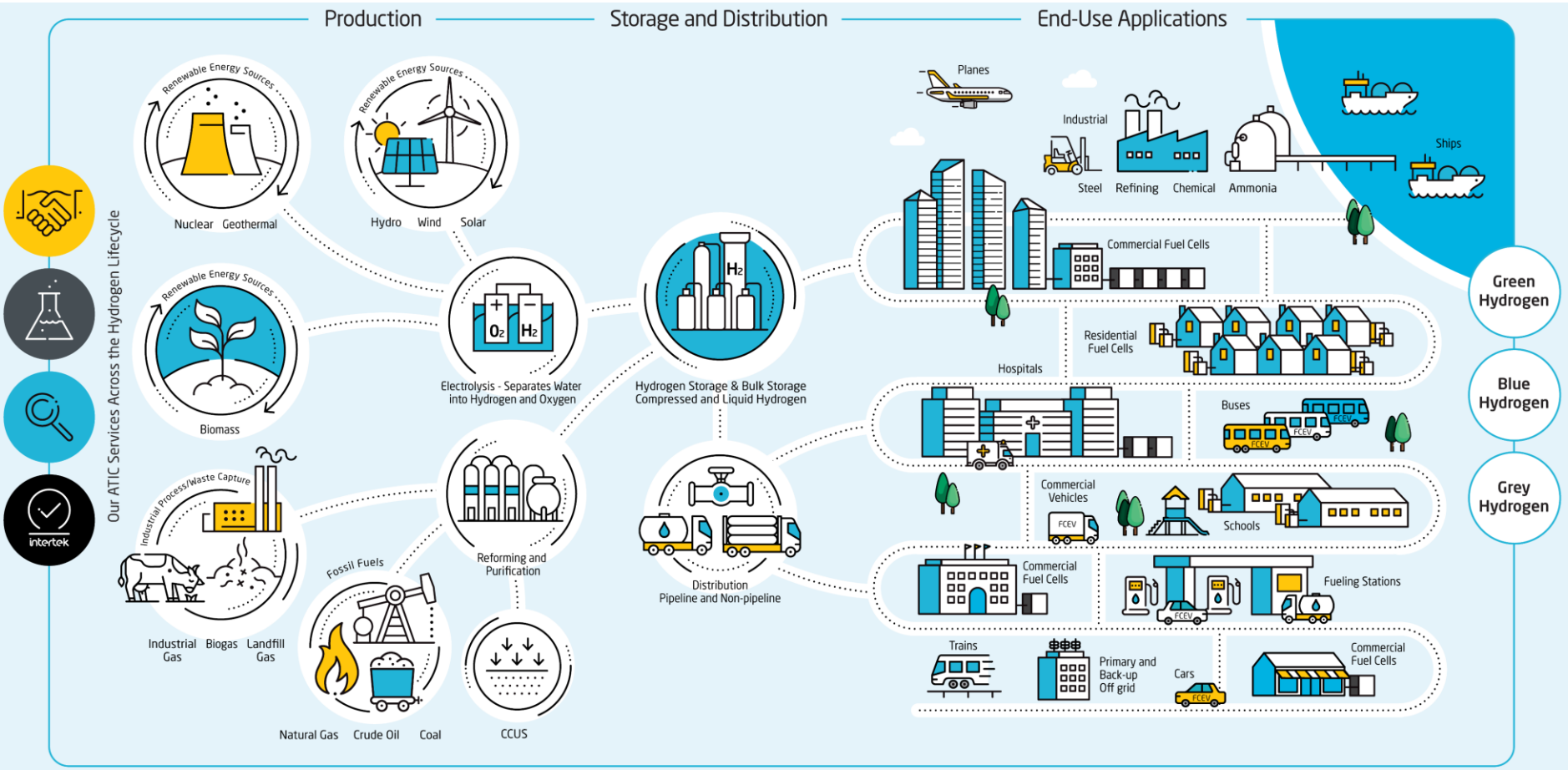
His company is currently supporting green hydrogen projects in all Australian states with value exceeding thirty billion dollars, a preferred supplier to government, and also active in UK and New Zealand.

He is also known for his record in integrated operations and digital transformation across the full resource value stream which has identified tens of billions of dollars of value for clients around the world, COVID support at state and national level, and supported the Australian presence at United Nations Climate Change Conference COP27 in 2022. He was selected by the United Nations to contribute as an Expert on the Green Hydrogen Opportunity for SE Asia to the UN ESCAP on SDG7 in Bangkok in March 2023.

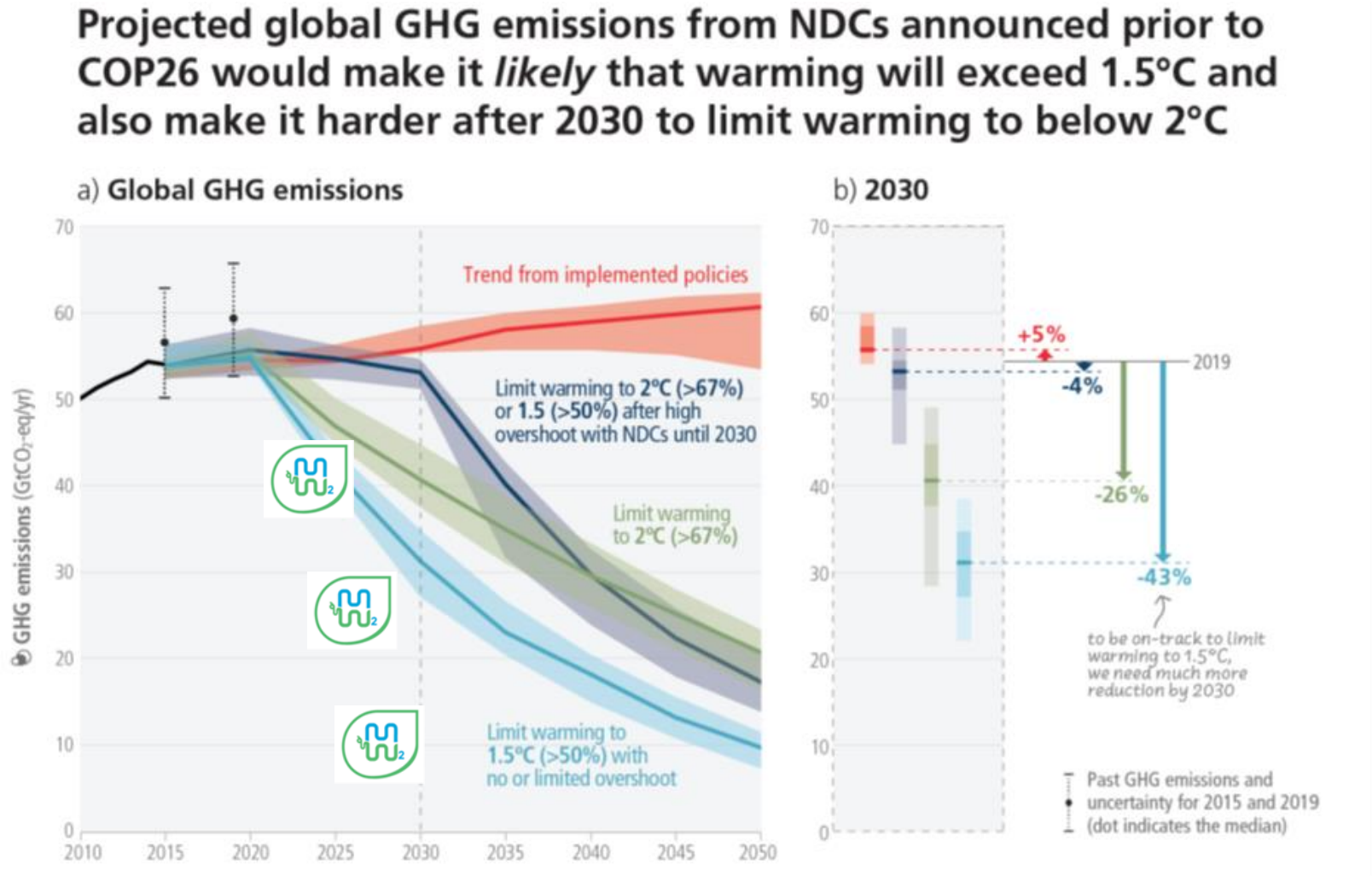
Projects in many countries, mainly renewable & green hydrogen



Illustrative Hydrogen Ecosystem



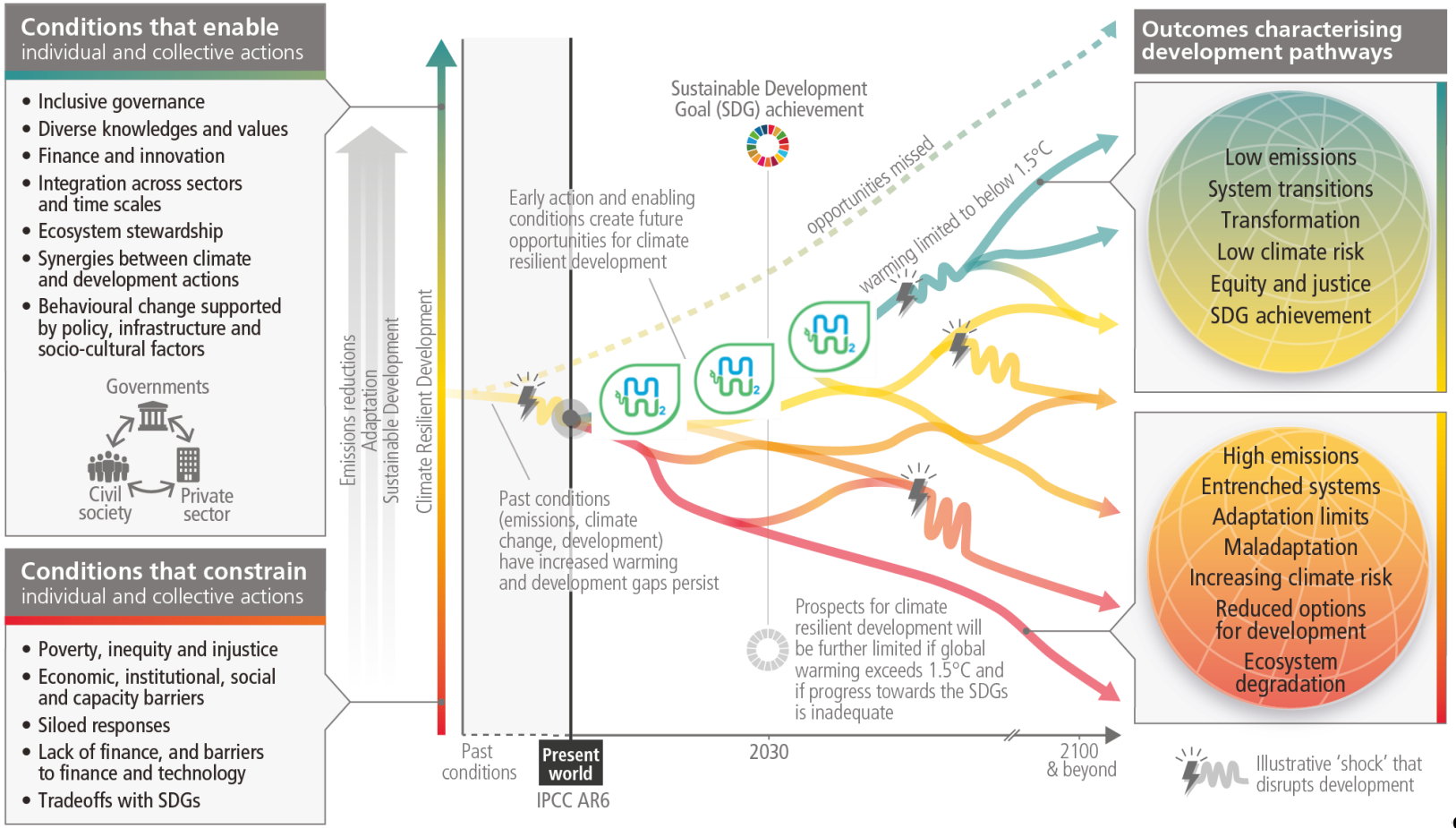
Renewable energy and hydrogen offer an economic pathway to near zero emissions by 2030 in a range of impactful applications: Power, transport, industry



The Role of Hydrogen and Renewables in enabling climate resilient development: early economic opportunity for zero emission by 2030

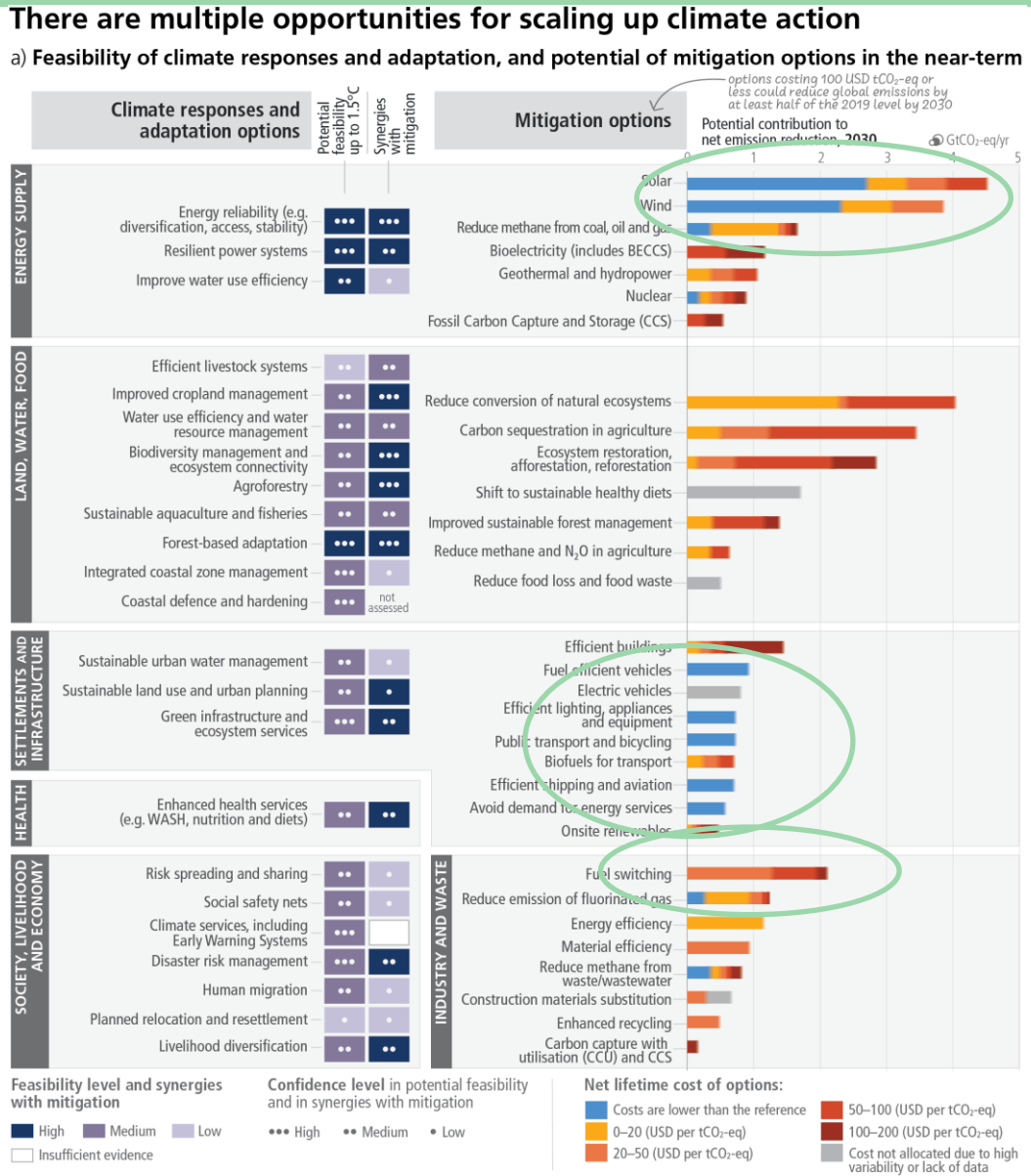
There is a rapidly narrowing window of opportunity to enable climate resilient development

Multiple interacting choices and actions can shift development pathways towards sustainability

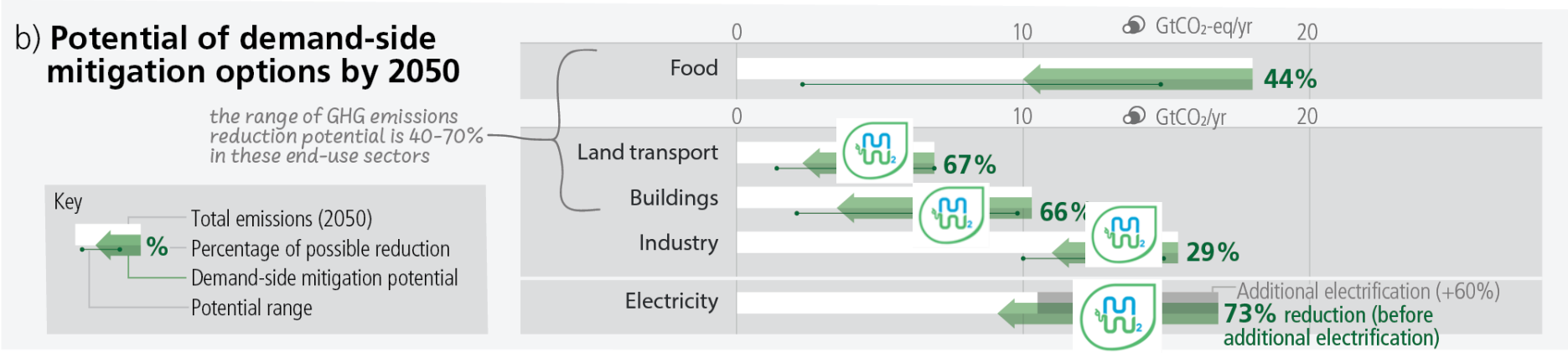


grated Energy

The Role of Hydrogen and Renewables in enabling climate resilient development: Energy, Infrastructure and Livelihood



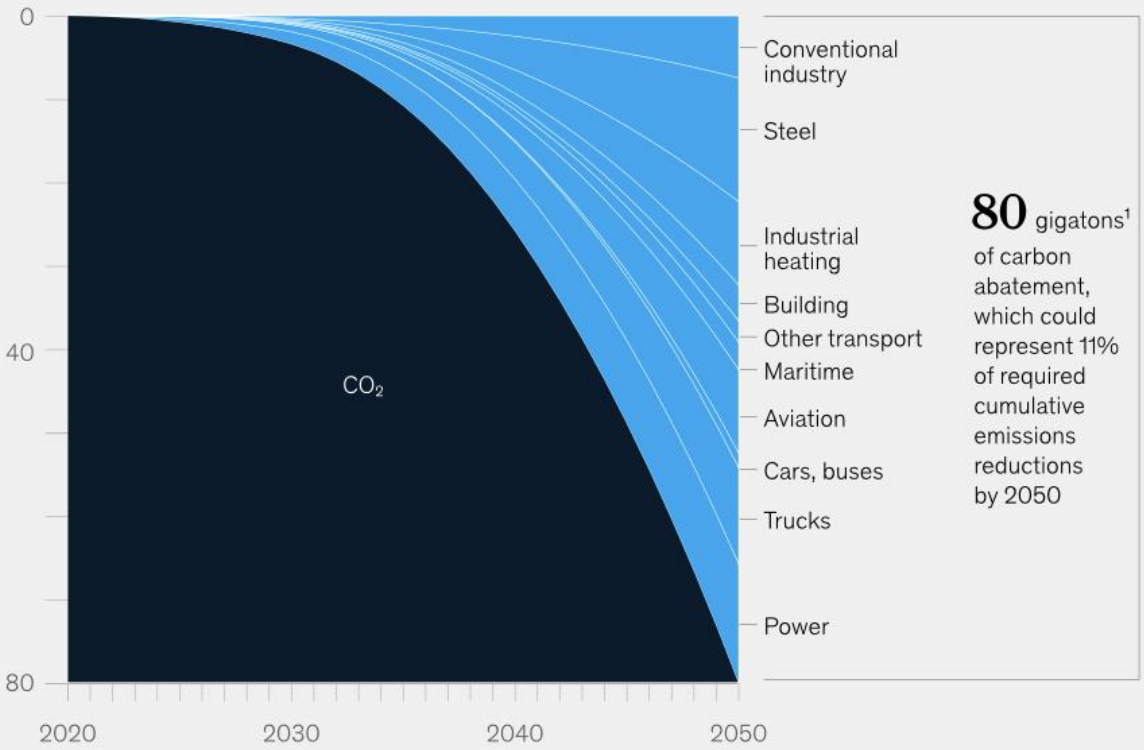
Hydrogen Enables Large Reductions in Emissions due to Land Transport, Buildings, Industry and Electricity



Hydrogen Plays a key role in Decarbonisation

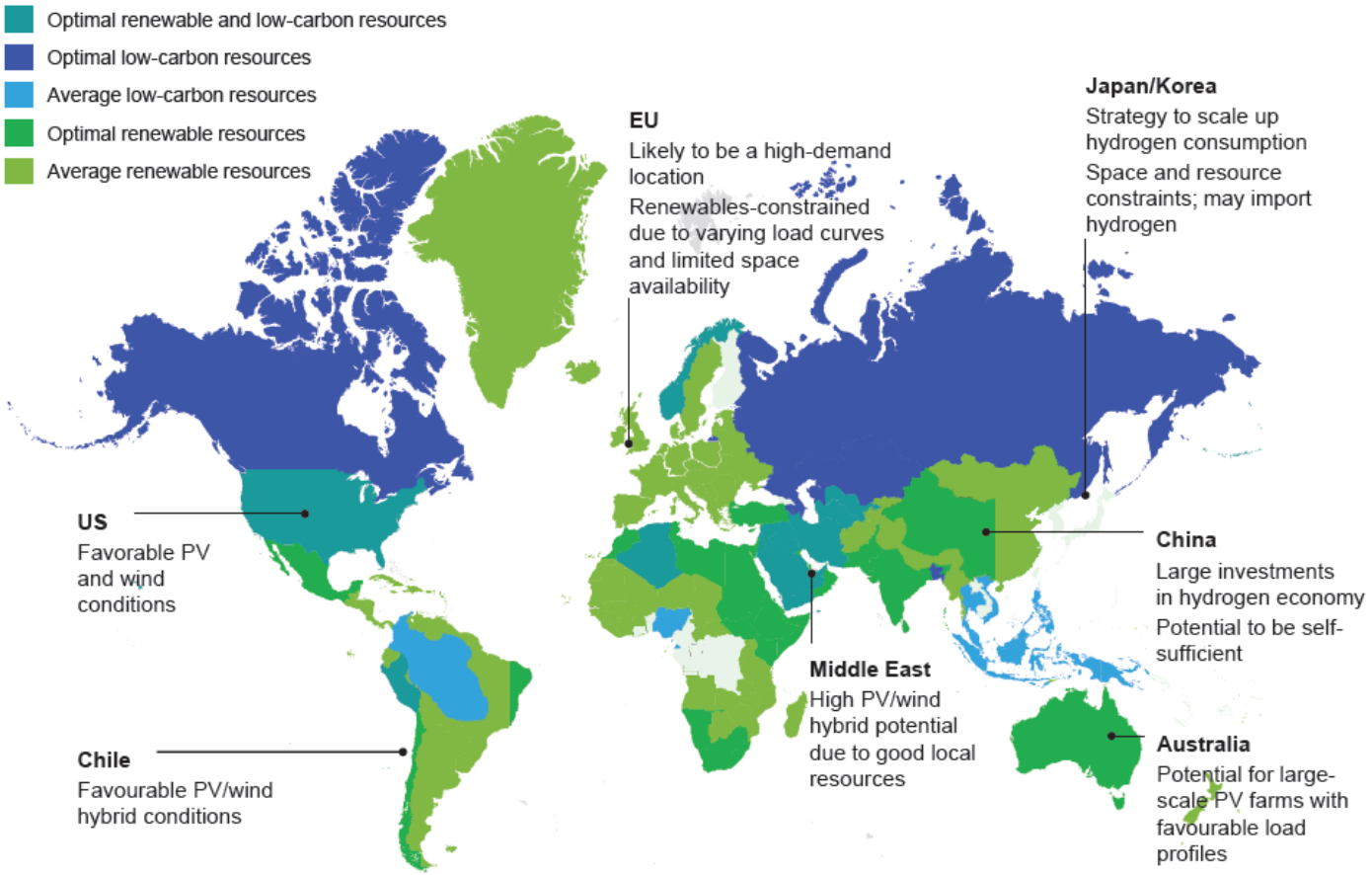
Clean hydrogen can contribute as much as 80 gigatons of CO_2 abatement by 2050, with most coming from industrial uses and transport.

CO_2 abated from hydrogen end use, gigatons of CO_2 (cumulative reduction)



[1]The 80 gigatons (Gt) cumulative CO_2 abatement potential through 2050 constitutes approximately 11% of the emissions reductions required to stay within the carbon budget of 420 Gt needed to limit global warming to 1.5–1.8°C.
Source: Hydrogen Council Decarbonization Pathways; McKinsey Hydrogen Insights

Australia globally advantaged for solar / hydrogen

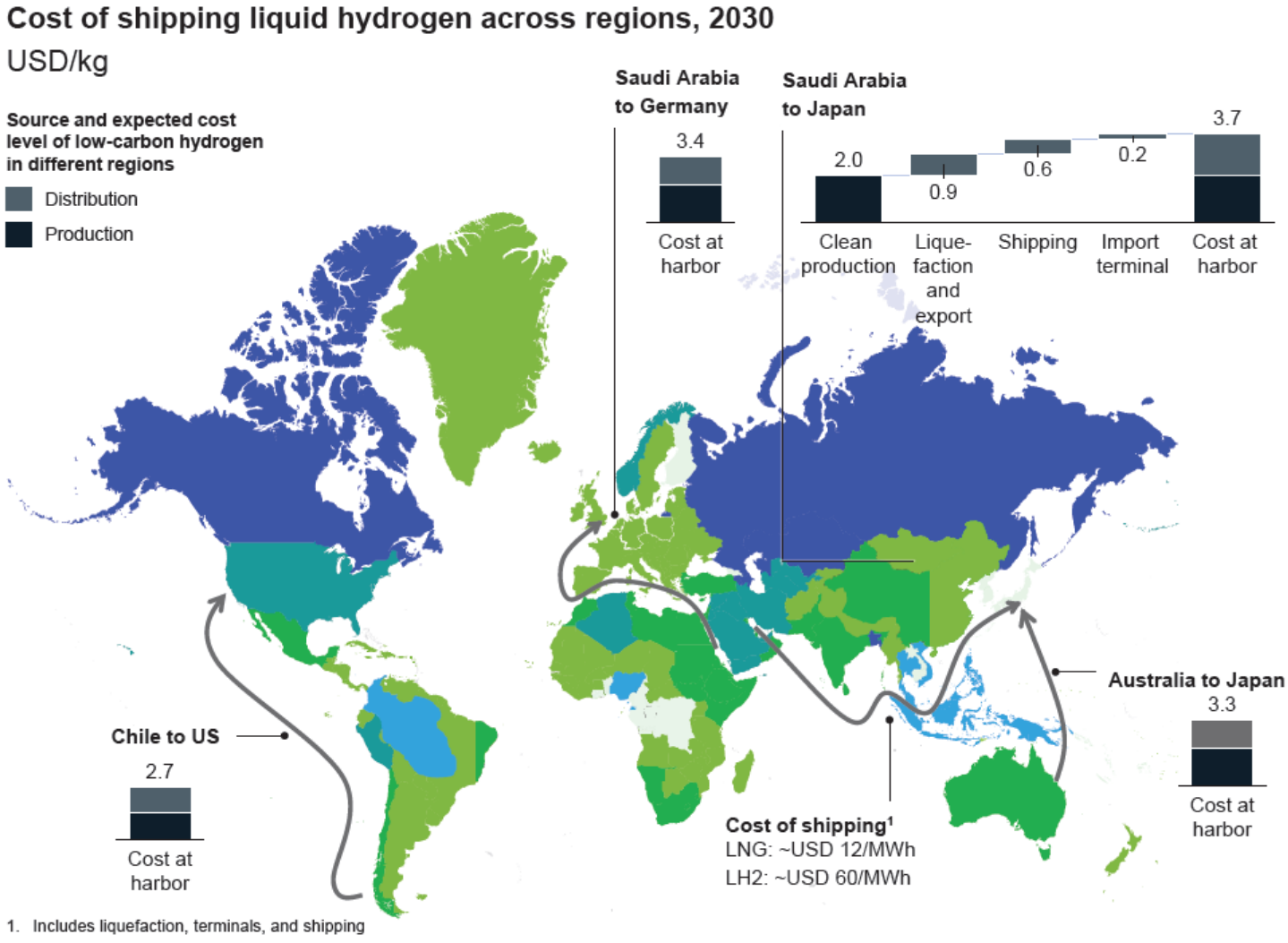


SOURCE: IEA; McKinsey

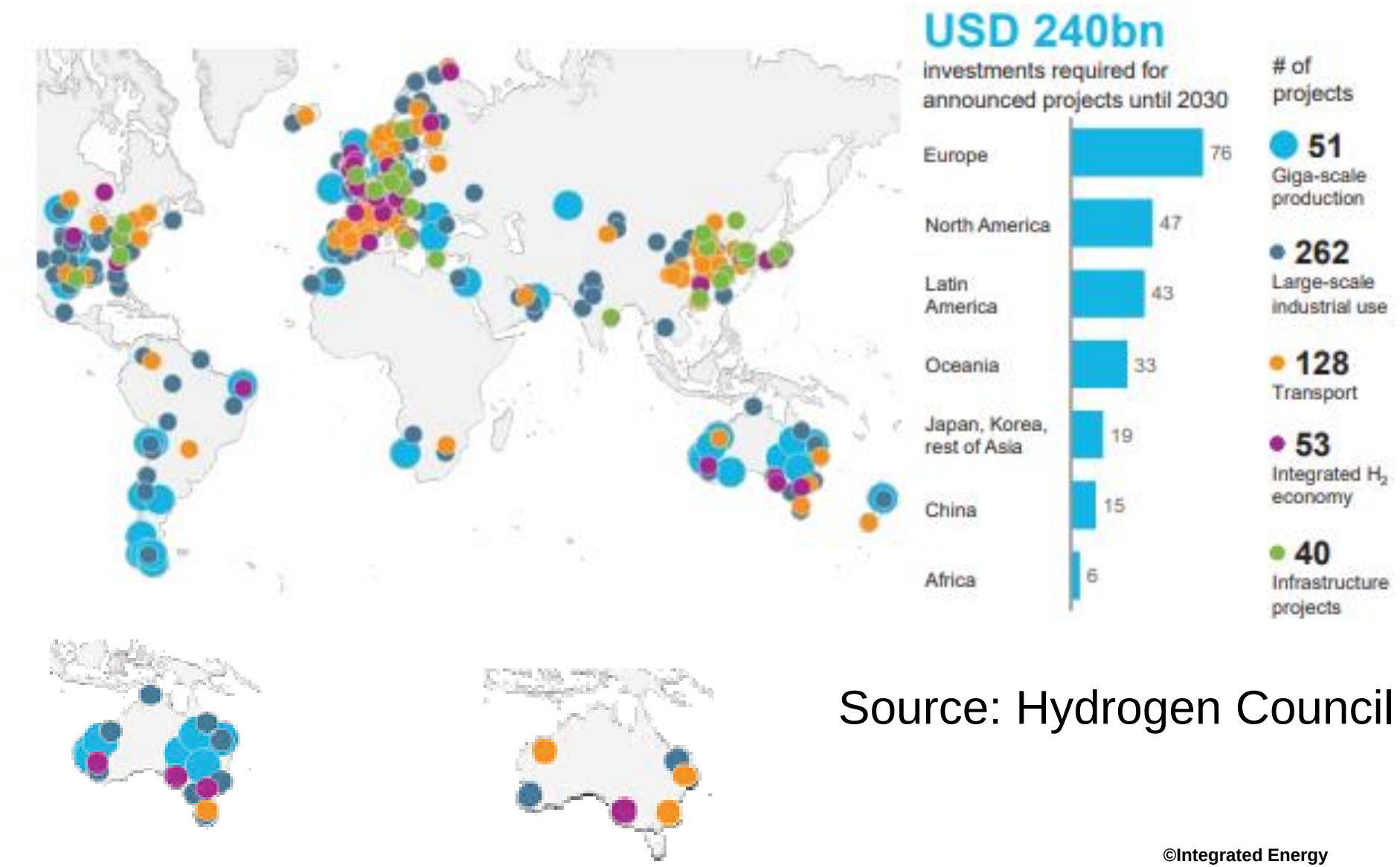
Demand centres, e.g. EU, North-east Asia, are often constrained for resources, and may not be able to self-supply hydrogen.

Countries with complementary load profiles of wind and PV can produce renewable hydrogen at very low prices.

Indicative costs of hydrogen production and shipping show the opportunity for export to Korea

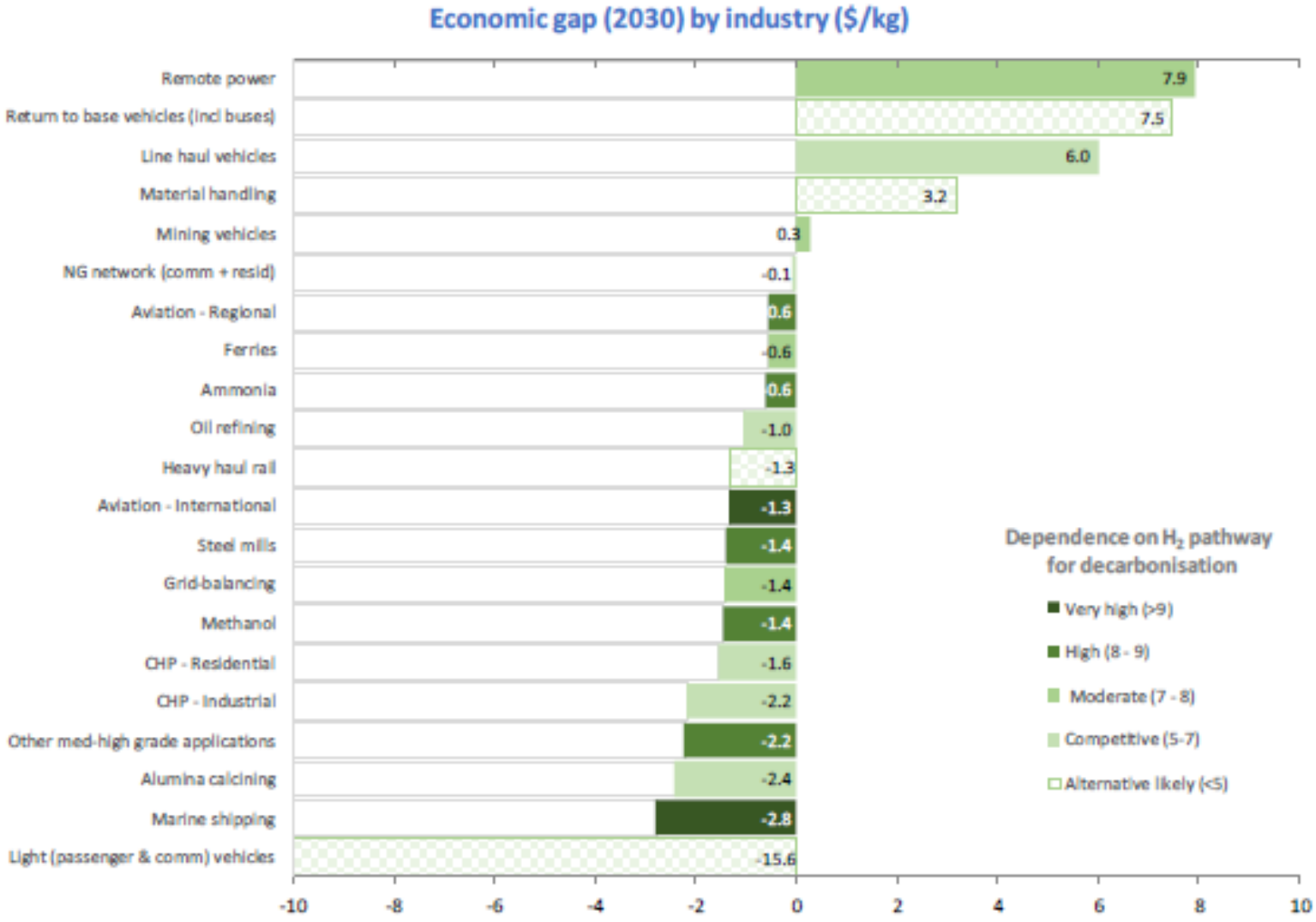


AUSTRALIAN PROJECTS PROMINENT ON WORLD SCALE : eg FFI, Intercontinental, IGE Arrowsmith (292 t/day), with 71 Projects, 25 in WA and 27 in Qld (15 export)

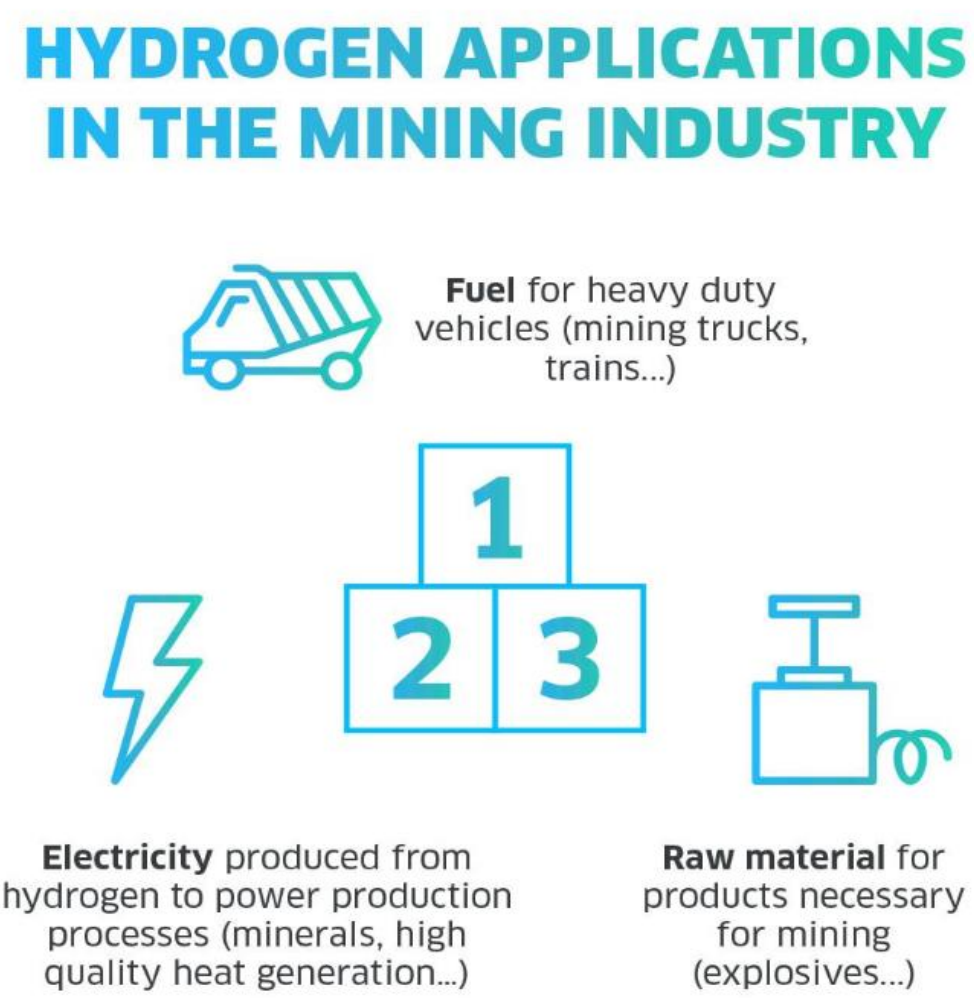


Source: Hydrogen Council

AUSTRALIAN MARKET ECONOMICS: TRANSPORT AND REMOTE POWER ECONOMIC TODAY



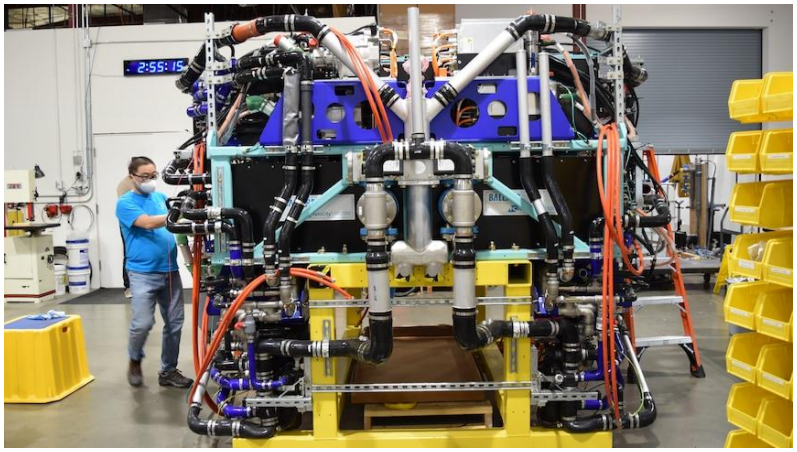
Hydrogen Applications in the Mining Industry



Hydrogen-powered haul truck

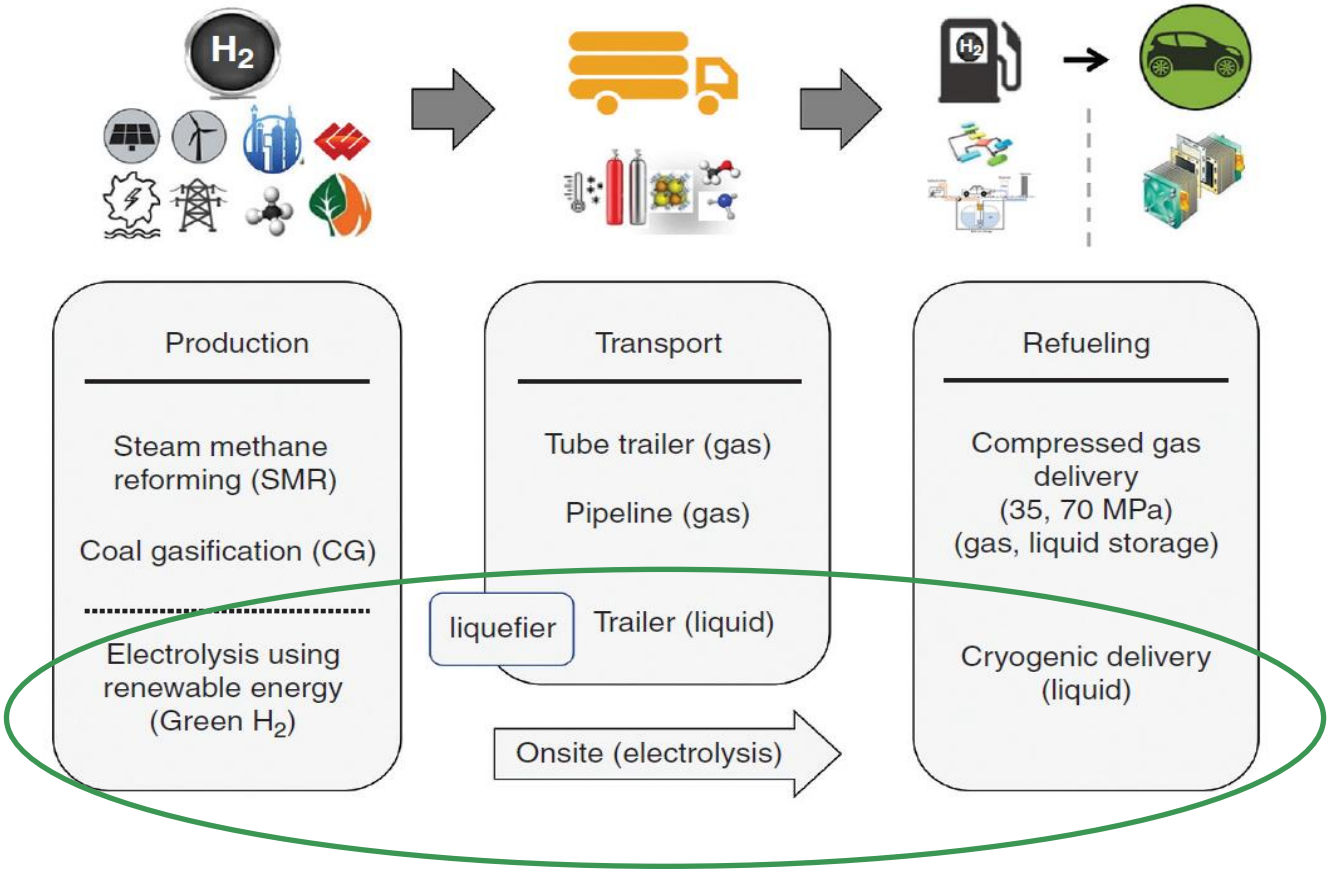
ANGLO AMERICAN AND AURIZON LOOK TO HYDROGEN-POWERED TRAINS IN QUEENSLAND

- Aurizon is Australia's largest rail freight company, with the decarbonisation of its supply chains at the centre of its target to reach net zero operational emissions by 2050. Aurizon has also commenced research & development for battery-powered trains with a number of industry parties and Australian universities.
- "Zero-carbon hydrogen-powered trains would also significantly boost the current environmental benefits of transporting more of Australia's bulk freight on rail. Rail freight already produces up to 16 times less carbon pollution per tonne kilometer than road.



Hydrogen Trucks

Overview of H2 supply chain for FCEV



OUR PROJECTS: Roadhouses New and Repurposed

Integrated Energy has designed for Hydrogen West and Hydrogen East a strategically located network of zero emission stations that will provide a harmonious solution for hydrocarbon free transportation fuels and hydrogen dispensers to co-exist together, side by side, under the canopy of service stations.

Hydrogen East

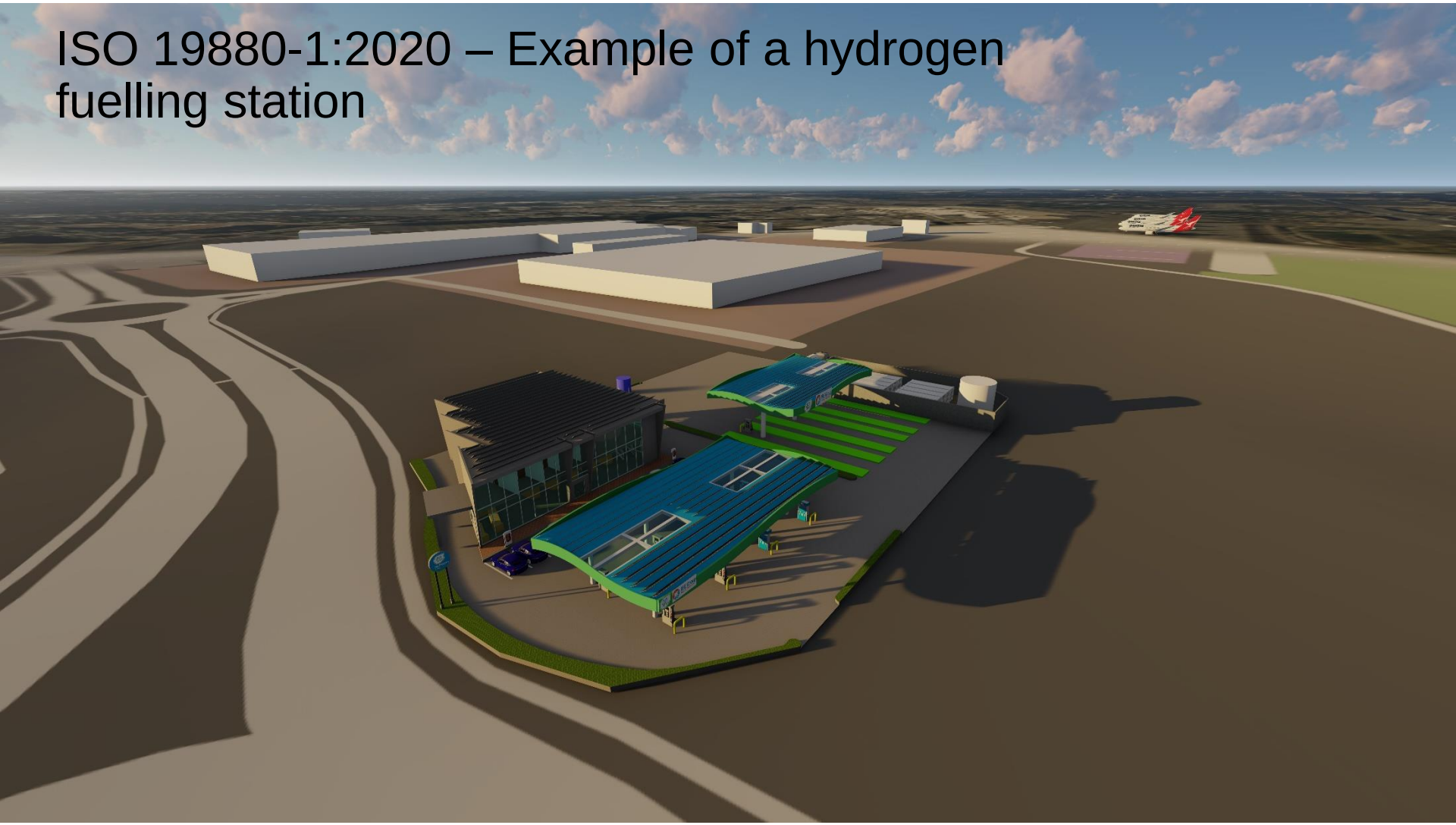
Hydrogen West

OUR PROJECTS: Perth Airport Greenfield Development

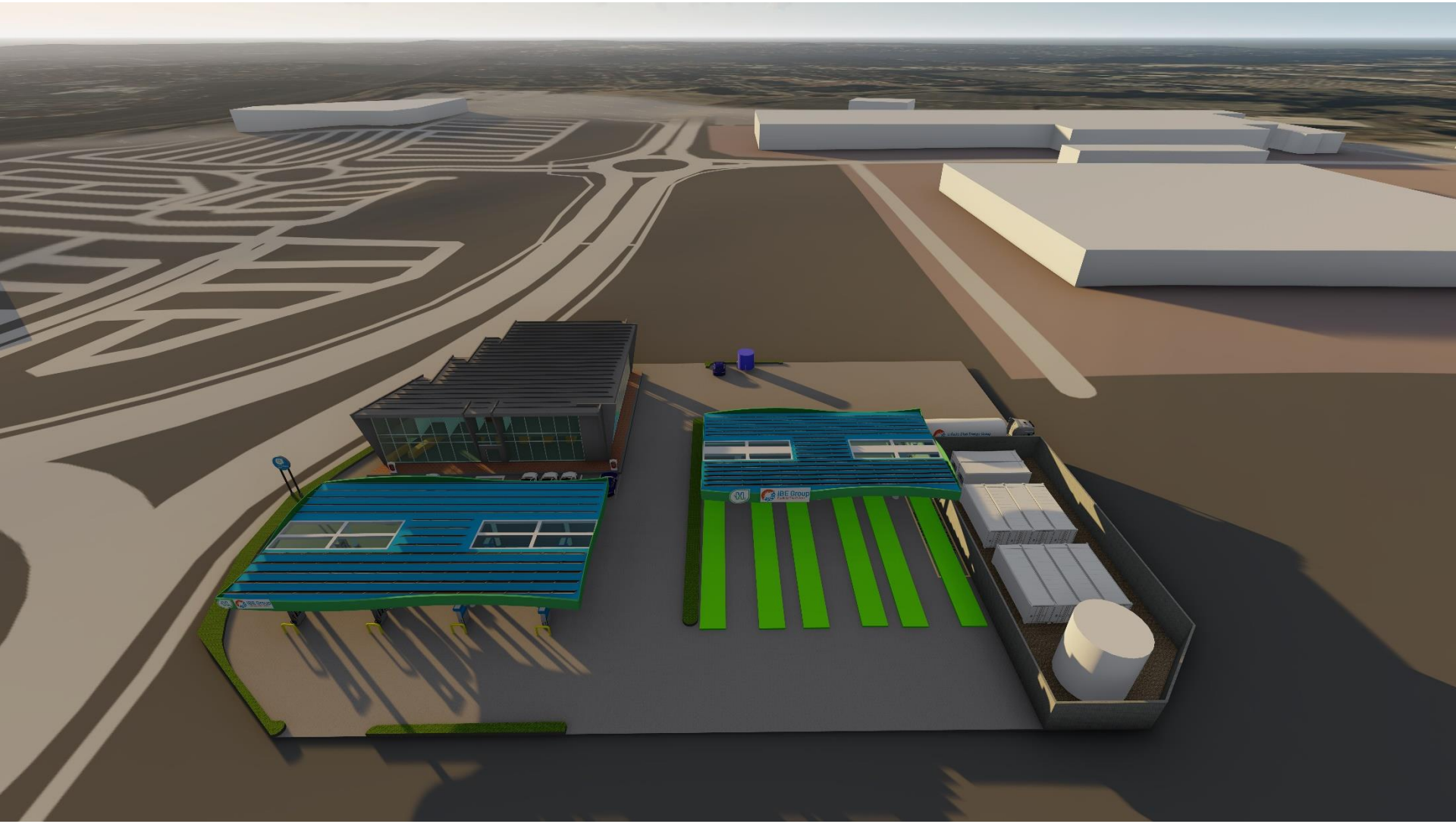
This planned development on an 5600m2 site at Perth Airport is the most strategic location for a hydrogen refuelling station in WA. It includes a site capacity of 6000 kg/day of hydrogen in liquid form. It will be develop in stages in keeping with hydrogen supply, including drive-through convenience services while having a 10-year hydrogen market exclusivity in the area.

Airport: Easy access with high traffic

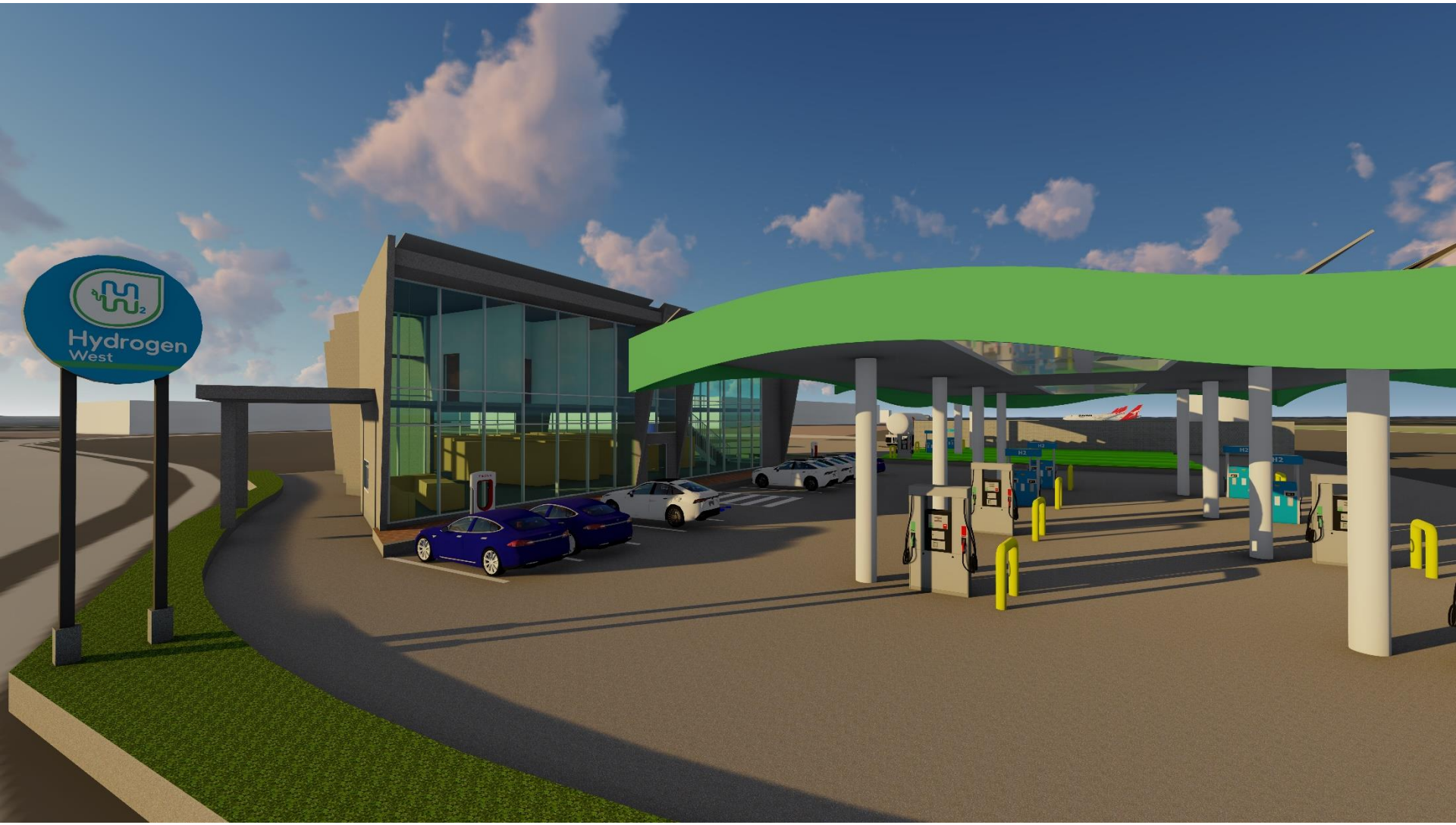
ISO 19880-1:2020 – Example of a hydrogen fuelling station



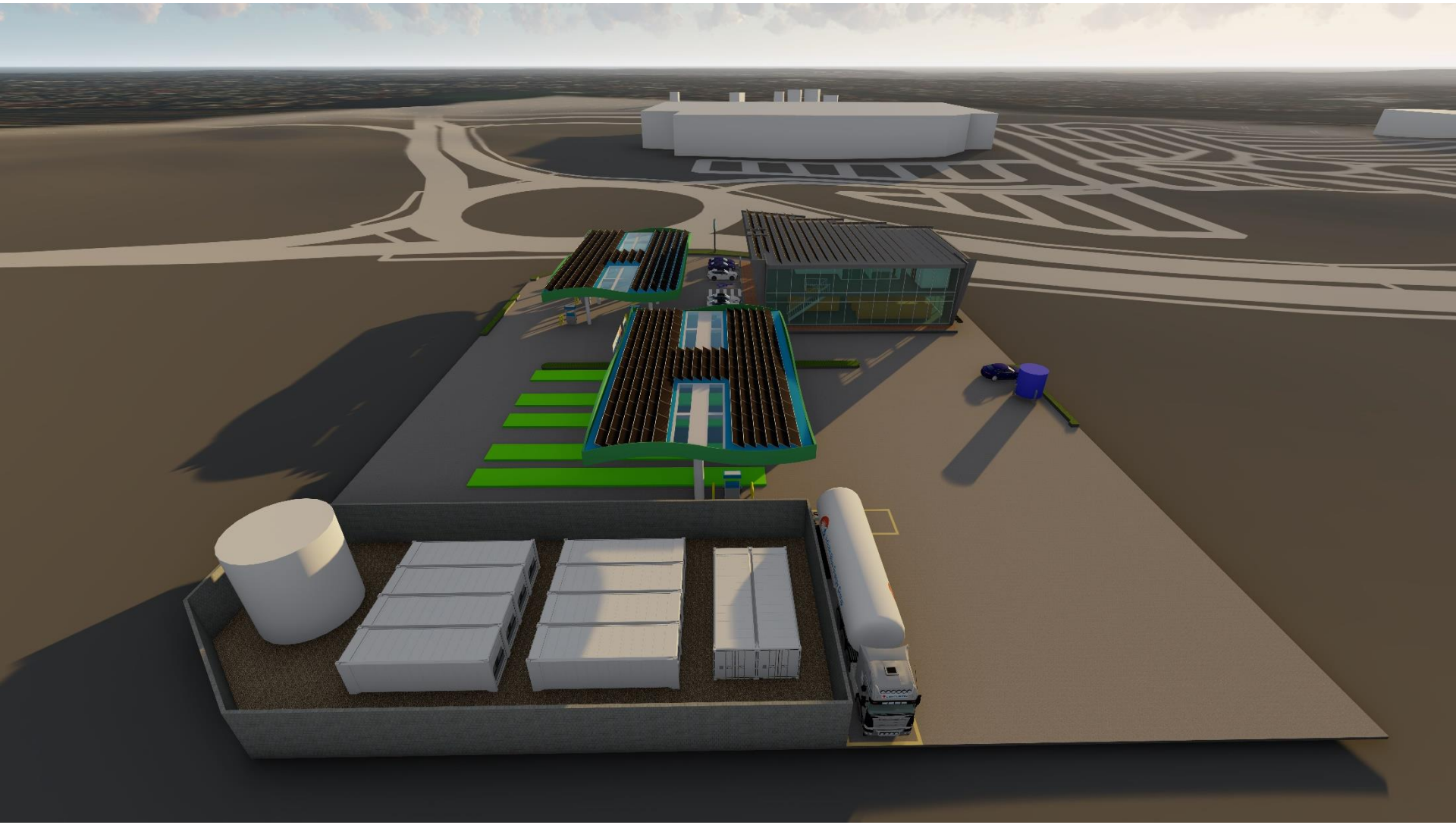
Perth Airport Site Design



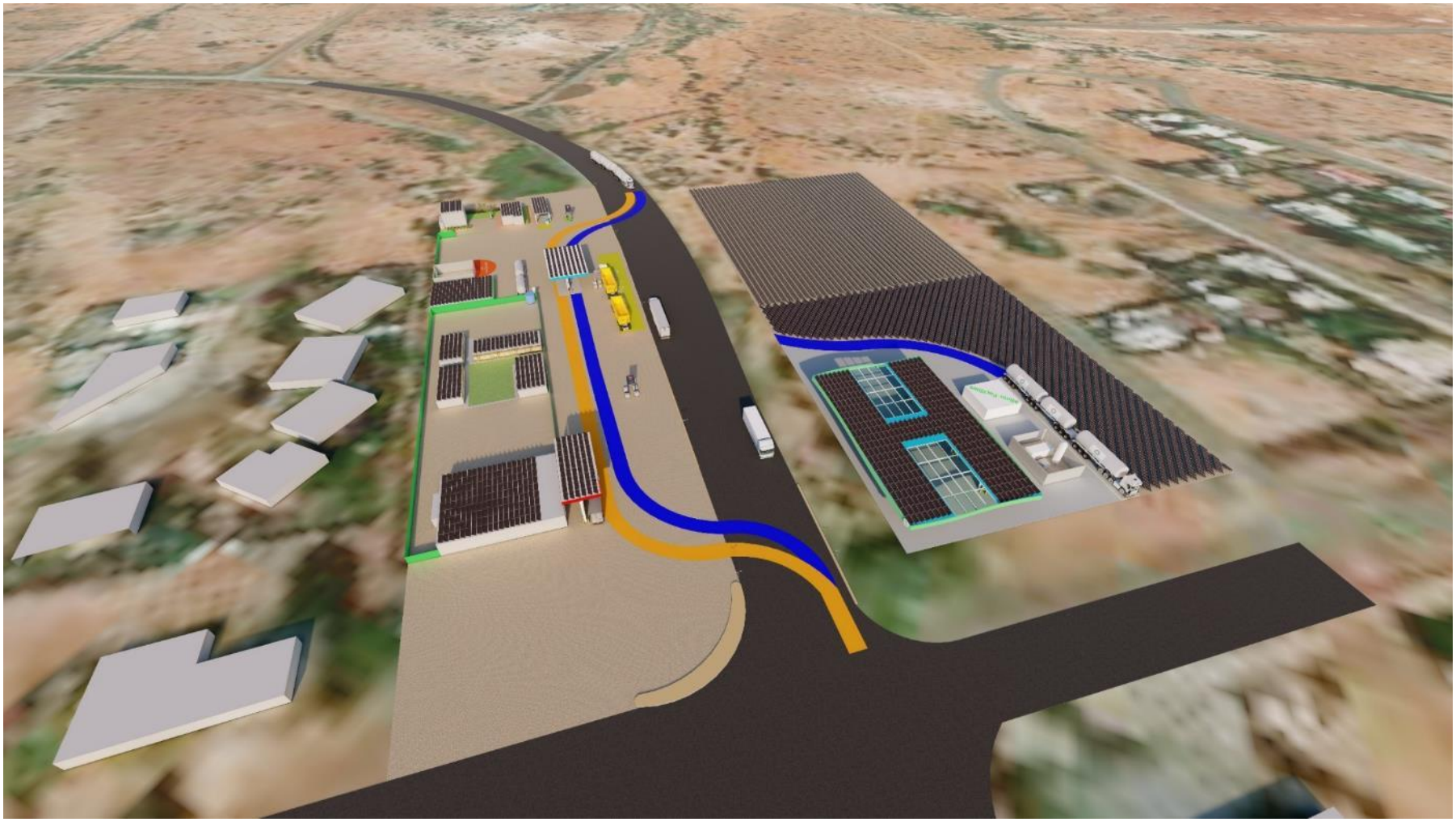
Airport: green hydrogen and ev charging



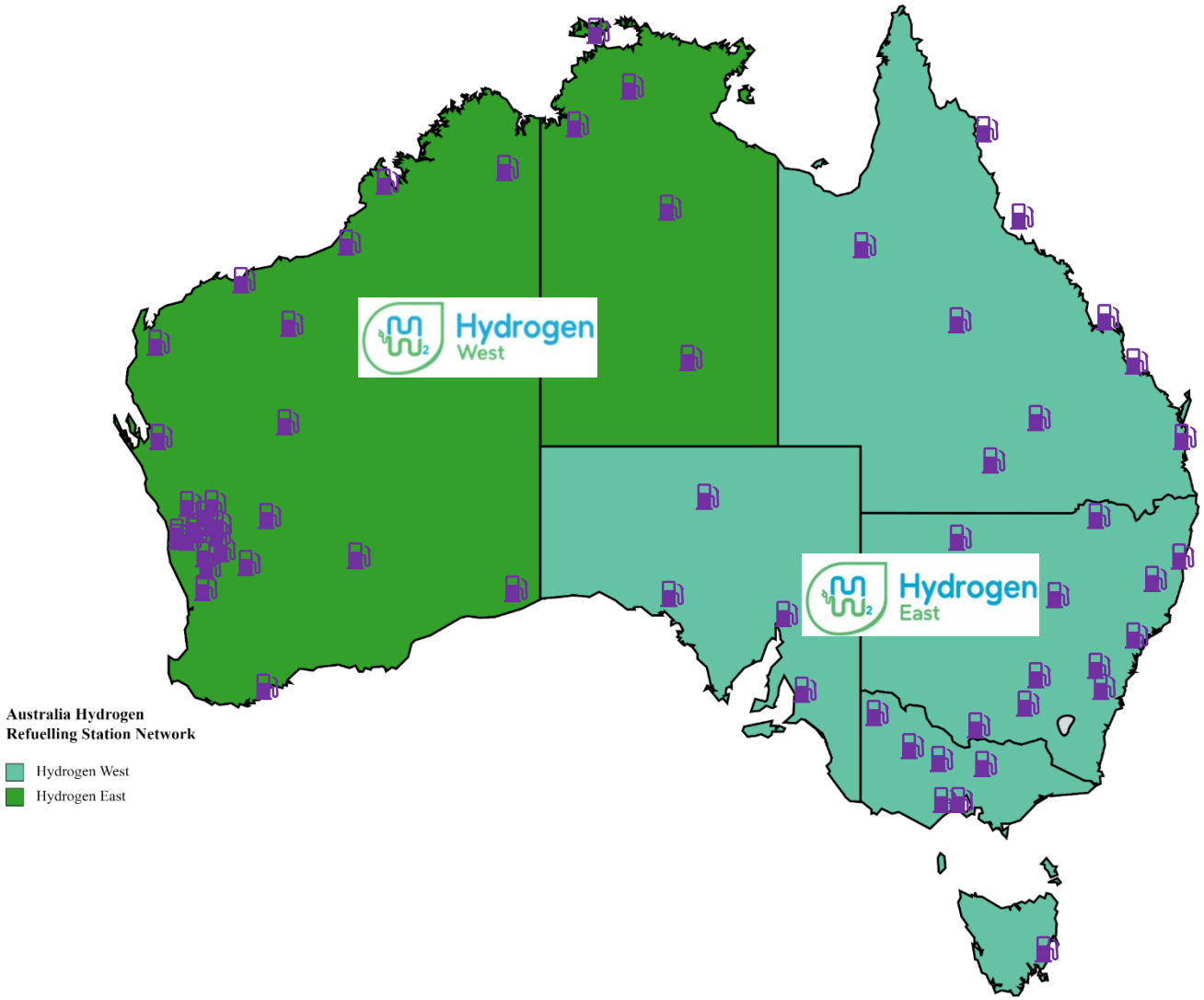
In strategic proximity to key customers



Cue Roadhouse – 2,300 kg/day



A national Hydrogen Station Network for Australia : Hydrogen West and Hydrogen East



Hydrogen East Network : Agreements for many tonnes per day liquid hydrogen being progressed

International Standards Work Program

- TC 197 WG24 focus on mobility use and application
- Ulm Face to Face meeting September 2022
- 60 global representatives esp USA Korea Japan Germany plus UK
- Research Labs and Hydrogen Vehicle Manufacturers and Hydrogen Suppliers and Ecosystem
- Australian representation by David Cavanagh Integrated Energy representing Australian Standards
- Progress on Refuelling Protocols 19885 Approval and next gen requirements fast safe refuelling
- Decades of experience and learning, and $ billions of R&D and commercialisation

Chamber of Minerals and Energy. Resource Industry Training Council, Hydrogen Awareness Course

Diverse and engaged participants, major resource companies, education providers, high school advisors… two delivered so far
Oversubscribed with two additional courses booked already…

United Nations COP27 Sharm El Sheikh, Egypt

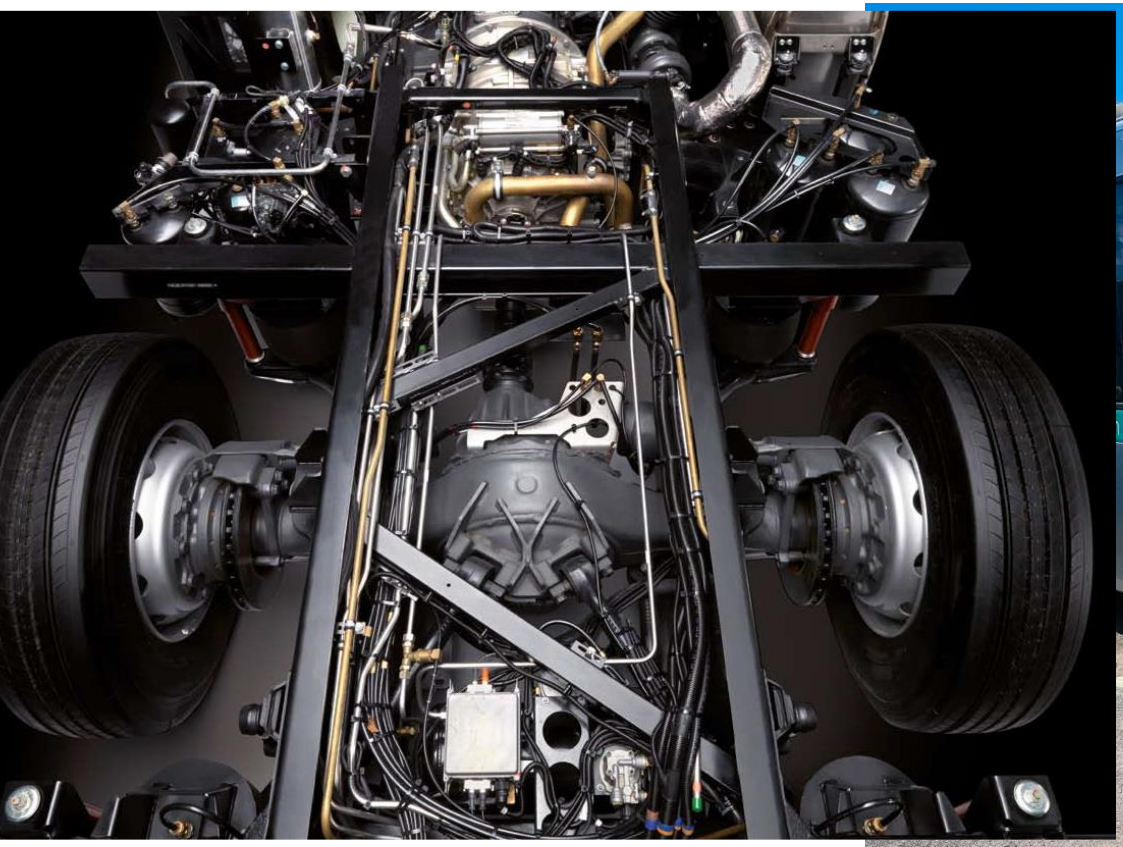
Green hydrogen forms an important part of a sustainable global energy and transportation solution…

Learning from COP 27 – 40,000 people at Sharm El Sheikh Egypt

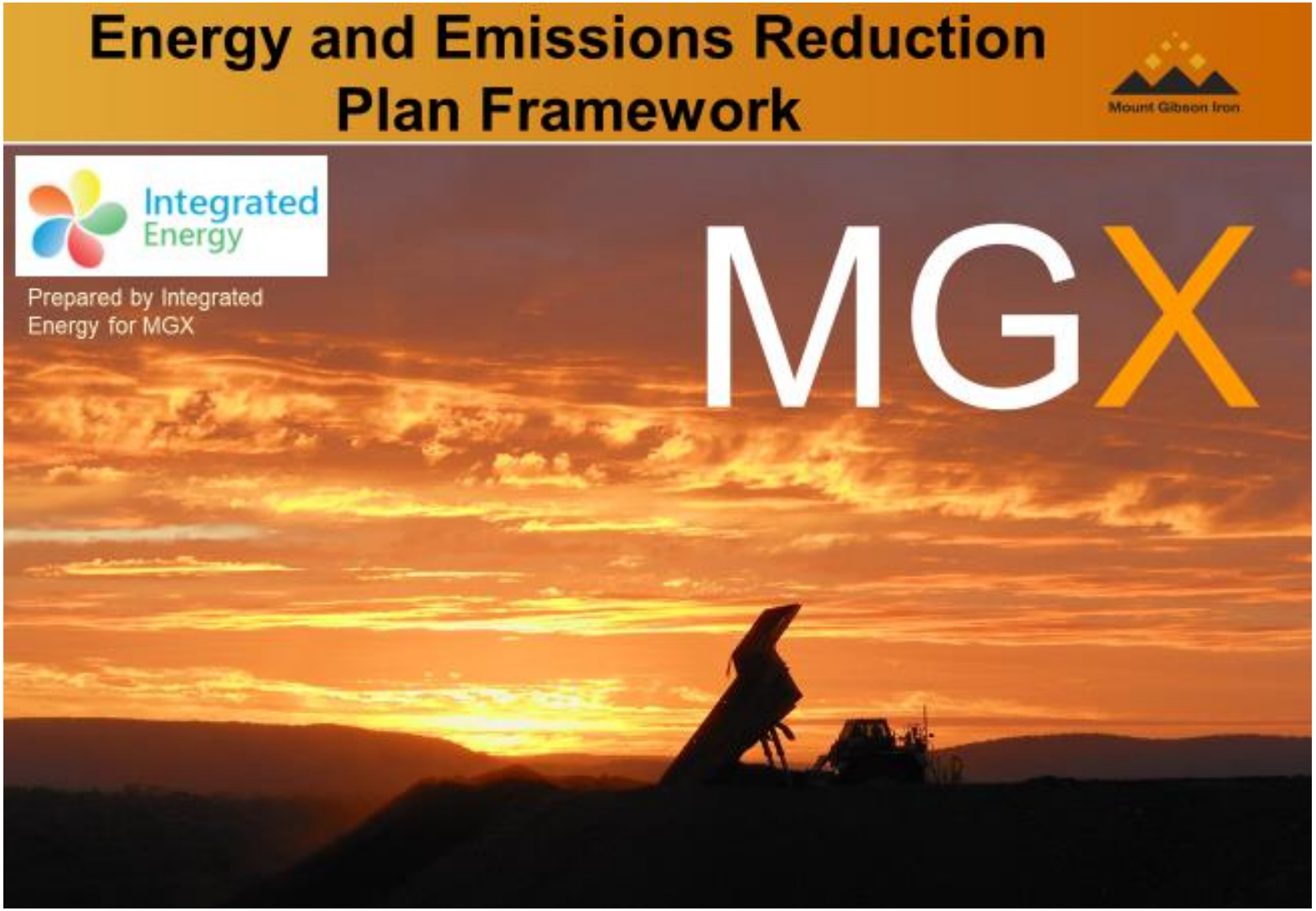
Green hydrogen forms an important part of a sustainable global energy and transportation solution…

Hydrogen Bus Conversion

- Mercedes CNG “Ecobus” purchased for plan to convert to hydrogen following Perth metro use
- First one of a potential fleet of four hundred plus
- Potential for growth to large scale economic demand for green hydrogen
- Engineering investigations progressing with feasible options for hydrogen use
- (Note Thailand also has a large CNG bus fleet)



MGX Energy and Emissions Reduction Plan Framework

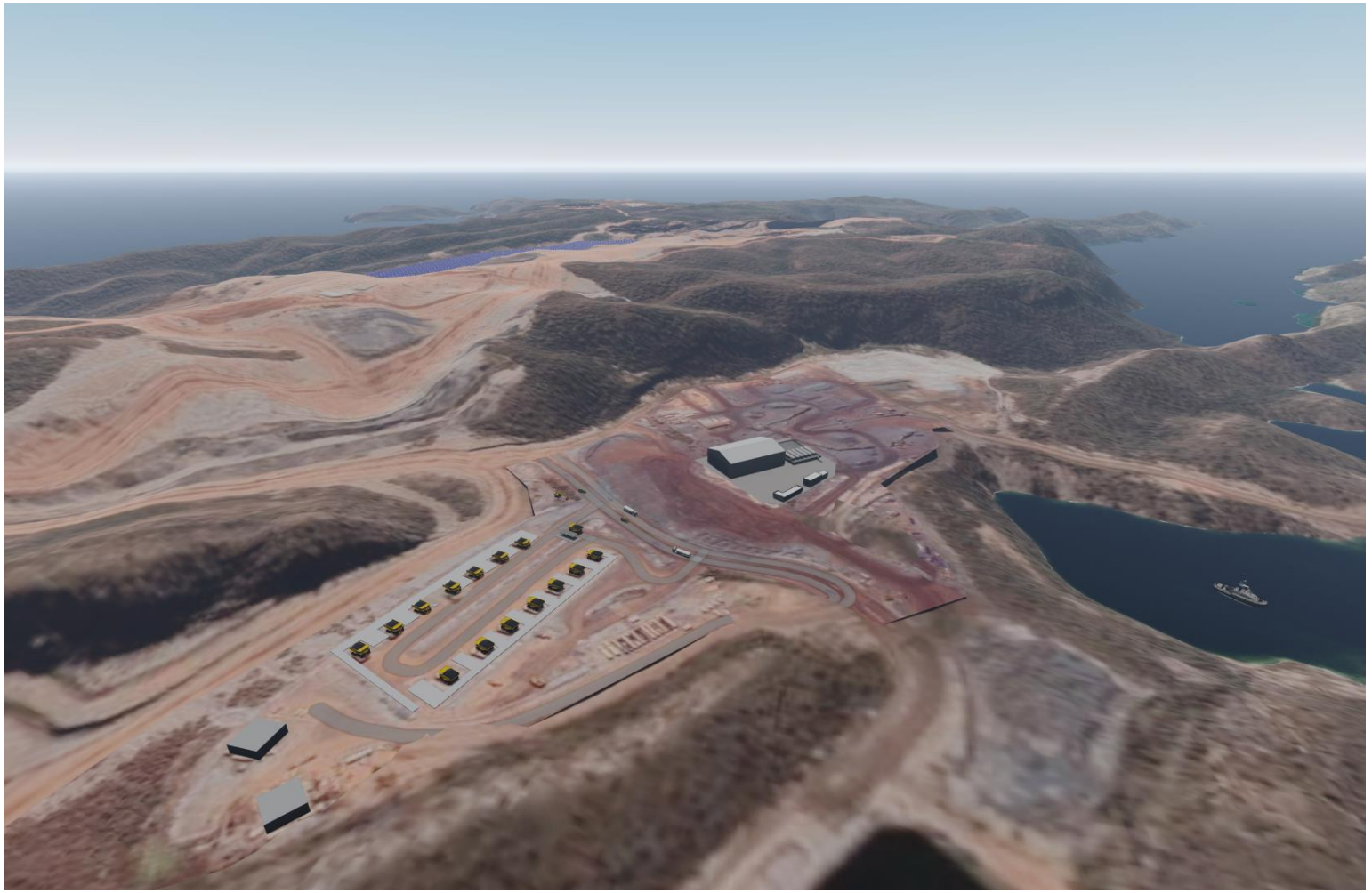


Mining Fleet

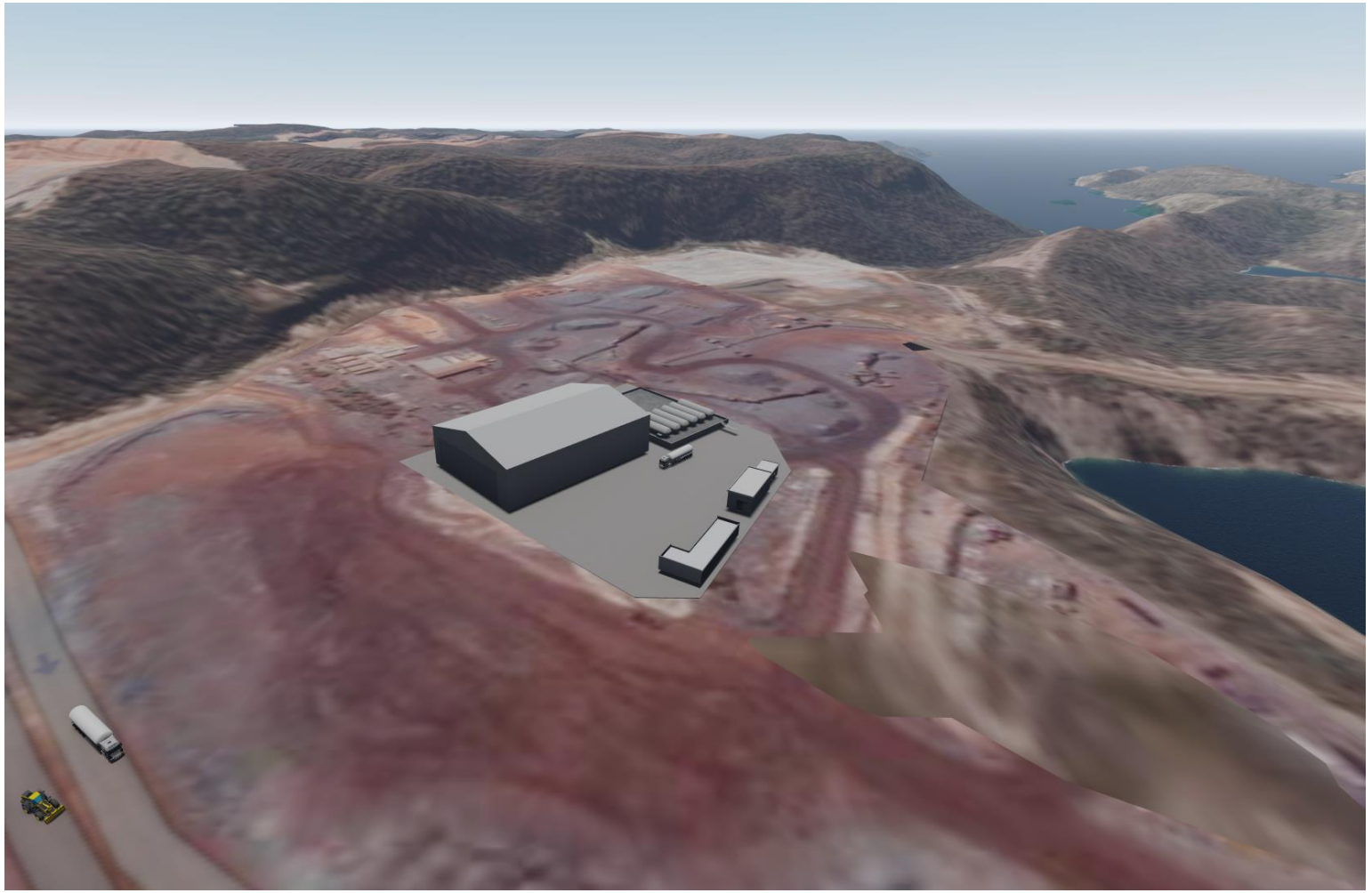
Refuelling H2 Dump Truck

Dump Truck Parking & H2 Plant

Dump Truck Parking & H2 Plant



H2 Plant & Storage



Reflections of a Journey through SE Asia and Asia Pacific

- There are large opportunities for sustainable, economic application of hydrogen and renewable energy through South East Asia and Asia Pacific (diesel consumption is a clue)
- This should be considered in the cultural, environmental, business and governance setting of each location
- Build on the strengths of what has already been achieved (eg Thailand CNG > HCNG)
- The learnings from Australia can support Asia Pacific in many ways:
  - Technical standards and market framing
  - Capability development
  - Project development opportunities
  - New markets for Asia Pacific goods and services

- We look forward to discussing further….

Renewable Energy and Hydrogen offers a safe, sustainable solution for Asia Pacific

- Hydrogen offers a safe, sustainable solution for Asia Pacific, with transport an important early application viable today, supported by many Governments
- Road transport provides a key infrastructure component in the Australian hydrogen ecosystem, building a domestic market for hydrogen
- Australia is an ideal partner to supply hydrogen internationally with investment opportunity
- Standards and Regulations play an important role and we are building from a successful framework
- Integrated Energy are developing the enabling standards and human capability which enable the safe, reliable growth of hydrogen for transport, on a state, national and global basis
- Heavy duty transportation is an investible leading application for green hydrogen
- Large scale opportunity for Australian know how, hydrogen and Asia Pacific products
- How can we help …

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Thank you

- Look forward to answering your questions

Backup