

Methodology for “Indonesia’s captive coal giant: better data to shape industrial competitiveness”

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This document describes how Ember estimates annual captive electricity generation data for Indonesia. It supplements our report on captive coal power in Indonesia and main [Data Methodology](#), which describes our datasets, definitions and general methods.

All data is available to download for free on the Ember website. It is provided on an 'as is' basis, and is assembled using the best data available to us at any given time. Every effort has been made to ensure accuracy, and where possible we compare multiple sources to confirm their agreement. We take no responsibility for errors.

If you notice an issue or have any suggestions, comments, or questions, please do contact us at data@ember-energy.org.

Overview

Captive power is expanding fast in Indonesia's industrial development. However, the quality of their operational data and emissions are still limited. In 2025, the Ministry of Energy and Mineral Resources (MEMR) has published the yearly [Handbook of Energy and Economic Statistics of Indonesia \(HEESI\)](#), with captive installed capacity and production gathered by a top-down approach from PLN statistics, Electricity Statistics of Directorate General Electricity, and Directorate General of New and Renewable Energy and Energy Conservation.

To complement the HEESI's figures, we propose a bottom-up approach to calculate annual captive generation by different fuels based on industrial activities of the captive end-users.

Sources

- Captive Power Study Report from the Just Energy Transition Partnership Secretariat (or JETP report in short) (published in November 2025) - the break down of captive industrial end-users, captive capacity and generation by fuels and by industries, assumptions of energy intensity,
- Global Energy Monitor (GEM) (updated in 01/2026) - unit-level capacity data for coal, gas and oil captive power plants, including locations, industry for captive use, operational status, and operating dates,
- Earthwise' Indonesia Captive Coal Power Plants Database (updated in 01/2026)
 - unit-level capacity data for coal captive power plants, including locations,

industry for captive use, operational status, operational years, and alternate fuels.

General notes

Definition of industrial parks in captive power

The classification follows JETP Captive Power Study. While most industrial facilities are located inside industrial parks, each tenant typically operates its own captive power plant; such plants are therefore classified by the tenant's industry. The "industry park" category covers captive plants supplying multiple tenants within the same park, whose electricity end-use cannot be attributed to a single industry.

Definition of renewable fuels in captive power

In the scope of the study, renewables include hydropower, solar, and bioenergy. Waste heat recovery is not considered a renewable energy source. Despite being considered to emit zero emission for power generation, there is uncertainty over energy sources used to generate heat.

Definition of other industries between sources

Due to the difference in industry classification, in this calculation, the term "Other Industries" represent the capacity reported from EW's following commodity: Cement & Building + Textiles + Foods + "Copper, Gold & Silver" + Wood. This is a bit different from the definition of JETP's "Other = agriculture, cement, coke, copper, sugar, textiles, wood and other unspecified industries"

General assumptions for captive power estimation

Energy intensity:

- Nickel metal production intensity is based on the JETP report.
- Bauxite-alumina and alumina-aluminium process intensities are based on the JETP report.

Capacity factor of Other Industries

In the JETP study, in the calculation of the capacity factor of Other Industries from generation and capacity in 2024, the term “Other Industries” includes the following industrial activities: Industrial Parks, Oil & Gas, CPO, Chemicals, and Others. This is because there was a difference in classification when JETP reports 2024 generation values (p. 51) and capacity values (p.22)

Percentage of captive power in nickel processing

In nickel processing, captive power is estimated to currently account for 90% of that industry's power supply capacity.

Parameters	Assumed values	Unit	Source
Nickel metal energy intensity	42.5 ¹	MWh/tonne	Derived from total captive coal generation and nickel production in 2024 as reported in the JETP report
Bauxite-Alumina energy intensity	0.27	MWh/tonne	JETP
Alumina-Aluminium energy intensity	14.5	MWh/tonne	JETP
Nickel produced by captive power	0.9	Of total processed nickel production	JETP
Electricity demand to process oil palm fruit	20	kWh/tonne	IRENA

¹ The estimation in this report does not split by processes; therefore, the assumption is in the high-end of the range and could carry uncertainties.

Methodologies for industry-specific captive power generation

Nickel

There are commonly two main nickel production pathways: [rotary kiln-electric furnaces \(RKEF\)](#) and [high-pressure acid leaching \(HPAL\)](#), with different electricity intensities. The product of the RKEF route is mainly nickel pig iron (NPI) and ferronickel (FeNi) for the stainless steel industry. The HPAL route produces mixed hydroxide precipitate (MHP) and mineral sulfide precipitate (MSP), which can be primarily used for lithium-ion EV battery manufacturing. According to the JETP report, the electricity intensity of the RKEF is 34-43 MWh/tonne, while that of HPAL is around 8 MWh/tonne of nickel.

Processed nickel production estimation

The time-series nickel mine production from 2000 - 2025 is gathered from [Mineral Commodity Summaries](#) from USGS.

The USGS's [Indonesia 2023 Minerals Yearbook](#) reported the breakdown of Ni content in nickel mines and intermediates, including laterite ore, mixed hydroxide precipitate (MHP), matte (smelter), ferronickel, and nickel pig iron (NIP). As the matte reported by USGS can be double-counted due to the NPI-derived matte, only the ore-fed matte is reported from [PT Vale](#). The average recovery rate for nickel mine - processed product is calculated as:

$$\text{Average recovery rate} = \frac{MHP_{Ni, 2023} + Matte_{ore-fed only, 2023} + NIP_{2023} + Ferronickel_{2023}}{Mine, laterite ore_{Ni, 2023}}$$

The time-series processed nickel production by captive power is derived as:

$$\text{Process nickel production}_{2000-2025} = \text{Mine, laterite ore}_{Ni, 2000-2025} \times \text{Average recovery rate} \times 90\%$$

Captive Power Demand

The captive power demand is calculated as:

$$\text{Captive demand}_{Ni, 2000-2025} = \text{Process nickel production}_{2000-2025} \times EI_{Ni}$$

Fuel Breakdown

- Oil, Hydropower, Waste Heat Recovery: Generation values from 2010–2024 are assumed to remain constant at 2024 levels. Generation is assumed to be 0 prior to 2010 (only captive coal existed before 2010).
- Coal (Main Fuel): Calculated as the remaining power demand after subtracting other fuels.

Aluminium

Bauxite ores are the primary source of aluminium. Before turning into aluminium metal, the bauxites have to go through the [Bayer process](#) to transform into alumina (Al₂O₃). The process is broken down into 4 main steps: digestion, clarification, precipitation, and calcination. The aluminium processing therefore has higher energy intensity compared to that of the alumina, as it has to go through the whole bauxite → alumina → aluminium process. Based on JETP's assumption, the aluminium and alumina processing has 14.5 MWh/tonne and 0.27 MWh/tonne of energy intensity, respectively.

In this study, we calculate the captive demand from aluminium production based on alumina and aluminium outputs of Indonesia.

Aluminium output production

The time-series alumina production is gathered from [USGS Asia Pacific regional reports](#) from 2002 – 2023. For 2000 and 2001, due to unavailable data, the aluminium production is assumed to be equal to 2003's values. All alumina production pre-2014 is assumed to be 0.

It is reconciled that the USGS's time-series reported aluminium production is equivalent to INALUM reported production, without counting production coming from other companies. However, from 2023 – 2025, besides USGS's values, we also add more estimated outputs from [Huachin's](#) and other miscellaneous aluminium plants.

Captive Power Demand

Since aluminium production has two production outputs, the total demand will be the sum of power demand for alumina and aluminium, each is calculated by the following formula:

$$Captive\ demand_{Alumina/Aluminum, 2000-2025} = Process\ alumina/aluminum\ production_{2000-2025} \times EI_{Alumina/Aluminum, 2000-2025}$$

Fuels breakdown

Alumina production was reported from 2015. Based on Earthwise's Captive Coal Database, it is assumed to use captive coal.

For Aluminium production:

- All production from INALUM from 2000 uses captive hydropower.
- From 2023 onward, there is production from Huachin and other smelters. They are assumed to use captive coal, based on data from Earthwise's Captive Coal Database.

Pulp and Paper

- The time-series capacity has been gathered from Earthwise's database.
- Based on JETP's study, there are four fuels contributing to the captive power generation: coal (mostly), bioenergy and waste heat energy thanks to co-generation during paper drying and processing step, and solar. With the calculated capacity factor for pulp and paper derived from the JETP's reported 2024 capacity and generation, the coal captive power generation is calculated.
- Other fuels (i.e., Bioenergy, WHR, Solar) are assumed to have constant generation as 2024 reported in JETP throughout the entire time series.

Chemicals

- The captive power demand is assumed to be 100% from coal.
- The capacity factor is calculated based on 2024 capacity and generation of “Other Industries” in the JETP report.
- The time-series capacity is gathered from GEM’s Coal Plant Tracker.

Oil & Gas (for industrial purposes)

- The captive power demand is assumed to be 100% from gas.
- The capacity from 2019 – 2024 follows the JETP report, pre-2019 capacity is gathered from GEM’s Oil & Gas Plant tracker.
- The capacity on 2025 is assumed to be constant with 2024 value
- The capacity factor is calculated based on 2024 capacity and generation of “Other Industries” in the JETP report.

Mining

- The total captive power demand is the sum of the power demand met by Coal and Gas.
- From 2019 – 2024, the capacity is from JETP Study,
- The capacity in 2025 is assumed to be constant with the 2024 value
- From 2000 – 2019: the capacity is 2019 data minus the YoY change in capacity according to GEM’s trackers.
- The capacity factor is calculated based on 2024’s capacity and generation of “Mining” reported by the JETP.

Steel

- The total captive power demand is assumed to be 100% from Coal
- From 2019 – 2024, the capacity is from JETP Study,
- The capacity in 2025 is assumed to be constant with the 2024 value
- For pre-2019 capacity, the value stays constant with JETP data in 2019
- The capacity factor is calculated based on 2024 capacity and generation of “Other Industries” in the JETP report.

Industrial Park

- The total captive power demand is assumed to be 100% from Coal

- From 2019 - 2024, the capacity is from JETP Study,
- The capacity in 2025 is assumed to be constant with the 2024 value
- For pre-2019 capacity, the value stays constant with JETP data in 2019
- The capacity factor is calculated based on 2024 capacity and generation of "Other Industries" in the JETP report.

Other Industries

- The total captive power demand is assumed to be 100% from Coal
- The time-series capacity is gathered from Earthwise's database.
- The capacity factor is calculated based on 2024 capacity and generation of "Other Industries" in the JETP report.

Crude Palm Oil (CPO)

The total captive power demand for CPO is assumed to be 100% bioenergy, as most of the palm mills are small and scattered, mostly using their biomass by-product after the palm oil processing to generate steam and electricity for their own use. The time-series captive demand is inferred based on the time-series oil palm fruit production, gathered from [FAOSTAT](#), and the assumption of electricity requirement for processing oil palm fruit production (i.e., 20 kWh/tonne).