deepCstore

Development of long-distance & large-scale CCS value chain using liquefied CO_2 ship transportation

23rd May 2024

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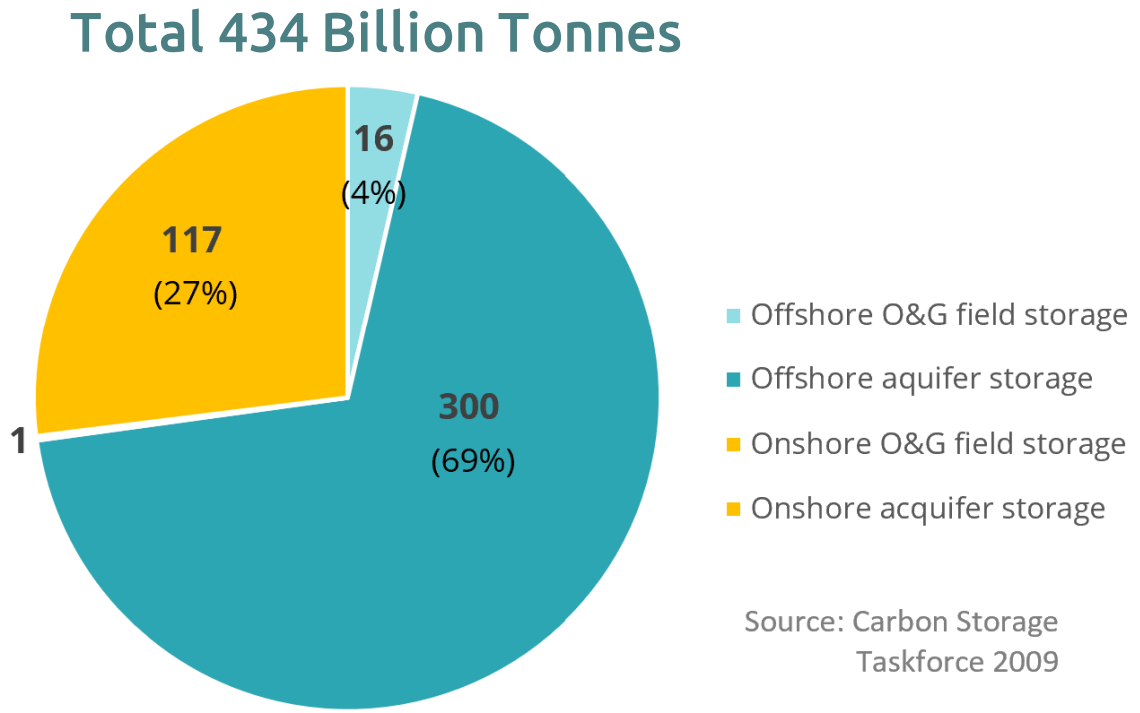
Agenda

- Context
- Technical
- Commercial
- Policy & Regulation
- Conclusion

Why CO_2 Storage in Australia?

- With net emissions in 2020 being ~500 million tonnes CO_2-e*, Australia has ~870 years worth of storage.
- 73% (316 billion tonnes) of its CO_2 storage resource capacity resides offshore.
- CO_2 storage acreages accessible, with well established CCS legislation & regulation.

* Source: "Australia's NDC Communication 2022" (Commonwealth of Australia)

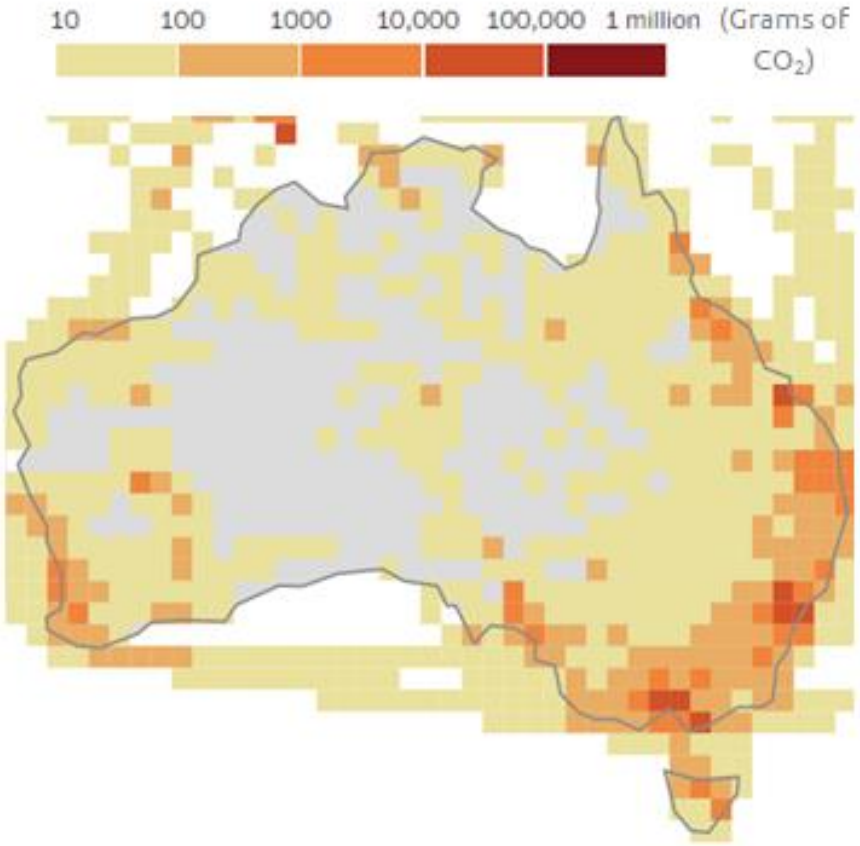


Key Challenge for Reducing Emissions is “Distance”

Prospective CO_2 Storage Sites

Source: Commonwealth of Australia (DISER) 2021

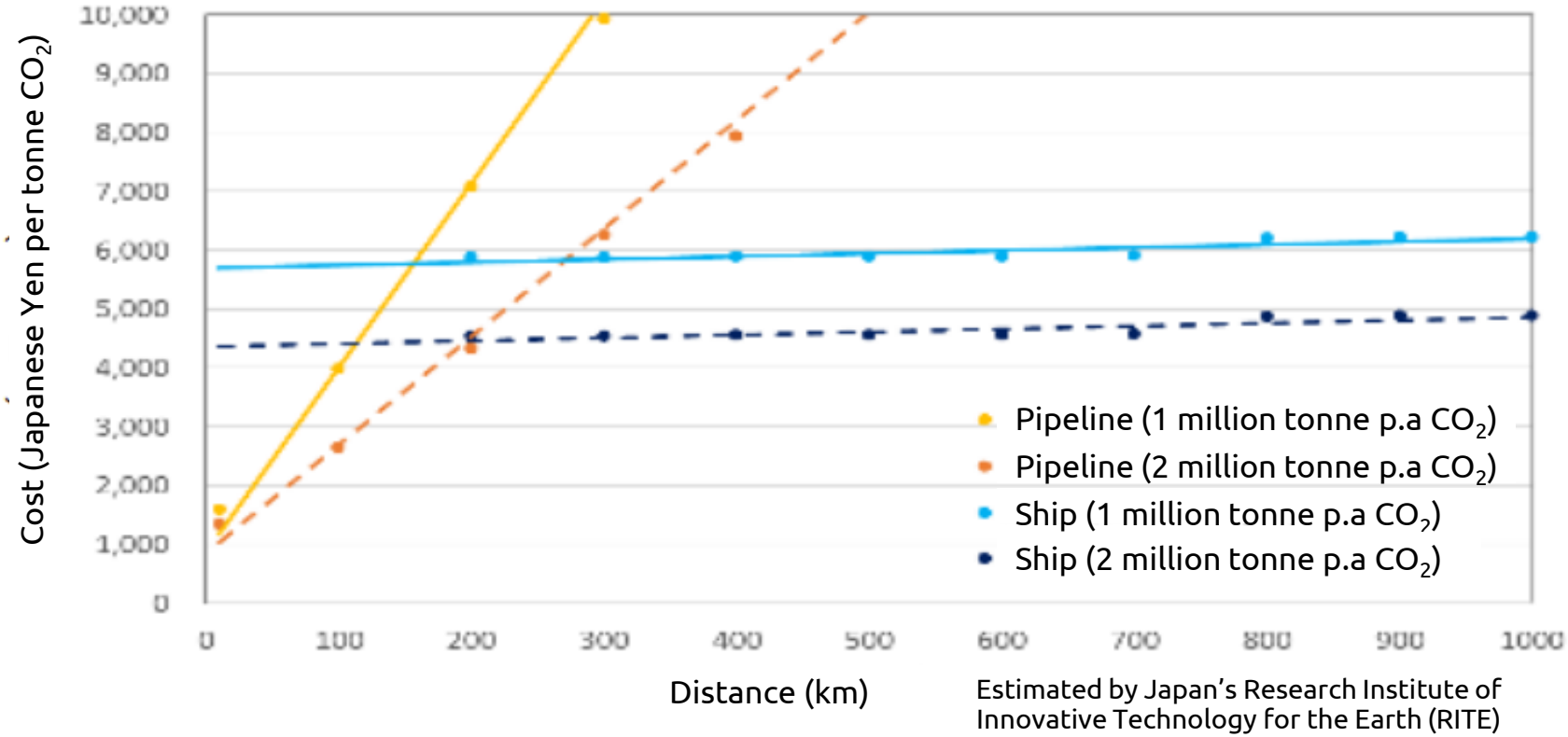
CO_2 Emissions (2001 to 2012 mean)



Source: The Washington Post 2015

Relationship of CO_2 transport volume, distance & cost

- "Upon exceeding 200km, shipping can be lower cost."*
- "Technical capability to manage 'low temperature & low pressure' large volume liquefied CO_2 ship transportation is essential." *



Estimated by Japan's Research Institute of Innovative Technology for the Earth (RITE)

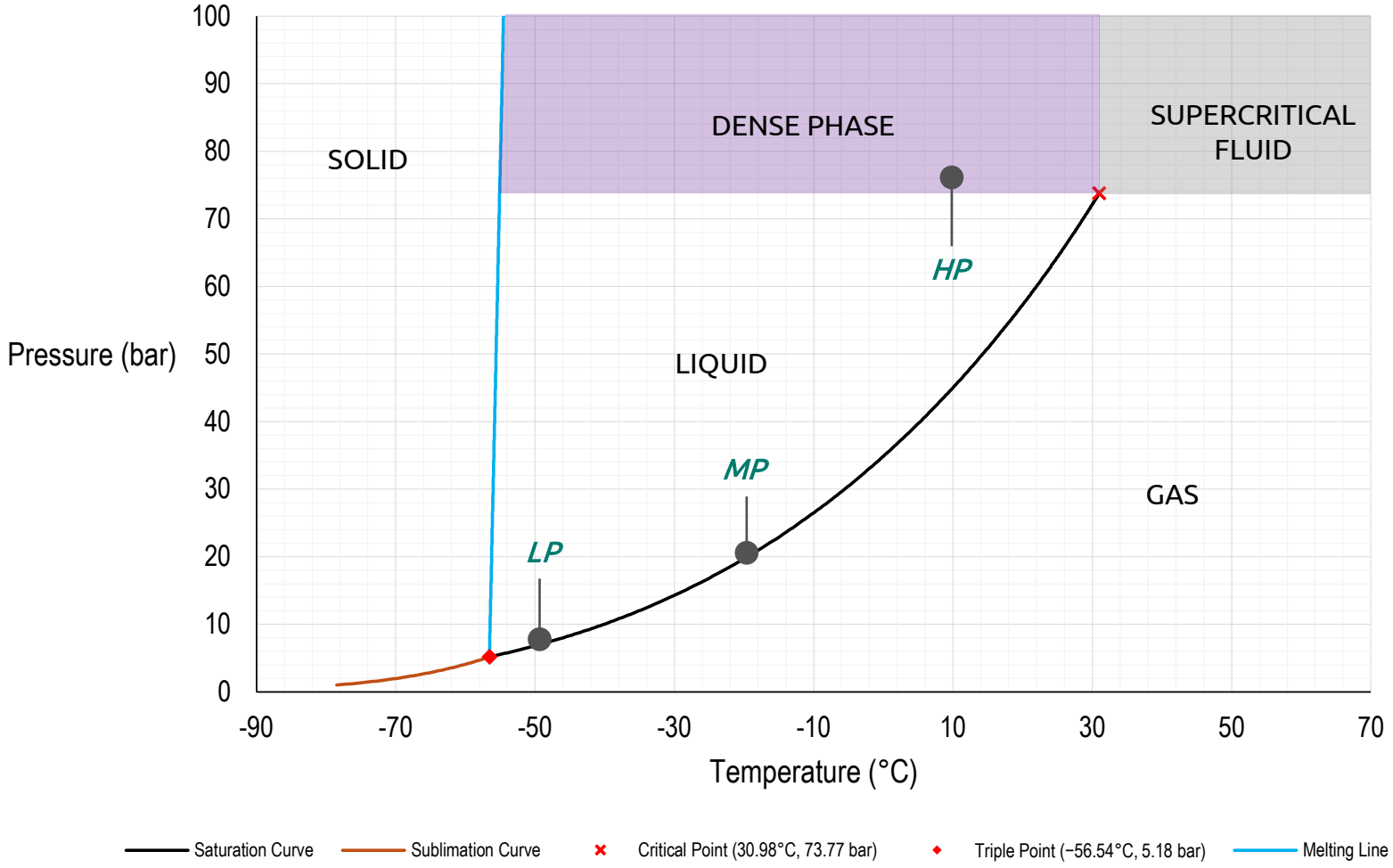
** From "CCS Long-term CCS Roadmap Investigative Commission Interim Summary" report (page 17), Japanese Government (METI), 2022*

Key technical decisions

- Liquefaction condition
- CO_2 supply specification
- LCO_2 ship parcel size

Liquefaction condition

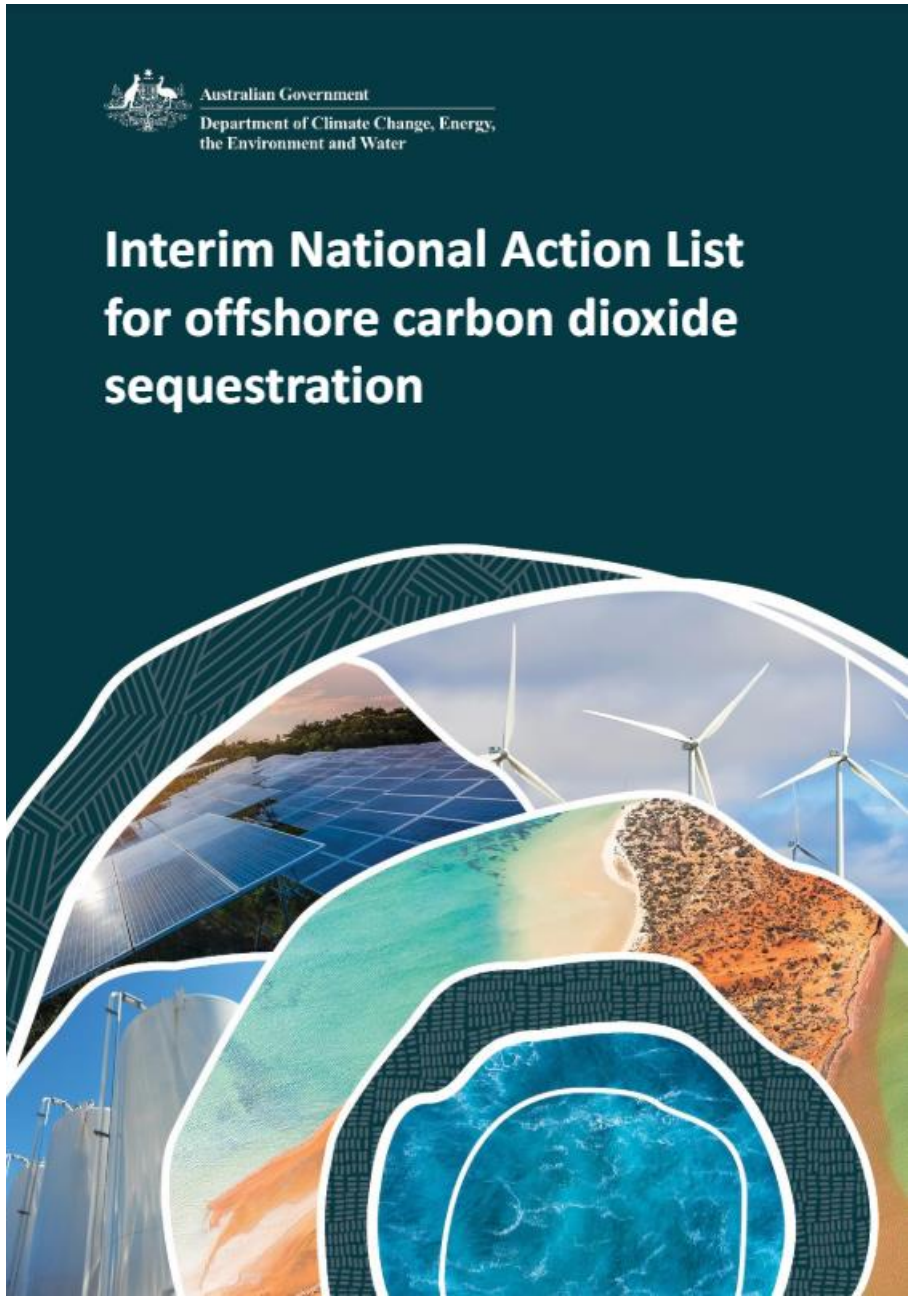
- Pressure ↑ = tank wall thickness & tank unit cost ↑
- LP & MP: Light ends reduced to soluble levels (CO_2 ~99+%). BOG from liquefaction needs to be managed.
- HP: Light ends will not drop out (CO_2 ~96+%)



CO_2 specification

- DCCEEW issued the Interim National Action List.
- Prior to liquefaction: Identical for LP, MP & HP
- Post liquefaction: Provided specification is adhered to prior to liquefaction, there is no requirement for compositional control

deepC Store invites participation in DCCEEW's stakeholder consultation to finalise National Action List.



LCO_2 ship parcel size

- Key premises
  - Deliver full cargoes
  - Unloading per ship < 24 hours
- Optimise unit cost & operability
  - Annual offtake volume
  - Distance
  - Number of ships & utilisation rate
  - Utilisation rate & tank size of facilities
  - Ship design standardisation

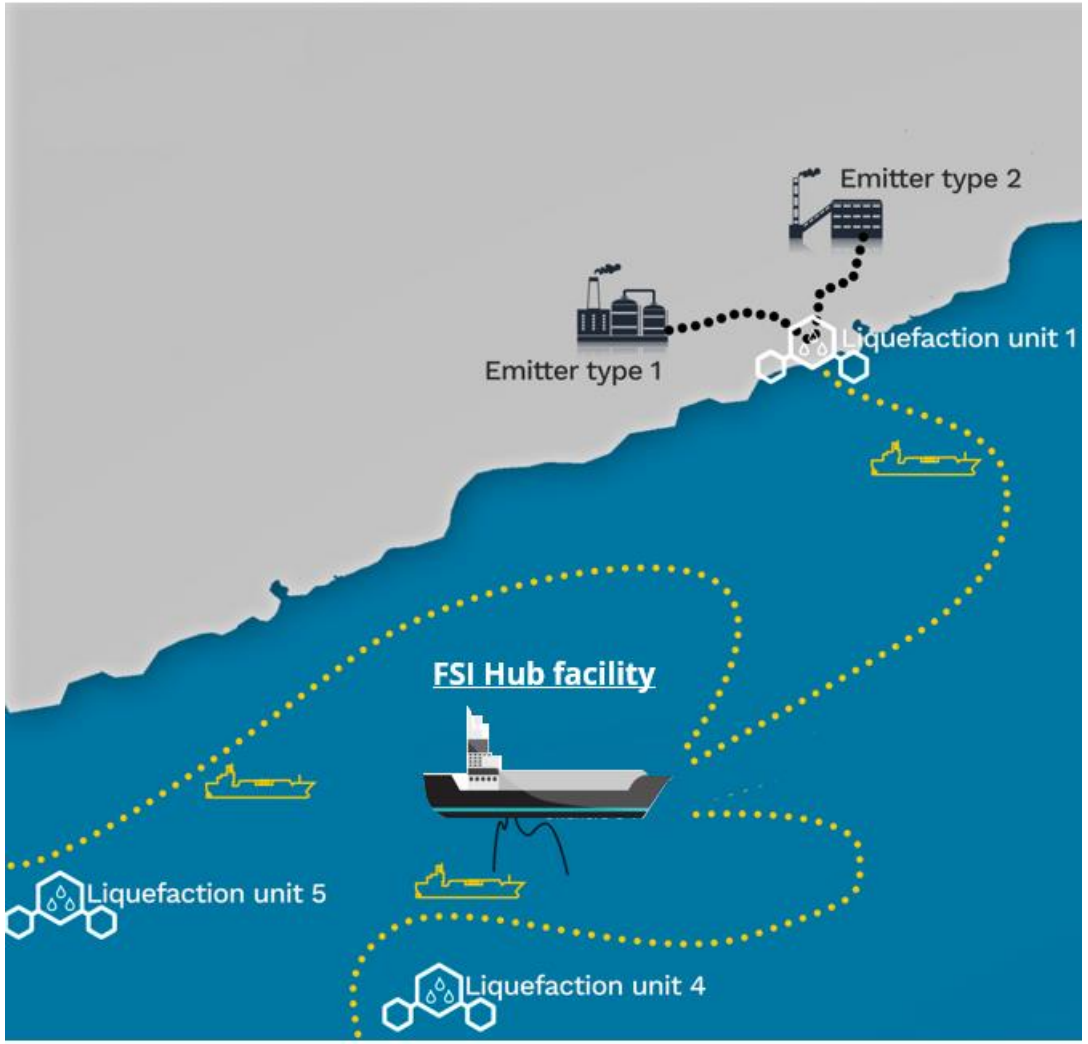


Image of CStore1 (courtesy to Technip Energies)

Key Commercial Considerations

- Business models
- Key EPC & operations risks & opportunities

Business models

- 230 MTPA (>1% annual global emissions) used by fertiliser industry, EOR, etc (IEA, 2019).
- Setting aside CO_2 being used, captured CO_2 has limited commercial value. Instead, value is derived from regulatory constructs that allow for monetary value generation:
  - carbon tax
  - “cap & trade” mechanism
  - tax credit
  - subsidy for CCS

Key EPC & operations risks & opportunities

- Majority are known & manageable by industry.
- "Who owns the CO_2 injected" is also important.

Risks	EPC cost / schedule overrun & performance risks
	Delivery / offtake risks (volume & specification)
	Asset damage / loss risks (FM & non-FM events for EPC & Ops)
	Payment risks
	CO_2 price risk
	Environmental (remediation & 3rd party) liabilities for CO_2 release
	Decommissioning liabilities
	Long-term sequestration liability
Opportunities	Under-run of EPC schedule &/or cost
	Excess CCS volume / capacity
	CO_2 price upside
	Residual value of facilities after initial contract duration

CCS Specific

Key Policy & Regulatory Considerations

- Comparative assessment across key jurisdictions
- Actions for nations to enable transboundary CCS

Comparative assessment across key jurisdictions*

- USA, EU, others are offering favourable incentives.
- Access to funding & talent is influenced by global competition.

	EU	USA	Australia	Malaysia	Indonesia	Japan
Enabling legislation and rules	●	●	●	●	●	▲
Cost reduction measures	●	●	▲	●	●	▲
Carbon pricing measures	●	▲	▲	▲	▲	▲
Strategic signalling by government	●	▲	▲	▲	▲	●

● Sufficient measures in place

▲ Measures insufficient

* Based on deepC Store's assessment using IEA's categories from "CCUS Policies and Business Models" (IEA, 2023)

Actions for nations to enable transboundary CCS

- Submit instrument of ratification & declaration of provisional application to IMO
- Execute bilateral agreements between CO_2 supply & storage nations

deepC Store invites support to earn social license for transboundary CCS

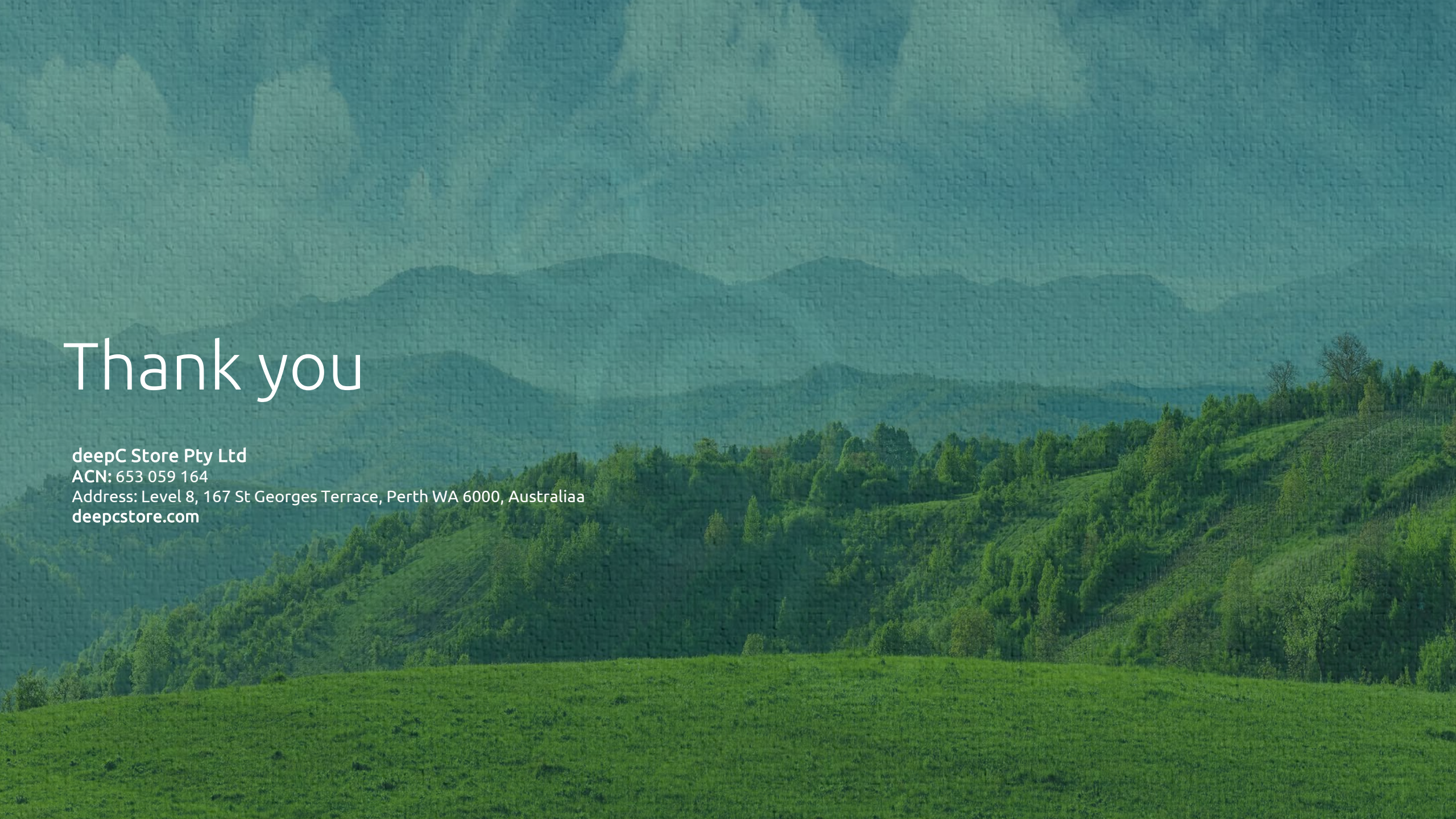
Conclusion

- Developing large-scale CCS values chains via LCO_2 ship transportation is essential to unlock the full potential of offering CCS to all industrial sectors.

- Ongoing collaborative effort is needed among governments, CO_2 suppliers, CCS project proponents, & industry to enable domestic & transboundary CCS value chains.

Acknowledgements

- Members of deepC Store Pty Ltd
- CStore1 Partners (in alphabetical order)
  - ABL Group
  - CSIRO
  - JX Nippon Oil & Gas Exploration Corporation
  - Kyushu Electric Power
  - Mitsui OSK Lines
  - Osaka Gas, Osaka Gas Australia
  - Technip Energies
  - Toho Gas
- PGS ASA, & Azuli (Australia) Pty Ltd



Thank you

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