

CCS Technical Workshop 2021

27 January 2021

Building Decarbonization Society in Indonesia through Carbon Capture, Utilization and Storage (CCUS)

Dr. Mohammad Rachmat Sule

*Study Program of Geophysical Engineering & Geothermal Engineering, Institut Teknologi Bandung

*Manager of National Center of Excellence for CCS, CCUS and Flared Gas Utilization

*Manager of Center for CO₂ and Flared Gas Utilization, Institut Teknologi Bandung



Growing Energy Demand



Growing Energy Demand

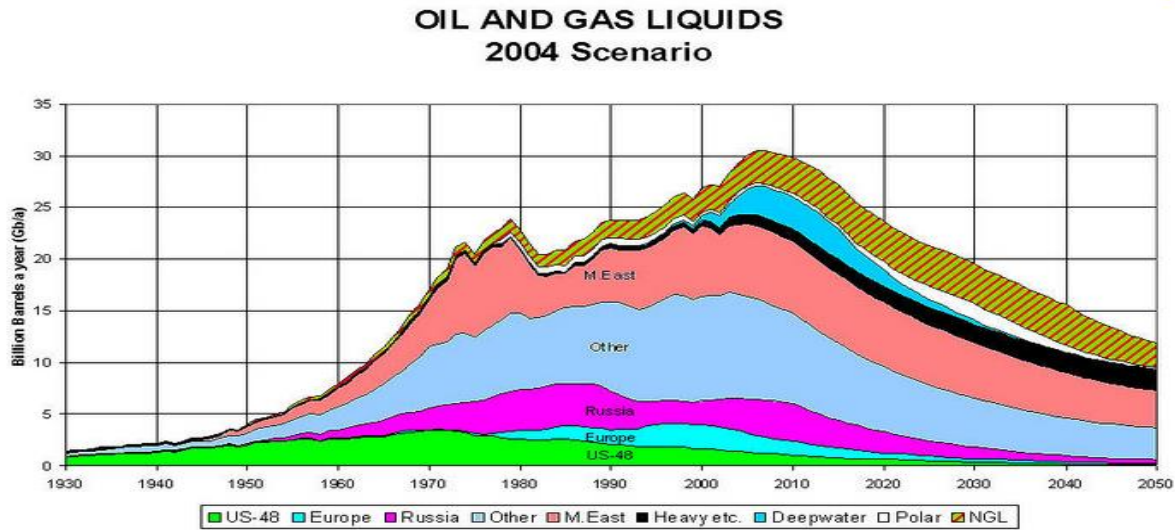


Who has the oil?

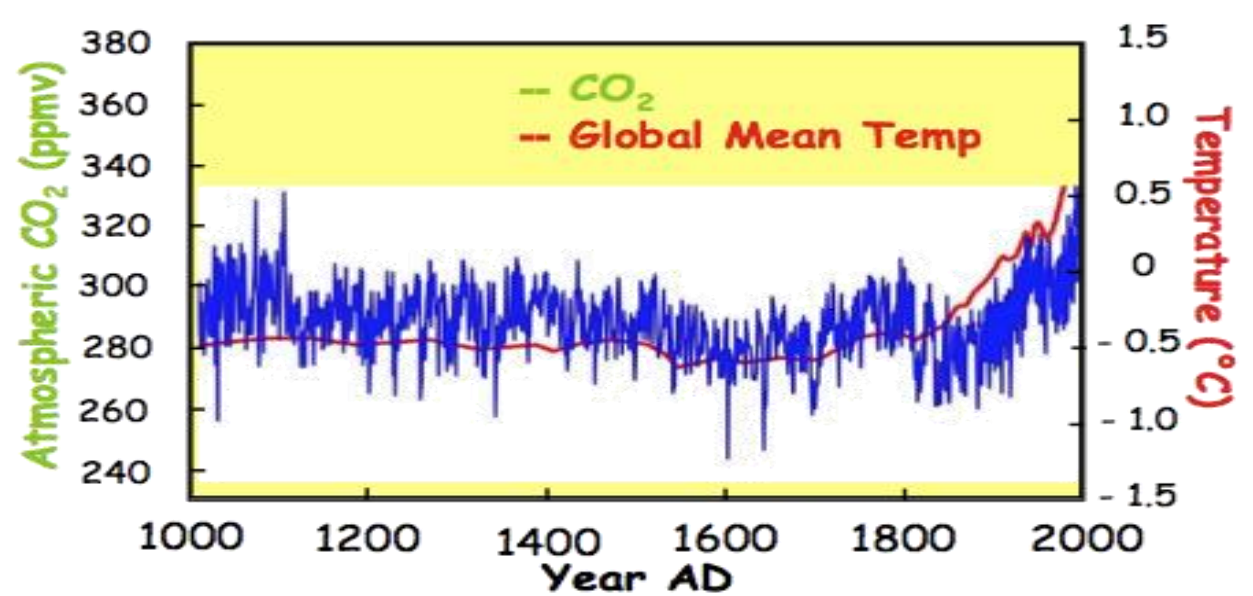


(<http://www.energybulletin.net/37329.html>)

Present World Crisis

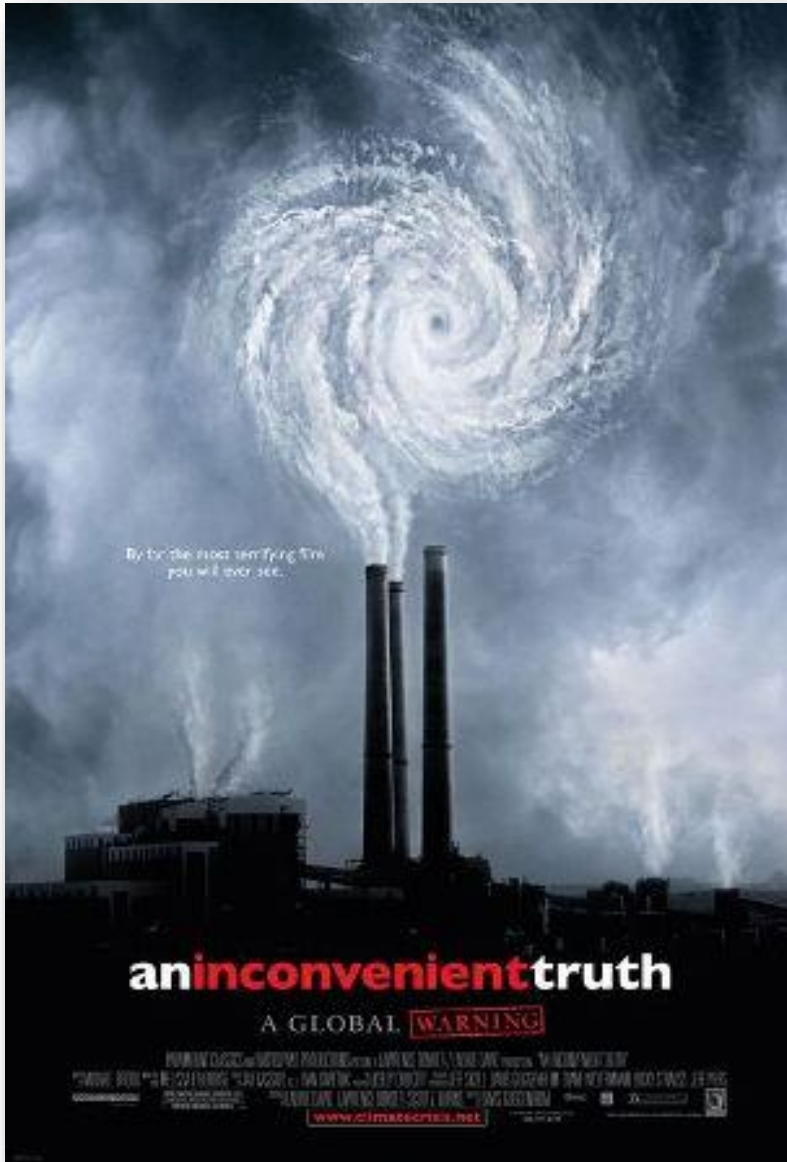


Peak Oil

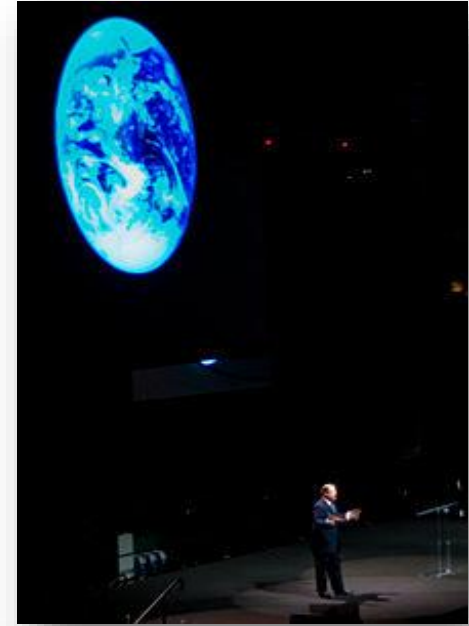


Climate Change

Climate Change Awareness Campaign



- American documentary film (and book) released in 2006 directed by Davis Guggenheim about former **United States Vice President Al Gore's** campaign to educate citizens about global warming
- **Won 2 Academy Awards & Box Office Success:**
 - ✓ Best Documentary Feature
 - ✓ Best Original Song
- **An Inconvenient Sequel: Truth to Power** (released in 28 July 2017)



To stop global warming

- It will take
 - ① increased energy efficiency,
 - ② increased renewable energies,
 - ③ the decarbonisation of power generation from fossil fuels.

- The only technology available to mitigate greenhouse gas (GHG) emissions from large-scale fossil fuel usage is CO2 capture and storage (CCS). (from CO2 Capture and Storage, IEA, 2008)

National CoE for CCS - CCUS and ZRF

--- First activity was stated in 2009 ---

- Established based on DG Oil & Gas Appointed Letter (May 2017) -

The purposes of establishment:

- Realization of National commitment to reduce GHG of 29% in 2030 by national effort and could increase up to 41% if International support is available.
- Promoting the reduction of GHG emission from Energy Sector in Indonesia
 1. Developing technology related to CCS/CCUS and it can be used for future EOR and EGR activities (CCUS) in order to maintain and increase oil & gas production.
 2. Develop real projects related to CCS and CCUS, such as: Gundih CCS Pilot project, development of CO₂ separation technology, CCS/CCUS SOP, Regulation, etc.
 3. Extended to other oil & gas fields with high CO₂ content, such as Natuna D alpha, some fields in South Sumatera and East Java, etc.

Draft of regulation for promoting CCS and CCUS in Indonesia was produced by the CoE CCS-CCUS in 2019 (supported by ADB)



THE PRESIDENT
OF THE REPUBLIC OF INDONESIA

REGULATION OF THE PRESIDENT
OF THE REPUBLIC OF INDONESIA
NUMBER __ YEAR 20 __
ON CARBON CAPTURE AND SEQUESTRATION

BY THE GRACE OF THE ALMIGHTY GOD

THE PRESIDENT OF THE REPUBLIC OF INDONESIA,

Considering : that in order to encourage the efficient utilization of Indonesia's natural resources as well as to develop carbon capture and sequestration technologies as a possible option to advance Indonesian government policies seeking to reduce greenhouse gas emissions within the context of sustainable development,

that in order to provide a legal basis for carbon capture and sequestration projects, including for addressing long-term liability for sequestered carbon dioxide, and thereby provide greater certainty to support the development of efficient and effective projects,

that in order to assure the integrity of carbon capture and sequestration projects in terms of their health, safety and environmental aspects through existing and new regulations, policies and standards,

that in order to provide a system for permitting carbon capture and sequestration projects that is performance-based according to the underlying degree of risk of such activities, with the objective of mitigating the risks associated therewith,

that in order to coordinate the efforts of government agencies at the national and local levels in developing regulations, policies and standards; evaluating applications for permits for carbon capture and sequestration projects; and overseeing these projects,

that in order to ensure that Indonesia serves as a positive example in the development of carbon capture and sequestration through adherence to best international practices, including through public engagement initiatives,

it is necessary to stipulate Regulation of the President on Carbon Capture and Sequestration;

In View of : 1. Article 4 paragraph (1) of the 1945 Constitution of the Republic of Indonesia;

Just Fresh from the oven (Nov - Des 2020)




Arifin also emphasized that development of Carbon Capture, Utilization, and Storage (CCUS) is vital to reduce CO2 emissions. "CCUS is currently a key issue at the global level relating to reduction of CO2 emissions and reuse of the same to increase oil recovery in depleted oil fields," said Arifin.

In closing, Arifin invited all stakeholders to collaborate in enhancing CCUS capacity and use. According to him, it is necessary to strengthen the framework for public-private cooperation by creating a sustainable platform for accelerated implementation of CCUS, identification of investment opportunities, and improvement of business environment as well as dissemination of policies, regulations, and best practices. "Indonesia welcomes all parties to join us in developing CCUS in order to achieve the commitment to sustainable energy", Arifin concluded. (1Y)

Minister of EMR Reiterates Commitment to Use of Cleaner Fuels in East Asia Energy Forum

Wednesday, 18 November 2020 - Dibaca 164 kali

Besides that, the Government of Indonesia is currently finalizing the Draft of Presidential Decree on Economical Value of Carbon


MENTERI KOORDINATOR BIDANG KEMARITIMAN DAN INVESTASI
REPUBLIK INDONESIA

Nomor Surat: B-4153/MEK/OMAR/RES/HK.01/020X/2020
Tanggal: 30 Desember 2020
Lampiran: 1 (satu) berkas
Hal: Rancangan Peraturan Presiden tentang Penyelenggaraan Nilai Ekonomi Karbon untuk Pencapaian Target NDC dan Pengendalian Emisi Karbon dalam Pembangunan Nasional

Kepada Yth:
Bapak Presiden
di
Jakarta

Bersama ini dengan hormat kami sampaikan kepada Presiden perihal tersebut pada pokok surat dengan penjelasan sebagai berikut:

- Sebagai tindak lanjut surat kami kepada Presiden nomor B-264/MEK/OMAR/RES/ HK.01/020Y/2020 perihal penyempurnaan Rancangan Peraturan Presiden tentang Instrumen Nilai Ekonomi Karbon untuk Pencapaian NDC dan Pengendalian Emisi Karbon dalam Pembangunan, Kementerian Sekretariat Negara telah melakukan rapat koordinasi dengan kementerian teknis dan lembaga.
- Berhubung masih ada masalah substansi yang belum dipecahkan, maka rapat memulakan bahwa rancangan Perpres tersebut dikordinasikan kembali oleh Kementerian Koordinator Bidang Kemaritiman dan Investasi.
- Kementerian Koordinator Bidang Kemaritiman dan Investasi telah menyelenggarakan serangkaian rapat koordinasi dengan kementerian teknis dan lembaga terkait. Selain itu juga telah dilakukan konsultasi publik dengan sektor swasta dan masyarakat.
- Proses koordinasi dan konsultasi publik tersebut, menghasilkan kesepakatan substansi dan juga mengupah untuk menjadi Penyelenggaraan Nilai Ekonomi Karbon untuk Pencapaian Target NDC dan Pengendalian Emisi Karbon dalam Pembangunan Nasional.
- Adapun pokok-pokok bahasan dalam Rancangan Peraturan Presiden tersebut, sebagai berikut:
 - Proses Bina Rancangan Peraturan Presiden ini telah mengikuti unsur-unsur Instrumen Gas Rumah Kaca, Penurunan Emisi Karbon Nasional (NDC), Instrumen Nilai Ekonomi Karbon (NEK) dan Pembangunan Rendah Karbon (PRK) yang merupakan satu kesatuan yang utuh.
 - Penyelenggaraan NEK melalui perdagangan karbon domestik dan internasional harus dilaksanakan secara akurat, transparan dan dapat dipertanggung jawabkan dengan tetap mengedepankan kepentingan nasional.
 - Pedagangan karbon disyajaikan untuk memenuhi komitmen Indonesia kepada internasional sesuai komitmen perubahan iklim yang telah direfleksikan untuk pencapaian NDC sebesar 29% dengan upaya sendiri dan 41% dengan dukungan kerjasama dari luar negeri pada tahun 2030

d. Pembangunan Rendah Karbon merupakan platform baru pembangunan yang bertujuan untuk mempercepat pertumbuhan ekonomi dan sosial melalui kegiatan pembangunan rendah emisi dan mengurangi eksploitasi sumberdaya alam yang berlebihan untuk mendukung pencapaian NDC.

e. Dalam rangka memberikan arah kebijakan dan pelaksanaan NEK untuk mencapai NDC dan pengendalian emisi karbon dalam pembangunan, dibentuk Komite Pengarah, dengan susunan sebagai berikut:

Ketua : Menteri Koordinator Bidang Kemaritiman dan Investasi
Wakil Ketua : Menteri Koordinator Bidang Perencanaan, Pembangunan dan Investasi
Anggota : Menteri Lingkungan Hidup dan Kehutanan, Menteri PPN/Bappenas, Menteri Dalam Negeri, Menteri Keuangan, Menteri ESDM, Menteri Pertanian, Menteri Perindustrian, Menteri Kelautan dan Perikanan, Menteri Perhubungan, Menteri PUPR, dan Kepala BMKG.

Ketua Bidang substansi NDC dan NEK: Menteri Lingkungan Hidup dan Kehutanan
Ketua Bidang substansi PRK: Menteri PPN/Bappenas
Ketua Bidang koordinasi Wilayah: Menteri Dalam Negeri
Ketua Bidang substansi Fiskal dan Pembiayaan: Menteri Keuangan

Mengingat kebutuhan pengaturan penyelenggaraan NEK ini sudah sangat mendesak dan dinantikan oleh pemerintah pusat, pemerintah daerah, dunia usaha dan masyarakat, serta dalam memenuhi komitmen Indonesia kepada dunia internasional, bersama ini kami sampaikan Rancangan Peraturan Presiden dimaksudkan guna penetapan sebagai Peraturan Presiden.

Demiikian, atas perkenan dan arahan Bapak Presiden, kami ucapkan terima kasih.


Menteri Koordinator Bidang Kemaritiman dan Investasi
Agus S. Pardianto

Tembusan Yth:
1. Wakil Presiden (sebagai laporan);
2. Menteri Koordinator Bidang Perencanaan, Pembangunan dan Investasi;
3. Menteri Sekretaris Negara;
4. Menteri Lingkungan Hidup dan Kehutanan;
5. Menteri Perencanaan Pembangunan Nasional/Kepala Bappenas;
6. Menteri Hukum dan Hak Asasi Manusia;
7. Menteri Dalam Negeri;
8. Menteri Keuangan;
9. Menteri Energi Sumber Daya Mineral;
10. Menteri Perhubungan;
11. Menteri Pekerjaan Umum dan Perumahan Rakyat;
12. Menteri Perindustrian;
13. Menteri Perdagangan;
14. Menteri Pertanian;
15. Menteri Kelautan dan Perikanan;
16. Sekretaris Kabinet;
17. Kepala Badan Meteorologi, Kлимatologi, dan Geofisika.

DRAFT

Draft Penyempurnaan 5, 28 Desember 2020 jam 17.45 WIB CLEAN

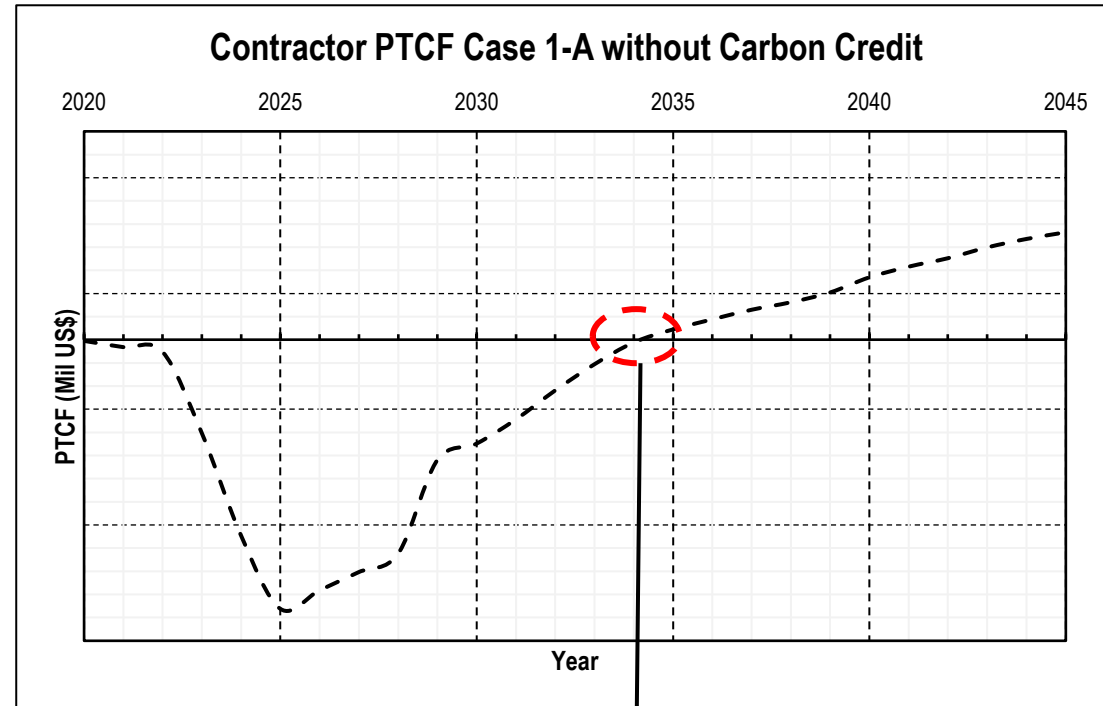
RANCANGAN PERATURAN PRESIDEN
NOMOR:
TENTANG
PENYELENGGARAAN NILAI EKONOMI KARBON UNTUK PENCAPAIAN TARGET NDC DAN PENGENDALIAN EMISI KARBON DALAM PEMBANGUNAN NASIONAL
DENGAN RAHMAT TUHAN YANG MAHA ESA
PRESIDEN REPUBLIK INDONESIA

Menimbang :

- bahwa berbagai dampak dan akibat perubahan iklim mempengaruhi kualitas kehidupan masyarakat sehingga perlu dilakukan langkah-langkah perlindungan masyarakat sebagaimana maksud Pasal 28 H ayat (1) UUD 1945 serta Pasal 65 ayat (1) UU Nomor 32 Tahun 2009 tentang Perlindungan dan Pengelolaan Lingkungan Hidup;
- bahwa dalam rangka mengendalian perubahan iklim sebagaimana dimaksud dalam huruf a, pemerintah telah melakukan ratifikasi Paris Agreement melalui UU No 16 Tahun 2016 tentang Pengesahan Paris Agreement To The United Nations Framework Convention on Climate Change (Peretujuan Paris Atas Konvensi Kerangka Kerja Penserikatan Bangsa-Bangsa Mengenal Perubahan Iklim) yang didalamnya memuat kewajiban Pemerintah dalam kontribusi penurunan emisi GRK (national determined contribution/NDC) untuk membatasi kenaikan suhu rata-rata global di bawah 2°C hingga 1,5°C dari tingkat suhu pra industrialisasi;
- bahwa karbon sebagai indikator universal dalam mengukur kinerja upaya pengendalian perubahan iklim yang direfleksikan dalam NDC, selain mempunyai nilai ekonomi yang penting dan memiliki


SITI AURBAYA

An example from a case study in Indonesia

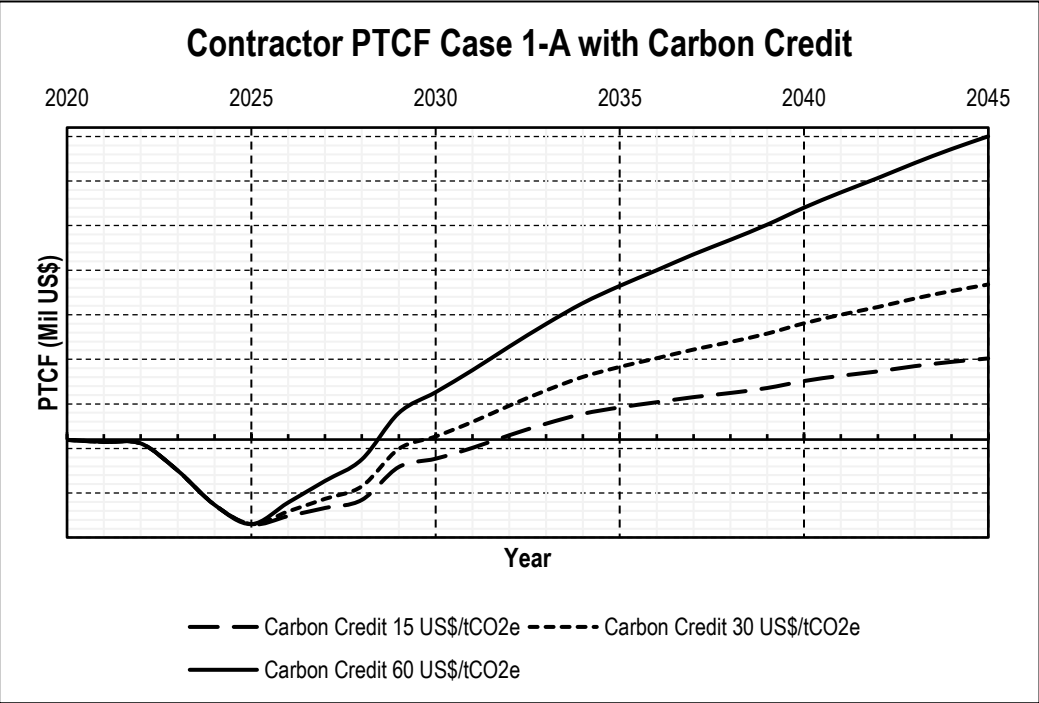


Est. POT @ Q1 2034

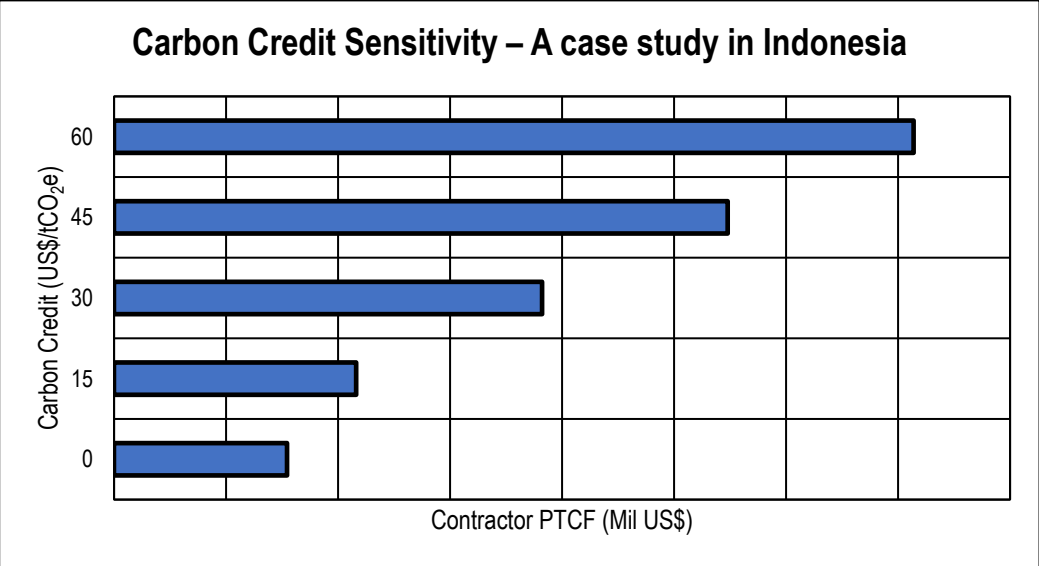
*Carbon credit will be used as **Cost Recovery deduction**
*It is assumed that 100% of CO₂ injected is included into carbon credit calculation.

- Base case for calculation until 2045 is without any carbon credit
- Pay Out Time is around Q1 2034

Analysis on Carbon Credit Sensivity for Project Economics @ 2045



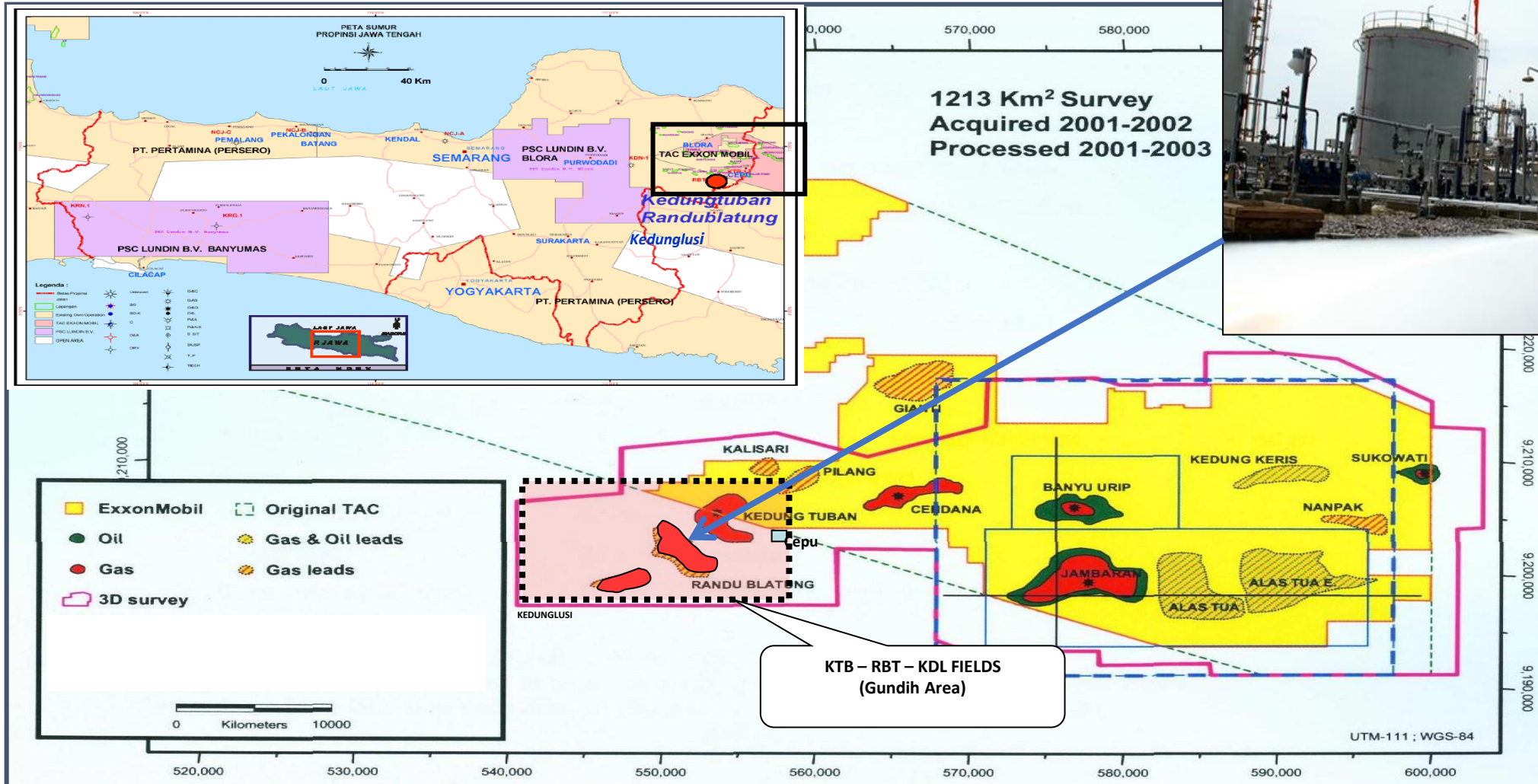
- Estimated Project pay out time for
- Carbon Credit 15 US\$/tCO₂e : Q1 2032
 - Carbon Credit 30 US\$/tCO₂e : Q4 2029
 - Carbon Credit 60 US\$/tCO₂e : Q2 2028
- PTCF Comparison for project USD 60 carbon credit is **twice as profitable** as the project with USD 30 carbon credit and **3.6 times more profitable** compared to the project with USD 15 carbon credit.
 - Based on the calculation, carbon credit is able to reduce operating expenditure to **zero**, therefore increasing profit for both contractor and the Government of Indonesia.



- References of Carbon Pricing Around the World:
- EU ETS : 25 US\$/tCO₂e (50-60 US\$/tCO₂e in 2022)
 - Hitachi: 46.7 US\$/tCO₂e
 - Iceland Carbon Tax: 31.3 US\$/tCO₂e
 - Beijing Pilot ETS: 10.4 US\$/tCO₂e

Latest Status of Gundih Project: Shifting from CCS Pilot Project to CCUS (CO₂-EGR) Project

Map of Gundih area and its surrounding areas



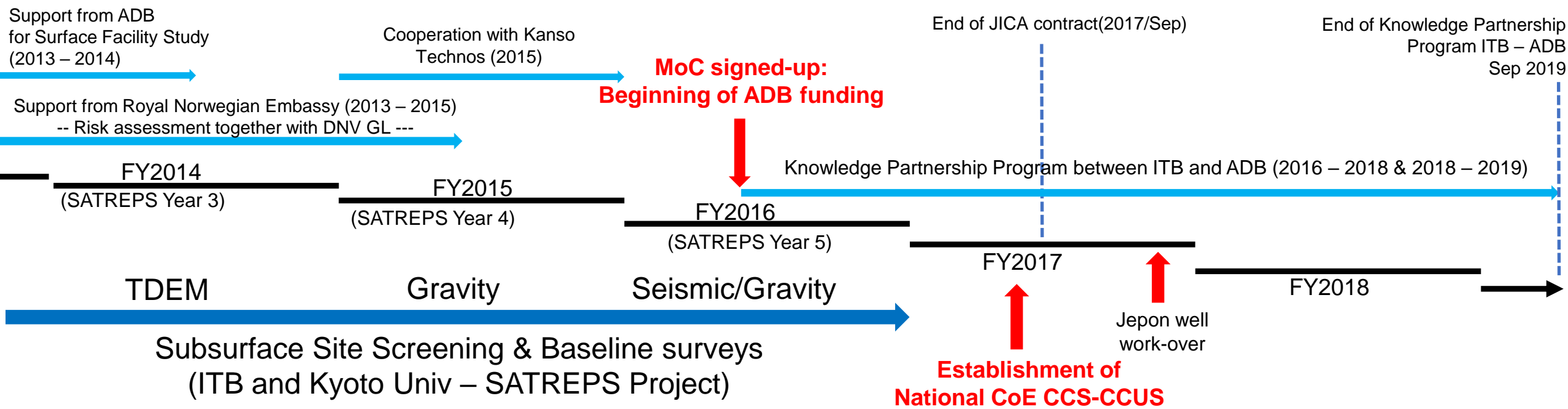
- 70 MMSCFD for 12 years
- CO₂ = 21%, equivalent to 800 tpd

Historical Gundih CCS Pilot Project (2012 – 2019)



Contributors:

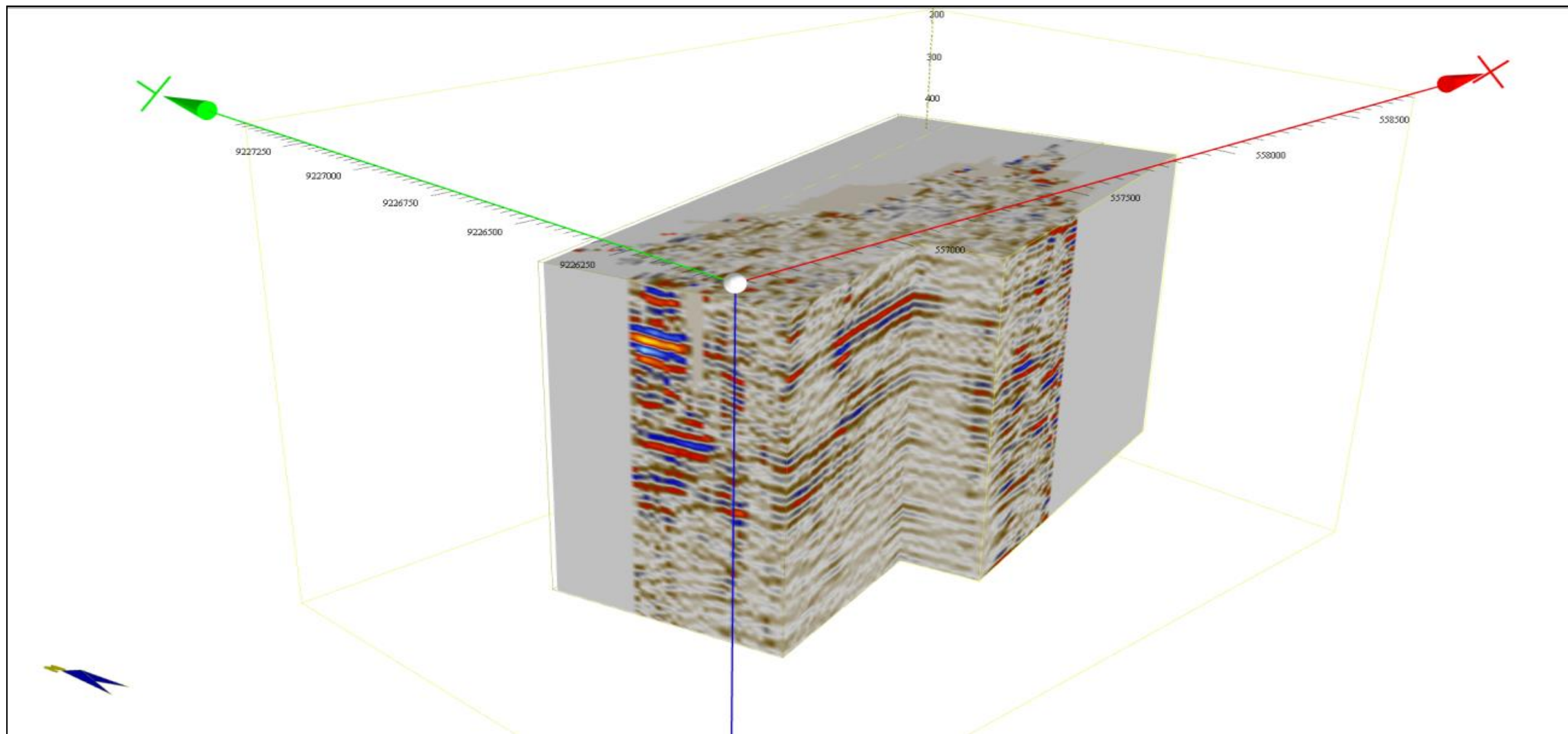
SATREPS project (2012-2017), ADB TA (2013 – 2014),
 Royal Norwegian Embassy (2013 – 2015), Kanso Technos (2015)
 and Knowledge Partnership Program ITB and ADB (2016 – 2019)





1. Provides guidance to the students before going to the field
2. Vibro being prepared before the action
3. Recording group in action (Labo)
4. DSS-12 recording system
5. GRS system
6. Geophone
7. DSS-12 warehouse

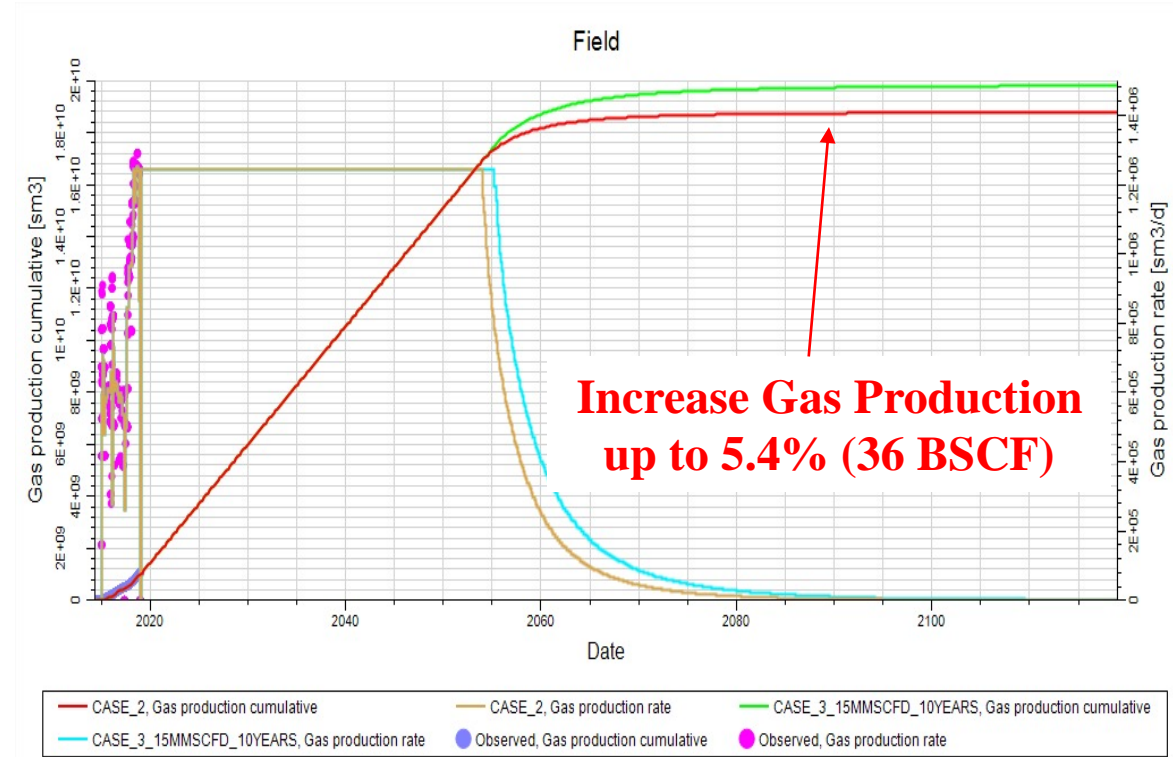
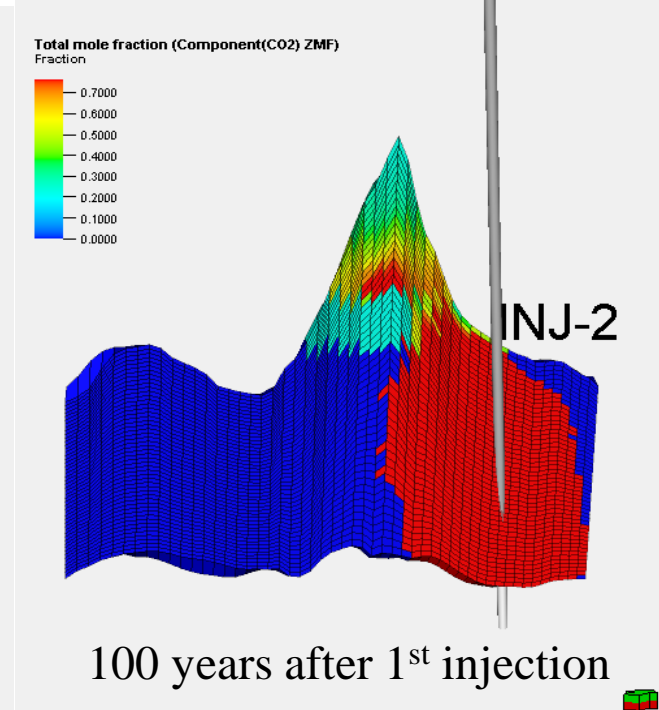
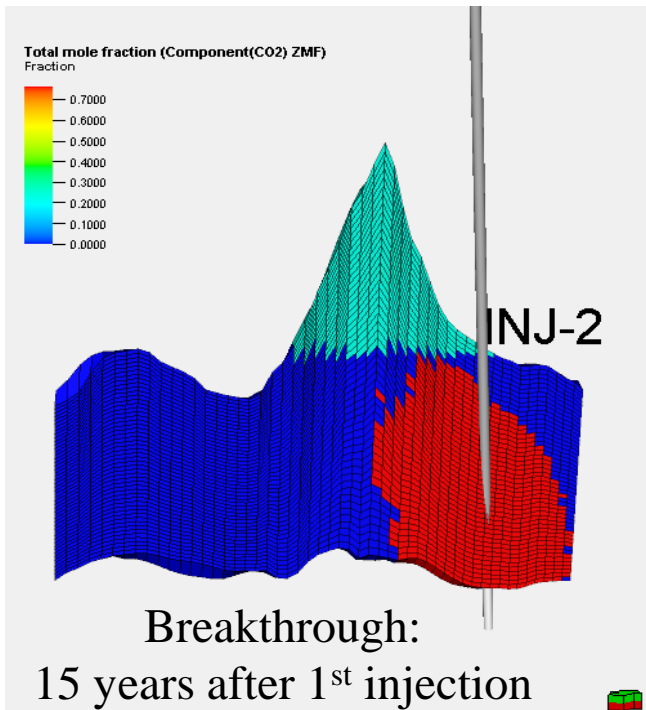
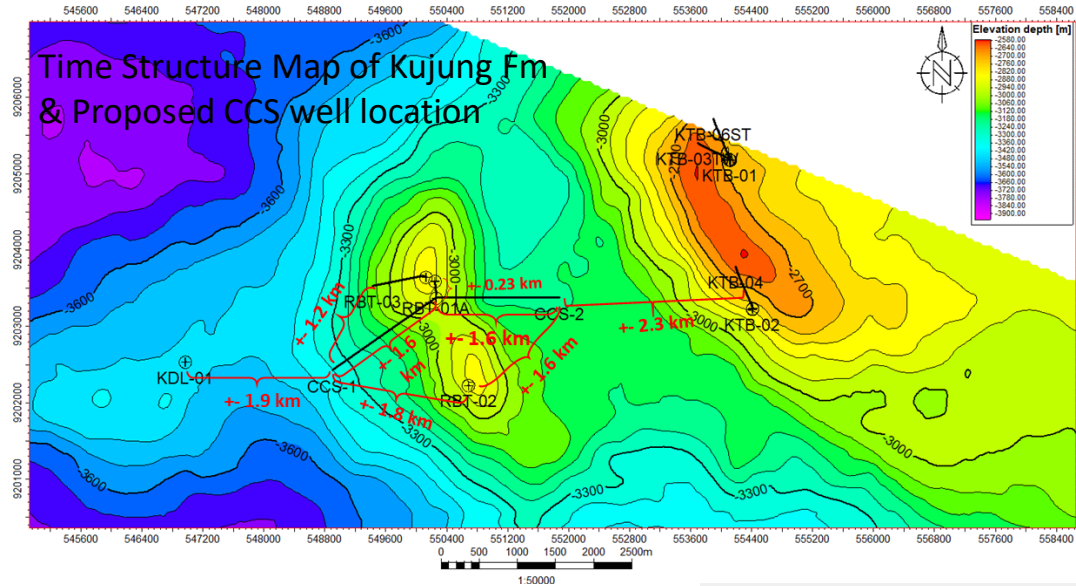
Pseudo 3D seismic cube



NEW Scenario of CCUS Project in GUNDIH AREA

Currently Gundih CPP releases 800 tpd of CO₂. If all of available CO₂ is injected to Kedungtuban structure:

- 3 mio of CO₂ will be reduced for 10 years injection time.
- Incremental gas production of 36 BSCF for 10 years, equivalent to approx. USD 120 mio.
- The Opex and Capex for 10 years CO₂ injection = USD 35 mio.
- Offering participation of foreign institutions for injecting CO₂, e.g. using JCM scheme.



Newest Good News that received May 2020: Approved FS Joint Crediting Mechanism: Proposing MRV Methodology for Gundih Project (Jun 2020 – Feb 2021, funded by METI)

Tasks and Roles 2020 (Just an idea)	ITB/CoE	JN / JP
Subsurface Study		
- Discussion on the Current Study	✓ ✓	✓ ✓
- Further Discussion	✓	✓ ✓ ✓
- Model Modification	✓	✓ ✓ ✓
- New Simulation	✓	✓ ✓ ✓
CO₂ Transport / Injection /Well Systems		
- Discussion on Current Study	✓ ✓	✓ ✓
- Concept Design	✓ ✓ ✓	✓
- Cost Estimation	✓ ✓ ✓	✓
- Study for Permit/License/Approval	✓ ✓ ✓ ✓	
Monitoring Plan		
- Discussion on the Current Study	✓ ✓	✓ ✓
- CO ₂ Monitoring	✓	✓ ✓ ✓
- Monitoring Plan after Closure	✓	✓ ✓ ✓
Standards/Regulation		
- Planning compliant to Std./Reg.	✓	✓ ✓ ✓
Social Acceptability		
- Outreach Planning	✓ ✓ ✓	✓
Technology Applicability		
- CO ₂ injection		✓ ✓ ✓ ✓
- Monitoring		✓ ✓ ✓ ✓
Symposium for Dissemination of Outcome	✓ ✓ ✓	✓



日本経済新聞

朝刊・夕刊 ストーリー Myニュース 日経会社情報 人事ウ

トップ 速報 マネー 経済・金融 政治 ビジネス マーケット テクノロジー 国際 オピニオン スポーツ

CO₂の地中貯留、海外で展開 Jパワーなど実証へ

2020/5/17 22:40 | 日本経済新聞 電子版

保存 共有 印刷 ツイット その他

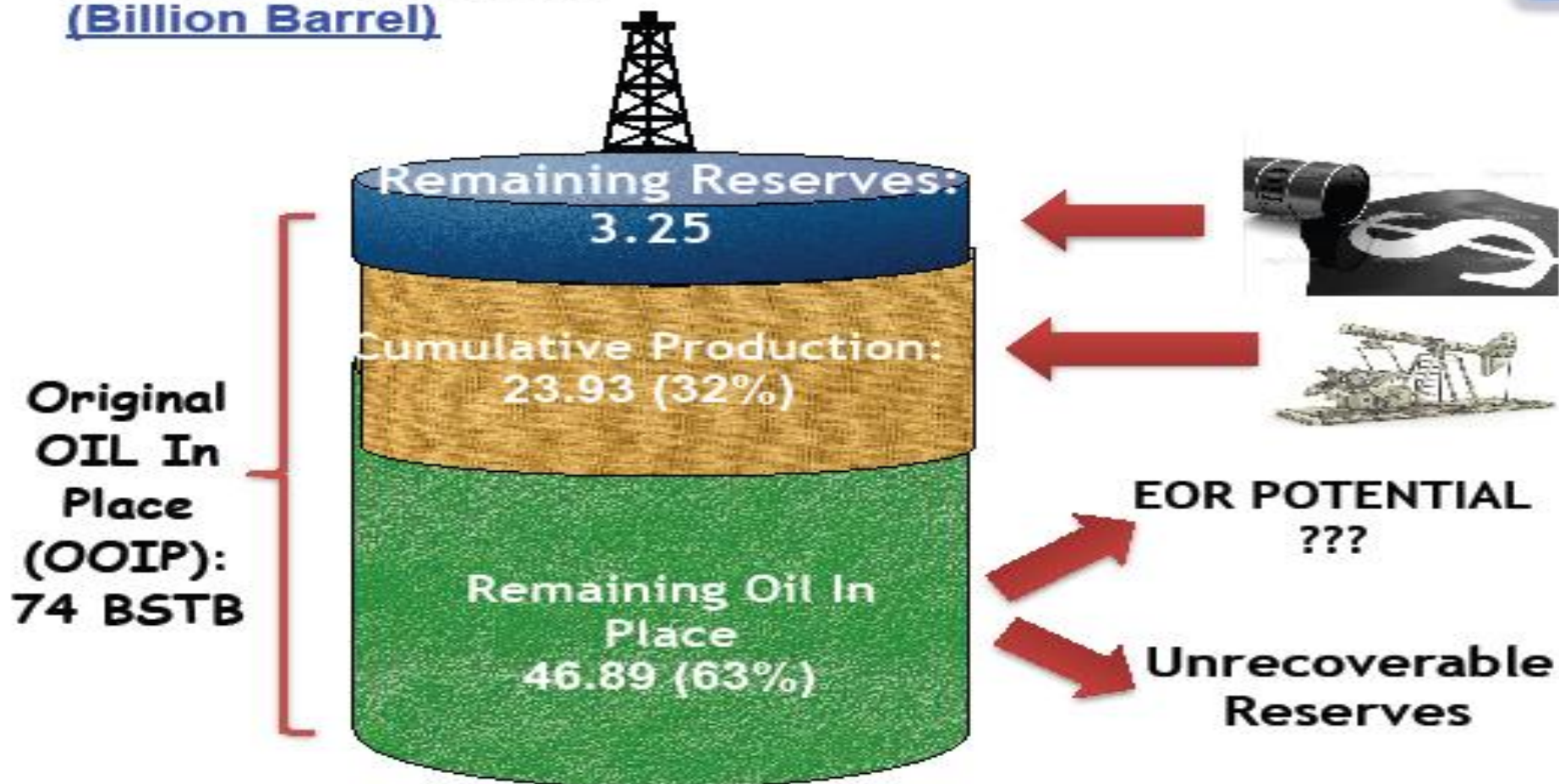
二酸化炭素（CO₂）を地中に埋めて排出量を減らす技術を日本の官民が海外展開する。経済産業省とJパワーなどがインドネシアのガス田で実証事業に乗り出す。石炭火力の需要が当面残るアジアで、日本の温暖化対策技術をアピールする狙いがある。

近く事業化調査を始め、2021年度から4年かけて数十億円規模の実証事業を計画する。経産省が予算を計上し、Jパワーや日揮のグループ会社、日本エヌ・ユー・エス（東京・新宿）…

EOR Potential



Reserves Distribution:
(Billion Barrel)

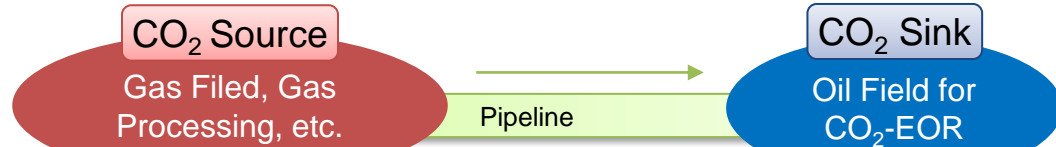


Source: SKK Migas Indonesia Oil Reserves Data (1/1/2014)

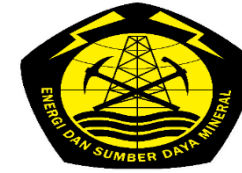
On-going collaboration between CoE CCS-CCUS at ITB & JANUS Co. Ltd.

--- Supported by DG Oil and Gas & METI's Global Env. Partnership Office ---

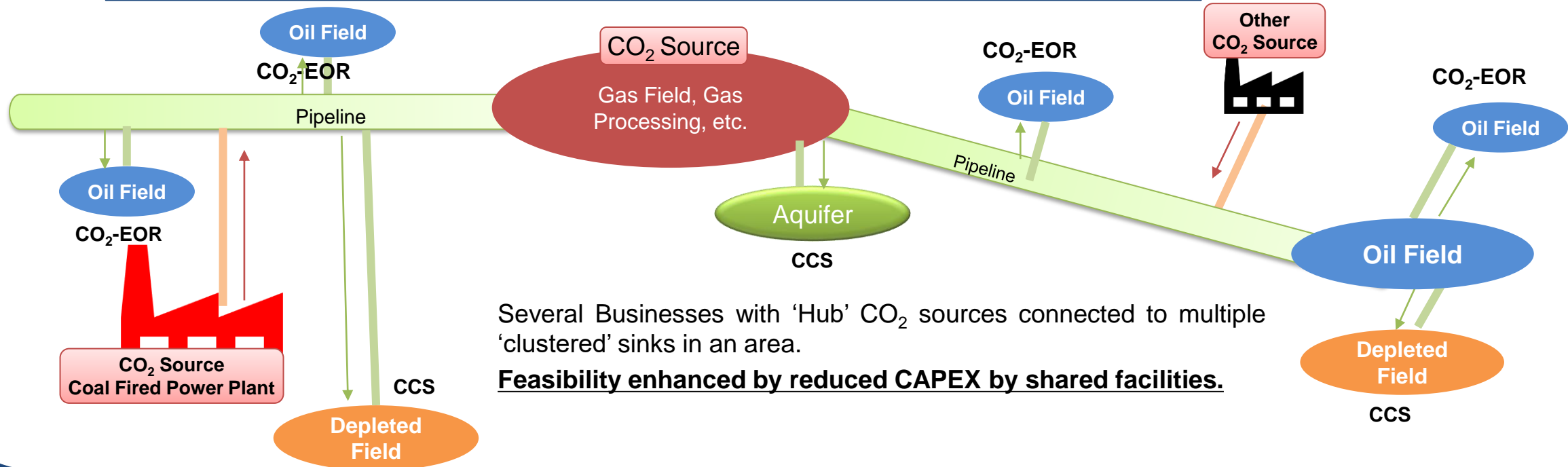
Conventional One-by-One CCUS



A business with one source connected to one sink
Feasibility damaged by Large CAPEX



CCUS in a way of 'Hub-Clustering' Regional CO₂ Management



Several Businesses with 'Hub' CO₂ sources connected to multiple 'clustered' sinks in an area.

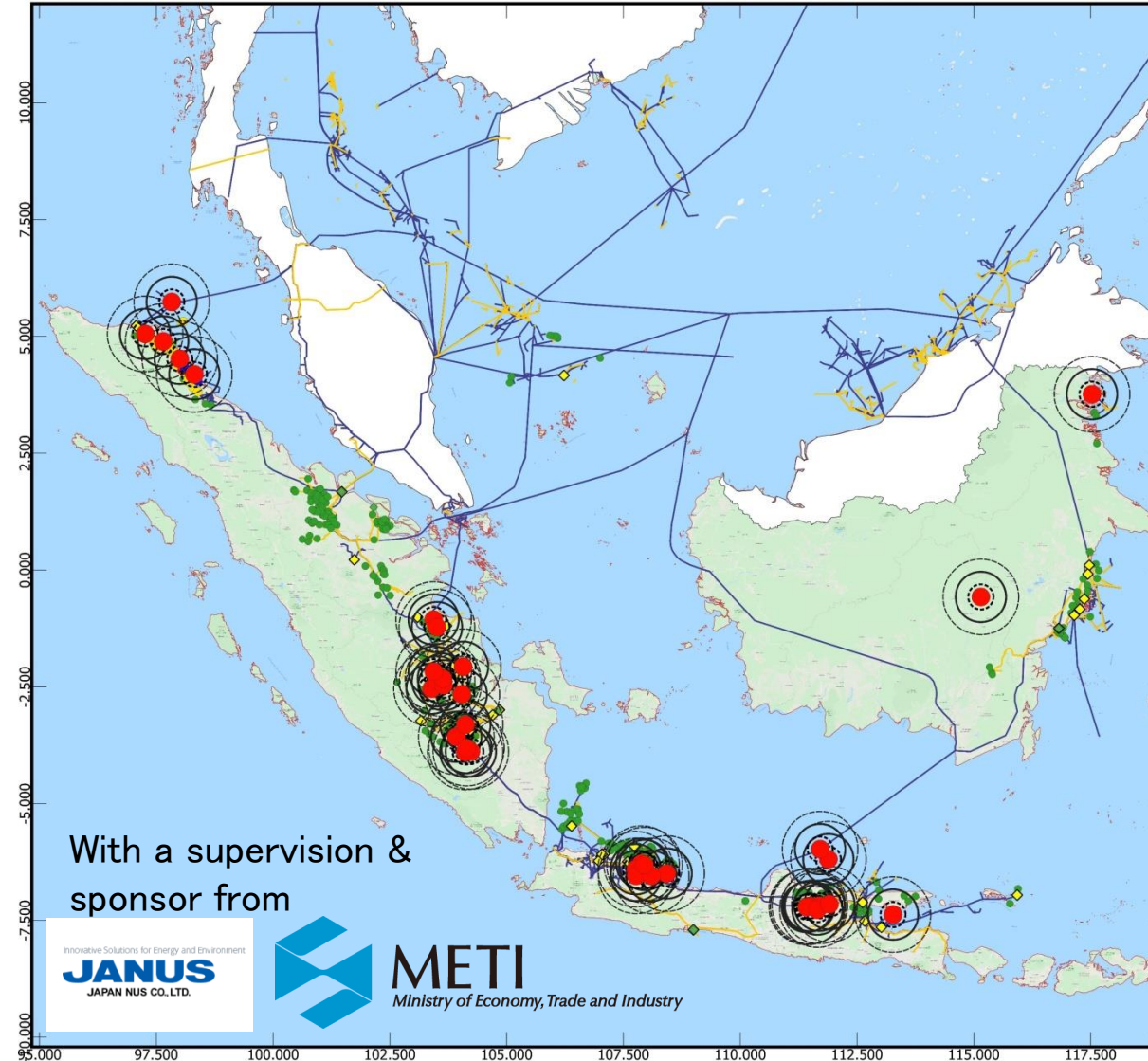
Feasibility enhanced by reduced CAPEX by shared facilities.

Overview of Potential CO₂ Source Map (Sumatera, Java, Kalimantan)

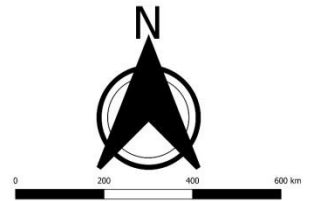
CO₂ Source (subject to be discussed)

- The Oil-Gas CO₂ is calculated by CO₂ content (%) x remaining gas reserve (mmscf)
 - Low CO₂: < 5,000 mmscf
 - Medium CO₂: 5,000 – 20,000 mmscf
 - High CO₂: > 20,000 mmscf
- Industrial CO₂: from Cement Industry, Petrochemical, Coal Mining, Pulp Industries (>1,500 TCO₂/day)
- Power Plant (coal) CO₂ is classified as:
 - Low: <1,000,000 TCO₂e
 - Medium: 1 - 2 mio TCO₂e
 - High: > 2 mio TCO₂e

Hub-Clustering have been done in Gas Fields, Industry, and Coal Power Plant



Map of Potential CO₂ Source in Sumatera, Java, and Kalimantan Region



Legend

- Pipelines Indonesia Liquid
- Pipelines International Gas
- ◇ Gas Processing_point
- ⬢ Industry and CPP CO₂ Source
- High Oil and Gas Source CO₂
- High Source
- Coal Power Plant Source of CO₂
- High Potential
- Indonesia Potential Sink for CCS/CCUS
- Sink (Oil Field)



- Note that the CO₂ unit available from oil&gas in database is volume (mmscf gas) not flowrate (mmscfd or mmscfy)
- Blue hexagon = CO₂-rich industry, Red Squares = high CO₂ produced from Power Plant.

Potential CO₂ Source in South Sumatera

CO₂ Source from Oil & Gas

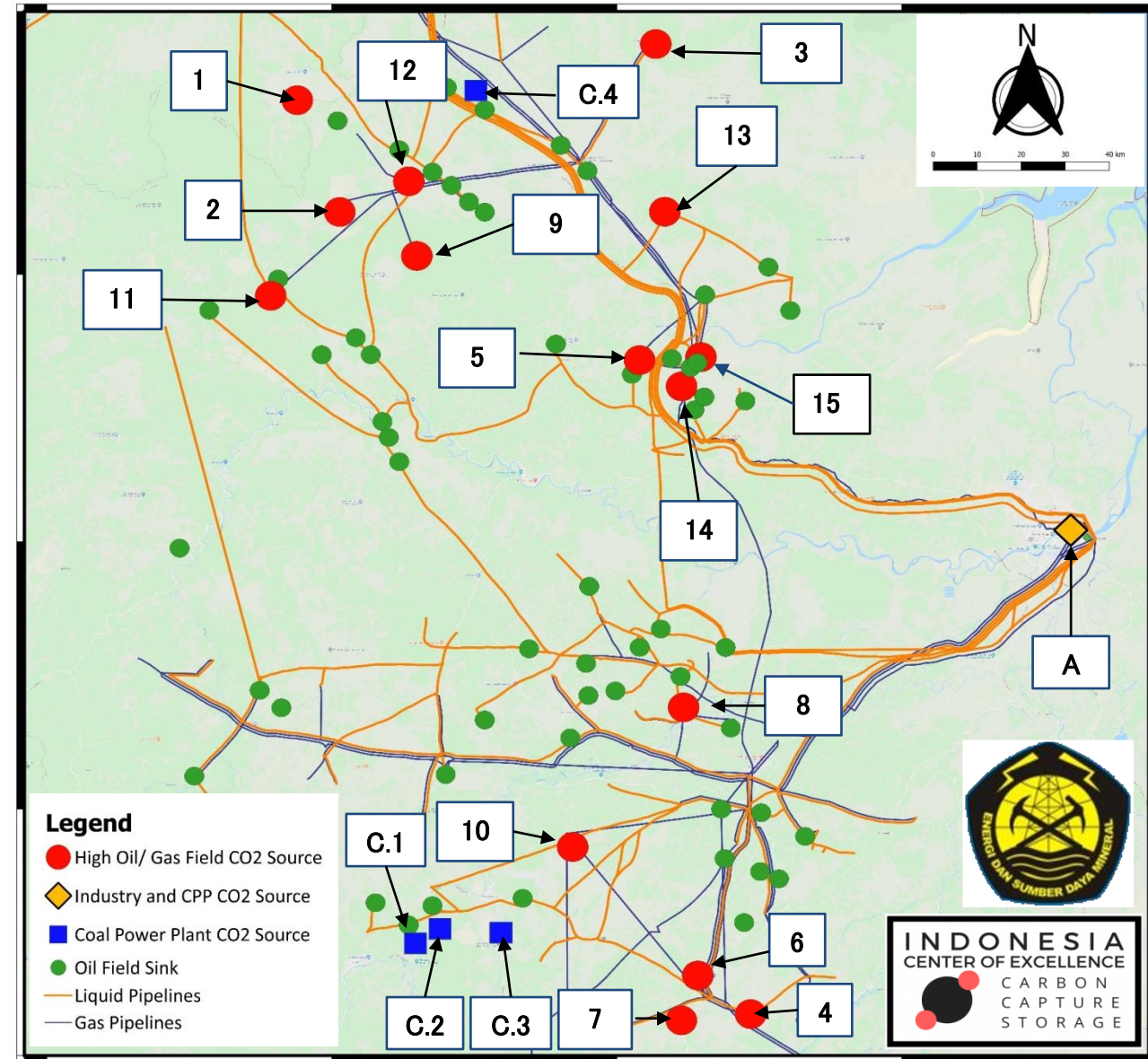
No	Field Name	Operator
1	Bungin 1	ConocoPhillips (South Jambi) Ltd
2	Dayung	ConocoPhillips (Grissik) Ltd
3	Gelam	ConocoPhillips (Grissik) Ltd~PT Pertamina/Talisman (Jambi Merang) Ltd
4	Kuang	PT Pertamina EP
5	Letang	ConocoPhillips (Grissik) Ltd
6	Pagardewa	PT Pertamina EP
7	Prabumenang	PT Pertamina EP
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

CO₂ Source from Industry

No	Industry Category	Company
A	Petrochemical	PT Pupuk Sriwidjaja

CO₂ 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



Map of Potential CO₂ Source in South Sumatera Region
Category: Oil and Gas Field; Industry; Power Plant

Some perceptions among us



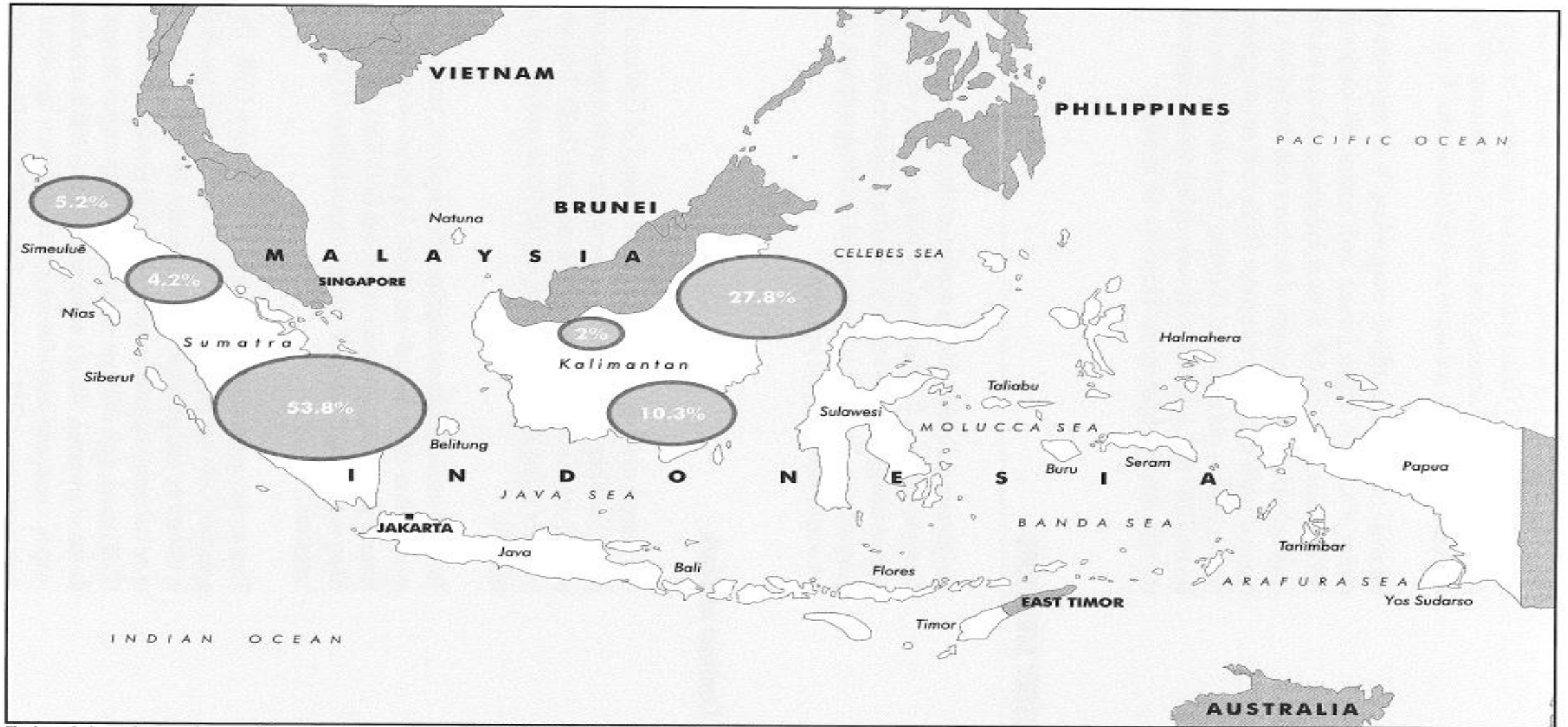
What we have learnt:

Fantastic dream is sometimes difficult to be realized; it depends on the background situation in each country



Indonesia is a Coal Country

Distribution of coal (ca. 18,7 billion tonnes as reserve and 90 billion tonnes as potential resource)

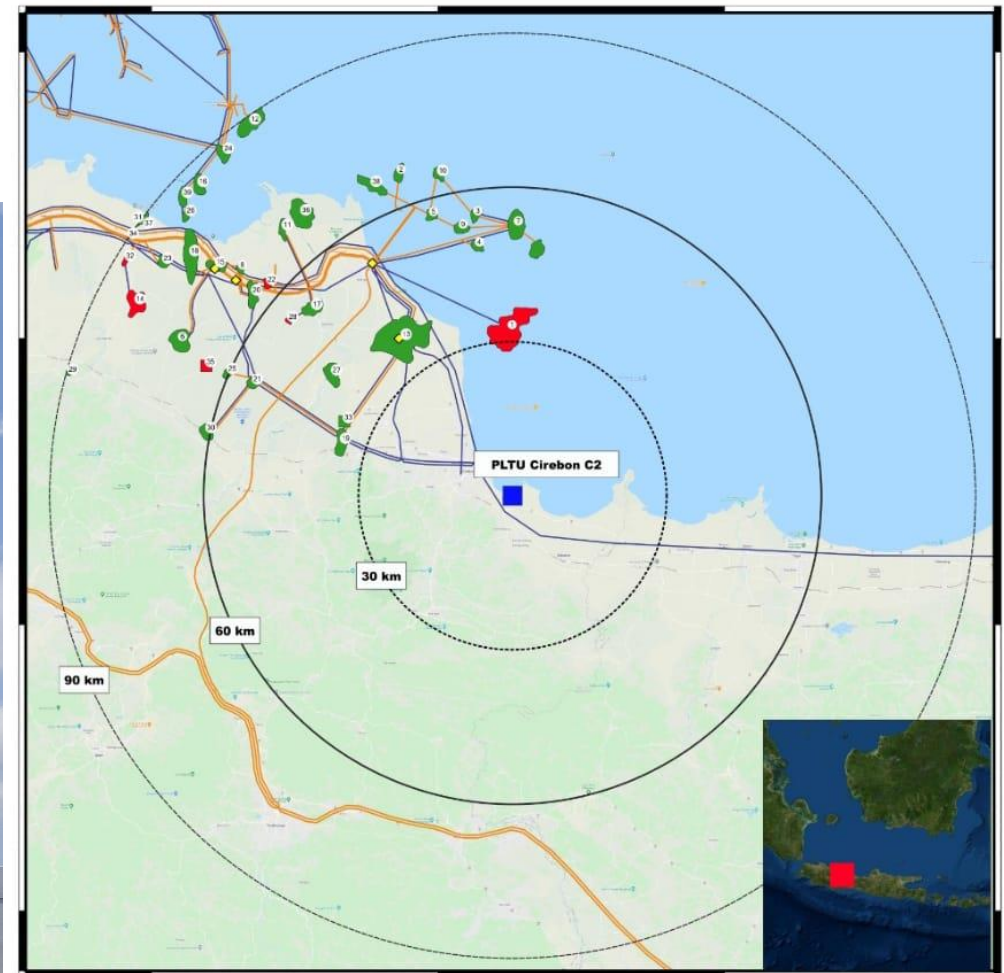


The boundaries and names shown and the designations used on maps included in this publication do not imply official endorsement or acceptance by the IEA.

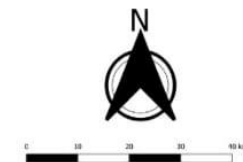
Note: Some disparity in totals may occur due to rounding.

Source: Ministry of Energy and Mineral Resources.

CO2 from Coal Fired Power Plant



Sink from Oil and Gas Fields Around PLTU Cirebon C2
West Java

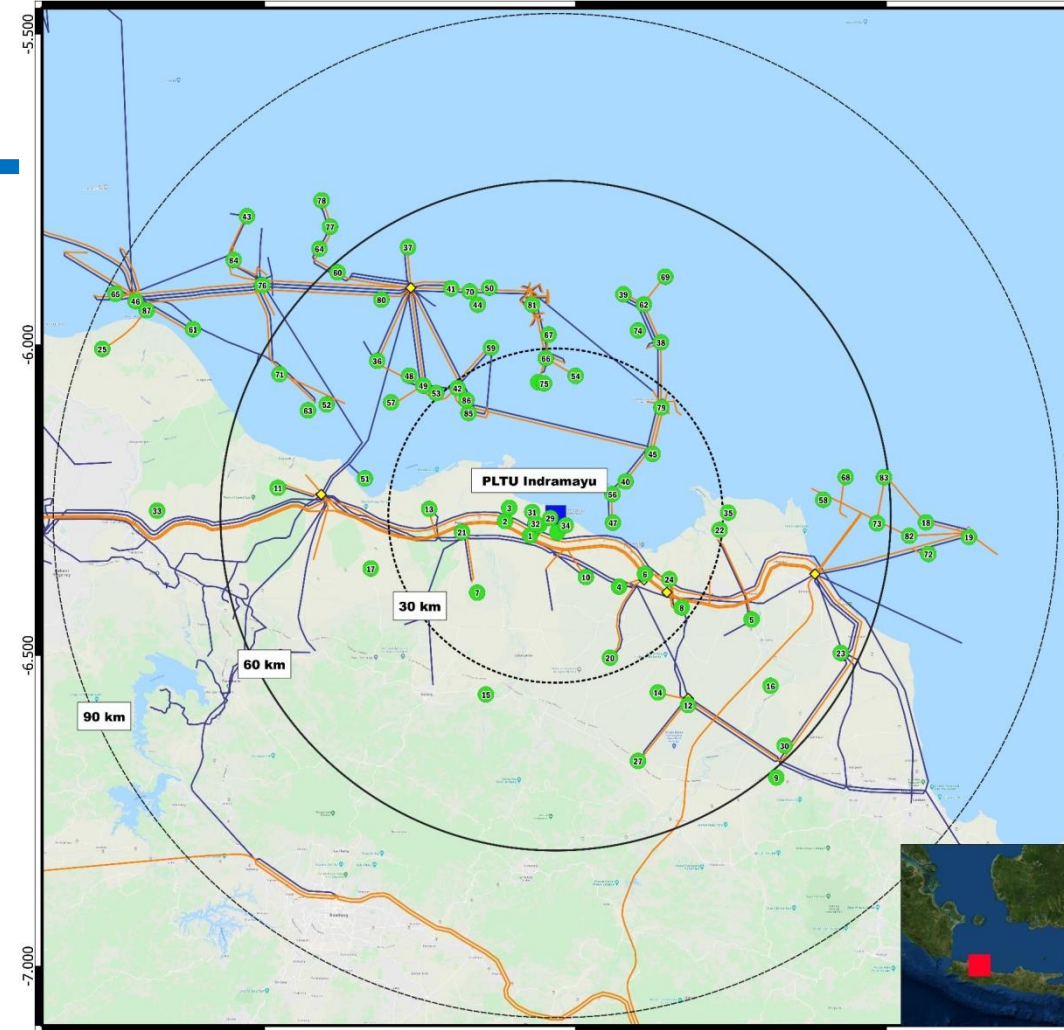


Legend

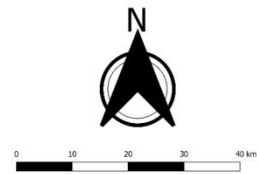
- PLTU Cirebon C2
- ◆ Gas Processing_point
- Liquid Pipelines
- Gas Pipelines
- Fields_Structure**
- Gas
- Oil
- ⋯ Cluster A (30 km)
- Cluster B (60 km)
- Cluster C (90 km)

PLTU Indramayu (290 MW) Cluster A

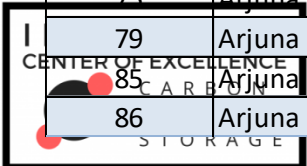
No ID	FIELD_NAME	Operator	PROD_STAT	GN_HC_TYPE
1	Karang Enggal	PT Pertamina EP	Producing	Oil & Gas Fields
2	Jati Asri	PT Pertamina EP	Producing	Oil & Gas Fields
3	Jati Sinta	PT Pertamina EP	Producing	Oil & Gas Fields
4	Kandang Haur Timur	PT Pertamina EP	Producing	Oil & Gas Fields
6	Cemara Barat	PT Pertamina EP	Producing	Oil & Gas Fields
7	Pegaden	PT Pertamina EP	Producing	Oil & Gas Fields
8	Cemara Selatan	PT Pertamina EP	Producing	Oil & Gas Fields
10	Kandang Haur Barat	PT Pertamina EP	Temporarily shut-in	Oil & Gas Fields
13	Bojongraong	PT Pertamina EP	Producing	Oil & Gas Fields
20	Gantar	PT Pertamina EP	Producing	Oil & Gas Fields
21	Pamanukan Selatan	PT Pertamina EP	Producing	Oil & Gas Fields
22	Waled Utara	PT Pertamina EP	Producing	Oil & Gas Fields
24	Cemara Timur	PT Pertamina EP	Producing	Oil & Gas Fields
26	Melandong	PT Pertamina EP	Producing	Oil & Gas Fields
28	Karang Baru	PT Pertamina EP	Producing	Oil & Gas Fields
29	Tegal Taman	PT Pertamina EP	Producing	Oil Fields
31	Karang Baru Barat	PT Pertamina EP	Temporarily shut-in	Oil & Gas Fields
32	Karang Tunggal	PT Pertamina EP	Temporarily shut-in	Oil & Gas Fields
34	Jati Keling	PT Pertamina EP	Producing	Oil & Gas Fields
40	Arjuna FS	PT Pertamina Hulu Energi ONWJ Ltd	Temporarily shut-in	Oil & Gas Fields
42	Arjuna U	PT Pertamina Hulu Energi ONWJ Ltd	Producing	Oil & Gas Fields
45	Arjuna FF	PT Pertamina Hulu Energi ONWJ Ltd	Temporarily shut-in	Oil & Gas Fields
47	Arjuna FZ	PT Pertamina Hulu Energi ONWJ Ltd	Producing	Oil & Gas Fields
54	Arjuna ESR	PT Pertamina Hulu Energi ONWJ Ltd	Producing	Oil & Gas Fields
55	Arjuna ESS	PT Pertamina Hulu Energi ONWJ Ltd	Producing	Oil & Gas Fields
56	Arjuna FSW	PT Pertamina Hulu Energi ONWJ Ltd	Producing	Oil & Gas Fields
66	Arjuna ES	PT Pertamina Hulu Energi ONWJ Ltd	Producing	Oil & Gas Fields
75	Arjuna EST	PT Pertamina Hulu Energi ONWJ Ltd	Temporarily shut-in	Oil & Gas Fields
79	Arjuna F	PT Pertamina Hulu Energi ONWJ Ltd	Producing	Oil & Gas Fields
85	Arjuna UB	PT Pertamina Hulu Energi ONWJ Ltd	Producing	Oil & Gas Fields
86	Arjuna UY	PT Pertamina Hulu Energi ONWJ Ltd	Producing	Oil & Gas Fields



Sink from Oil Fields Around PLTU Indramayu West Java



- Legend**
- Coal Power Plant
 - Gas Processing_point
 - Liquid Pipelines
 - Gas Pipelines
 - Sink (Oil Field)
 - Cluster A (30 km)
 - Cluster B (60 km)
 - Cluster C (90 km)

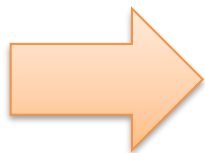


ZERO ROUTINE FLARING (ZRF) PROGRAM – 2030

Source of Flaring → It should be minimized by monetisation of Flared Gas



Oil and Gas Field



- Natural Gas (90% methane)
- CO₂
- Inert Gas: N₂



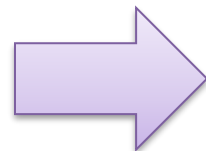
Oil Refinery



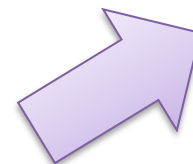
- Mixture of Hydrocarbon
- H₂ (occasionally)



LNG Facilities



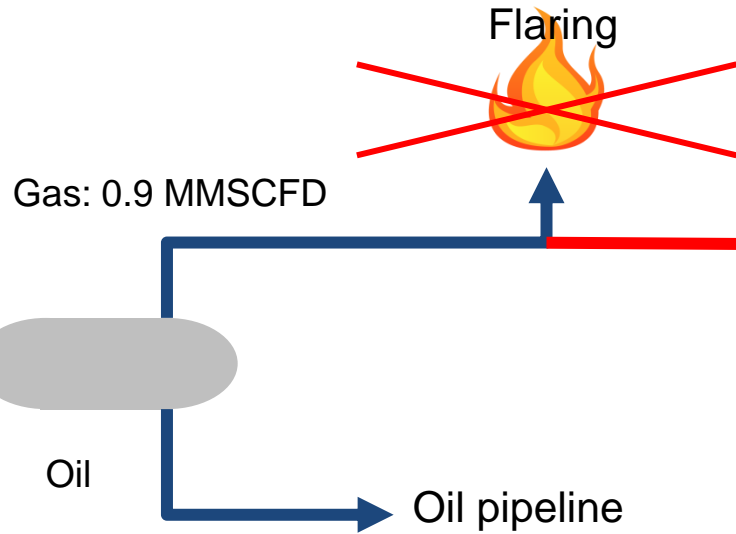
- Natural Gas



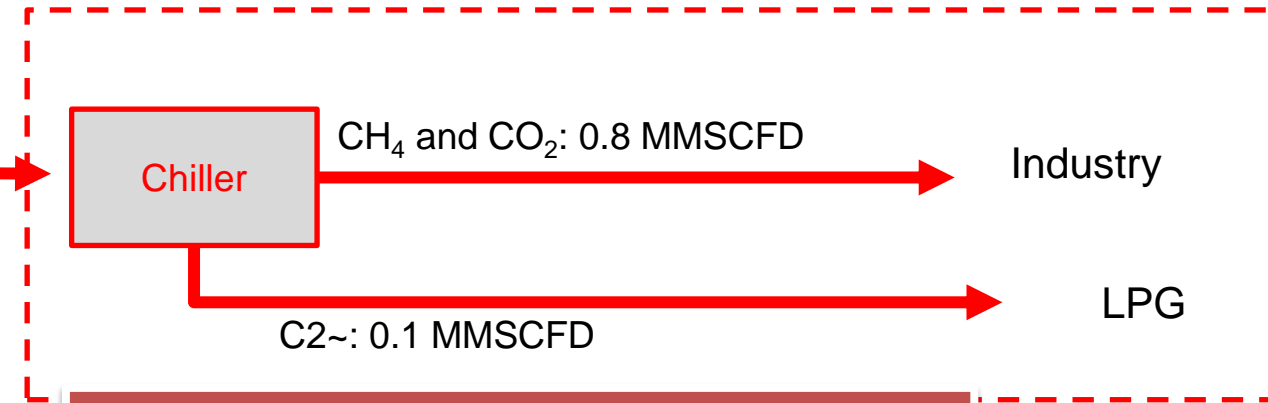
Flaring

Associated Gas Recovery and Fuel Producing Facility with JCM Scheme toward Zero Flaring (under pre-study)

Case 1



CAPEX: 5~6 Million USD

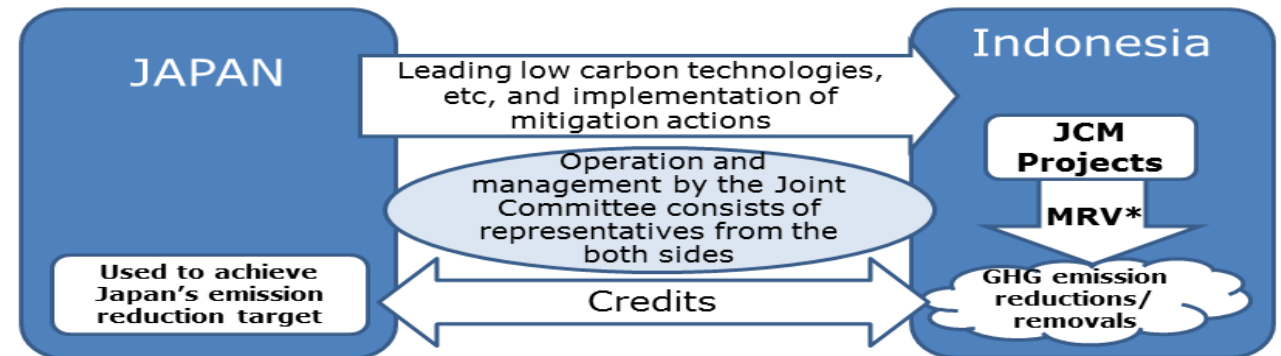


CO₂ reduced by substitution of existing fuels

There exist several similar cases approved by CDM.
CO₂ emission reduction estimated by CDM Methodology AM0009.

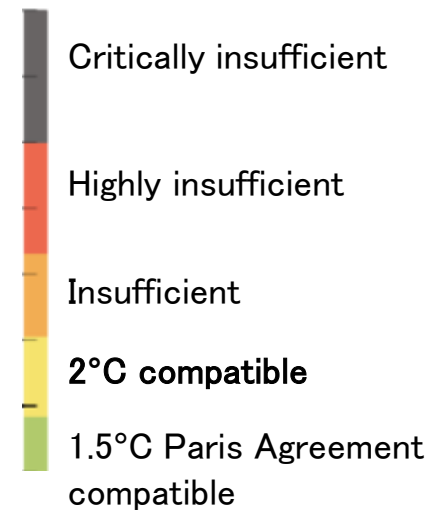
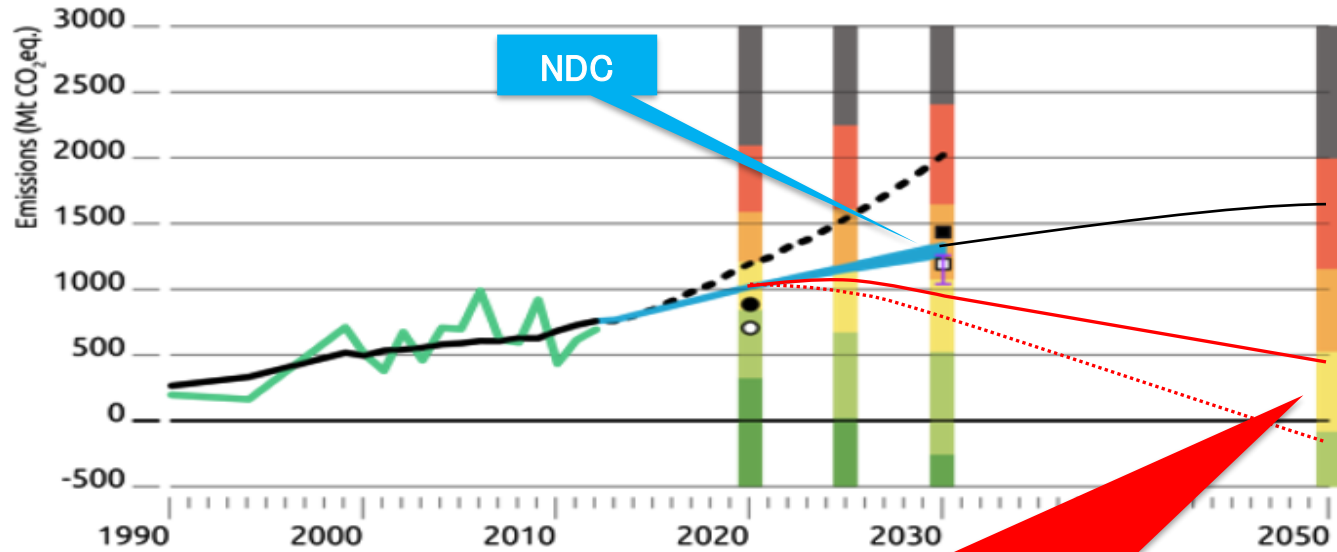
JCM Scheme between Indonesia and Japan

Applicability of JCM Scheme
Under pre-study by...

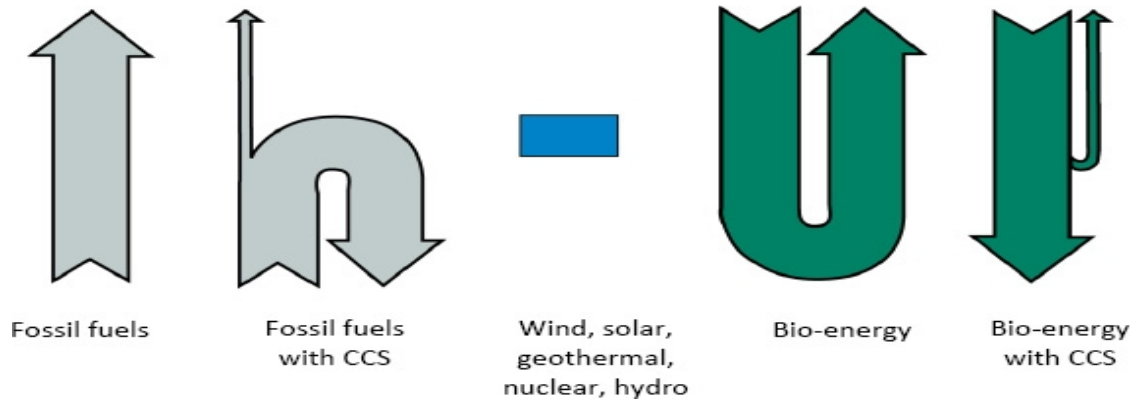


*measurement, reporting and verification

NEEDS FOR BECCS & DDPP BECCS INDONESIA



Needs for Negative Emissions

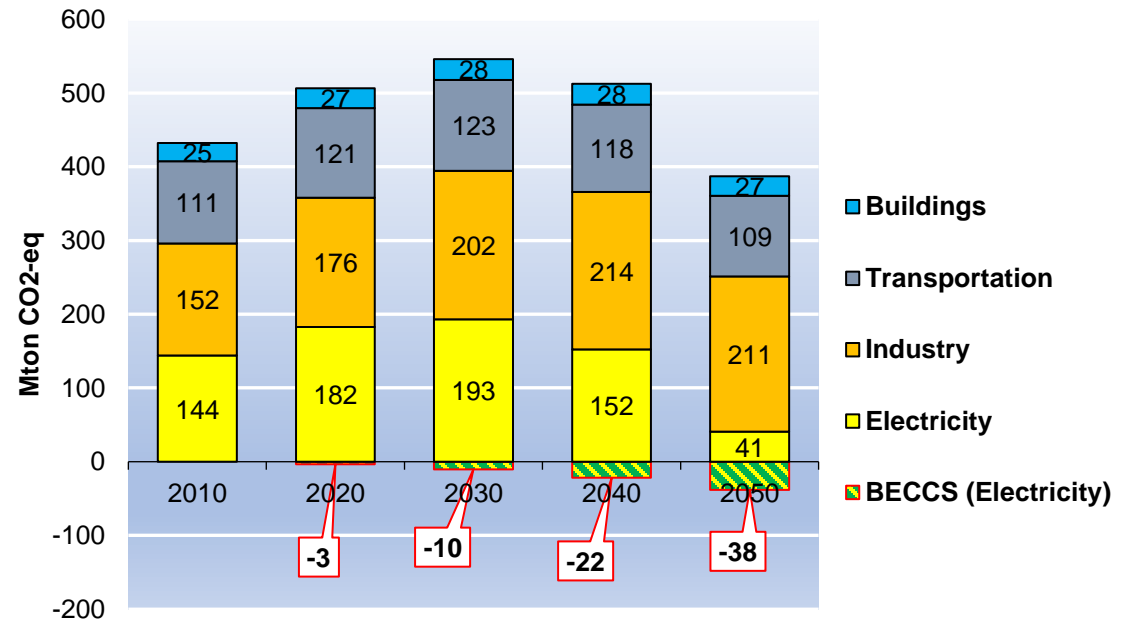


By 2050, 1.14 ton CO₂/cap is compatible with world 2DS (2.2 ton CO₂/cap*) under BECCS scenario

*world average DDPP

Some source: Climate Action Tracker (2017), Global CCS Institute (2016)

CO2 Emissions Development Scenario



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/>

