CURRENT STATUS AND FUTURE PATH OF DEVELOPMENTS FOR CCUS IN INDONESIA

JUNE 08, 2018
Outline

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In 2015, CO₂ emissions from the energy sector 551 Mt with average growth of 4.8% per-year.

GoI’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.

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

2012
ADB TA: Determining CCS Potential South-east Asia
Conducted by LEMIGAS, supported by BAPPENAS, DJMIGAS, SKK Migas, PERTAMINA, GCCSI

2013
Study of EOR and CCS Opportunity of CO2 byproduct SNG Plant

2015
CCS for Coal-Fired Power Plants in Indonesia
To provide PT. PLN with technical, economic, operational, and environmental analysis of the CCSR for selected coal-power plants
To explore the EOR market as cost-offsetting mechanism for CCS projects at the selected site

2016
FS of CO2 EOR Pilot Project in Beringin Depleted Oil Field

2017
FEED of CO2 EOR Pilot Project in Beringin Depleted Oil Field

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 barel. Potential of CO2 storage ± 300 million tonne.
<table>
<thead>
<tr>
<th>STAGE 1</th>
<th>Pilot</th>
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<tr>
<td></td>
<td>▪ 50-100 tonnes per day of CO₂ over several months</td>
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<td></td>
<td>▪ Knowledge of reservoir performance to support financing and designing a Demo project.</td>
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<tr>
<th>STAGE 2</th>
<th>Demonstration</th>
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<tr>
<td></td>
<td>▪ Larger quantities of CO₂ injected into many wells continuously over many years</td>
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<td></td>
<td>▪ 500-1,000 tonnes per day or more of CO₂ injected over 10 + years.</td>
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<td></td>
<td>▪ Confirmation of long-term successful CO₂ storage to support financing and construction of at least one full scale commercial operation</td>
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<tr>
<th>STAGE 3</th>
<th>Commercial</th>
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<td>▪ Very large quantities of CO₂ captured from one or more sources injected into one or more locations for a very long time period</td>
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<td></td>
<td>▪ 2,500 -5,000 tonnes per day CO₂ captured and injected over 20+ years.</td>
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<td></td>
<td>▪ Capture and store sufficient quantities of CO₂ to substantially reduce Indonesia’s CO₂ emissions</td>
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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

GATE 1
Pilot CO₂ 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 CO₂/day has been successful

GATE 5
Case for a storage demonstration is approved based on a successful pilot assessment
**Proposed CCUS pilot project**

**Merbau Gas Gathering Station Site**
- Pure CO₂ Stream
- Amine regenerator
- CO₂ Compressor
- Dryer package
- CO₂ Liquefaction
- 75 ton CO₂/hari
- 20 bar, 35°C
- 20 bar, -20°C
- 75 ton CO₂/hari

**Beringin Field Site**
- Liquid CO₂ Pump
- Injection Pump
- Heater
- To Injection Well
- 75 ton CO₂/day

**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

<table>
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<tr>
<th>Component Facility</th>
<th>Merbau</th>
<th>Beringin</th>
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<tbody>
<tr>
<td>Process and Mechanical</td>
<td>6,792</td>
<td>196</td>
</tr>
<tr>
<td>Electrical</td>
<td>375</td>
<td>134</td>
</tr>
<tr>
<td>Instrument</td>
<td>145</td>
<td>17</td>
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<tr>
<td>Piping</td>
<td>219</td>
<td>40</td>
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<tr>
<td>HSE</td>
<td>79</td>
<td>79</td>
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<tr>
<td>Civil</td>
<td>73</td>
<td>142</td>
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<tr>
<td>Well conversion</td>
<td></td>
<td>1,860</td>
</tr>
<tr>
<td>Monitoring</td>
<td></td>
<td>157</td>
</tr>
<tr>
<td>Subtotal</td>
<td>7,683</td>
<td>2,626</td>
</tr>
<tr>
<td>TOTAL CAPEX (U$. 000)</td>
<td>10,309</td>
<td></td>
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<tr>
<td>TOTAL OPEX 1st year</td>
<td></td>
<td>1,760</td>
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Note:
- Land road (20 km)
- National road (45 km)
Deep review of the pilot project candidate

- CO$_2$ EOR and storage pilot planned in Beringin field using inverted 5-spot
- Simulation studies to establish expected pilot performance
- Design for CO$_2$ 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 CO$_2$ EOR sequestration in a South Sumateran reservoir;
- Understanding CO$_2$ EOR processes when applied in conjunction with CO$_2$ sequestration;
- To increase the level understanding of and confidence in CO$_2$ EOR sequestration;
- Gain valuable experience and expertise in operating a CO$_2$ 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 CO$_2$ EOR sequestration nationally; and
- To obtain information for the development of appropriate legal and regulatory frameworks for CO$_2$ EOR sequestration.
Expected outcome of this pilot project

Prime mover for CO₂ EOR and Sequestration in the region

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<tr>
<th>Cluster</th>
<th>CO₂ Storage (Mt)</th>
<th>Oil Storage (MMstb)</th>
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<tbody>
<tr>
<td>North Cluster</td>
<td>20</td>
<td>120</td>
</tr>
<tr>
<td>Southeast Cluster</td>
<td>27</td>
<td>149</td>
</tr>
<tr>
<td>West Cluster</td>
<td>25</td>
<td>79</td>
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Presidential Regulation No 61/2011
Concluding remarks

- Deployment of CCUS in Indonesia is aligned with national energy policy and GoI’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 CO$_2$ 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

www.lemigas.esdm.go.id