OVERVIEW OF CCS PILOT STUDY AT GUNDIH FIELD, CENTRAL JAVA

Presented by

Seminar on Evaluation of CO2 Storage Potential,
Bandung Institute of Technology, Indonesia
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HISTORY OF THE STUDY

A collaboration effort that is conducted between:

• Institut Teknologi Bandung, Kyoto University,
• Pertamina UTC and Pertamina EP

Supported by

• Japan International Cooperation Agency (JICA) and
• Japan Science and Technology Agency (JST)
OUTLINE

• INTRODUCTION
• LOCATION OF CCS PILOT STUDY
• DATA AVAILABILITY
• REGIONAL GEOLOGY AND TECTONIC SETTING
• G&G CHARACTERISTIC OF CCS RESERVOIR TARGET
• TENTATIVE RESULTS
• FUTURE PLAN AND TARGET
• SUMMARY AND DISCUSSION
The study concerns approximately 0.3 million ton of CO₂ emitted annually during production of natural gas in a gas field presently under development in the Gundih Area.

A pilot study for research and development of technologies for assessing both shallow and deep strata at sites of CO₂ injection.

Essential for safe application of CO₂ sequestration technologies, and for monitoring of underground distribution and behavior of CO₂ through capacity development of organizations and human resources.
GEOSEQUESTRATION (CCS) CONCEPT AND FLOW

- Carbonaceous Fuels
- Capture Processes
- Transport and Storage Options

(Source: CO2CRC)
Geological Sequestration

Overview of Geological Storage Options
1. Depleted oil and gas reservoirs
2. Use of CO₂ in enhanced oil and gas recovery
3. Deep saline formations — (a) offshore (b) onshore
4. Use of CO₂ in enhanced coal bed methane recovery

Coal Bed
Abundant Oil Field
Deep Aquifer
CO₂-EOR
Deep Aquifer
SITE CHARACTERIZATION METHODOLOGY OF CCS

Gibson-Poole (2009)
Study Area

KENDENG TROUGH

Bandung Basin

Volcanoes of the Dieng Plateau

JAVA ISLAND

EAST JAVA BASINAL AREA

Smith (2005)
REGIONAL STRUCTURES AND HYDROCARBON OCCURRENCES

OIL AND GAS SEEPAGES COMBINE WITH STRUCTURE PATTERN OF JAVA

Sapiie et al., (2006)
TECTONIC ELEMENTS OF EAST JAVA BASINAL AREA
TECTONIC ELEMENTS OF EAST JAVA BASINAL AREA
STRATIGRAPHIC CORRELATION AND NOMENCLATURES OF JAVA ISLAND

Sapiie et al., (2006)
N – S Central Java Cross Section

Sapiie et al., (2006)
TECTONIC EVOLUTION OF EAST JAVA REGIONS

- HC produced from several strat. sequences
- "Multiple petroleum system"
  ⭐ CCS Reservoir Target
• Map showing trends of habitats of oil and gas in the East Java Basin.
• Four trends can be recognized containing oil, thermogenic and biogenic gas fields.
• The habitats are closely related with the geologic setting and petroleum system. (Satyana and Purwaningsih, 2007)
LOCATION OF GUNDIH FIELD
BOUGER ANOMALY GRAVITY MAP

Source: http://www.bandaarcgeophysics.co.uk/
KTB (Kedung Tuban) – RBT (Randu Blatung) – KDL (Kedung Lusi) fields
GEOGRAPHICAL MAP OF GUNDIH AREA

KETERANGAN:

- WORKOVER WELL
- PLAN OF SUBSURFACE DEVELOPMENT WELL (CLUSTER SYSTEM)
- INJECTION WELL
- SETTLEMENT
- OPEN AREA
- RICE FIELD
FACT OF GUNDIH FIELD

- Gundih field was operated by PT. Pertamina EP, which has **initial gas in place (IGIP) 435,96 BSCF** and could produce 62 MMSCFD in 12 years.

- **CO₂** content which generated directly from the field is **21%** from total gas, whereas if after through CPP (Central Processing Plant) the percentage of CO₂ produced is about 15% from total gas in this field (Kadir, 2012).

- PT. Pertamina EP provided 2D/3D seismic data and well data to evaluate subsurface GGR in this area.
Gundih Field

Reservoir which sought in this study is a shallow reservoir to facilitate the injection of CO$_2$. This reservoir is laying above 3 main structures that have been proven to have gas reserves;

- Kedung Tuban,
- Randu Blatung,
- Kedung Lusi.
Regional Scale Geological Map

Source: GRDC REGIONAL GEOLOGY MAP OF JAVA ISLAND

[Map showing geological features with markers for Semarang, Surabaya, and Yogyakarta]
NGRAYONG FORMATION – SHALLOW TARGET

Outcrop distribution of the Ngrayong Formation (Ardhana, 1999)

CCS Reservoir Target
PALEOGEOGRAPHY OF NGRAYONG SAND
Ngrayong Formation – Depositional Model (Ardhana, 1993)
DATA AVAILABILITY IN GUNDIH FIELD

- 2D/3D SEISMIC
- 9 WELLS
3D Seismic Data

Area:
197 km²

- First trace FFID: 2000
- Last trace FFID: 2838
- First trace SP: 12379
- Last trace SP: 12553
- First trace CDP: 200006232
- Last trace CDP: 283806406
Well Correlations

Ngrayong Formation

Asikin, in progress
Asikin, in progress
Reservoir Simulation Methodology

Stratigraphic & structural modeling -> geological model -> reservoir simulation model

Ekowati, *in progress*
Roll out plan: 2015 – 2025

Injection plan: inject up to 10,000 tonCO2 in 10 years in deep storage (Kujung Fm.) and shallow storage (Ngrayong Formation)

CO2 supply: at various rate (500 ton CO2/year - 0.1 MtonCO2/year)

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<th>Rate in 1 year (tonCO2)</th>
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Ekowati, in progress
Ngrayong Formation in Gundih field doesn’t have a big closure to inject CO₂. The formation has an open structure to the north that will have a possibility to migrate the injection of CO2 (Asikin, 2012).

Kujung Formation does not provide sufficient storage capacity. With optimum injection surface rate of 960 tonCO2/year @ Pinitial = 940 psia, maximum total gas injection is 7000 tonCO2 in 10 years with negligible increase in pressure value (Ekowati, 2012).

Ngrayong Formation provides sufficient storage capacity. With injection surface rate of 1,000 tonCO2/year, total gas injection could reach 10,000 tonCO2 in 10 years with negligible increase in pressure value (Ekowati, 2012).

However, uncertainty factor is still large since many assumptions are used to generate the model properties. There is a possibility that injection at Ngrayong Formation will be leak to the surface or charging into Caluk structure through the northern fault.

Future works will concentrate in determining possible location in the northern part of Gundih Field with most likely residual trapping mechanism.