Environmental Product Declaration

In accordance with ISO 14025:2006 for:

Electricity

from

PT PLN Indonesia Power PLTGU Cilegon

Programme:	The International EPD® System, www.environdec.com
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Programme information

Programme:	**The International EPD® System** EPD International AB Box 210 60 SE-100 31 Stockholm Sweden EPD registered through the fully aligned regional hub: EPD Southeast Asia Kencana Tower Level M Bussiness Park Kebon Jeruk Jalan Raya Meruya Ilir Nomor 88, Jakarta Barat 11620 Indonesia
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Accountabilities for PCR, LCA and independent, third-party verification
Product Category Rules (PCR)
PCR: Electricity, Steam and Hot/Cold Water Generation and Distribution, 2007:08, Version 5.0.0 UN CPC 171, 173
PCR review was conducted by: The Technical Committee of the International EPD® System. See www.environdec.com/TC for a list of members. Review chair: Lars-Gunnar Lindfors. The review panel may be contacted via the Secretariat www.environdec.com/contact
Life Cycle Assessment (LCA)
LCA accountability: PT Properindo Enviro Tech
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Independent third-party verification of the declaration and data, according to ISO 14025:2006, via: ☒ EPD verification by individual verifier Third-party verifier: Dr. Subramanian Senthilkannan Muthu Approved by: The International EPD® System
Procedure for follow-up of data during EPD validity involves third-party verifier: ☐ Yes ☒ No

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Company information

Owner of the EPD: PT PLN Indonesia Power PLTGU Cilegon
Contact: (+62) 254-5751555; www.plnindonesiapower.co.id

Description of the organisation:

PT PLN Indonesia Power PLTGU Cilegon, hereinafter referred to as the Cilegon Gas and Steam Power Plant (PLTGU Cilegon), is located on Jalan Raya Bojonegara, Margasari Village, Serang, Banten. From PLTGU Cilegon, electricity amounting to approximately 700 megawatts (MW) is channeled to the Java-Bali electricity system via a 150 kV transmission network, so that it can be used by industries and households in Serang and its surroundings. Operating since 2006, PLTGU Cilegon is managed by a subsidiary of National Electricity Company (PLN), namely Indonesia Power. This plant consists of two gas turbine units and one steam turbine unit. PT PLN Indonesia Power PLTGU Cilegon has a production capacity of 740 MW.

The principle of generating electrical energy is the conversion of fuel energy into electrical energy. PLTGU is a merger between Gas Power Plant (PLTG) and Steam Power Plant (PLTU). The energy conversion that occurs in PLTGU is a combined thermodynamic cycle between the Brayton Cycle (gas turbine) and the Rankine Cycle (steam turbine). The unique characteristic that differentiates a PLTGU compared to a PLTU is the process of utilizing residual heat energy from the combustion process in a gas turbine to heat water into steam in a boiler and drive the steam turbine. While the boiler at a PLTU uses coal or petroleum fuel to produce steam, the boiler at a PLTGU does not use any fuel but instead uses the Heat Recovery Steam Generator (HRSG) method. With this principle, a PLTGU has a high thermal efficiency of 56%.

PT PLN Indonesia Power PLTGU Cilegon has conducted LCA studies in 2021 and the most recent one in 2023. These LCA assessments were based on a full year of company data from the preceding year. For the EPD of its electricity product, PT PLN Indonesia Power PLTGU Cilegon used the latest 2023 study, which has been updated to align with the latest PCR guidelines. The 2023 study was chosen to align with the company's LCA roadmap, as 2024 will focus solely on data inventory in preparation for the next LCA study. Additionally, 2022 (the year the data was drawn from) marked the start of an operational change, shifting to the use of 1 gas turbine, 1 steam turbine, and 1 HRSG, unlike the previous year, which used 2 gas turbines, 1 steam turbine, and 2 HRSGs.

Certifications:

- ISO 9001:2015
- ISO 14001:2015
- ISO 45001:2018
- ISO 50001:2018
- Gold PROPER
- Perusahaan Ramah Lingkungan Kab. Serang (Serang Regency Environmentally Friendly Company Award)
- Zero accident
- P2HIV Platinum

Name and location of production site:
Bojonegara-Salira Main Road, Margasari Village, Pulo Ampel District, Serang Regency, Banten Province, Indonesia.

Product information

Product name:
Electricity

Product description:
The electricity product system studied starts with upstream processes, including natural gas production and transportation via pipelines. Core processes covering main electricity generation and ancillary processes. Downstream processes including electricity transmission and distribution by National Electricity Company (PLN) to the consumers. Electricity serves as an energy source for both domestic households in Serang, Banten, and also industrial activities within the Serang industrial area. The LCA study held by PT PLN Indonesia Power PLTGU Cilegon has included 100% of the electricity produced in 2022.

UN CPC code:
UN CPC 171 Electrical Energy

Geographical scope:
The location of the entire process studied is in Indonesia with the following details:
- The location of the natural gas supplier is in Pagar Dewa, South Sumatra.
- The location of the power plant is in Serang City, Banten.
- The electricity distribution location is in Serang City, Banten

LCA information

Functional unit:
1 kWh net of electricity produced with measurement through metering before being distributed to the consumers. The term "net electricity" in this case refers to the amount of electricity produced that will be transmitted and distributed to consumers, excluding the electricity used for the power plant's own operational needs. The reference flow used in this study is the amount (kWh) of electricity produced based on 2022 data intensity, with a total production of 1,532,010,988.48 kWh.

Reference service life:
PT PLN Indonesia Power PLTGU Cilegon is assumed to operate for 40 years.

Time representativeness:
Specific data: The data period used is 1 year (January 1 - December 31, 2022).
Generic data: Generic data are using generic datasets with temporal representativeness ranges from 2011 – 2022.

Database(s) and LCA software used:
LCA was conducted using SimaPro version 9.6. Selected generic data used in this report was taken from Ecoinvent 3.9.1. The database is used in the impact assessment of upstream, core, and downstream processes.

System diagram:
PT PLN Indonesia Power PLTGU Cilegon is a type of gas and steam power generation industry with a production capacity of 740 MWh of electricity. The main raw material (upstream) is natural gas originating from third party company (PT Perusahaan Gas Negara Tbk) which is then processed in the PLTGU Cilegon's production process unit (core) to generate electricity which are then distributed to consumers through transmission and distribution network (downstream). LCA study of PT PLN Indonesia Power PLTGU Cilegon has covered its main product, electricity with a percentage of 100%.

Description of system boundaries:

The boundary in the LCA Study of PT PLN Indonesia Power PLTGU Cilegon in 2023 is defined as Upstream to Downstream according to the PCR: Electricity, Steam and Hot/Cold Water Generation and Distribution, 2007:08, Version 5.0.0 UN CPC 171, 173. The production system begins at the upstream scope, including drilling process & production of natural gas, transportation of natural gas using pipeline, production & transportation of materials used in the core processes such as high-speed diesel (HSD), fuels, maintenance materials such as oil lubricant, oil filter, cleaning cloth, battery, and also chemicals. Due to data limitations related to third-party involvement, the upstream scope of this study excludes construction and decommissioning processes. The core scope or the main processes in this study includes power plant infrastructure (construction and decommissioning), power generation process encompasses the combustion of natural gas with air and converting thermal energy generated into electrical energy, as well as other ancillary processes such as fuel (natural gas) preparation processes, water and wastewater treatment processes, maintenance processes, use of reserve power (generator set), office building operation, on-site transportation, and waste management (solid and hazardous waste). Then the downstream scope consists of the infrastructure (construction and decommissioning) of the transmission facility, and also electricity transmission and distribution to the consumers. The flow chart of the company's production process as a whole can be seen in Figure 1.

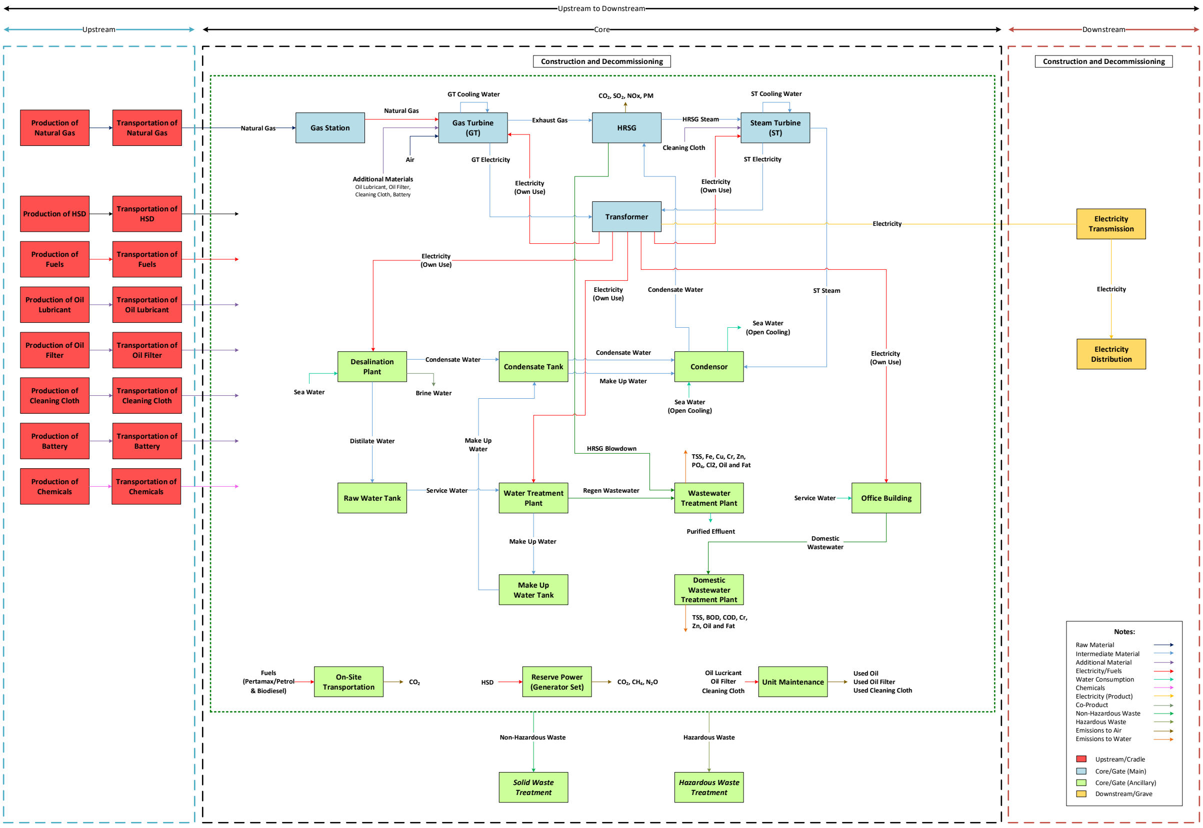

Figure 1 Electricity Production System and System Boundaries of PT PLN Indonesia Power PLTGU Cilegon LCA Study

Data Collection Procedure:

PT PLN Indonesia Power PLTGU Cilegon collected data for each process unit included in the system boundary, including raw material data, fuel, electrical energy consumption, emissions to air, emissions to water, emissions to land, and land use data in 2022. The collected data is divided into 2 types of data, namely primary data and secondary data, in accordance with what has been determined in the Guidelines for the Preparation of Life Cycle Assessment (LCA) Reports by the PROPER Secretariat - Ministry of Environment and Forestry Republic Indonesia and PCR: Electricity, Steam and Hot/Cold

Water Generation and Distribution, 2007:08, Version 5.0.0 UN CPC 171, 173. The definitions of primary and secondary data are:

a. Primary data : Data obtained either by measurement or calculation in accordance with the results of monitoring by the company.
b. Secondary data : Data from literature studies or journals in relation to the required calculations.

Details of the inventory data used in this LCA are:

- Input:
  a. Raw material : Air
  b. Fuel/energy : Natural gas, HSD, pertamax/petrol, biodiesel, electricity
  c. Chemicals : Eliminox, NH_3, Na_2HPO_4, trisodium phosphate anhydrate, anti scale, anti foam, HCl, NaOH, Resin, Cl_2, coagulant
  d. Water usage : Sea water, utility water
  e. Other material use : Oil lubricant, oil filter, cleaning cloth, battery, land use

- Output and/or Product:
  a. Emissions to air : Carbon dioxide (CO_2), methane (CH_4), dinitrogen monoxide (N_2O), sulfur dioxide (SO_2), nitrogen oxides (NOx), particulates.
  b. Emissions to water : Residual chlorine, Total Suspended Solids (TSS), Fe, Cu, Cr, Zn, PO_4, Biochemical Oxygen Demand (BOD), Chemical Oxygen Demand (COD), oil
  c. Hazardous waste : Used battery, expired chemicals, used chemical bottles, used chemical drums, used chemical jerrycans, used chemical cans, used cleaning cloth, used oil filters, used oil lubricant, used resin, dirty oil
  d. Non-Hazardous waste : Garden waste, food waste, domestic waste, paper waste
  e. Product : Electricity

More information:

Assumptions:

The following assumptions were used in this LCA study:

1. Greenhouse gas emissions are estimated based on the assumption of complete combustion. It is assumed that all of the fuel being burned reacts fully with oxygen during the combustion process. This means all carbon in the fuel is converted to carbon dioxide (CO_2), all sulfur is converted to sulfur dioxide (SO_2), and all nitrogen is converted to nitrogen oxides (NOx).
2. Electricity consumption is estimated based on the design specifications of the equipment and the operational hours involved in the electricity generation process.
3. The utilization of annual data, derived from the conversion of daily data maintained by the company.
4. For the impact analysis of the biodiesel production process in upstream scope, a combination of diesel production dataset and palm oil refining dataset is used. The allocation of production quantities is based on the composition of biodiesel in Indonesia, which consists of 70% diesel and 30% palm oil.
5. For the impact analysis of the oil filter production process in upstream scope, it is assumed that the main material used in oil filter production is brass; therefore, a brass production dataset was used due to the limitations in obtaining primary data or datasets specifically focused on the impacts of oil filter production.

6. The infrastructure (construction and decommissioning) processes for power generation (core) and transmission and distribution (downstream) are projected to be operational for the next 40 years. According to the typical technical service life table in section 4.2 of the PCR, power plants utilizing combustion technology can operate for up to 40 years.
7. Decommissioning process data is obtained from a literature source (Spath and Mann, 2000), specifically information on the types of materials used in power plant construction (concrete, steel, aluminium, and iron). It is assumed that the decommissioning process will produce the same types of waste as the materials used in construction. The impact on the decommissioning phase is assessed by inserting these materials as waste and emissions to treatment in SimaPro 9.6 software.
8. The environmental impacts of the power plant decommissioning process are assessed using the Ecoinvent 3.9.1 database, with waste quantities adjusted based on the infrastructure details from the power plant construction phase.
9. Material transportation distances for the production process were estimated using Google Earth version 10.65.1.2 and assessed using the Ecoinvent 3.9.1 database.
10. Due to limitations in obtaining direct data related to the transmission and distribution process carried out by third parties (not under the control of PT PLN Indonesia Power PLTGU Cilegon), electricity transmission and distribution losses are estimated to account for 8.76% of the total net electricity. The losses amount is based on the Handbook of Energy & Economy Statistics of Indonesia 2022 by the Ministry of Energy and Mineral Resources Republic of Indonesia.

Cut-off rules:
The cut-off criteria Life Cycle Assessment (LCA) report for PT PLN Indonesia Power PLTGU Cilegon employs cut-off rules based on mass, energy, and environmental considerations. In this approach, 99% of the mass, energy, and environmental input and output data associated with each unit process within the electricity production system are considered to have a direct impact on the environment. This translates to a cut-off level of 1%.

Data quality:
This LCA has followed the data quality requirements according to the PCR: Electricity, Steam and Hot/Cold Water Generation and Distribution, 2007:08, Version 5.0.0 UN CPC 171, 173 where specific data should always be used. All specific data used for core processes are collected from the actual factory (PT PLN Indonesia Power PLTGU Cilegon) where product-specific processes are performed, except for core infrastructure and decommissioning data, which were assessed using Ecoinvent 3.9.1 database due to data unavailability. For upstream, downstream processes and infrastructure, the selected generic data has been used because specific data is not available. Data quality assessments have been conducted in accordance with the Data Quality Assessment Guidelines for Lifecycle Inventory Data.

Allocation:
This LCA study has followed the allocation rules in accordance with PCR: Electricity, Steam and Hot/Cold Water Generation and Distribution, 2007:08, Version 5.0.0 UN CPC 171, 173. The impact of PT PLN Indonesia Power PLTGU Cilegon is considered to be the entire impact of the electricity production process, so there is no allocation in the assessment of the production process. The entire process of treating hazardous waste generated from electricity production in this study utilizes the incineration method, while non-hazardous waste is entirely disposed of in landfill. Consequently, there is no allocation in the waste treatment process. The impacts resulting from the treatment of both hazardous and non-hazardous waste from PT PLN Indonesia Power PLTGU Cilegon are borne by the waste generator, which is PT PLN Indonesia Power PLTGU Cilegon itself.

Results of the environmental performance indicators

The environmental performance results are relative expressions and do not predict impacts on category endpoints, the exceeding of thresholds, safety margins or risks. The assessment results are summarized in below and quantities are expressed per declared unit:

1. For electricity generation (upstream, core, core – infrastructure, and total generated), the values are shown per kWh of electricity generated.
2. For electricity distribution (downstream, downstream – infrastructure, and total distributed), the values are presented per kWh delivered to the end-user. It's assumed that 8.76% of the generated electricity is lost during transmission and distribution.

Impact category indicators

PARAMETER		UNIT	Upstream	Core	Core-Infrastructure	Total Generated	Downstream	Downstream-Infrastructure	Total Distributed
Global warming potential (GWP)	Fossil	kg CO_2 eq./kWh	1.03E-01	4.58E-01	3.99E-03	5.65E-01	4.95E-02	1.34E-02	6.28E-01
	Biogenic	kg CO_2 eq./kWh	6.98E-04	3.01E-08	2.96E-04	9.94E-04	8.71E-05	1.40E-03	2.48E-03
	Land use and land transformation	kg CO_2 eq./kWh	5.55E-05	1.05E-09	2.82E-06	5.84E-05	5.11E-06	2.15E-05	8.50E-05
	TOTAL	kg CO_2 eq./kWh	1.03E-01	4.58E-01	4.01E-03	5.65E-01	4.95E-02	1.33E-02	6.28E-01
Ozone layer depletion (ODP)		kg CFC 11 eq./kWh	1.96E-04	9.52E-04	3.66E-05	1.18E-03	1.04E-04	6.46E-04	1.94E-03
Acidification potential (AP)		mol H^+ eq./kWh	1.68E-05	5.69E-10	1.29E-06	1.81E-05	1.59E-06	4.95E-05	6.92E-05
Eutrophication potential (EP)	Aquatic freshwater	kg P eq./kWh	6.77E-05	3.92E-04	1.05E-05	4.71E-04	4.12E-05	3.67E-05	5.48E-04
	Aquatic marine	kg N eq./kWh	7.07E-04	4.30E-03	1.14E-04	5.12E-03	4.48E-04	4.89E-04	6.06E-03
	Aquatic terrestrial	mol N eq./kWh	9.31E-04	1.02E-03	3.60E-05	1.99E-03	1.74E-04	1.43E-04	2.31E-03
Photochemical oxidant creation potential (POCP)		kg NMVOC eq./kWh	7.39E-10	3.22E-14	5.90E-11	7.98E-10	6.99E-11	6.90E-10	1.56E-09
Abiotic depletion potential (ADP)	Metals and minerals	kg Sb eq./kWh	8.59E-08	6.69E-12	1.08E-07	1.94E-07	1.70E-08	8.47E-06	8.68E-06
	Fossil resources	MJ, net calorific value/kWh	8.87E+00	2.67E-05	5.34E-02	8.92E+00	7.81E-01	1.58E-01	9.86E+00
Water deprivation potential (WDP)		m^3 world eq. deprived/kWh	9.18E-03	6.47E-04	8.89E-04	1.07E-02	9.38E-04	1.03E-02	2.19E-02
Fine Particulate Matter Formation		kg PM2.5 eq/kWh	1.80E-04	1.57E-04	1.14E-05	3.48E-04	3.05E-05	1.59E-04	5.38E-04

* Disclaimer: The results of this environmental impact indicator shall be used with care as the uncertainties of these results are high or as there is limited experience with the indicator.

* Notes:

Upstream	:	Impacts of raw material, fuels, maintenance material, chemicals production and transportation.
Core	:	Impacts of all process units within the company's core business scope (electricity production).
Core – Infrastructure	:	Impacts of power plant infrastructure, including decommissioning processes.
Total Generated	:	Total of Upstream + Core + Core Infrastructure
Downstream	:	Value for product losses, calculated by multiplying the percentage loss by the Total Generated impact.
Downstream – Infrastructure	:	Impacts of electricity transmission and distribution infrastructure.
Total Distributed	:	Total of Upstream + Core + Core Infrastructure + Downstream + Downstream Infrastructure

Resource use indicators

PARAMETER		UNIT	Upstream	Core	Core-Infrastructure	Total Generated	Downstream	Downstream-Infrastructure	Total Distributed
Primary energy resources – Renewable	*Use as energy carrier*	MJ/kWh, net colorific value	1.24E-02	4.11E-07	2.61E-03	1.50E-02	1.31E-03	3.08E-02	4.71E-02
	Used as raw materials	MJ/kWh, net colorific value	0	0	0	0	0	0	0
	TOTAL	MJ/kWh, net colorific value	1.24E-02	4.11E-07	2.61E-03	1.50E-02	1.31E-03	3.08E-02	4.71E-02
Primary energy resources – non renewable	*Use as energy carrier*	MJ/kWh, net colorific value	9.28E+00	1.35E+04	9.16E-03	1.35E+04	1.18E+03	4.99E-02	1.47E+04
	Used as raw materials	MJ/kWh, net colorific value	0	0	0	0	0	0	0
	TOTAL	MJ/kWh, net colorific value	9.28E+00	1.35E+04	9.16E-03	1.35E+04	1.18E+03	4.99E-02	1.47E+04
Secondary material		Kg/kWh	6.61E-03	1.17E-08	0	6.61E-03	5.79E-04	2.22E-03	9.41E-03
Renewable secondary fuels		MJ/kWh, net colorific value	2.05E+04	5.42E+01	2.64E+04	4.70E+04	4.12E+03	3.52E-03	5.11E+04
Non-renewable secondary energy		MJ/kWh, net colorific value	0	0	0	0	0	0	0
Net use of fresh water		m^3/kWh	5.14E-02	8.92E-04	1.17E-02	6.40E-02	5.61E-03	1.11E-01	1.81E-01

Based on the resource use table above, the main energy sources used in the electricity production of PT PLN Indonesia Power PLTGU Cilegon in each area. In the upstream data, the energy sources used come from Renewable energy – use as energy carrier of 1.23E-02 MJ/kWh which comes from geothermal energy, kinetic (wind) energy, biomass (gross calorific value) energy, solar energy, and potential energy; Non-renewable energy – use as energy carrier of 9.28E+00 MJ/kWh which comes from natural gas and coal; Secondary materials of 6.61E-03 Kg/kWh which comes from raw materials use such as sand; Renewable secondary fuels of 2.05E+04 MJ/kWh which comes from the use of cobalt and molybdenum; and Net use of fresh water of 5.14E-02 m3 which comes from water use. In the core data, the energy sources used come from Renewable energy – use as energy carrier of 4.11E-07 MJ/kWh which comes from geothermal energy, kinetic (wind) energy, biomass (gross calorific value) energy, solar energy, and potential energy; Non-renewable energy – use as energy carrier of 1.35E+04 MJ/kWh which comes from natural gas and coal; Secondary materials of 1.17E-08 Kg/kWh which comes from raw materials use such as sand; Renewable secondary fuels of 5.42E+01 MJ/kWh which comes from the use of cobalt, nickel, silicon, copper, and molybdenum; and Net use of fresh water of 8.92E-04 m3 which comes from water use. In the core – infrastructure data, the energy sources used come from Renewable energy – use as energy carrier of 2.61E-03 MJ/kWh which comes from geothermal energy, kinetic (wind) energy, biomass (gross calorific value) energy, solar energy, and potential energy; Non-renewable energy – use as energy carrier of 9.16E-03 MJ/kWh which comes from natural gas and coal; Renewable secondary fuels of 2.64E+04 MJ/kWh which comes from the use of cobalt and molybdenum; and Net use of fresh water of 1.17E-02 m3 which comes from water use. In the downstream data, the energy sources used come from Renewable energy – use as energy carrier of 1.30E-03 MJ/kWh which comes from geothermal energy, kinetic (wind) energy, biomass (gross calorific value) energy, solar energy, and potential energy; Non-renewable energy – use as energy carrier of 1.18E+03 MJ/kWh which comes from natural gas and coal; Secondary materials of 5.79E-04 Kg/kWh which comes from raw materials use such as sand; Renewable secondary fuels of 4.12E+03 MJ/kWh which comes from the use of cobalt, molybdenum, nickel, silicon, and copper; and Net use of fresh water of 5.61E-03 m3 which comes from water use.

Waste indicators

PARAMETER	UNIT	Upstream	Core	Core - Infrastructure	Total Generated	Downstream	Downstream - Infrastructure	Total Distributed
Hazardous waste disposed	kg/kWh	5.71E-08	3.37E-05	0	3.38E-05	2.96E-06	1.23E-04	1.59E-04
Non-hazardous waste disposed	kg/kWh	1.32E-11	6.45E-05	6.25E-02	6.26E-02	5.48E-03	1.29E-06	6.80E-02
Radioactive waste disposed	kg/kWh	0	0	0	0	0	0	0

Based on waste indicators table above, the waste generated from the production process of PT PLN Indonesia Power PLTGU Cilegon is in the form of hazardous and non-hazardous waste generated in the upstream, core and downstream scopes. In the upstream process, 4.36E-01 kg of hazardous waste are generated, or equivalent to 2.84E-10 kg/kWh. This hazardous waste comes from sources such as refinery sludge, gypsum, mineral oil, solvent mixture, polystyrene, and incineration residues. Additionally, 2.03E-02 kg of non-hazardous waste are produced during the upstream process, equivalent to 1.32E-11 kg/kWh. This non-hazardous waste originates from sources like municipal solid waste, waste yarn, and waste textile. The core processes generate hazardous waste at the amount of 51,676.50 kg, equivalent to 3.37E-05 kg/kWh which comes from used battery waste, expired chemicals, used chemicals packaging (bottles, drums, jerrycans, cans), used cleaning cloth, dirty oil, used oil lubricant, used oil filters, and used resin. While the non-hazardous waste generated is 98,800.58 kg or equivalent to 6.45E-05 kg/kWh which comes from garden waste, food waste, domestic waste, and paper waste. The core – infrastructure processes generate non-hazardous waste from the construction and decommissioning process of the power plant. The waste generated are 9.57E+07 kg or equivalent to 6.25E-02 kg/kWh which comes from concrete, steel, aluminium, and iron. The downstream infrastructure generates 1.84E+05 kg of hazardous waste, equivalent to 1.23E-04 kg/kWh. This hazardous waste comes from waste polyvinyl chloride, waste polyethylene, and waste mineral oil. Additionally, 1.94E+03 kg of non-hazardous waste is produced during the downstream scope, equivalent to 1.29E-06 kg/kWh. This non-hazardous waste originates from sources like waste concrete, waste copper, waste aluminium, scrap steel, waste rubber, and waste wood pole.

Output flow indicators

PARAMETER	UNIT	Total	Upstream	Core	Core - Infrastructure	Total Generated	Downstream	Downstream - Infrastructure	Total Distributed
Component for reuse	Kg/kWh	0	0	0	0	0	0	0	0
Material for recycling	Kg/kWh	0	0	0	0	0	0	0	0
Material for energy recovery	Kg/kWh	0	0	0	0	0	0	0	0
Exported energy, electricity	MJ/kWh	0	0	0	0	0	0	0	0
Exported energy, thermal	MJ/kWh	0	0	0	0	0	0	0	0

Impact Contribution

The contribution of the impact resulting from the upstream to downstream process of PT PLN Indonesia Power PLTGU Cilegon can be seen in the Figure 2 below. Impact in the upstream process is mostly contributed by the production and transportation of natural gas. The impact is caused by the use of natural gas and other fossil resources needed in the process of extracting and transporting raw materials. In the core process, the potential impact comes from the plant infrastructure (construction and decommissioning) process and main production units such as the Heat Recovery Steam Generator (HRSG), as well as ancillary processes such as wastewater treatment plant, office building, on-site transportation, reserve power (generator set), and also hazardous & non-hazardous waste transportation and processing. The impact on the core process is caused by emissions released to air and water from the main electricity production and ancillary processes. Whereas in the downstream process, the potential impact comes from downstream-infrastructure and downstream processes in the form of electricity transmission and distribution networks infrastructure.

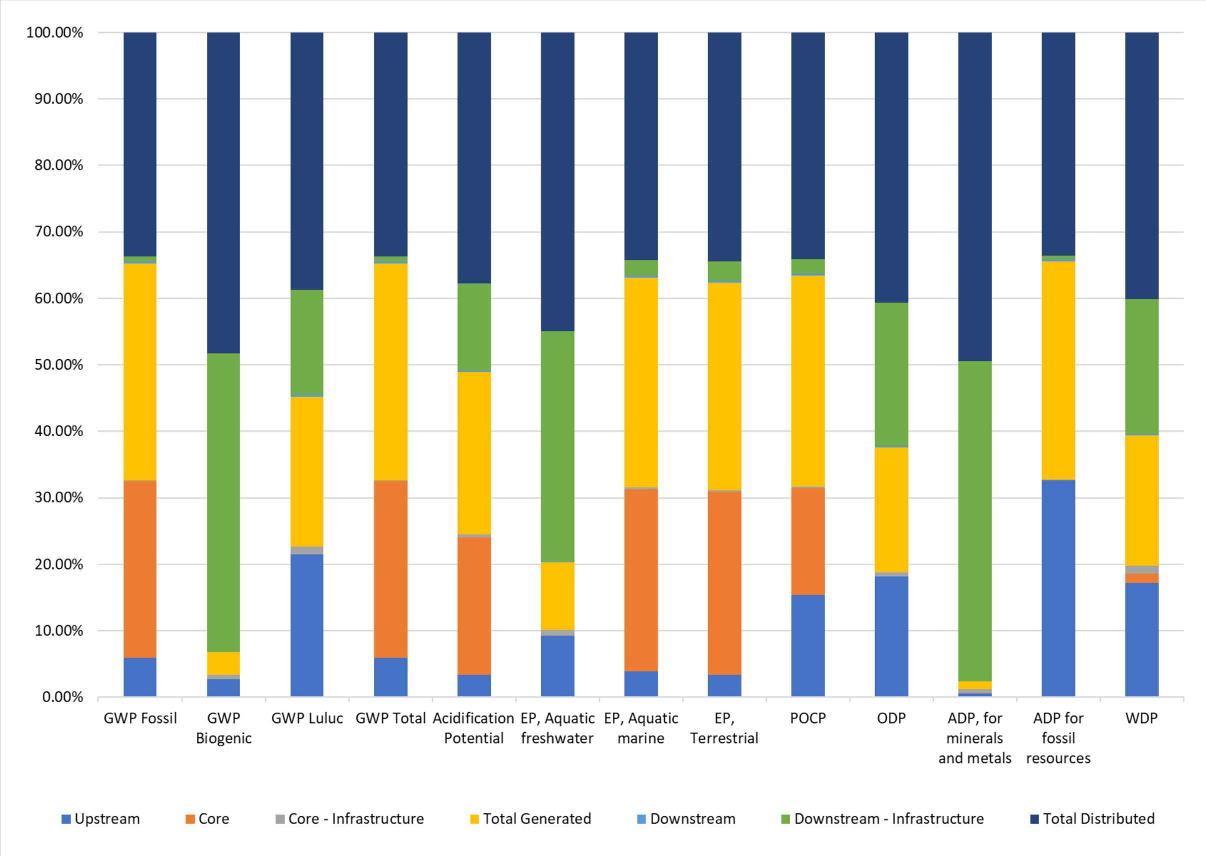

Figure 2 The Distribution of the Upstream to Downstream Impact Contribution

Additional environmental information

Biodiversity Conservation Development

The biodiversity monitoring activities are conducted within two designated conservation areas managed by PT PLN Indonesia Power PLTGU Cilegon. These areas are located within Ring 1 (power plant area) and Ring 2 (office area), specifically along Bojonegara-Salira Main Road, Margasari Village, Pulo Ampel District, Serang Regency, Banten. The specific coordinates for the research site are 05° 55' 50" South and 106° 06' 15" East.

Environmental Risk

PT PLN Indonesia Power PLTGU Cilegon adheres to a comprehensive environmental risk management strategy. This strategy entails the proactive identification of significant environmental risks associated with their production processes. These potential risks encompass energy consumption, water usage, wastewater discharge, air pollution, hazardous waste generation, and non-hazardous waste production. PT PLN Indonesia Power PLTGU Cilegon calculates its environmental management performance on an annual basis. This performance is then reported through a verification report that integrates Life Cycle Assessment (LCA) studies. Said report is submitted to the Ministry of Environment and Forestry of the Republic of Indonesia. A more detailed exposition of the environmental risk control programs implemented by PT PLN Indonesia Power PLTGU Cilegon is provided in the table below.

ASPECT	PROGRAM
Energy	• Modification of chamber level switch water box condenser steam turbine of PLTGU Cilegon plant
Air Pollution	• Tripod inlet air filter modification • Gas use variable application • Desalination plant repowering • Modification of under frequency relay on gas turbine • Improvement of gas turbine flame detector through modification of distance pieces • Optimizing fan operation of the CCW GT cooling system • Repowering condenser to prevent condensation tube leaks
Water and wastewater	• Reuse condensate desalination plant to avoid condensate tank overflow and external water efficiency when the unit stops • Enhancement performance of HRSG 1.1 and HRSG 1.2 economizer inlet valve • Optimization of water deionization service • Regulation of dilute NaOH and HCl injection in the Ph control & oxidation pit • HRSG continuous blowdown valve optimal open operation pattern to reduce PO_4 pollutant load • Modification of phosphate injection relay in HRSG drum
Hazardous waste	• Oil purification to reduce used oil waste • Resin waste reduction with chemical injection timing • Advanced waste reduction with special-tools to remove spiral wound gasked type A-M-10
Non-hazardous waste	• Go-log based on SQLite and RFID as a method for reducing paper usage

Noise

Generally, noise comes from machinery in power plants (boilers, pumps, turbines, etc.) and can be a common environmental concern. This issue can be mitigated by conventional noise reduction techniques, such as installing silencers or sound absorbers within the power plant building.

Electromagnetic Field

According to Indonesian law, there is no restriction on electromagnetic fields (EMF) and no data is available from the power plant.

Land Use

The total land used by PT PLN Indonesia Power PLTGU Cilegon equals to approximately 170,000 m^2. The power plant PT PLN Indonesia Power PLTGU Cilegon Power consist of two gas turbine units and one steam turbine unit. The power plant has operated for 16 years (up until 2022, the year of data used). The area of PT PLN Indonesia Power PLTGU Cilegon consists of various main processing units such as gas station, gas turbine, HRSG, steam turbine, gas turbine transformer, and steam turbine transformer. Also supporting facilities such as desalination plant, raw water tank, water treatment plant, make up water tank, condensate tank, condensor, wastewater treatment plant, office building, domestic wastewater treatment plant, reserve power, and hazardous and non-hazardous waste management facility. According to Corine Land Cover Classes, the land used to be open spaces with little or no vegetation (class 3.3) and now became an industrial area (class 1.2).

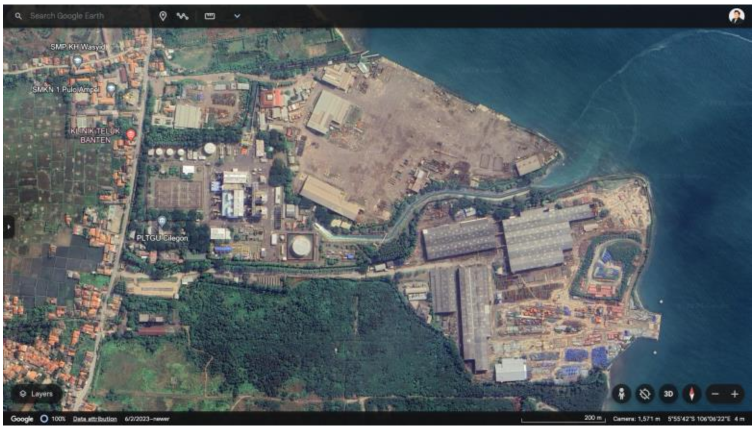

Figure 3 PT PLN Indonesia Power PLTGU Cilegon seen from Google Earth

Contact Information

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