Determining the Prospects for CCS in Southeast Asia

Pradeep Tharakan, PhD

Energy Specialist (Climate Change)

ADB

Presentation Outline

- ADB’s CCS Program
- Costs of CCS projects
- Indonesia Case Study
- Proposed CCS pilot in Indonesia

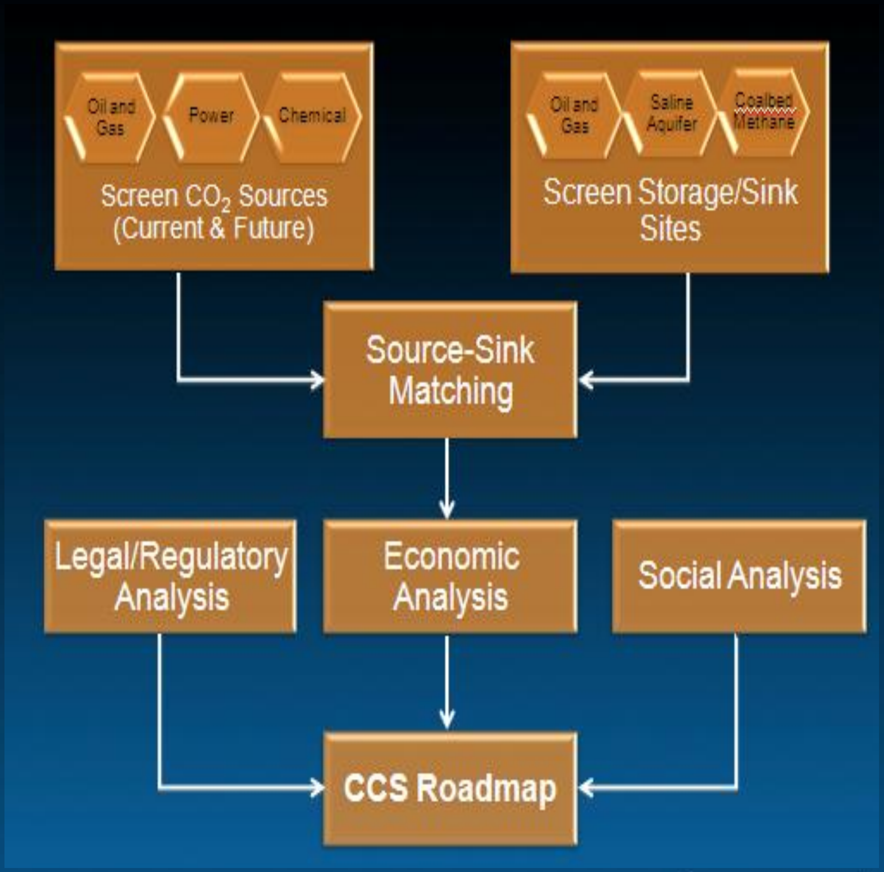
ADB and Carbon Capture and Storage

Dedicated CCS Fund – set up with GCSSI and open to other donors (e.g. UK ICF)

- China:
  - CCS studies linked to China's first coal-fired IGCC plant at Tianjin (completed),
  - New studies focused on CCS in gas-fired power plants, and oxyfuel combustion-based capture and related road maps (recently initiated)
- S.E. Asia:
  - Regional study to develop national-level scoping analysis and develop road maps for pilots (close to completion)

CCS in Southeast Asia

- Focus on 4 countries: Indonesia (South Sumatra region), Philippines (CALABARZON region), Thailand and Viet Nam
- US$1.35 Million grant from ADB CCS Fund – GCCSI
- TA output –
  - Detailed country reports – confidential (September 2012)
  - Regional analysis report – highlights and comparisons (October 2012)



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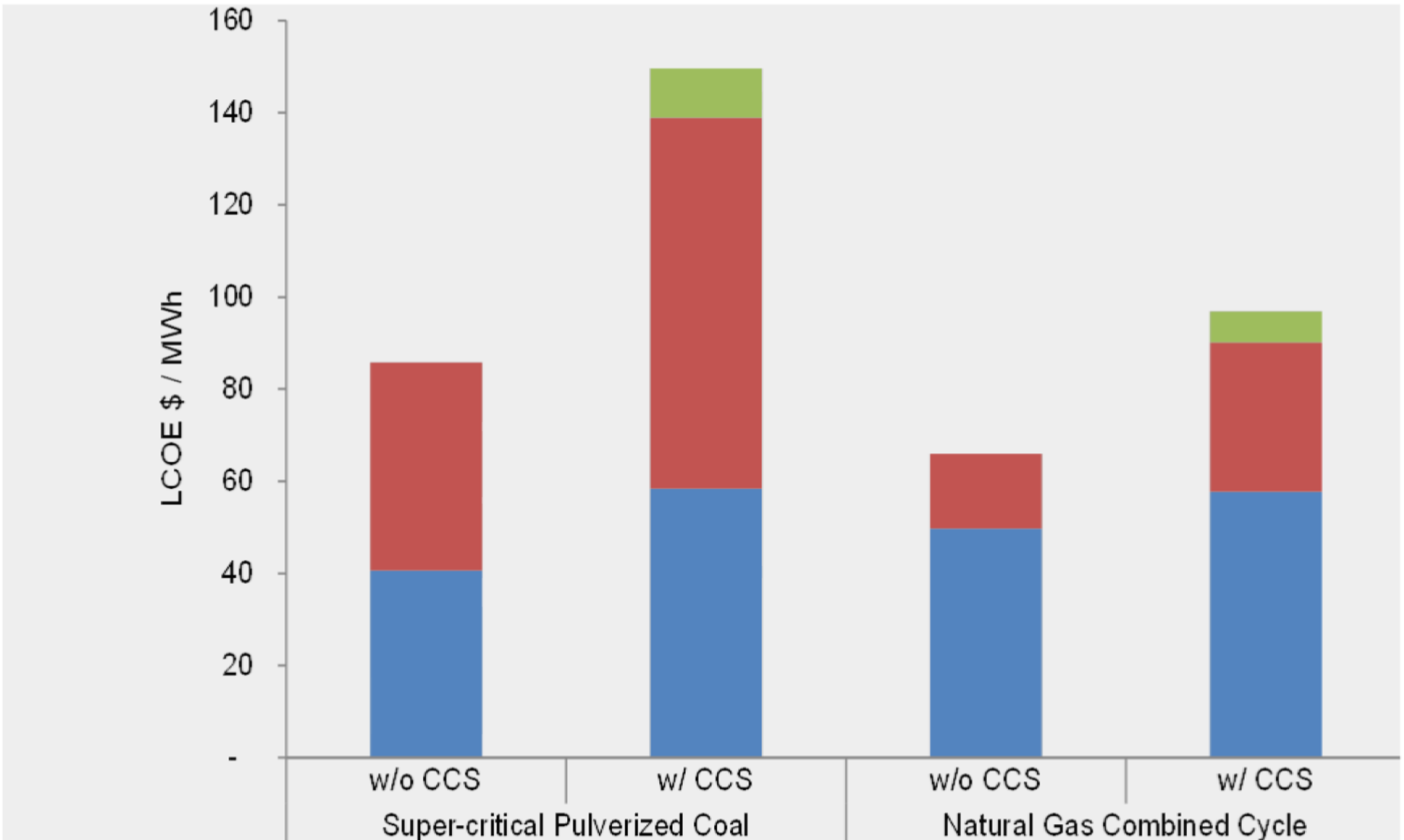
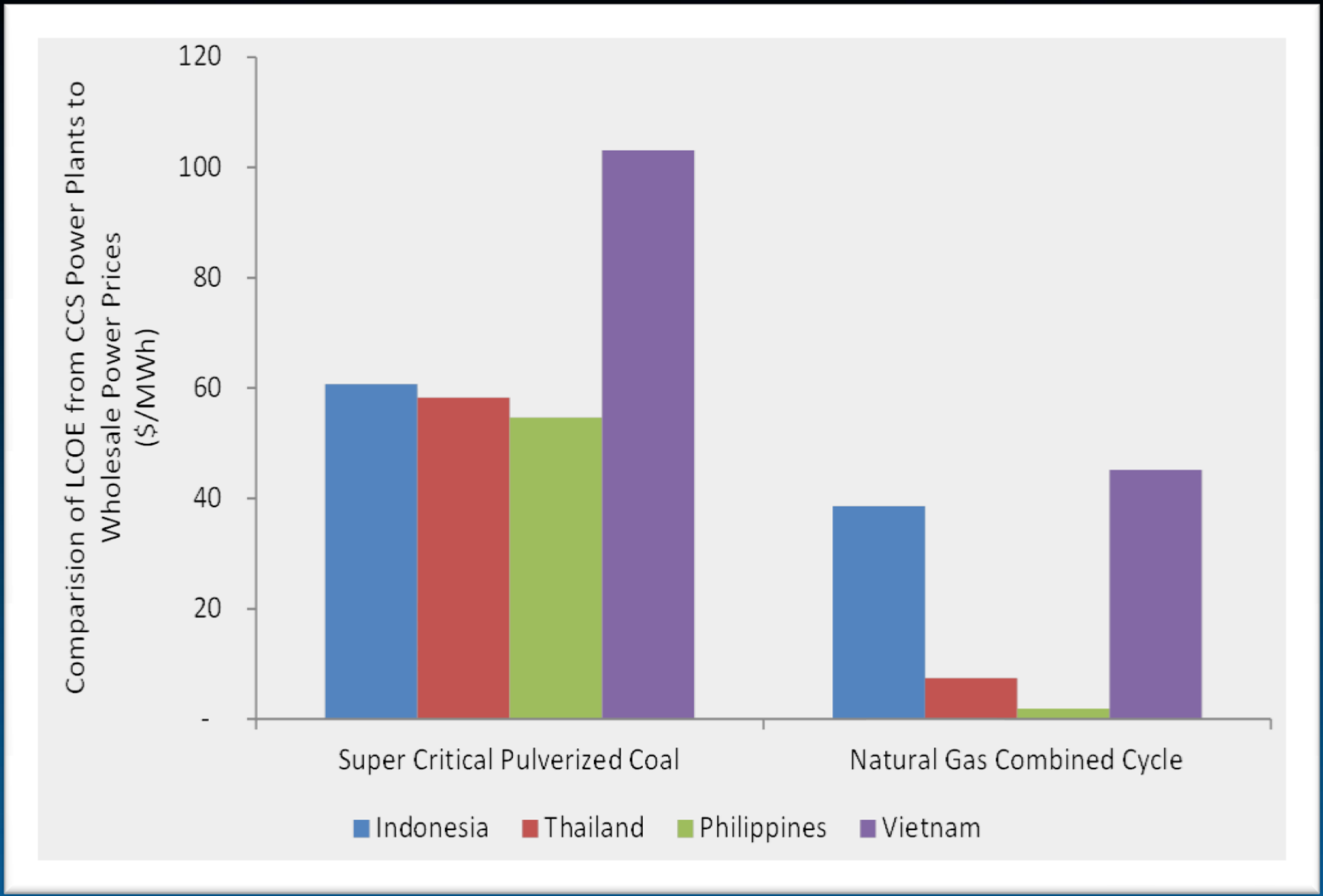
LCOE with and without CCS

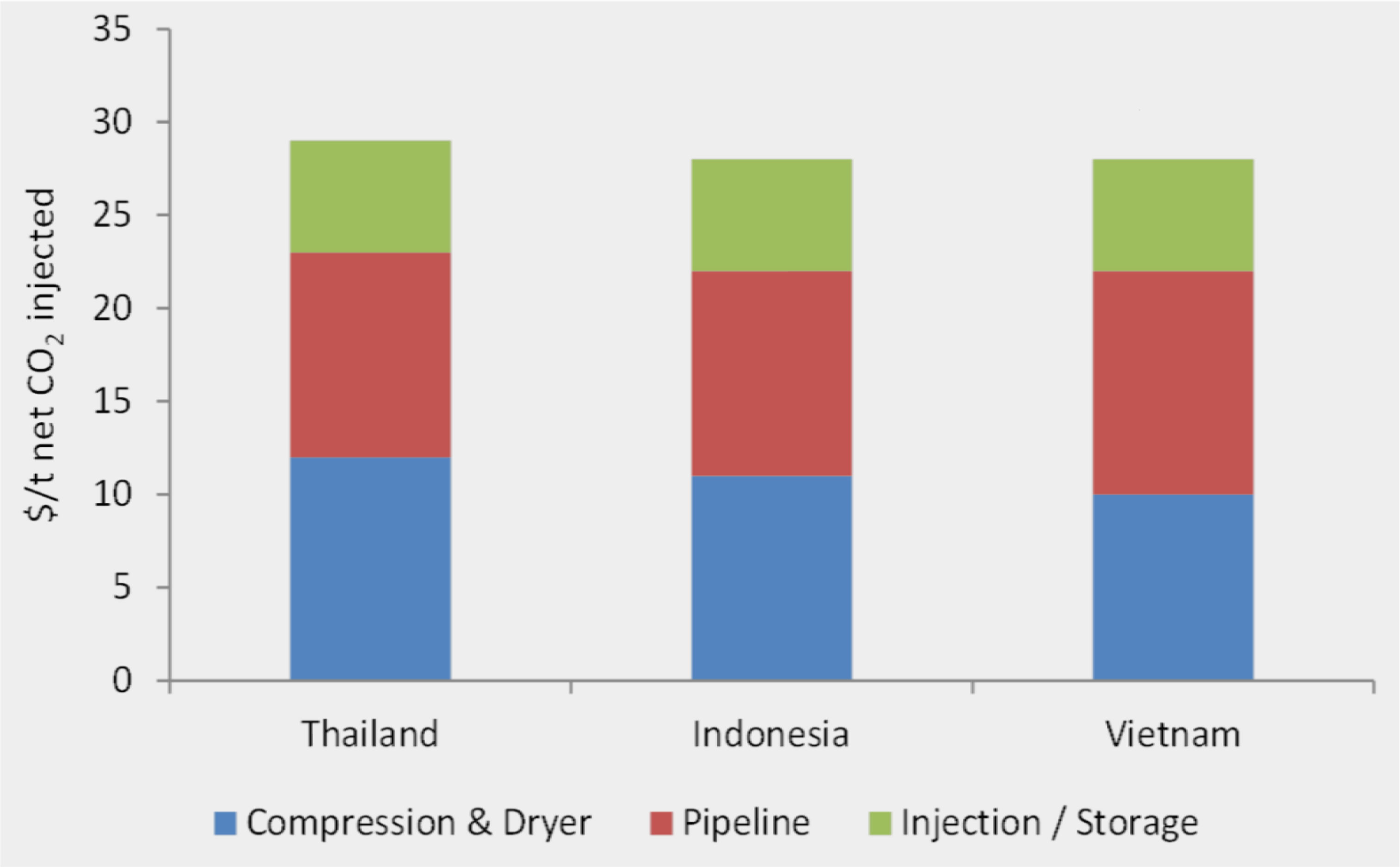


	Super-critical Pulverized Coal: w/o CCS	Super-critical Pulverized Coal: w/ CCS	Natural Gas Combined Cycle: w/o CCS	Natural Gas Combined Cycle: w/ CCS
Transport & Storage		11		7
Capital and O&M	45	81	16	32
Fuel	41	58	50	58

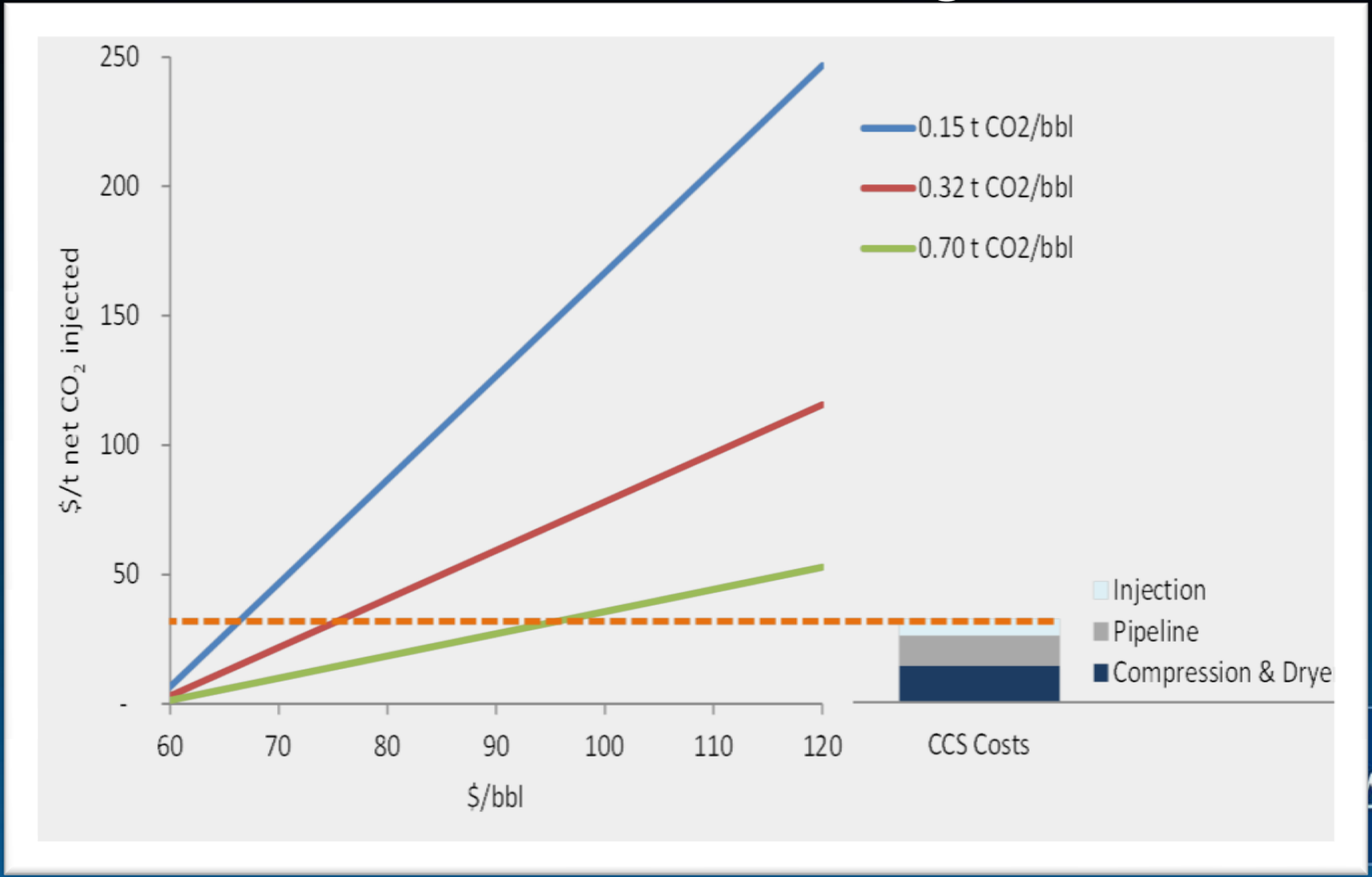
Range in Increased Tariffs Needed for CCS



Levelized Cost of Gas Processing and CCS



Inc Costs/Financing Options: Gas Processing

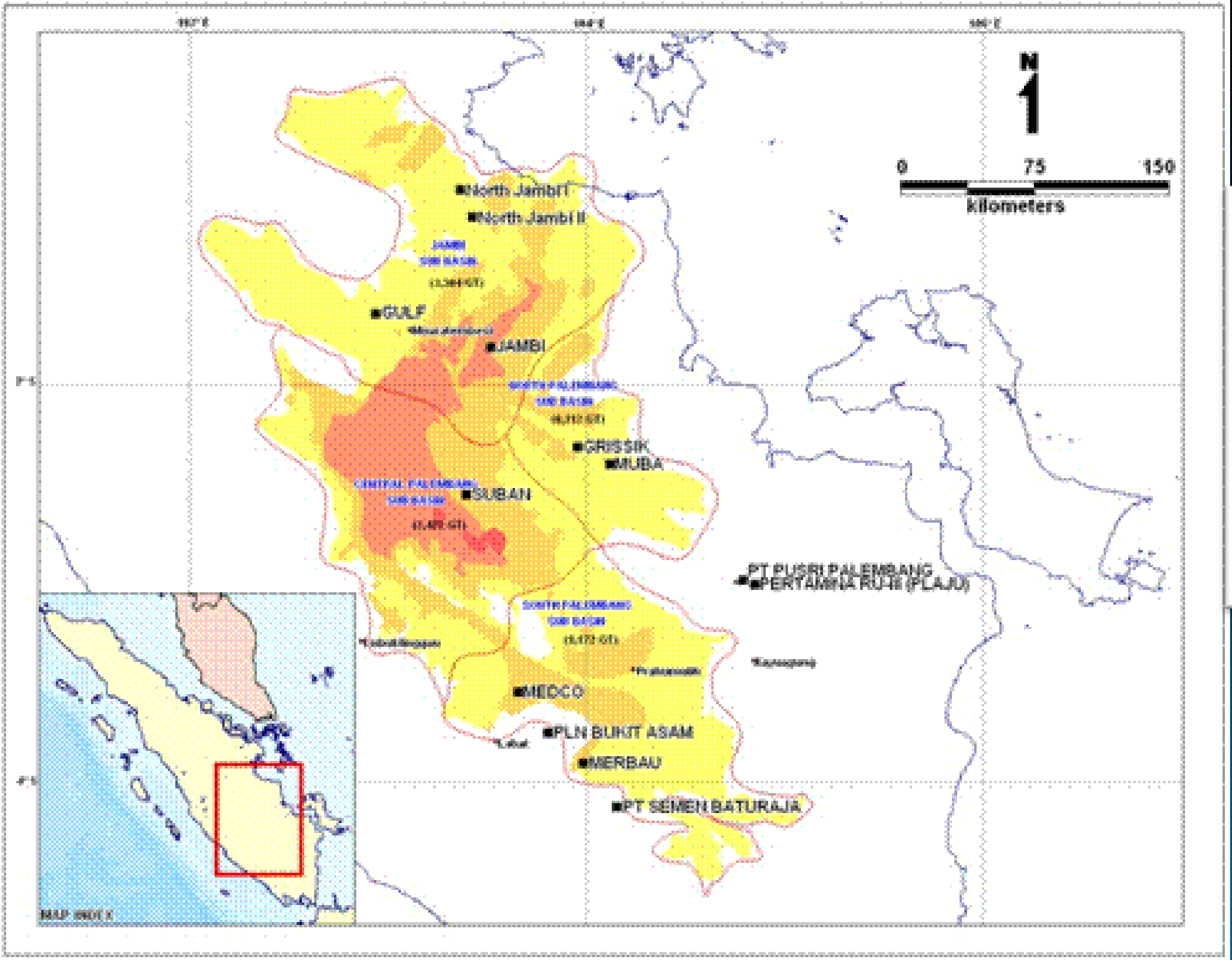


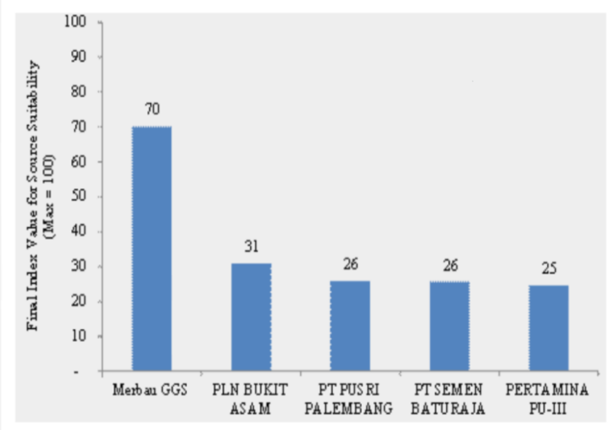
CCS in Southeast Asia

- Near-term Focus on Gas Processing Facilities
  - Existing capacity with oil and gas operators
  - High CO_2 fields provide a low cost CO_2 supply
  - Combine with EOR for additional revenue (INO, THA and VN)
- Medium term emphasis on gas-fired power plants
  - Especially if a shift to increasing gas use as projected happens
  - In countries where the electricity tariff structure is supportive
  - Combine with EOR for additional revenue (INO, THA and PHI)
- Medium-to-long term emphasis on coal-fired power plants
  - Lack of familiarity with SC and USC coal-fired plants
  - Lower margins from increased tariffs are a hard sell
  - Best prospect for INO with access to good domestic coals

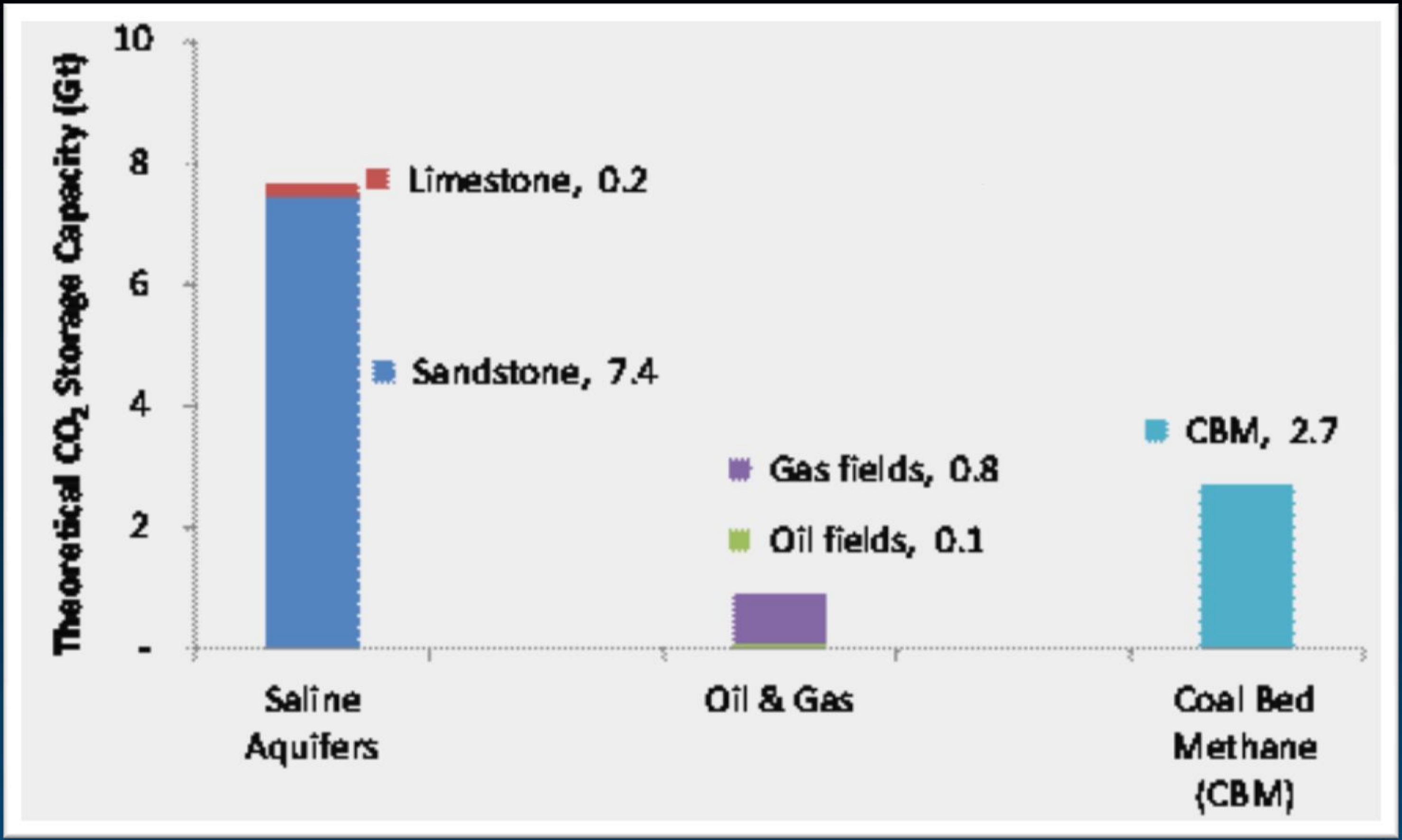
INDONESIA COUNTRY STUDY

Ranking of Sources



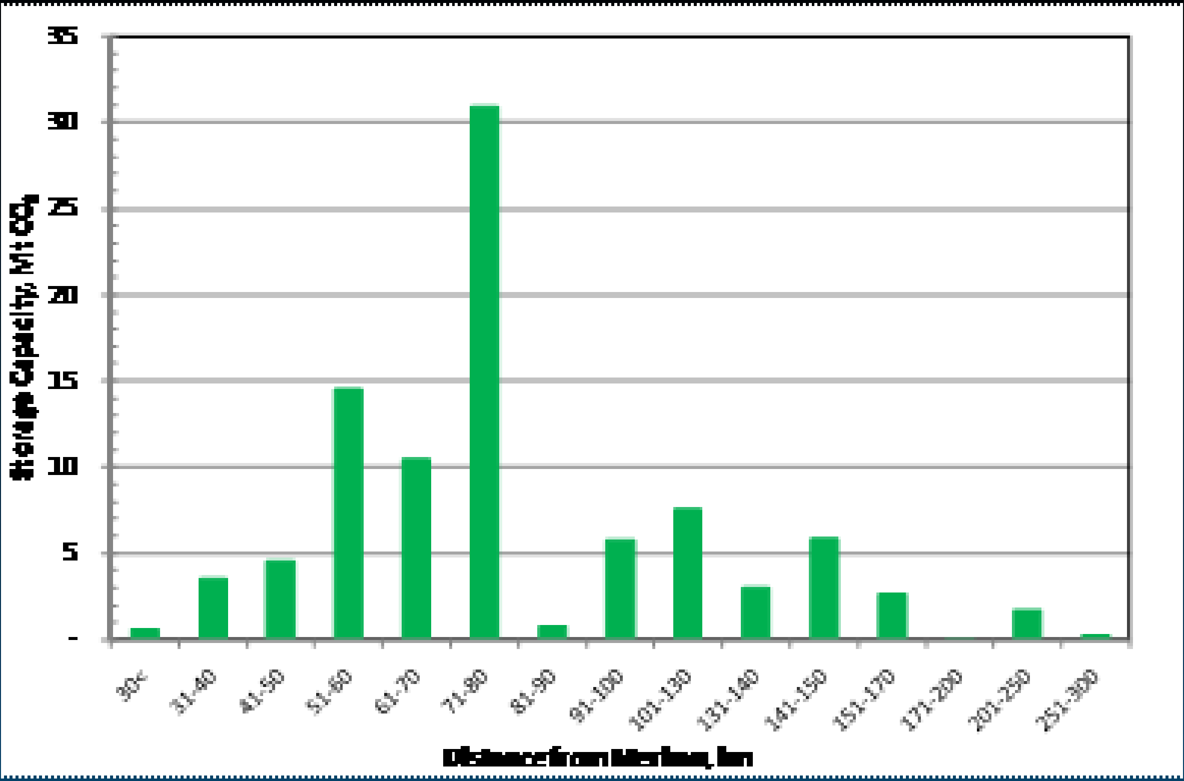


Estimated Storage Capacity by Category



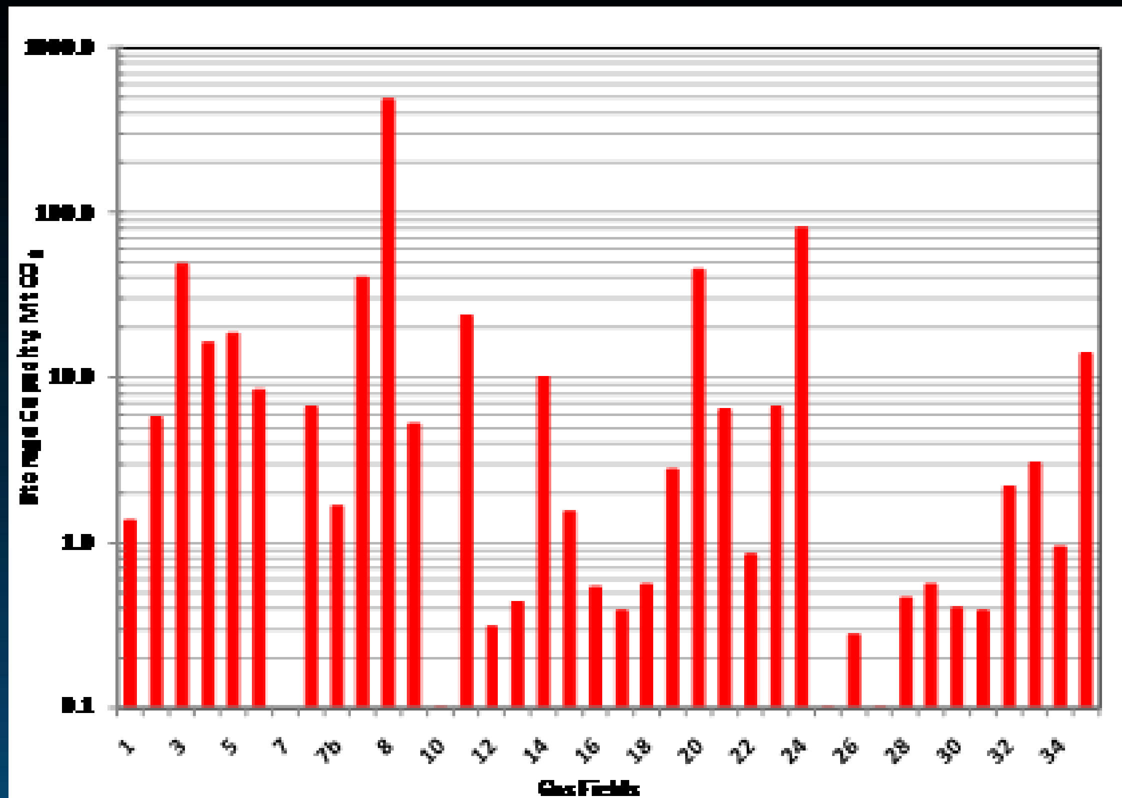
South Sumatera Appears to Have Sufficient Storage Potential to Store the CO_2 Emissions of All Its Point Sources

Storage Capacity by Depleted Oil Fields



The CO_2 storage in oil fields is based on the pore space made available through primary recovery and additional recovery due to CO_2-EOR on a reservoir basis. Both primary and tertiary recoveries were used in calculating the total CO_2 storage. This method results in much more storage certainty (i.e. effective storage capacity assessment), compared to the two other methodologies used in the saline aquifers and CBM resources (i.e. a theoretical storage capacity assessment). Most of the oil fields individually have small storage capacities, with only one field exceeding a storage capacity of 10 Mt CO_2. When grouped together by proximity to each other, the largest cumulative capacity was approximately 55 Mt CO_2 in an area within 30 kilometers (km) of each other, out of a total capacity of 92 Mt for the oil fields examined. These oil fields contain 59% of the original oil in place (OOIP) in South Sumatera. Figure 4 below illustrates the storage capacity from depleted oil fields clustered together by proximity to each other.

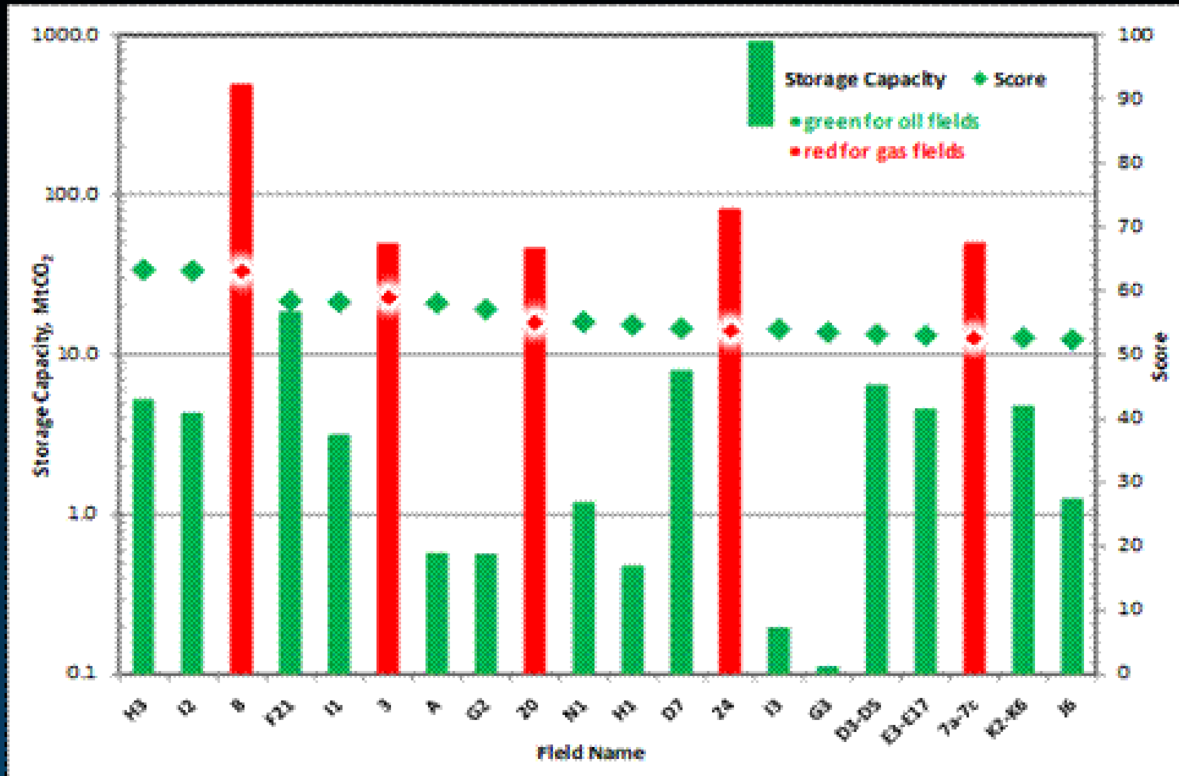
Storage Capacity by Gas Fields



Gas fields offer 10 times more storage volumes than oil fields in South Sumatera. Cumulative storage capacity for all 35 gas fields at depletion was estimated to be 831 Mt CO_2. Ten of the gas fields have capacities greater than 10 Mt, five greater than 40 Mt and two greater than 80 Mt CO_2. One of the fields (Field No. 8) has a capacity of approximately 500 Mt CO_2—more than five times greater than any of the other gas fields examined.

These gas fields contain 47% of the original gas in place (OGIP) in South Sumatera.

Analysis Rankings of Top 20 Oil and Gas Fields



The H3 Oil Field Achieved the Highest Score on Storage Ranking, though F21 Is the Suggested Storage for a Pilot . H3 and I2, the two highest-scoring fields, are both oil fields. The high ranking is due to their potential for incremental CO2-EOR recovery. I2 has the highest injectivity of any oil field while H3 is the only oil and gas field which has a willing partner at the present time. The Operator has planned to apply CO2-EOR in this field. Gas field No. 8 is ranked third with a total storage capacity of 488 Mt CO2 while the two highest-ranked oil fields have storage capacities of approximately 5 Mt CO2 each.

The largest storage capacity in an oil field is for F21 at 18 Mt CO2 and is ranked fourth. Its storage capacity is three times larger than H3 and I2 and it is also closer to Merbau GGS. There is a difference in scoring between the H3 and F21 oil fields because the H3 oil field is the only oil or gas field evaluated which had a willing industry partner at the present time.

Key Principles for Scoping a Pilot

- A pilot must yield information that will allow prediction of the incremental oil production and CO_2 storage expected in a larger demonstration or full commercial operation.
- For the pilot, the CO_2 transport could be by truck or boat as the construction of a pipeline will not be justified for these low quantities of CO_2.
- For pilots, the source should ideally be pure CO2 or close to it. The sink should ideally be a large depleted oil or gas reservoir, where in the future the storage costs can be offset by increased production of oil and gas from the reserves.

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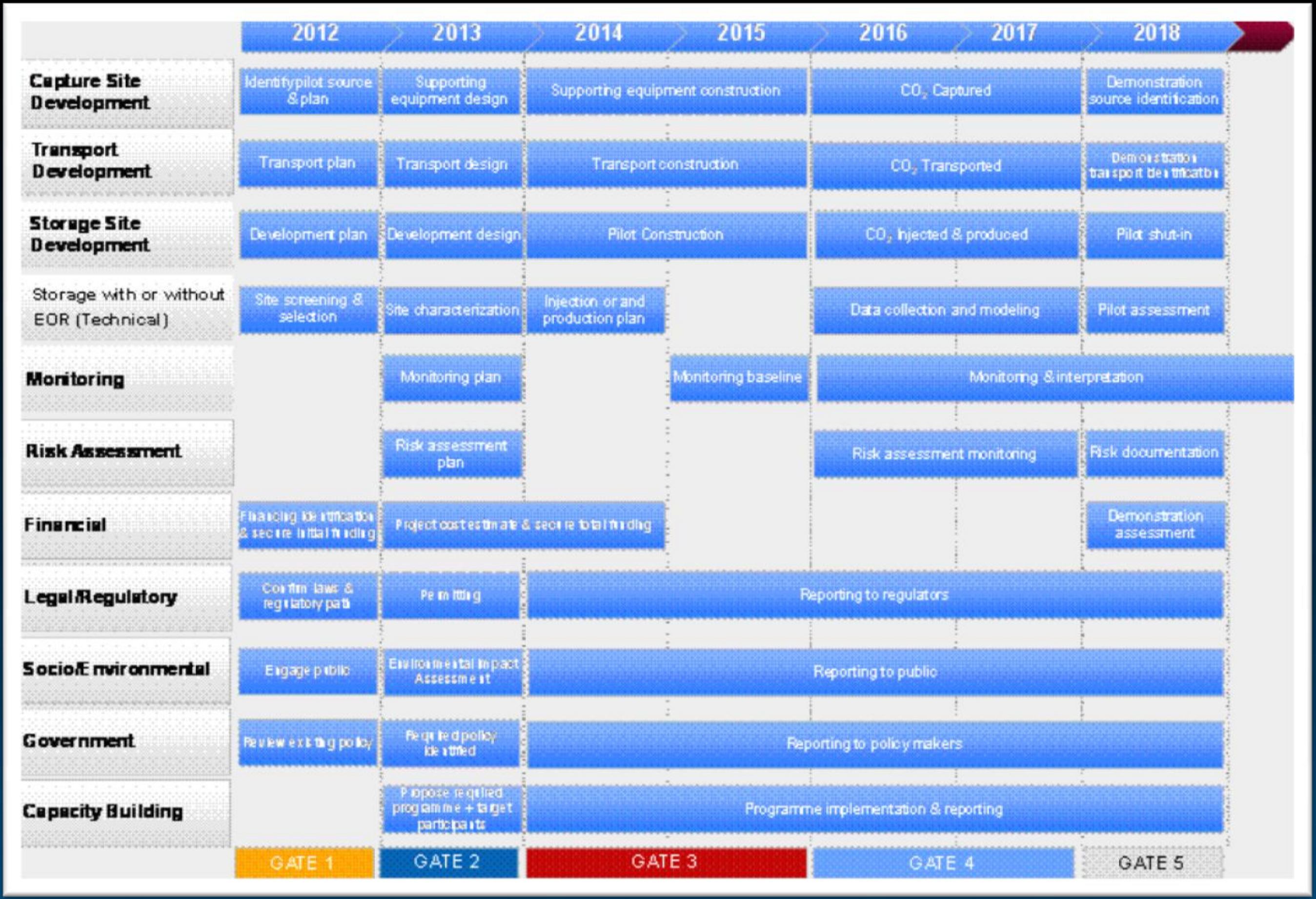
Road Map for CCS Pilot Deployment



Gate 1: Pilot CO_2 source and storage site have been identified and the owners/ operators are supportive.
Gate 2: Pilot funding has been secured and permitting has been completed.
Gate 3: The construction of the pilot has been completed.
Gate 4: Injection of 50–100 tons of CO_2/day has been successful.
Gate 5: Case for a storage demonstration is approved based on a successful pilot assessment.

ADB Proposal for Co- Financing a Pilot

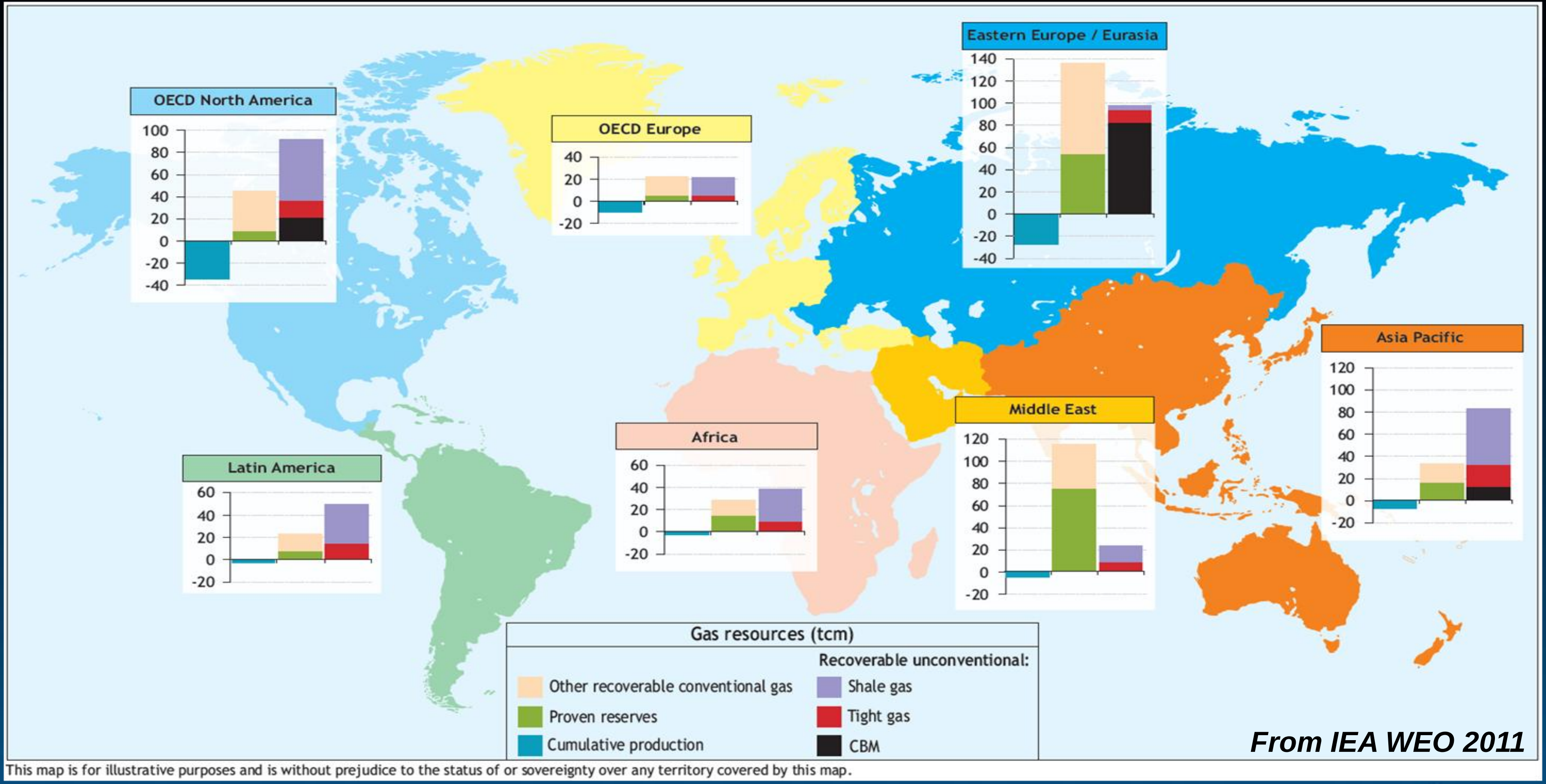
- ADB can provide 10 –12 million USD in grant financing to the government of Indonesia (financed by the UK government and administered by ADB)
- Consulting services, capital grants, training and capacity building
- Proposal to co-finance a pilot with Government of Japan
  - First pilot in Indonesia and hence synergies need to be tapped
  - PERTAMINA or any other operator may not be keen to initiate multiple pilots
- ADB's proposed program will be developed in close cooperation with BAPPENAS, DG MIGAS and the operator (PERTAMINA) and JICA

THANK YOU

www.adb.org

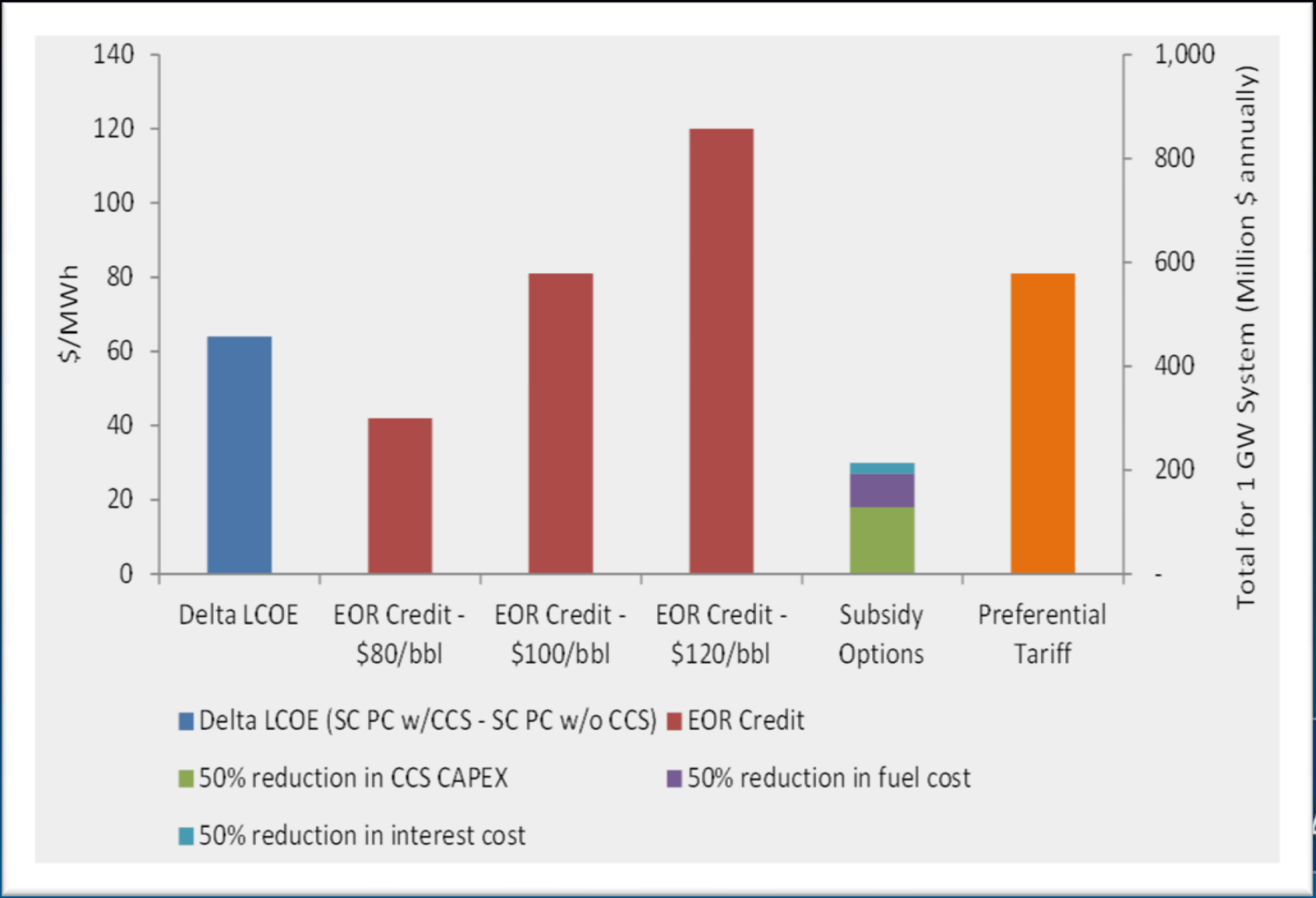
ptharakan@adb.org

WEO 2011 – a growth outlook on natural gas resources and supply

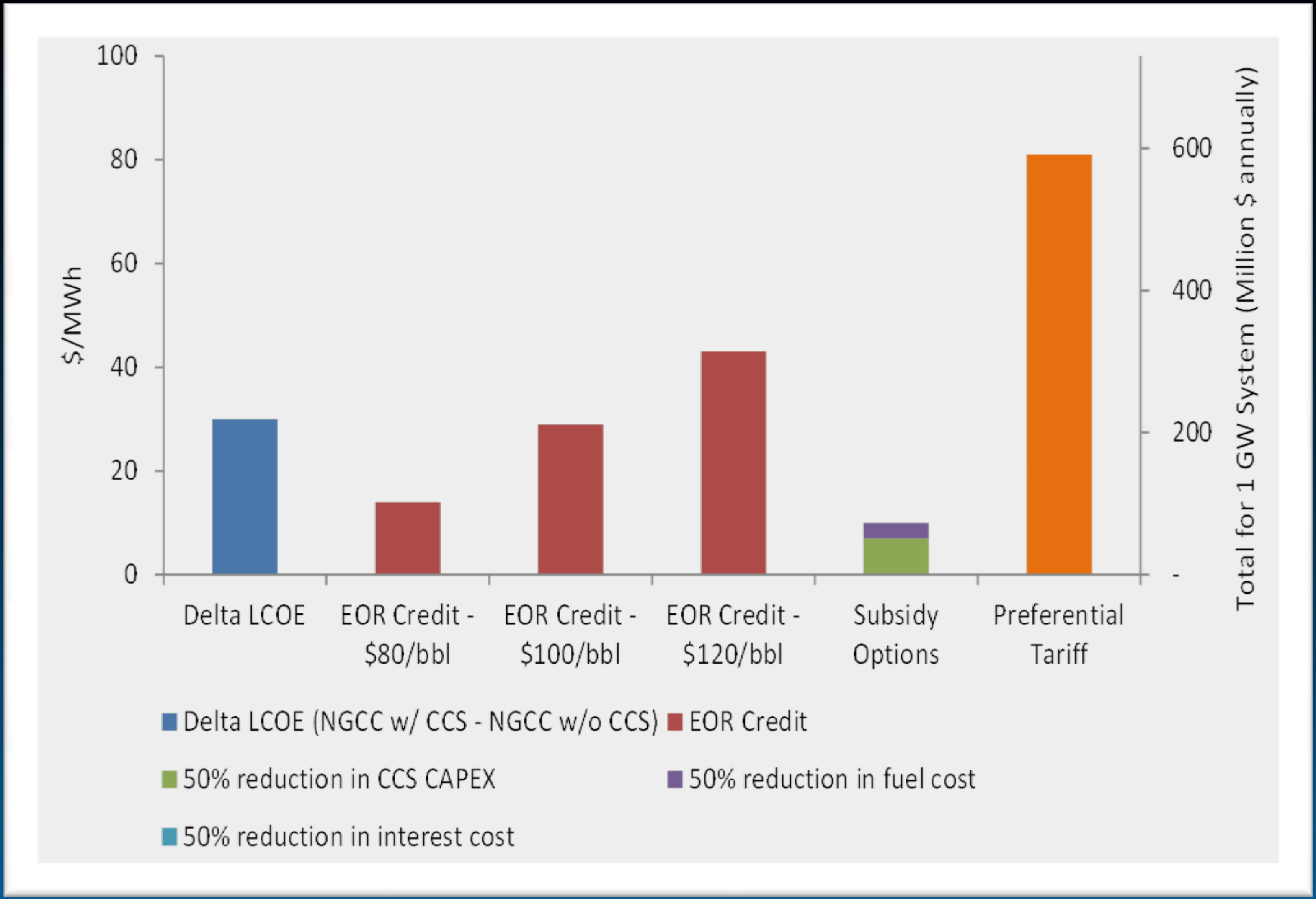


Enhances security of supply: resources double and exceed 250 years of current production; regionally, resources exceed 75 years of current consumption

Inc Costs/Financing Options for Coal-CCS



Inc Costs/Financing Options for NGCC-CCS



Two-Stage Criteria to Rank Oil and Gas Fields for CO_2 Storage Suitability

Qualifying Criteria	
Capacity	Capacity > 10 Mt, with exceptions for satellite fields
Injection rate	Injection rate > 100 t of CO_2/day/well
Injectivity and capacity	Reservoir > 3 m thick
Confinement: Depth	Depth to top of reservoir > 1,000 m
Confinement: Seal	Seal thickness > 3 m
Confinement: Faults	No active faults
Preferential Criteria	
Capacity	CO_2 storage (21)
Injection rate	CO_2 storage per day per well (10)
Injectivity and capacity	Number of existing production/injection wells (10)
Confinement: Depth	Seal thickness (16); No. of abandoned wells (4); Containment of other resources (4)
Economics	Cost recovery (enhanced oil recovery or other offset) (17); existing infrastructure (4); monitoring opportunity (4); availability (depletion date) (5, plus a bonus of 5 if both oil and gas reservoirs are in single field); willingness of operator (5)

Note: Number within parenthesis indicates the maximum attainable score in each criterion.