



6 th Research and Development 20 (RD20) for Clean Energy Technologies
December 2-6, 2024, Convention Centre, India Habitat Center, New Delhi,
India

Dec 2, 2024

The advancement of Biofuels in Indonesia: Status & Updates

by Novi Syaftika

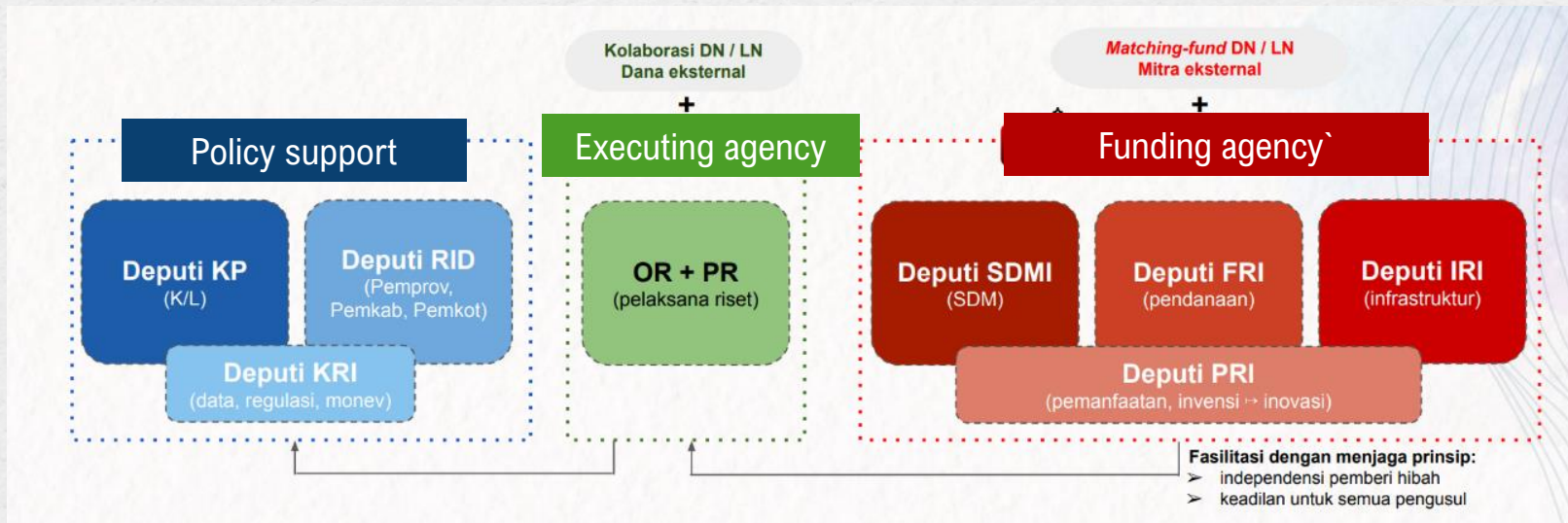
**Centre for Industrial Process and Manufacturing Technology
National Research and Innovation Agency (BRIN)
Indonesia**



- **National Research and Innovation Agency**
(BRIN) was established in 2019



- Merged of 4 agencies (BPPT, LIPI, BATAN, LAPAN), Ministry of Research and Technology, and more than 34 research centers from ministries all over Indonesia.
- Total employees: >13,000 persons



Head of Research Organization of Energy and Manufacture

Prof. Cuk Supriyadi Ali Nandar



Former RD20 Summer School Chairman (2024 in Indonesia)

Research Centre for Industrial Process & Manufacture



Dr. Hens Saputra

Research Centre for Transportation Technology



Dr. Aam Muharam

Research Centre for Sustainability



Nugroho Adi Sasongko, Ph.D

Research Centre Structural Strength



Dr. Mahfudz Al Huda

Research Centre for Hidrodynamics technology



Dr. Widjo Kongko

Research Centre for Energy Conversion and Conservation



Dr. Tata Sutardi

Research Centre for Standardization



Dr. Teguh Muttaqie S.T., M.Sc.

Novi Syaftika
Researcher

Field of work: Biomass utilization for bioenergy and valuable products development.





REPUBLIC OF INDONESIA



8 million km² •

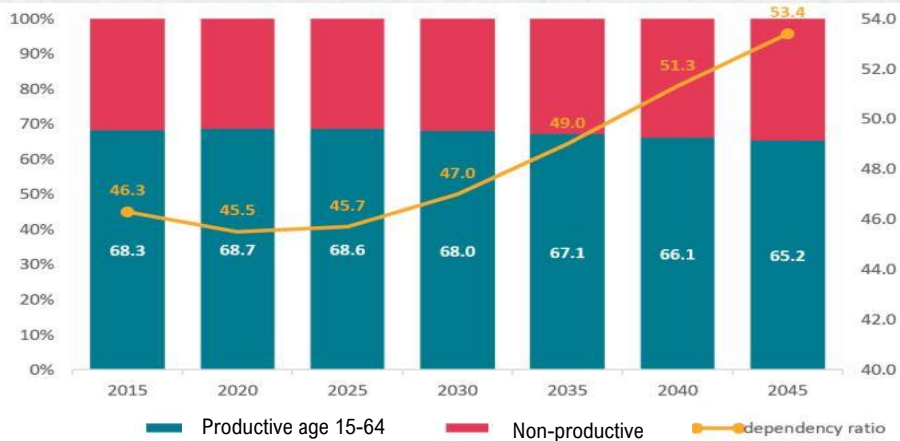
282,48 million people •

17,000 islands •

2nd world largest in biodiversity •



- Located at the ring of fire (earthquakes, eruptions, etc)
- Largest producer of palm oil (50 million metric ton (2023))
- In 2045 is projected to reach 318.96 million people



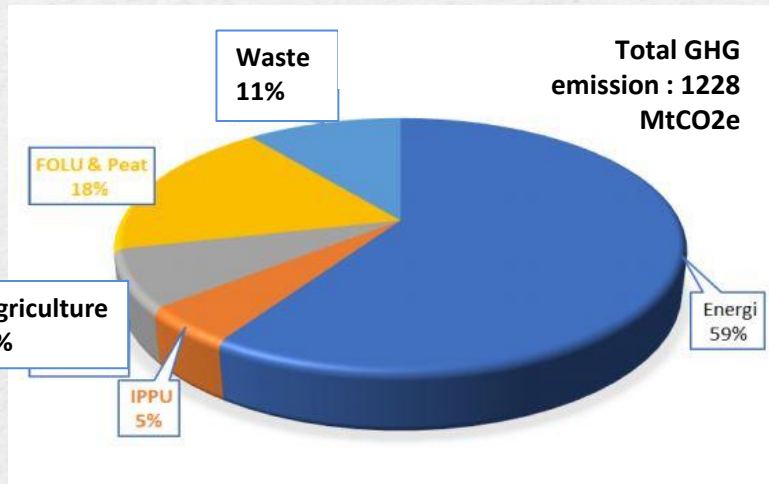
INDONESIA
E M A S
2045
2045 will be 100 years
(GOLD) of Indonesian
Independence

- Categorized as ‘upper-middle income’ by the World Bank in 2023
- Eagerly become high income country by 2045.



NET ZERO EMISSIONS
2060

Declared in the UN Climate Change Conference (COP 26), Glasgow, 2021



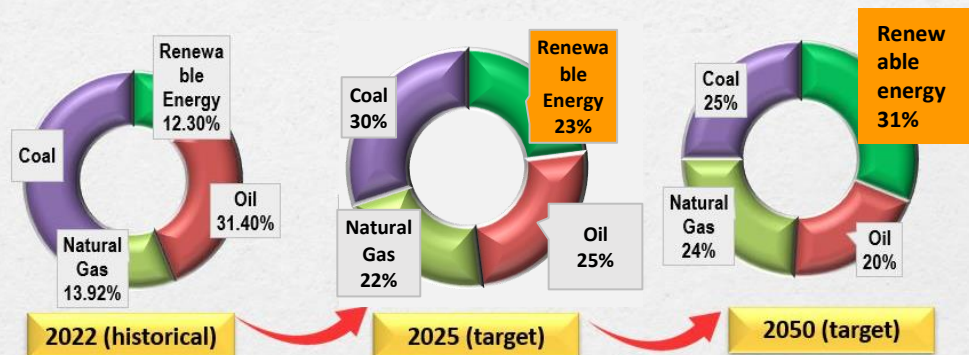
GHG emission based on sector (2022)

Source: Ministry of Environment and Forestry

NZE strategies

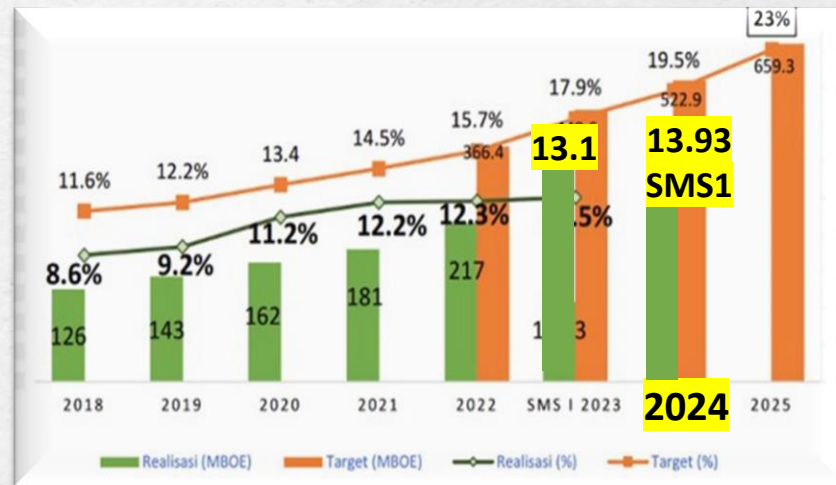
1. Implementation of Energy Efficiency
2. Electrification (EV, induction stoves, agricultural electrification, etc.)
3. Moratorium on new coal-fired power plants (PLTU) & phase-down of existing PLTU.
4. Development of Renewable Energy (on-grid, off-grid & Biofuels)
5. New Energy Sources (nuclear, hydrogen, ammonia)
6. CCS/CCUS

PRIMARY ENERGY MIX AND RENEWABLE ENERGY SHARE



Primary Energy Mix

Source: National Energy Council



Target and realization of NRE shares in Primary Energy Mix 2023

Source: MEMR (2023)

2023: 13.1 %

2024 (1st semester) realization: 13.93%

2025 target: 23%

2050 target: 31%

Progress on GHG Emission Reduction

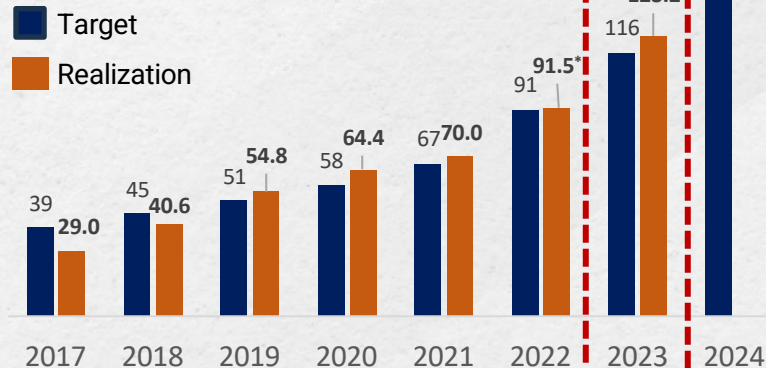


eNDC 2030

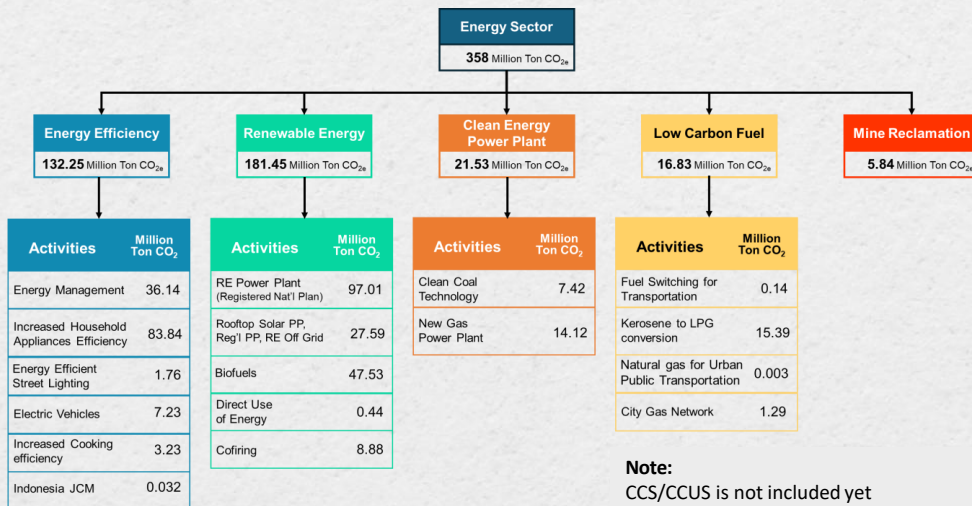
No.	Sector	GHG Emission in 2010	GHG Emission in 2030			Emission Reduction	
			BaU	CM1	CM2	CM1	CM2
1	Energy	453.2	1669	1311	1223	358	446
2	Waste	88	296	256	253	40	45.3
3	IPPU	36	70	63	61	7	9
4	Agriculture	111	120	110	108	10	12
5	Forestry	647	714	217	-15	500	729
Total		1334	2869	1953	1632	915	1240

Unit: MtCO_{2e}

GHG Emission in energy sector



Million Ton CO₂



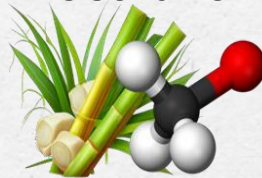
No.	Mitigation	2023		Target 2030	%
		Target	Realization		
1	Energy Efficiency	29.14	31.87	132.25	24,1%
2	New and renewable energy	51.00	51.29	181.45	28,3%
3	Low carbon fuel	15.92	15.55	16.83	92,4%
4	Clean Power Plant	16.54	13.33	21.53	61,9%
5	Others	3.95	11.18	5.84	191,4%
TOTAL		116.45	123.22	358,00	34,4%

Biodiesel



Using transesterification process to produce FAME from vegetable oil (B10, B20, etc means blended biodiesel with conventional fossil diesel)

Bioethanol



Using fermentation to produce ethanol from carbohydrate

Sustainable Aviation Fuel (SAF)



Using FT process, or hydroprocess or Alcohol to Jet Fuel process to produce SAF from vegetable oil or other sources

HVO (Hydrotreated Vegetable Oil)



Using hydroprocess to produce HVO from vegetable oil

Bio-gasoline



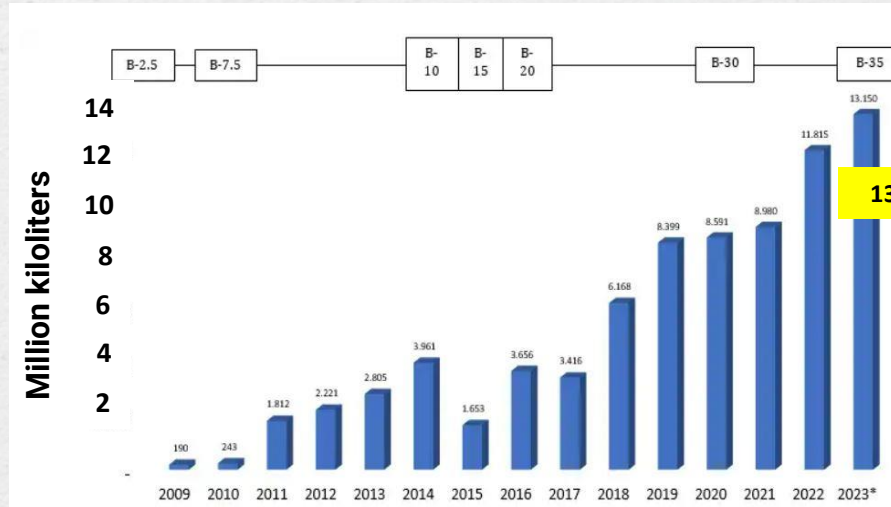
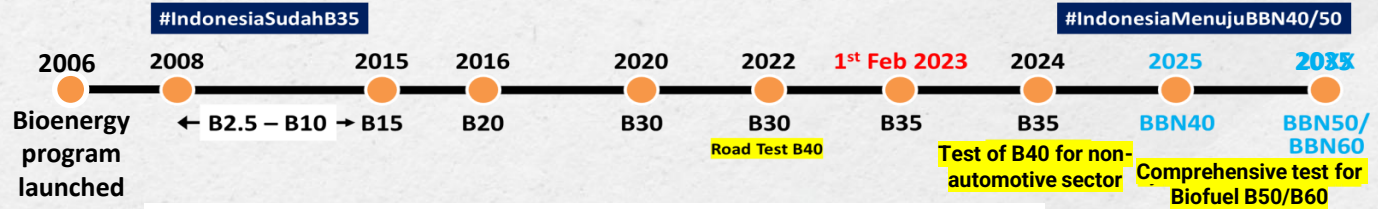
Using FT process, hydroprocess or alcohol to gasoline process to produce Biogasoline from vegetable oil or other sources



B15, B30, etc = Blended biodiesel (FAME) with conventional diesel



98% biodiesel is for domestic consumption



Biodiesel production Indonesia 2009 – 2023

(source: APROBI)

PROPOSED MINIMUM RATIO OF BIODIESEL BLENDING

A. PSO (FAME-based)

2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035
35%	40%	40%	40%	50%	50%	50%	50%	50%	50%	50%	50%

B. NON - PSO

	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035
FAME	35%	35%	35%	35%	40%	40%	40%	40%	40%	40%	40%	40%
HVO	-	5%	5%	5%	10%	10%	10%	10%	10%	10%	10%	10%

Ensuring feedstock sustainability

- Enhance the smallholder oil palm replanting program.
- Utilize critical lands and/or former mining lands to plant biofuel feedstocks.
- Diversify feedstocks by utilizing non-food oil crops such as Jatropha oil, Calophyllum inophyllum oil etc .

Development program

- Increase the capacity of biodiesel plants, particularly in the central and eastern regions.
- Prepare the implementation of B40 and B50 while considering the balance of CPO supply and utilization, the availability of incentives, and infrastructure readiness.
- Increase the production of HVO/green diesel for Non-PSO (existing installed capacity: 130,000 kL).
- Prepare the implementation of sustainability indicator in biodiesel (IBSI).

Biodiesel producers (2022)

Source: palmoilina.asia

Keterangan: **aprobi**

Following Domestic Procurement (Jan-Dec 2021)

Not following Domestic Procurement

North Sumatera

1	PT Sintong Abadi	35,000 kL	USD 2,444,000
2	PT Musim Mas (Medan)	459,770 kL	USD 31,339,031
3	PT Permata Hijau Palm Oleo	417,214 kL	USD 56,165,185

Riau

4	PT Sari Dumai Oleo	413,793 kL	USD 41,379,310
5	PT Intibenua Perkasatama	442,529 kL	USD 55,555,556
6	PT Cilindra Perkasa	287,356 kL	USD 46,581,449
7	PT Pelita Agung Agrindustri	229,885 kL	USD 48,275,862
8	PT Pelita Agung Agrindustri	568,966 kL	USD 70,671,724
9	PT Sari Dumai Sejati	689,655 kL	USD 30,000,000
10	PT Wilmar Bioenergi Indonesia	1,603,448 kL	USD 158,126,118
11	PT Bayas Biofuels	862,069 kL	USD 85,000,000

Riau Island

14	PT Musim Mas (Batam)	896,552 kL	USD 172,364,673
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Banten

15	PT Alpha Global Cynergy	12,000 kL	USD 3,000,000
16	PT Multimas Nabati Asahan	568,966 kL	USD 48,642,000

West Java

17	PT Sinar Mas Bio Energy	455,400 kL	USD 111,678,349
18	PT Sumiasih	114,943 kL	USD 26,666,667
19	PT Darmex Biofuel	287,356 kL	USD 57,629,630

Lampung

12	PT LDC Indonesia	482,759 kL	USD 78,518,519
13	PT Tunas Baru Lampung	402,299 kL	USD 26,962,963

East Java

20	PT Anugerahini Gemanusa	160,920 kL	USD 48,984,354
21	PT Batara Elek Semesta Terpadu	780,459 kL	USD 52,618,102
22	PT Wilmar Nabati Indonesia	2,250,000 kL	USD 109,335,484
23	PT Energi Baharu Lestari	229,885 kL	USD 6,370,370
24	PT Eterindo Nusa Graha	568,966 kL	USD 80,548,055
25	PT Eco Prima Energi	579,310 kL	USD 30,099,594

Bali

26	PT Bali Hijau Biodiesel	360 kL	USD 222,222
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South Kalimantan

27	PT SMART Tbk	440,517 kL	USD 59,677,951
28	PT Jhonlin Agro Raya	568,966 kL	USD 60,426,512

Central Kalimantan

29	PT Sukajadi Sawit Mekar	402,299 kL	USD 52,222,222
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East Kalimantan

30	PT Kutai Refinery Nusantara	1,143,247 kL	USD 65,640,556
31	PT Energi Unggul Persada	948,276 kL	USD 25,444,253

North Sulawesi

32	PT Multi Nabati Sulawesi	475,862 kL	USD 32,620,407
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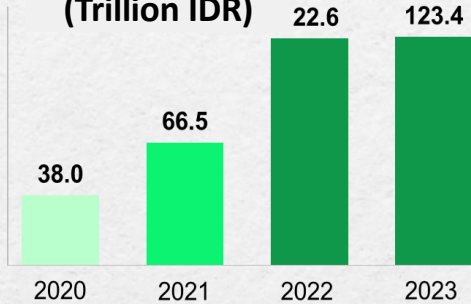
REGION	KAPASITAS (kL)	INVESTASI (USD)
Sumatera	7.791.322	903.384.834
Jawa	5.370.634	575.794.827
Kalimantan	3.503.305	263.411.493
Sulawesi	475.862	32.620.407
TOTAL	17.141.122	1.775.211.561

Number of biodiesel producers: 32

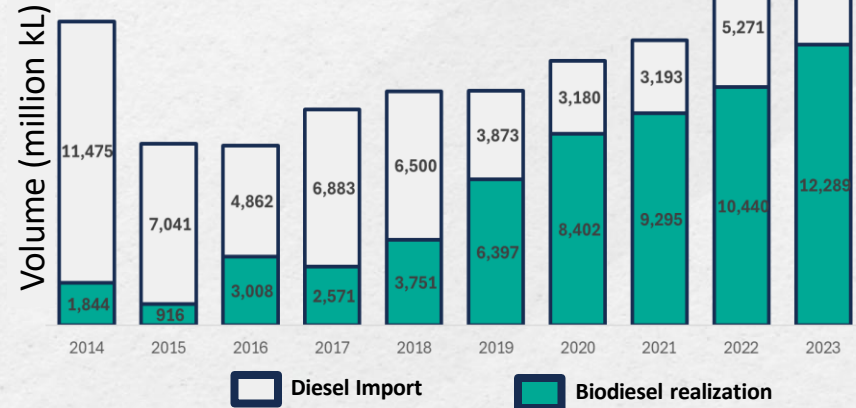
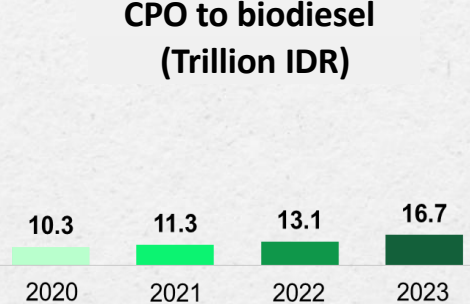
Biodiesel achievements



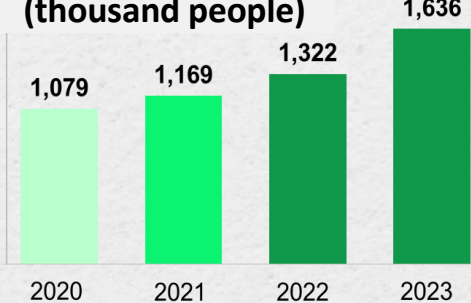
**Savings in foreign exchange
(Trillion IDR)**



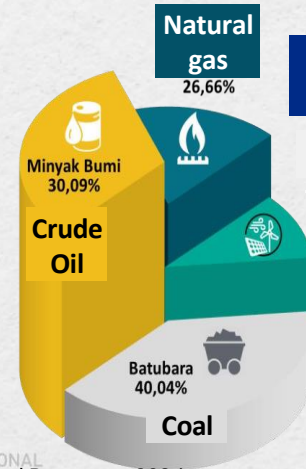
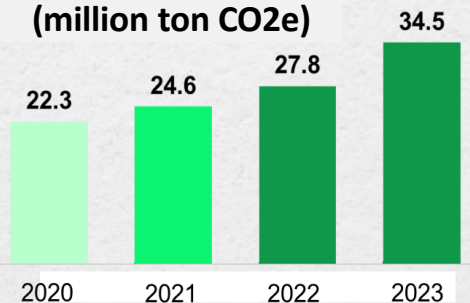
**Value addition from
CPO to biodiesel
(Trillion IDR)**



**Employment
(thousand people)**



**GHG emission
(million ton CO2e)**



BIODIESEL CONTRIBUTION IN ENERGY MIX

NRE

123,21%



Biodiesel

4,6%

23%
TARGET NRE
@ 2025 : 23%

Note:

2020 – 2022: B30; Feb 1, 2023: B35

2006

Bioethanol from cassava was launched but then sustainability was hindered by the competition with food, high cost and lack of regulatory support.

2019

More assertive bioethanol program, infrastructure preparation and incentive support

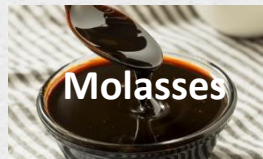
2023

Bioethanol E5 program was launched by Pertamina as Green95 mainly from sugarcane molasses. By August 2024 sold in 95 gas stations, with satisfactory sales.
















Current production 40,000 kL.

The government released Presidential Regulation Number 40/2023 about **“The acceleration of national sugar self sufficiency and bioethanol production for biofuel”**.

- Expansion of sugarcane plantations to 700,000 hectares (ha) especially in eastern region (Papua) to increase bioethanol production to 1.2 million kiloliters (kl) per year by 2030.
- Exploring diversification of raw materials (sorghum or agricultural waste like palm oil Empty Fruit Bunch (EFB), etc).



Road map based on Ministry of Energy and Mineral Resources Regulation Number 12, 2015

Bioethanol Mandatory	APRIL 2015	JANUARI 2016	JANUARI 2020	JANUARI 2025
 Small enterprises, fisheries, transportation and PSO	1% 	2% 	5% 	20% 
 Non PSO transport	2% 	5% 	10% 	20% 
 Industry and commercial	2% 	5% 	10% 	20% 

Current Bioethanol Production Capacity

No.	Produsen Bioetanol	Lokasi	Kapasitas (Juta liter/tahun)	Kapasitas FGE (Juta liter/tahun)	Feedstock
1	PT Molasindo	Medan, Sumatera Utara	6.0	-	Molasses
2	PT Medco Ethanol	Lampung	40.0	-	Molasses
3	PT Indo Lampung Distillery	Lampung	40.0	-	Molasses
4	PT Indonesia Ethanol Industri	Lampung	50.0	20.0	Singkong, Jagung
5	PT PG Rajawali III	Cirebon, Jawa Barat	6.0	-	Molasses
6	PT Madu Baru	Yogyakarta	7.5	3.0	Molasses
7	PT Indo Acidatama Tbk	Surakarta, Jawa Tengah	50.0	-	Molasses
8	PT Energi Agro Nusantara	Mojokerto, Jawa Timur	30.0	30.0	Molasses
9	PT Ethanol Ceria Abadi	Jombang, Jawa Timur	12.0	-	Molasses
10	PT Molindo Raya Industrial	Lawang, Jawa Timur	90.0	10.0	Molasses
11	PSA Jatiroto PTPN XI	Lumajang, Jawa Timur	6.0	-	Molasses
TOTAL			337.5	63.0	

Recently proposed ROAD MAP

Biofuels	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035
Bioethanol (Non-PSO)	5%	5%	5%	5%	5%	10%	10%	10%	10%	10%	10%	10%

The government will revise the bioethanol roadmap and consider the availability of raw material, infrastructure, management and system.

GENERAL TIMELINE OF SAF (SUSTAINABLE AVIATION FUEL)

2015
-
2021

First Flight Test

Pertamina's and ITB's First Test Flight successfully developed J2,4 fuel (2.4% bioavtur)

J2,4 fuel is produced through co-processing using RBSPKO in TDHT RU Cilacap

The First Test Flight using CN-235-220 FTB, route Bandung – Jakarta in October 2021.

2022

MoU Ministry of Energy and Mineral Resources with Ministry of Transportation

On July 18, 2022, a Memorandum of Understanding was signed between the Directorate General of New and Renewable Energy and Energy Conservation (EBTKE) and the Directorate General of Civil Aviation, one aspect of which is the use of biofuels in aircraft.

2023

Commercial Flight Test

On October 27, 2023, a successful test flight using J2.4 fuel was conducted on a PT Garuda commercial aircraft, a Boeing 737-800

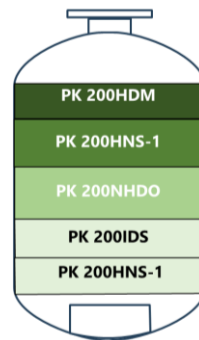
Next
Step

Development Plan

The implementation roadmap for bioavtur, with a comprehensive study from technical and economic perspectives, will be carried out soon.



New TDHT Catalyst Configuration



Implementation Timeline

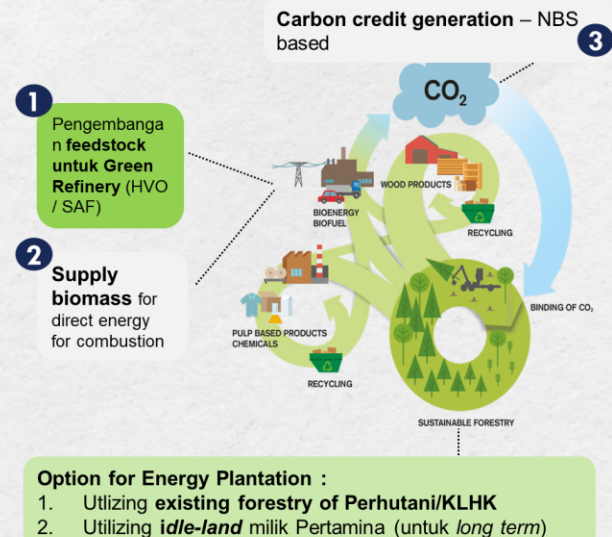
- ✓ Pilot Kick Off Meeting
February 2024
- ✓ Submission of Technical Proposal
May 2024
- ✓ Joint Agreement Letter
Agreed upon Joint Agreement
Letter No. 033/G40000/2024-SO
dated July 29th, 2024
- Catalyst Procurement
On-Going/Waiting for KPI
Approval
- Change of Catalyst (CoC)
Est. 2025

Source: PT Pertamina Persero

Non-edible oil for Feedstock Green Refinery

Parameter	Malapari (<i>Pongamia Pinnata</i>)	Nyampung (<i>Calophyllum inophyllum</i>)	Kepuh (<i>Sterculia foetida</i>)	Karet (<i>Hevea brasiliensis</i>)	Jarak pagar (<i>Jatropha curcas L</i>)	Kopra/ Dried Coconut
Visual						
CO ₂ sink	38 kg/tree/yr	525 kg/tree/yr	367 kg/tree/yr	78 kg/tree/yr	25 kg/tree/yr	28 kg/tree/yr
Oil content	28 – 34 %	65 – 75 %	50 – 60 %	40 - 50 %	28 – 40 %	65 – 75 %
Seed Productivity	11.8 ton/ha/yr (4-5 years after planting)	20 ton/ha/yr (5-7 years after planting)	20 ton/ha/yr (4 years after planting)	2 ton/ha/yr (3-5 years after planting)	5 ton/ha/year (1 years after planting)	3 ton/ha/year
Land req. for Cilacap Phase 2 (6 MBSD)	± 90,000 ha	± 23,000 ha	± 29,000 ha	± 358,000 ha	± 198,000 ha	± 149,000 ha
Distribution location	Pangandaran, Carita, Lembata, North Bali, Alas Purwo, Baluran, NTB	Alas Purwo, Kep. Seribu, Baluran, Ujung Kulon, Pangandaran, Carita, Cilacap, Maluku	Sumbawa, Gunungkidul, Sulawesi, NTT, Maluku	South Sumatra, North Sumatra, Riau, West Kalimantan	NTB, Cirebon, Subang, Banjar, Jember, South Kalimantan	Sepanjang pesisir pantai Indonesia
Altitude	0-1 200 mdpl	0-200 mdpl	0-400 mdpl	0-200 mdpl	0-500 mdpl	0-600 mdpl
Distribution of fatty acids	C16-C18	C16-C18	C16-C18	C16-C18	C16-C18	C12-C14

Energy Plantation Business Scheme



SAF ROADMAP (2015)

BIOAVTUR/SAF	APRIL 2015	JANUARY 2016	JANUARY 2020	JANUARY 2025
 AVIATION	-	2% 	3% 	5% 

Proposed New Road Map for SAF

Biofuel /SAF	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035
Bioavtur	2%	2%	2%	2%	2%	2%	5%	5%	5%	5%	5%	10%

Work in progress

- Currently, the Ministry of Energy and Mineral Resources (ESDM) is revising Minister of Energy and Mineral Resources Regulation No. 32 of 2008, including updating the roadmap for SAF (Sustainable Aviation Fuel) in the aviation sector.
- Increasing SAF production.
- Conducting a comprehensive study on the use of Used Cooking Oil (UCO) as a feedstock for SAF.
- Diversifying feedstocks by utilizing non-standard coconuts, palm kernel expeller (PKE), and biomass waste.
- Performing techno-economic studies for the commercialization of SAF.
- Proposing a mandate for SAF blending.



Source: Infosawit.com

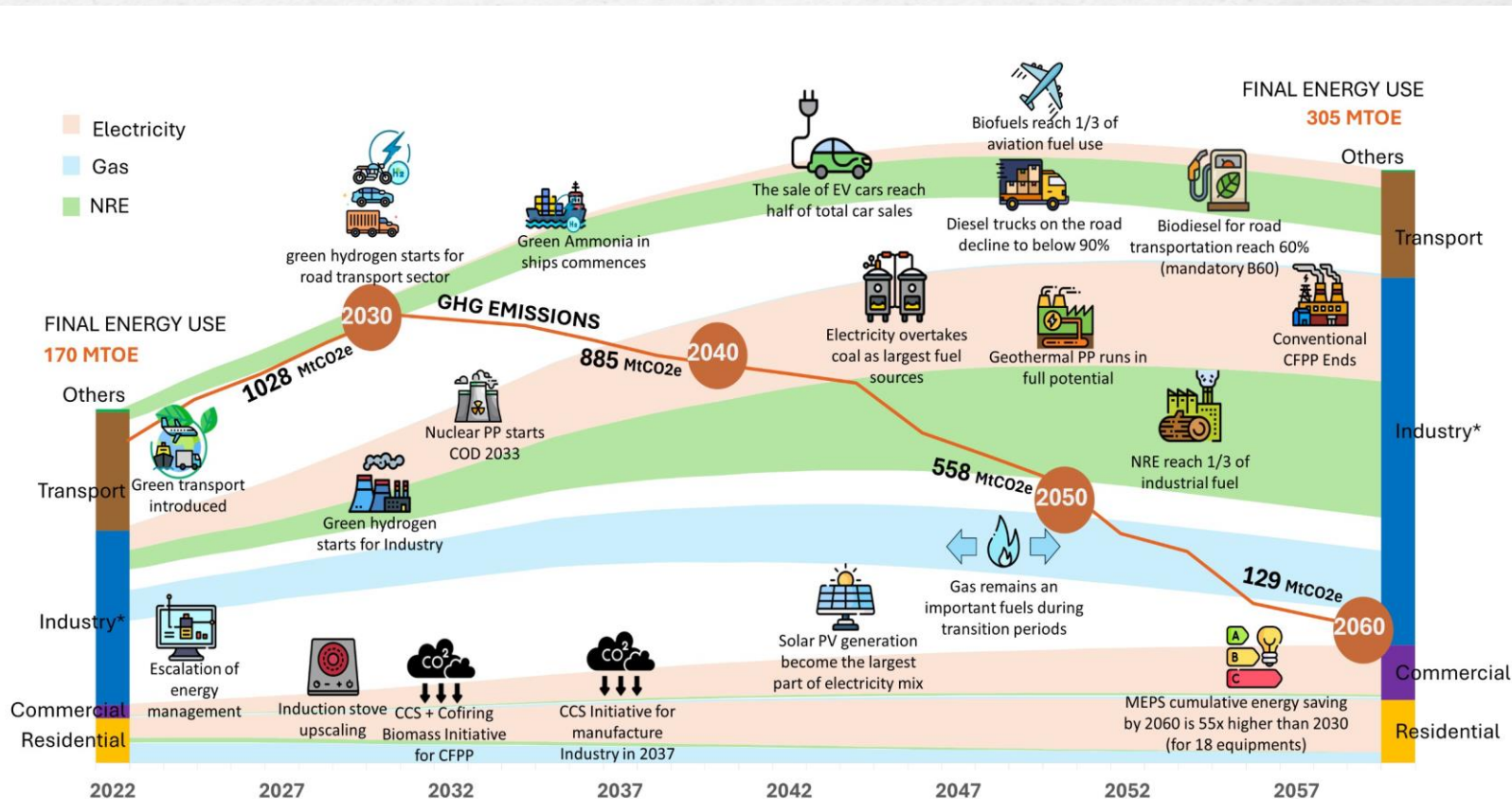


Source: Betanews.com

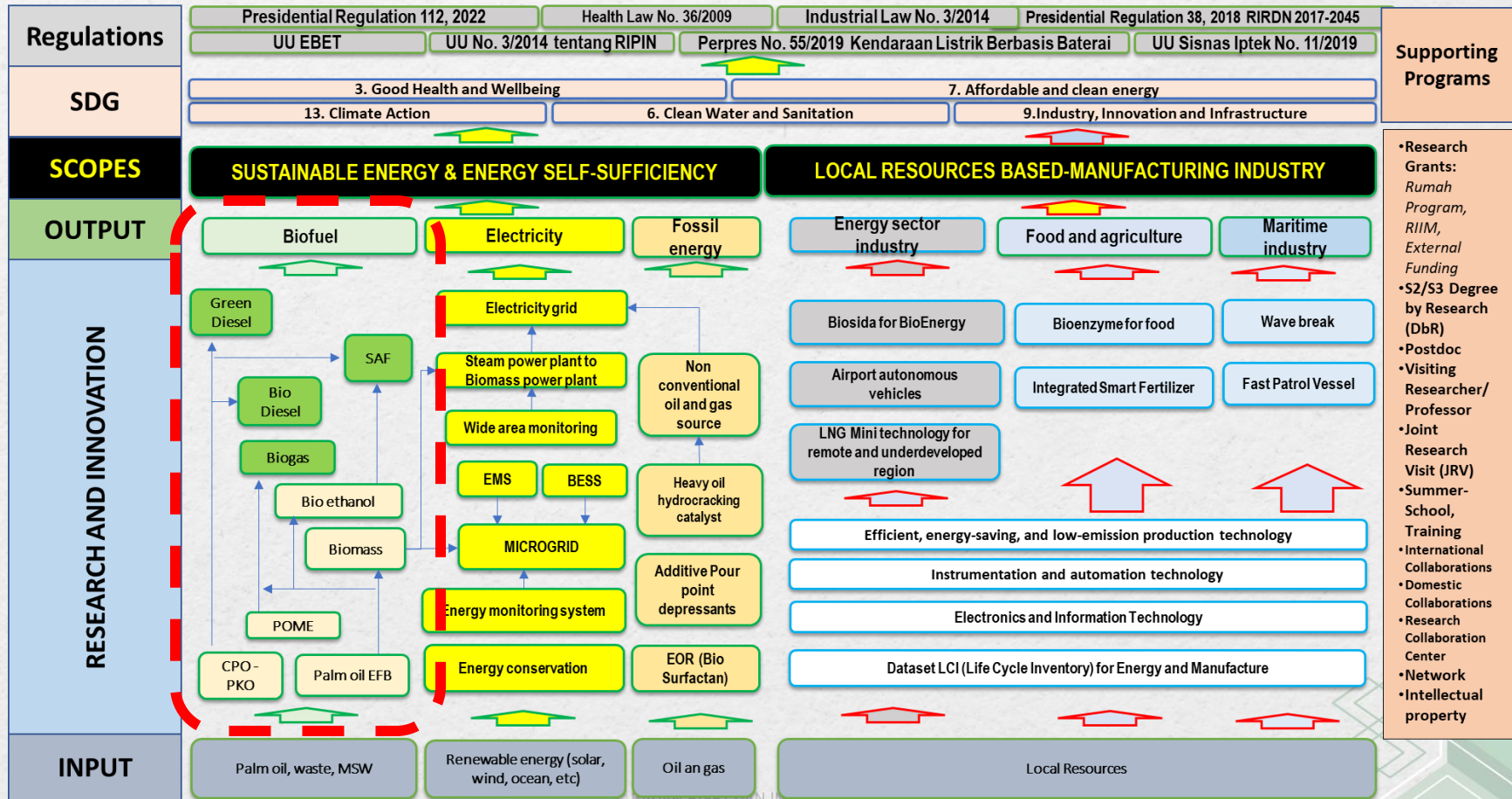
- Bio-gasoline or green gasoline is chemically more similar to gasoline compare to bio-ethanol.
- Bio-gasoline that has begun in research and implementation test level using palm oil as raw material, called **Bensa (Bensin Sawit)** or palm oil gasoline developed by ITB University, has a RON value of 110, higher than conventional gasoline.
- Road tests have been conducted over a distance of 2000 km, from West Java to North Sumatra.
- Scaling up and optimization including the catalyst is under development.

Source: <https://gapki.id/en/news/2024/01/25/den-ri-to-replace-fossil-gasoline-with-bio-gasoline/>

Draft of the Energy Sector Roadmap for NZE



*Note: Industrial fuels and feedstock (non-energy use).



- Research Grants: Rumah Program, RIIM, External Funding
- S2/S3 Degree by Research (DbR)
- Postdoc
- Visiting Researcher/ Professor
- Joint Research Visit (JRV)
- Summer-School, Training
- International Collaborations
- Domestic Collaborations
- Research Collaboration Center
- Network
- Intellectual property

CLUSTER OF PALM OIL AND WASTE BASED – BIOENERGY RESEARCH AND INNOVATION (2025)

1

The pre-treatment technology of empty palm fruit bunches into boiler fuel.

2

The technology for processing empty palm fruit bunches into biogas.

3

Palm-based Hydrogen production technology

4

Palm oil-based SAF (sustainable aviation fuel) and green diesel production technology

5

Technology for processing plastic waste into liquid and gas fuel

Supporting researches:

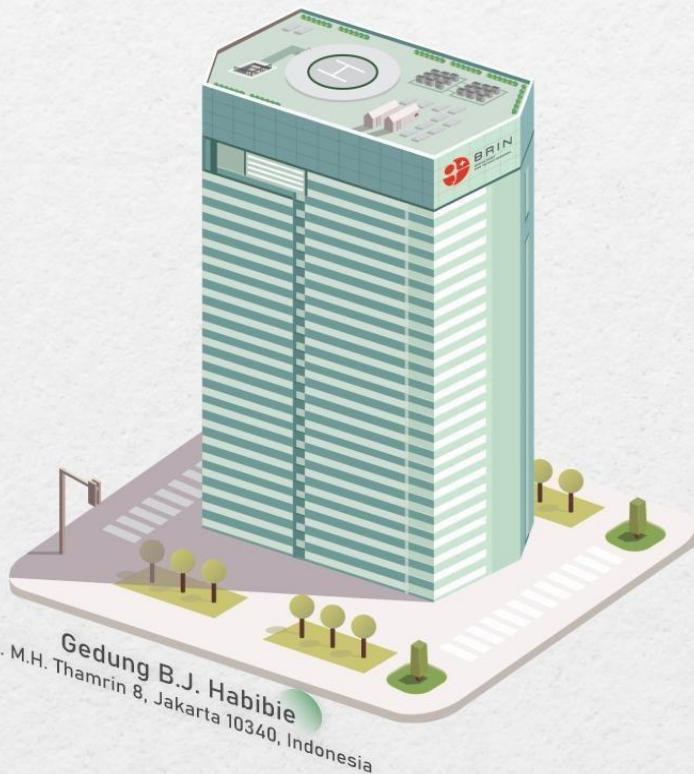
- Exploration on raw materials for SAF and green diesel production;
- SAF and green diesel production process technology from palm-based lignocellulosic materials via 2nd generation bioethanol;
- Research on SAF and other green diesel production process technology.

Supporting researches:

- Studies on plastic waste in big cities;
- Quality and standards of fuel oil products processed from plastic waste.

5

Other researches supporting bioenergy based on palm oil, other biomass, or waste, covering solid, liquid, and gas forms



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