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Carbon Capture and Storage in SE Asia

Opportunities and Challenges

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CCS-M Workshop (C2W1): Malaysia Case Study
2-4 June 2015, Kuala Lumpur, Malaysia



Status of CCS: SE Asia





CCS IN SE Asia-projects and programs

- Pre-feasibility and storage study for Gundih pilot scale project completed in Indonesia
- PETRONAS announced large-scale CCS project with dedicated storage associated with EOR
- Vietnam EOR pilot project
- The Coordinating Committee for Geoscience Programmes in East and Southeast Asia (CCOP) regional storage programme
 - Cambodia, Indonesia, Lao PDR, Malaysia, Philippines, Thailand, Viet Nam
 - Storage Atlas



CCS IN SE Asia-programs and publications

- *Prospects for Carbon Capture and Storage in Southeast Asia*, and associated country-level scoping studies, prepared by ADB for:
 - Indonesia, Philippines, Thailand, Viet Nam
- *Understanding carbon capture and storage potential in Indonesia* November 2009, prepared by Indonesia CCS Study Working Group
- *Permitting Issues Related to CCS for Coal-Based Power Plant Projects in Developing APEC Economies*
 - Indonesia, Malaysia, Philippines, Thailand, Viet Nam
- Malaysia CCS Scoping Study, followed by development and implementation of capacity development program
- Malaysia permitting matrix Malaysian CCS legal and regulatory workshop report
- Malaysia working towards *CCUS R&D Roadmap* – planned testing of CO₂ capture technologies on operational coal-fired power plant



Enabling CCS Projects





Global Status of CCS: 2014

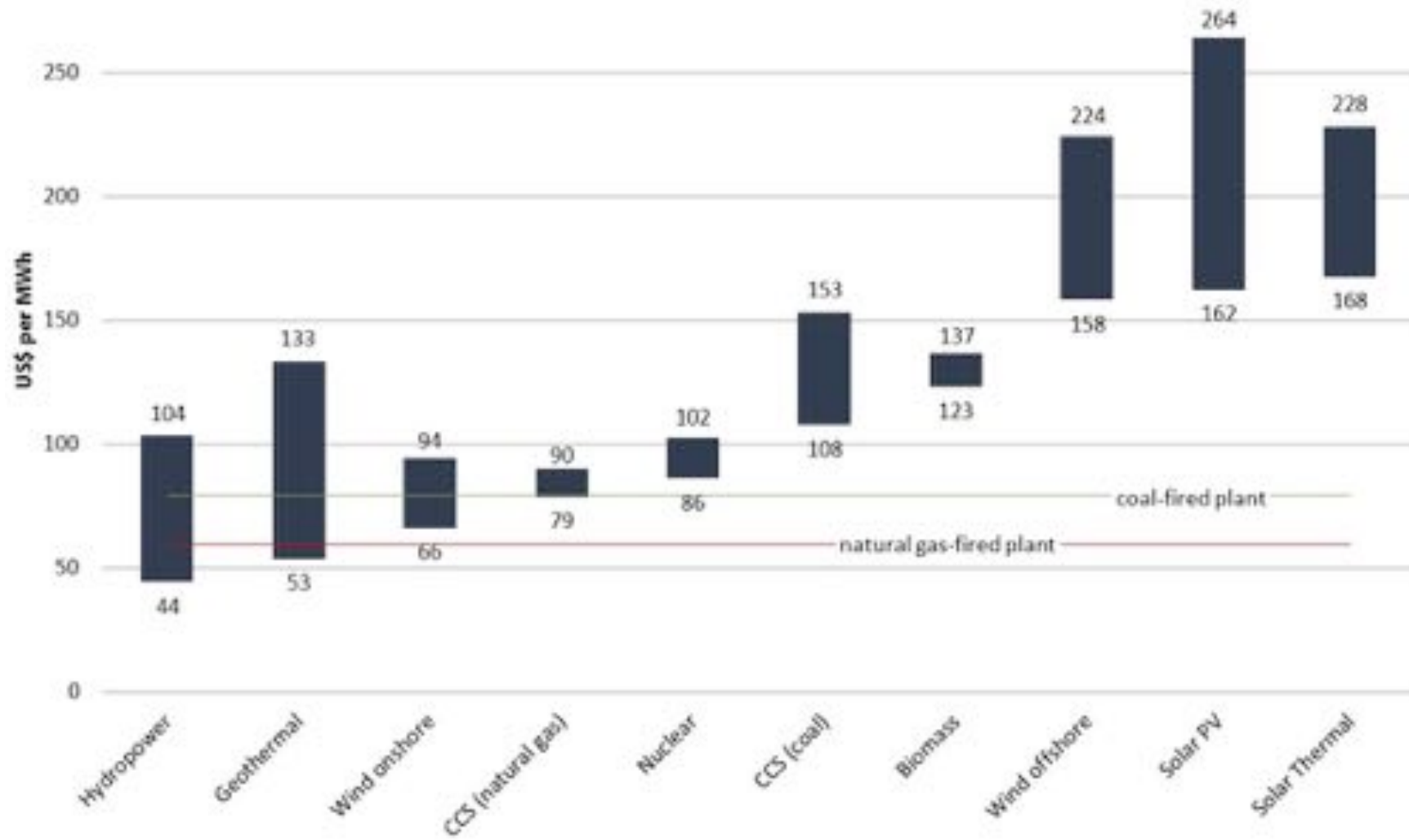
Recommendations:

1. Financial and policy support structures needed in the near term
2. Strong, sustainable emission reduction policies-encourage CCS
 - Policy predictability for investors
 - CCS is not disadvantaged
3. Policies and funded programs for storage exploration and appraisal
4. Devoted effort to knowledge sharing, capacity development and the implementation of other policies and legal frameworks
5. Urgent attention to development of policies that incentivise industrial CCS



Financial support- perceptions versus reality

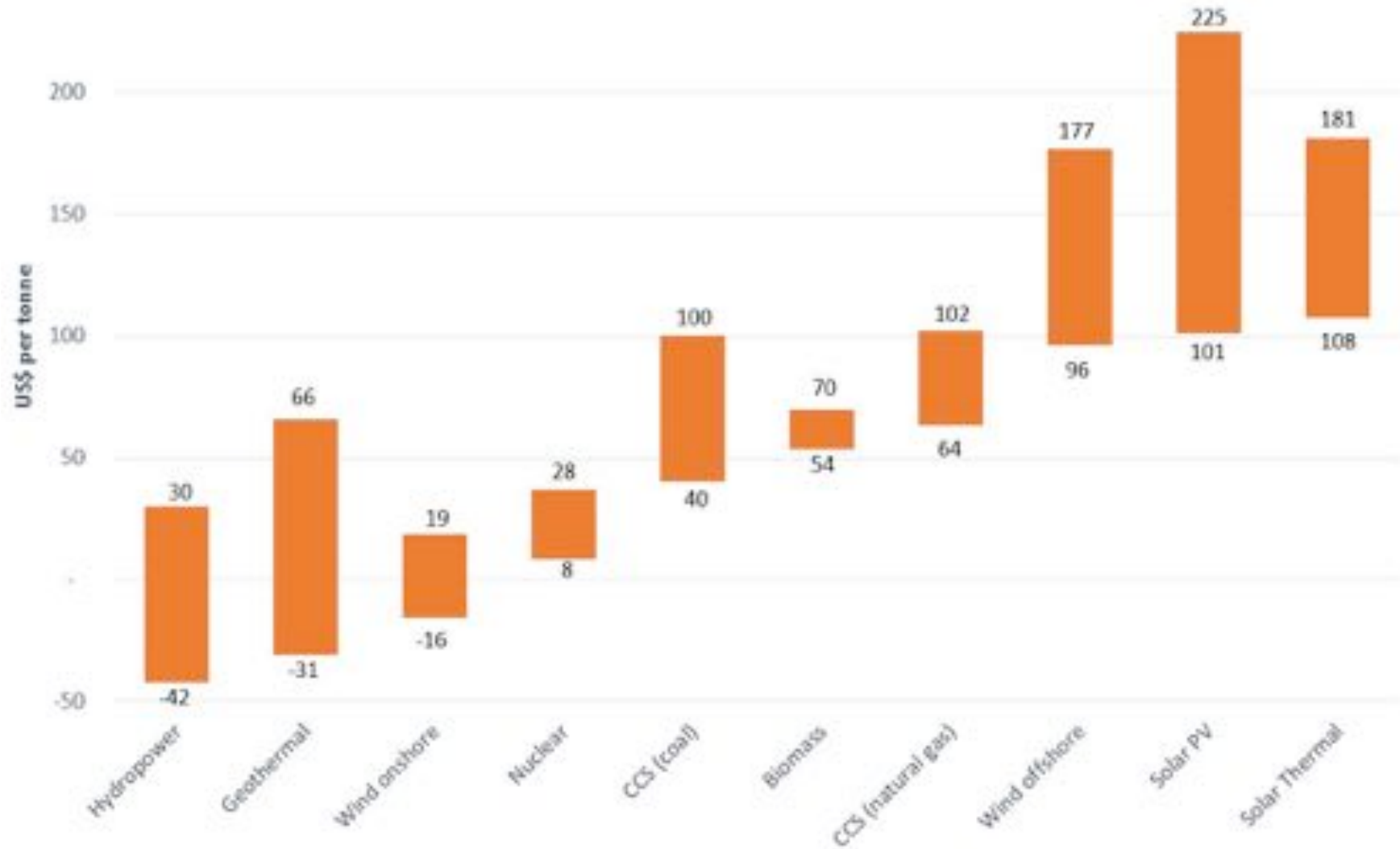
Power generation levelised costs





Costs- abatement versus development

Power generation costs of CO₂ avoided





Policy and financial support structures

Encourage CCS, provide investor stability

Clean energy investment* between 2004-2013 (USD):

CCS:
20
billion

All clean
energy:
1929
billion



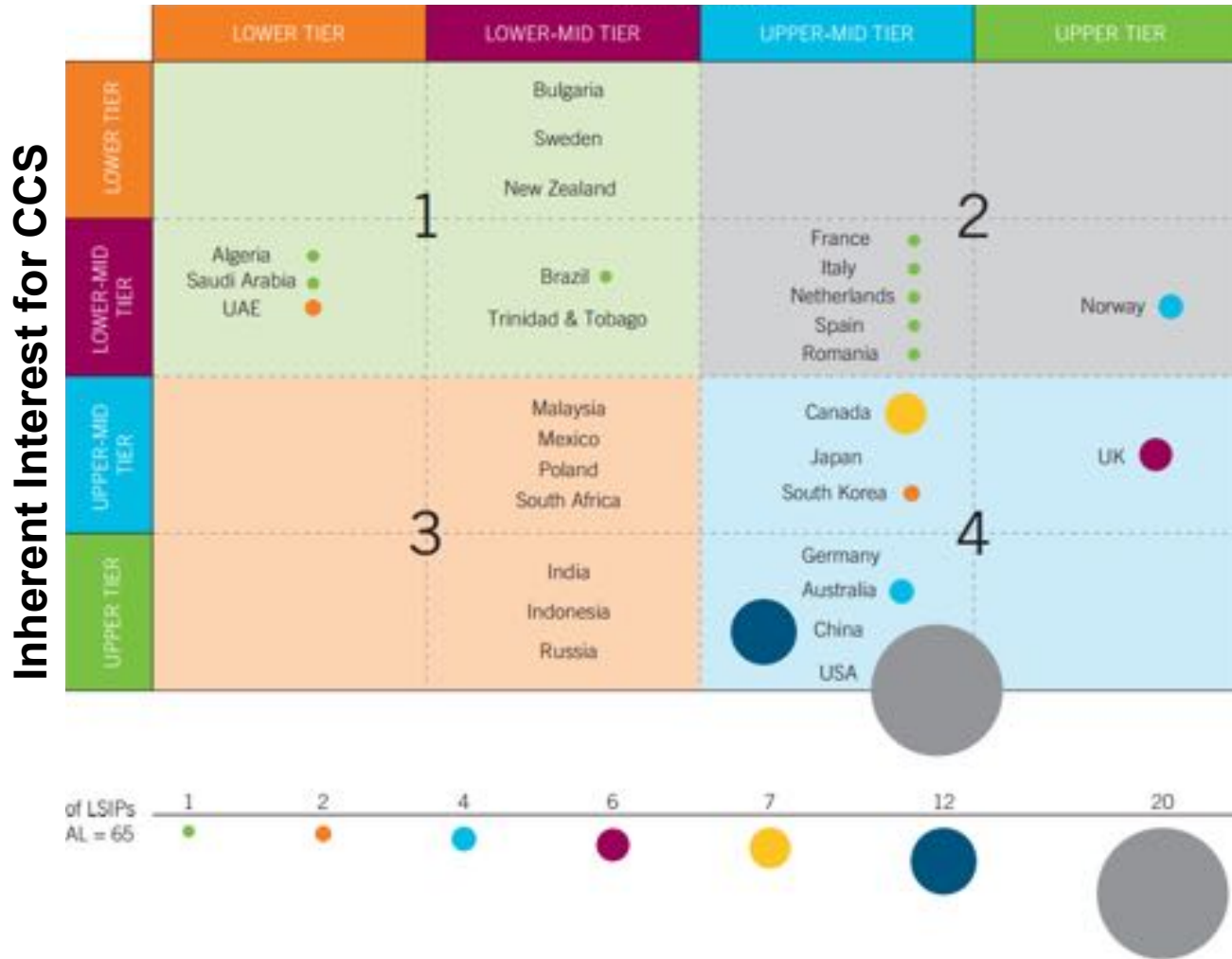
* Includes technology development, projects, M&A. Source: BNEF.

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Policy: nationally, locally?

CCS Policy Index



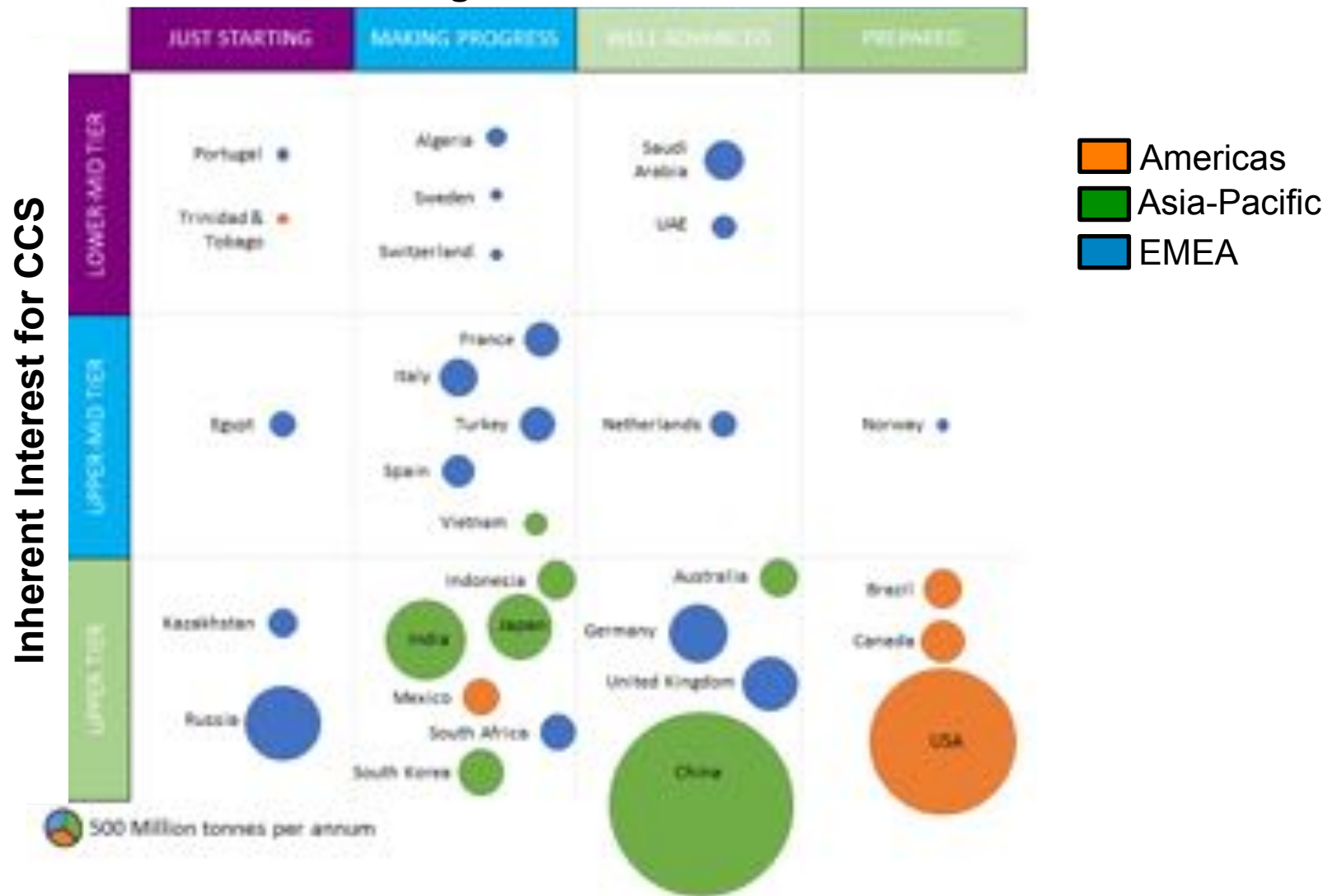
SE Asia: Quadrant 3

- High emissions/
reliance on fossil
fuels
- CCS policy
underdeveloped
- Gain from second-
generation
- Focus on capacity
development and
strengthening CCS
intuitions



Need storage exploration and appraisal

Storage Readiness: 2014





Incentivise industrial CCS

Advanced, innovative and accessible natural gas extraction, processing, transport and use- an obvious target



Source: IEA WEO 2013

This map is without prejudice to the status of or sovereignty over any territory, to the delimitation of international frontiers and boundaries and to the name of any territory, city or area.

* Facilities with expansions under construction or planned.



Opportunities and Challenges in SE Asia





Key challenges for Indonesia

Key CCS challenges identified Indonesian stakeholders:

- Developing regulations for an integrated CCS project
- Seeking funding for additional cost of CCS
- Reducing the energy penalty
- Developing technical experience in CO₂-EOR
- Engaging public to educate them on CCS, especially in regions that will host projects



Key challenges for (SE Asia)

(Global Status of CCS Recommendations)

Key CCS challenges identified stakeholders:

- Developing regulations for an integrated CCS project
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Investment in enabling activities essential

Learn from international examples and regional experiences

1. Understand storage
2. Address local legal and regulatory issues
3. Focus R&D on 'local' issues
4. Develop experience through pilot sites

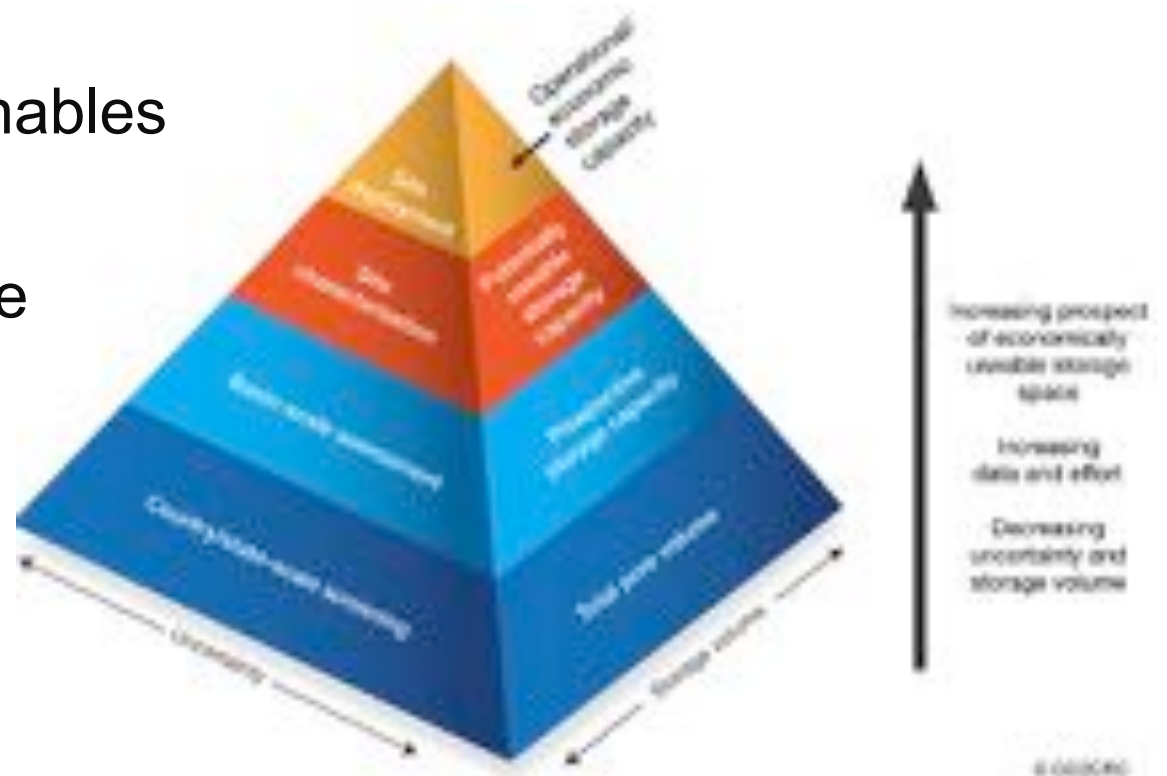
....then ready for next generation capture technologies

ACT NOW!



Understand storage early

- Regional storage focus
 - Future resource
- Source-sink matching
 - Nationally
 - Locally
- Early action enables
 - planning
 - best practice
 - cooperation
 - refinement





Storage: regional understanding

Global CCS Institute (2015) Global storage readiness assessment





Advanced oil and gas- enablers

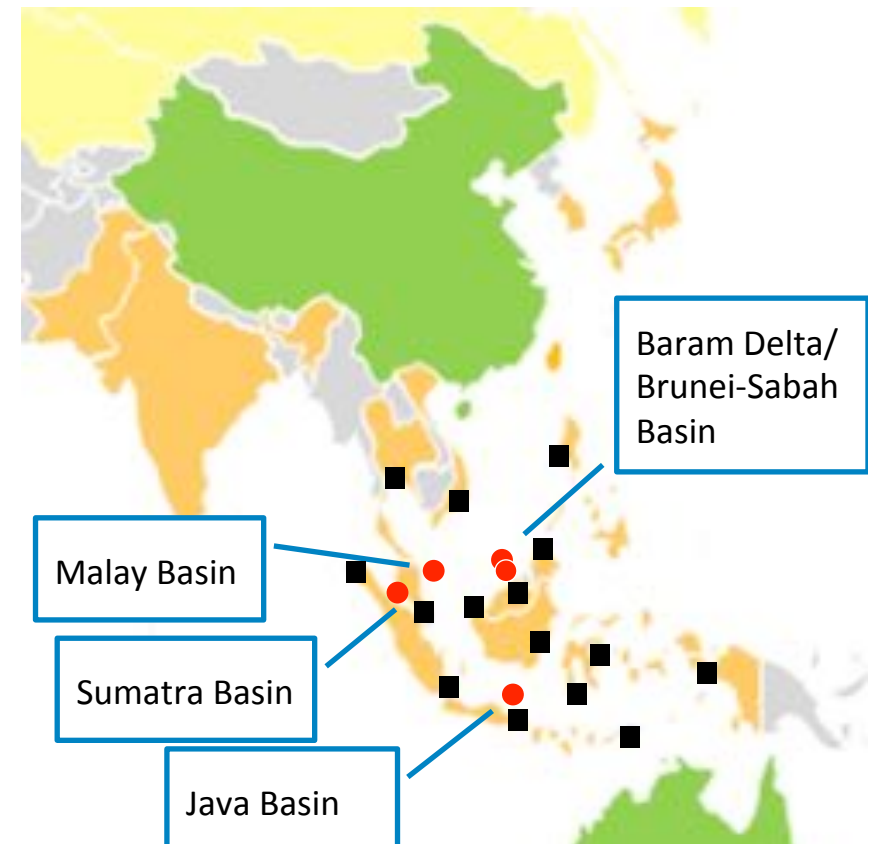
LNG

- Expertise in exploration, processing and movement of large quantities of natural gas

EOR

- CCS 'enabler'
 - Commercial viability
 - Knowledge, expertise, acceptance
- 5 CO₂-EOR basins
 - Total OOIP 236,480 MMBO (ARI, 2013, inc. China)

- Potential CO₂-EOR site
- SE Asia LNG facilities





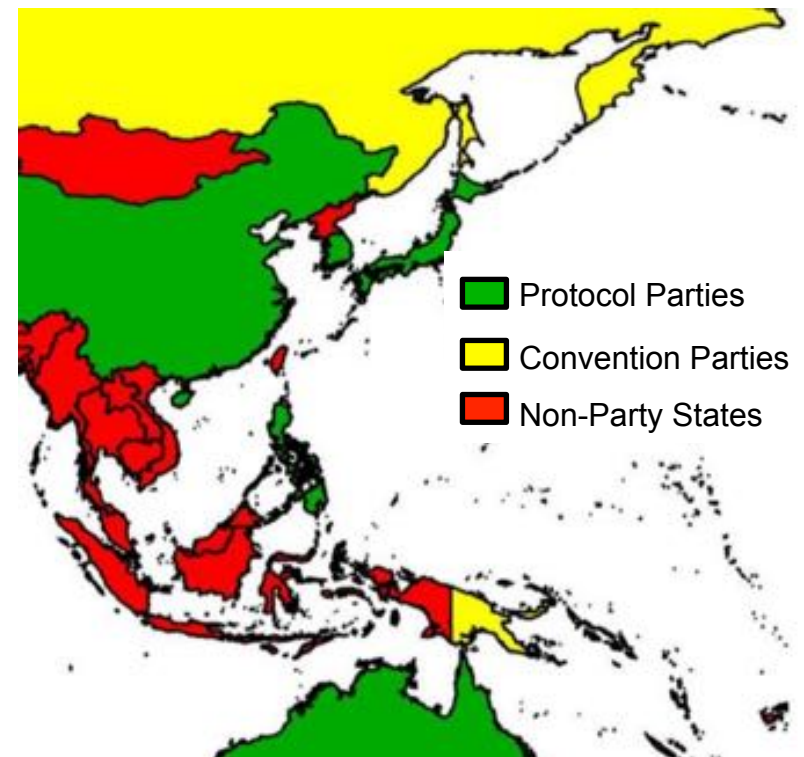
Legal and regulation framework

International (cross-boundary) regulatory mechanisms

- Protocol to the Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter (London Protocol)
 - 2006: allow for offshore CO₂ storage
 - 2009: allow for cross-border transportation of CO₂ for storage, *yet to be ratified*

Dedicated national CCS legislation

- Each country needs to develop legal and regulatory frameworks specific to their country
- 'Second generation' regulators can draw upon examples of existing CCS legislation:
 - Australia
 - EU
 - USA



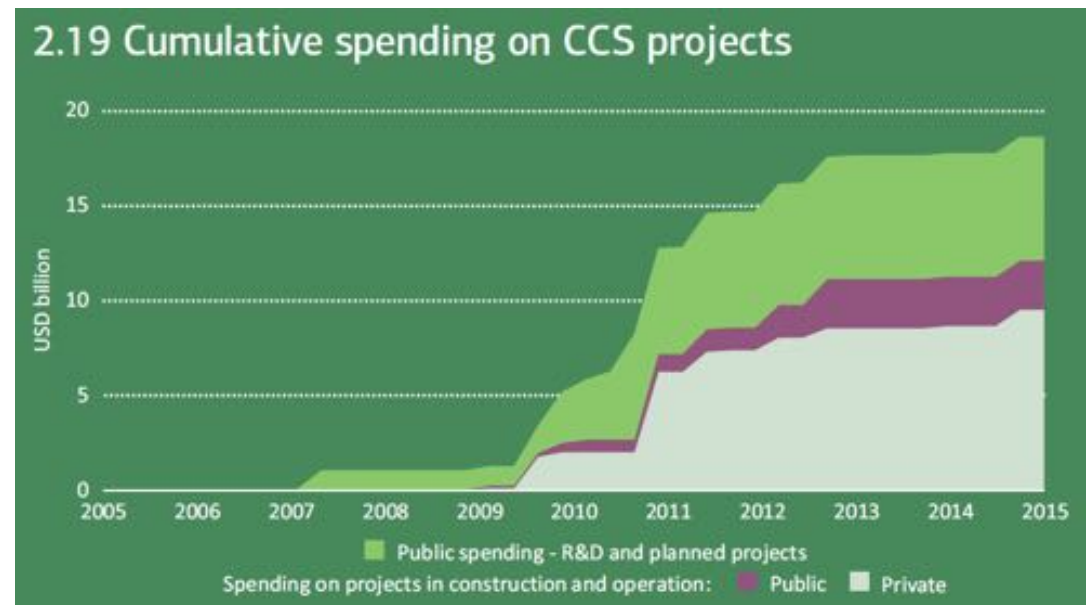
Source: IMO, 2014



CCS knowledge and expertise: R&D

Focus R&D on 'local' issues

- Capture
 - Coal- eg. amines
 - Gas PCC- lower costs
- Storage
 - Offshore
 - MMV
 - CCUS- EOR, EGR
- Transport
 - Ship, re-use of LNG tankers/ facilities



Source: IEA ETP 2014



CCS knowledge and expertise: Pilots (1)

- Currently only one pilot project in planning phase
 - Gundih, Indonesia
- Regionally, CIDA, Otway, Nagaoka, Tomokomai

Develop experience through pilot sites

- International assistance
- Nationally relevant, locally applied
- Cost effective
 - <\$1 million to \$100 million

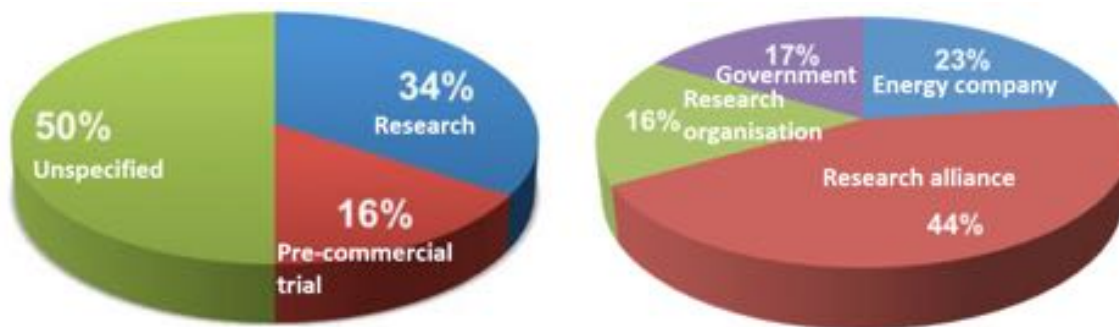
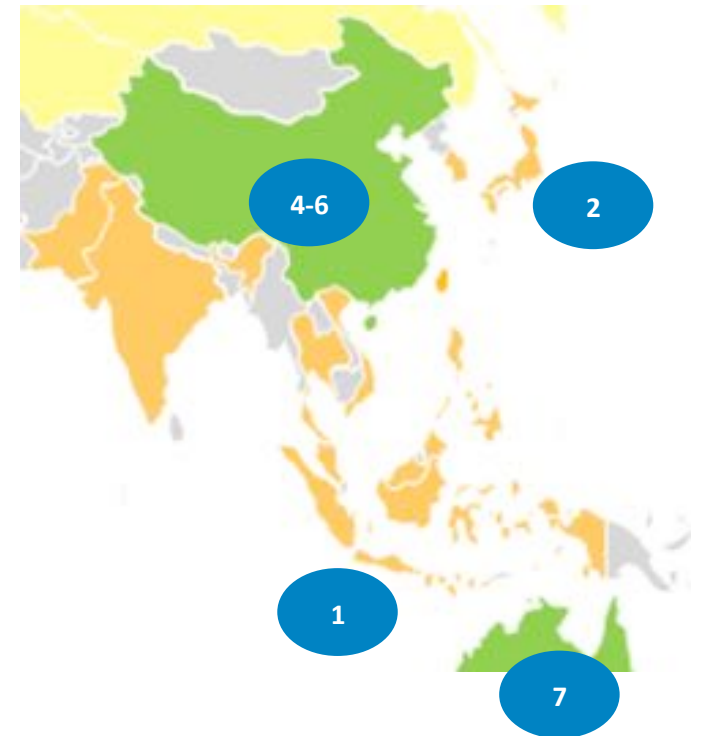


Figure 2. Distribution of purpose (left) and ownership (right) for small-scale projects. Source: Cook et al 2013



CCS knowledge and expertise: Pilots (2)

Think small and plan big- should be 'scalable'

- Affordable, nearby and adequate source
 - But, need potentially large-scale emitters
- Truck transport is an option to reduce costs
 - But, plan for pipeline infrastructure
- Site logistically suitable
 - Expandable
 - Regulator engaged
- Injection – provides answers to key questions
 - But, ensure injectivity can be increased
- Storage characterisation and capacity is still needed to be known at the pilot scale!
- MMV- baseline



CCS knowledge and expertise: Pilots (3)

Pilot project provide opportunity:

- Address and develop country-specific legal and regulatory issues
- Test capture technologies in local conditions
- ‘Prove’ storage
- Develop local skills and knowledge
 - Scientists and technical experts
 - Government, regulators, geological surveys etc.
 - Suppliers of infrastructure
- Educate the public



Conclusion

Act now – to benefit later

Plan

- Storage evaluation
- Source-sink matching

Prepare

- Target legal and regulation issues

Practice

- R&D focus on local issues
- Pilot projects

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