Economic Research Institute for
ASEAN and East Asia

The First Asia CCUS Network Forum
22 – 23 June 2021

CO_2-Souce-Sink Match GIS System for Indonesia

Mohammad Rachmat Sule*, Alfian, Steven Chandra & M. Firdaus Al Hakim

*Study Program of Geophysical Engineering & Geothermal Engineering, Institut Teknologi Bandung
*Manager of Center for CO_2 and Flared Gas Utilization, Institut Teknologi Bandung
*Manager of National Center of Excellence for CCS/CCUS

CO_2 Sources from Main Energy Sectors in Indonesia

Indonesian target for GHG emission reduction **from energy sector** from 2020 – 2030 (20 years): ~ 400 Mt of CO_2.

Some facts about CO_2 from some sites in Indonesia:

- Cumulative total CO_2 that could be injected in Gundih field for 10 years ~ 3 Mt of CO_2
- Cumulative total CO_2 that could be injected in Tangguh field for 10 years **~ 32 Mt of CO_2**
- Cumulative CO_2 that could be produced from main oil and gas fields in Eastern Java (incl. Gundih, Banyu Urip, Sukowati, & JTB) for 10 years **~ 35 Mt of CO_2**
- Potential of CO_2 to be injected from Banggai Ammonia Plant (Central Sulawesi) for 10 years **~ 10 Mt of CO_2**
- Potential of pure CO_2 injection from DME Project in Tanjung Enim – South Sumatra for 10 years (from coal gasification) ~ 40 Mt of CO_2 (there will be another 25 Mt of CO_2 for 10 years from boiler incl. impurities)

  → Potential of GHG reduction from those above planned projects only (10 years): **~ 117 Mt of CO_2** (29% of GHG emission reduction target from energy sector)

If we add the potential of CO2 produced from coal-fired power plant:

- CO_2 released from PLTU Cirebon (650 MW, 80% capacity factor) **~ 4.5 Mt** of CO_2 per year (Note: 1 MWh ~ 0.9 ton of CO_2)
- CO_2 released from all Coal-fired power plants in Indonesia (totally 35 GW, 80% capacity factor) **~ 250 Mt** of CO_2 per year

→ Thus, CCUS can play an important role in Indonesia, since there are a lot of CO_2 sources from energy sector, but their locations are close enough to depleted oil reservoirs and coal mining, so that CO_2-EOR, CO_2-EGR and ECBM can perhaps be carried out economically in Indonesia.

The Uniqueness of CCUS Implementation in Indonesia

1. It makes the environment in the vicinity of energy facilities cleaner, because a large portion the produced GHG emission is injected underground.
    a. From Oil and Gas Facility and Coal Gasification within 10 years: 117 Mt (29% of reduction target from energy sector, not incl. potential CO2 reduction from several LNG plants (e.g. Badak LNG Plant etc.), from gas fields (e.g. Donggi, Senoro etc.), from planned blue ammonia, etc.
    b. From coal fired power plant: ~250 Mt/year (technology for capturing CO_2 from boiler is not ready, yet).

2. It gives an opportunity for both the government of Indonesia and the oil and gas companies to receive additional income from incremental hydrocarbon production.

3. It creates an opportunity to receive more economic benefit from selling carbon credits.

Note: - CCUS activities in a oil and gas block could be as part of field development scenario, thus could be proposed in the POD proposal.
- CCS/CCUS activities should be part of oil and gas operations, thus CAPEX-OPEX will become oil and gas operation cost, which is integrated to the field economic.

Proposal:
Development of CO2-source-sink match GIS system

INDONESIA CENTER OF EXCELLENCE
CARBON CAPTURE STORAGE

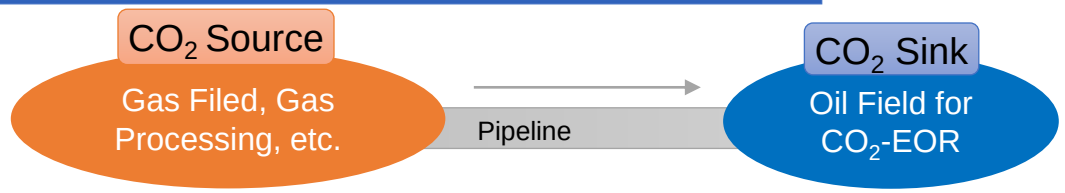
INDONESIA CENTER OF EXCELLENCE FOR CCS AND CCUS

INSTITUT TEKNOLOGI BANDUNG 1920

Development of CO_2-Source-Sink GIS System for Indonesia

Suggestion: This system will be accessible for public for inviting investors

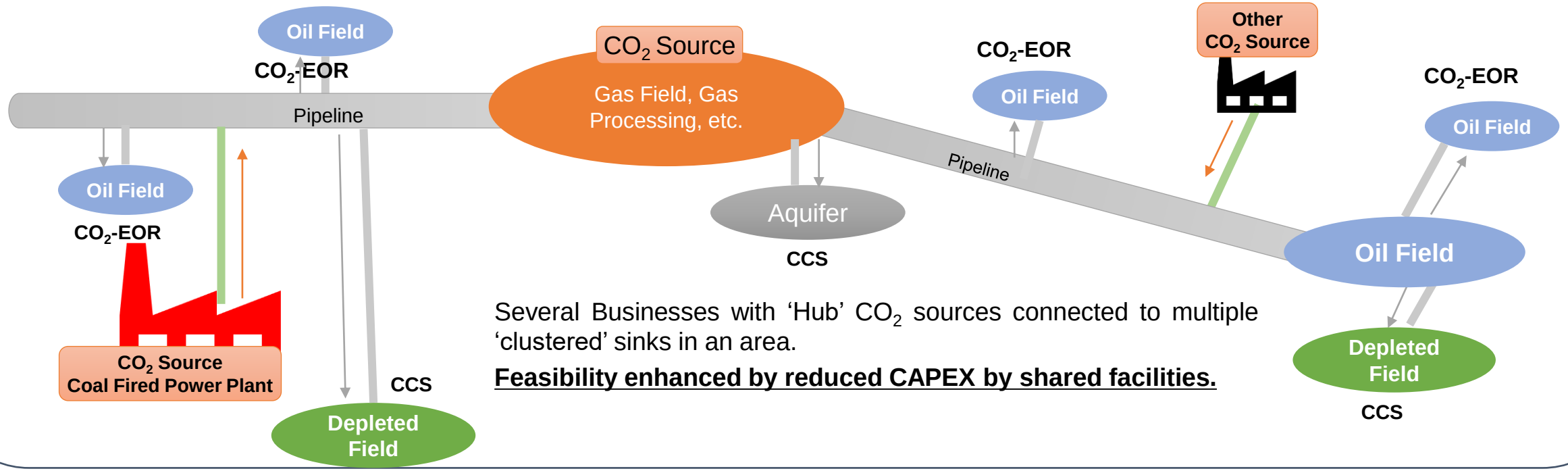
Conventional One-by-One CCUS



A business with <u>one</u> source connected to <u>one</u> sink

<u>Feasibility damaged by Large CAPEX</u>

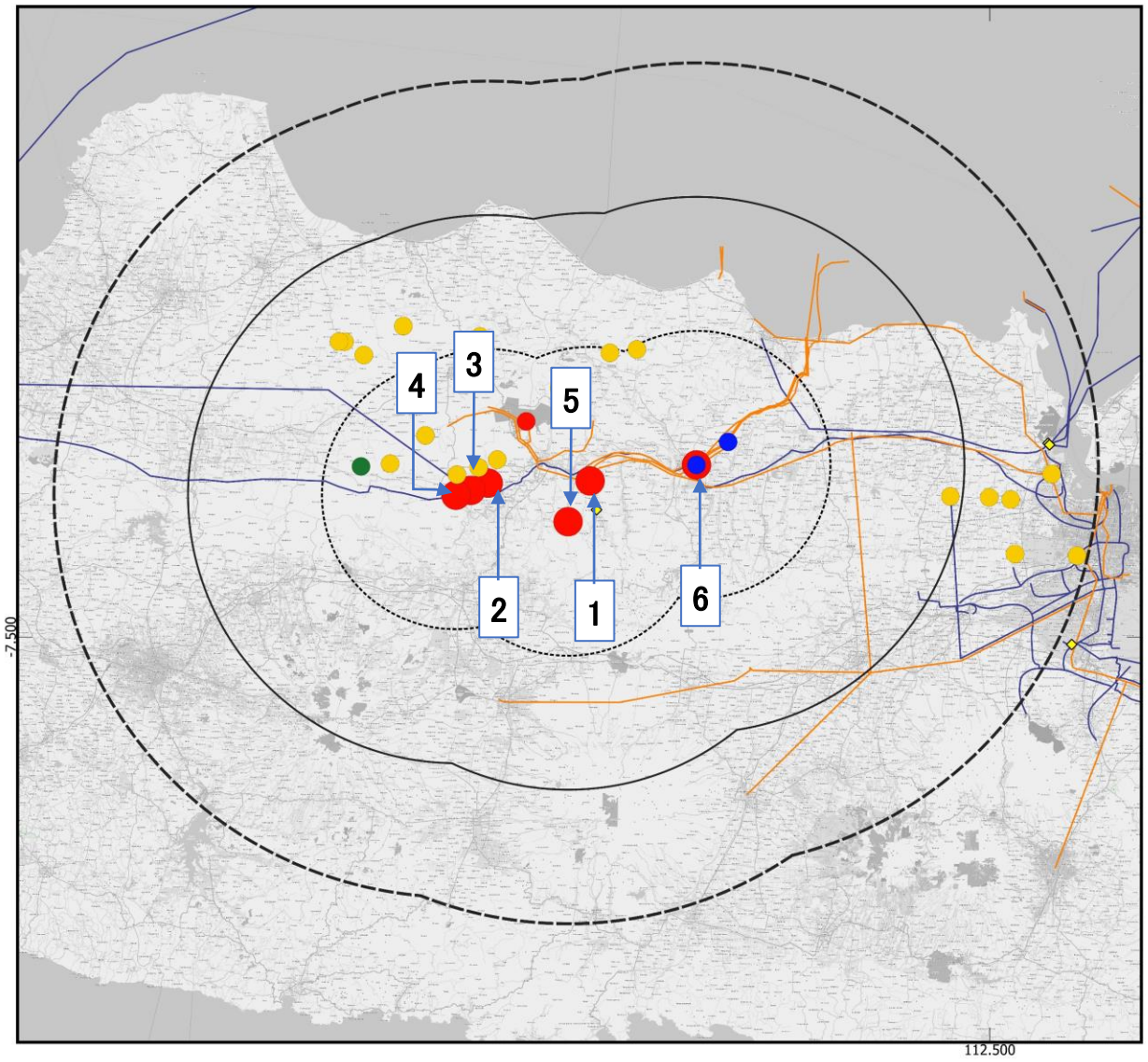
CCUS in a way of 'Hub-Clustering' Regional CO_2 Management



Several Businesses with 'Hub' CO_2 sources connected to multiple 'clustered' sinks in an area.

<u>Feasibility enhanced by reduced CAPEX by shared facilities.</u>

Potential CO_2 Source in East Java from Gas Fields



East Java Hub Cluster Map
Oil and Gas Source

Legend

- Pipelines Indonesia Liquid
- Pipelines International Gas
- Gas Processing_point

High CO2 Source

- High Oil and Gas Source CO2
- East Java Zone A
- East Java Zone B
- East Java Zone C

East Java Sink

- Feasible
- Feasible w/ Further Study
- Technically not Favoured
- Not Feasibe

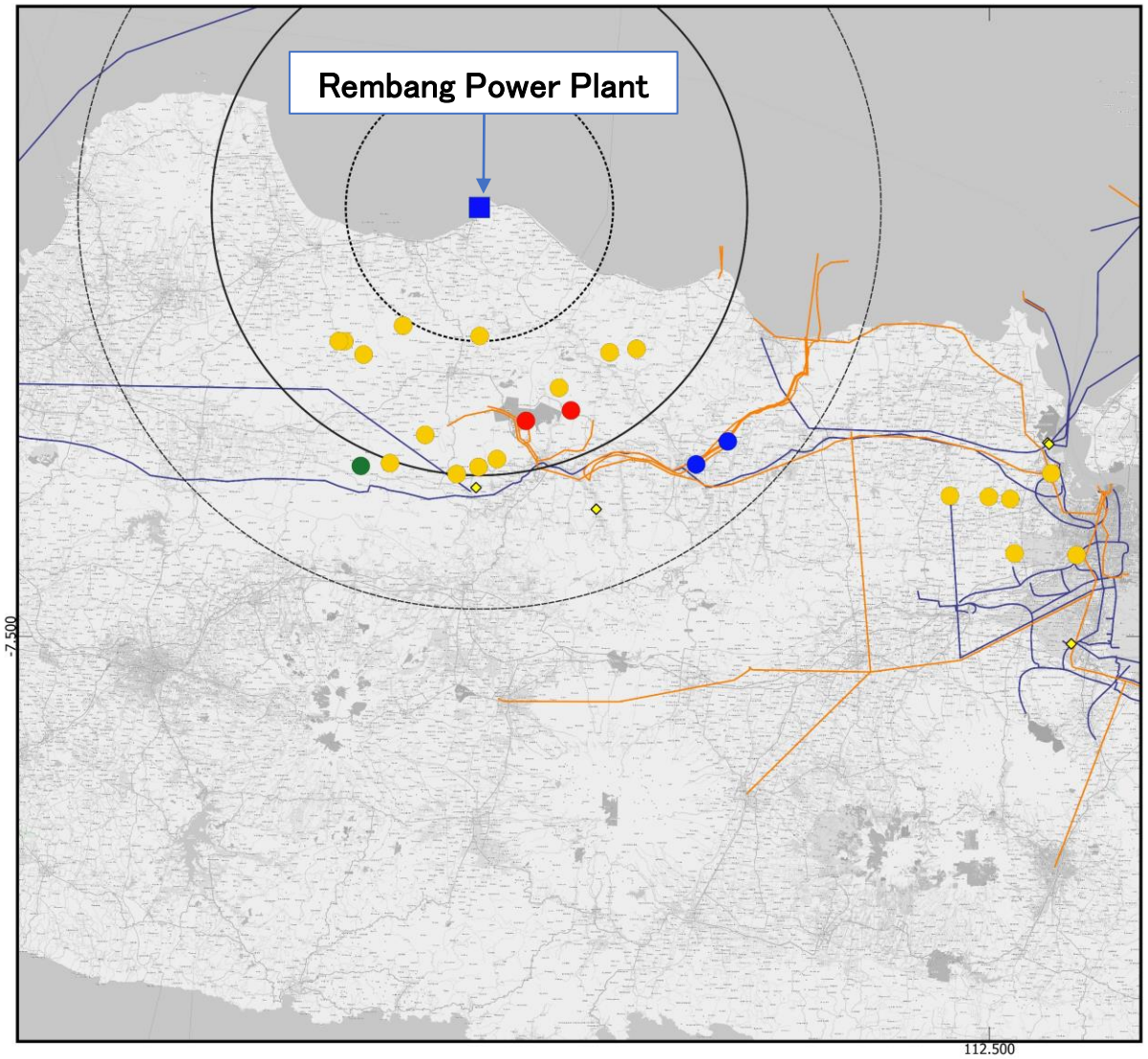
INDONESIA CENTER OF EXCELLENCE CARBON CAPTURE STORAGE

Potential Fields:

1. Banyu Urip
2. Kedung Tuban
3. Randu Blatung
4. Kedung Lusi
5. Tiung Biru
6. Sukowati

Estimated CO_2 Potential:
180 MMSCFD eq. to 10,000 tpd (Muslim et al, 2013; Hartono et al, 2017)

Potential CO_2 Source in East Java from Coal



East Java Hub Cluster Map
Coal Power Plant Source

N

0 20 40 60 km

Legend

- Pipelines Indonesia Liquid
- Pipelines International Gas
- Gas Processing_point
- East Java Zone A
- East Java Zone B
- East Java Zone C
- High Coal Power Plant

East Java Sink

- Feasible
- Feasible w/ Further Study
- Technically not Favoured
- Not Feasibe

INDONESIA CENTER OF EXCELLENCE CARBON CAPTURE STORAGE

Potential Source:
Rembang Power Plant (PLTU Rembang)

Power Generation: 300 MW

Estimated CO_2 Potential:
>2 million tonnes of CO_2 per annual

Challenge:
No existing pipeline from Rembang PP to potential sinks

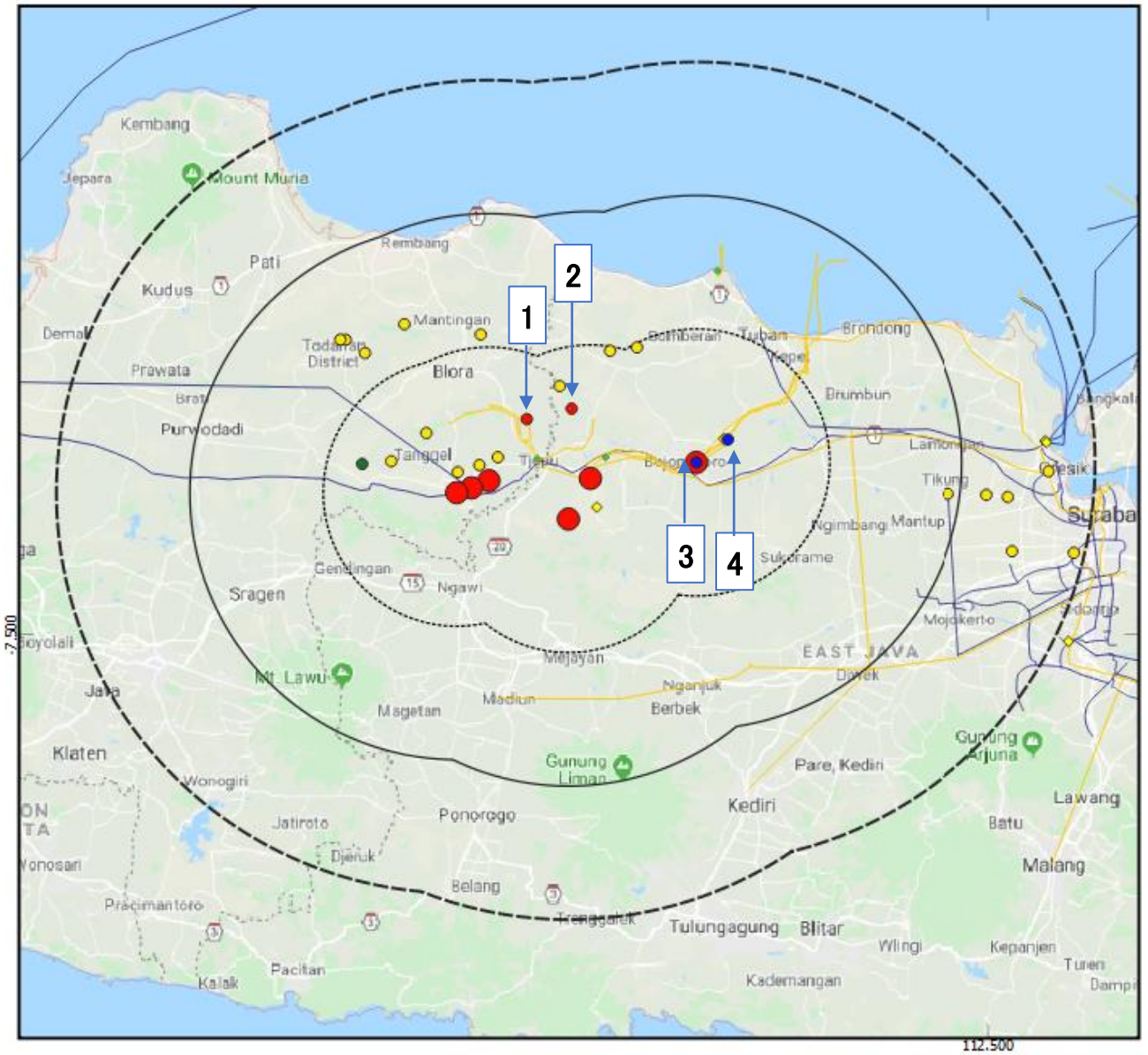
Potential CO_2 Sink- East Java

Potential Sink Fields:

1. Ledok Field (Old Field, very high uncertainty)
2. Kawengan Field (Old field, production approx. 1250 BOPD)
3. Sukowati Field (Most possible candidate, already on PERTAMINA's EOR Roadmap, production approx., 10,000 BOPD)
4. Mudi Field (possible candidate, production approx. 9,500 BOPD)

Estimated CO_2 Sequestered:
9650 tonnes per day

Estimated additional oil recovery:
4000-7000 BOPD



East Java Hub Cluster Map
Oil & Gas Source

N

0 20 40 60 km

Legend

- Pipelines Indonesia Liquid
- Pipelines International Gas
- Gas Processing_point
- East Java Zone A
- East Java Zone B
- East Java Zone C

High Oil and Gas Source CO2

- High

East Java Sink

- Feasible
- Feasible w/ Further Study
- Technically not Favoured
- Not Feasibe

INDONESIA CENTER OF EXCELLENCE
CARBON CAPTURE STORAGE

Potential CO_2 Source in South Sumatera

CO_2 Source from Oil & Gas

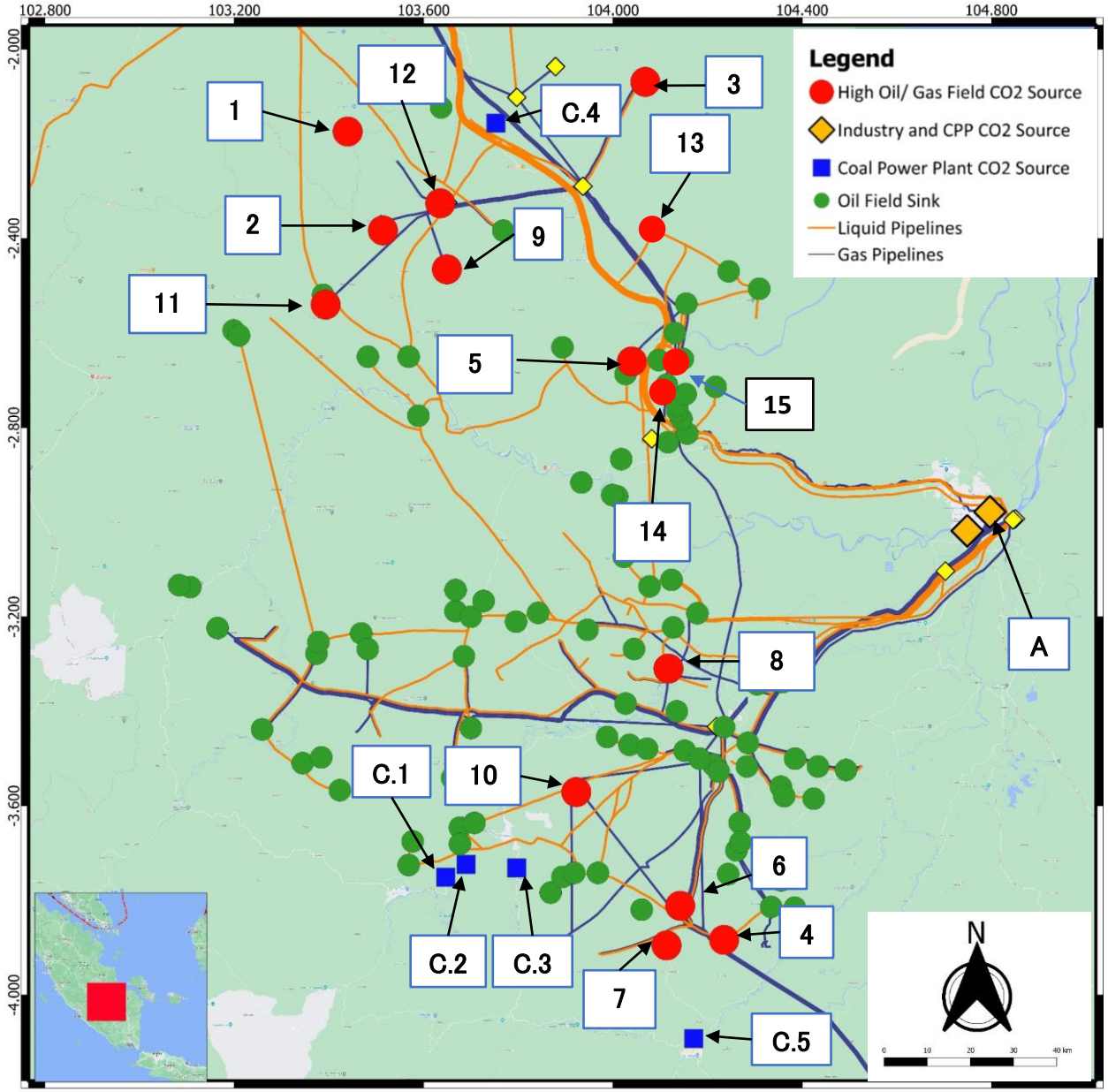
No	Field Name	Operator
1	Bungin 1	ConocoPhillips (South Jambi) Ltd
2	Dayung	ConocoPhillips (Grissik) Ltd
3	Gelam	ConocoPhillips (Grissik) Ltd~PT Pertamina/Talisman (Jambi Merang) Ltd
4	Kuang	PT Pertamina EP
5	Letang	ConocoPhillips (Grissik) Ltd
6	Pagardewa	PT Pertamina EP
7	Prabumenang	PT Pertamina EP
8	Raja	PT Pertamina EP
9	Sambar 1	ConocoPhillips (Grissik) Ltd
10	Singa (Medco)	PT Medco E&P Lematang
11	Suban	ConocoPhillips (Grissik) Ltd
12	Sumpal	ConocoPhillips (Grissik) Ltd
13	Bentayan	PT Pertamina EP
14	Tanjung Laban	PT Pertamina EP
15	Ramba	PT Pertamina EP

CO_2 Source from Industry

No	Industry Category	Company
A	Petrochemical	PT Pupuk Sriwidjaja

CO_2 Source from Power Plant

No	Coal Power Plant	Owner
C.1	Keban Agung	PT Priamanaya Energi
C.2	PLTU Banjarsari	PT Bukit Pembangkit Innovative
C.3	Bukit Asam #2	PT PLN (Persero) Pembangkitan Sumatera Bagian Selatan
C.4	Sumsel-5	PT DSSP Power
C.5	Baturaja	PT Bakti Yudha Nugraha Power



Potential Source of CO2 in South Sumatera
Source Category: Gas Field, PLTU, Industry

Potential CO_2 Source in East Kalimantan

CO_2 Source from Oil & Gas

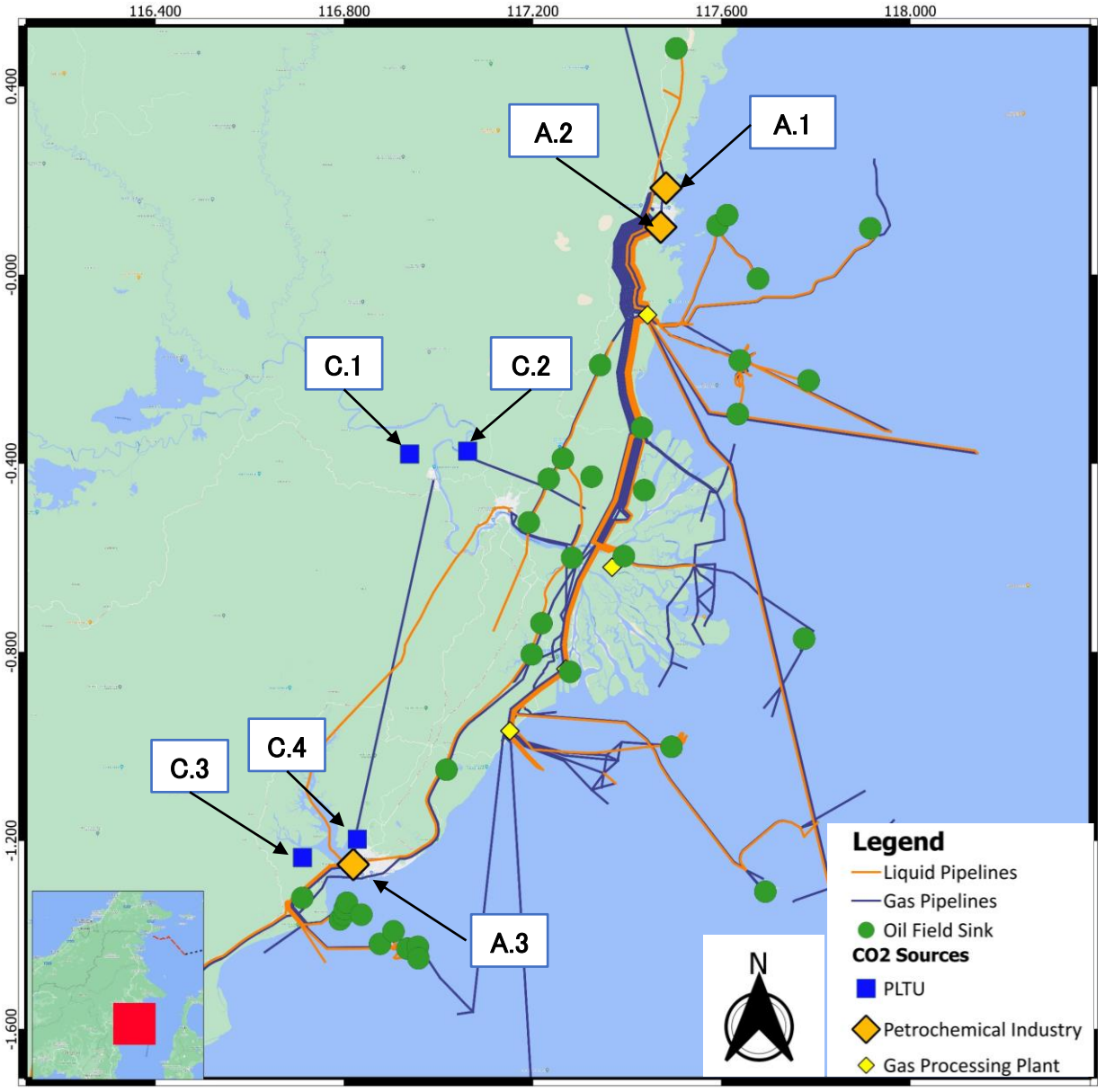
No	Field Name	Operator
No Data		

CO_2 Source from Industry

No	Industry Category	Company
A.1	Petrochemicals	PT Pupuk Kalimantan Timur
A.2	LNG Plant	PT. Badak NGL
A.3	Refinery	PT. Pertamina (RU V)

CO_2 Source from Power Plant

No	Coal Power Plant	Owner
C.1	PLTU Senoni	PT Kalimantan Powerindo
C.2	PLTU CFK	PT PT Cahaya Fajar Kaltim
C.3	PLTU Teluk Balikpapan	PT PLN (Persero) Pembangkitan dan Penyaluran Kalimantan
C.4a	PT Kariangau Power	PT Kariangau Power



Potential Source of CO2 in East Kalimantan
Source Category: Gas Field, PLTU, Industry

Capacity Building Program

Center of Excellence for CCS/CCUS, in a cooperation with IEAGHG hosts

International Virtual Course on CCUS:
26 July – 6 Aug 2021

Further info: https://admission.itb.ac.id/home/summer-courses/ivc21-141
To register : https://admission.itb.ac.id/registration/nonreguler

THANK YOU

Email: coe-ccs@fttm.itb.ac.id & rachmat.sule@itb.ac.id

http://ccs-coe.fttm.itb.ac.id/

http://ccs-gundih.fttm.itb.ac.id/

INDONESIA CENTER OF EXCELLENCE CARBON CAPTURE STORAGE

Center for CO_2 & Flared Gas Utilization

skkmigas

RISTEKDIKTI

PUSAT UNGGULAN IPTEKS PERGURUAN TINGGI INDONESIA