Role of Technologies in Sustainable Energy and Carbon Management

Oki Muraza

SVP Technology & Innovation

Directorate of Strategy, Portfolio, and New Ventures

PT Pertamina (Persero)

Japan, 25th January 2024 | 42nd JCCP International Symposium

Pertamina is moving ahead towards Net Zero Emission

While enabling energy security for Indonesia, Pertamina is committed to support Government of Indonesia commitment to achieve Net Zero by 2060 or sooner by developing roadmap of asset decarbonization, green business portfolio, and develop carbon offset.

Aspiration:

Scope 1 & 2: Net Zero Emission by 2060 (or earlier)

STRATEGIC INITIATIVES

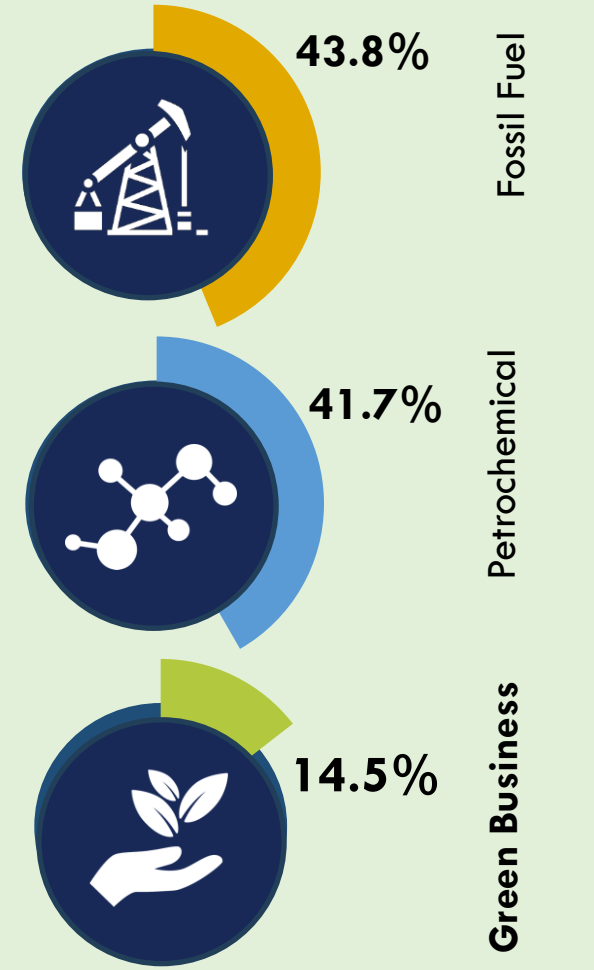
Scope 1 & 2 Reduction	Scope 3 Reduction	Scope 1 & 2 Offset
Decarbonization own operations	**Low Carbon Business**	**Carbon Offset**
• Energy efficiency • Loss reduction (e.g., flare, methane) • Green power generation • Static equipment electrification • Low or zero carbon fuel for fleets including via electrification	• Geothermal • Solar • Wind • Biofuels • Blue and Green Hydrogen • Battery and EV Ecosystem	• Carbon Capture Utilization Storage (CCUS) • Carbon Capture Storage (CCS) • Nature-Ecosystem Based Solution *(NEBS)* • Carbon market business

ENABLERS

Carbon Accounting, Performance Management and Pertamina Internal Carbon Price

Sustainability Organization, Capabilities

Investment Strategy



*Investment by the oil and gas industry in low-emissions sources of energy is **less than 5%** of its upstream investment*
(Source: IEA, World Energy Investment 2023 -Overview and key findings)

CO_2 Utilization: CO_2 Reforming for High CO_2 Gas Fields

CO_2 reforming of methane technology that utilize stranded field with high CO_2 content

Parameter	Value
Gas Composition	(%mole)
CO_2	**>40%**

Jambi Stranded Gas Fields

East Java Stranded Gas Fields

Process Scheme of **CO_2 reforming of methane**

Natural gas and CO_2 reforming

Syngas (H_2 + CO) With various ratio of syngas, H2/CO ≥ 2; ≥1; <1

Field with CO_2 content (30-70%)

Petrochemical plant

Petrochemicals product

Scope of Cooperation

1. Obtain the suitability of **CO_2 reforming of methane technology** that can contribute to emissions reduction
2. Determination of **potential petrochemical products** form the utilization of natural gas with high CO_2 content
3. Calculation of **Life Cycle Analysis (LCA)** of the CO_2 reforming of methane process
4. Study of **economics and business potential**, and other activities that support the goals of cooperation

Target products:

- Ethylene glycol, H_2/CO = 2.0
- Methyl Methacrylate (MMA), Only CO is required
- Methanol, H_2/CO = 2.5
- Oxo-alcohol, H_2/CO = 1.0
- Methanol Co-production with CO, H_2/CO = 1.2

CO_2 Utilization : CO2 EOR in Jatibarang Field

As a first step towards full scale, CO2 injection can be done using **the Huff & Puff method** because the CO2 requirement is much less when compared to a full-scale project, so that the costs will be less, and the execution of the work is simpler.

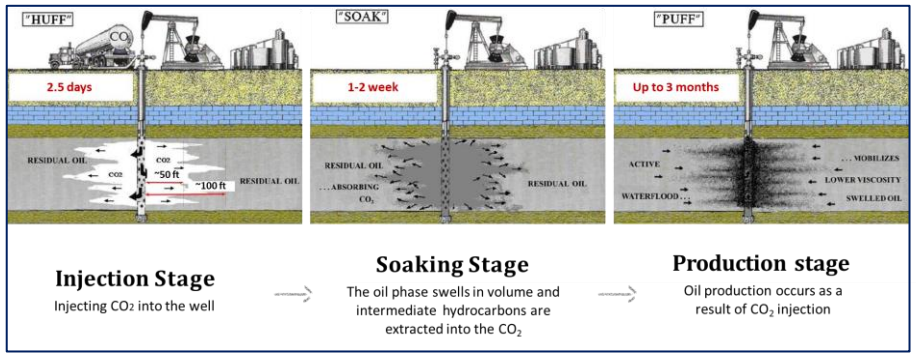
Project Objective

1. To strengthen **sustainability** portfolio
2. To Increase oil production recovery as much as 13 % from CO2 EOR

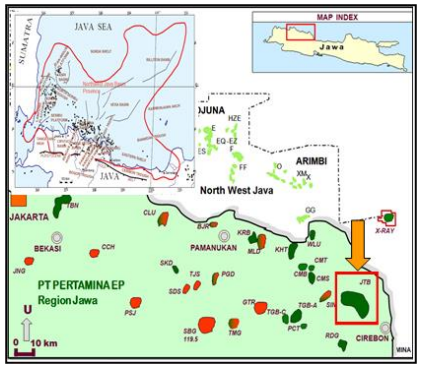
Methodology: Huff & Puff

- Investigate "miscible" CO2-EOR effect, evaluate CO2 Infectivity into the formation and field Operation Assessment.
- Huff and Puff will also act as a risk mitigation before Full Field application.

Expected results: Oil rate increase, water cut reduction, oil saturation reduction, fluid property change observed.



Project Overview



Field / Discovered	On shore / 1968
Operator / Area	PEP Zona 7 / Jatibarang
Location	Jatibarang, Cirebon, West Java
Current Oil Production	8865 BOPD (Nov 2022)
Water Injection	44,745 BWIPD
Field Water Cut	96.5%

Project Timeline

Geomechanic & Static Remodelling Study
2019 – 2020

2021 – 2022
CO2 EOR (Subsurface & Surface) Study

CO2 Huff & Puff Trial
2022

2023 – 2025
CO2 EOR Pilot

Full-field CO2 EOR Preparation
2026

2027 – 2030
Workover, Drilling, Engineering, Procurement

2031
Full scale EOR

CH_4 Utilization : POME to Biomethane

Low Hanging Fruit Initiative to Tackle Climate Change & Build New Green Business

Palm Oil Mill Effluent (POME) is a waste-based feedstock that is collected at palm oil mills during the palm oil production process. It has been acknowledged as a suitable feedstock for biofuels in the EU Renewable Energy Directive (RED) II. Every ton of CPO produced generating an average of 2.43 ton of POME.

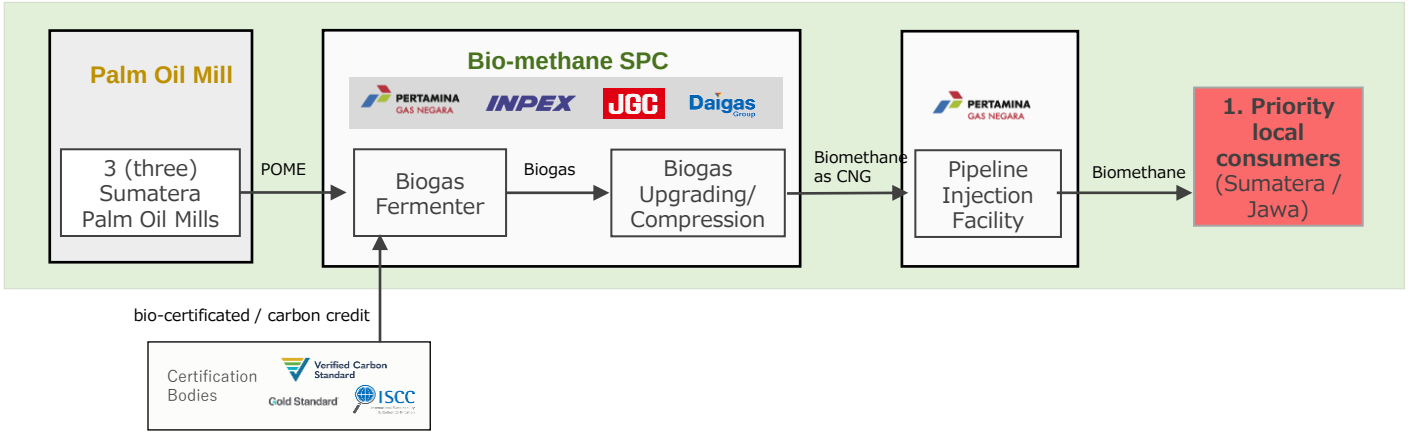
Palm oil for Renewable Gas

palm oil — *palm oil mill effluent* — biogas / biomethane biopower

PROJECT PROFILE

- Partner Companies : Pertamina, PGN, Osaka Gas, INPEX, JGC Holdings
- Project Activity : production of clean biomethane fuel (bundled by bio-certificate) & generating carbon credit
- Biomethane prod. rate : 10,000 ton/year (Potential Customer in Sumatera/Java) targeted 100,000/year by 2030
- GHG emission red. : 150,000 ton CO2e/year
- Start of operation : 2025

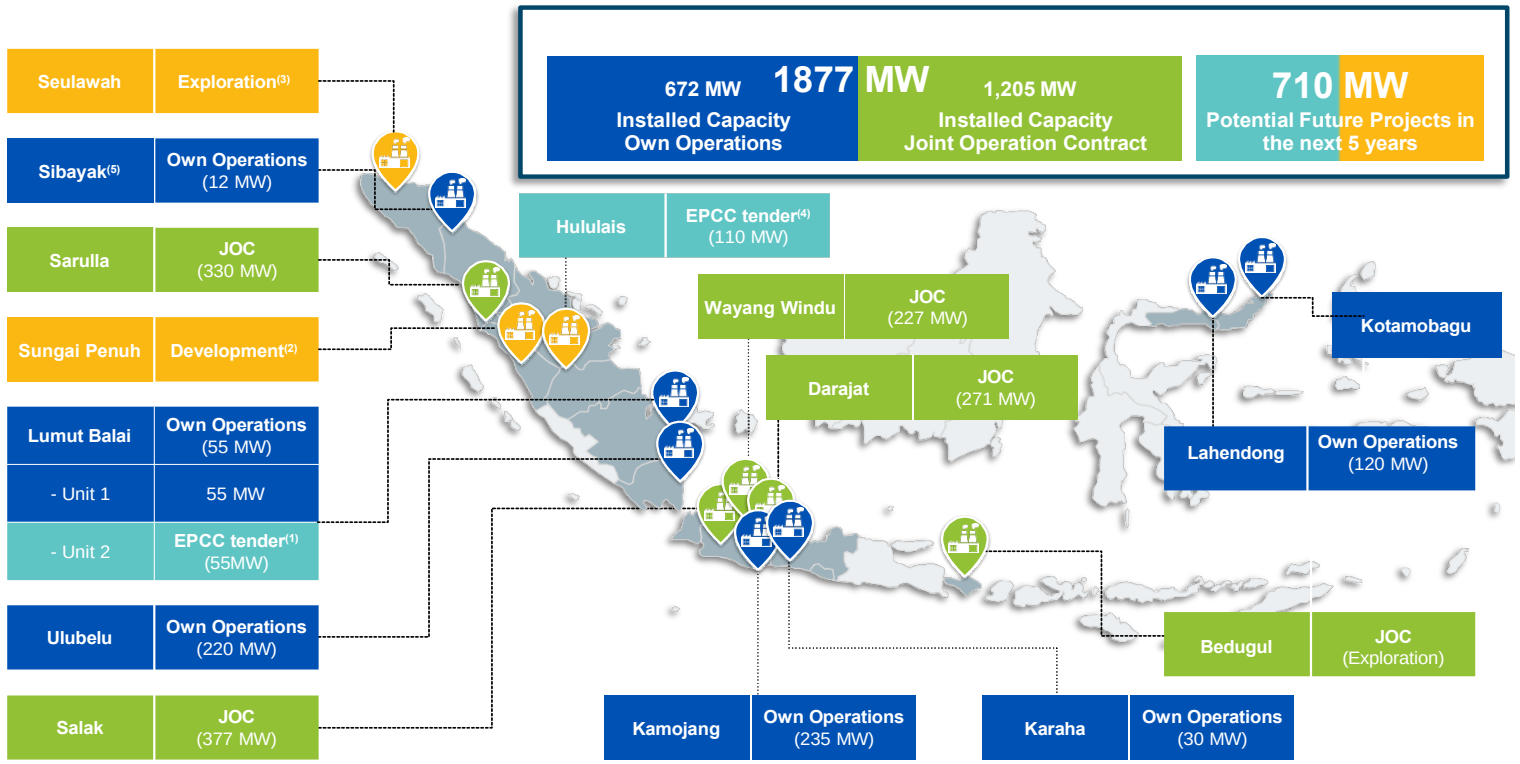
BUSINESS SCHEME

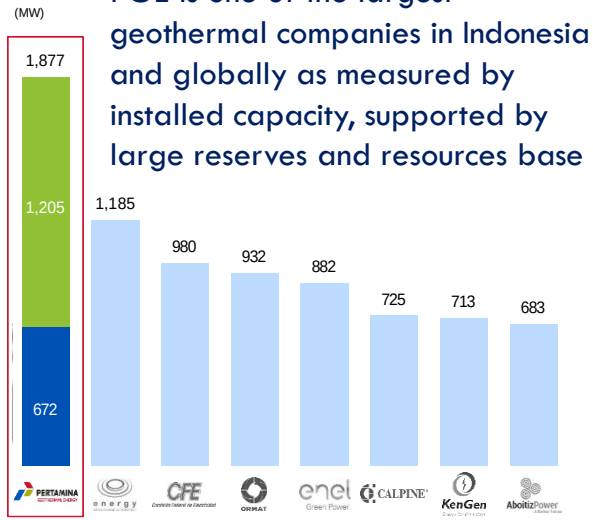


- PGN / JGC / Daigas / INPEX jointly develop POME Biomethane Business
- 1st PJ in Indonesia “Biomethane Injection to Main Pipeline” Supply Chain
- Aiming for expansion of Biomethane Supply Chain with Pipeline Injection
- Indonesia become a country that provide green gas and can attract investment come to Indonesia

Sustainable Energy: Pertamina's Geothermal Portfolio

Pertamina Geothermal Energy (PGE) installed capacity comprises of **~80%** of total geothermal installed capacity in Indonesia





PGE is one of the largest geothermal companies in Indonesia and globally as measured by installed capacity, supported by large reserves and resources base

Own Operation

Joint Operation Contract

Energizing Green Future

Green Hydrogen from Geothermal Energy – Ulubelu Plant

Background

- Supporting the National Energy Policy, the NRE mix portion up to 23% in 2025.
- Applying Renewable Energy within Pertamina group.
- The synergy between Pertamina units/subsidiaries.

Project Scope

- Development of a green Hydrogen pilot plant project that uses electricity from PGE's geothermal power plant (PLTP) to produce carbon emission-free green Hydrogen with a capacity of ±100 kg/day.

Timeline

Item	Year
Start	2023
Finish	2025

Ulubelu Geothermal Power Plant, Unit - 3 & 4

Polypropylene plant at Refinary Unit III, Plaju

Business Scheme

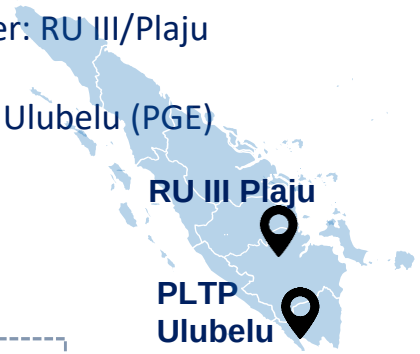
- Green Hydrogen Supply

PERTAMINA GEOTHERMAL ENERGY ⟷

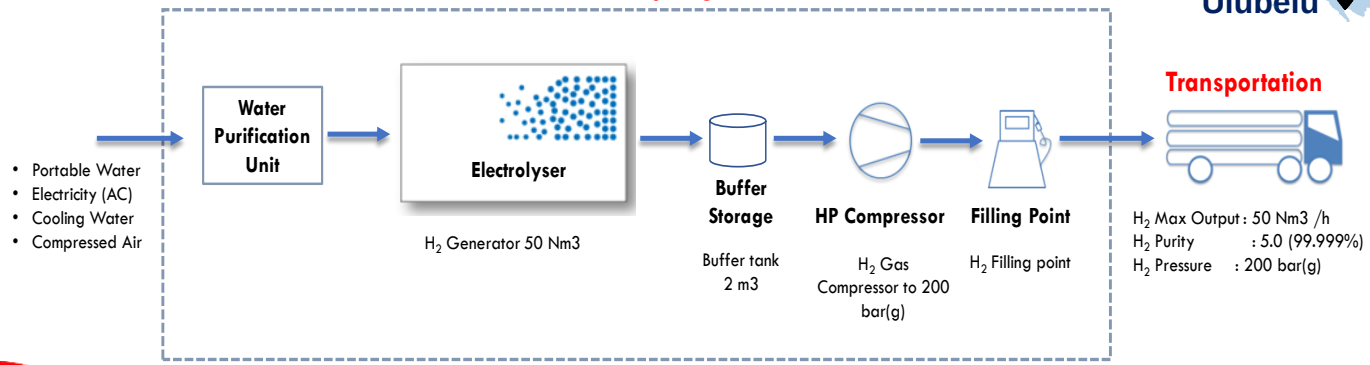
- Petrochemical Plant
- Refinery Plant

Location

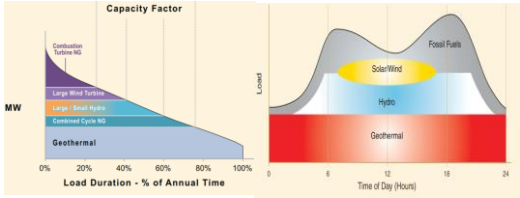
- Hydrogen Off taker: RU III/Plaju
- Hydrogen Plant: Power Plant PLTP Ulubelu (PGE)



Process Flow Diagram of Green Hydrogen Pilot Plant



Geothermal is Suitable for Green Hydrogen Production

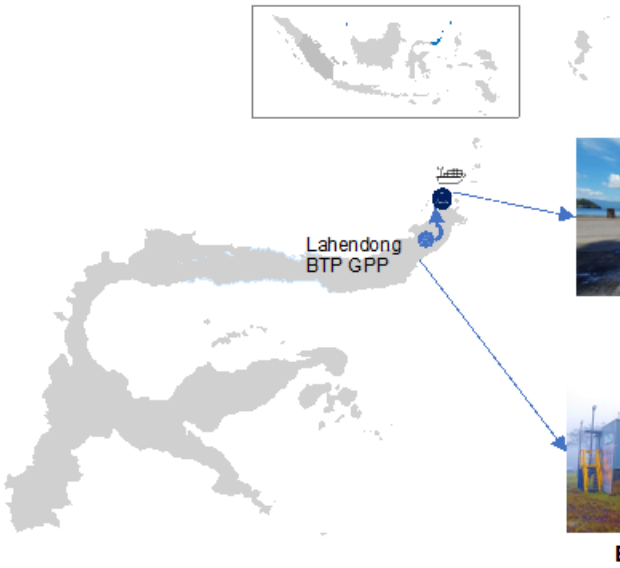


- The **CF** of electricity generation from geothermal energy is a **highest** and the most **stable** compared to other NRE sources.
- Due to its stability and reliable source, geothermal is used as a **base load in the grid**.
- Baseload energy - it's always on: GPP produces electricity consistently 24/7. The power output is highly predictable and stable, thus facilitating energy planning with remarkable

@pertamina

Green Hydrogen from Geothermal Energy – Lahendong Plant

To shift toward sustainable energy, Pertamina New & Renewable Energy (Pertamina NRE) will collaborate with Pertamina's Refinery to supply and utilize green hydrogen produced from Pertamina Lahendong Geothermal Plant



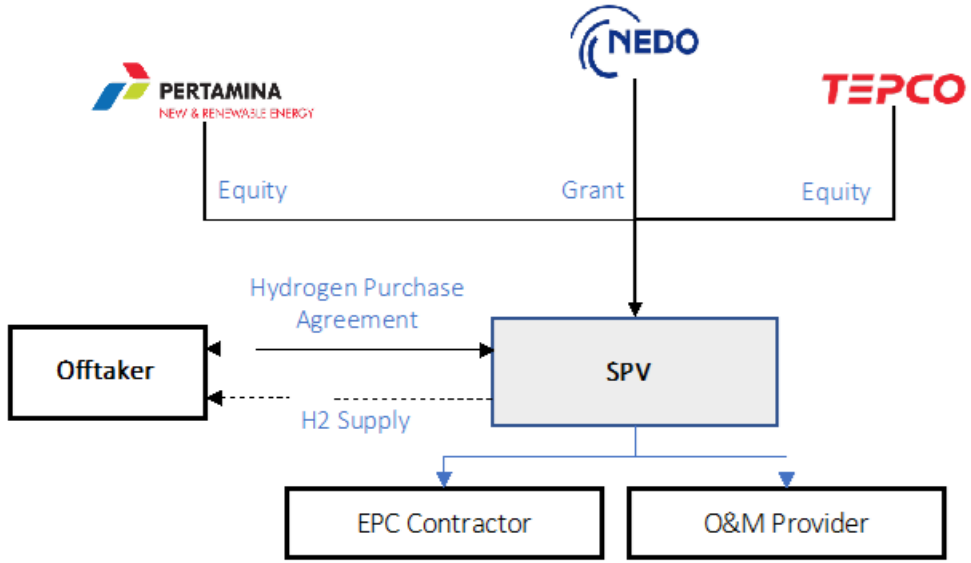
Bitung Port

Site survey conducted in **PELINDO** Port. 2 (two) available ports 1) Cargo Port and 2) Conventional Port.

BTP & H_2 Plant location

Power from Geothermal BTP Plant in Lahendong will **produce 180 ton GREEN H_2 per year**

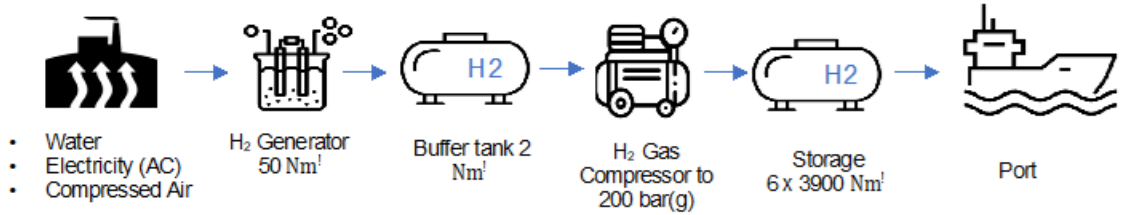
Business Scheme



Project Development Milestone

Q2 2023	Q2 2024	Q3 2024	Q4 2026
• PFS Completed	• FS Completed	• EPC Start	• COD

H_2 Production Process



- Water
- Electricity (AC)
- Compressed Air

H_2 Generator 50 Nm³

Buffer tank 2 Nm³

H_2 Gas Compressor to 200 bar(g)

Storage 6 x 3900 Nm³

Port

Natural Based Solution: Rubber Agroforestry

This collaboration is expected to produce Voluntary Carbon Credit products that can be used by Pertamina to produce Carbon Neutral Oils, as well as the potential for additional revenue from the sale of rubber and wood from rubber trees

Project Profile

- **Location:**
  Gunung Para Estate
  Dolok Merawan Subdistrict
  Serdang Bedagai District
  North Sumatra Province
- **Vegetation:**
  Rubber tree
- **Total Area:**
  4,030 ha
- **Estimation of total CO_2 absorption**
  (carbon credit generated)
  1,176,846 ton in 30 years

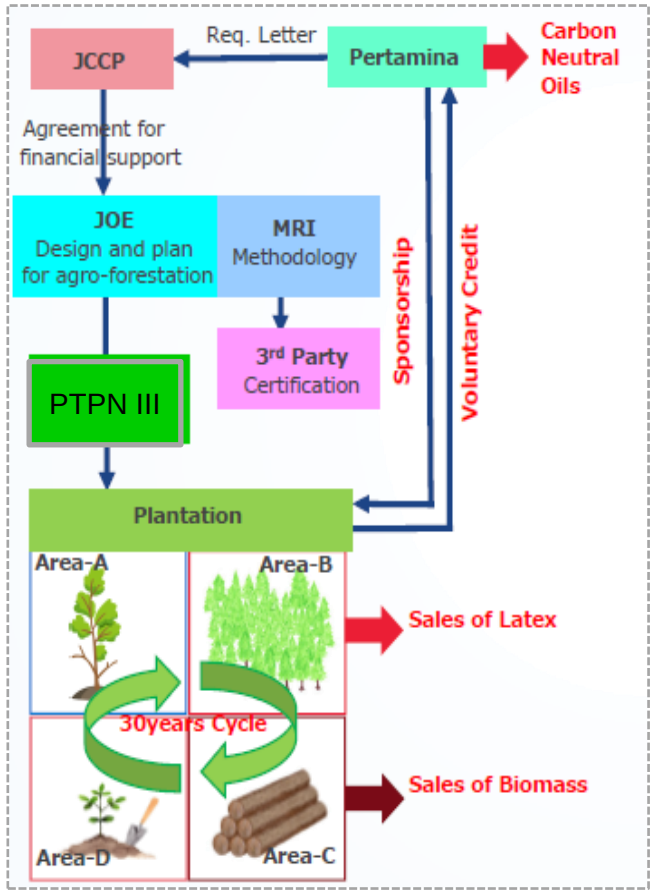
Pertamina is the beneficiary of the carbon credits generated from the project

JCCP, as a funding provider, will not receive benefits from the carbon credits generated

PTPN III as a provider of rubber plantation land (which already exists), can be a beneficiary of the resulting carbon credits

JOE, as a project consultant, will not receive benefits from the carbon credits generated

Partnership Scheme



Project Timeline and Budget

Items	FY2023	FY2024	FY2025	FY2026	FY2027
Design& Planning for Agro-forestation of Rubber Tree	→	→	→		
Establishing the methodology for voluntary credit		→	→		
Survey of trend and potential about carbon neutral oils	→	→	→		
PDD Process			→	→	
Validation and verification				→	
Settlement and carbon trading					→

Year	Source of Funding	Note
1	Funded by JCCP for the first 4 years	The designing and planning for agro-forestation, the methodology for voluntary credit and the trend survey of Carbon Neutral Oils shall be completed simultaneously.
2		Field work shall be commenced with the commitment among all the stakeholders including the local government, public firms and the local community by supporting the plantation for such as employment, training, procurement, preparation of land & infrastructure, marketing of latex & biomass.
3		
4		
5 - 25	Pertamina – PTPN to discuss and collaborate on the funding, carbon credit, and revenue stream	Rubber trees usually produce latex from 5th year for 25 years and to be replanted in 30 years cycle. In order to produce voluntary credit continuously, multiple areas shall be arranged for proper rotation.

Project Status

- NDA between Pertamina – PTPN – JOE was signed in 2022 as basis for *pre-assessment* of project feseability.
- On-progress MoA finalization between JCCP, Pertamina, and PTPN as funding basis in 2023.
- On-progress finalization of voluntary credit methodology.

BUMN UNTUK INDONESIA

PERTAMINA

thank you

Sincerely Yours

@pertamina

PERTAMINA CALL CENTER 135

www.pertamina.com