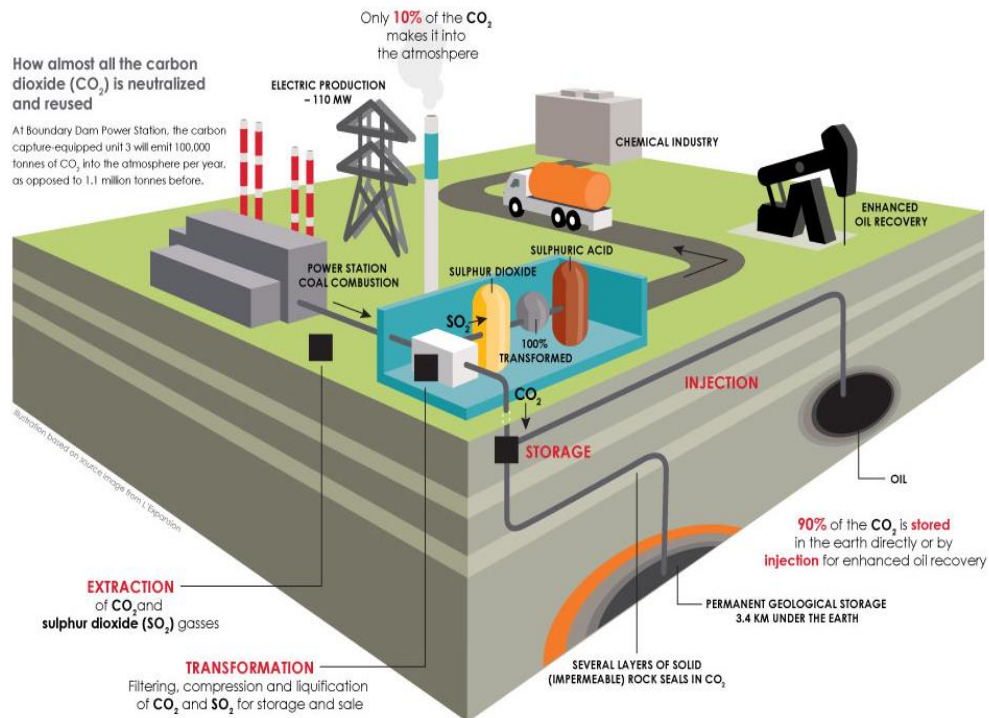




CURRENT STATUS AND FUTURE PATH OF DEVELOPMENTS FOR CCUS IN INDONESIA

JUNE 08, 2018



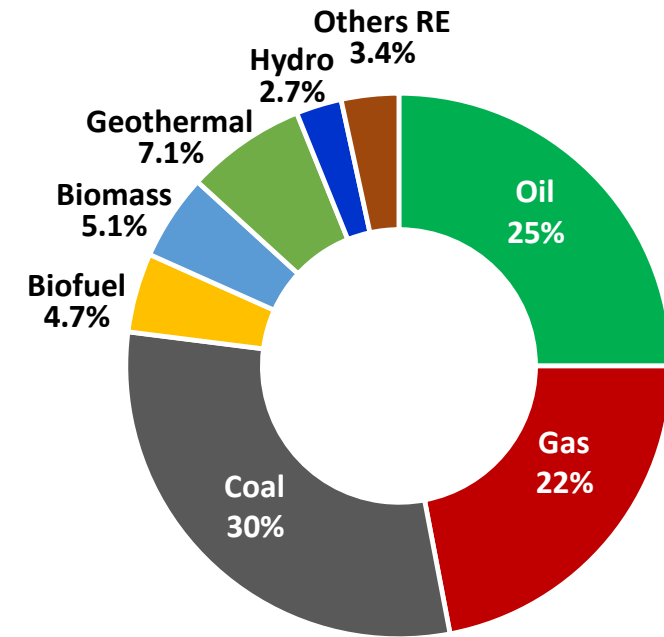
Outline

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Background

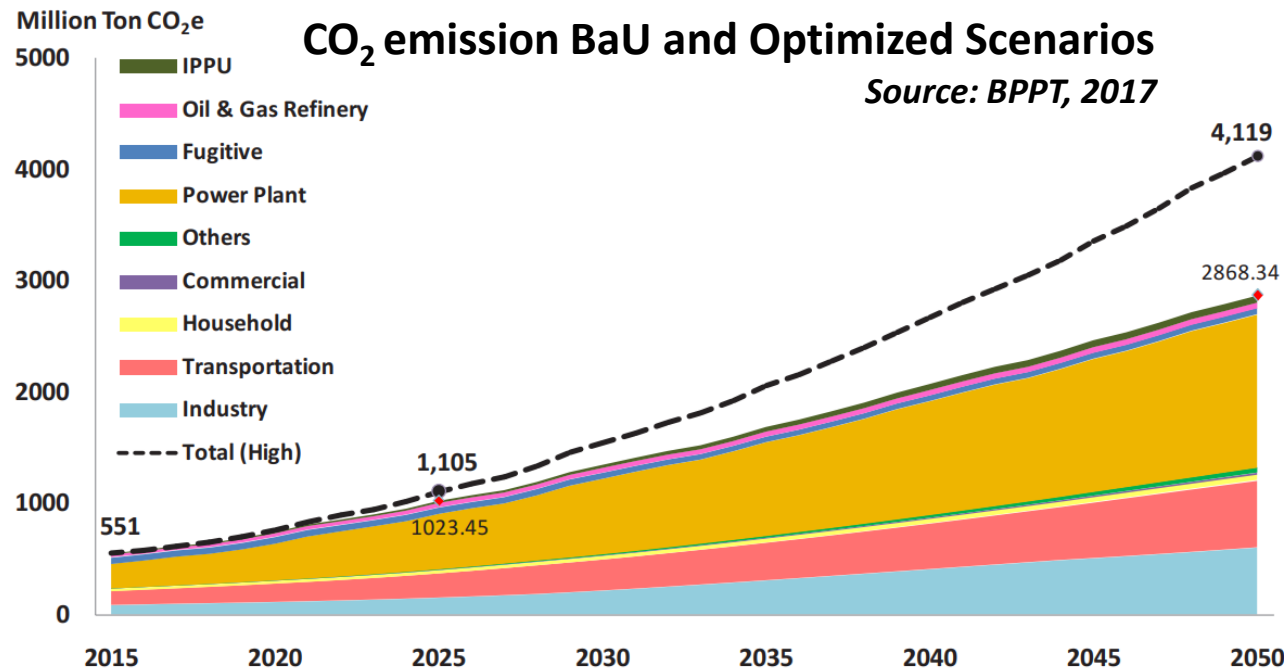
- In 2015, CO₂ emissions from the energy sector 551 Mt with average growth of 4.8% per-year.
- Gol's has set unconditional emission reduction target of 29% and conditional reductional target up to 41% of the BAU scenario by 2030,
- Current efforts are considered still insufficient to achieve CO₂ emissions abatement target in 2030.
- It is imperative for Indonesia to investigate options for CCUS.
- CCUS includes the use of CO₂ in enhanced oil recovery (EOR) operations, but also includes other potential beneficial uses of captured CO₂.

Government Regulation No 79/2014 Optimizing Energy Mix 2025

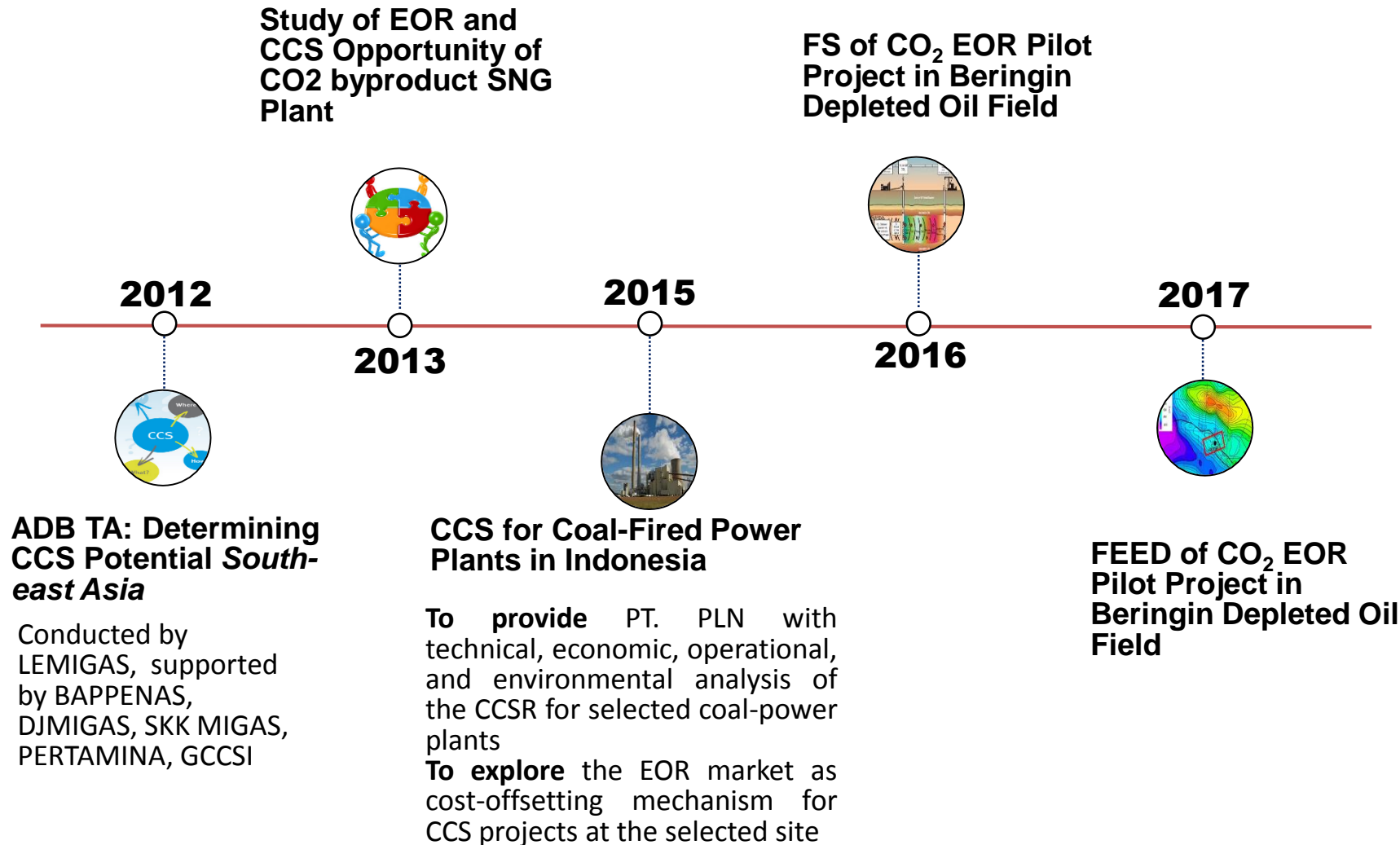


- Energy Mix improvement for 2025 is still dominated by fossil fuel
- As a result of objective function of Energy Mix improvement:

The energy sector can achieve 1023 Mt CO₂ reduction in 2025 from 1105 Mt in BaU



CCUS Milestones in Indonesia



WHY CCS WITH CO₂ EOR

- The use of CO₂ for EOR provides a driver and early mover for deploying CCS particularly for Indonesia
- Rationale the selected South Sumatera: Large presence of the industrial and power sector in South Sumatera, Large and various CO₂ sinks, South Sumatera has low density population, Existing infrastructure, Relatively stable geological setting from seismic and tectonic activity
- LEMIGAS study shown that additional potential oil reserves from CO₂ EOR application in South Sumatera is ±480 MMstb. Potential of CO₂ storage ± 75 million tonne. At national level, additional potential oil reserves ±2 miliar barrel. Potential of CO₂ storage ± 300 million tonne.

CCUS Deployment Strategy in Indonesia

STAGE 1



Pilot

- 50-100 tonnes per day of CO₂ over several months
- Knowledge of reservoir performance to support financing and designing a Demo project.

STAGE 2



Demonstration

- Larger quantities of CO₂ injected into many wells continuously over many years
- 500-1,000 tonnes per day or more of CO₂ injected over 10 + years.
- Confirmation of long-term successful CO₂ storage to support financing and construction of at least one full scale commercial operation

STAGE 3

Commercial

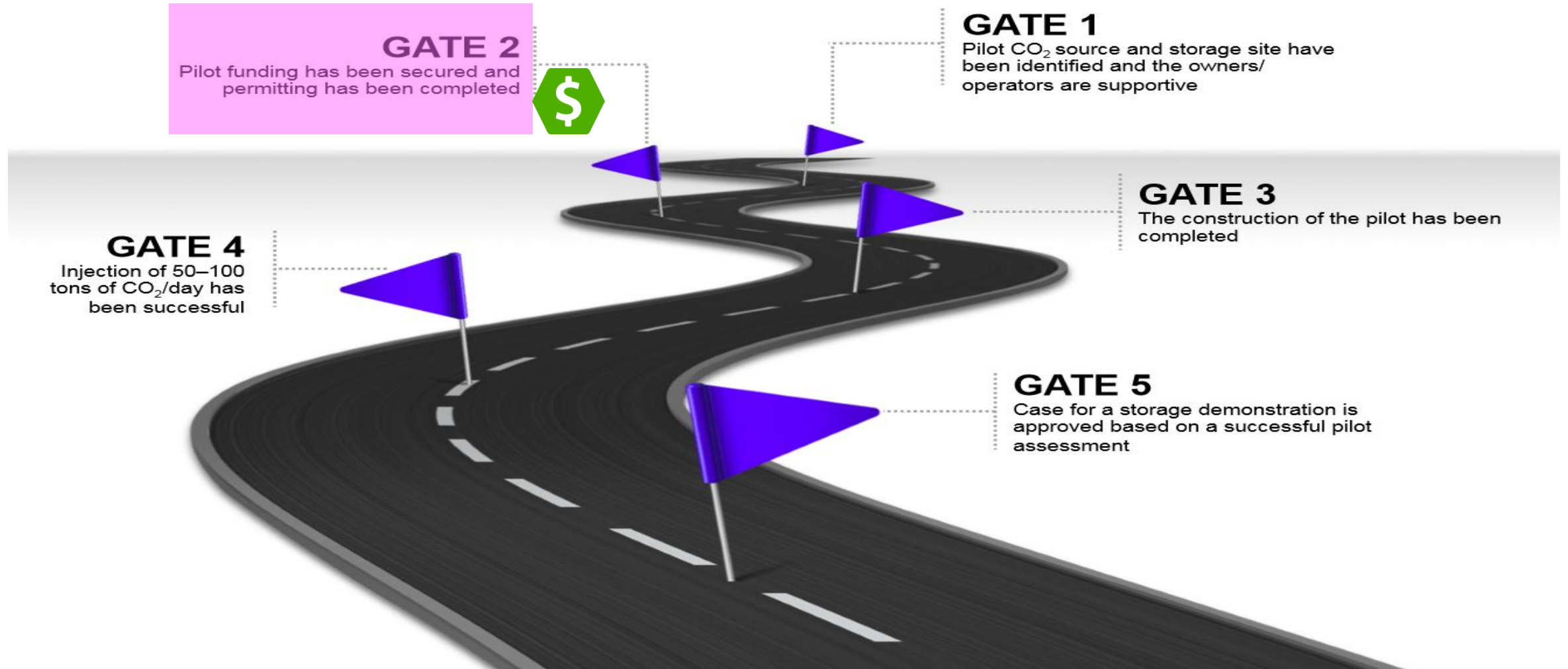
- Very large quantities of CO₂ captured from one or more sources injected into one or more locations for a very long time period
- 2,500 -5,000 tonnes per day CO₂ captured and injected over 20+ years.
- Capture and store sufficient quantities of CO₂ to substantially reduce Indonesia's CO₂ emissions

A roadmap for CCUS pilot project

Emphasis to improve energy security in conjunction with EOR / CTL / CTG / Biomass

Roadmapping

Five stage gates for the pilot

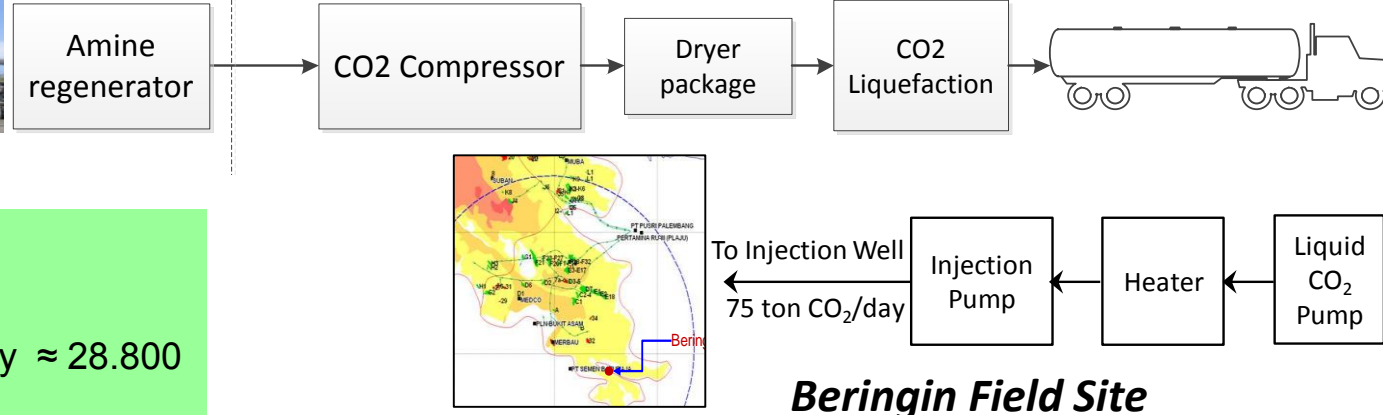


Proposed CCUS pilot project



Pure CO₂ Stream

75 ton CO₂/hari
1,85 bar, 50°C



Note:
Land road (20 km)
National road (45 km)

MERBAU GAS GATHERING STATION:

- As CO₂ Source
- CO₂ production: 1,5 MMscfd ≈ 79 ton/day ≈ 28.800 ton / year (2016)
- Has 1 processing train.
- The removal of CO₂ takes place absorber column by using a multi-stage proprietary A-MDEA process.
- The pure CO₂ (99.9%) is vented to the atmosphere.

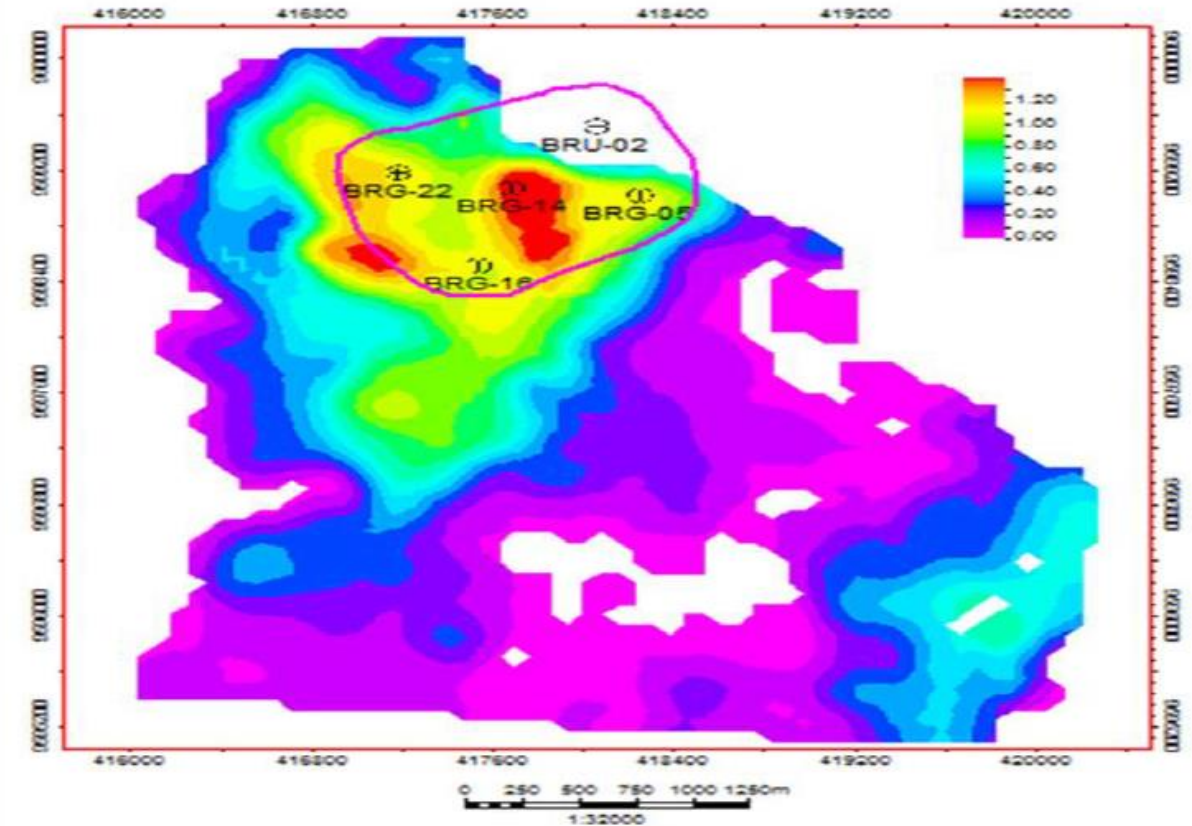
BERINGIN FIELD:

- CO₂ Storage capacity = 180,000 ton of CO₂
- For five years, oil recovery gain will be at 1.4 % RF by immiscible CO₂ injection
- For pilot project, one injection well and four producing wells will be applied
- Total amount of CO₂ injected is 75 ton per day

Component Facility	Merbau	Beringin
Process and Mechanical	6,792	196
Electrical	375	134
Instrument	145	17
Piping	219	40
HSE	79	79
Civil	73	142
Well conversion		1860
Monitoring		157
Subtotal	7,683	2,626
TOTAL CAPEX (U\$. 000)		10,309
TOTAL OPEX 1st year		1,760

Deep review of the pilot project candidate

- CO₂ EOR and storage pilot planned in Beringin field using inverted 5-spot
- Simulation studies to establish expected pilot performance
- Design for CO₂ transport from Merbau gas processing plant + other surface facilities
- Monitoring plan with active and passive technologies



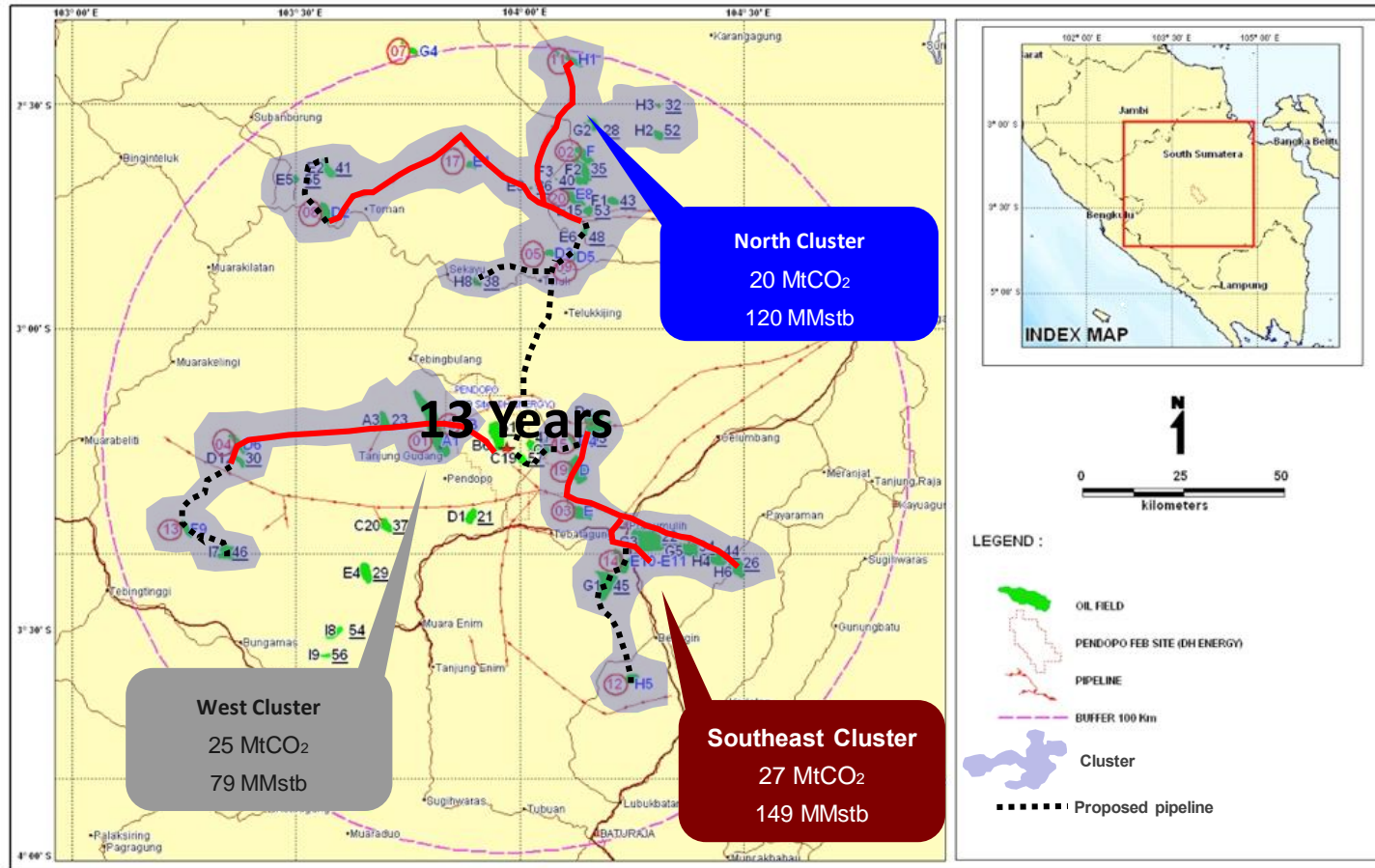
Why we need a CCUS pilot project

This pilot project generates support of Indonesian stakeholders in the following areas:

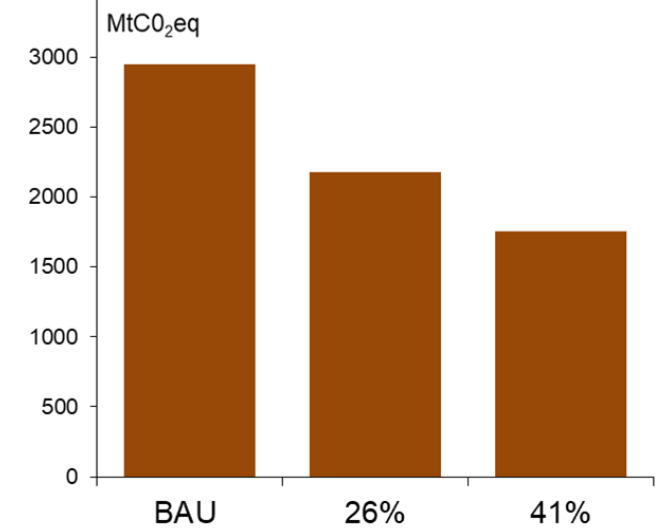
- Confirm feasibility of CO₂ EOR sequestration in a South Sumateran reservoir;
- Understanding CO₂ EOR processes when applied in conjunction with CO₂ sequestration;
- To increase the level understanding of and confidence in CO₂ EOR sequestration;
- Gain valuable experience and expertise in operating a CO₂ EOR sequestration project;
- To synthesize the information collected from the pilot project as the basis to seek the possibility for deployment of CO₂ EOR sequestration;
- To support capacity building in CO₂ EOR sequestration nationally; and
- To obtain information for the development of appropriate legal and regulatory frameworks for CO₂ EOR sequestration.

Expected outcome of this pilot project

Prime mover for CO₂ EOR and Sequestration in the region



BaU vs. reduction target in 2020



Sectors	26%	41%
	Giga Ton	
Forestry + Land Peat	0.672	1.039
Agriculture	0.008	0.011
Energy and Transport	0.038	0.056
Industry	0.001	0.005
Waste	0.048	0.078

Presidential Regulation No 61/2011

Concluding remarks

- Deployment of CCUS in Indonesia is aligned with national energy policy and Gol's commitment to achieve unconditional emission reduction target of 29% and conditional reductional target up to 41% of the BAU scenario by 2030
- The utilization of CO₂ in petroleum industry particularly for EOR is highly encouraged in achieving both emission reduction and national oil production targets.
- Enabling the development of highly contaminated gas fields e.g. East Natuna



Thank you

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