**INDONESIA ASSUMPTIONS**

## Energy Policy Context and Recent Developments

**Paris Agreement**

Indonesia submitted its First NDC in November 2016, stipulating an unconditional target of 29% and a conditional target of up to 41% compared to the business as usual (BAU) scenario in 2030. Updated NDC came on 22 July 2021, which includes the adoption of the Katowice Package, mentioning Indonesia's strategy to achieve the 2030 emission reduction target. This updated NDC is also equipped with Long Term Strategy for Low Carbon and Climate Resilience 2050.

On 23 September 2022, the emission reduction target was revised again by Enhanced NDC, where the unconditional Emission Reduction target in 2030 became 31.89% compared to 29% in 1st NDC, while the Emission Reduction target subject to international support became 43.20% in 2030 compared to 41% in the 1st NDC.

In addition, during COP26 in 2021, the Ministry of EMR stipulated the Net Zero Emission target in 2060. In this scenario, the energy sector (power generation, industry, and transportation) will still emit 129 million tons of CO2 equivalent, but it will be sunk by the FOLU sector.

**POLICIES**

* [**Indonesia Golden Target 2045**](https://perpustakaan.bappenas.go.id/e-library/file_upload/koleksi/migrasi-data-publikasi/file/Policy_Paper/Ringkasan%20Eksekutif%20Visi%20Indonesia%202045_Final.pdf)

Indonesia is upgrading from Middle-Income Country to High-Income Country in 2045, with GDP per capita of USD 23,199.

* **National Energy Policy (Government Regulation Number 79/2014)**

Stipulated the target of Energy Mix 2025: NRE 23%, Oil 25%, Coal minimum 305, and Gas Minimum 22%.

* **Net Zero Emission target in 2060, During COP26 in 2021,**

Ministry of EMR stipulated the Net Zero Emission target in 2060. In this scenario, the energy sector (power generation, industry, and transportation) will still emit 129 million tons of CO2 equivalent, but it will be sunk by the FOLU sector

* **Enhanced NDC, September 2022,**

Unconditional Emission Reduction target in 2030 became 31.89% compared to 29% in 1st NDC, while the Emission Reduction target subject to international support became 43.20% in 2030 compared to 41% in the 1st NDC

* **Long Term Strategy for Low Carbon and Climate Resilience LTS – LCCR 2050**
* **National Energy General Plan 2017 (Government Regulation Number 22/2017)**

As the implementation of the National Energy Policy (Government Regulation 79/2014), the National Energy Plant emphasizes the target of New and Renewable Energy in 2025 to be 23% of the National Energy Mix. It also stipulated a 1% reduction in energy intensity.

* **Middle-Term Development Plan 2020-2024**

In 2024, it targets electricity consumption per capita of 1400 kWh, 4 million connections of city gas, 2 units of the Grass Root Refinery project, and 4 Refinery Redevelopment Master Plan.

* **Presidential Regulation Number 112 year 2022**

Acceleration of Renewable Energy power plant development to support the energy mix target and the Green House Gas Emission by:

1. Restriction of New CFPP development except the ones integrated with the industrial site;
2. Urging the National Utility Company (PLN) to conduct CFPP early retirement.

**EMISSION TARGET**

[Indonesia Enhanced NDC 2030 document](https://unfccc.int/sites/default/files/NDC/2022-09/23.09.2022_Enhanced%20NDC%20Indonesia.pdf) with detailed emission target has been submitted to UNFCC in 2022. As Government of Indonesia has also the commitment reaching NZE 2060, the emission target has been propagated onto 2060 as follow:

|  |  |
| --- | --- |
| **Energy Subsector** | **Emission Target in 2060 (MTon CO2)** |
| Power Generation | 0 |
| Industry | 60 |
| Transportation | 52 |
| Household/buildings and others | 17 |
| TOTAL | 129 |

## SCENARIOS DESCRIPTION

## The Reference Scenario

The REF scenario for Indonesia follows historical trends of supply and demand. Energy efficiency and fuel economy standards continue to improve gradually. Electrification and fuel switching away from coal and other emission reduction programs shall be considered only if there is a strong and convincing contract or agreement between entities or detailed and bonding regulation from the government. Some regulations or planning documents that are too ambitious shall not be considered. Critical policies that seem loosely to change if the government regime changes also shall not be considered.

Fossil fuels, coal, and gas will remain the dominant fuels. Some significant renewables will appear, such as biofuel and biomass.

## The Target Scenario

The target scenario represents the idealistic realization of Net Zero Emission 2060, even if there is no detailed contract between entities or strong bonding regulation from the Government body. Energy intensity decreases at 1% per year. The transition from ICE to EV, electrification program, or any other energy conversion program in the community and industry was smoothly conducted.

After 2060, the power sector is going to be fully renewable. Oil import is no longer continued. Passenger cars and motorbikes will be 100% electric, while trucks and buses will be hydrogen-fueled.

Big islands in Indonesia will be connected with an interconnection grid, making the previously separated system widely interconnected where power transfer can smoothly happen.

**Population**

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The UNDESA Model “UPPER 80 PI” scenario looks similar to Proyeksi Penduduk Indonesia by BPS, Moderat Scenario (in 2050, it will reach 333 million people).

|  |  |  |
| --- | --- | --- |
|  | **Reference** | **Target** |
| **Macro** | * Population: UNDESA “High” * GDP: APERC macro model | |
| **Agriculture** | * Energy Efficiency and Energy Transition trend in agriculture sector continues | * Continuation of Gas Conversion Program for Farmers and Fishermen after 2024 * Producing bioethanol from sugar cane field |
| **Buildings** | * Energy efficiency trends and fuel switching trends continue * Natural gas remains available for heating (and cooking), but market share declines as induction stoves gain market share * City gas trends continue. 2.4 million households in 2024 will be connected to city gas and replace the previous utilization of LPG, and the next City Gas Development plan will be fully executed * Minimum development of Solar PV Rooftop | * Homecharging for the Electric Vehicle (minimum home charging capacity for EV user is 7.7 kVA subscription) * EV Charging stations will grow in fuel stations, Shopping Mall Parking lots, Office buildings, Apartment Building Parking Spaces, etc. In 2030, 4-wheeler EV Charging Stations were 48.118 units, and 2-wheeler Battery Swapping Stations were 196.179 units. * Rooftop Solar PV regulation for office and commercial buildings and housings. In 2025, it will reach 3,610 MW * Induction Cooker is used by 8.1 household (2025), 18.1 million HH (2030), 54.3 million HH (2060) * City Gas Network for 5.2 million HH (2025), 15.2 million HH (2030), 22.7 million HH (2060) * Implementation of MEPS. In 2030, it will save energy up to 8% or around 98,632 GWh, reducing GHG emissions of as much as 83.8 Million tons of CO2 |
| **Industry** | * Energy efficiency and fuel-switching trends continue * Strong industry will remain using autogenerators (not grid-connected) utilizing coal as fuel. * Small amount of hydrogen for steel and chemicals sectors starting in 2035 and increasing through 2060 | * Industry sector that will grow significantly: Nickel and other mineral mining (bauxite, etc.) and also the smelting process chain, Palm oil, and its affiliated products * The target of energy intensity decline is 1% per year from 2015 to 2050 (National Energy Policy, 2014). * Implementation of Energy Conservation Management (Presidential Regulation No. 33 the Year 2023), which oblige the Energy provider to> 6000 ton of oil equivalent per year, Energy user/consumer > 4000 ton of oil equivalent per year, and building consume> 500 ton oil equal per year, to conduct Energy Conservation Management. By doing energy conservation, the energy saving target in 2050 is 407.6 MTOE or 38.9% from BaU. * In the Java-Bali system, more auto generator owners will move to become utility customers as many benefits are offered due to the current oversupply condition. * Green Hydrogen Development starting in 2031. Green Hydrogen will replace natural gas for high-temperature heating processes starting in 2041 * Biofuel in the industrial and transportation sector reach 40% in 2025 * CCS for cement and steel industries starting from 2036 * Utilization of CCS in industries up to 13 million tons of CO2 |
| **Transport** | * Automotive continues historical sales trends | * EV target in 2030 is 2.2 million 4-wheelers (8% of car stocks) and 13.47 million 2-wheelers in 2030 (20% of the motorbike stocks). In 2060, the target is 65 million 4-wheelers (90% of car stocks) and 175 million 2-wheelers (80% of the stocks). There is no specific target for EV Bus and EV Truck because they will be concentrated on biofuel utilization. * The energy sector (Transport, industry, and power) is expected to reduce emissions to 1300 tons of CO2 equivalent by 2030 (358 million tons of CO2 reduction from BaU) and 129 tons of CO2 in 2060. From the total 358 million tons of CO2 reduction target in 2030, the transportation sector is expected to contribute as much as 72.2 million tons of CO2 equivalent emission reduction. * In 2060, the emission target for the transportation sector shall be 52 tons of CO2 eq. * Commercial hydrogen utilization in the transportation sector will start in 2031. By 2060, ammonia and hydrogen cover half of domestic shipping fuel demand, and hydrogen accounts for 7% of road transport, particularly for trucks. * Biodiesel blending for industrial and transportation starting from 2026 will be 40% of the mix and shall be maintained at a minimum in that level until 2060. Bioavtur blend is going to be 2% in 2024, and in 2035 it will be 10%. |
| **Power and heat** | * Power plant development and technology choice are based on the least cost principle. * The Interconnection of Java – Bali, Sumatera, Kalimantan, and Sulawesi power systems is based on the least cost principle. * PLN Development Planning 2021-2030 is implemented with significant delay. | * Additional CFPP can only be built if integrated with an industrial resort, and its operation has to stop in 2050. * In 2025, the primary energy supply will be 23% from new and renewable energy, 55% from coal, 22% from gas, and 0.4% from oil. * The peak CO2 emission shall be between 2035 and 2045. * Net Zero Emission target in 2060 (Power Generation should be net zero emission in 2060). * Nuclear utilization for power generation starts in 2039. * Export to Singapore Solar PV in Small islands around Batam Island as many as 2 GW * Continuing import from SESCO Sarawak * PLN, as the leading electricity player in Indonesia (owning 83% of installed power generation capacity), has issued its development planning for 2021-2030, which is assumed to be fully executed. * Interconnection of Java – Sumatera – Kalimantan – Sulawesi power system. * Early retirement of CFPP starts in 2030 |
| **Hydrogen Supply** | * Hydrogen just used in the petrochemical industry | * Commercial hydrogen utilization in 2031 in the transportation sector and 2041 in the industry sector; * After 2060, all CCGT will use hydrogen fuel; otherwise wise be equipped with CCUS * Hydrogen demand for the Transport sector will be 800 Petajoule in 2060, and the corresponding supply capacity will be around 7 million tonnes of H2 equivalent; * After 2060, all CCGT shall use hydrogen fuel; otherwise, they shall be equipped with CCUS; * In coal plants without CCUS, co‐firing with ammonia picks up quickly around 2040, with blending rates rising to nearly 60% ammonia by volume in 2050 and nearing 100% by 2060 in the APS. For natural gas‐fired power plants without CCUS, co‐firing with hydrogen reaches over one‐third of hydrogen by volume in 2050 and nearly 80% by 2060 in the APS; * Green Hydrogen is not going to be used as an energy carrier but instead will used to generate electricity and then transmitted via HVDC/HVAC transmission line; * By 2060, in the APS, ammonia and hydrogen will cover half of domestic shipping fuel demand, and hydrogen will account for 7% of road transport, particularly for trucks. |
| **Refining** | * Pertamina currently has 6 (six) operating RU, Dumai, Plajum Cilacap, Balongan, Kasim, and Balikpapan. | * Fully completion of the Pertamina Refinery Development Plan and Grass Root Refinery Plan * Refinery facility accommodates biofuel, which also includes Sustainable Aviation Fuel |
| **Fossil Fuel Supply** | * Coal is main input of electricity. Seeing the trends from 2010-2021 * Gas is also increasing as export banning is continued * Oil follows historical trends | * In 2030, target lifting is 1 mbopd and 12 billion cubic feet per day * Oil demand 2050 will increase by 2505 to 3.97 bopd (RUEN), while gas demand will still be lower than production. Therefore, the revitalization of refinery units and the major development of new oil reserves are crucial. |
| **Climate** | * NDC pathway not modeled. * Net-zero energy sector not realized by 2060 | * NDC and Long-term Strategy used as guidelines * Net-zero electricity sector achieved in 2060 |

**SUPPLY**

1. **Oil Supply**

Current oil production lifting is between 600-800 MBOEPD. Government is targeting for 1000 MBOEPD lifting in 2030.

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Oil Lifting 2015-2023 (<https://www.skkmigas.go.id/>)

Oil reserve status:

* Oil Proven Reserve is 4.17 Billion Barrel of crude oil (Status July 2023)
* Current number of basins is 128 units, which comprised of 20 producing basins, 8 drilled basins but not yet producing, 19 hydrocarbon indicated basins, 13 drilled but no discovery, and 68 undrilled basins.
* Onstream Project in 2023:
  + FOREL BRONANG, 10,000 bopd, 43 MMscfd, November 2023
  + SP JATIASRI, Pertamina EP, 2,900 bopd, 16 MMcfd, December 2023
  + SANGA-SANGA, Pertamina EP, 2,177 bopd, December 2023
  + YY, PHE ONWJ, 2,000 bopd, August 2023
* Next Upstream Oil strategic project is HIDAYAH Project, by Petronas Carigali Madura II Ltd., with capacity 25,726 BOPD which is on stream estimatedly Q1 2027

1. **Gas Supply**

Current production is around 6,600 MMSCFD, which is continuously depleting from the previous years.

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Gas Production 2015 -2023 (<https://www.skkmigas.go.id/>)

Total Gas Reserve in 2022 is 55 TSCF, but the proven reserves is on 36 TSCF. Gas Production target is 12 BSCFD in 2030. Calculation of gas reserves also changes since 2019. Thus, it is difficult to compare the trend of reserves in the last 10 years. The gas reserves trend in 2013-2022 can be seen in Figure below (from Indonesian Energy Outlook 2023):

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Future development of Indonesia Gas Resources is as below:

A map of the world

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By developing the gas resources, projection of Indonesia Gas Balance from 2023 to 2032 is as follow:

A graph of a company's profit

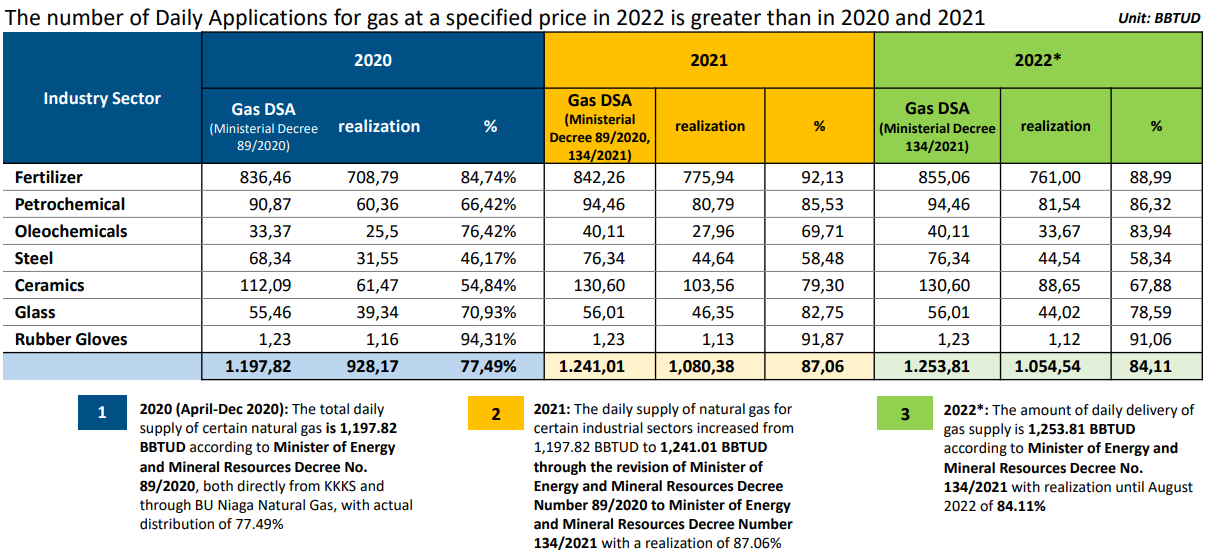
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While the utilization of gas currently is mostly for domestic use (68%) or 3,686 bbtud (2022). The policy to prioritize gas domestic utilization shall be continued in the coming years especially due to energy transition program.

A graph of gas prices

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Where the breakdown of the gas consumption for the industries is as follow:



Future gas downstreaming gas is as follow:

A map of the world

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1. **Coal Supply**

Verified Total Coal reserve based on [Indonesia Minerba Balance 2022](http://203.189.89.148/images/Publikasi/BukuNeraca/buku-neraca-latest.pdf) is 92,139.01 million tonnes, while production in 2022 is 687.43 million tonnes.

|  |  |  |
| --- | --- | --- |
| **Types of Coal** | **Resources Amount (million tonnes)** | **Verified Reserves**  **(million tonnes)** |
| Low Calorie (< 5,100 kal/gr) | 32,175.77 | 12,537.85 |
| Medium Calorie (5,100 – 6,100 kal/gr) | 49,038.34 | 18,488.24 |
| High Calorie (6,100-7,100 kal/gr) | 8,412.20 | 1,837.08 |
| Very High Calorie (>7,100 kal/gr) | 2,512.71 | 514.77 |
| **TOTAL** | **92,139.02** | **33,377.94** |

Projection of coal production to 2045 is as below (taken from the [Road Map Of Coal Development 2021-2045](https://www.minerba.esdm.go.id/upload/ebook/20220329144914.pdf)):

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From the total coal production, a significant portion is exported overseas (China, Japan, United States, etc). While domestically, current utilization of coal domestically is mainly for power generation. Until 2045, utilization of domestic coal is still for the power generation. However, coal is going to be co-fired with other type of fuel. Other option of coal utilization is the conversion of coal to other form of fuel or to equip the coal firing with clean coal technology to provide more eco-friendly coal utilization. List of coal conversion development program:

1. Methanol production and Dimethyl Eter
2. Production of Synthetic Natural Gas, Ammonia and Hydrogen
3. Upgraded Coal from Low Calorie to higher calorie
4. Clean Coal technology with CCS-CCUS utilization

**REFINERY**

New Oil refinery development program is launched to reduce dependency upon oil fuel import.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **No.** | **Refineries Facilities** | **Existing Capacity**  **(MBOEPD)** | **New Capacity**  **(MBOEPD)** | **Status** | **COD Target** |
| 1 | Dumai | 177 | TBA | **Pre FS, Bidding BEDP** | TBA |
| 2 | Musi | 127.3 | TBA | Planning | TBA |
| 3 | Cilacap | 348 | 370 | Negotiation | 2028 |
| 4 | Balikpapan | 260 | 360 | 82% (Sept 2023) | 2024 |
| 5 | Balongan | 125 | 150 | COD | 2022 |
| 6 | Tuban TPPI | 100 | 300 | Construction (7.89% per Oct 2023) | 2024 |
| 7 | Bontang | - | 300 | Project Negotiation | 2027 |
| 8 | Cepu | 3.8 | 3.8 | No Re-development | - |
| 9 | Kasim | 10 | 10 | No Re-development | - |
|  | **TOTAL** | **1,176.1** | **>1,800** |  |  |

**AGRICULTURE**

* Government will continue the conversion program of diesel engines to gas engines for farmers and fishermen. It is conducted by giving for free a number of Gas Converter Kit.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Year** | **2020** | **2021** | **2022** | **2023** |
| Number of Converter Kit for Fishermen | 25,000 | 28,000 | 30000 | 30000 |
| Number of Converter Kit for Farmers | 10,000 | 28,000 | 30,000 | 30,000 |

* Producing bioethanol from sugar cane field (Presidential Regulation No. 40/2023)
  + Intensification of sugar cane field to reach self-sufficiency production (No import) for household demand in 2028, no import for industry demand in 2030
  + Intensification of sugar cane field to enable productivity of sugar cane field up to 93 ton per hectare
  + Development of new sugar cane field as many as 700,000 hectares
  + Efficiency improvement of sugar cane refinery facility to reach 11.2% rendement
  + Bioethanol production from sugar cane field as many as 1,200,000 kL in 2030

**INDUSTRY**

* Road Map of National Industry development isstipulated in[*RIPIN 2015-2035*](https://www.kemenperin.go.id/ripin) *(Government Regulation Number 14 year 2015)*;
* Industry sector that will grow significantly: Nickel, iron steel, and other mineral mining (manganese, bauxite, etc.) and also the smelting process chain. List of the companies and their planned processing capacity can be found [here](https://www.minerba.esdm.go.id/upload/ebook/20220329144756.pdf).
* Target of NZE 2060:
  + Green Hydrogen Development starting in 2031. Green Hydrogen will replace natural gas for high-temperature heating processes starting in 2041
  + Biofuel in the industrial and transportation sector reach 40% in 2025
  + CCS for cement and steel industries starting from 2036
  + Utilization of CCS in industries up to 13 million tons of CO2 in 2060
* Government Policies On Energy Efficiency ([Government Regulation No, 33 Year 2023)](https://peraturan.bpk.go.id/Details/252083/pp-no-33-tahun-2023) will affect the industry efficiency significantly. Indonesia has started intensive effort to improve the energy efficiency since 2014. National Energy Policy 2014, has mandated reduction in the Energy intensity with target 1% reduction/year. National Energy Policy 2014 set up 1% per year reduction of energy intensity to 2050. Current achievement, average final energy intensity reduction from 2015-2021 is 1.5% per year or has declined 9.7% from baseline 2015.

The regulation is mandating energy efficiency management improvement that must be conducted by the industry. This energy management program comprises of the establishment of energy management structures and person in charge of energy efficiency improvement projects in the company, the existence of regular energy audit by independent body, and also utilization of high efficiency / eco-saving equipments, Implementation of MEPS for industrial equipment. Energy for industry is mostly used for electric motor. Minimum Energy Performance Standard (MEPS) for electric motor has not been established yet, and therefore there is still gap where energy intensity could be reduced.

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Target of Energy Intensity Reduction

Achievement of Energy Intensity Reduction

**BUILDING**

* Continuation of City gas development program, to replace Liquid Petroleum Gas (LPG) and Biomass. Current LPG import is average 6 million tonnes.
* Number of households that has city gas connections in 2022 is 871.000 households.
* Target of City gas connections are 22.7 million households in 2060.

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| --- | --- | --- | --- | --- | --- | --- |
| **Year** | **2025** | **2030** | **2035** | **2040** | **2050** | **2060** |
| City Gas | 5.2 | 10.2 | 15.2 | 20.2 | 22.7 | 22.7 |

* **Continuation of Rooftop PV**
* Government is planning 3.6 GW Rooftop PV in 2030
* However, this plan could not be accommodated by the utility due to the system absorption capability.
* In 2030, Utility can absorb 9,600 MW (Java-Bali), 480 MW (Sumatera), 340 MW (Sulawesi) and 750 MW (Kalimantan)
* **Continuation of Energy Conservation Program**
  + Implementing MEPS for household appliances. Currently MEPS has been regulated for refrigerator, rice cookers and fans and in 2025 becomes 11 appliances
  + Utilization of Induction cooker in households instead of biomass or LPG stoves.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Year | 2025 | 2030 | 2035 | 2040 | 2050 | 2060 |
| Induction Cooker | 8.1 | 18.1 | 28.2 | 37.9 | 46.6 | 54.3 |

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**HYDROGEN**

* Indonesia just commercially developed first green hydrogen power plant in 2023 by utilizing the energy from the natural gas-fueled CCGT Muara Karang combined with renewable energy from solar PV (413 kWp, equivalent to 718 MWh/year).
* Hydrogen production is considered green hydrogen due to the Renewable Energy Certificate (REC) obtained from Kamojang Geothermal Power Plant whose CO2 abatement equivalent to 2077 MWh/year.
* Future Development, the similar scheme will be implemented in several other CCGT power plant:

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **No.** | **Power Plant** | **H2 Capacity Production**  **(ton/year)** | **H2 Consumption**  **(ton/year)** | **H2 Excess**  **(ton/year)** | **Solar PV Used Existing**  **(kWp)** | **Solar PV Additional plan**  **(kWp)** |
| **1.** | CCGT Muara Karang | 32.45 | 7.8 | 24.65 | 413 | 2160 |
| **2.** | CCGT Muara Tawar | 7.48 | 2.00 | 5.48 | 8.2 | 480 |
| **3.** | CCGT Gresik | 11.97 | 4.00 | 7.97 | 10.0 | 840 |
| **4.** | CFPP Indramayu | 3.54 | 1.33 | 2.20 | 0.7 | 300 |
| **5.** | CFPP Rembang | 7.06 | 4.41 | 3.53 | None | 486 |
| **6.** | CFPP Tanjung Awar-Awar | 7.09 | 3.94 | 0.08 | 15.0 | 135 |
| **7.** | CFPP Paiton Unit 1-2 | TBD | TBD | TBD | 2.0 | TBD |
| **8.** | CFPP Paiton Unit 9 | 5.67 | 4.73 | 3.67 | 0.6 | 180 |
| **9.** | CFPP Pacitan | 7.06 | 4.41 | 1.94 | 6.9 | 165 |
|  | TOTAL | 82.30 |  | 49.51 |  |  |

* This green hydrogen plant development is intended to show the readiness of Indonesia to enter the hydrogen market. Currently, the Hydrogen Refueling station is under construction as the offtaker for the green hydrogen produced from the CCGT. Initial consumers of the hydrogen refueling station will be government cars.

**TRANSPORT**

* EV target in 2030 is 2.2 million 4-wheeler (8% of car stocks) and 13.47 million 2-wheeler in 2030 (20% of the motorbike stocks). In 2060 target is 65 million 4-wheeler (90% of car stocks) and 175 million 2-wheeler (80% of the stocks). There is no specific target for EV Bus and EV Truck, because they will be concentrated to biofuel utilization.
* Energy sector (Transport, industry and power) are expected to reduce emission to 1300 ton CO2 equivalent by 2030 (358 million ton CO2 reduction from BaU) and 129 Mton CO2 in 2060. From the total 358 million ton CO2 reduction target in 2030, transportation sector is expected to contribute as much as 72.2 million ton CO2 equivalent emission reduction.
* In 2060, emission target for transportation sector shall be 52 ton CO2 eq.
* Commercial hydrogen utilization at the transportation sector will start in 2031. By 2060, ammonia and hydrogen cover half of domestic shipping fuel demand and hydrogen accounts for 7% of road transport, particularly for trucks.
* Biodiesel blending for industrial and transportation start from 2026 will be 40% of the mix, and shall be maintained minimum in that level until 2060. Currently Indonesia is implementing Biodiesel B-35 blend and under trial of blending B40.
* Bioavtur blend is going to be 2% in 2024, and in 2035 it will be 10%. Current status of Bioavtur, Garuda Indonesia has successfully flew with Bioavtur 2.4% and is underway of certification for commercial purpose. In 2060, 55% emission reduction from aviation is targeted by the utilization of bioavtur.

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| **A screenshot of a computer  Description automatically generated** | |  |  |  | | --- | --- | --- | | Year | E-Car | E-Motorbike | | 2030 | 2.2 million | 13.47 million | | 2035 | 9.3 million | 51 million | | 2040 | 23 million | 101 million | | 2050 | 50.2 million | 163 million | | 2060 | 65 million | 175 million | |

**Road Map of Biofuel Implementation**

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Type of fuel** | **2023** | **2024** | **2025** | **2026** | **2027** | **2028** | **2029** | **2030** | **2031** | **2032** | **2033** | **2034** | **2035** |
| **Biodiesel** | **35%** | **35%** | **35%** | **40%** | **40%** | **40%** | **40%** | **40%** | **40%** | **40%** | **40%** | **40%** | **40%** |
| **Bioetanol (Non Public Transport)** | **5%** | **5%** | **5%** | **5%** | **5%** | **5%** | **10%** | **10%** | **10%** | **10%** | **10%** | **10%** | **10%** |
| **Diesel Biohydrocarbon (Non Public Transport)** | **-** | **5%** | **5%** | **5%** | **5%** | **10%** | **10%** | **10%** | **10%** | **10%** | **10%** | **10%** | **10%** |
| **Gasoline Biohydrocarbon (Non Public Transport)** | **-** | **-** | **5%** | **5%** | **5%** | **5%** | **5%** | **5%** | **5%** | **5%** | **5%** | **5%** | **10%** |
| **Bioavtur** | **-** | **2%** | **2%** | **2%** | **2%** | **2%** | **2%** | **5%** | **5%** | **5%** | **5%** | **5%** | **10%** |

**POWER**

* Indonesia consists of 6 (six) large power systems, plus many small island power systems:
  + Jamali (Covering Java, Bali and Madura Islands interconnections)
  + Sumatera (Sumatera and Bangka Island),
  + Kalimantan Interconnection System (Middle, South and East Kalimantan)
  + Equator System (West Kalimantan)
  + Sulutgo System (Northern Part Sulawesi and Gorontalo)
  + Sulbagsel System (Southern Part of Sulawesi)
  + Other small systems
* It is targeted to connect Jamali, Sumatera, Kalimantan and Sulawesi System into a single interconnection system

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Jamali Annual Demand Profile

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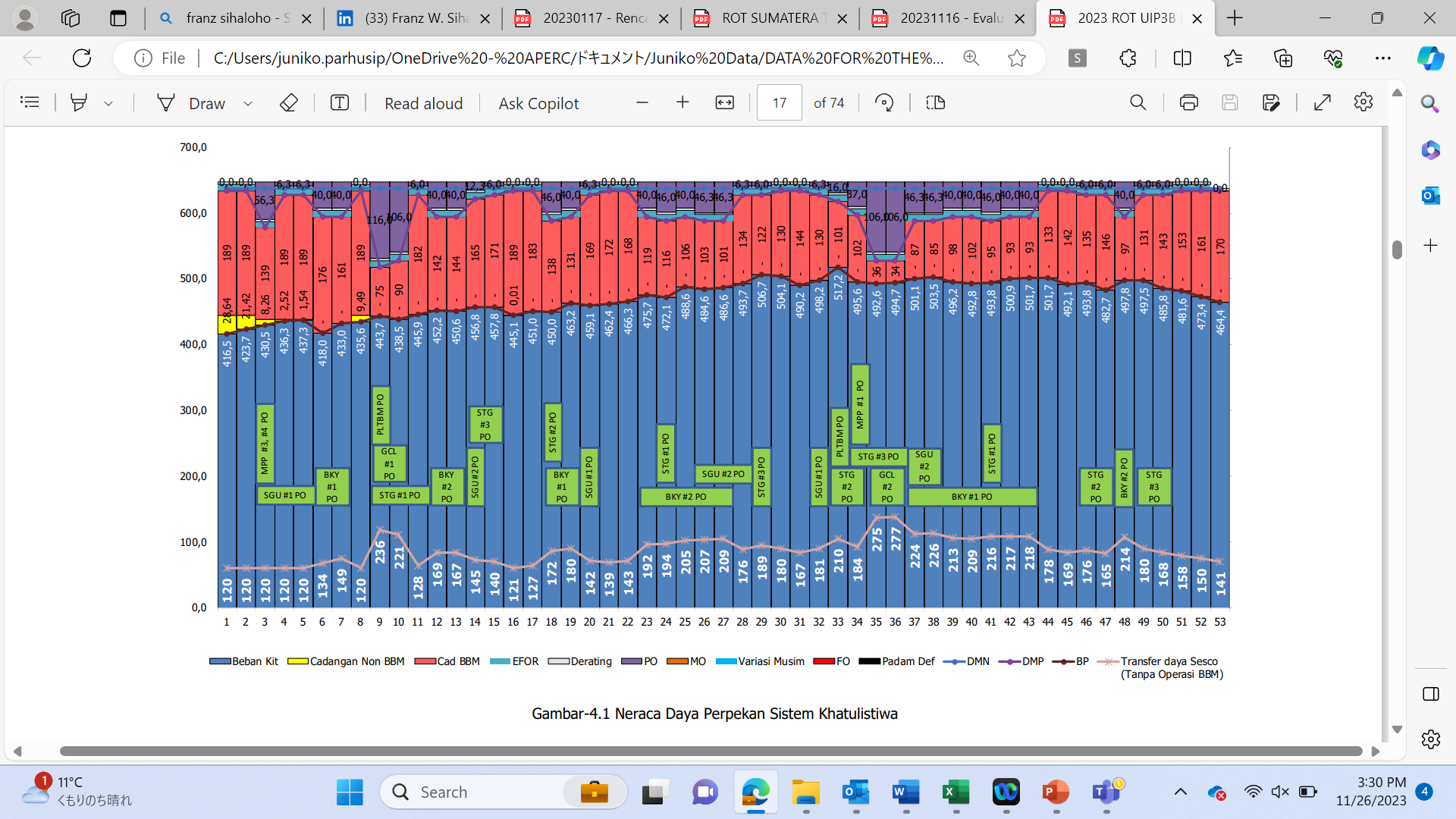
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**Sumatera System – Annual Demand Profile**

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**Kalimantan Interconnection System – Annual Demand Profile**



**Equator System – Annual Demand Profile**

A screenshot of a computer

Description automatically generated

**Sulutgo System - Annual Demand Profile**

A screenshot of a computer

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**Sulbagsel System - Annual Demand Profile**

**Examples of other small system**

A screenshot of a computer

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**Ambon System**

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**Ternate-Tidore System**

**Primary Fuel Prices for Electricity Power Generation**

As part of Government subsidy for the provision of electricity to the citizens, Coal and Gas Price for utility power plant are capped by the Government. Coal company and Gas Company must provide some share of their production to supply the power plant (Domestic Market Obligation or DMO Policy).

However, this policy may not take forever especially if the subsidy is considered very high in the next years, or electricity access and electricity affordability among the citizens are considered affordable.

|  |  |
| --- | --- |
| **Primary Energy** | **Price Policy** |
| Coal | USD 70/ton for electrical utility companies and its IPPs,  For coal specification: Calorific Value 6322kcal/kg, Total Moisture 8%, Sulfur Content 0.8%, Ash 15%). For other coal specifications other than specified, price will be calculated based on formula.  USD 52/ton for 4.700 kcal/kg |
| Gas | Average at plant gate price USD 6.00 – 8 USD/mmbtu), depend on the distance of power plant from the gas resources |
| Diesel and Gasoline | USD 0.45/litre (for calorific value 9.100 kcal/l) |
| Gasoline | USD 0.35/litre (for calorific value 9.700/litre) |

**Any capacity constraints (limits) on the use of specific technologies (especially renewables, storage, and imports)**

* Additional CFPP can only be built if it is integrated with an industrial resort, and its operation has to be demolished in 2050.
* In 2025 primary energy supply will be 23% from New and Renewable Energy, Coal 55%, Gas 22% and Oil 0.4%.
* CO2 emission peak shall be between 2035-2045.
* Net Zero Emission target in 2060 (Power Generation should be net zero emission in 2060.
* Nuclear can be operated in 2039
* Export to Singapore from Solar PV in Small islands around Batam Island as many as 2 GW
* Continuing import from SESCO Sarawak

**Projects in the PLN Development Plant 2021-2030:**

In its Power Development Plan which is approve by Minister of Energy and Minstal Resources, Some new plants have been planned to execute. But currenyl the , listed in below’s tabee:

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  | **2022** | **2023** | **2024** | **2025** | **2026** | **2027** | **2028** | **2029** | **2030** | **Total** |
| **PLN Owned** | | | | | | | | | | | | |
| CFPP | 488 | 306 | 228 | 50 | 231 | - | 24 | - | 20 | - | 1347 |
| Geothermal | - | - | - | 5 | 155 | 120 | 25 | 195 | 15 | - | 515 |
| CCGT | 350 | 1279 | - | - | - | 80 | - | - | - | 100 | 1809 |
| GT/Gas Engine | 260 | 543 | 316 | 240 | 370 | 60 | 95 | - | 10 | 70 | 1964 |
| Diesel | - | 5 | - | - | - | - | - | - | - | - | 5 |
| Microhydro | - | - | - | 13 | 35 | 22 | - | 2 | 11 | - | 83 |
| Hydro | 110 | 43 | 132 | 87 | 258 | 177 | 44 | 201 | 568 | 100 | 1720 |
| Pumped Storage | - | - | - | - | 1040 | - | - | 943 | 250 | 1250 | 3483 |
| PLTS | 59 | 126 | 237 | 266 | 773 | 17 | 8 | 25 | 32 | 157 | 1701 |
| PLT Lain | - | 2 | - | 165 | 155 | - | - | 10 | - | 300 | 632 |
| PLT EBT Base | - | - | - | - | - | 100 | 265 | 215 | 280 | 150 | 1010 |
| **Sub Total** | **1267** | **2304** | **913** | **826** | **3017** | **576** | **461** | **1591** | **1187** | **2127** | **14269** |
|  |  |  |  |  |  |  |  |  |  |  |  |
| **IPP** | | | | | | | | | | | | |
| PLTU | 4200 | 938 | 414 | - | 1660 | 1660 | - | - | - | - | 8872 |
| PLTU MT | - | 1200 | 600 | 300 | - | 600 | 600 | - | - | - | 3300 |
| PLTP | 136 | 108 | 190 | 136 | 715 | 170 | 98 | 255 | 225 | 808 | 2840 |
| PLTGU | 2035 | - | - | - | - | - | - | - | - | - | 2035 |
| PLTG/MG | - | - | - | - | - | 20 | - | - | - | - | 20 |
| PLTM | 144 | 154 | 277 | 276 | 154 | 22 | - | - | 2 | 6 | 1036 |
| PLTA | 290 | 10 | - | - | 1180 | 150 | 412 | 467 | 200 | 600 | 3309 |
| **Sub Total** | **6818** | **2615** | **2672** | **1434** | **4788** | **2822** | **1250** | **867** | **1327** | **1413** | **26006** |
|  |  |  |  |  |  |  |  |  |  |  |  |
| **Utility Mutual Partnership** | | | | | | | | | | | | |
| CFPP | - | - | 300 | - | - | - | - | - | - | - | 300 |
|  |  |  |  |  |  |  |  |  |  |  |  |
| **Total** | **8085** | **4919** | **3886** | **2260** | **7805** | **3398** | **1710** | **2458** | **2514** | **3540** | **40575** |

**NZE 2060 Commitment Plan:**

* NRE Mix 100% with total capacity 708 GW:
  + Solar 421 GW,
  + Wind 94 GW,
  + Hydro 72 GW,
  + Bioenergy 60 GW,
  + Nuclear 31 GW,
  + Geothermal 22 GW,
  + Tidal/Ocean 8 GW.
  + Plus *Pumped Storage* 4,2 GW and BESS 56 GW.
* Pumped storage from 2025
* Additional Coal PP is only for projects that are already under contract and construction. IPP’s Coal PP retired after the PPA ended. Combined Cycle PP retired after the age of 30 (remaining < 1 GW, PLTU: 2057, PLTGU: 2056).
* Additional generation after 2030 only from New and Renewable Energy.

1. **Policies on using CO2 reduction technologies for conventional power plants (ammonia, H2)**

* 2041, Green Hydrogen to replace natural gas for high temperature heating process
* Prioritizing the co-firing of biomass (as the emission is not going to be counted as power generation emission, but yet it will be counted as FOLU sector emission, based on IPPC guidelines)

1. **Specific emission targets for the power sector?**

* In 2030, it targeted 29% GHG emission reduction from BaU or 41% with International support
* Peak emission shall be between 2035-2045
* BaU, emission peak at 2060, 642 million ton CO2