

# Cliff Head CO2 Storage Project

Progress in converting a mature life offshore oil field to permanent CO2 storage operation to deliver low-cost clean ammonia through integrated CCS

GCCSI Japan CCS Forum

15 November 2023

PILOT ENERGY LIMITED  
ASX:PGY



# Compliance Statements



## Disclaimer

This investor presentation has been prepared by Pilot Energy Limited ABN 86 115 229 984 (Pilot or the Company). Any material used in this presentation is only an overview and summary of certain data selected by the management of Pilot. The presentation does not purport to contain all the information that a prospective investor may require in evaluating a possible investment in Pilot nor does it contain all the information which would be required in a disclosure document prepared in accordance with the requirements of the Corporations Act and should not be used in isolation as a basis to invest in Pilot. Recipients of this presentation must make their own independent investigations, consideration and evaluation of Pilot. Pilot recommends that potential investors consult their professional advisor/s as an investment in Pilot is considered to be speculative in nature.

This presentation contains “forward looking statements” concerning the financial condition, results of operations and business of Pilot. All statements other than statements of fact or aspirational statements, are or may be deemed to be “forward looking statements”. Often, but not always, forward looking statements can generally be identified by the use of forward looking words such as “may”, “will”, “expect”, “intend”, “plan”, “estimate”, “anticipate”, “continue”, “outlook”, and “guidance”, or other similar words & may include, without limitation, statements regarding plans, strategies and objectives of management, future or anticipated production or construction commencement dates and expected costs, resources or reserves, exploration results or production outputs.

## Assumptions and Forward Looking Statements

Forward looking statements are statements of future expectations that are based on management’s current expectations and assumptions, known and unknown risks and uncertainties that could cause the actual results, performance or events to differ materially from those expressed or implied in these statements. These risks include, but are not limited to price fluctuations, actual demand, currency fluctuations, drilling and production results, commercialisation reserve estimates, loss of market, industry competition, environmental risks, physical risks, legislative, fiscal and regulatory developments, economic and financial market conditions in various countries and regions, political risks, project delay or advancement, approvals and cost estimates.

Statements in this presentation are made only as of the date of this presentation unless otherwise stated & the information in this presentation remains subject to change without notice. Reliance should not be placed on information or opinions contained in this presentation. To the maximum extent permitted by law, Pilot disclaims any responsibility to inform any recipient of this presentation on any matter that subsequently comes to its notice which may affect any of the information contained in this document and presentation and undertakes no obligation to provide any additional or updated information whether as a result of new information, future events or results or otherwise.

No representation or warranty, express or implied, is made as to the fairness, accuracy, completeness or correctness of the information, opinions or conclusions contained in or derived from this presentation or any omission from this presentation or of any other written or oral information or opinions provided now or in the future to any person. To the maximum extent permitted by law, neither Pilot nor, any affiliates, related bodies corporate and their respective officers, directors, employees, advisors and agents (Relevant Parties), nor any other person, accepts any liability as to or in relation to the accuracy or completeness of the information, statements, opinions or matters (express or implied) arising out of, contained in or derived from this presentation or any omission from this presentation or of any other written or oral information or opinions provided now or in the future to any person.

## Competent Persons Statement

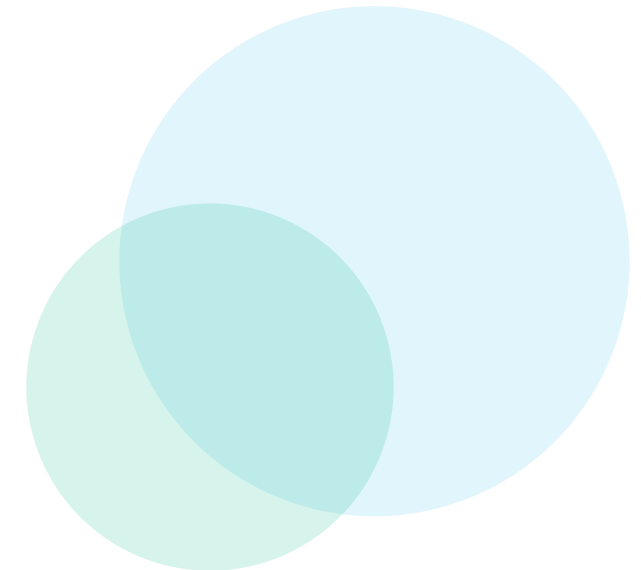
This announcement contains information on conventional petroleum and CO<sub>2</sub> Storage resources which is based on and fairly represents information and supporting documentation reviewed by Dr Xingjin Wang, a Petroleum Engineer with over 30 years’ experience and a Master in Petroleum Engineering from the University of New South Wales and a PhD in applied Geology from the University of New South Wales. Dr Wang is an active member of the SPE and PESA and is qualified in accordance with ASX listing rule 5.1. He is a former Director of Pilot Energy Ltd and has consented to the inclusion of this information in the form and context to which it appears.

## Authorisation

This presentation has been authorized by the Chairman and Managing Director on behalf of the Board of Directors of Pilot Energy Limited

## Mid West Renewable Energy Reporting Conditions

Pilot has agreed to certain conditions with the ASX in respect its renewable energy activities in relation to nature of activities and expenditure limits. Proceeding beyond the conditions will constitute a change in the nature and scale of the Company’s activities in terms of Listing Rule 11.1 and as such the Company will be required to comply with all of the requirements of Chapters 1 and 2 of the Listing Rules before it proceeds beyond the agreed limits.



# Presentation Summary

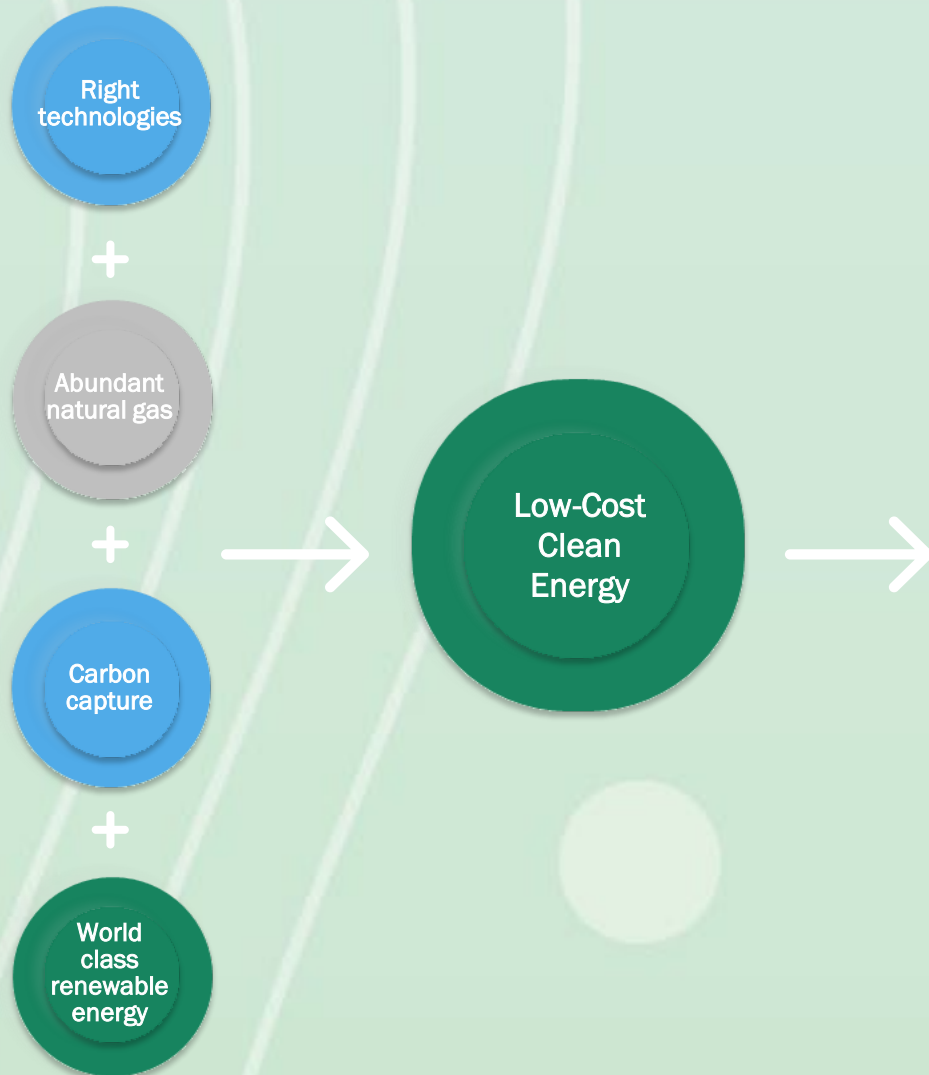


## The Mid West Clean Energy Project is an integrated CO<sub>2</sub> storage to Clean Ammonia export project

- Pilot Energy Limited is an Australian oil and gas producing company and only one of a handful of offshore production operator licensed to operate in Australian Commonwealth waters
- Pilot is transitioning to clean energy production and supply through the development of an integrated CO<sub>2</sub> storage project enabling the production of clean ammonia leveraging existing production infrastructure and renewable energy resources
- This case study presentation focuses on the CO<sub>2</sub> storage aspect of the project. The project is currently in the Pre-FEED/FEED stage and CO<sub>2</sub> storage operations are anticipated to commence in 2026 followed by blue ammonia production from 2028
- Initial development of CO<sub>2</sub> storage project will be capable of providing up to 67 million tonnes of permanent storage with an initial injection rate of 2.5 mmtpa through 2050
- Significant potential to increase CO<sub>2</sub> storage capacity to over 100 million tonnes with a CO<sub>2</sub> injection rate of 5 mmtpa by 2030 through additional development
- Pilot has encountered numerous technical, regulatory and commercial challenges which has shaped project development.
- This case study shares Pilot's learnings to assist the efficient transition of hydrocarbon fields from production into CO<sub>2</sub> storage facilities and operation

# Strategy

Deliver low-cost clean energy by building off natural competitive advantages



The Four Pillars - Building from a firm foundation

Western Australia - a natural partner of production and supply of Clean Ammonia



## Australia

Western, South, Queensland, Tasmania etc.

Natural gas

Renewables

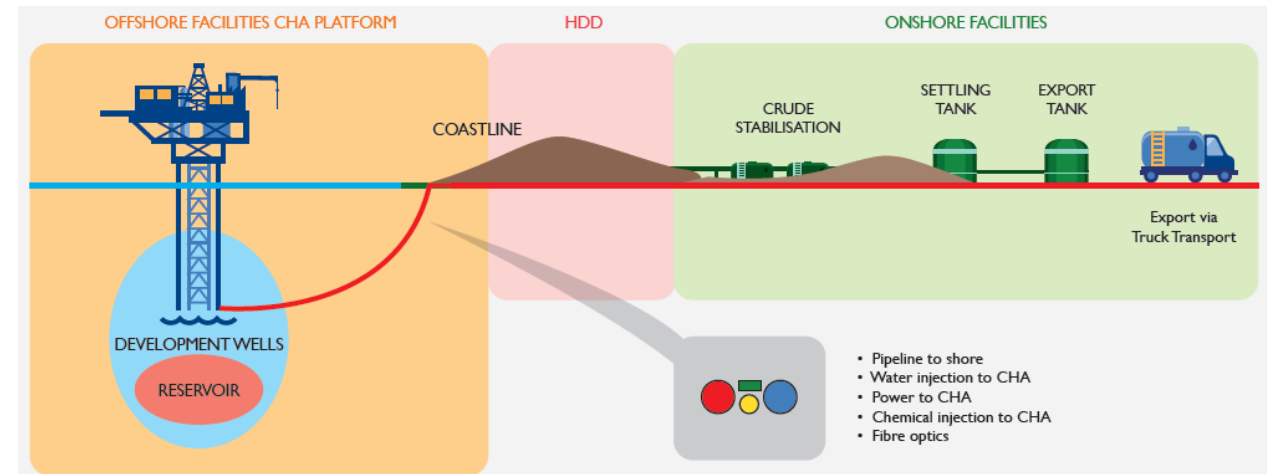
Mid West Clean Energy Project

The Deliverables - Clean, Low-Cost and Achievable

# Cliff Head CCS – Leveraging existing infrastructure

## Cliff Head Oil Field – overview of current facilities & operation

- Mature, end-of-life oil field located ~14km offshore in Commonwealth Waters in 16m water depth
- Production commenced in May 2006 producing to date ~17.1 mmbbls oil and ~133 mmbbls water
- Proven injection history with 136.5 mmbbls water injected into field to maintain reservoir pressure
- Facilities include:
  - Cliff Head A unmanned offshore platform (CHAP)
  - Onshore Arrowsmith Stabilisation Plant (ASP)
  - Twin 10” offshore/onshore production and water injection pipelines connecting CHAP to ASP
  - Power & control umbilical from ASP to CHAP
  - 5 oil production wells with artificial lift
  - 3 water injection wells



Cliff Head A Offshore Platform – Future CCS Injection Facility



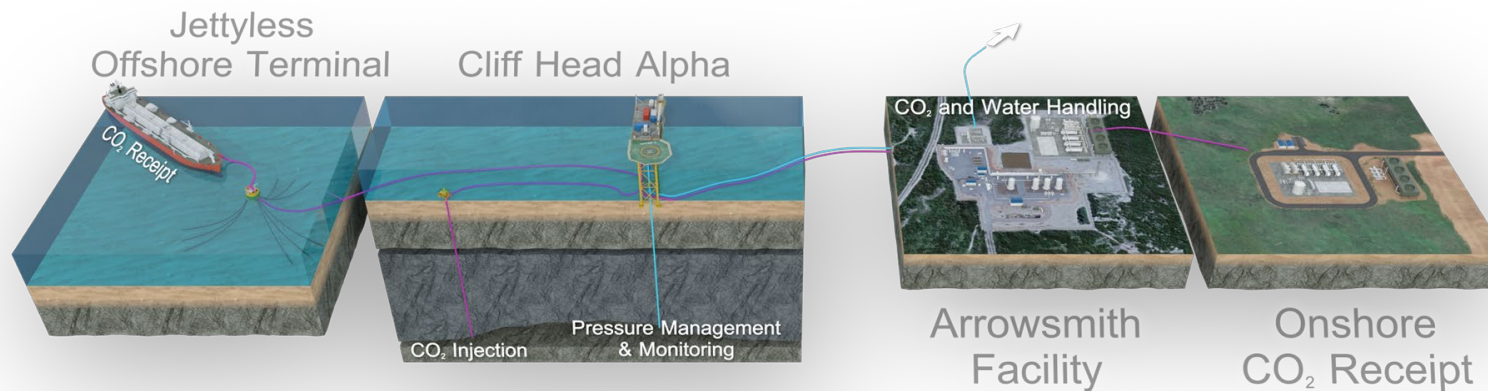
Arrowsmith Stabilisation Plant – Future CO2 Aggregation Facility



# CO<sub>2</sub> Storage Facility

Cliff Head CO<sub>2</sub> Storage Facility is a key enabler of low-cost Clean Ammonia production

- Foundation for development of Clean Ammonia production
- Brownfield re-development utilizing existing Cliff Head Oil Field facilities
- Clear Commonwealth regulatory pathway with application lodged with NOPTA
- Minimal risk and capex requirements through re-use of existing reservoir & facilities
- Aiming to provide up to 5 million tpa of CO<sub>2</sub> storage continuing through 2050
- Levelized cost of storage (LCOS) of less than A\$20/tonne of CO<sub>2</sub> (excluding transport)
- Targeting first CO<sub>2</sub> injection from onshore CO<sub>2</sub> receiving facility 2026

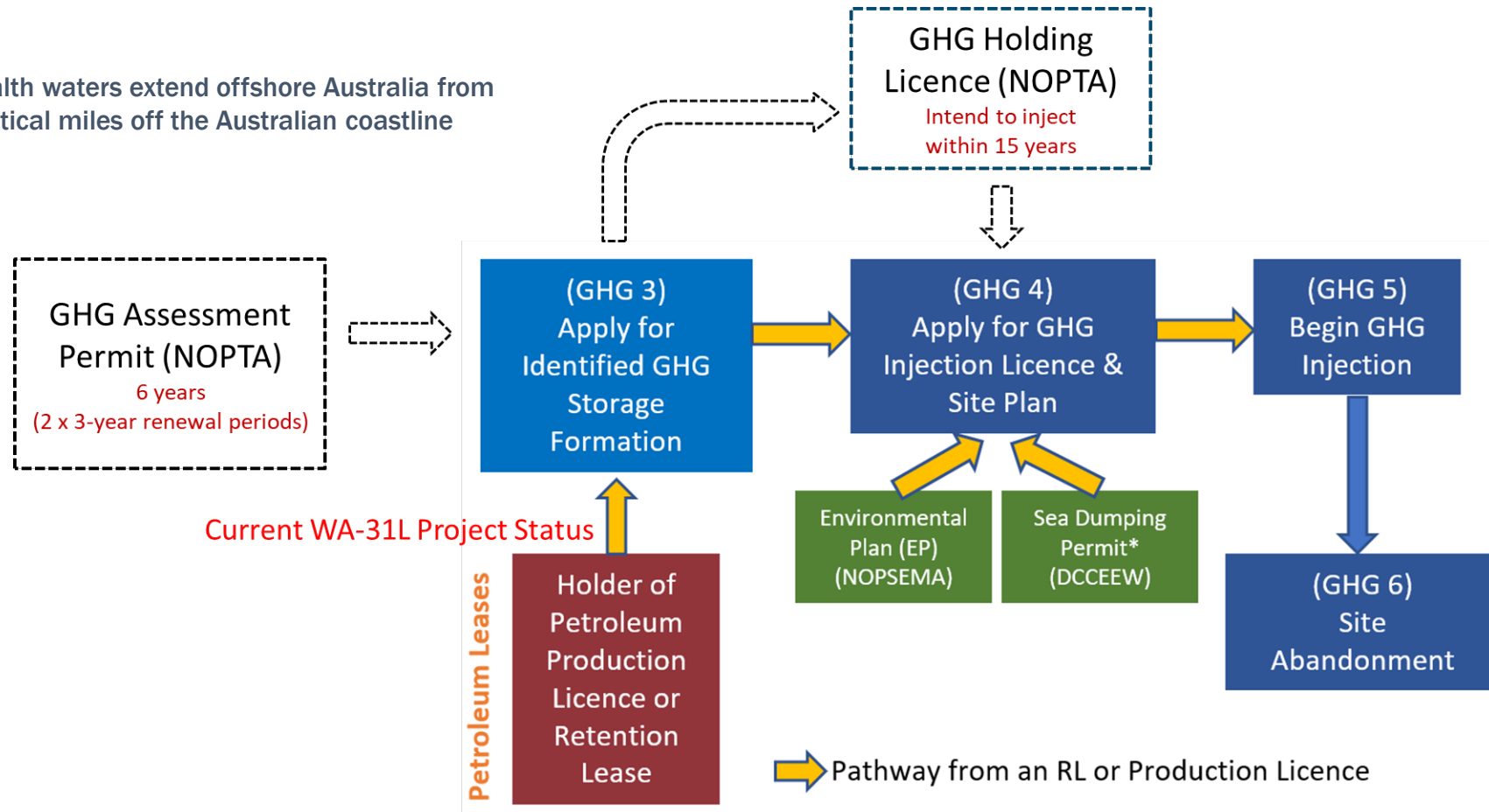


See Pilot Energy website for CCS Project video at <https://www.pilotenergy.com.au/videos-webcasts>

# Australian CO2 storage regulatory pathway

Pilot is first ever applicant for transitioning a petroleum production licence in Commonwealth waters to GHG storage under an existing & clear regulatory pathway

Commonwealth waters extend offshore Australia from 3 to 200 nautical miles off the Australian coastline



Offshore Petroleum & Greenhouse Gas Storage Act of 2006 (OPGGSA) applies to all petroleum & GHG activities in Commonwealth waters

Cliff Head Oil Field production license is located 6 nautical miles (~11kms) west off the Western Australian shoreline and governed by OPGGSA

# Key regulatory challenges



## Pilot Energy is the first applicant under existing Australia Commonwealth legislation

- Australian Commonwealth legislation - Offshore Petroleum & Greenhouse Gas Storage Act (OPGGSA) - administered by NOPTA and NOPSEMA - has been in place since 2006 with supporting regulations/guidelines since 2011
- Existing legislation provides for ability to conduct Greenhouse Gas (CO<sub>2</sub>) storage exploration, appraisal, development and operational activities in Australian Commonwealth waters (offshore Australia from 3 to 200 nautical miles)
- OPGGSA also provides for the ability to apply to declare a discovery of a suitable Greenhouse Gas Storage Formation (DoSF)
- Once a DoSF is approved a license holder can apply to convert an existing petroleum production license area into a CO<sub>2</sub> storage operation through lodgement of a GHG Injection License application covering the reservoirs covered by the DoSF
- To date only – GHG Assessment (exploration) licenses have been granted – all of which are in their first term
- Pilot Energy is the first ever applicant to seek approval for a DoSF and following approval of the DoSF will quickly lodge GHG Injection License application
- Many of the concepts throughout the GHG regulatory framework - though familiar and similar to the existing tried and tested petroleum regulatory framework – are untried and in instances some regulatory terminology is undefined such as “engineering enhancements”
- The CO<sub>2</sub> Storage operation is also covered by the Sea Dumping Act (Australia’s legislation covering the London Protocol) which also requires Commonwealth legislation to be passed approving the CO<sub>2</sub> Storage amendments to the London Protocol (legislation before Parliament with passage pending)
- Applicable environmental legislation covering a CO<sub>2</sub> Storage operation exists but also is untested in this area



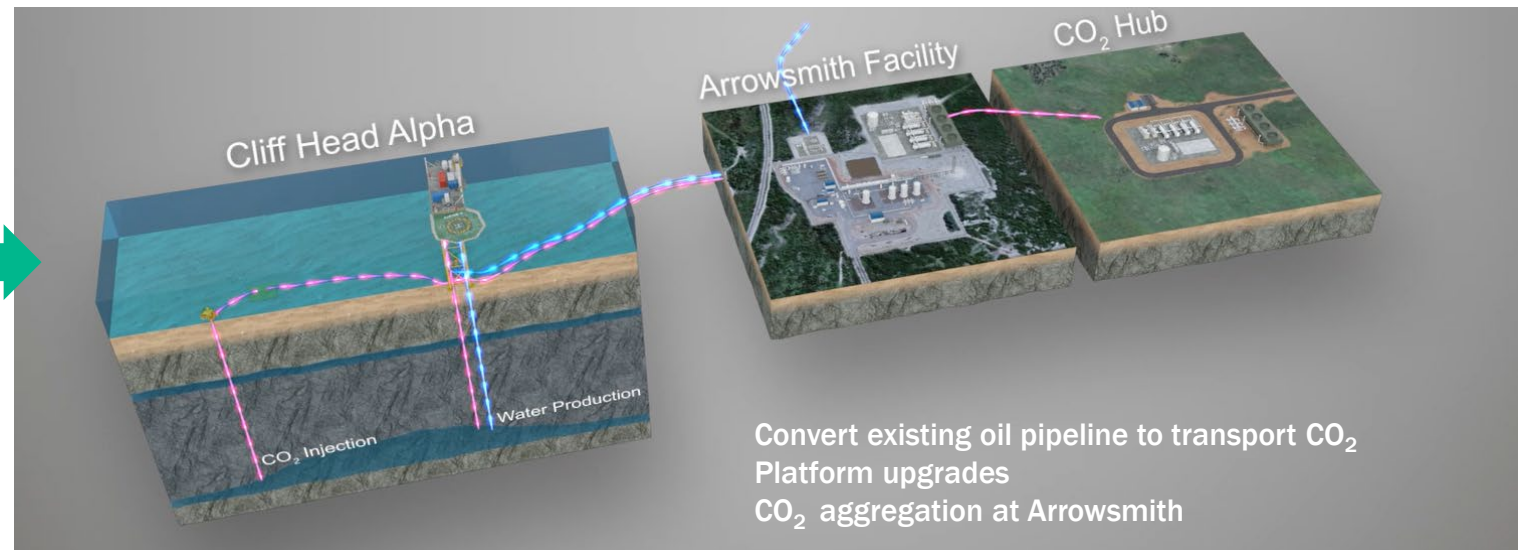
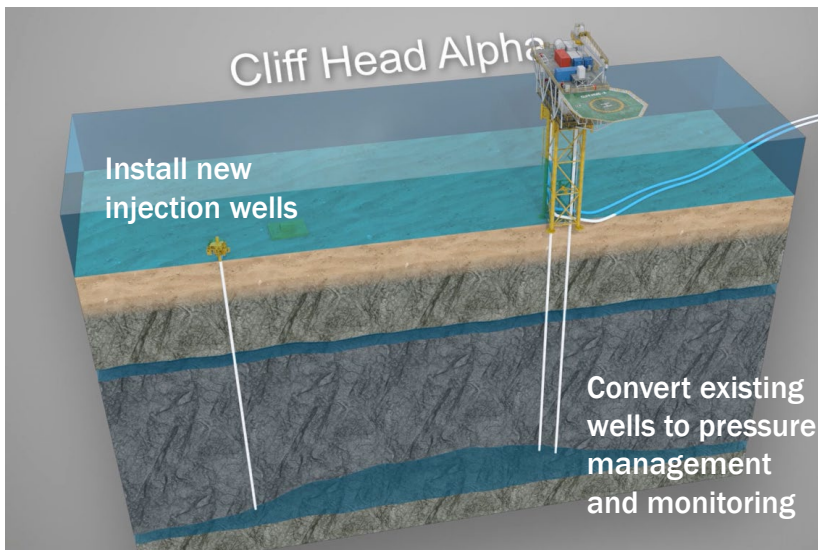
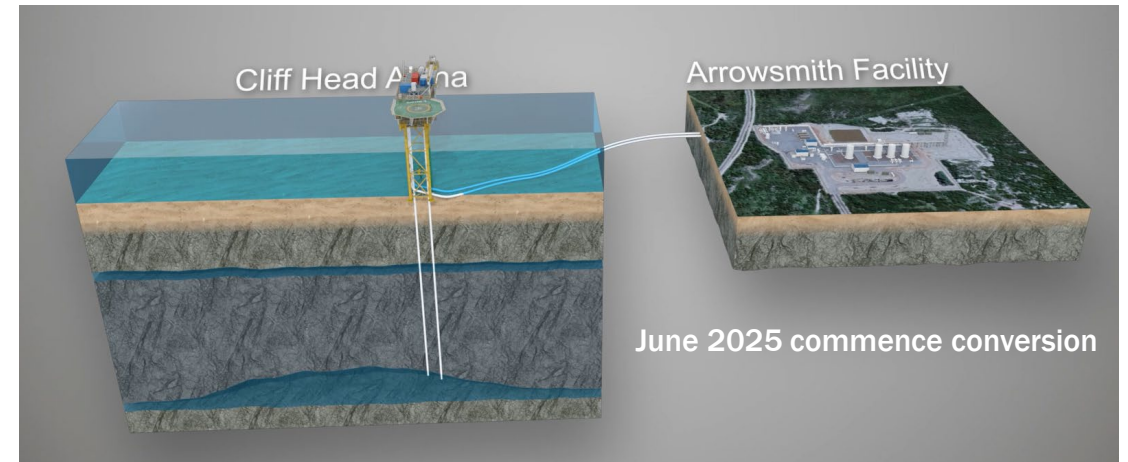
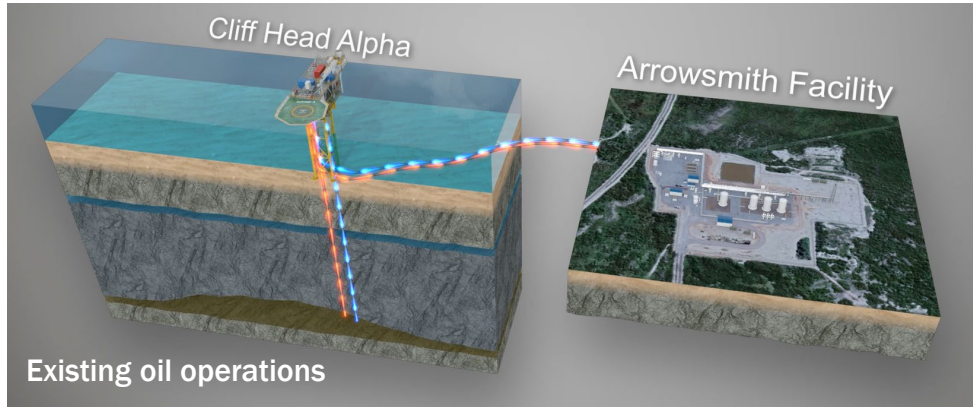
# From Declaration of Storage Formation to Injection License



Following approval of GHG Storage Formation, an application for a GHG Injection Licence can be made

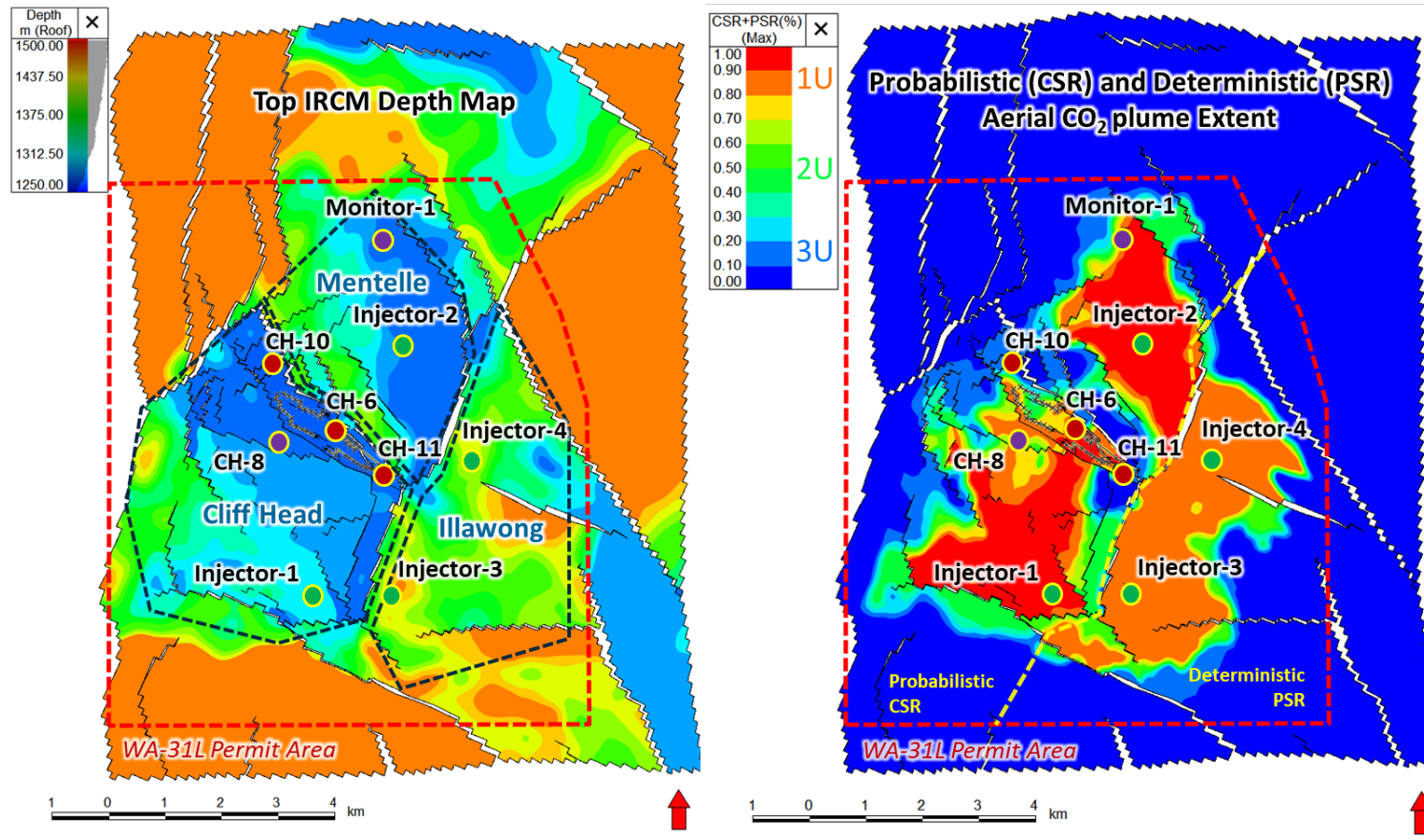
- Injection plan/plume area must demonstrate that it will be limited to existing production license area
- At a minimum the Site Plan will require:
  - A facilities design specifying required remedial works to transition the field from oil production to carbon storage
  - Detailed well design for new or repurposed wells, as well as a decommissioning plan for redundant wells in the field
  - A Monitoring, Measurement, and Verification (MMV) plan to ensure vertical and lateral containment of Stored CO<sub>2</sub>
  - In addition to the Site Plan, the following approvals are required to be eligible for a GHG Injection licence
    - Environmental Plan approved by Department of Climate Change, Energy, the Environment and Water (DCCEEW) and NOPSEMA
    - Sea Dumping Permit approved by DCCEEW

# Conversion from oil production to CO<sub>2</sub> storage operations



# CO2 Storage development concept

## Proposed WA-31L carbon storage development and resultant aerial CO2 plume extents

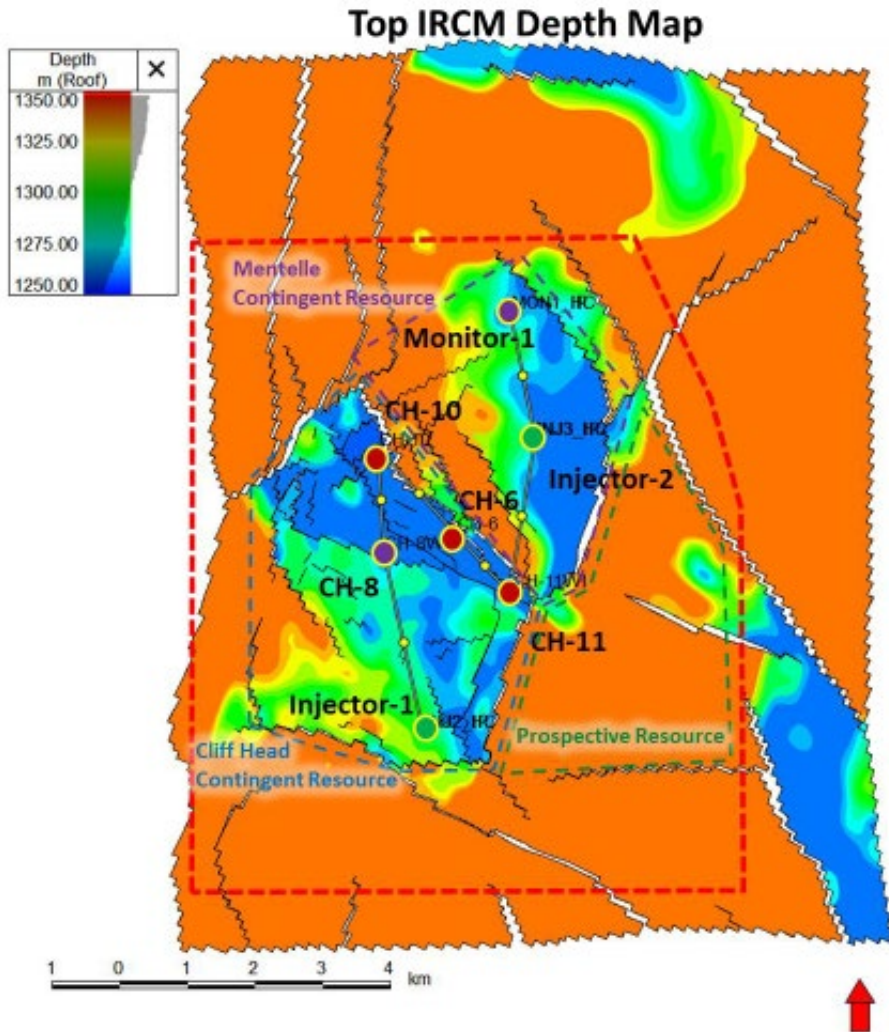


- Extensive 2D and full 3D seismic coverage over project area
- Full regional geological reinterpretation looking beyond the Cliff Head oil field
- New outward-looking CO<sub>2</sub> storage purpose-built static & dynamic reservoir modelling
- Over 6 million grid cells covering the main injection reservoir units
- Specific focus on main reservoirs associated with the Cliff Head oil field with 3 main storage areas identified
- 2 main storage areas – Cliff Head & Mentelle – with extensive well control and production/injection history form basis Contingent Resources
- Prospective Resources attributed to a third area – Illawong – with extensive 3D seismic but lacking well control & production/injection history

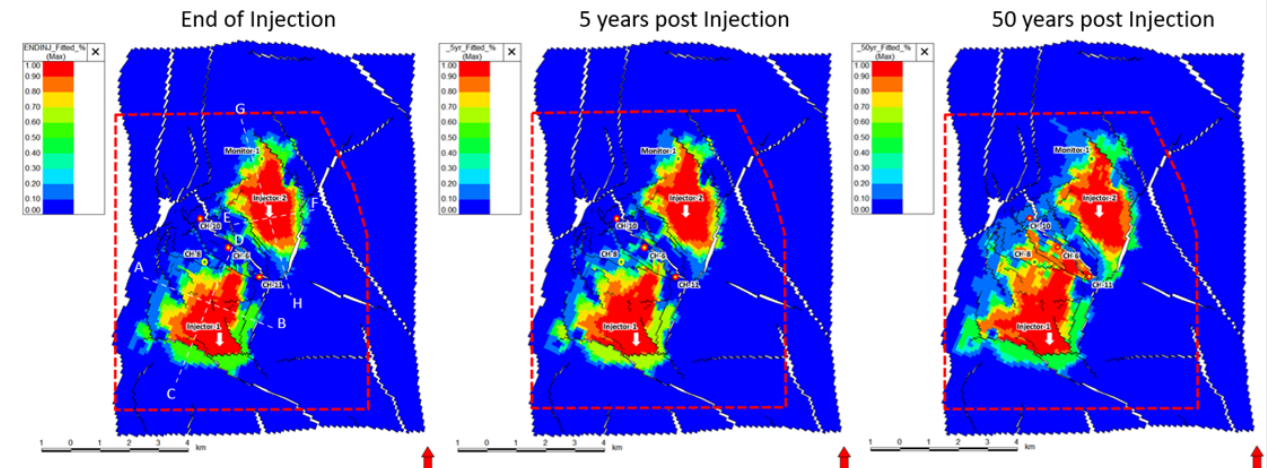
# Cliff Head CO<sub>2</sub> storage resources

Well Plan – CO<sub>2</sub> Injectors and Pressure Management & Monitoring

CO<sub>2</sub> Storage plume stable post injection



Probabilistic Aerial CO<sub>2</sub> Plume Extent – Irwin River Coal Measures

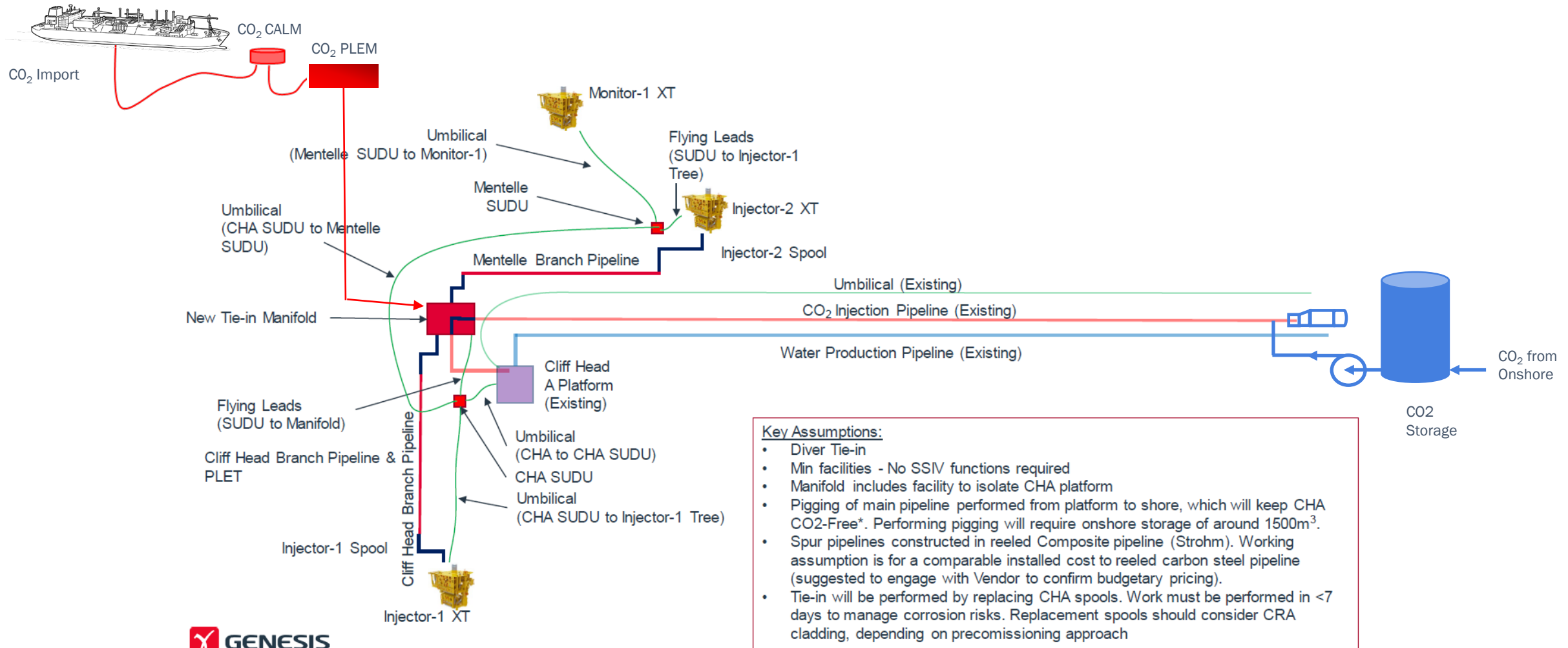


Resource*	Storage Capacity (million tonnes)	CO <sub>2</sub> Injection rate (million tonnes per annum)
1C	24.2	2.5
2C	45.6	
3C	67.0	
2U*	50.4	2.5

\*CO<sub>2</sub> Storage Resource and injection rate estimates prepared in accordance with SPE SRMS by CO<sub>2</sub>Tech

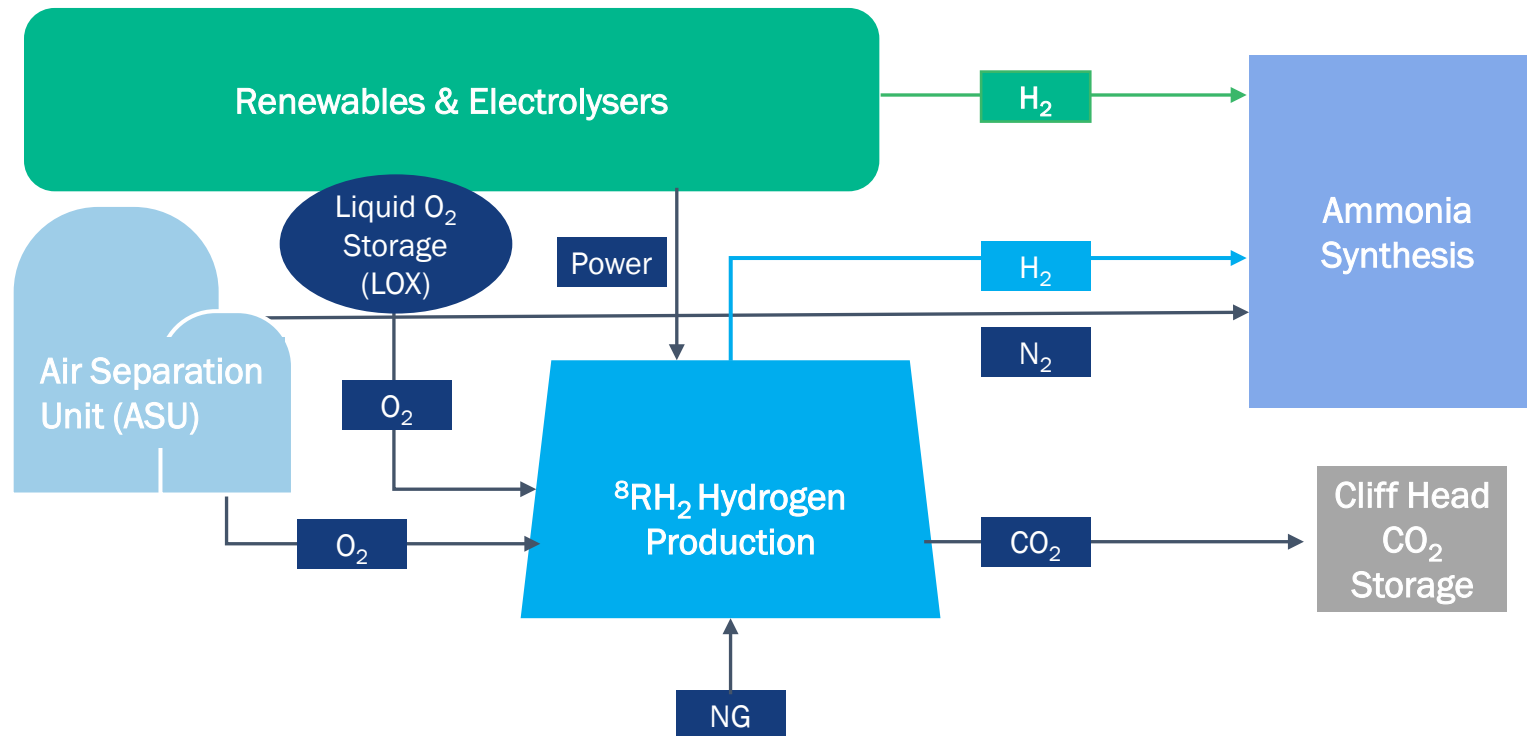
# CO2 Storage development concept - facilities

Proposed WA-31L carbon storage – development utilizing combination of existing and new facilities



# CO2 storage enables use of low carbon H2 technologies

Unique integration of CCS, renewables and proprietary technology enables production of low-cost Clean Ammonia



Integration of CCS and low-cost renewables through 8 Rivers technology delivers clean cost-competitive power, Hydrogen and Ammonia

## 8 Rivers <sup>8</sup>RH<sub>2</sub> technology

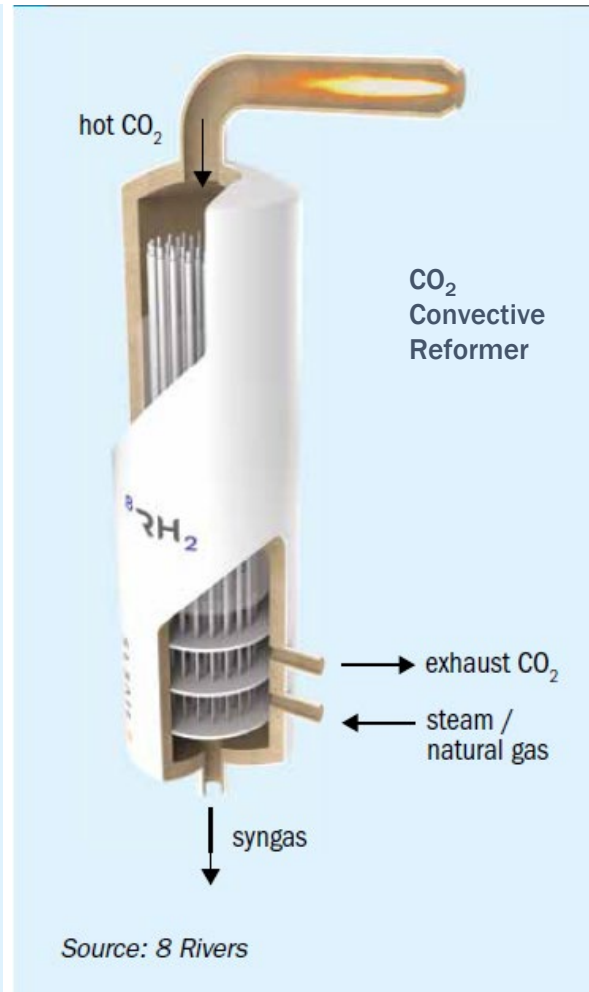
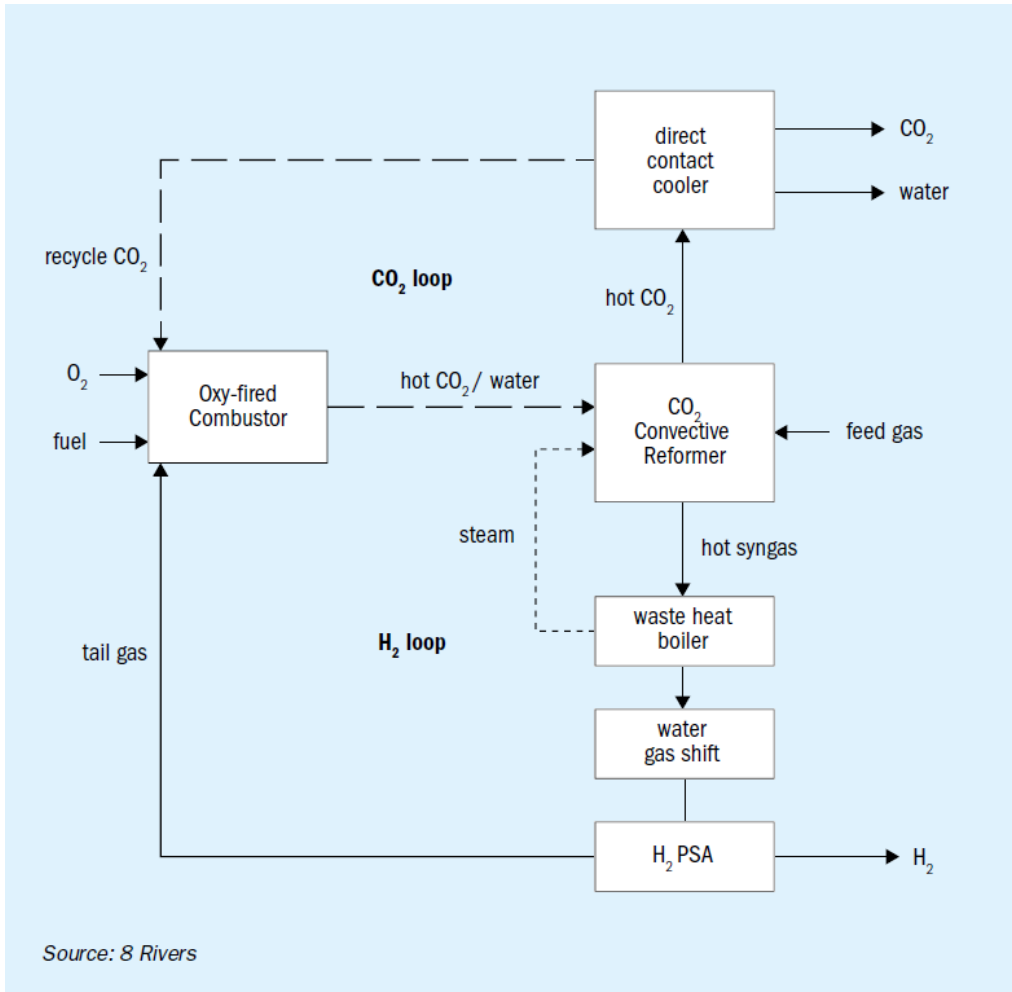
- Proven technology
- High hydrogen production efficiency while requiring minimal capital costs compared to over conventional power cycles
- Minimal water consumption

## A unique opportunity

- Blue Hydrogen only possible with CCS
- Integration of low-cost renewables delivers operational and capital cost synergies across both Blue and Green Hydrogen
- Compelling Low Carbon Hydrogen-to-Clean Ammonia solution with clear cost advantage

# 8 Rivers blue hydrogen - 8RH2 Gen 2 technology

CO<sub>2</sub> Convective Reformer (CCR) – 99% capture with lower capital and operating cost

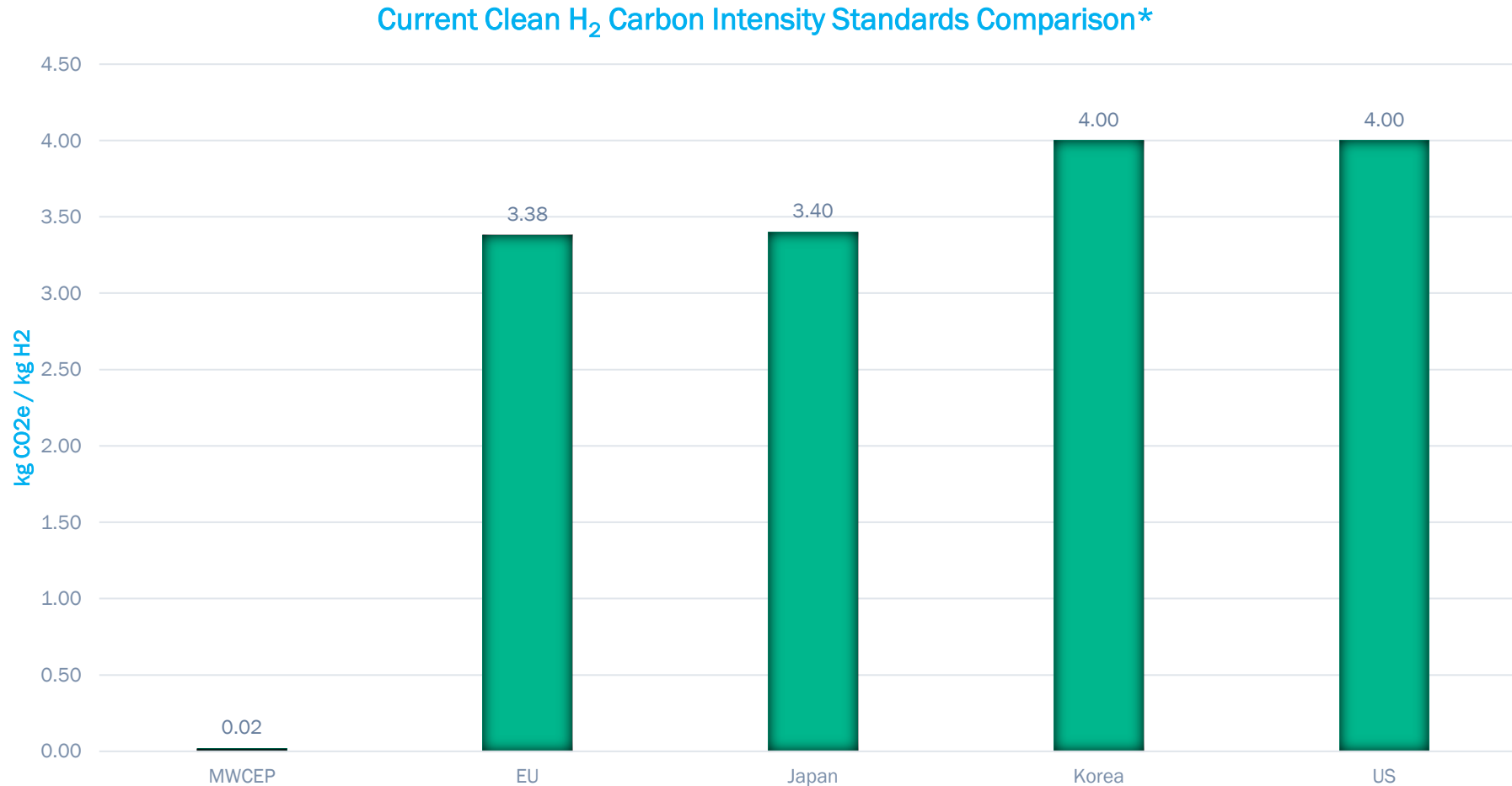


- 8RH2 Convective CO<sub>2</sub> Reforming (“CCR”) technology delivers improved natural gas-to-hydrogen generation efficiency with 99% CO<sub>2</sub> capture
- Conventional SMR/ATR process limited to 95% CO<sub>2</sub> capture
- 8RH2 CCR innovative use of high pressure/temperature CO<sub>2</sub> to drive reformation results in two separate flow streams like SMR at high pressure similar to ATR.
- CCR use of CO<sub>2</sub> as its working fluid enables inherent capture of 99% of produced CO<sub>2</sub>
- CO<sub>2</sub> generated in Blue Hydrogen production is in supercritical form ready for storage without expense of SMR/ATR post combustion capture
- Pilot and 8 Rivers completing Pre-FEED basis of design study detailing use of CCR at MWCEP

# Clean: The carbon intensity comparison



Mid West Clean Energy Project exceeds current Clean H<sub>2</sub> Carbon Intensity standards for EU, Japan, Korean & US

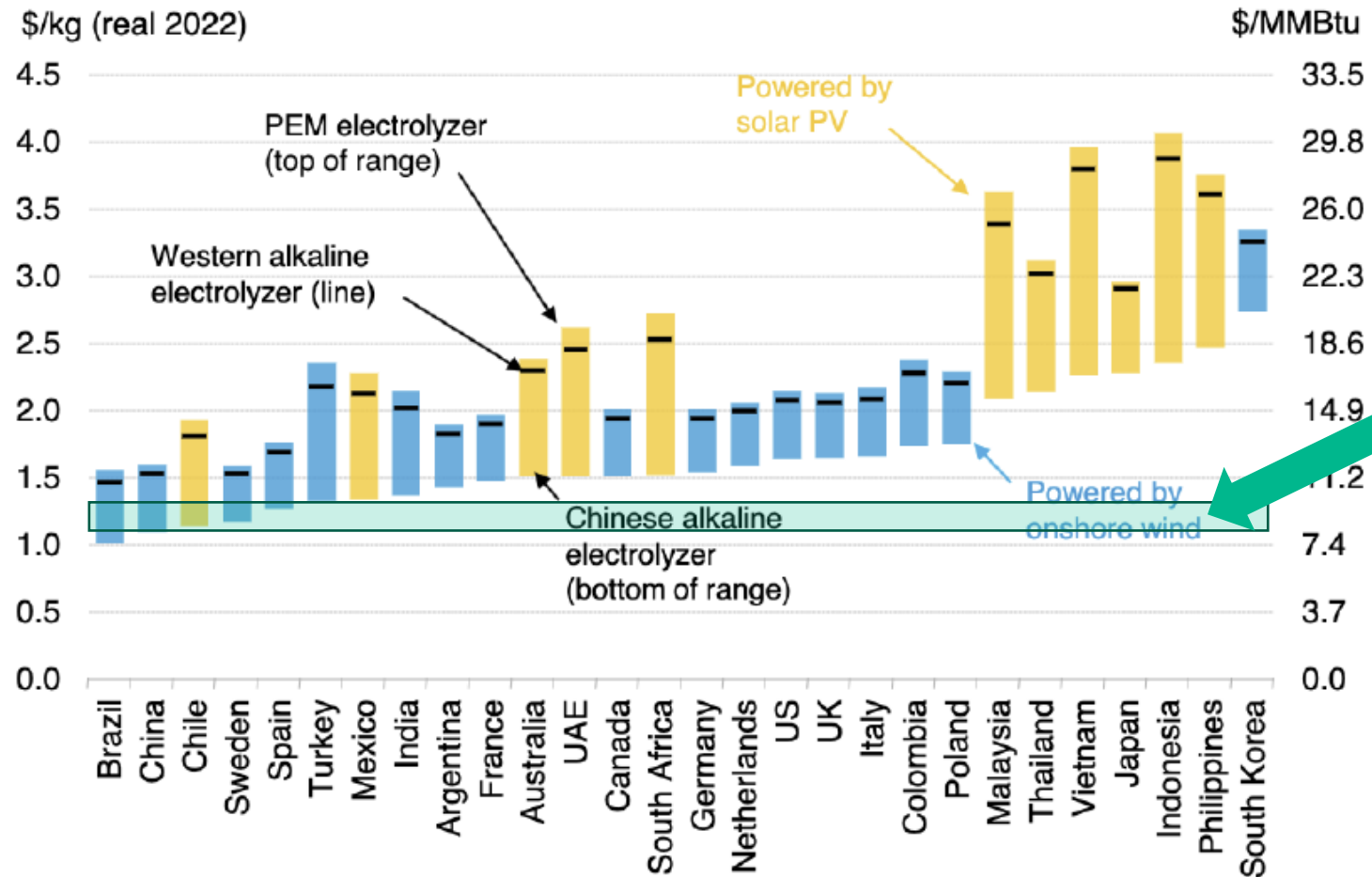


*Combination of breakthrough 8RH2 Gen 2 technology with integrated CCS and behind-the-meter renewables delivers low Carbon intensity*



# Globally Cost Competitive

**LCOH<sub>2</sub> from cheapest available renewable power in 28 markets, 2030\***



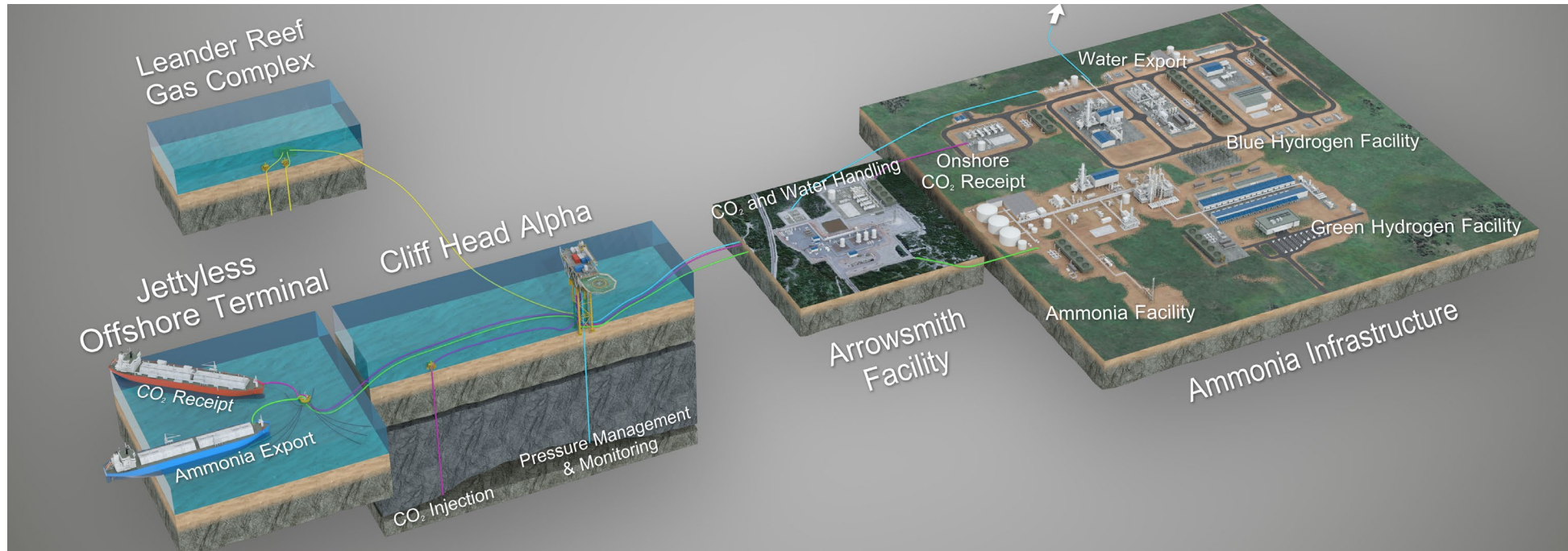
**MWCEP Clean H2 cost (real)**  
**USD 1.20/kg – USD 1.38/kg\*\***

Makes MWCEP competitive with projects from the cheapest 5 regions, Brazil, China, Chile, Sweden and Spain

\*Source: Bloomberg New Energy Finance Report 2023 Hydrogen Levelized Cost Update: Cost of Capital and inflation take hold, July 10, 2023

\*\* Source: Refer to Feasibility Results per ASX release on 28 March 2022, 7 June 2022 and 23 September 2022. 65 cent exchange rate applied to feasibility study results that delivered AUD 1.85 to 2.13/kg Blue H2 LCOH

# Mid West Clean Energy Project execution



## A Clean Ammonia export project with full carbon capture through integrated CCS

### Carbon Storage

Timing: ~2026

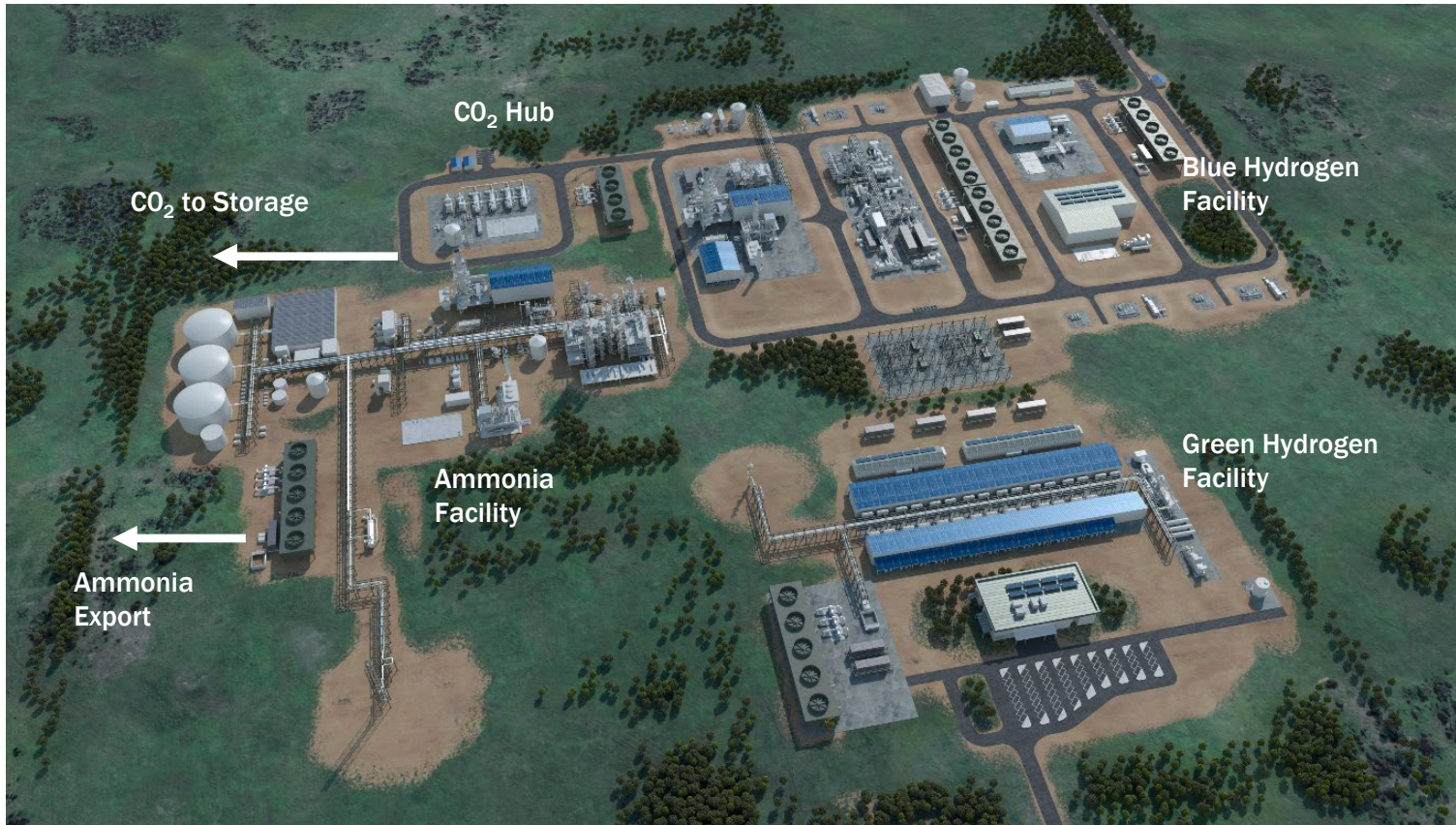
- Conversion of Cliff Head Offshore oil field to CCS
- Permanent CO<sub>2</sub> storage in depleted offshore oil field
- Offshore facilities to include direct offshore LCO<sub>2</sub> receipt capability
- Over 1 million tpa CO<sub>2</sub> injection from 2026
- Targeting continuous CO<sub>2</sub> injection through to 2050

### Clean Ammonia Production

Timing: ~2028

- Targeting Clean Ammonia production of over 1.2 million tpa
- Clean Ammonia produced from combined Blue & Green Hydrogen Plant
- Blue H<sub>2</sub> with full carbon capture through integrated Cliff Head CCS
- Green H<sub>2</sub> from self-sourced industrial water supply + low-cost, behind-the-meter renewables
- Estimated levelized cost of ammonia (LCOA) of A\$400/tonne

# Achievable: Bringing it all together

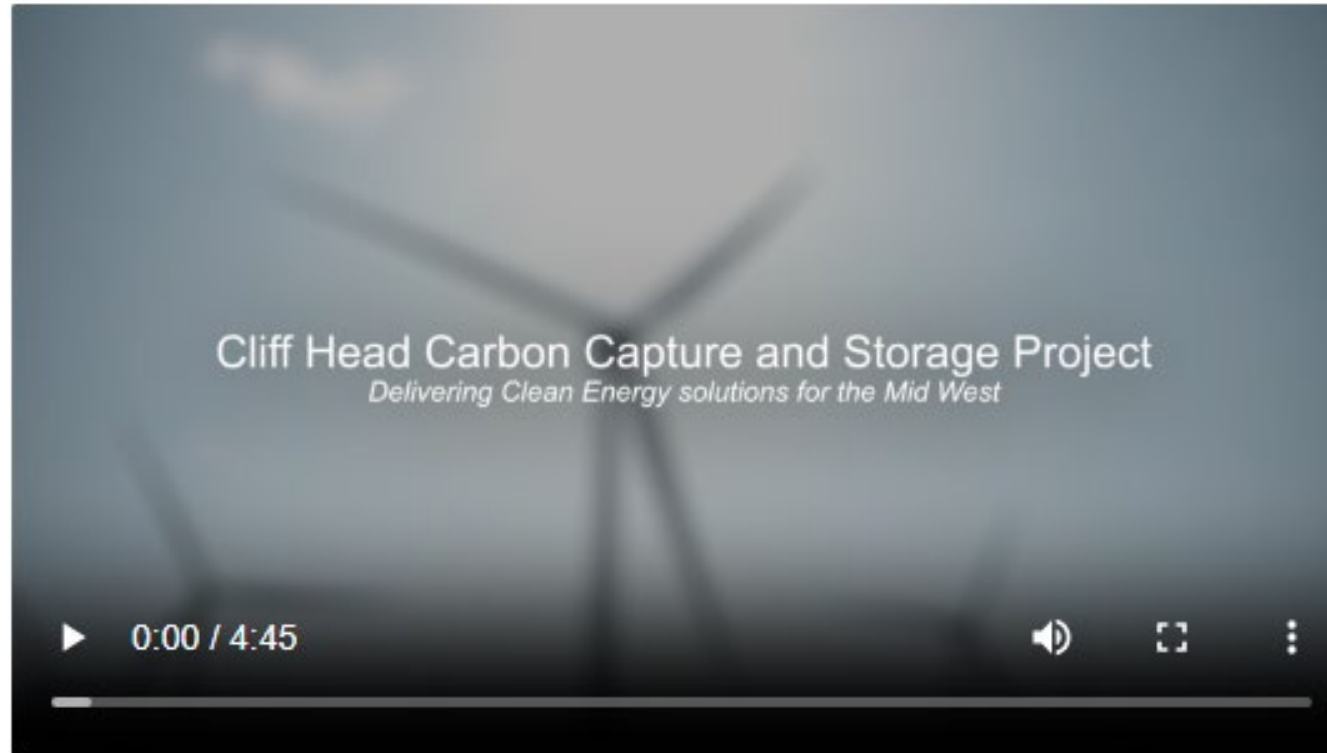


## Ammonia production

- Targeting ammonia production of up to 1 million tpa of cost competitive clean ammonia for export
- Blue Hydrogen production utilising 8 Rivers <sup>8</sup>RH<sub>2</sub> technology integrated with Cliff Head CO<sub>2</sub> Storage
- Abundant nearby low-cost conventional gas supply for Blue Hydrogen production
- Green Hydrogen electrolysis system fully integrated with <sup>8</sup>RH<sub>2</sub> Blue Hydrogen technology.
- CO<sub>2</sub> Storage project provides long-term self-sourced industrial water for Blue and Green Hydrogen production
- Oxygen produced from Green Hydrogen electrolysis used for Blue Hydrogen production
- Low-cost, behind-the-meter renewables provides power for CO<sub>2</sub> Storage through to Clean Ammonia production

Integrated production system maximises use of all production streams – Power, Heat, Water, Hydrogen, Oxygen & Nitrogen – No waste

# Mid West Clean Energy Project video



## Mid West Clean Energy Project – Cliff Head CCS: English language version

5th June 2023

## Contact Details

Pilot Energy Limited  
Suite 301, 35 Spring Street  
Bondi Junction, NSW 2022

[www.pilotenergy.com.au](http://www.pilotenergy.com.au)



**Brad Lingo**  
Chairman  
[blingo@pilotenergy.com.au](mailto:blingo@pilotenergy.com.au)

**Tony Strasser**  
Managing Director  
[tstrasser@pilotenergy.com.au](mailto:tstrasser@pilotenergy.com.au)

**Nick Watson**  
GM Corporate Development  
[nwatson@pilotenergy.com.au](mailto:nwatson@pilotenergy.com.au)