

CO₂ STORAGE IN AUSTRALIA

POTENTIAL, PROSPECTS AND PERMITS

CHRISTOPHER CONSOLI

SENIOR CONSULTANT

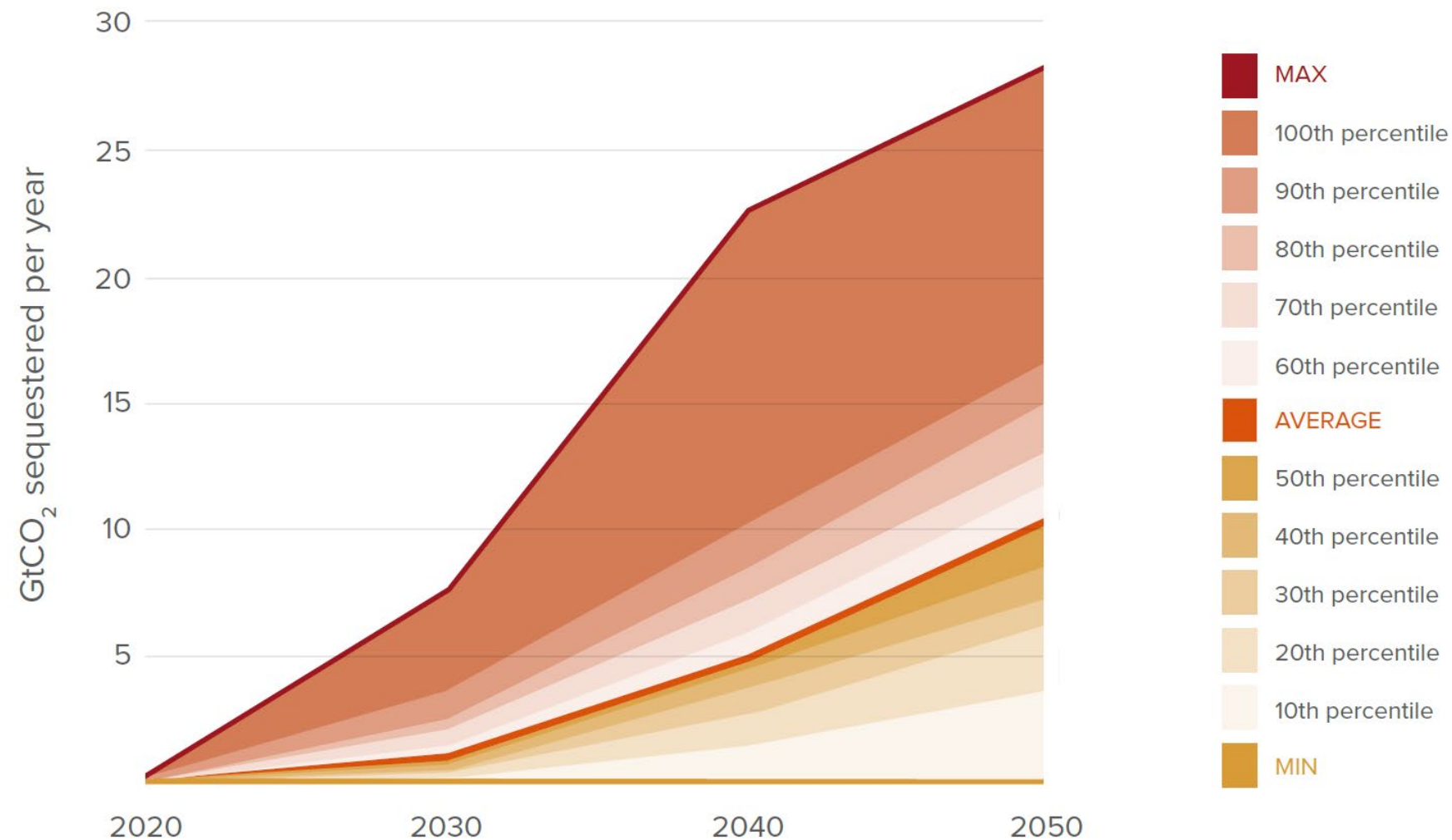
GLOBAL CCS INSTITUTE

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STORAGE IS KEY

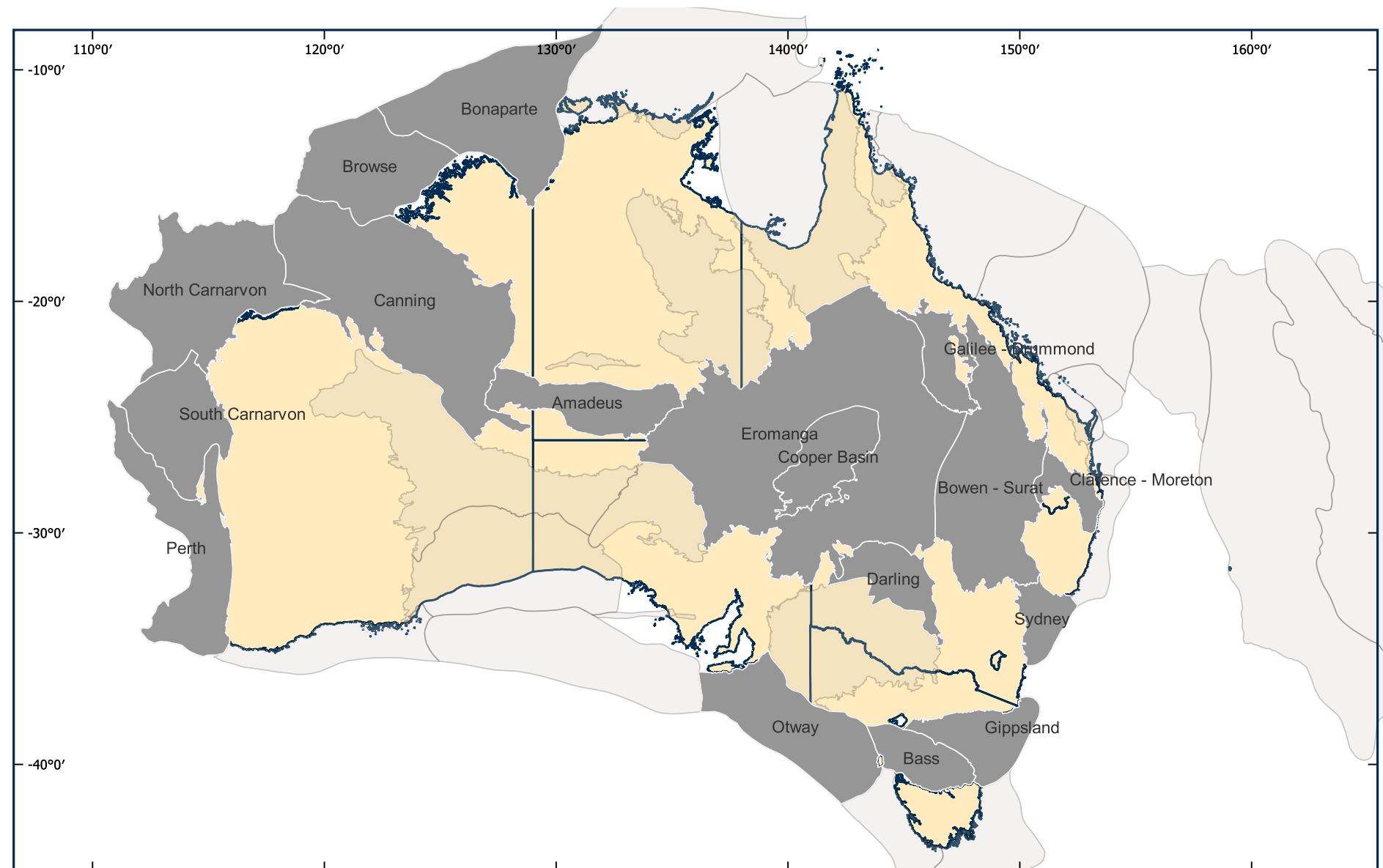
SCENARIO PATHWAYS MODEL 348GT TO 1,218GT CO₂ TO BE STORED THIS CENTURY



Global status of CCS: 2021 - Conclusions

-  Define the role of CCS in meeting national emissions reduction targets and communicate this to industry and the public
-  Create a long-term, high value on the storage of CO₂.
-  Support the identification and appraisal of geological storage resources.
-  Develop specific CCS laws and regulations that include the transfer of liability to the government subject to acceptable performance and behaviour of the stored CO₂.
-  Identify opportunities for CCS hubs and facilitate their establishment.
-  Provide capital grants, low-cost finance and/or guarantees to reduce the cost of capital for CCS investments.

AUSTRALIAN STORAGE BASINS



Australian Sedimentary Basins

■ Storage Basins ■ Sedimentary Basins

Source of basin outlines: Geoscience Australia
Cooper Basin shown overlain the Eromanga Basin
for stylistic purposes only.

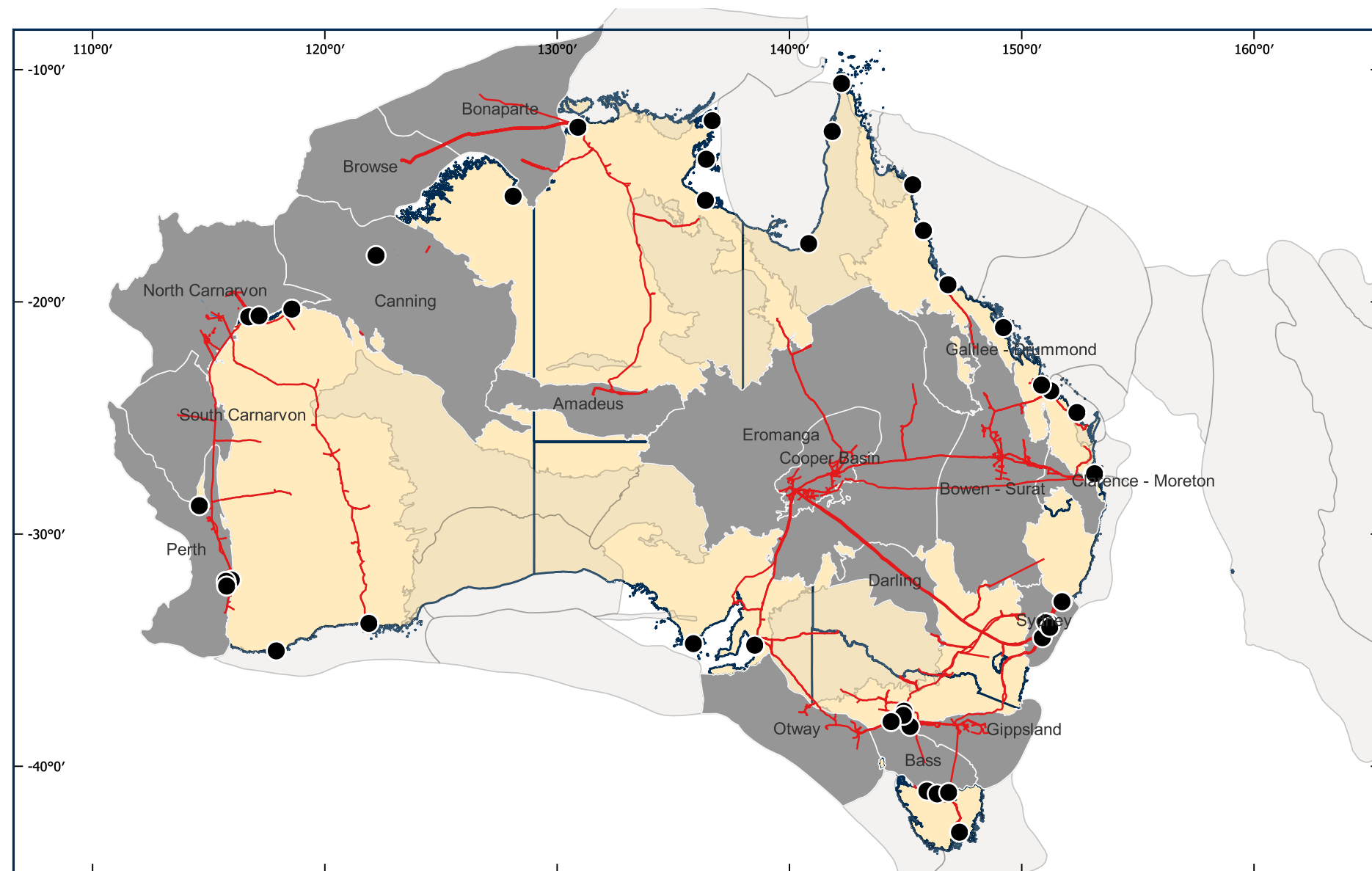
Global CCS Institute's Storage Assessment Tool

- Criteria-based system
- 70 Criteria

Outputs

- Ranks Basin
- Qualifies basins as Highly-Suitable to Unlikely

AUSTRALIAN STORAGE BASINS



Australian Sedimentary Basins

■ Storage Basins ● Liquid Fuel Terminals
■ Sedimentary Basins — Oil and Gas Pipelines

Source of basin, terminals and pipelines:
Australian Government
Cooper Basin shown overlain the Eromanga
Basin for stylistic purposes only.

Global CCS Institute's Storage Assessment Tool

- Criteria-based system
- 70 Criteria

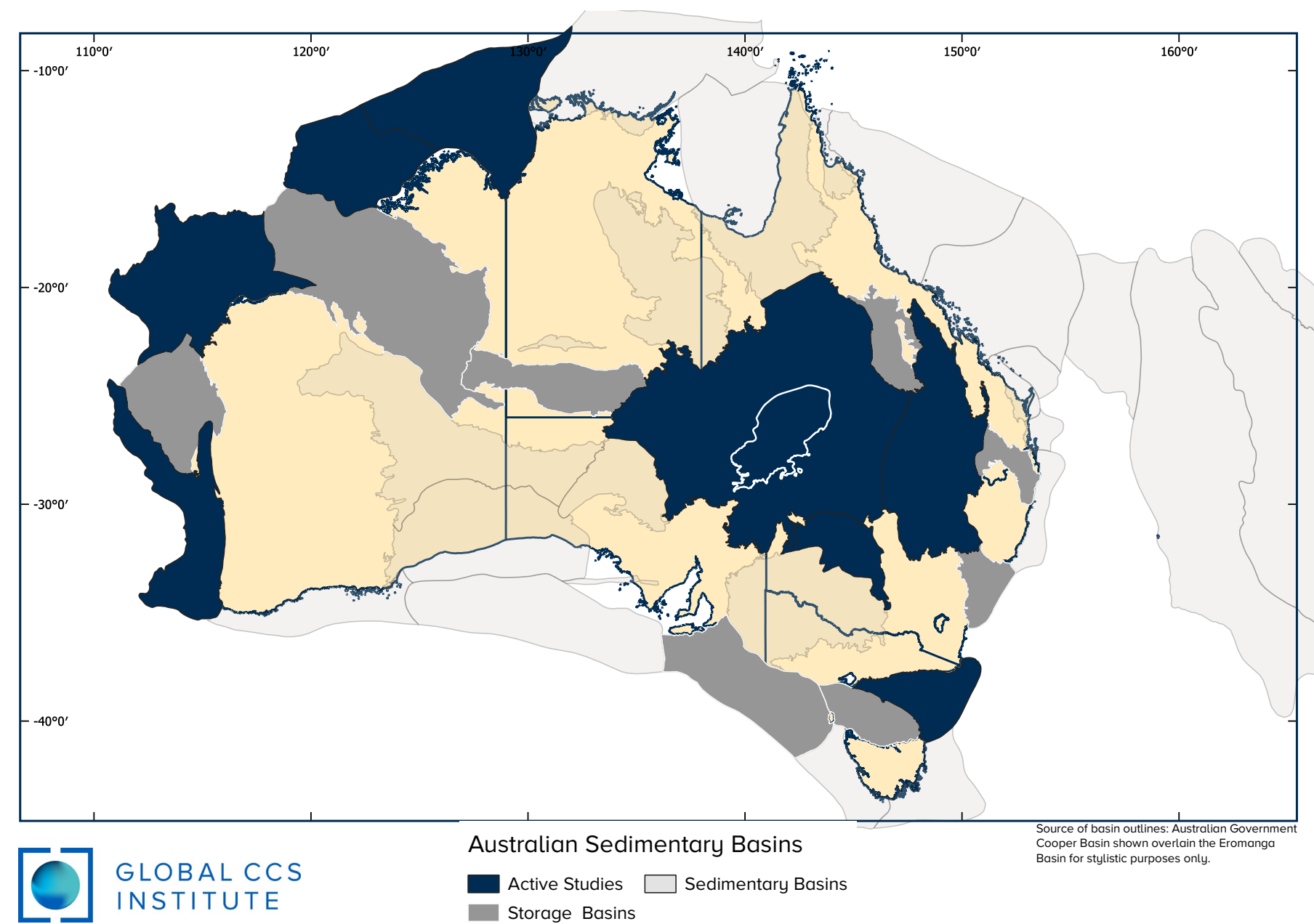
Outputs

- Ranks Basin
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International Import?

STORAGE PROJECTS IN AUSTRALIA

STAGES: EXPLORATION, APPRAISAL, CONSTRUCTION, INJECTION



INJECTION RATES ARE HIGH

Northern Carnarvon Basin (Chevron)

- 3-4 million tonnes per annum (MTPA)

Surat Basin (Garnett et al 2013):

- 0.2 to 2.4 MTPA CO₂ across the 4 areas

Gippsland Basin (CarbonNet)

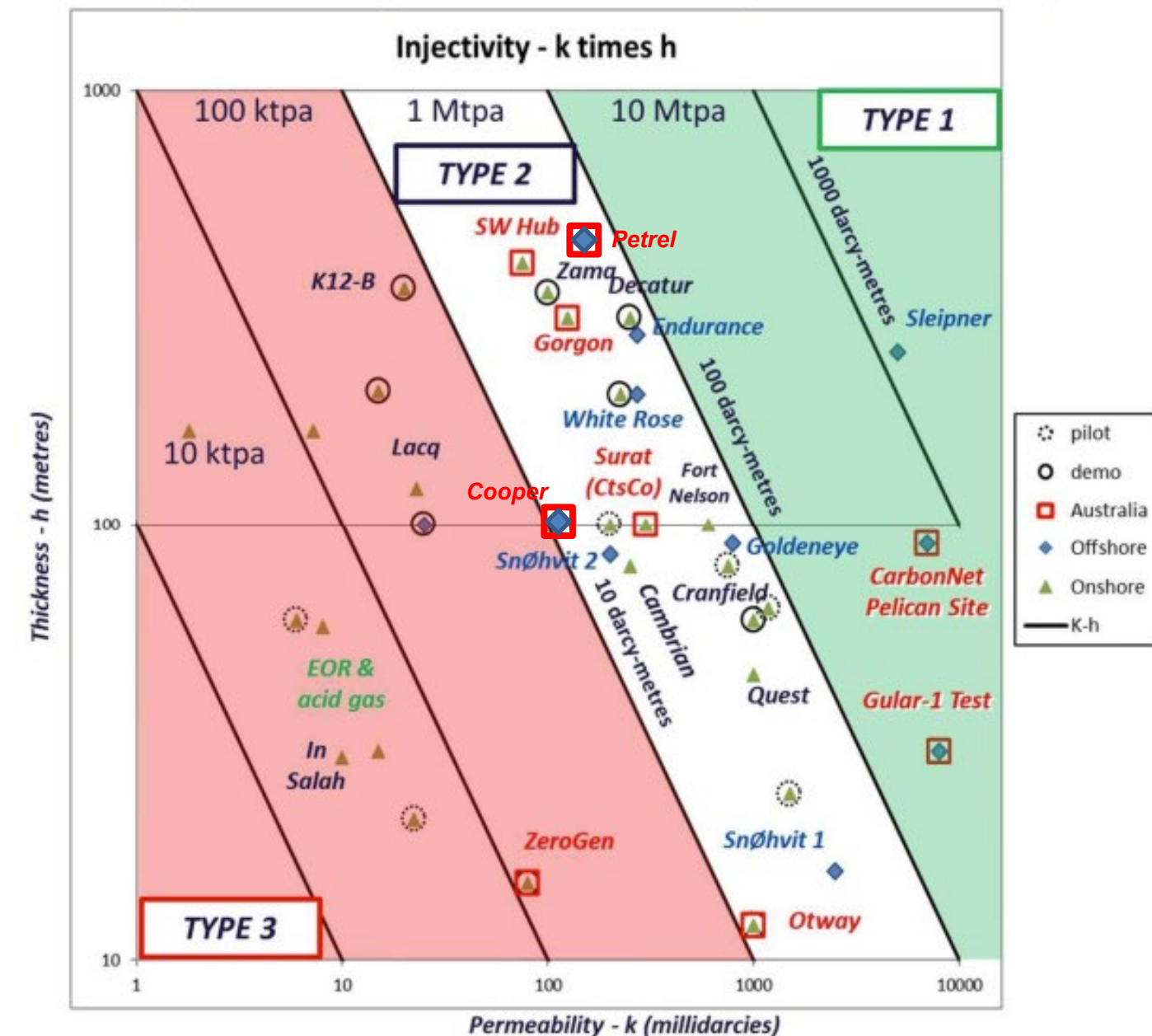
- 10 MTPA CO₂ based on an appraisal well at the Pelican Storage Site

Cooper Basin (Santos)

- 20 MTPA CO₂ based on well data and oil production data at the Moomba Site

Bonaparte Basin (Clennell et al. (2017); GA, CSIRO, Shell, ENI

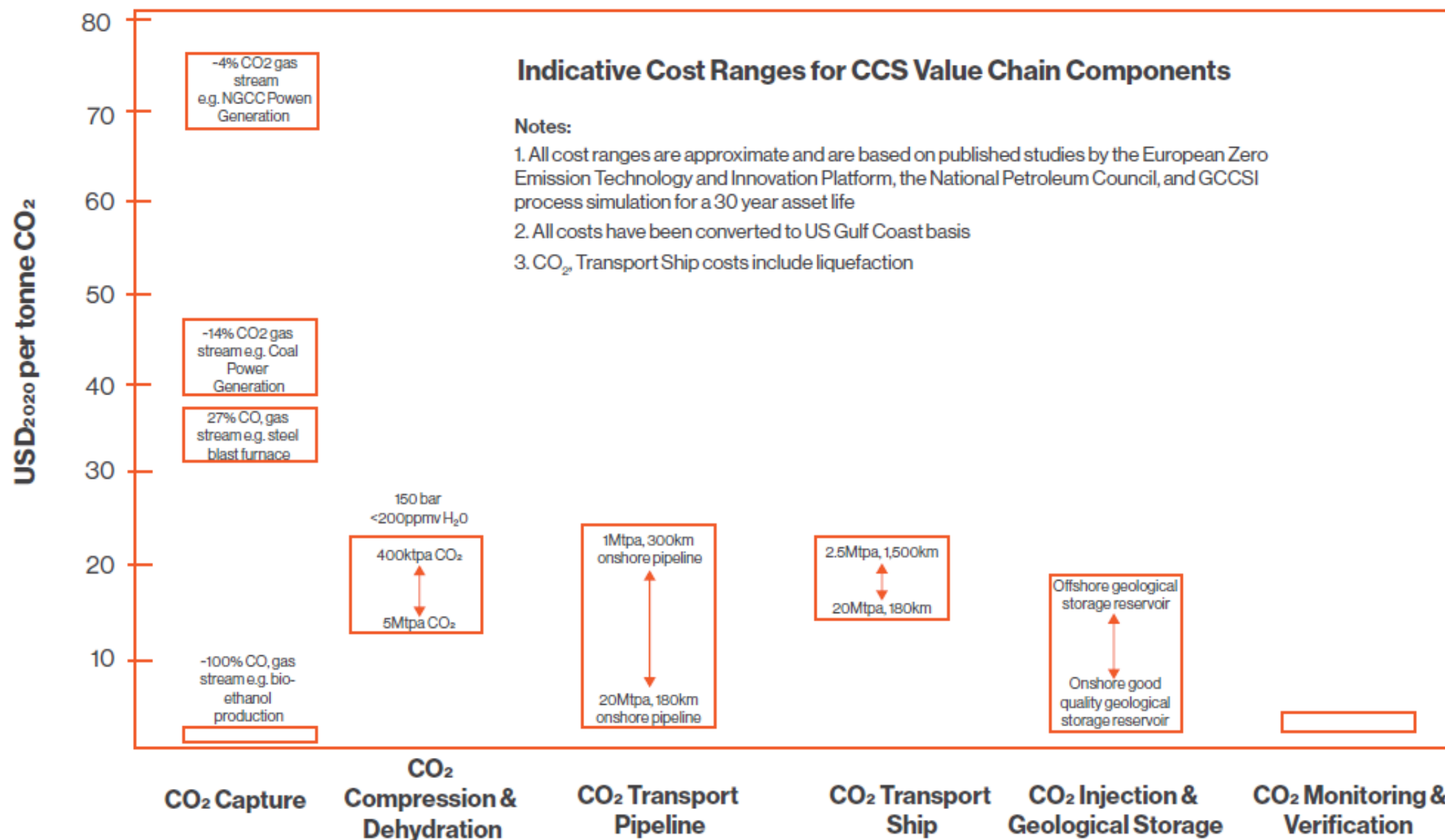
- 2.0 - 7.5 MTPA CO₂ based on limited data and a dynamic



Injection rates globally with examples with Australian examples shown in Red Boxes, courtesy of Nick Hoffman, CarbonNet

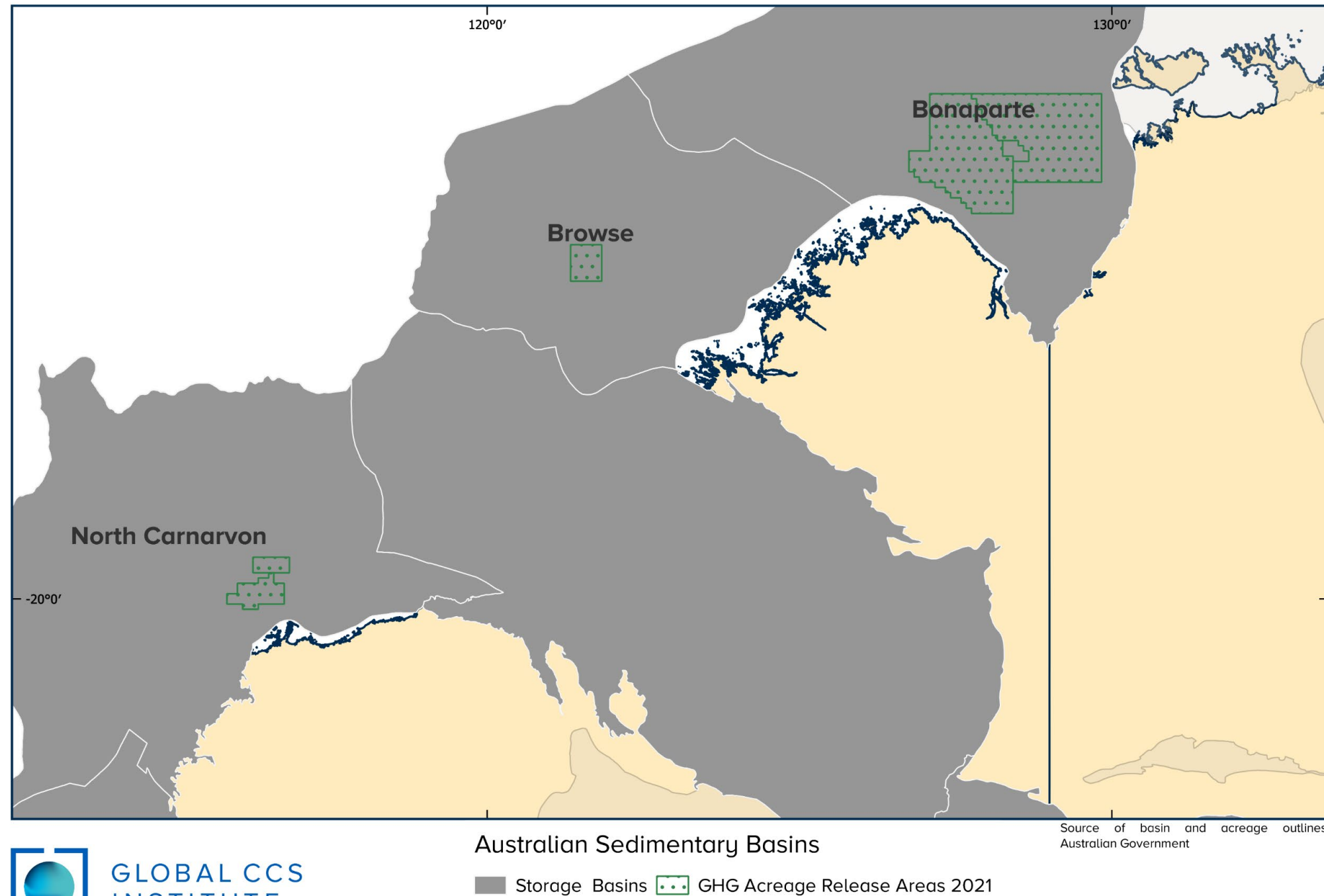
COST OF TRANSPORT AND STORAGE

- Capture and transport are dependent on scale and concentration
- Storage is dependent on location, injection rate and plume footprint?



Australia is currently ranking at the high end for offshore (do to distances) and comparable for onshore

2021 ACREAGE RELEASE



2021 Acreage Release

- Five offshore areas are available
- Geoscience Australia holds a wealth of information

Key aspects in the successful work programme

- Injectivity
- Quality and extent of reservoir and seal
- Capacity
- Containment
- Monitoring

Submission

- National Offshore Petroleum Titles Administrator
- Work program bds accepted between 4 – 10 March 2022
- Competitive Process
 - Work Programme

2021 ACREAGE RELEASE

Current Permits held by

- CarbonNet Gippsland Basin, Victoria– Declaration of Storage
- CTSCo Surat Basin, Queensland
- Santos Cooper Basin, potentially under an existing licence

Bonaparte

- 32 – 88 GtCO₂ (Carbon Storage Taskforce 2009)
- Overlies the Petrel and Tern Fields
- Highly-suitable reservoir seals, unproven (moderate confidence)

Browse

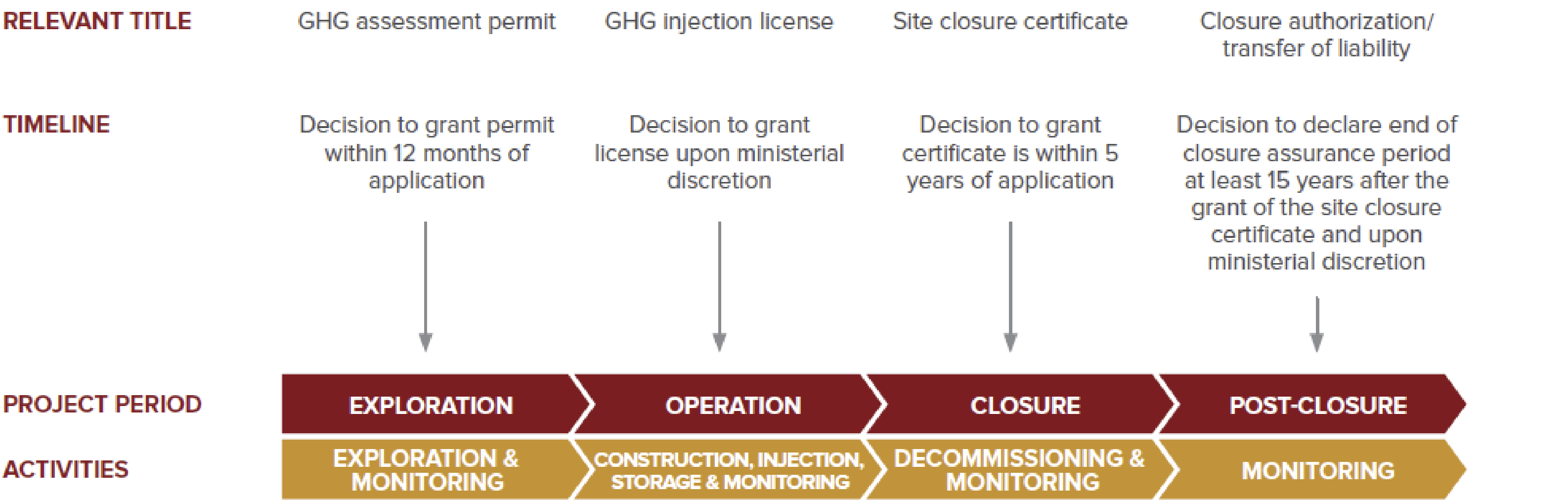
- 7.0 – 16.3 GtCO₂ (Carbon Storage Taskforce 2009)
- Overlies Woodside Browse FLNG (Brecknock-Calliance Fields) currently under development
- Permits not within suitable areas (from previous studies)

Northern Carnarvon

- 25.5 – 89.3 GtCO₂ (Carbon Storage Taskforce, 2009)
- Stacked reservoir-seal pairs
- Located within oil and gas fields
- North of Gorgon

PERMITTING THROUGHOUT THE PROJECT LIFECYCLE

Australian Commonwealth regime



ACREAGE RELEASE -AUSTRALIA

ACCESS AND RIGHTS TO THE SUBSURFACE

- **The Australian Commonwealth government retains sovereign rights over the waters beyond the coastal waters of the States:**
 - Australia's exclusive economic zone and continental shelf
 - For the purpose of exploring for and exploiting natural resources.
- **Exploration or injection activities are prohibited in offshore Commonwealth waters, without first obtaining the relevant titles established under the OPGGSA.**
- **Release of acreage, within the Commonwealth's offshore waters, is the starting point for the site selection process.**
- **Nomination of areas from interested parties, including private companies and State and Territory governments:**
 - Sites are subsequently shortlisted as potential sites for GHG exploration
 - Geoscience Australia then prepares geological data
 - Consideration of any potential conflicts.
- **To date, there have been three greenhouse gas storage acreage release processes.**

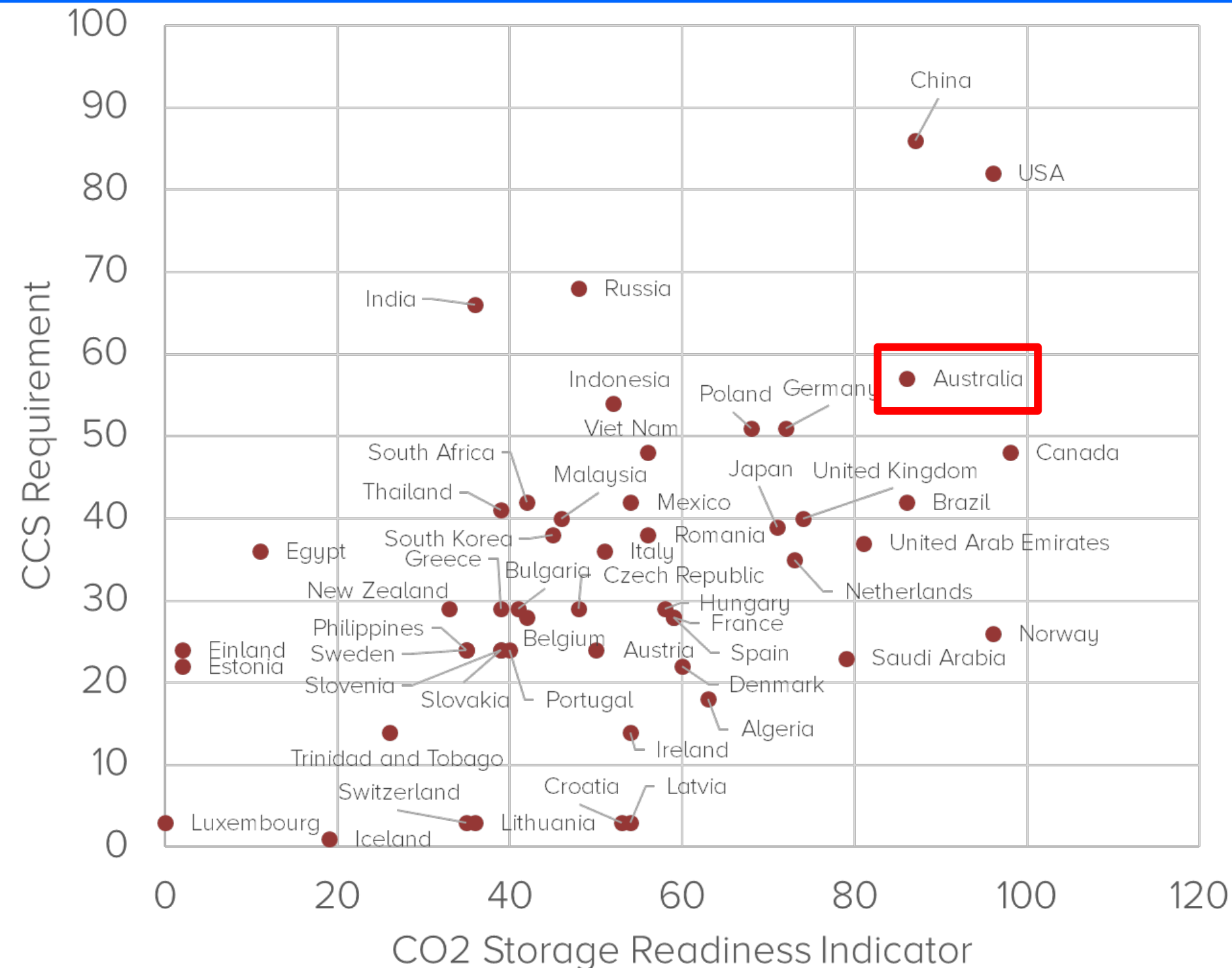
EXPLORATION –AUSTRALIA (COMMONWEALTH)

- To explore for a potential GHG storage formation, an application must first be made to the Minister for a GHG assessment permit.
- A GHG Assessment Permit enables a holder to undertake exploration activities for identifying potential storage sites:
 - Granted through a competitive tender process
 - Application is to be made to Minister based on either work or cash-bid
 - Rights to appraise a formation, under the permit, include the right to inject and store CO₂
 - Duration of 6 years, with the possibility of renewing the permit for a further 3 years.
- **Additional approvals are also required:**
 - An applicant is required to obtain approval from the Minister to undertake a key "GHG operation".
 - To ensure full consideration is given to the impact upon petroleum exploration and production activities and that there is no "significant risk of significant adverse impacts"
 - Environmental environment plan to be approved prior to undertaking a GHG activity.
- **Applicant may apply for a GHG holding lease to retain an area, which has been the subject of an assessment permit until they are able to commence injection and storage activities.**

INJECTION LICENCE – AUSTRALIAN OFFSHORE REGIME

- **Injection and storage activities are to be carried out under a GHG injection licence:**
 - Authorises permanent storage of CO₂
 - Granted in relation to storage formations which have been "declared" by the Minister as an identified GHG storage formation.
- **A licence application must contain information relating to the applicant's proposed activities, as well as their technical and financial resources.**
- **Three plans are to be submitted and approved as part of the approvals process:**
 - Site plan
 - Decommissioning plan
 - Environmental plan.
- **In granting a licence, the Minister must be satisfied that there will be no "significant risk of a significant adverse impact" on certain petroleum titles.**
- **The information to be specified in the licence, includes details of:**
 - GHG substance to be injected and its origins
 - The proposed period of injection
 - Volume of GHG substance to be injected.
- **Term of the licence is indefinite; however, injection must occur within 5 years.**

CO₂ STORAGE “READINESS”



CRITERIA

- Geology
- Storage Potential
- Knowledge and Data
- Maturity
- Accessibility
- Injection and Storage

De-risking storage sites is one of the key drivers to the deployment of carbon capture and storage projects. (policy and regulations being the other)

AUSTRALIAN STORAGE OVERVIEW

Highly-suitable or suitable storage basins in each state and territory (apart from ACT/NSW)

- The large offshore basins off Victoria, northern and central WA and the NT provide a significant opportunity for multiple large-scale CCS facilities
- Multiple storage basins are also present inland from the central and southern Qld, as well as in central Australia (Qld and SA)
- Limited opportunities are present in southern Western Australia and New South Wales

Basins likely host 1000's of years of CO₂ injection and storage, with low-moderate confidence in estimates

- Conclusion based on broad-scale studies between 2008-2015
- The potential storage areas (next slides) have moderate-high confidence in estimates.

The proven viability of storage reservoirs and individual sites for storage is unknown across most of Australia

- A national site-scale, a storage-focussed programme is required

A strong regulatory framework and acreage release available

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