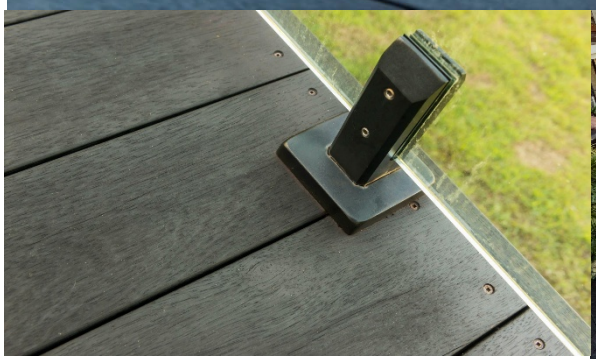
LCA STUDY REPORT

Heimu (Merbau TMT)

Version 1.0 (2025-08-01)

CV KHARISMA DUTA UTAMA



Contents

General information

Life Cycle Assessment (LCA) study of HEIMU (MERBAU TMT)
Commissioner of LCA study, LCA practitioner: Agusta Samodra Putra, Hismiaty Bahua, Inna Zulfa Kurniawati, Hasbie Hasbillah *(Tropical Forest Foundation)*
Date of issue of LCA report: 2025-08-01
The Life Cycle Assessment study has been performed in accordance with the requirements of ISO 14040-44 (LCA methodology), ISO 14025 (EPD), EN15804+A2, EN16760:2015, Applicable PCRs: Wood-Based Products, Basic Product from Forestry, JRC Characterization Factor EF 3.1
Geographical Scope Indonesia

Company information

CV. Kharisma Duta Utama is an established industrial wood processing company located in Gresik Regency, East Java, Indonesia. With over 20 years of experience, the company utilizes advanced wood processing technology. The company is committed to sustainable and reliable wood processing operations and has held SVLK certification since 2014 and FSC-CoC certification since 2016. CV Kharisma Duta Utama's finished products are primarily used for household and garden components, with export markets in Asia, Europe, Australia and New Zealand. The company is committed to using raw materials that originate from secure, legal and sustainable sources.

As part of our commitment to sustainability and reducing our environmental impact, we believe that a scientific study is needed to measure and quantify the environmental impact of each stage of our wood processing production. We expect the results of this study to inform future improvements at CV Kharisma Duta Utama. One tool that can be used to achieve this is the Environmental Product Declaration (EPD), which is based on Life Cycle Assessment (LCA).

Owner of the LCA study

CV. Kharisma Duta Utama

Contact

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Location of production site : Gresik
Address : Jl. Mayjend Sungkono No.53, Gresik East Java, Indonesia

Description of the organization

CV. Kharisma Duta Utama is a well-established industrial wood processing company based in Gresik Regency, East Java, Indonesia. Following global market development, all wood products must be made from traceable, legally sourced timber and managed sustainably. The management expressed its commitment that all wood raw materials used will be 100% FSC certified. Currently, CV Kharisma Duta Utama is 100% FSC certified with Certificate Number CU-COC-857403, issued by certification body CONTROL UNION CERTIFICATIONS. Furthermore, CV Kharisma Duta Utama also has a timber legality certificate in the form of SVLK with Certificate Number VLK 00024 issued by SUCOFINDO INTERNATIONAL.

Product-related or management system-related certifications

The manufacturing process is in accordance with the international standards as follows:

FSC certification

FSC (Forest Stewardship Council) Certification is an international certification granted to wood, paper, or other forest-based products that come from environmentally, socially, and economically responsible forest management.

CV. Kharisma Duta Utama has obtained this certification under the **certificate number: CU-COC-857403**, with the certification type **Chain of Custody (CoC)**. This certification ensures that the company has implemented a supply chain control system that guarantees its products come from responsibly managed sources in accordance with FSC standards.

SVLK certification

SVLK (Timber Legality Verification System) is an Indonesian national certification system that verifies that **timber and timber products are sourced and processed legally**, in compliance with Indonesian regulations on forest governance and sustainability.

The SVLK certificate is issued by the Ministry of Environment and Forestry (MoEF) of Indonesia to ensure that the harvesting, transportation, processing, and trading of timber are carried out legally and responsibly.

Objectives of SVLK:

- To prevent illegal logging
- To improve the competitiveness of Indonesian timber products in global markets
- To support sustainable forest management and good governance

CV. Kharisma Duta Utama has been granted a **SVLK (Timber Legality Verification System)** certificate with the registration number **VLK-00024**. This certification confirms that the company complies with Indonesia's timber legality standards and ensures that its wood products are sourced, processed, and traded in accordance with legal and sustainable practices.

Product information

Product name

Heimu (Merbau TMT)

Product identification

Heimu (Merbau TMT) is a thermally modified timber product derived from Merbau wood (*Intsia bijuga*), a tropical hardwood species known for its exceptional strength, natural durability, and rich appearance. The raw material used in the production of Heimu is responsibly sourced from the Papua Forest, which is legally licensed and certified under the PHPL (Sustainable Production Forest Management) system, ensuring compliance with national and international sustainability and legality standards.

The production process involves the transformation of wet (green) Merbau timber into a finished product through a chemical-free thermal modification process. This process alters the wood's cellular structure to significantly improve its dimensional stability, resistance to decay, insect resistance, and weather durability. As a result, Heimu (Merbau TMT) provides a longer service life compared to untreated wood, with reduced maintenance requirements.

The final product is manufactured to meet the moisture content (MC) levels specified in applicable product standards, ensuring suitability for both indoor and outdoor applications. Heimu (Merbau TMT) is widely used in residential, commercial, and public projects for structural and decorative purposes.

Product characteristics

Heimu Product (Merbau TMT) is characterized as a hardwood, offering long-lasting durability for both outdoor and indoor applications. This is due to its composition from Merbau wood that has undergone a thermal modification process (TMT), including rigorous drying procedures and testing to assess moisture content and overall product quality. As a result, the final product exhibits enhanced stability and resistance, making it suitable for long-term use in various environments.

Materials content of product

100% Merbau wood

Packaging characteristics:

Heimu Product (Merbau TMT) is packed using plastic material that complies with international shipping standards, specifically utilizing PTE-type plastic. Each shipment or product packaging is arranged per pallet and reinforced with strapping bands, along with an outer plastic wrap to ensure the safety and protection of the products during container

loading. This packaging method ensures that the product remains secure and intact throughout the transportation process to the customer.

Dangerous substances (if any)

-

Product application

Heimu (Merbau TMT) is a thermally modified timber product derived from Merbau wood. The thermal modification process, carried out without the use of chemical additives, enhances the wood's dimensional stability, durability, and resistance to biological degradation. This environmentally friendly treatment makes Heimu a sustainable choice for a wide range of architectural and structural applications.

Due to its improved performance characteristics, Heimu (Merbau TMT) is suitable for both outdoor and indoor uses, including components in residential, commercial, and public space construction.

Typical applications include:

- Outdoor areas: decking, façades, exterior stairs, garden furniture, and partitions

- Indoor areas: flooring, ceilings, door and window frames, staircases, and wall paneling

The combination of natural aesthetics, environmental responsibility, and enhanced performance makes Heimu (Merbau TMT) a preferred choice for architects, builders, and designers seeking sustainable wood solutions.

HS code

4407.29.91 / 4409.22

UN CPC code

31102

Geographical scope

- The products are manufactured in Indonesia (modules A1-A3)
- A1: Biak, Indonesia
- A3: Gresik, Indonesia

LCA information

Goal and Scope

The objective of this LCA study:

1. To assess the environmental performance of producing 1 m^3 of Heimu (Merbau TMT)
2. To apply an LCA study for the environmental product declaration of Heimu (Merbau TMT) for business-to-business and business-to-customer.

Declared unit

The declared unit is 1 m^3 of Heimu (Merbau TMT) at the manufacturer's gate.

Reference service life

The general service lifetime of Heimu (Merbau TMT) is more than 50 years, depending on the moisture and environmental exposure.

Time representativeness

The inventory data refers to the 12-month period between 2024-01-01 – 2024-12-31, representing conventional operation conditions and average results used for the LCA calculation.

Database(s) and LCA software used

The LCA software is OpenLCA software system (2.5 version). Ecoinvent v. 3.10 provides the life cycle inventory dataset for several of the raw and process materials obtained from the upstream system. No datasets older than 10 years were used.

Electricity Mix

The climate impact of Indonesian electricity is used for power generation, transmission, and distribution in this LCA study. The dataset for electricity used is from EcoInvent v. 3.10, the inventory is modelled for Indonesian case.

Methodology

The following impact models have been used:

1. EN 15804+A2
2. EF 3.1 characterization factor

System Boundary

Description of system boundaries:

The LCA is divided into three information modules during the production stage. Information modules A1-A3 are based on actual site-specific information from CV KDU and background dataset from the EcoInvent database. The infrastructure for management purposes is not included in this study.

A1: Upstream

According to EN 15804, A1 shall include all raw material extraction and processing of auxiliary material inputs. Therefore, A1 consists of all production of raw material, such as wood plantation, energy generator (electricity), packaging, and auxiliary material input. Wood raw material was extracted from PT. Wapoga Mutiara Industries Biak, Papua Indonesia.

A2: Transport to the manufacture

Transport is relevant for the delivery of raw materials from suppliers to the gate of the manufacturing site. Raw materials for the production are transported by shipping and land transportation. Wood raw materials for the production are transported by Ship in a container from Biak to Surabaya Indonesia and with Trucking from Port Surabaya to Factory CV Kharisma Duta Utama at Gresik, Indonesia.

A3: Manufacturing

The production of Heimu (Merbau TMT) involves raw material incoming storage, kiln dry (KD), TMT treatment, Blanking, Cross cut, Ripsaw, Molding, and Packaging. It also covers internal transport support between operations, the boiler, and maintenance.

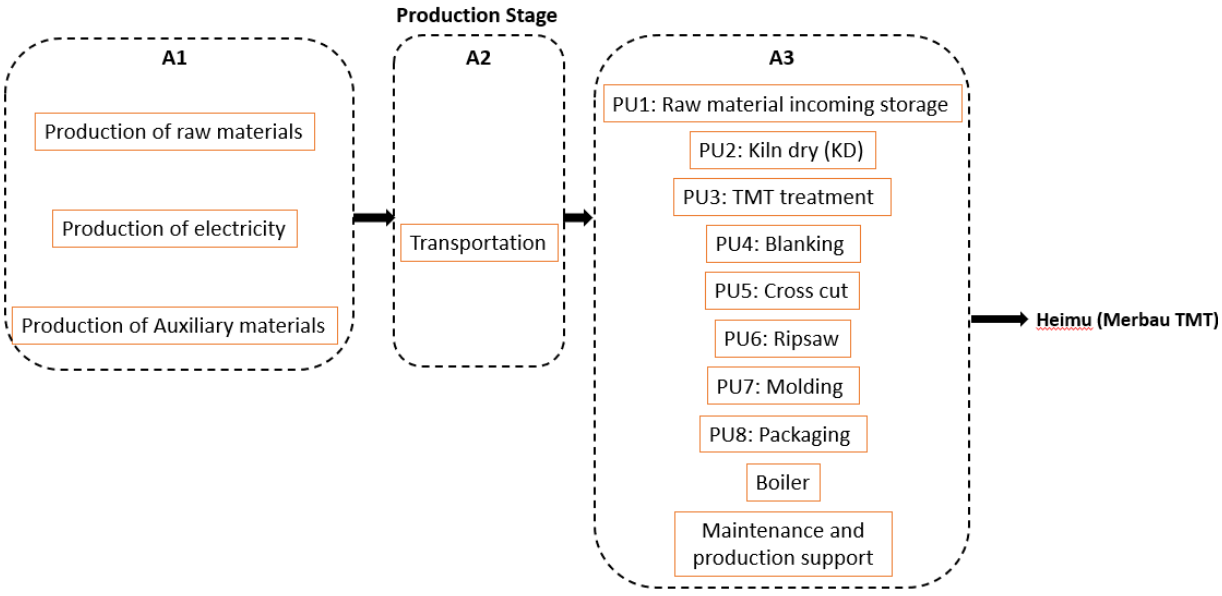

Figure 1: Technical flowchart of system boundary

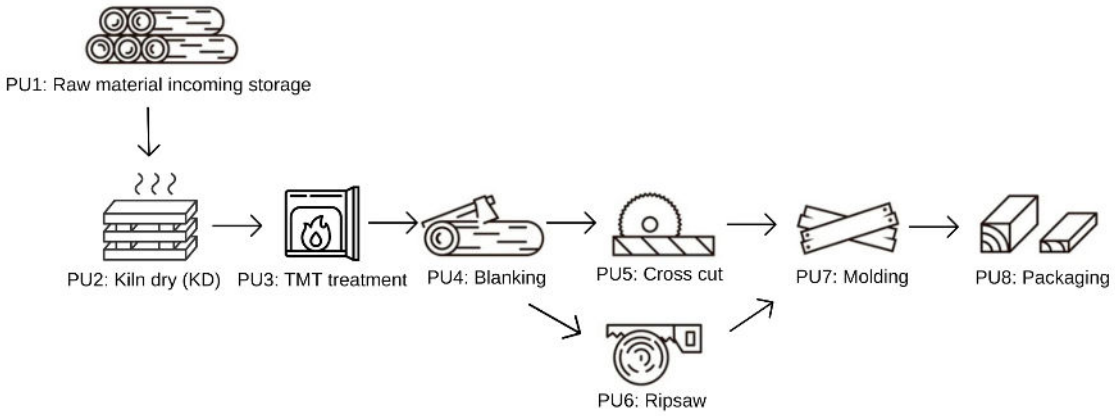

Figure 2: Manufacturing process unit (PU)

PU1: Raw material incoming storage

The process begins with the receipt of raw Merbau timber, sourced from sustainably managed and certified forest concessions. Upon arrival at the production site, the wood undergoes verification and quality inspection. It is then stored under covered, ventilated facilities to prevent degradation before entering the drying phase. Moisture content and wood density are monitored to prepare the timber for controlled processing.

PU2: Kiln dry (KD)

The initial drying process is carried out in kiln chambers using thermal energy (steam-based) and forced-air circulation to reduce the moisture content of the wood to a level suitable for thermal modification. This phase takes place over several weeks, under controlled temperature and humidity conditions. Water misting and air exchange systems are used to manage the drying rate and prevent defects such as cracking or case hardening. This step aligns with industry standards for hardwood kiln drying.

PU3: TMT treatment

Once dried, the timber undergoes a thermal modification process, which involves heating the wood at high temperatures in a low-oxygen environment. This process chemically alters the wood's structure to increase its resistance to biological degradation, dimensional instability, and moisture absorption. The procedure is entirely chemical-free, relying solely on controlled heat and steam, and is recognized as an environmentally preferable alternative to conventional chemical treatments. The wood is then cooled and conditioned before further processing.

PU4: Blanking

Following thermal modification, the timber is roughly dimensioned through a blanking process. This involves cutting the wood into standardized lengths and widths, preparing

it for more precise machining. Blanking ensures efficient use of raw material and minimizes internal stress prior to detailed profiling.

PU5: Cross cut

In the cross-cutting stage, timber is trimmed to shorter lengths based on product specifications. This step enables flexible sizing for various applications such as flooring, decking, or cladding. Off-cuts and defective sections are separated and typically redirected for reuse or energy recovery.

PU6: Ripsaw

Ripsawing reduces the width of timber pieces by cutting them longitudinally. This enables the production of narrow profiles, which are required for finished products. Precision cutting ensures dimensional accuracy and surface uniformity.

PU7: Molding

At this stage, the wood is molded into its final shape, depending on the intended application, such as decking boards, flooring planks, or architectural cladding. Molding machines profile the timber, add grooves or chamfers, and smooth the surfaces. Quality control is performed to ensure that all pieces meet the tolerances for shape and size as specified in relevant product standards.

PU8: Packaging

Final products are cleaned, graded, and packaged for distribution. Packaging materials typically include protective plastic wrap, straps, and labels. For export or longer storage, products may also be waxed or treated to enhance durability during transport. This stage ensures the product maintains its quality and traceability through the supply chain.

The system boundary on Heimu (Merbau TMT) production adapted *cradle-to-gate*.

Table 1 Modules declare and geographical scope

	Product stage			**Construction**		**Use Stage**							**End-of-life**					**Recycling potential**
Modules	A1	A2	A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4		D
Modules declared	x	x	x	-	-	-	-	-	-	-	-	-	-	-	-	-		-
Geography	ID/GLO	ID/GLO	ID	-	-	-	-	-	-	-	-	-	-	-	-	-		-
Share of specific data	>95%																	

x: module included; A1: raw material supply; A2: transport to A3; A3: Manufacturing; A4: transport to A5; A5: construction and installation; B1: Use; B2: Maintenance; B3: Repair; B4: Replacement; B5: Refurbishment; B6: Operational energy use; B7: Operational water use; C1: De-construction demolition; C2: transport; C3: Water processing; C4: Disposal; D: Reuse-recovery-recycling potential

Share of specific data: data gathered from the actual manufacturing plant where product-specific processes are carried out.

Geography:

A1: Modeled background LCI database based on the information from the manufacturing plant regarding the specific amount.

A2: Modeled background LCI database for transportation data, as specific distance for material transport.

A3: Data gathered from the specific data in the manufacturing plant

Cut-Off rule:

The life cycle inventory (LCI) for this EPD has been developed in accordance with the cut-off rules specified in EN 15804+A2. All known material and energy flows contributing to the system have been included. In accordance with the standard, at least 95% of the total mass and energy inflows per module are accounted for in the inventory data. Any excluded flows are considered to be of negligible environmental relevance and are not expected to significantly affect the overall outcome of the life cycle assessment.

Assumptions and Limitations

This EPD is based on specific production data and process information from a manufacturing facility located in Indonesia. The assessment is limited to the product stage (Modules A1–A3) and does not include the use phase or end-of-life stages.

Geographical coverage: Indonesia (production site and raw material origin)

Temporal coverage: The data represent the average annual production over a 12-month period

Technological coverage: Site-specific technologies for thermal modification, sawing, and molding of Merbau timber.

Allocation rule

In this study, no allocation was used.

Life Cycle Inventory

Life Cycle Inventory (LCI) analysis entails collecting data and performing calculations to quantify the material and energy inputs and outputs associated with a product system. All inputs and outputs of a unit operation linked to the entire product system are referenced to the system's final product of the declared unit as 1 m3 of Heimu (Merbau TMT). Input and output data from unit processes are collected as part of the LCI analysis. Depending on the required data quality, different sources, including on-site measurements and data from established databases, were provided in this study.

Specific data in this study derived from specific production processes or average data derived from specific production processes shall be the first choice as a basis for calculating this EPD. For all inputs and outputs in the manufacturing stage (A1-A3). The specific data (A1-A3) of all inputs- output value is based on an annual average production for the 2024 January 01 – 2024 December 31 by various data collection methods such as raw material, chemical, electricity used and waste generation recording.

Table 2 LCI of foreground data (PU1 A3) for 1 m3 of Heimu (Merbau TMT) as FU

Category	Materials	Value	Unit	Dataset
Input				
Raw material	Merbau sawn wood (MC 50%)	1.19	m3	Sawlog and veneer log, meranti, measured as solid wood under bark (RoW)
Output				
	Wood for KD (MC 35%)	1.19	m3	
Emission to air	Water	152.28	kg	

Table 3 LCI of foreground data (PU2 A3) for 1 m3 of Heimu (Merbau TMT) as FU

Category	Materials	Value	Unit	Dataset
Input				
	Wood for KD (MC 35%)	1.19	m3	
Energy	Steam from boiler	423.529	m3	
Energy	Electricity	52.38	kWh	Electricity, high voltage (ID)
Output				
	Wood for TMT (MC 16-18%)	1.19	m3	
Emission to air	Water	217.66	kg	

Table 4 LCI of foreground data (PU3 A3) for 1 m3 of Heimu (Merbau TMT) as FU

Category	Materials	Value	Unit	Dataset
Input				
	Wood for TMT (MC 16-18%)	1.19	m3	
Energy	Electricity	488.802	kWh	Electricity, high voltage (ID)
Output				
	Dry Wood TMT	1.19	m3	
Emission to air	Water	172.58	kg	

Table 5 LCI of foreground data (PU4 A3) for 1 m3 of Heimu (Merbau TMT) as FU

category	Materials	Value	Unit	Dataset
Input				
	Dry Wood TMT	1.19	m3	
Energy	Electricity	8.08	kWh	Electricity, high voltage (ID)
Output				
	BBK blanking TMT wood	1.18	m3	
Waste	Wood dust	0.004	kg	Collected in dust collector

Table 6 LCI of foreground data (PU5 A3) for 1 m3 of Heimu (Merbau TMT) as FU

Category	Materials	Value	Unit	Dataset
Input				
	BBK blanking TMT wood	0.82	m3	
Energy	Electricity	3.905	kWh	Electricity, high voltage (ID)
Output				
	BBK crosscut TMT wood	0.699	m3	
Waste	Wood dust	0.036	kg	Collected in dust collector
Waste	Off cut wood	0.132	kg	95% to boiler, 5% to joint finger wood

Table 7 LCI of foreground data (PU6 A3) for 1 m3 of Heimu (Merbau TMT) as FU

category	Materials	Value	Unit	Dataset
Input				
	BBK blanking TMT wood	0.35	m3	

category	Materials	Value	Unit	Dataset
Energy	Electricity	0.678	kWh	Electricity, high voltage (ID)
Output				
	BBK ripsaw TMT wood	0.331	m3	
Waste	Wood dust	0.011	kg	Collected in dust collector
Waste	Off cut wood	0.006	kg	to boiler

Table 8 LCI of foreground data (PU7 A3) for 1 m3 of Heimu (Merbau TMT) as FU

category	Materials	Value	Unit	Dataset
Input				
	BBK crosscut TMT wood	0.699	m3	
	BBK ripsaw TMT wood	0.331	m3	
Energy	Electricity	32.83	kWh	Electricity, high voltage (ID)
Output				
	MD TMT (BJ) wood	1	m3	
Waste	Wood dust	0.009	kg	Collected in dust collector

Table 9 LCI of foreground data (PU8 A3) for 1 m3 of Heimu (Merbau TMT) as FU

category	Materials	Value	Unit	Dataset
Input				
	MD TMT (BJ) wood	1	m3	
Aux material	Strapping	0.204	kg	
Aux material	Plastic	0.475	kg	packaging film, ldpe (RoW)
Aux material	Plastic for ETH	0.66	kg	packaging film, ldpe (RoW)
Aux material	Wax	3.997	kg	petroleum slack wax (RoW)
Aux material	Carton box	0.272	kg	corrugated board box (RoW)
Output				
Product	Heimu (Merbau TMT)	1	m3	
Waste	Strapping	0.01	kg	
Waste	Plastic	0.005	kg	
Waste	Plastic for ETH	0.005	kg	

Table 10 LCI of transportation (A2) for 1 m3 of Heimu (Merbau TMT) as FU

category	Materials	Value	Unit	Dataset
Input				
Transportation of raw material	Shipping	2538.01	t*km	transport, freight, sea, bulk carrier for dry goods (GLO)
Transportation of raw material	Land transport	28.42	t*km	transport, freight, lorry >32 metric ton, EURO4 (RoW)
Transportation of auxiliary material	Land transport	0.14	t*km	transport, freight, light commercial vehicle (RoW)

Life Cycle Impact Assessment (LCIA)

The LCIA results for Heimu (Merbau TMT) refer to the life cycle related environmental performance of 1 m^3 of Heimu (Merbau TMT). Table 11 presents the product's potential environmental impact according to EN 15804+A2 (EF 3.1).

Table 11 Environmental impact – mandatory indicators according to EN 15804

Environmental impact	Indicator Abbreviation	Unit
Global Warming Potential - biogenic	GWP - biogenic	kg CO_2 eq
Global Warming Potential - fossil fuels	GWP-fossil	kg CO_2 eq
Global Warming Potential - land use and land use change	GWP-luluc	kg CO_2 eq
Global Warming Potential - total	GWP - total	kg CO_2 eq
Depletion potential of the stratospheric ozone layer	ODP	kg CFC-11 eq
Acidification potential, Accumulated Exceedance	AP	mol H^+ eq
Eutrophication potential - freshwater	EP-freshwater	kg P eq
Eutrophication potential - marine	EP- marine	kg N eq
Eutrophication potential, Accumulated Exceedance	EP- terrestrial	mol N eq
Formation potential of tropospheric ozone	POCP	kg NMVOC eq
Abiotic depletion potential for non-fossil resources	ADPE	kg Sb eq
Abiotic depletion for fossil resources potential	ADPF	MJ
Water (user) deprivation potential, deprivation-weighted water consumption	WDP	m^3 World eq

The Results of Environmental Performance

The table 12 presents the environmental impact analysis for mandatory indicators in EN 15804. Meanwhile, Table 13 presents the use of primary energy per declared unit of a product across various life cycle stages. Use of primary energy were declared as following:

- PERE = Use of renewable primary energy excluding renewable primary energy resources used as raw materials;
- PERM = Use of renewable primary energy resources used as raw materials;
- PERT = Total use of renewable primary energy resources;
- PENRE = Use of non-renewable primary energy excluding non-renewable primary energy resources used as raw materials;
- PENRM = Use of non-renewable primary energy resources used as raw materials; PENRT = Total use of non-renewable primary energy re-sources;
- SM = Use of secondary material;
- RSF = Use of renewable secondary fuels;
- NRSF = Use of non-renewable secondary fuels;
- FW = Use of net fresh water

Table 12 Results of the LCIA according to mandatory indicator of EN 15804+A2 for 1 m3 of Heimu (Merbau TMT)

Indicator	Unit	Results per declared unit			
		A1	A2	A3	A1-A3
GWP - total	kg CO2 eq	-56.566	7.848	-286.483	-335.201
GWP - fossil	kg CO2 eq	264.702	7.844	467.203	739.749
GWP - biogenic	kg CO2 eq	-323.042	-0.001	-754.576	1077.619
GWP-luluc	kg CO2 eq	1.774	0.005	0.890	2.669
ODP	kg CFC-11 eq	1.69E-6	1.14E-7	2.18E-6	3.98E-6
AP	mol H+ eq	1.334	0.153	2.737	4.225

Indicator	Unit	Results per declared unit			
		A1	A2	A3	A1-A3
EP-freshwater	kg P eq	0.421	0.00048	0.795	1.216
EP- marine	kg N eq	0.389	0.036	0.792	1.217
EP-terrestrial	mol N eq	3.233	0.402	6.894	10.529
POCP	kg NMVOC eq	0.988	0.116	1.971	3.074
ADPE	kg Sb eq	0.00012	2.09E-5	8.38E-5	2.25E-4
ADPF	MJ	3115.76	100.274	4915.92	8131.96
WDP	m^3 World eq	43.772	0.404	92.204	136.380

Table 13 Results of the primary resources indicator based on EN 15804+A2 for 1 m3 of Heimu (Merbau TMT)

Indicator	Unit	Results per declared unit			
		A1	A2	A3	A1-A3
PERE	MJ	1.36E+4	1.296	3.14E+4	4.50E+4
PERM	MJ	-	-	-	-
PERT	MJ	1.36E+4	1.296	3.14E+4	4.5E+4
PENRE	MJ	3117.315	100.279	4916.033	8133.628
PENRM	MJ	-	-	-	-
PENRT	MJ	3117.315	100.279	4916.033	8133.628
SM	MJ	-	-	-	-
RSF	MJ	-	-	-	-
NRSF	MJ	-	-	-	-

Indicator	Unit	Results per declared unit			
		A1	A2	A3	A1-A3
PERE	MJ	1.36E+4	1.296	3.14E+4	4.50E+4
PERM	MJ	-	-	-	-
PERT	MJ	1.36E+4	1.296	3.14E+4	4.5E+4
PENRE	MJ	3117.315	100.279	4916.033	8133.628
PENRM	MJ	-	-	-	-
PENRT	MJ	3117.315	100.279	4916.033	8133.628
SM	MJ	-	-	-	-
FW	m3	1.237	0.010	2.091	3.338

Interpretation

The environmental impacts per declared unit across each life cycle from raw material acquisition (A1) until the manufacturing stage (A3) were assessed. The following key insights were identified from the data:

1. Climate change
   - The climate change (total) impact is dominated by A2 (transportation).
   - Biogenic carbon contributions exhibit negative values in A1 and A3, indicating carbon uptake during these stages.
2. Acidification and Eutrophication
   The A3 stage is the highest contributor for AP and EP parameters.
3. Ozone Depletion and Photochemical Ozone Formation
   The A3 stage is the highest contributor for ODP and POCP parameters.
4. Resource use
   A1 and A3 contribute significantly for the ADPF parameter.
5. Water use
   A1 and A3 contribute significantly to the WDP parameter.

References

- ISO 14020:2000 Environmental labels and declarations - General principles
- ISO 14025:2006 Environmental labels and declarations - Type III environmental declarations - Principles and procedures
- ISO 14040:2006 Environmental management- Life cycle assessment - Principles and framework
- ISO 14044:2006 Environmental management - Life cycle assessment - Requirements and guidelines
- www.environdec.com
- EN 15804:2019+A2