



Indonesia's NRE Development in Energy Transition towards Net Zero Emission

Presented by:
Director of Various New Renewable Energy

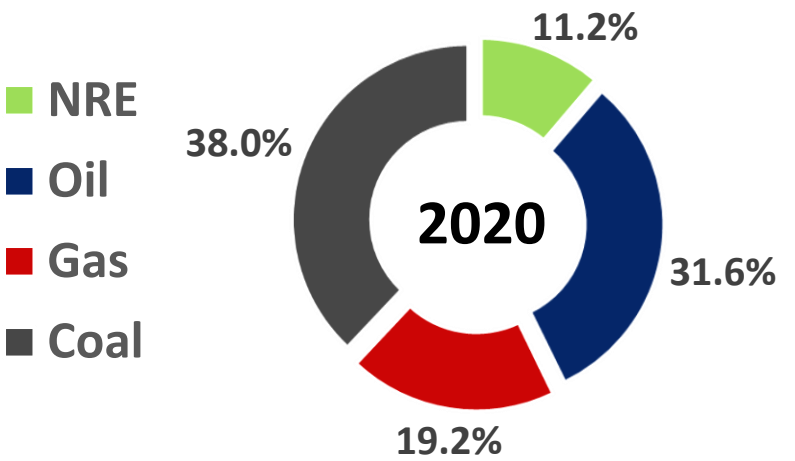
*at Roundtable Discussion on the topic of "Post-COP26:
What We Know and The Impact on Indonesia"*

November 23th, 2021

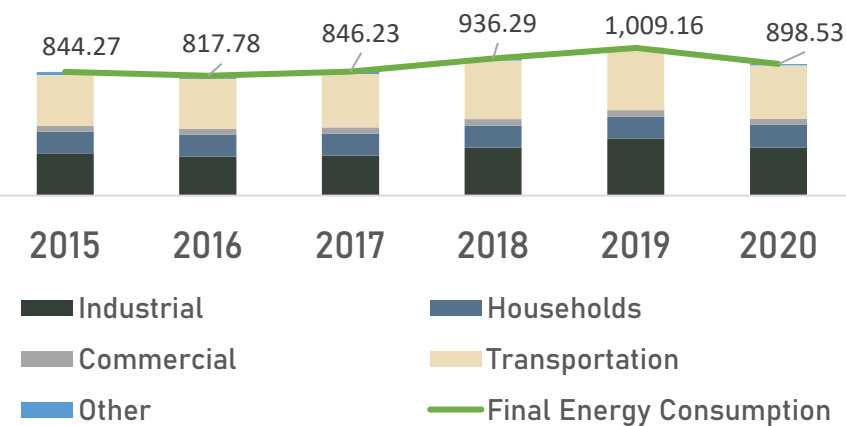
CURRENT ENERGY CONDITION

Decreased final energy demand due to the pandemic. Primary energy mix still dominated by fossil energy

Primary Energy Mix



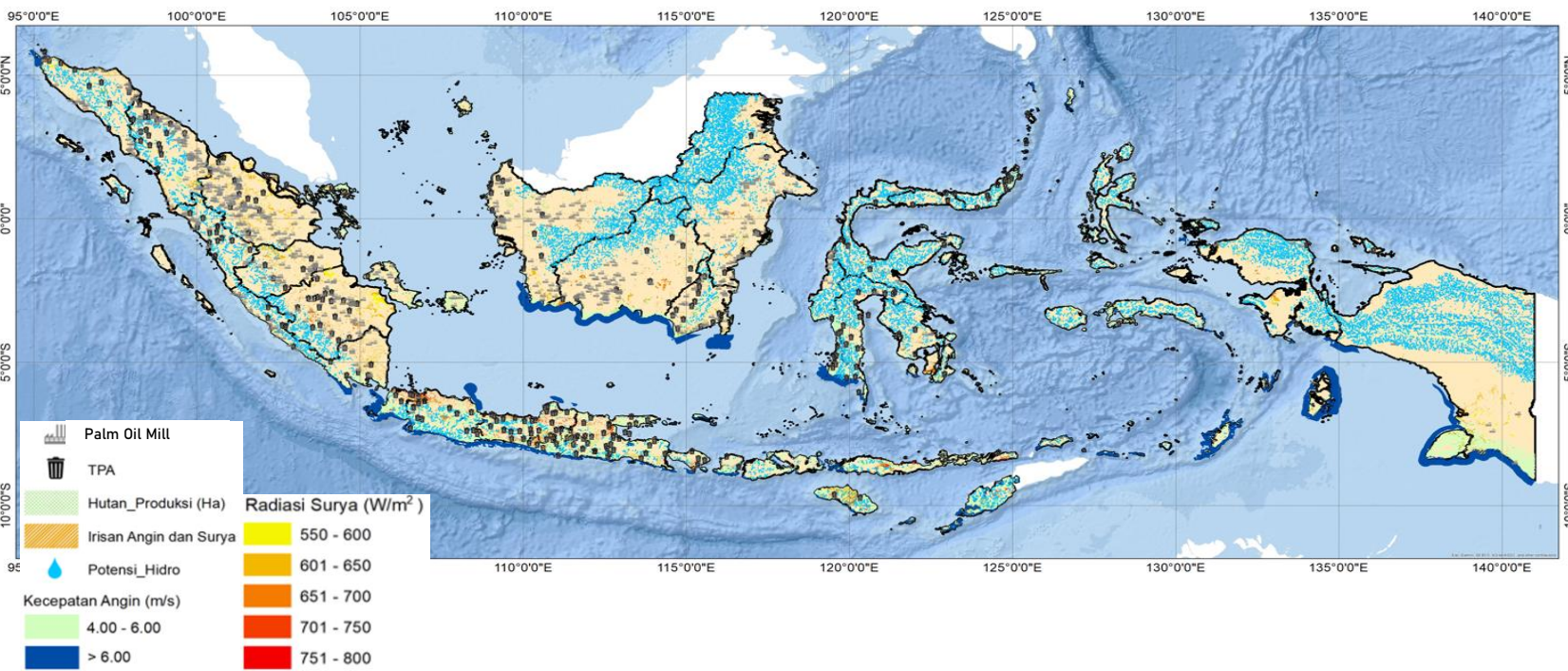
Energy Consumption



- 1 **Dependency on fossil fuels is still high** (Oil 31.6%; Coal 38%; Gas 19.2%; NRE 11.2%)
- 2 **Indonesia has become net oil importing country since 2004** (Consumption + 1.5 million bopd; Production + 700 thousands bopd, 2020)
- 3 **Excluding Covid-19 Pandemic, the energy consumption has been rising (2020)** (3.12 BOE/capita; Electrification Ratio 99.4%)
- 4 **Energy subsidy is high** (energy subsidies until September 2021 have reached Rp 88.2 trillion)
- 5 **Fuel operational reserves are only sufficient for 20 – 23 days and there is no energy buffer reserve**
- 6 **The potential for new and renewable energy is still not fully utilized**

INDONESIA'S NRE POTENTIAL

Abundant NRE potential provides huge opportunities to be developed



- Hydro potential is spread throughout Indonesia, especially in North Kalimantan, Aceh, West Sumatra, North Sumatra and Papua.
- Solar potential is spread throughout Indonesia, whereas NTT, West Kalimantan, and Riau having higher radiation.
- Wind potential (>6 m/s) is mainly found in NTT, South Kalimantan, West Java, South Sulawesi, Aceh and Papua.
- The potential of marine energy is spread throughout Indonesia, particularly in Maluku, NTT, NTB and Bali.

LARGE NRE POTENTIAL, LOW UTILIZATION

ENERGY	POTENTIAL (GW)	UTILIZATION* (MW)
SOLAR	3,294.4	194
HYDRO	94.6	6,432
BIOENERGY	56.9	1,923
WIND	154.9	154
GEOTHERMAL ENERGY	23.7	2,186
OCEAN	59.9	0
TOTAL	3,684.4	10,889

01 The potential for new renewable energy in the predictable category is still being calculated. Currently, only 0.3% of the total potential has been utilized.

02 In addition to renewable energy, the existing potential of new energy is still not widely developed.

Note:
*) Based on the data of September 2021
Nuclear has Uranium potential for 89,483 tons and Thorium for 143,234 tons

INDONESIA'S COMMITMENT TOWARD EMISSION REDUCTION

Strong and consistent commitment to reduce 2030's GHG emission by 29% or 41% based on latest NDC

PRESIDENT DIRECTIVES



Transforming towards **NRE and green technology-based economy**



Encouraging **green development** through the development of a **Green Industrial Park**



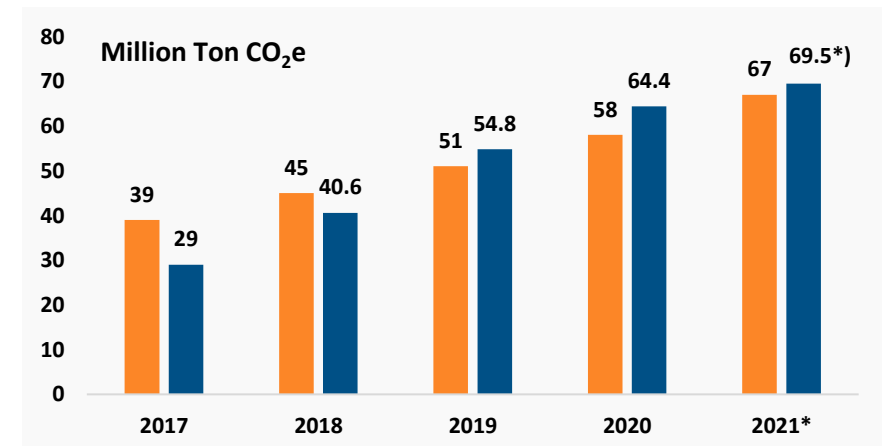
Increasing investment of energy transition through **the development of biofuels and electric vehicles ecosystem, including lithium battery industry**



The **carbon market** and **carbon price** must be part of efforts to address the issue of climate change



ENERGY SECTOR MITIGATION REALIZATION



PROJECTION OF TOTAL EMISSION FROM ENERGY SECTOR

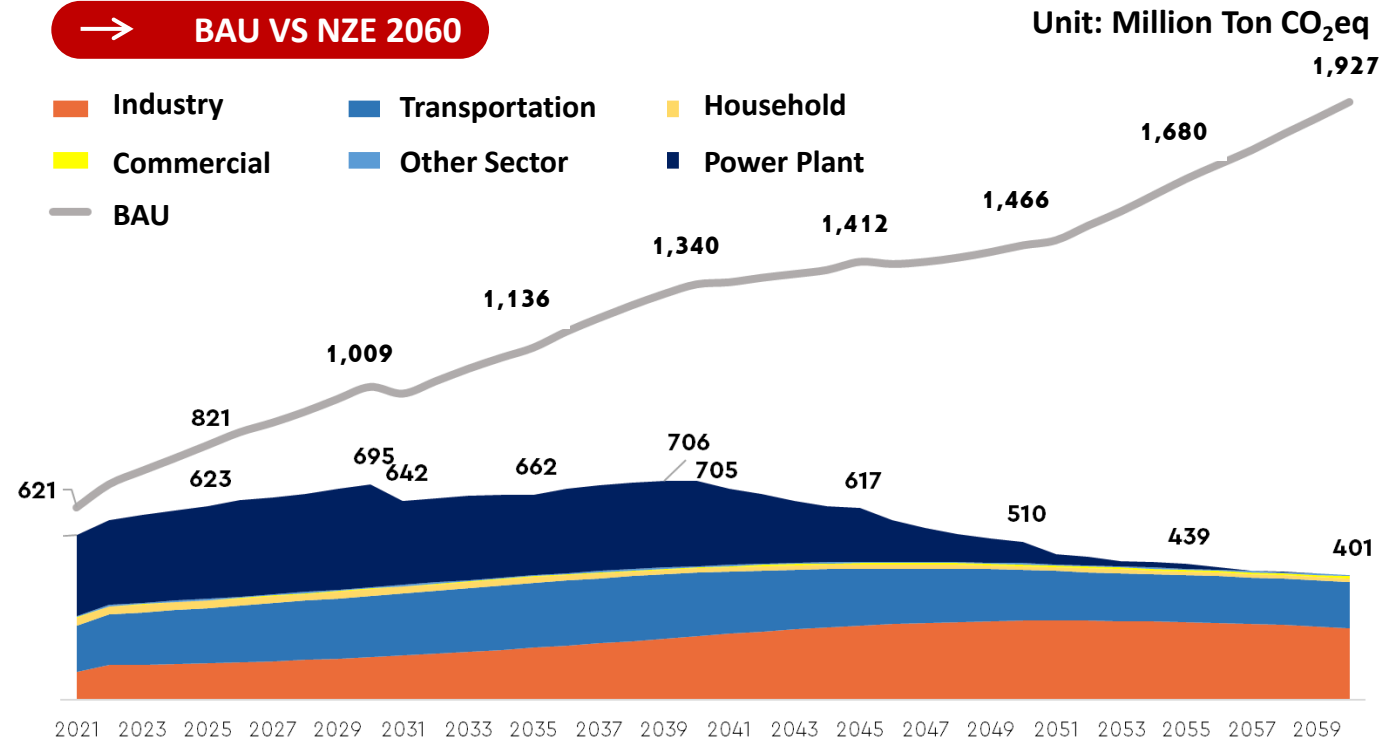
Mitigation actions will reduce emission to 20% of BaU's emission by 2060

→ 2020

NO	EMISSION SOURCES	EMISSION TOTAL IN 2020 (million ton CO ₂ e)
1.	Transportation	132.9
2.	Manufacture Industry	105.1
3.	Commercial etc.	29.4
4.	Fossil Power Plant	279.3
5.	Oil Refinery	8.6
6.	Coal Processing and Fugitive Emission	31.4
TOTAL		586.8

1. Energy sector emissions in 2020 is around 580 million tons CO₂-e.
2. Emission in 2030 will reach 695 million tons CO₂-e and sharp decline to 642 million tons CO₂-e will occur afterward.

→ BAU VS NZE 2060



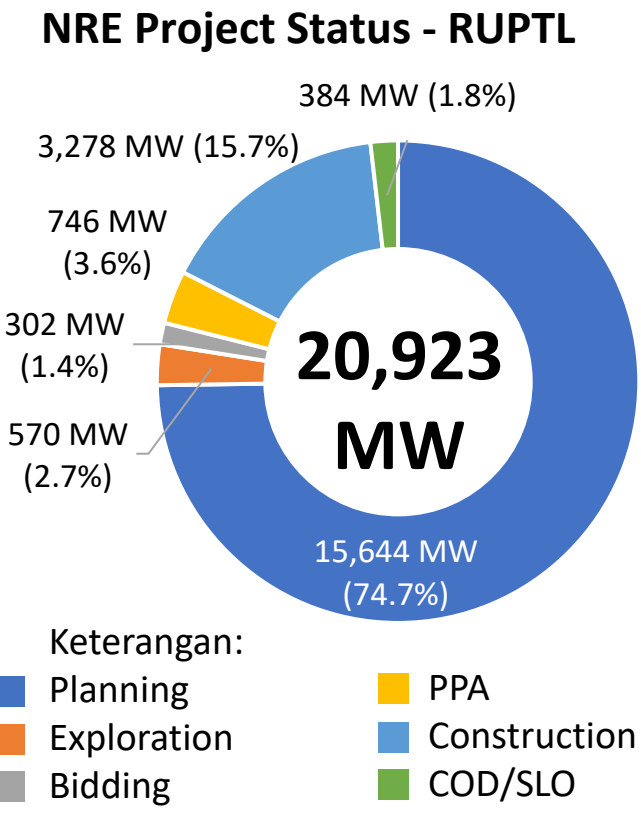
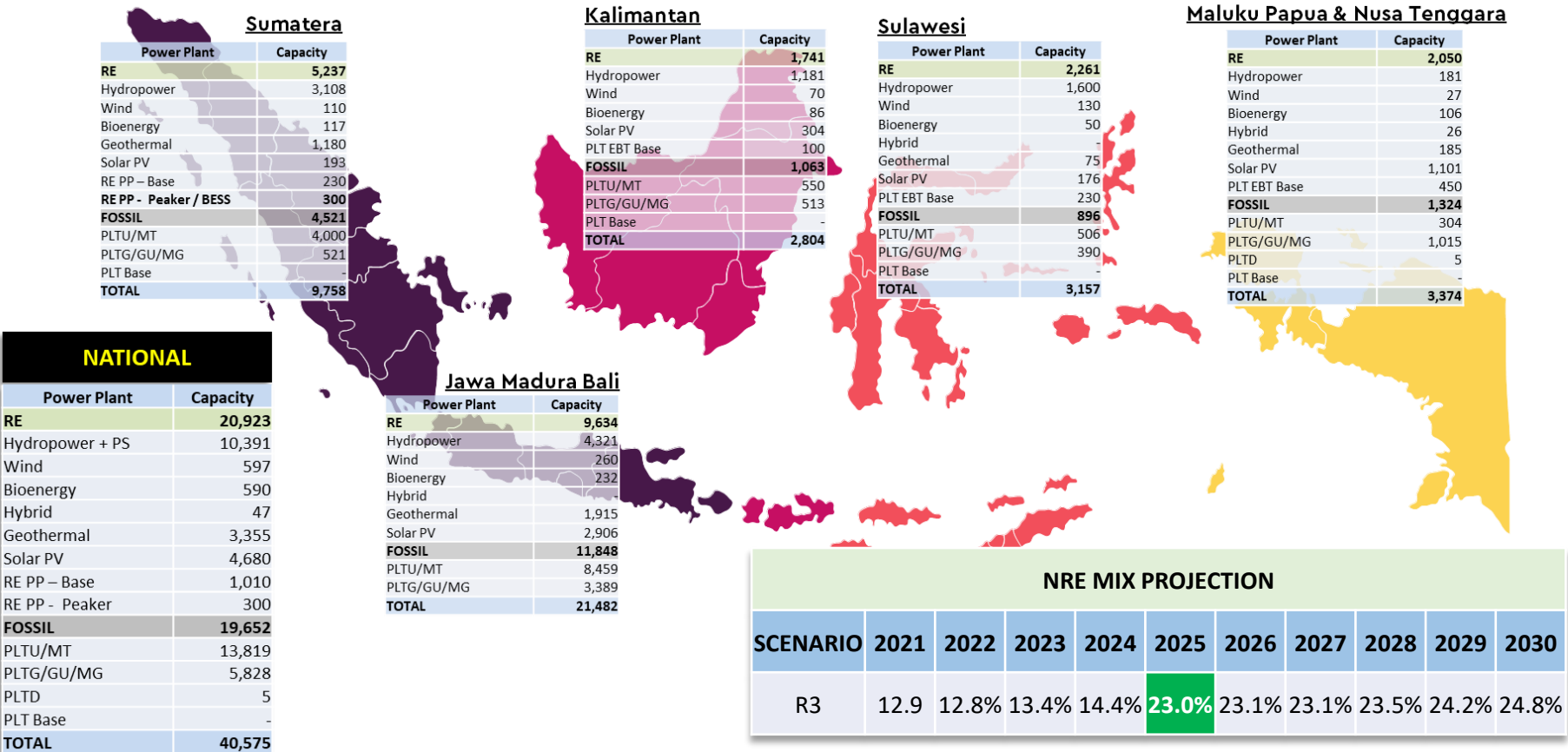
3. Peak emission will occur around 2039 of 706 million tons CO₂-e. Emission will decrease significantly after 2040 following completion of fossil power plant contract. Power plant's emission will be null in 2060.
4. In 2060, Emission in the demand side is projected around 401 million ton CO₂-e.



DEVELOPMENT PLAN ACCORDING TO RUPTL 2021-2030

“Greener RUPTL as a Foundation for Achieving Zero Carbon 2060”

- 20.9 GW (51.6%) NRE Capacity to Meet the 23% NRE Target in 2025 and the NDC Target in 2030
- NRE development is undertaken in all electrical systems in accordance with the power balance

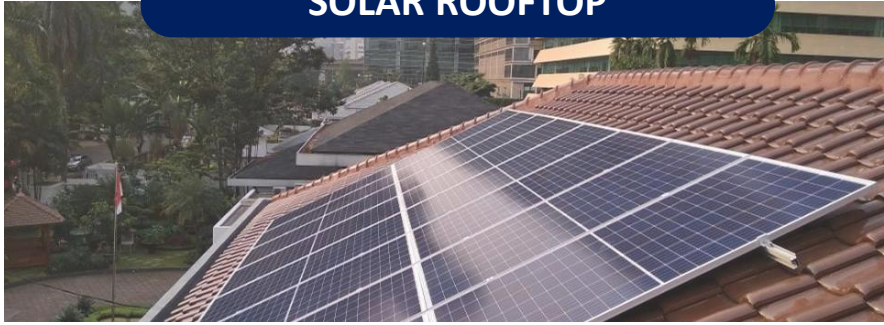


- Supervise the implementation of the project on a regular basis to ensure that the COD can be achieved as planned.
- Carry out monitoring and inter-ministerial consultation on a regular basis to de-bottleneck the problems faced by developers.
- Facilitate the preparation of FS and grid Studies with financing from foreign aid to accelerate the feasibility of the EBT Power Plant project.

SOLAR POWER PLANT DEVELOPMENT

Solar energy is the most abundant NRE potential, its costs continue to decline, and rapid deployment makes solar power generation a priority

SOLAR ROOFTOP



2025 Target: 3.61 GW

Reduce GHG emission 5.4 million ton CO₂

- Government Building (37.35 MW)
- Social group and PLN Customer (16.65 MW)
- Business (728.68 MW)
- Industry (1,307.10 MW)
- Household (1.525 MW)

Installed Capacity by September 2021: 39.28 MWp (4,262 customers), among them:

- Coca Cola Solar Rooftop at Cikarang 7.2 MWp (the largest in ASEAN)
- Danone Aqua Solar Rooftop at Klaten 3 MWp

Regulation:

MEMR Regulation No. 49/2018 jo. MEMR Regulation No. 13/2019 jo. MEMR Regulation No. 16/2019
Coordinating Ministry of Economy Regulation 7/2021 about Revision of National Strategic Program List

LARGE SCALE SOLAR PP

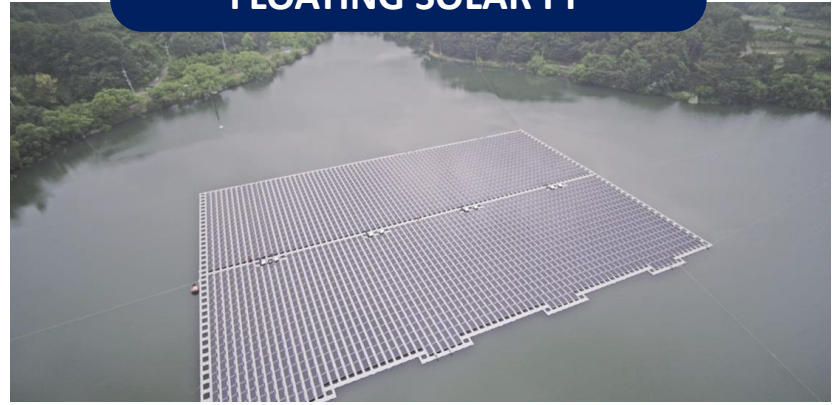


2030 Target: 4.68 GW

- Jamali (2,906.06 MW)
- Sumatera (192.82 MW)
- Kalimantan (303.71 MW)
- Sulawesi (175.79 MW)
- MPNT (1,101.04 MW)

GHG Emission Reduction: 6.97 million ton CO₂e

FLOATING SOLAR PP



Potential : 26.65 GW (271 locations)
Potential at Existing Hydro PP: 11,913 MW (28 locations)

- Jawa Bali (1,783.4 MW) -13 locations
- Sumatera (7,143.1 MW) – 3 locations
- Kalimantan (26.7 MW) – 1 locations
- Sulawesi (2,920.6 MW) – 6 locations
- Maluku – Papua – Nusa Tenggara (39.4 MW) - 5 locations

GHG Emission Reduction: 39.68 million ton CO₂e

FOSSIL PRIMARY ENERGY CONVERSION

De-dieselization program was launched in November, 2020



Map of Diesel PP Conversion to NRE PP, Phase-1 (200 Locations)

1

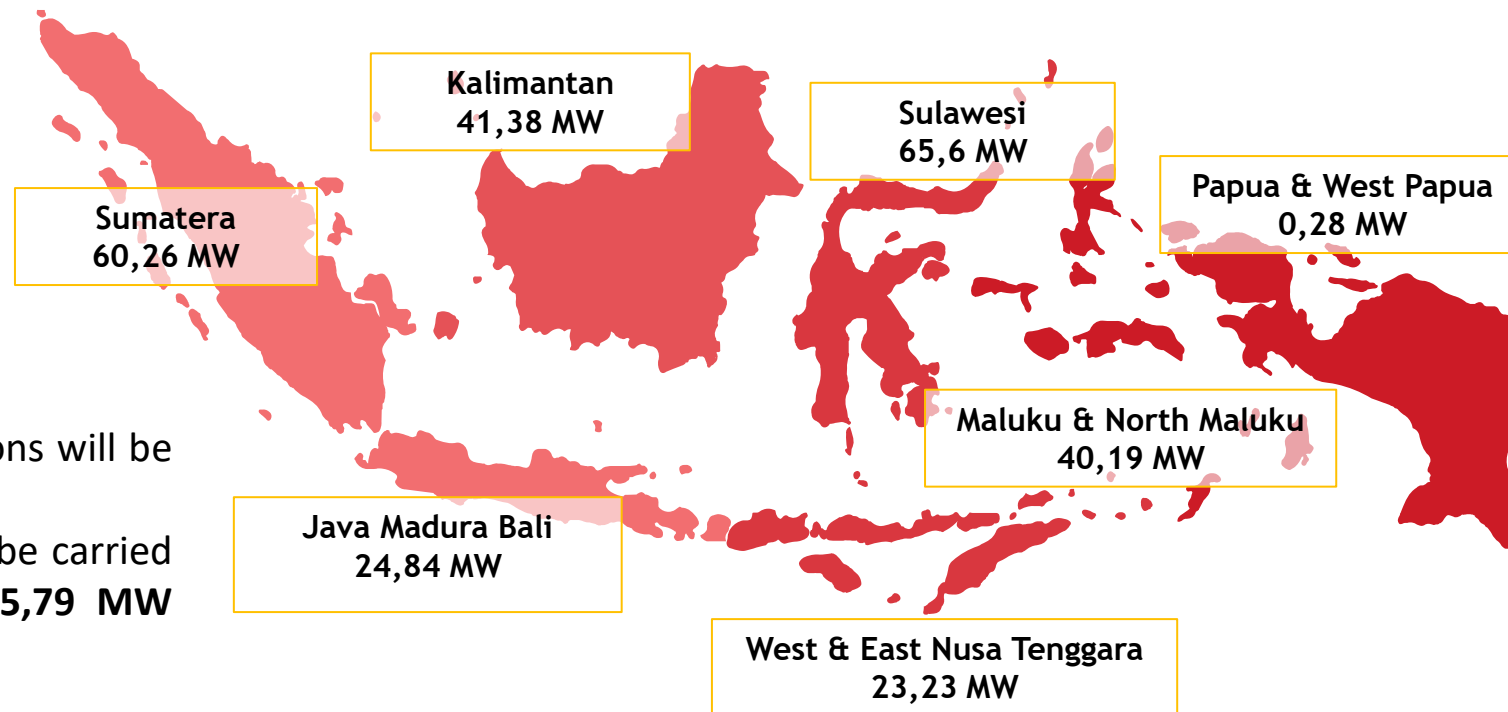
Criteria of diesel conversion:

- Isolated area (offgrid)
- Machine age > 15 years
- Average SFC 0.359 lt/kWh
- Operating hours < 24 hours

2

Around 5.200 units of Diesel PP in 2.130 locations will be converted gradually through:

- Conversion to NRE PP of 499 MW that will be carried out through several phases. **Phase-1 : 255,79 MW distributed in 200 locations.**
- Connection to grid
- Gasification program



ROADMAP TOWARDS NET ZERO EMISSION

Vision toward 100% NRE by 2060

2021: Pres. Reg. on NRE, Pres. Reg on *Coal Retirement, Steam PP co-firing*, CCT, Diesel to gas & NRE conversion

2022: Law on NRE, electric stoves 2 million households/annum

2024: Interconnection, *smart grid & smart meter*

2025: NRE 23% dominated by Solar PP

- Electrification Ratio 100%
- Electricity Demand 1,217 kWh/capita
- Pumped Storage start COD
- Emission reduction 198 million ton CO₂

2031: First Stage Retirement for sub-critical CFPP, inter island interconnection start COD

- No more Diesel PP
- Start hydrogen use for electricity
- Increase Battery Usage

2035: NRE 57% is dominated by Solar PP, hydro, geothermal energy

- Electricity Demand 2,085 kWh/capita
- Emission reduction 475 million ton CO₂

2048: Large Scale Ocean Current PP start COD

2049: First Nuclear PP starts COD

2050: NRE 93% is dominated by Solar, Hydro, and Bioenergy

- Reduce sales of conventional cars
- Electricity Demand 4,299 kWh/capita
- Emission reduction 956 million ton CO₂

2021-2025

2031-2035

2041-2050

2026-2030

2027: Gradual reduction of imported LPG

2030: NRE 26.5% is dominated by Hydro, Geothermal Energy and Solar PP

- No new fossil PP after 2030
- EV 2 million of four-wheelers and 13 million of two-wheelers
- City gas for 10 million houses,
- The utilization of DME
- Electricity Demand 1,548 kWh/capita
- Emission reduction 314 million ton CO₂

2036-2040

2036: Second Stage Retirement sub-critical, critical, & partly super critical CFPP

2040: NRE 66%, dominated by Solar, Hydro & Bioenergy

- Reduce sales of conventional motorcycles
- LED Lamps 70%
- Electricity Demand 2,847 kWh/capita
- Emission reduction 796 million ton CO₂

2051-2060

2051: Massive Utilization of Hydrogen

2054: Gas Fired PP cap. <1GW

2057: Coal Fired PP cap. <1GW

2060: NRE 100%, is dominated by Solar PP, hydro, and wind

- All two-wheelers are electric-based
- Electric stoves 52 million households,
- City gas for 23 million SR
- Electricity Demand 5,308 kWh/capita
- Emission reduction 1,526 million ton CO₂

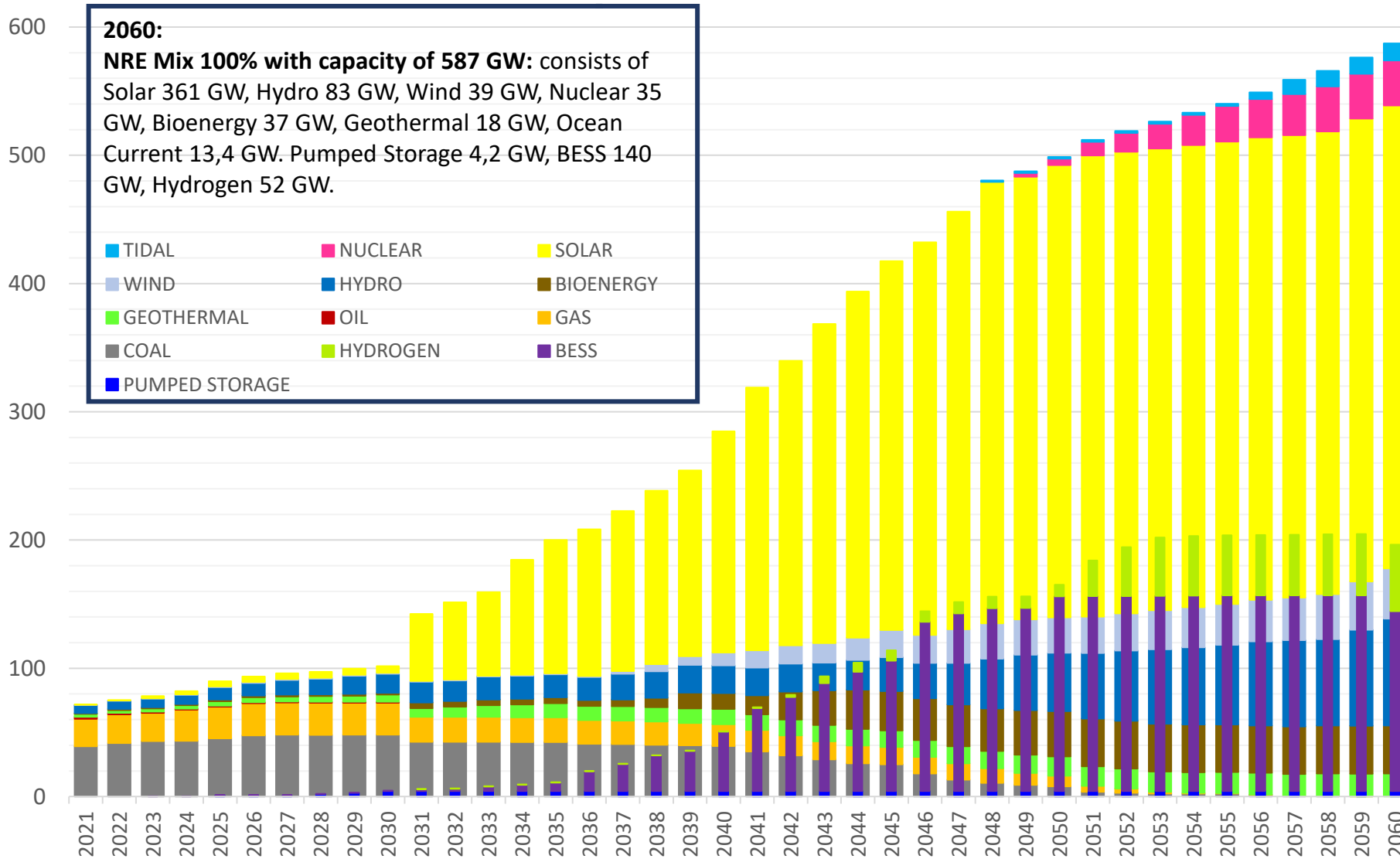
NZE



ELECTRICITY SUPPLY PLAN

VRE as the backbone, with PV's domination

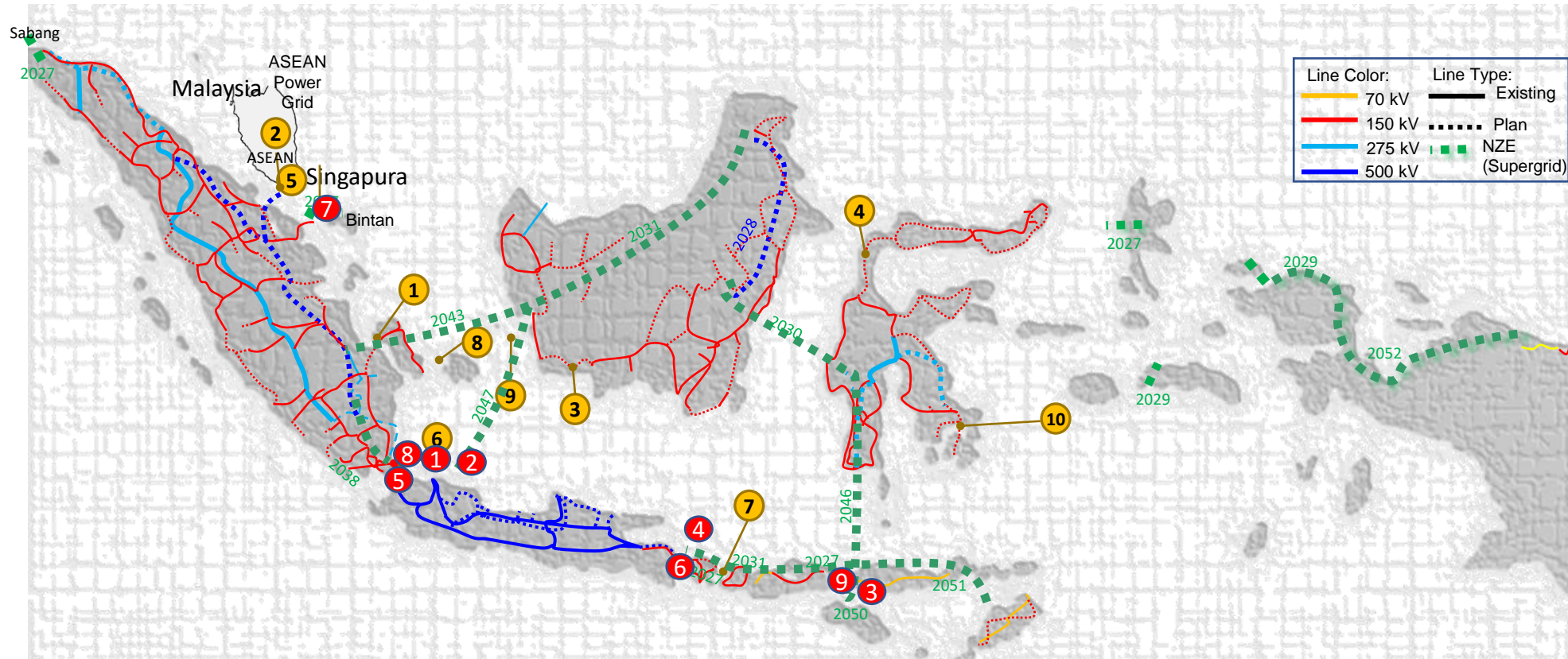
Capacity : Giga Watt



- Coal/Gas PP:** No additional CFPP unless contracted/under construction. PLN CFPP will be retired earlier than asset revaluation. IPP CFPP retired after PPA ends. Gas PP retired after 30 years (residual < 1 GW, CFPP: 2057, Gas PP: 2054)
- NRE:** Additional power plant after 2030 will only come from NRE. Starting from 2035, will be dominated by Variable Renewable Energy (VRE) in form of Solar PP, followed by Wind PP and Ocean Current PP in the following year.
- Geothermal PP:** Maximized up to 75% of potential.
- Hydro PP:** Will be maximized and sent to load center in other islands. Serves to balance VRE power plants.
- STORAGE:** Pumped storage start in 2025, Battery Energy Storage System (BESS) massively used in 2021. Hydrogen will be utilized gradually starting from 2031 and massively by 2051.
- Nuclear PP:** Enter system in 2049 to maintain system reliability and will reach 35 GW by 2060.

SUPER GRID AND SMART GRID TECHNOLOGY

The Key to Enhance NRE Penetration



- PLN Smart Grid Pilot Project**
- Two-ways Communication (Jakarta)
 - Smart Community (Karawang, Jawa Barat)
 - Smart Microgrid (Sumba, NTT)
 - Two-ways Communication (Denpasar, Bali)
 - Two-ways Communication (Tangerang, Banten)
 - Two-ways Communication (Nusa Lembongan, Bali)
 - Advanced Metering Infrastructure (Batam)
 - Advanced Metering Infrastructure (Cengkareng-Jakarta)
 - Smart Microgrid-Automatic Dispatch System (Sumba, NTT)

- A. Already included in the RUPTL project list:**
- 150 kV Sumatera-Bangka Interconnection (2022);
 - 500 kV Sumatera-Malaysia Interconnection (2030), supporting cooperation framework of ASEAN Power Grid;
 - 150 kV Kalimantan Interconnection (2023);
 - 150 kV Sulbagut-Sulbagsel Interconnection (Tambu-Bangkir COD 2024).

- B. Still in narrative and need further study:**
- Sumatera-Singapura Interconnection (included Sumatera-Bintan Interconnection), supporting cooperation framework of ASEAN Power Grid, needs further study;
 - 500 kV Sumatera-Jawa Interconnection (needs further study considering supply and demand);
 - 150 kV Bali-Lombok Interconnection (needs further study to support Jawa-Nusa Tenggara Interconnection Plan);

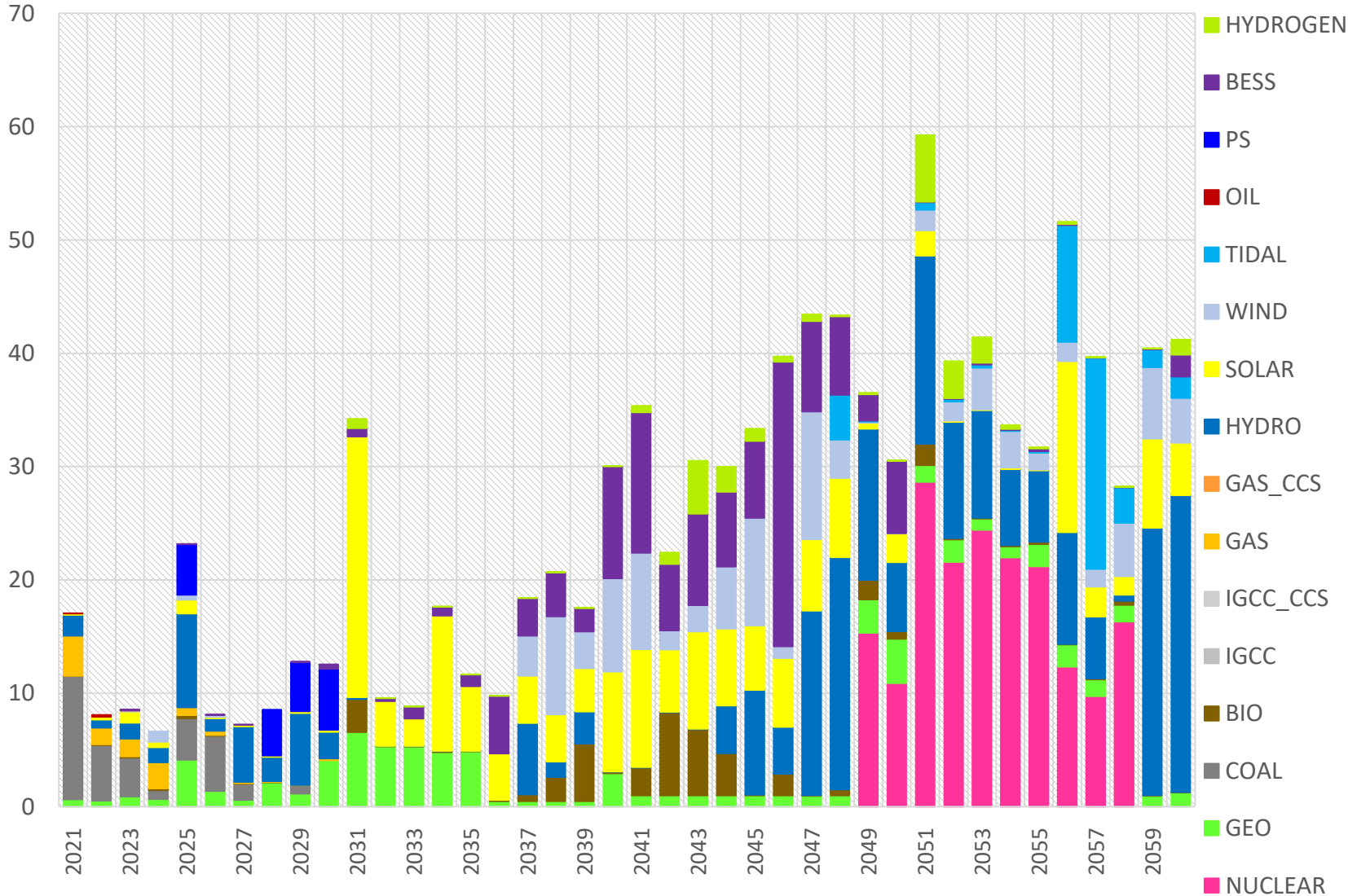
- 150 kV Bangka-Belitung Interconnection (needs further study to support Sumatera-Kalimantan Interconnection Plan);
- Belitung-Kalimantan Interconnection (needs further study as a part of Supergrid Nusantara Program);
- 150 kV Baubau-Sulbagsel Interconnection (needs further study to support reliability in Bau-Bau).

Note: Supergrid will be started after 2025


INVESTMENT REQUIREMENT FOR ELECTRICITY GENERATION

Huge investment opportunity with 70% of the amount needed for hydro, nuclear, solar PV, BESS

USD Billion



ENERGY TYPE	INVESTMENT (MILLION USD)	CAPACITY (GW)
HYDRO	230,040	74.9
NUCLEAR	182,503	35.0
SOLAR	169,703	464.8
BESS	119,828	174.9
WIND	98,719	39.8
GEO THERMAL	77,088	15.9
TIDAL	40,936	13.4
BIO	39,209	38.2
COAL	30,700	15.2
HYDROGEN	25,233	52.3
PUMP STORAGE	18,244	4.2
GAS	10,351	10.2
OIL	213	0.2
TOTAL	1,042,768	707.7 *

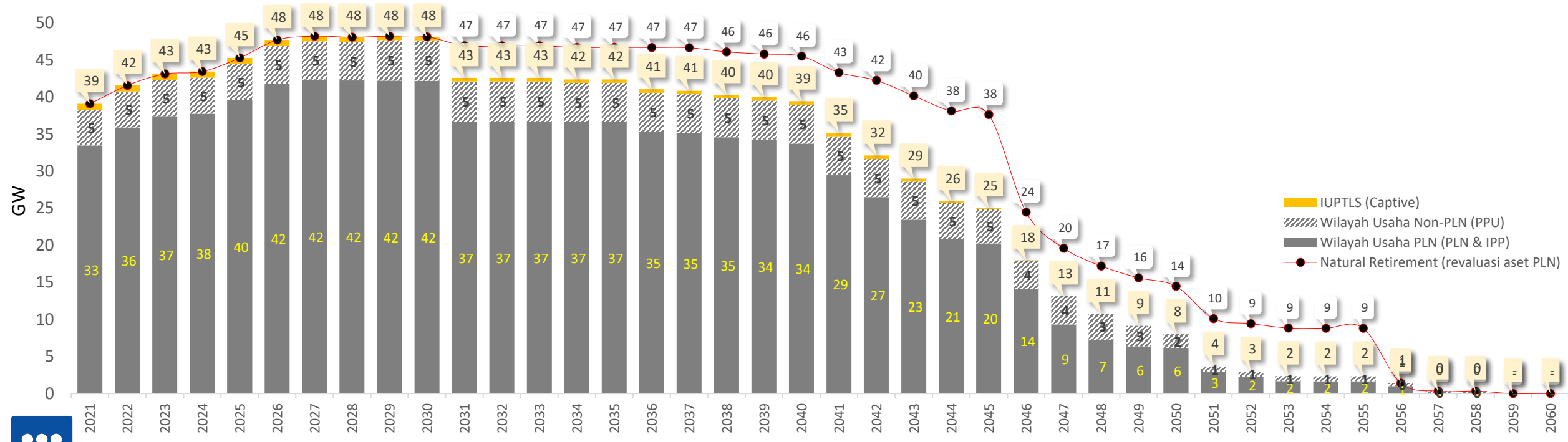


Total Investment Needed:
1,043 billion USD
25 billion USD /year

* Only for power plants, does not include storage

COAL FIRED POWER PLANT (CFPP) EARLY RETIREMENT SCENARIO

CFPP will be replaced by NRE Power Plants

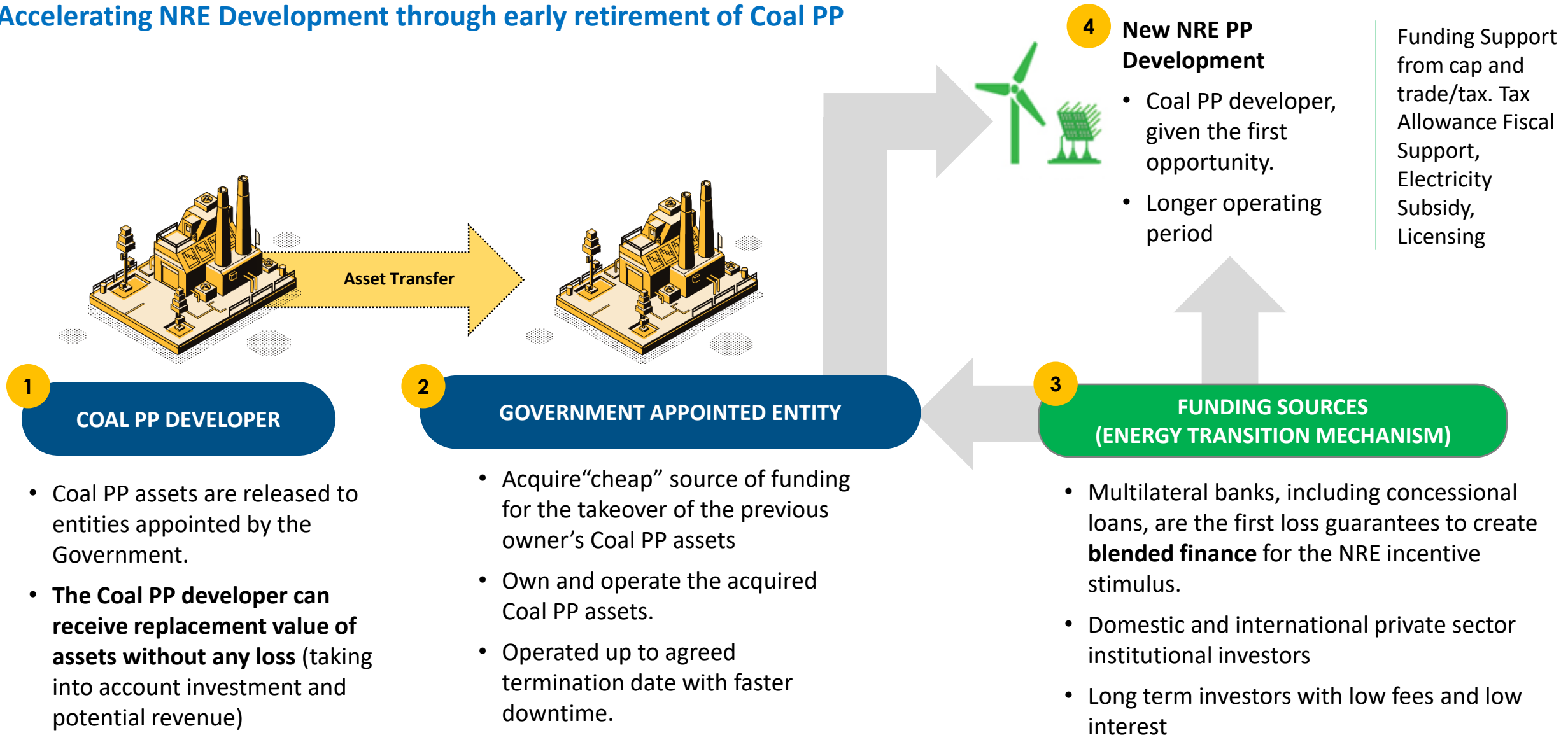


1. Coal PP Capacity includes existing and on-going Coal PP in all business areas (PLN and non PLN);
2. The increase of Steam PP capacity up to 2026 is from on-going projects;
3. Phasing out of Coal PP will contribute to reduce emission in power generation sector.
4. PLN's Coal PP age : max 30 years, IPP's : 25-30 years (based on PPA).
5. Phasing out schemes will impact on PLN's financial of 38 billion USD, based on re-evaluation of PLN's asset in the end of 2015 (the age of PLN's Coal PP was extended to 30-40 years). Therefore, the natural retirement of the PLN's Coal PP will occur in 2046-2056.

6. Preparation of Coal PP Phasing Out :
 - ✓ A legal basis is needed to enable entities in implementing the program continuously;
 - ✓ Needs further study of Phasing Out of PLN's Coal PP before 2030 due to re-evaluation of PLN's asset;
 - ✓ IPP's Coal PP will be only operated up to the expiration of PPA and not extended;
 - ✓ Phasing out also applies to Coal PP in non PLN business area and IO PP;
 - ✓ No more new Coal PP unless has been contracted or constructed; and
 - ✓ Coal PP licensing in OSS system needs to be restricted.

ENERGY TRANSITION MECHANISM-ETM

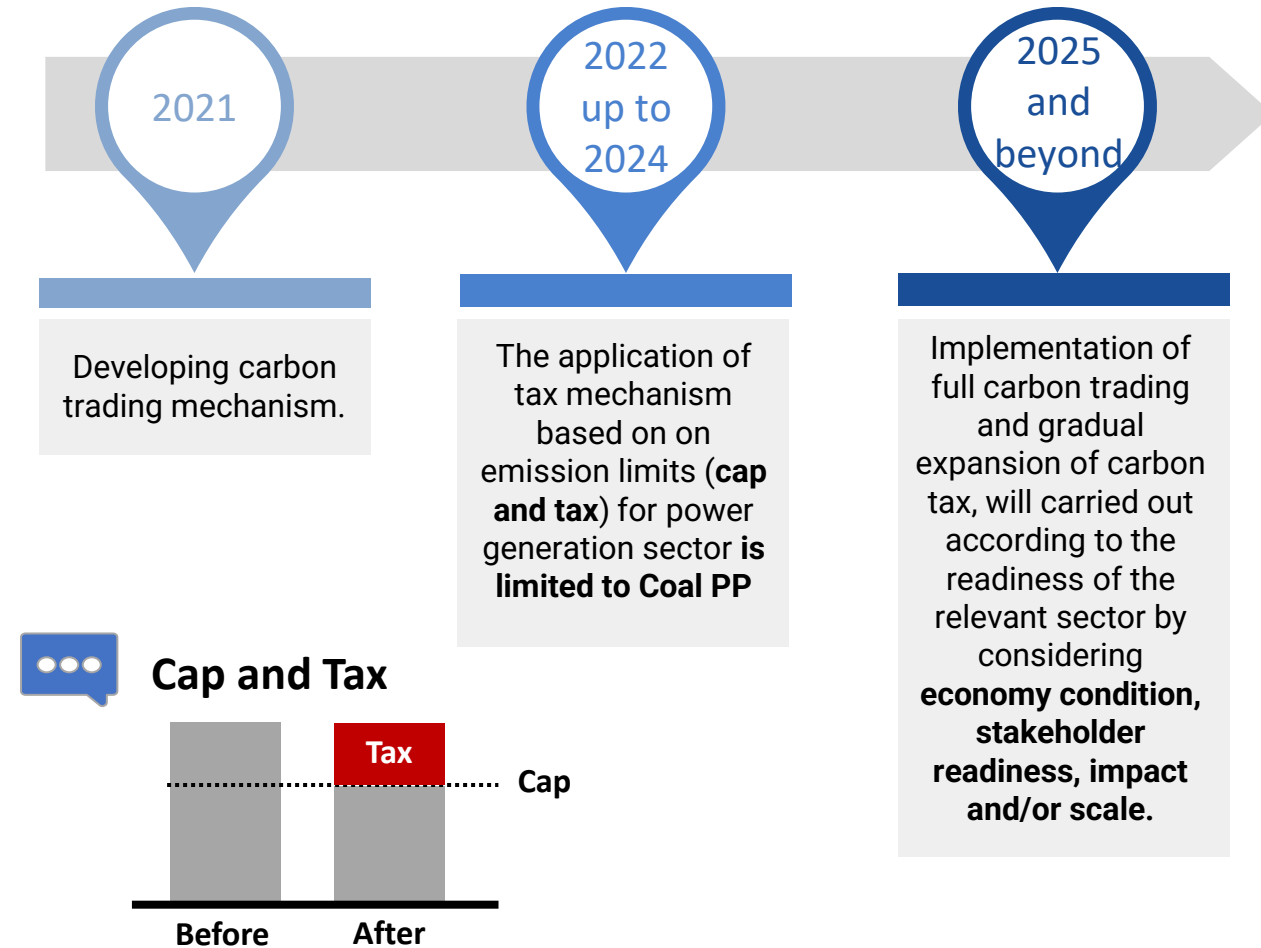
Accelerating NRE Development through early retirement of Coal PP



CARBON TAX – regulated by Law No. 7 of 2021

- 01** A carbon tax is imposed on carbon emissions that have a **negative impact on the environment**.
- 02** The imposition of a carbon tax is carried out regarding **the carbon tax roadmap** set by the Government and/or **the carbon market roadmap**.
- 03** The subject of the carbon tax is an **individual or entity** that buys goods that contain carbon and/or carries out activities that produce carbon emissions.
- 04** The carbon tax rate is set higher/equal to the carbon price in the carbon market or a minimum of IDR 30.00 per kg CO₂e.
- 05** Effective April 1, 2022 in **the coal power plant sector** with a **cap & tax scheme**.

Implementation of Carbon Tax Imposition



LONG-TERM STRATEGY ON ENERGY SECTOR: Towards Net Zero Emission – Demand Side *

Residential Sector



- 1 Stop importing LPG before 2030, exactly by 2027.
- 2 LPG production is from new refinery /RDMP and Rich Gas.
- 3 Electric stove penetration/average induction 1,4 million households/year), 2022-2040 ± 2 million households/year, 2060 is for 58 million household.
- 4 City gas: additional up to 2030 for 10 million SR, and the total by 2060 will be 23 million SR.
- 5 **Energy Efficiency Level** for equipment is predicted to reduce 12% of energy consumption up to 2030, based on Minimum Energy Performance Standard (MEPS) Roadmap of MEMR.

Industrial Sector



- 1 Increasing electricity share from 30% in 2020 to 33% by 2060.
- 2 Reducing coal share from 35% in 2020 to 12% by 2060.
- 3 Increasing gas share from 26% in 2020 to 48% by 2060.
- 4 **Efficiency level for electricity and thermal** in industry is projected to increase within the range of 0,4-0,8 by 2060, depending on its industrial type and process.

Transportation Sector



- 1 Stop importing Oil Fuels (other than Avtur) starting by 2030.
- 2 Biodiesel utilization is maintained for 30%.
- 3 The target for electric two-wheelers is 13 million by 2030, and 100% sales by 2040.
- 4 Electric two-wheelers for 2 million by 2030, and 100% sales by 2050.
- 5 Electric bus for 6 million by 2030 and 80% sales by 2060.
- 6 **Electric vehicle efficiency level** particularly electric two-wheelers and electric four-wheelers is on average 80-85% higher than Internal Combustion Engine (ICE) vehicles, based on DGNREEC internal study in 2020.

**) Imported LPG will significantly decrease based on Grand Strategy on Energy (GSEN) and could save USD 4 Billion/year during the period of 2021-2040

(Source: Draft GSEN-MEMR)

Description:

*) long-term modelling simulation on energy is on process

**) The decrease of imported Oil Fuels could save USD 8,8 Billion/year within the period of 2021-2040 from KBLBB, BBG, Biofuel program excluding the increase of refinery capacity.

(Source: Draft GSEN-MEMR)

1

The efforts to address the climate change in Indonesia are represented by the directives of the President to **encourage energy transition towards clean energy and green economy**. The directives are then translated into **three term targets: 23% NRE in energy mix in 2025, 29% emission reduction in 2030, and net zero emission in 2060**.

2

The focus of energy transition are illustrated on a **road map that mandates massive renewable energy development**, and reduction of carbon emissions through **reduction of fossil energy consumption**.

3

The transition to net zero emission requires **energy infrastructure, technology, and financing**. With improved infrastructure such as grid interconnections, **Indonesia will have the opportunity to optimize the utilization of new, renewable energy to reach NRE 100% in 2060**.



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