EPD®
THE INTERNATIONAL EPD® SYSTEM

Southeast Asia EPD

Environmental Product Declaration

In accordance with ISO 14025 for:

DAUN BUAH™ GRANULATED UREA

From

PT Pupuk Kalimantan Timur

PUPUK KALTIM

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

EPD registered through the fully aligned regional hub
EPD Southeast Asia, www.epd-southeasia.com

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Company information

Description of the organisation:

PT Pupuk Kalimantan Timur (Pupuk Kaltim) is a subsidiary of PT Pupuk Indonesia (Persero). Pupuk Kaltim sits in a land area of 443 hectares in Bontang, East Kalimantan. Pupuk Kaltim's main business is producing and selling Ammonia, Urea, and NPK, to meet domestic needs or for export purposes. For the distribution of the domestic subsidy sector, Pupuk Kaltim's marketing area covers East Java, North Kalimantan, East Kalimantan and the whole island of Sulawesi in Indonesia.

Certifications:

- **SNI ISO 9001:2015**
- **ISO 14001:2015**
- **ISO 45001:2018**
- **ISO 55001:2014**
- **ISO 50001 : 2018**
- **Green industry**
- **Green Port Award**

Details of Pupuk Kaltim's commitment to sustainable development can be found in the company's sustainability report.

Name and location of production site:

Kelurahan Guntung & Kelurahan Loktuan, Bontang, Kalimantan Timur, Indonesia

Vision

To become a growing and sustainable world-class Company in the fertilizer, chemical and Agrobusiness industry.

PT Pupuk Kalimantan Timur (Pupuk Kaltim) is the largest urea plant in Indonesia, located in Bontang City, East Kalimantan. The plant is established in the year 2014 with a urea production rate of 545,684.09 Ton/year. The urea product is shipped to East Java in Tanjung Priok and Meneng Port from which the product is distributed to farmers via road transportation.

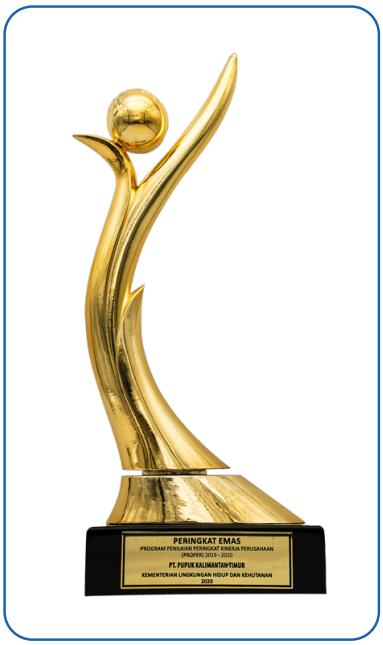
Pupuk Kaltim realizes the strategic significance of the development of telecommunication and information technology in improving the efficiency of plant operational performance as well as its benefits in reducing the environmental impact of production activities.

Therefore, all personnel at Pupuk Kaltim are ready to embrace the Industry 4.0 era through a thorough transformation in operational activities, from the procurement of raw materials to the production and distribution processes.

We design and implement a comprehensive energy management program, consistently recording reductions in greenhouse gas emissions and conventional gas emissions, reducing waste, and increasing cooperation in the utilization of waste from the operations of our production facilities. We also intensify the use of information technology in environmental conservation programs and community empowerment.

*The efforts done by Pupuk Kaltim have resulted in **the fourth consecutive GOLD PROPER rating for 2020**, acknowledging our continuous journey in contributing to the achievement of various development goals in Sustainable Development Goals (SDGs).*

Pupuk Kaltim is the first fertilizer producer in Indonesia to receive the Green Industry certification from the Ministry of Industry of the Republic of Indonesia.



Product information

Product name:

Daun Buah™ Urea

Product identification:

Urea is also known as Carbamide, Carbonyldiamide, and Carbamidic Acid with chemical formulation $(NH_2)_2CO$ or CH_4N_2O

Product description:

Urea fertilizer, also known as nitrogen (N) fertilizer, has a nitrogen content of 46%. Urea is made from the reaction between ammonia and carbon dioxide in a chemical process into solid urea. Pupuk Kaltim produces urea in the form of granules. Granulated urea is more suitable for the plantation segment, although it can also be used for food crops. Daun Buah™ Urea is the brand used for non-subsidized granular urea fertilizer produced by Pupuk Kaltim, white in color with a grain size of 2: 4.75 mm.

Product composition:

- Nitrogen: min 46.0% (w/w)
- Water: 0.5 % (w/w)
- Biuret (CAS no. 108-19-0): 1.2 - 1.5% (w/w)
- Density: 2.31 g/cm3
- Bulk density: 44 - 49 lb/ft3 or 750 kg/m^3

Agronomic Efficiency Index (AEI):

Agronomic Efficiency Index (AEI) is an indicator of the impact of applied urea on rice productivity. The AEI of Pupuk Kaltim's granulated urea is estimated to be in the range of 20-25 kg rice/kg granulated urea based on a field study conducted by the internal R&D team.

UN CPC code 3461:

Nitrogenous fertilizers

SNI 2801:2010

Geographical scope

Indonesia

Head Office & production site

Bontang

Uptake Index (UI):

For urea application on soil is 23 460 kg/2000M2 farmland, Uptake Index for urea is represented by Nitrogen uptaken, when the urea is applied on soil, 27% of N will be uptaken by plant, while 68% will be persisted on soil and the rest which is 5% will be lost and brought by water as run off .

LCA information

Declared Unit:
1 metric ton of granulated urea and its packaging.

The declared unit may have different functionality depending on the composition of the product that is declared.

Reference service life:
Not applicable

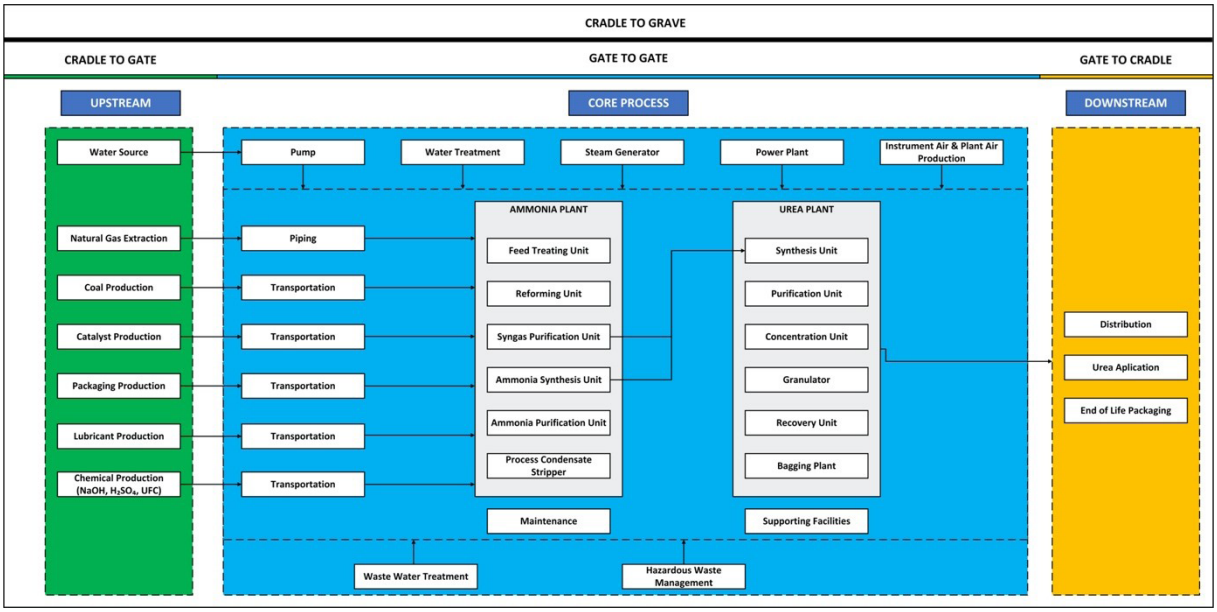
Time representativeness:
Specific data based on data in 2019.

Generic data: 29% data are from generic datasets with temporal representativenes ranges from 2015-2019.

Database(s) and LCA software used:
LCA was conducted manually using Microsoft Excel.

No databases were directly used for the background data. Journal publications were used as the source of secondary data (see Appendix), where the journal publications used datasets from known databases such as Ecoinvent, Gabi database, JEMAI, SIRIM, and others.

System diagram:



System boundaries:
This is a "cradle-to-grave" life cycle analysis reported in accordance with EPD Product Category Rule (PCR) 2010:20 Mineral or chemical fertilizers, Version 3.0.

The product life cycle is divided into three stages:

Upstream Processes	Core Process	Downstream Process
· Natural gas and coal extraction processes, · Chemical and auxilliary materials production processes, and · Primary and secondary packaging material manufacturing processes	· Transportation of raw and auxilliary materials into the core process; · Production processes (ammonia, urea), · Utility processes; · Transportation of solid waste (Hazardoues Waste (HW) and non-HW) from production Wastes to contractors; · Wastewater treatment; · Air emission management; · Storage/warehouse; · Electricity production (GTG).	· Transportation from warehouses to distribution warehouses, · Transportation from production warehouses and distribution warehouses, · Transportation from production warehouses to customers, · Product use by customers and · End-of-life processing of packaging waste

Excluded life cycle stages:
Technical systems that are excluded in the scope of the study are:
a) The production process of equipment, buildings and other capital goods,
b) Personnel business trips,
c) Personnel travel to and from the office, and
d) Research and development activities.

The study excludes
- Fugitive gas emission streams and VOC (Volatile Organic Substance) emissions, venting and boiler blowdown. The equipment is designed to prevent the release of fugitive gas emission. Under normal condition, fugitive gas emission will not be released.
- Processes that take place under abnormal conditions such as production failures and quality failures

Main assumptions:

- There is no mass interconnected flow along the process of raw and auxiliary materials, production process and product transportation/distribution and product applications.
- The generation of spent catalyst in 2019 is obtained by dividing catalyst weight by actual period use of the catalyst. Note: there is no catalyst replacement in the Plant IA; The catalyst change every 5 years, the data use for calculation is a total catalyst for 5 years divided by 5 (average use for 1 year).
- Similar fuel types consumed for trucks and ships from which these emit gas with a composition referring to Guidelines for the Implementation of the National Greenhouse Gas Inventory Methodology for Calculation of Greenhouse Gas Emission Levels of the Ministry of Environment in 2012.
- Farmers do not use vehicles to carry urea from their house to their farmland.
- One distribution route and one urea supply source for East Java applies consistently. The route starts from Bontang port to Meneng Port and Surabaya Port from where the granulated urea is transferred to all areas in East Java.
- There is no either neglected fugitive emission representing full normal plant operation within the period of study.
- There is no production failures and quality failures unreported beyond data examined by LCA team in the form of total hours operation within year 2019.
- There is no either neglected venting and boiler blowdown within the period of study.
- Reliable measurement data collected from electronic logsheet covering Granulator, CO_2 Compressor, Primary Reformer, Shift Converter, Ammonia Synthetic Loop (Synloop), Ammonia Recovery Unit (ARU) & Hydrogen Recovery Unit (HRU), Auxiliary Boiler, Package Boiler, Granulator, Waste Heat Boiler, Prilling Tower (PT)-2A, PT-2B, PT-2C, PT-2D, and Gas Turbin Generator.
- Reliable environmental quality measurement and monitoring covering air emission and wastewater effluent.
- Reliable data and information from secondary previous studies covering natural gas extraction, coal production, chemicals and auxiliary chemicals, natural gas distribution, packaging manufacturing. For instance, consistent quality as reported in the certificate of analysis for natural gas dan coal.
- Reliable transportation data of input material and product in terms of mileage, delivery frequency both on land and on water transportation.
- Emission from wastewater plant can be sufficiently represented by parameter (NH_3, Chemical Oxygen Demand, Total Suspended Solids, oils and fats, Cl_2) stipulated in company monitoring plan following government threshold limit.
- Emission from hazardous waste management can be sufficiently represented by parameter (used oil, used catalyst, used rags) stipulated in company monitoring plan following government requirement of hazardous waste regulation.
- Used packaging follows end of life routes consisting of mechanical recycling, landfilling and burning.

Limitations:

The limitations of this study are as follows:

- The study bases on annual rate to have similar and equivalent unit for all emissions to enable calculation. Some emissions are available as a continuous daily or monthly rate which need to be converted to annual rate. For instance, ammonia plant catalyst functioned at a 5 year, its mass flow is obtained by dividing the catalyst tonnage by 5.
- Catalyst production is represented by NiO production but for environmental impact data covered all metal catalyst (NiO, CoMo, ZnS, FeO, and CuO).

More information:

Cut-off rules:

The implementation of the study is that all processes within the product system are not cut-off. 100% of life cycle inventory data of the total inflow from the core module have been covered. There are some processes where Pupuk Kaltim has limited data access, so that the emission and consumption calculations are based on secondary data comprising of flowrate and categorized impact.

Data quality:

The data quality as shown in Table 2.3 shows is sufficient to carry out LCIA where the data generated and accessible by Pupuk Kaltim reaches a percentage of 100%. This includes data on gas distribution, catalyst transportation, ammonia plant, urea plant, utility plant, wastewater treatment plan, HW management, air pollution control, and product transportation.

In the downstream, products are distributed to the farmers. 97% product distributed to the farmers were considered for the calculation of the end-of-life of the packagings. Data on gas wells, catalyst factories, auxiliary chemical plants, packaging factories use 100% secondary data because Pupuk Kaltim has access to these data.

Table 1 Data Category

	Input	% Data	Output	% Data
Generic Data	27	23.89	58	28.57
Primary Data	86	75.44	142	69.95
Proxy	1	0.88	3	1.48
Total	**114**	**100**	**203**	**100**

From the table above shows that 100% data categorized as primary and generic.

Agronomic Efficiency Index (AEI):

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Uptake Index (UI):

For urea application on soil is 23 460 kg/2000M2 farmland, Uptake Index for urea is represented by Nitrogen uptaken, when the urea is applied on soil, 27% of N will be uptaken by plant, while 68% will be persisted on soil and the rest which is 5% will be lost and brought by water as run off .

Content declaration

Product

Table 2 Product content declaration

Materials / chemical substances	CAS No.	%	Environmental / hazardous properties
Nitrogen		46.0 (min)	Contains gas under pressure; may explode if heated. May displace oxygen and cause rapid suffocation.
Water		0.5 (max)	Not classified as a hazardous chemica
Biuret	108-19-0	1.2-1.5	Causes severe skin burns and eye damage.

Packaging

Distribution packaging:

The products are distributed in 50 kg packing

Consumer packaging:

The product is packaged in a 50 kg capacity plastic packaging weighed 150 grams and composed of 48 grams of polyethylene and 102 grams of polypropylene

Recycled material

Provenience of recycled materials (pre-consumer or post-consumer) in the product:
The product does not contain any recycled materials

Environmental performance

Potential environmental impact

Table 3 Environmental Impact Calculation Results (Upstream-Core-Downstream)

Impact Category	Unit	Method	Impact Potential Value per Declared Unit				
			Code	Upstream	Core	Down-stream	Total
Global Warming Potential	kg CO_2 eq	CML v. January 2016	GWP100	4.18	897.00	216.51	1 117.26
Acidifi-cation Potential	kg SO_2 eq	CML v. January 2016	AP	3.65	0.70	0.24	4.59
Photo-chemical Oxidant Formation Potential	kg NMVOC eq.	ReCiPe 2008	POFP	0.20	0.35	0.02	0.57
Eutro-phication Potential	kg PO_4^{3-} eq.	CML 2001 baseline, v.January 2016	EP	0.03	0.05	0.03	0.11
Abiotic depletion potential – Elements	kg Sb eq.	CML 2001 baseline, v.January 2016	ADP elements	0.02	0.00	0.00	0.02
Abiotic depletion potential – Fossil fuels	MJ, net calorific value	CML 2001 baseline, v.January 2016	ADP fossil fuels	30 855.14	0.00	0.00	30 855.14
Water Scarcity Footprint (WSF)	m^3 H_2O eq	AWARE Method	WSF	0.01	0.00	0.00	0.01

Environmental impact category based on product system boundary as shown above, core contribute the highest GWP (897 kg CO_2 eq/Ton Urea Granules) from primary reformer (383.46 kg CO_2 eq/Ton Urea Granules). Upstream contribute the highest abiotic depletion potential – fossil fuels (30 855.14 MJ, net calorific value) from natural gas resources (29.985 MJ, net calorific value).

Use of resources

The resource use based on the life cycle inventory (LCI) per declared unit

Table 4 Indicators describing use of primary and secondary resources

Parameter		Unit	Up-stream	Core	Down-stream	Total
Primary energy resources – Renew-able	Use as energy carrier	MJ, net calorific value	0	0	0	0
	Used as raw materials	MJ, net calorific value	0	0	0	0
	TOTAL	MJ, net calorific value	0	0	0	0
Primary energy resources – Non-renew-able	Use as energy carrier	MJ, net calorific value	157	11 805	0	11 962
	Used as raw materials	MJ, net calorific value	0	30 959	0	30 959
	TOTAL	MJ, net calorific value	157	42 764	0	42 921
Secondary material		kg	2 338	14	0	2 352
Renewable secondary fuels		MJ, net calorific value	0	0	0	0
Non-renewable secondary fuels		MJ, net calorific value	0	7 041	1.28E-04	7 041
Net use of fresh water		m^3	0.14	1.06	0.00	1.20

Waste production and output flows

Waste production

Table 5 Environmental indicators describing waste production per declared unit

Parameter	Unit	Upstream	Core	Downstream	Total
Hazardous waste disposed	kg	0	8.77 E-02	0	8.77E-02
Non-hazardous waste disposed	kg	0	5.78E-01	0	5.78E-01
Radioactive waste disposed	kg	0	0	0	0

Output flows

Table 6 Environmental indicators describing output flows per declared unit

Parameter	Unit	Upstream	Core	Downstream	Total
Components for reuse	kg	0	0	0	0
Material for recycling	kg	0	6.43E-01	0	6.43E-01
Materials for energy recovery	kg	0	2.22E-02	0	2.22E-02
Exported energy, electricity	MJ	0	0	0	0
Exported energy, thermal	MJ	0	0	0	0

Verification and registration

Programme	**The International EPD System** EPD registered through the fully aligned regional hub: **EPD Southeast Asia** www.epd-southeastasia.com
Programme Operator	**EPD International AB** Box 210 60, SE-100 31 Stockholm, Sweden **EPD Southeast Asia** Kencana Tower Level M, Business Park Kebon Jeruk Jl. Raya Meruya Ilir No. 89, Jakarta Barat 11620 Indonesia https://www.epd-southeastasia.com/

EPD registration number:	S-P-04685
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Reference year of data:	2019
Geographical scope	**Indonesia**
Product group classification:	UN CPC 3461 Nitrogenous fertilizers, mineral or chemical SNI 2801:2010
Product category rules (PCR):	**Product category rules (PCR):** Mineral or chemical fertilizers Registration number, version: 2010:20, Version 3.0 UN CPC 3461, 3462, 3463, 3464 & 3465
PCR review was conducted by:	The Technical Committee of the International EPD® System. Chair of the PCR review: Lars-Gunnar Lindfors The review panel may be contacted via info@environdec.com.

Independent third-party verification of the declaration and data, according to ISO 14025:2006:	☐ EPD process certification ☒ EPD verification
Third party verifier: Approved by:	Claudia Pena Urrutia claudia@epd-americalatina.com The International EPD® System
Procedure for follow-up of data during EPD validity involves third party verifier:	☒ Yes ☐ No

The EPD owner has the sole ownership, liability, and responsibility for the EPD. EPDs within the same product category but from different programmes may not be comparable.

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Appendix

Table A Data Source for Upstream Process (PCR Mineral or Chemical Fertilizer version 3.0 2010:20)

Material	Model	Data Source	2019 Analysis	Scope	Double Counting
Natural gas	Extraction process and gas treatment calculated through generic data, stoichiometry or extraction process database and gas treatment	Composition data based on certificate of analysis, average data within 1 year	Literature (Scone &James, 20130)	Cradle to Gate Gas Extraction	No DC, since the Emission Calculation only for Gas Extraction.
Coal	Coal mining process calculated based on generic data using a model or coal mining process database	1) composition data based on certificate of analysis, average data of 1 year 2) database/ model for coal mining process	Literature (Supply data from supplier, Lab analysis results)	Product composition analysis	NO DC, Lab Analysis done to Coal before supplied to Pupuk Kaltim). Supplier do not conduct LCA (not doing calculation)
Auxilliary material (chemicals, lubricant and catalyst)	Data considered from other input from other process	Material data in generic term based on database or literature	From literature (Frazier et al 2015)	Data collected from supplier	None
Transporting coal	· Distance x load (ton. km) · Distance from supplier, considered from coal mine site · Mode of transportation used (see Table of Mode of Transport) · Load per mode	· The distance from the coal mine site is assumed to be the shortest distance between the Supplier and the Plant obtained based on Google Earth generic data or GPS. · Payload data is a total data of 1 years.	Primary data	Emission of Transport coal from Extraction location to Pupuk Kaltim's location	No DC, data used is Primary data supplied by supplier. Supplier do not conduct LCA.
Transporting auxilliary	· Distance x load (ton. km) · Distance from supplier, considered from coal mine site · Mode of transportation used (see Table of Mode of Transport) · Load per mode	· The distance from the supplier is assumed to be the shortest distance between the Supplier and the Plant obtained based on Google Earth or GPS generic data. · Payload data is a total data of 1 year.	Mileage data	Emission of Transport Auxiliary from Supplier location to Pupuk Kaltim's location	No DC data purely from transportation activity. no other calculation other than this.

Material	Model	Data Source	2019 Analysis	Scope	Double Counting
Water sources		· Data is based on direct measurement based on flowmeter, data is calculated based on a total of 1 year · The electricity consumption data for the intake pump is the primary direct measurement data based on the kwhmeter, the total data is 1 year	Seawater consumption flow rate	Gate to Gate	NO DC, using direct measurements at the main activity. Counting done on the spot.

Table B Type of Transport Mode (PCR Mineral or Chemical Fertilizer version 3.0 2010:20)

Modes of transportation	Type	Fuel Consumption (km/L)	Type of fuel (Gasoline/ Diesel/ LNG)	Reference	2019 study	Scope	Double Counting
Land	Truck double 6 tires 110 Ps – 130 Ps (4 x 2) 5 tonne payload	6 km/Liter or 1.2 ton.Km/L or 5 km/L	Diesel	Supply Chain Indonesia	The fuel consumption data used is km/L	Specific data	NO DC, Calculation done for real transportation, no other calculation other than this.
Sea	DWT 4500 – 6 000 Ton	6 – 11,5 ton/day	Diesel	Pupuk Kaltim	Conform to the ships used by Pupuk Kaltim with capacities of 1 000 tons, 8 000 tons, and 40 000 tons/day.	Specific data	NO DC, Calculation done for real transportation, no other calculation other than this.

Table C Data sources of core processes

Power Generation	**Solid waste, if using coal fuel**	**Fly ash/bottom ash direct measurement (in tons), total data 1 year.**	**-**	**Primary data from PT Pupuk Kaltim**	**Specific data**	**None**
		Transportation (distance and load) of fly ash/bottom ash to third party contractors, total data is 1 year.			Specific data	None
Power plant Steam Boiler	Water/Gas	Primary data based on measurement (flowmeter), total consumption data for 1 year	-		Specific data	None
	Solid waste, if using coal fuel	Fly ash/bottom ash direct measurement (in tons), total data 1 year.	-		Specific data	None
		Transportation (distance and load) of fly ash/bottom ash to third party contractors, total data 1 year.			Specific data	None
	Air Emission	Emission composition is direct measurement primary data based on sampling analysis every 6 months, 2 samples in 1 year	-		Specific data	None
		Air emission flow rate data based on the results of sampling 6 every 6 months, 2 samples in 1 year.			Specific data	None
Steam Boiler Generation	Air Emission	Primary Data Emission composition and flow rate based on Continuous Emission Monitoring System (CEMS), total data for 1 year.	-		Specific data	None
Power plant Steam Boiler	Blowdown from Boiler	Avoidance data	The significance of the environmental impact is assumed to be small so that it can be avoided.		Specific data	None

Production of Plants Air and Air Instruments	Steam input consumption data	Primary data Direct measurement based on flowmeter, total data 1 year.	-	Specific data	None
		The electricity used is electricity generated from the electricity generation process	-	Specific data	None
Consumption of Plant Air and Air Instrument	**Consumption of Air instruments**	**The total production of air instruments is the primary direct measurement data based on the flowmeter, the total data is 1 year.**		**Specific data**	**None**
		Water instrument consumption data is a generic data based on the calculation of total consumption divided by the number of instruments proportionally.	-	Specific data	None
Consumption of Plant Air and Air Instrument	Consumption of Air instruments	Total production of plant water is direct measurement primary data based on flowmeter, total data is 1 year. Consumption of Plant Air is generic data based on the calculation of Total Production of Plant Air divided by the total number of processes that use Plant Air proportionally.	-	Specific data	None
		Total production of plant water is direct measurement primary data based on flowmeter, total data is 1 year. Consumption of Plant Air in Urea or Ammonia Process is Primary Direct Measurement Data based on flowmeter, total data is 1 year. Consumption of Plant Air in other Processes is generic data based on the calculation of the Difference between Total Production of Plant Air and Consumption of Urea or Ammonia Processes divided by the total number of other processes that use Plant Air proportionally.	One of the plant water consumption is the result of direct measurement, the rest is generic data calculated from the results.	Specific data	None

Water Treatment	**Electricity consumption**	**Electricity consumption data is Primary generic data based on the results of the proportional calculation of electricity consumption in the utility process, Total data 1 year (in kwh)**	-	**Only the electricity consumption of the whole plant is calculated**	**Specific data**	**Only the electricity consumption of the whole plant is calculated**
	· Consumption of chemicals	Chemical consumption data is primary data, total data is 1 year.		Chemical consumption data has been included in the report	Specific data	Chemical consumption data has been included in the report
	Sludge is processed into landfill into Emission to Soil	Sludge mass data is primary data based on extrapolation from sampling data, total data is 1 year.	-	PT Pupuk Kaltim does not produce significant sludge waste	Specific data	PT Pupuk Kaltim does not produce significant sludge waste
	Solid waste, if using coal fuel	Fly ash/bottom ash direct measurement (in tons), total data 1 year.	-		Specific data	None
		Sludge composition data is primary data based on sampling data from TCLP PP no. 101/Year 2014.			Specific data	None

Table D Sources of data for products generated from the system

Product	Measurement	Unit	Period	2019	Scope	Double Counting
Ammonia	Flowmeter	ton	1 Year	Ammonia weight by flowmeter	Specific data	None
Urea	Direct measurement (scale)	ton	1 Year	Urea weight by scale	Specific data	None
CO_2	Direct measurement /Flowmeter	ton	1 Year	Flow rate based on flowmeter	Specific data	None

Southeast Asia EPD

Environmental Product Declaration

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