

1 Introduction

PT Dharma Satya Nusantara Tbk. (DSNG) operates across integrated palm oil, wood products, and renewable energy businesses, with greenhouse gas emissions arising from plantations, mills, processing facilities, and biomass operations. The 2025 GHG inventory rebaselining was prepared to strengthen DSNG's emissions accounting in line with the GHG Protocol, ISO 14064, SBTi, IFRS S2, PERPRES 110/2025, IDX ESG requirements, and other relevant reporting expectations. The assessment covers organizational and operational boundaries, FLAG and non-FLAG emissions, emission factors, and supporting data governance.

This inventory is presented in two parts. Non-FLAG emissions cover energy and industrial sources, while FLAG emissions cover forest, land and agriculture sources arising from plantation operations and the FFB supply chain. The following sections set out the methodology, system boundaries, data inventory and results, followed by hotspot analysis, peer benchmarking and emission reduction recommendations.

Company information and the reporting period are presented in Table 5.

Table 6: Company information

Company information	
Website	https://dsn.co.id/
Business area	Palm oil cultivation, milling and refining
Operating units covered	3 strategic business units, 25 entities, 97 estate, 19 mills, 4 bulking facilities, 1 KCP, 2 CNG facilities, 47 supporting facilities
Reporting period	1 January 2025 to 31 December 2025
Base year	FY2025

1.1 Methodology

GHG accounting and reporting follows the 'Greenhouse Gas Protocol: A Corporate Accounting and Reporting Standard' and the complementary 'Corporate Value Chain (Scope 3) Accounting and Reporting Standard', supplemented for land-intensive activities by the 'GHG Protocol Land Sector and Removals Guidance' and the 'SBTi FLAG Guidance'. Accounting was based on the following principles:

- **Relevance:** an inventory boundary that reflects the GHG emissions of the company and serves the decision-making needs of users.
- **Completeness:** all emission sources within the chosen inventory boundary are accounted for, and any specific exclusion is disclosed and justified.
- **Consistency:** meaningful comparison of information over time, with transparently documented changes.
- **Transparency:** sufficient and clear data inventory, with relevant issues addressed coherently.
- **Accuracy:** minimised uncertainty and avoided systematic over- or under-quantification.

1.1.1 Non-FLAG methodology

Non-FLAG emissions cover energy-, process- and value-chain-related sources at DSNG's estates, mills, bulking stations, wood-panel and flooring plants, renewable-energy units

and offices. This follows the GHG Protocol Corporate Standard and the Corporate Value Chain (Scope 3) Standard, for the 2025 reporting period. Activity data were collected from the group's SAP records, fuel and electricity recaps, and mill process logs, and each record was traced to a source file in the data-collection checklist. Every activity was matched to an emission factor by category, approach and unit, and a result was calculated only where the activity unit and the factor unit were identical.

Fossil emissions are reported as non-biogenic. Biogenic CO₂ from burning biomass and the biodiesel share of B40 is reported separately, outside the scopes. The CH₄ and N₂O from biomass combustion stay in Scope 1.

TEMPLATE NOTE: POME methane is a large source for most palm oil operators and sits under Non-FLAG Scope 1 as a process emission, not under FLAG. Confirm this classification with the client before issuing.

1.1.2 FLAG methodology

FLAG emissions were quantified and reported separately from Non-FLAG emissions in accordance with SBTi FLAG Guidance. Land use change (LUC) was assessed using available LUCA records and spatial land-cover information, supported by remote-sensing datasets where required. Gross carbon stock losses from identified land conversion were estimated using Indonesia's FREL 2022 carbon-stock data, covering relevant aboveground biomass, belowground biomass, dead organic matter, and soil organic carbon pools. LUC emissions were allocated using linear amortisation over 20 years from the year of conversion.

Land-management emissions were quantified using a combination of direct and indirect activity data, depending on data availability. This included emissions from synthetic and organic fertiliser application, crop residues, and other relevant cultivation activities. Emission factors were primarily based on the 2019 Refinement to the IPCC Guidelines, with earlier IPCC guidance applied where no updated factor was available in the 2019 Refinement. Biomass-burning emissions were included only where burning was identified.

For nucleus and plasma areas with spatial and land-use history available, LUC was assessed at land-management-unit level. For third-party FFB and raw material for wood-related purchases where supplier-specific polygons or historical land-cover data were not available, FLAG emissions were estimated using a jurisdictional or regional land-use-change proxy based on the relevant sourcing area and purchased FFB and wood volume. Supplier-specific traceability data were used where available, while regional average factors were applied to the remaining untraceable volume.

1.1.3 Emission factors and global warming potential (GWP)

Global Warming Potential (GWP) is a measure of the climate impact of a greenhouse gas relative to carbon dioxide over a specified time horizon. The GWP values applied in this inventory are presented in Table 7. IPCC AR6 100-year values are used to determine the GWP. A full listing of emission factors and their sources is provided in Annex I.

Table 8: Applied global warming potentials (GWP)

Greenhouse gas	GWP (100 years)
Carbon dioxide (CO ₂)	1
Methane (CH ₄), fossil	27
Methane (CH ₄), biogenic	273
Nitrous oxide (N ₂ O)	1,526
Hydrofluorocarbons (HFCs)	164 – 14,590
Perfluorocarbons (PFCs)	7,378 – 13,902
Sulphur hexafluoride (SF ₆)	23,500
Nitrogen trifluoride (NF ₃)	16,100

Source: IPCC AR6, 2021

1.2 System boundaries

1.2.1 Organizational boundaries

DSNG's GHG inventory follows the operational control approach, under which GHG emissions are accounted for from operations over which DSNG has operational control during the reporting period.

The organizational boundary covers DSNG's three principal business activities: Palm Oil, Wood Products, and Renewable Energy, as well as the Head Office included in the GHG calculation.

The Palm Oil business covers the relevant estates, palm oil mills (PKS), bulking facilities, CNG facilities, kernel crushing plant (KCP), and supporting facilities. The Wood Products business covers the Panel and Floor operations, while the Renewable Energy business covers operations under DSE and BLN. The boundary also includes DSNG's Head Office and relevant regional or supporting offices where associated emission generating activities are included in the GHG inventory. An overview of the organizational boundary is presented in Table 9.

Table 10: Organisational boundaries

Business Activity	Operation / Facility Type	No. of Operating Units	Included in GHG Inventory
Palm Oil	Estates	97	Yes
	Palm oil mills (PKS)	19	Yes
	Bulking facilities	4	Yes
	CNG Facilities	2	Yes
	Kernel Crushing Plant (KCP)	1	Yes
	Supporting Facilities	47	Yes
Wood Products	Panel	1	Yes

Annex I: Emission factors

Table 28: Emission factors

Activity	Emission factor reference
Stationary and mobile combustion	KESDM (2019) national CO ₂ emission factors for diesel and petrol, adjusted for the B40 biodiesel blend; IPCC (2006) Guidelines for National Greenhouse Gas Inventories, Vol. 2, Ch. 3 (CH ₄ and N ₂ O); DEFRA/DESNZ (2025) GHG Conversion Factors (petrol pumps, compressed biomethane); biomass (fibre, shell, bark) CH ₄ and N ₂ O: national supplier-specific value (secondary data) following IPCC 2006 methodology
Grid electricity	KESDM (2019) Faktor Emisi Listrik, Jamali and Kalimantan grids (location-based)
POME methane	IPCC methane correction factor approach (IPCC (2019) Refinement to the 2006 IPCC Guidelines, Vol. 5, Ch. 6); COD-based factor of 5,400 kgCO ₂ e per tCOD
Wastewater and on-site waste	IPCC (2019) Refinement to the 2006 IPCC Guidelines, adjusted to typical inlet wastewater quality by site; IPCC (2006) for on-site organic waste treatment; Australian Government (2025) National Greenhouse Accounts Factors for on-site landfilled treatment; Petrik et al. (2024), Dutch mixed plastics waste DKR-350
Refrigerants	IPCC AR6 GWP (fire-extinguisher CO ₂ only); refrigerants R22, R32 and R410: IPCC AR6 GWP Values
BioCNG plant fugitive methane	IPCC (2019) Refinement, leakage rate and CH ₄ content of BioCNG
Fertilisers and agrochemicals	Brentrup et al. (2018), South-East Asia (NPK, urea, potassium chloride, superphosphate, limestone); ISCC EU (2016) (borate, kieserite); glyphosate: Brookes (2026), glyphosate production; ClimaTiq (2025) EU average herbicide and insecticide manufacturing; pesticides: FAO (2017) on global database of GHG emissions related to feed crops;
Other purchased goods and services	Watershed (2025) spend-based factors, adjusted from USD to IDR; ClimaTiq (2022, 2024, 2025) material datasets; aluminium sulphate and CaCO ₃ : CarbonCloud (2026); plywood: Muller, et al. (2023); PAC: Chai et al. (2015); published EPDs and LCAs listed in Annex II
Capital goods	US EPA (2025) Value Chain spend-based factors; Indonesia sector spend-based factors: Watershed (2025), adjusted from USD to IDR
Fuel- and energy-related activities (WTT and T&D)	DEFRA/DESNZ (2025) GHG Conversion Factors
Upstream and downstream transportation	DEFRA/DESNZ (2025) GHG Conversion Factors: freighting goods; Eco Transit (2025) (truck class 12 and container ship); Watershed (2025) for the spend-based remainder
Processing of sold products	Rosmeika et al. (2025), Environmental Impact of Palm Cooking Oil: A Case Study in Sumatra, Indonesia (CPO refining); Linders (2020) (palm kernel oil to food grade); Subramaniam and May (2012) (palm kernel to palm kernel oil); Heidari et al. (2023) (prefinished engineered flooring)
Use and end-of-life of sold products	DEFRA/DESNZ (2025) bioenergy factors; biomass CH ₄ and N ₂ O: national supplier-specific value (secondary data) following IPCC 2006 methodology
Waste generated in operations	US EPA (2025) WARM waste factors; Australian Government (2025) National Greenhouse Accounts Factors; DEFRA/DESNZ (2025)
Business travel and employee commuting	Hotel stays: Greenview (2026); bus: US EPA (2025) Value Chain; flights: BEIS (2025); commuting by car, motorcycle and rail and bus proxies: BEIS (2025)
Investments	Watershed (2025) spend-based factors, adjusted from USD to IDR

Activity	Emission factor reference
Land use change (dLUC)	Indonesia FREL 2022 (Forest Reference Emission Level)
Land use change from purchased FFB and wood (jLUC and sLUC)	WRI and Quantis (2025) Statistical Land Use Change Emissions from Deforestation and Land Occupation for Crops (purchased FFB); purchased wood: Muller, et al. (2023)
Fertiliser-induced N ₂ O	IPCC (2019) Refinement to the 2006 IPCC Guidelines (organic and non-organic fertiliser)
Liming and urea application	IPCC (2019) Refinement to the 2006 IPCC Guidelines (organic and non-organic fertiliser)
Open burning	IPCC (2019) Refinement to the 2006 IPCC Guidelines (organic and non-organic fertiliser)
Purchased FFB (FLAG)	WRI (2025) for purchased FFB; Müller, Szemkus and Hiete (2023), Carbon balance of plywood from a social reforestation program in Indonesia, Scientific Reports 13 (purchased plywood)
Biomass carbon stock	FREL (2022); IPCC (2019) Refinement (crop residue net biogenic emissions)

Bestari Sustainability derives its emission factors from reliable and credible sources and is not responsible for inaccuracies in emission factors provided by third parties.

Annex II: Data assumptions and extrapolations

The data inventory, emission factors and assumptions follow the principles of the GHG Protocol and the SBTi FLAG Guidance. Where activity data was unavailable, extrapolations and estimations were made using a conservative approach. The assumptions applied to each category are set out below.

Stationary and mobile combustion

Fuel consumption is quantified mainly with fuel-based factors. Fuel types and units vary by activity; biomass-related CO₂ is recorded separately as biogenic.

Electricity

Purchased electricity is quantified using a location-based method and ESDM grid factors.

POME and effluent treatment

POME methane is calculated from m³ which is converted to tCOD unit activity data based on COD influent and effluent quality, emission calculation is using a mass-based factor of 5,400 kgCO₂e/tCOD in the workbook.

Domestic and Industrial Wastewater

For Head Office (HO), domestic wastewater quantities were based directly on the data provided in the file N12. Limbah Cair Domestik HO.xlsx.

For the Palm Oil (PO) SBU, where measured domestic wastewater quantities were unavailable, wastewater generation was estimated using a per-capita water consumption assumption of 150 L/person/day, with 80% of water consumption assumed to become wastewater. The resulting wastewater generation factor was multiplied by the total number of employees and their family members. Influent and effluent wastewater quality parameters were estimated using references from published journals and studies representing employee residential areas and office-related facilities, including offices and employee accommodation/mess facilities, in Kalimantan.

For the Wood Product (WP) SBU, domestic wastewater quantities were based on the data provided in Limbah Padat & Cair WP.xlsx. It was assumed that 46.7% of total domestic wastewater constitutes blackwater. Influent wastewater quality was estimated based on literature values applicable to office areas, while effluent quality was based on monitoring data contained in Limbah Padat & Cair WP.xlsx. Industrial wastewater was included only for the Panel facility, as this facility applies biological wastewater treatment.

For the Renewable Energy (RE) SBU, domestic wastewater generation was estimated using the wastewater generation intensity observed at the WP Floor facility, equivalent to 0.0864 m³/person/day, multiplied by the number of employees.

Fertilisers and agrochemicals

Physical mass/activity data are used for major fertilisers and agrochemicals where available; item-specific and regional factors are applied. Item units are converted into kg.

Purchased goods and services

A mix of mass-based, average-data and spend-based methods is used. Mass-based and average data are prioritised for items that Spend-based estimates are suitable for screening but carry higher uncertainty.

Transportation and distribution

Upstream Transportation and Distribution

Upstream transportation assumptions were developed separately for fertilisers and chemicals, FFB, and other purchased items, reflecting differences in available supplier and routing information. Transportation distances were primarily derived from Transport Upstream_Update by SC.xlsx for fertilisers and chemicals, Jarak Pemasok ke PKS DSNG.xlsx for FFB, and Norma.xlsx for other purchased items. For other materials, the transportation proxy was generally assigned based on the identified sender or supplier. Detailed calculations are maintained in the ZPRGR / Upstream Transportation PO calculation files.

Downstream Transportation and Distribution

Downstream transportation was modelled as a multimodal chain where applicable, comprising land transport from the DSNG facility to the origin port, sea freight to the destination port, and final land transport to the customer. Sea and air freight distances were estimated using EcoTransIT, while land distances were estimated using Google Maps.

For Wood Product shipments, routing assumptions were based on Downstream Transport WP Floor and 01.Data Sales Panel 2025.xlsx. Domestic deliveries within Java were estimated from the Temanggung facility to the indicated destination city. For export shipments, the route generally covered Temanggung–Semarang Port, Semarang Port–destination port, and destination port–customer. Where exact customer locations were unavailable, representative city-level locations or an average port-to-customer distance of 21.4 km were applied.

Where shipment-specific information such as sea freight mode, vessel type, and number of containers was available from invoice data, these were used directly. Flooring unit conversions were based on available export information for wooden flooring under HS Code 44189910 and supporting information in 01.Data Sales Panel 2025.xlsx.

Waste generated in operations

Where actual solid waste quantity data were unavailable, solid waste generation was estimated using a per-capita waste generation intensity derived from TPST data, multiplied by the number of employees and their family members residing within the relevant operational area.

The waste generation intensity was derived from TPST data for the period October to December. The total quantities of organic waste, economically valuable inorganic waste, and non-economically valuable inorganic waste generated during this period were divided by the corresponding total number of employees and family members. The resulting waste generation intensities were:

Waste type	Waste generation intensity
Organic waste	0.12 kg/person/day
Economically valuable inorganic waste	0.01 kg/person/day
Non-economically valuable inorganic waste	0.10 kg/person/day

The underlying waste data and employee population used to derive these intensities were obtained from the TPST waste monitoring spreadsheet provided by DSNG.

Business travel and employee commuting

Travel calculations use distance, hotel-night and/or spend-based methods depending on data availability. Commuting of HO staff is based on survey while others is using proxy of 0.5–2 km from the working place.

End-of-Life Treatment

End-of-life assumptions for wood products were developed based on studies covering wood waste and construction-related wood waste management in Japan, the United States, and Europe.

For Panel products, the end-of-life pathway was assumed to involve recovery of the wood material for use as biomass energy.

For Panel products that are subsequently processed into flooring, recycling into wood chips for the manufacture of new products may be technically possible where the recovered material remains of sufficient quality. However, for the purposes of the GHG inventory, a conservative or worst-case assumption was applied whereby the recovered wood material is ultimately used as biomass energy rather than credited with continued material recycling.

For engineered flooring, the end-of-life pathway was similarly assumed to involve recovery for biomass energy, based on waste-management practices identified in studies from Europe and the United States.

Land use change (dLUC)

- Timeframe (2001–2025): Land-use changes were evaluated from 2001 to 2025 (aligned with a 25-year palm cycle)
- Emission Factors: Used a hybrid approach combining IPCC defaults (Tier 1) with Indonesia's FRL (Tier 2) where available
- Soil Carbon: Followed IPCC data for Kalimantan (Tropical Wet, LAC soils), applying a 40% soil carbon loss for forest conversions (van Straaten et al., 2015; Finstad et al., 2020) and only applicable for conversions from forest to cropland. For all other land types, it is set to 0 because, according to the LUCA report, some of land cover was already degraded or non-forest, thus not triggering significant soil carbon loss
- Satellite Mapping: Unmatched land transition matrix values (<0.6 ha) were rounded. Certain 2025 'bare ground' detections were influenced by spectral range from canopy pruning rather than new land clearing (confirmed by signed 2026 SAP ha statment by DNSG)
- Excluded Carbon Pools: For non-natural forest conversions, changes in deadwood and litter were set to zero (per IPCC Tier 1 guidelines, these pools quickly reach equilibrium ($dCDOM/dt = 0$) in non-forest lands, resulting in no net long-term carbon change
- No Biomass Burning & No Peatland: Land clearing was strictly mechanical (clear-cutting and auger boring for soil preparation) with no fire used ($BB=0$). Furthermore, all plantation occurred strictly on mineral soils with no peatland present ($Sdir=0$), resulting in zero emissions from peat drainage or organic soil conversion

Fire burning emissions

- The calculation uses the burned area as the *primary activity data* and only covers reported fire-affected areas
- The fire severity is assumed to be limited to the *surface level* of the oil palm plantation, affecting mulch, litter, shrubs, and undergrowth, without completely burning the entire land cover and/or land use

Fertiliser-induced N₂O and soil emissions

Fertiliser emissions were calculated using actual fertiliser application data for the reporting period. The calculation covers both direct and indirect N₂O emissions from nitrogen inputs, using emission factors and pathways based primarily on the 2019 Refinement to the IPCC Guidelines.

Purchased FFB, CPO, and wood products (FLAG supply chain)

Wood products

- Electricity use for veneer production is estimated at 40%, as the process only includes *rotary peeling* and *drying*, without *hot pressing* or *sanding*
- Electricity use for *sawn timber* is estimated at 30%, as the material only undergoes the sawing process
- Electricity use for logs is assumed to be zero, as roundwood does not undergo further processing at the facility
- Electricity use allocated to sawdust is estimated at <5%, as most of the material is generated as a residual material
- Upstream transportation for *sawmill products* is assumed to be lower than for *plywood*, reflecting generally shorter raw-material sourcing distances (90%), with 20% allocated to log transportation and <5% to sawdust
- Chemical resin/adhesive use is applied only to *plywood*; other wood products are assumed to have zero resin/adhesive use
- Emissions from *land management* are assumed to contribute <5%, as most of the wood is sourced from agroforestry systems