BETRA PREFABRICATED TRADE INDUSTRY JOINT STOCK COMPANY

ISO 14067

"Greenhouse gases - Carbon footprint of products - Requirements and guidelines for quantification"

within the scope of the standard

January 01, 2023 - December 31, 2023

Period

CONVENTIONAL SLEEPER WITHOUT PAD

CARBON FOOTPRINT

REPORTING

2023

Contents

1. Organization Introduction

Betra is located in Pamukova/Turkey and started production of main track sleepers in 2002. To date, Betra has produced approximately 3,500,000 main track sleepers for Turkish and world railroads. Betra produces more than 650,000 main track sleepers per year with 14 lines. Betra is the first sleeper plant established in Turkey. Betra is currently the largest main line sleeper producer in Turkey and the third largest long line sleeper producer in the world.

Betra has been producing Turnout Sleepers since 2008. Betra has produced approximately 850,000 m2 of Turnout Sleepers. In 2010, Betra's production capacity reached 200,000 metertulles per year with new investments. Betra is now Turkey's only and the world's largest manufacturer of turnout sleepers.

Betra also produces approximately 9000 Trak Base Plates and has an annual capacity of 15,000 units.

2. Executive Summary

This report, Yenice Mah. Put the gazebo. Betra Prefabrike San ve Tic. located at No:123 54900 Pamukova Sakarya/Türkiye. A.Ş.'s PAD-free sleepers are within the scope of ISO 14067 Greenhouse gases - Carbon footprint of products - Requirements and guidelines for quantification.

It includes the evaluation of the greenhouse gas emissions it causes to be released into the atmosphere.

Greenhouse gas emissions caused by products throughout their life cycle from cradle to grave are handled under the unit processes of raw material supply, transportation of raw materials, manufacturing, transportation to the stock area, transportation of the product to the customer, construction, installation, maintenance, repair, replacement, disassembly and demolition, transportation and waste processing and disposal. This report also includes life cycle analyzes from cradle to gate.

While creating this report, emission factors obtained from DEFRA, EPA, ADAME, IPCC and global warming potential data published by IPCC were used.

The functional unit is defined as 1 metertulle of sleeper.

When unit processes are considered, the emissions caused by each unit process are given below:

A1 Raw material supply 49.48 kgCO2e/metertulletulle, A2 transportation of raw materials 1.15 kgCO2e/metertulle, A3 manufacturing 9.54 kgCO2e/metertulle.

Within the scope of the scenarios established in the cradle to grave life cycle assessment, which includes Module A1 to A3 Product process and Module C1 to C4 end-of-life processes, it is seen that 1 meter of sleeper causes 60.46 kgCO2e emissions.

In the cradle-to-gate life cycle assessment within the scope of the Module A1 to A3 Product phase process, it is seen that 1 meter of sleeper causes 60.17 kgCO2e emissions.

Detailed explanation of emission amounts is included in this report.

3. Purpose of the Study

The general purpose of the carbon footprint calculation of the railway sleeper is to calculate all significant greenhouse gas emissions and removals throughout the life cycle of the product in line with the cutting criteria.

All relevant parties that Betra communicates with, including our employees, are our target audience who will evaluate the report.

4. Scope of the Study

Betra Prefabrike San. And Trade. A.Ş. Yenice Mah. Put the gazebo. It is the calculation of the carbon footprint caused by the functional unit determined as 1 metertulle/tulle of YHT Conventional PAD-free sleeper production, one of the products produced in its facility located at No:12354900 Pamukova Sakarya/Turkey, in 2023.

5. Functional unit and reference flow

The functional unit is 1 metertulle/tulle sleeper. In order to create the functional unit in question, the reference flows consumed per functional unit were determined as cement, stone dust, gravel, water, additive, pre-stressing wire, dowel, spring, ribbed iron, plastic plug, binding wire, mold oil.

Reference flows;

Table 1: Reference flows

Material Description	Activity Data/FB	Unit
Cement (52.5 N)	28.64	kg
Stone powder	61.18	kg
Gravel (No. 1 Aggregate and No. 2 Aggregate)	65.57	kg
This	8.8	M3
ACE 445 Additive	0.17	kg
Prestressing Wire	4.7	kg
Dowel SDU	2	Piece
2.5 Winding Spring	2	Piece
Ribbed Iron	0.6	kg
Plastic Plug	2	Piece
Stirrup Binding Wire	12	Piece
Mold Oil	0.038	kg

It was calculated as.

6. System Limit

The cradle-to-grave approach was used as the system boundary.

Unit processes; Raw material supply, transportation and manufacturing are taken into account in the calculations.

Electricity, natural gas, mineral and water enter the system boundaries as basic flow and leave the system as traverse.

In the study;

• Carbon dioxide equivalent emissions attributed to raw materials within the scope of raw material supply,

• Fuel used within the scope of transportation of raw materials,

• Energy used within the scope of manufacturing,

• The fuel and emissions used in transporting the product to the stock area have been taken into account.

7. List of Important Unit Processes;

Raw material supply, transportation and manufacturing processes are considered as unit processes.

8. Data Sources

The data collected throughout the study for the functional unit are given below.

Table 2: Data sources

Material	Data Source	Material	Data Source
Cement (52.5 N)	Purchasing Unit	Ribbed Iron	Purchasing Unit
Stone powder	Purchasing Unit	Plastic Plug	Purchasing Unit
Gravel (No. 1 Aggregate and No. 2 Aggregate)	Purchasing Unit	Stirrup Binding Wire	Purchasing Unit
This	Purchasing Unit	Mold Oil	Purchasing Unit
ACE 445 Additive	Purchasing Unit	Electric	Purchasing Unit
Prestressing Wire	Purchasing Unit	Electric Line Loss and Leakage	Purchasing Unit
Dowel SDU	Purchasing Unit	Natural gas	Purchasing Unit
2.5 Winding Spring	Purchasing Unit	Diesel (Forklift)	Purchasing Unit

9. List of Greenhouse Gases Considered

CO2, CH4, N2O were taken into consideration in this study.

10. Selected Calculation Factors;

The calculation factors used in the calculations and the sources from which they are taken are listed in the table below.

Table 3: Calculation factors

Emission Source	Unit of	Emission Factor	Unit of	Source
Cement (52.5 N)	kg	0.739	tco2e/ton	ÇİMSA Sustainability Report
Stone powder	kg	7.75	kgco2e/ton	DEFRA
Gravel (No. 1 Aggregate and No. 2 Aggregate)	kg	7.75	kgco2e/ton	DEFRA
This	M3	0.177	kgco2e/m3	DEFRA
ACE 445 Additive	kg	1.84	kCO2e/kg	On the CO2 footprint of polycarboxylate superplasticizers (PCEs) and

				its impact on the eco balance of concrete
Prestressing Wire	kg	1172.92	kgCO2e/ton	EPD
Dowel SDU	Piece	0.40	kg CO2e/2021 USD, purchaser price	EPD
2.5 Winding Spring	Piece	0.372	kg CO2e/2021 USD, purchaser price	EPA
Ribbed Iron	kg	4005.14	kgco2e/ton	DEFRA
Plastic Plug	Piece	0.40	kg CO2e/2021 USD, purchaser price	EPA
Stirrup Binding Wire	Piece	0.55	kg CO2e/2021 USD, purchaser price	EPA
Mold Oil	kg	1,401	kgco2e/ton	DEFRA
Electric	kwh	0.44	tCO2e/ Mhw	Ministry of Energy
Natural gas	Sm3	53.52 (NKD)	Tj / Gg	IPCC
	Sm3	55.4 (EF)	tCO2/ Tj	IPCC
	Sm3	4 (EF)	kgCH4/ Tj	IPCC
	Sm3	1 (EF)	kgN2O/ Tj	IPCC
Electricity Loss Leakage	%	14.98%	%	worldbank
Offroad Moving Combustion Diesel	ton	43 (NKD)	TJ/ Gg	IPCC
	ton	74100 (EF)	kgCO2/ Tj	IPCC
	ton	4.15 (EF)	kgCH4/ Tj	IPCC
	ton	28.6 (EF)	kgN2O/ Tj	IPCC
Onroad Moving Combustion Diesel	ton	0.87205	kg CO2e/km	DEFRA
Ship Moving Combustion	tons km	0.01407	KgCO2e/ton km	DEFRA
Burning Train Movement	tons km	0.02779	KgCO2e/ton km	DEFRA
Burning Train Movement	ton	43 (NKD)	Tj / Gg	IPCC
	ton	74100(EF)	kgCO2/ Tj	IPCC
	ton	4.15(EF)	kgCO2/ Tj	IPCC
	ton	28.6(EF)	kgCO2/ Tj	IPCC
Mining	ton	11th	kgCO2e/ton	ADAME
Material disposal Iron	ton	0.984911723	kgCO2e/ton	DEFRA
Material disposal Concrete	ton	0.984911723	kgCO2e/ton	DEFRA
Material disposal Ballast	ton	0.984911723	kgCO2e/ton	DEFRA

11. Selected Cutting Criteria and Cutoffs

Considering the weights of emission amounts within the scope of the system limit, 1% of the total emission was determined as the cut-off criterion for unit processes and all processes were evaluated.

Table 4: Cradle to Gate Life Cycle Analysis Unit Processes

	tCO2/ metertulle	kgCO2/ metertulle	%
RAW MATERIAL SUPPLY	0,049	49,476	82%
PRODUCTION	0,010	9,544	16%
TRANSPORT	0,001	1,112	2%

12. Selected Allocation Procedures

Electricity and natural gas consumption and production amounts are allocated to product types.

13. Description of Data

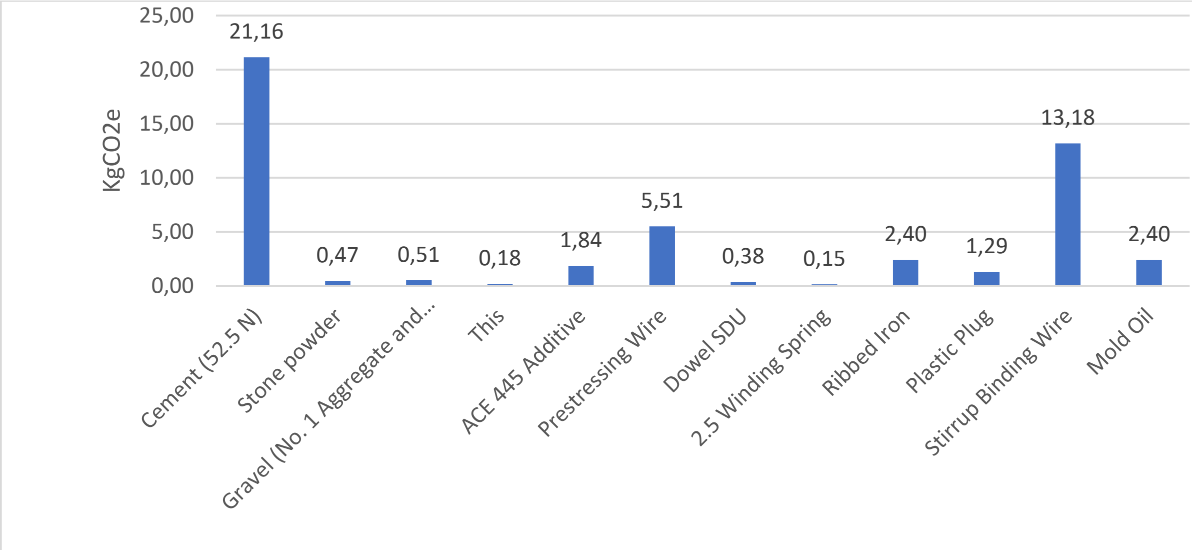
13.1 Raw material supply unit process;

The amount of materials per functional unit is calculated from annual purchases and is given below.

Table 5: Raw material supply unit process reference flows

Material Description	Activity Data/FB	Unit
Cement (52.5 N)	28.64	kg
Stone powder	61.18	kg
Gravel (No. 1 Aggregate and No. 2 Aggregate)	65.57	kg
This	8.8	M3
ACE 445 Additive	0.17	kg
Prestressing Wire	4.7	kg
Dowel SDU	2	Piece
2.5 Winding Spring	2	Piece
Ribbed Iron	0.6	kg
Plastic Plug	2	Piece
Stirrup Binding Wire	12	Piece
Mold Oil	0.038	kg

The amount of emissions arising for each material definition within the scope of raw material supply is shown in the graph below.



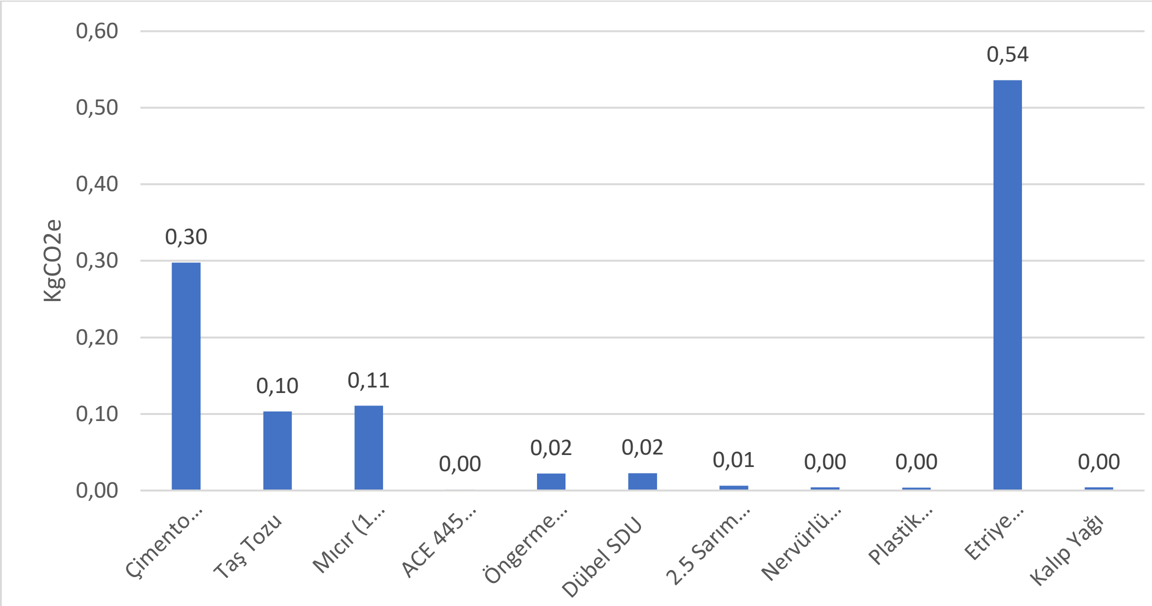
13.2. Transportation Unit Process of Raw Materials

The weights of the materials per meter, which is the functional unit, have been determined, and the distance they were transported by which type of vehicle was determined and given in the table below.

Table 6: Raw material transportation unit process data

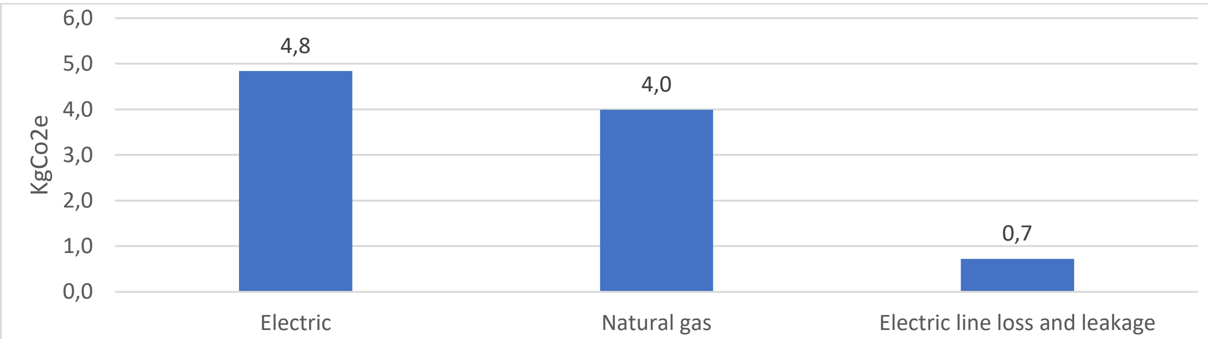
Material Description	Activity Data/FB (kg)	Mode of Transport	distance km
Cement (52.5 N)	28.64	HGV (all diesel) All HGVs	285
Stone powder	61.18	HGV (all diesel) All HGVs	60
Gravel (No. 1 Aggregate and No. 2 Aggregate)	65.57	HGV (all diesel) All HGVs	60
ACE 445 Additive	0.17	Vans Class III (1.74 to 3.5 tons)	135
Prestressing Wire	4.70	HGV (all diesel) All HGVs	130
Dowel SDU	1.30	Vans Class III (1.74 to 3.5 tons)	350
2.5 Winding Spring	1.00	Vans Class III (1.74 to 3.5 tons)	130
Ribbed Iron	0.60	Vans Class III (1.74 to 3.5 tons)	140
Plastic Plug	0.20	Vans Class III (1.74 to 3.5 tons)	400
Stirrup Binding Wire	3.60	HGV (all diesel) All HGVs	2267
Mold Oil	0.04	Vans Class III (1.74 to 3.5 tons)	500

The amount of emissions resulting from the transportation of raw materials is shown in the graph below.



13.3. Manufacturing unit process

The electricity and natural gas used during manufacturing were calculated per functional unit and the calculations were made based on these figures. Electricity line loss and illegal data was taken from the World Bank data and used as 14.98%.



13.4. Unit Process of Transporting the Product to the Stock Area;

The produced sleepers are transported to the stock area by forklift, and loading from the stock area to shipment is carried out by forklift. The annual total fuel amount was calculated per functional unit and the density of diesel was taken as 0.850 kg/lt.

It was determined that 0.0419 kgCO2e/metertulle emission was generated in this unit process.

14. Sensitivity Analyzes

If the cement under the raw material transportation heading is transported from cement factories located approximately 50 km away, instead of 285 km, the emission, which is currently 0.3 kgCO2e, will decrease to 0.05 kgCO2e.

It is seen that if 50% of the electricity is produced on site, the emissions from 4.8 kg CO2e can be reduced to 2.4 kg CO2e.

15. Results of Uncertainty Assessments;

The table regarding uncertainty evaluations is given below.

		kgCO2e/ metertulle	kgCO2e/ metertulle	Uncertainty	**Module C1 to Module C4 and where Module D is from source to end of manufacturing**
PRODUCT PHASE	RAW MATERIAL SUPPLY	0,05	49,48	8%	7%
	TRANSPORT	0,00	1,15	12%	
	PRODUCTION	0,01	9,54	9%	

Uncertainty;

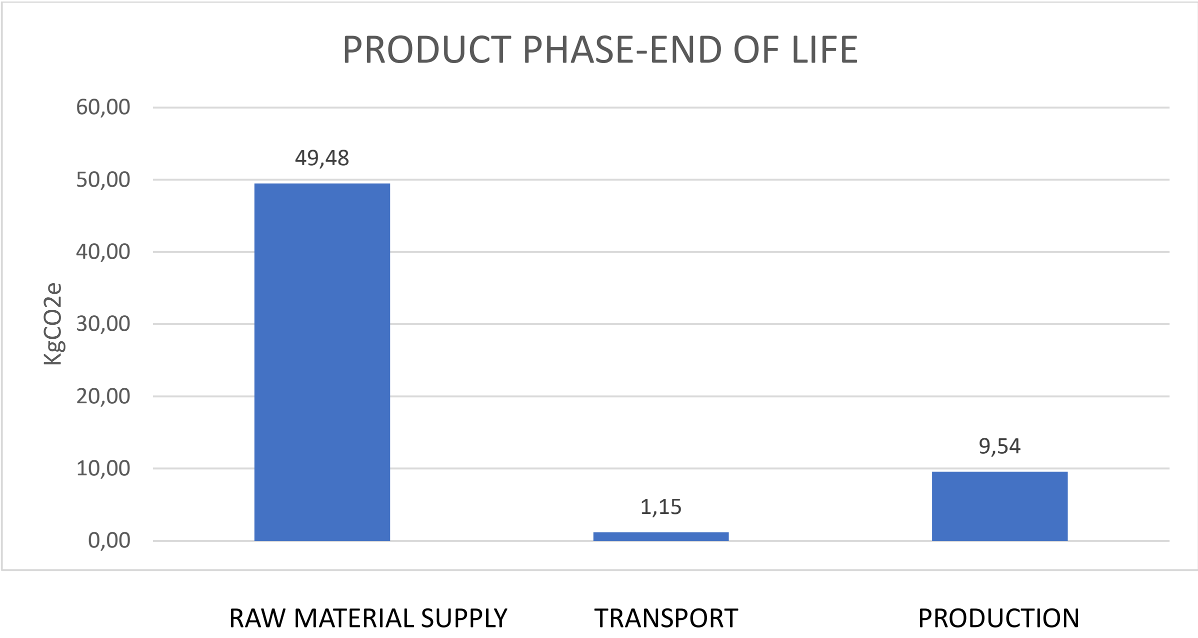
When a cradle-to-gate evaluation is made, the uncertainty is 7%.

16. Electricity

The electricity emission factor used during manufacturing was taken from the Ministry of Energy, and power line loss and leakage data was taken from the World Bank data and was used as 14.98%.

17. Results of Life Cycle Interpretation

In the cradle-to-gate life cycle assessment within the scope of Module A1 to A3 Product process, it is seen that it causes 60.17 kgCO2e emissions.


PRODUCT PHASE-END OF LIFE
KgCO2e
60,00
50,00
40,00
30,00
20,00
10,00
0,00
49,48
1,15
9,54
RAW MATERIAL SUPPLY
TRANSPORT
PRODUCTION

		BUILDING EVALUATION INFORMATION																
		BUILDING LIFE INFORMATION																**INFORMATION AFTER THE BUILDING LIFE**
		A1-A3			**A4-A5**		**B1-B7**							**C1-C4**				**D**
		PRODUCT PHASE			**CONSTRUCTION PROCESS**		**USE PHASE**							**END OF LIFE**				**BENEFITS AND BURDENS OUTSIDE THE SYSTEM LIMIT**
		A1	**A2**	**A3**	**A4**	**A5**	**B1**	**B2**	**B3**	**B4**	**B5**	**B6**	**B7**	**C1**	**C2**	**C3**	**C4**	**D**
		Raw material supply	**Transport**	**Production**	**Transport**	**Construction-Installation Process**	**Use**	**Care**	**Repair**	**Changing**	**Renovation**	**Operating Energy Use**	**Operating Water Usage**	**Dismantling-Demolition**	**Transport**	**Processing of Waste**	**disposal**	**Reuse, recovery, recycling, potential**
	Unit				**Scenario**	**Scenario**	**Scenario**	**Scenario**	**Scenario**	**Scenario**	**Scenario**	**Scenario**	**Scenario**	**Scenario**	**Scenario**	**Scenario**	**Scenario**	**Scenario**
with Module C1 to Module C4 and Module D	**KgCO2 e/ metertulle**	**49.48**	**1.15**	**9.54**														
From source to end manufacturing with Module C1 to Module C4, Module D and optional modules	**KgCO2 e/ metertulle**	**49.48**	**1.15**	**9.54**														

18. Exclusions

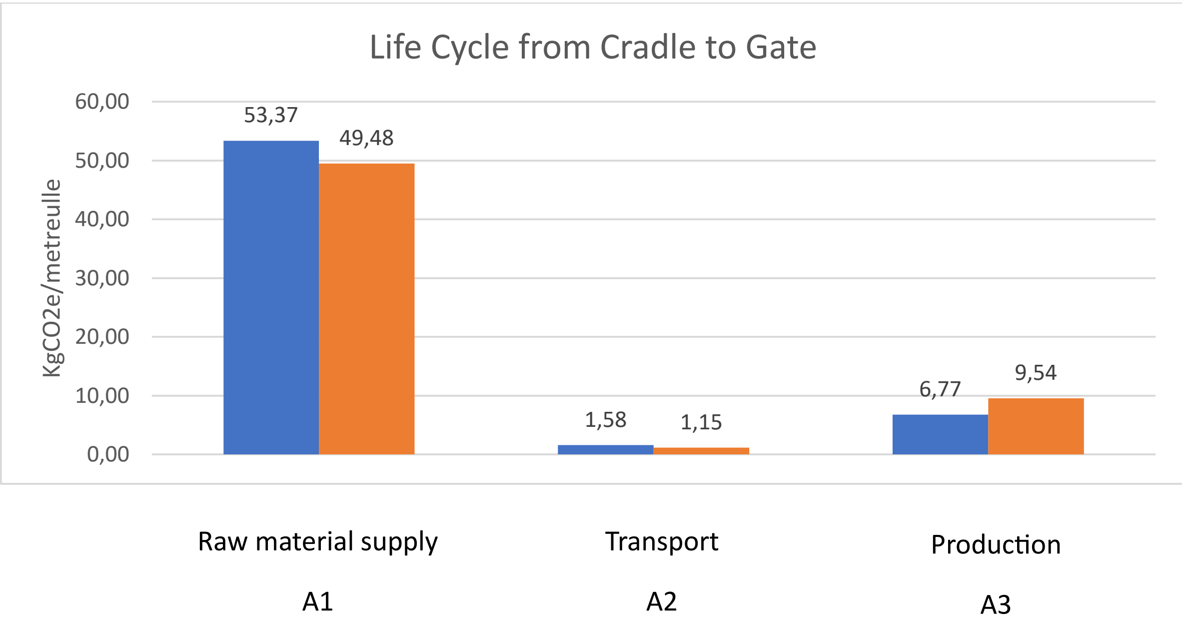
Cut-off criteria were applied and no processes were excluded.

19. Assessing the Impact of End-of-Life Scenarios on Final Results

Since cradle-to-gate life cycle assessment is performed within the scope of the Modules A1 to A3 Product process, end-of-life assessment is not addressed.

20. Comparison

Considering the emissions caused by the sleeper with and without pads from the cradle to the door, it is seen that there is an emission increase due to the pad in the product with pad in the raw material supply, however, the manufacturing emission increases in the product without pad due to the excess production of products without pad.



21. The Period It Represents

This study represents the period between January 1, 2023 and January 31, 2023.

22. Performance Monitoring Explained

Greenhouse gas emissions, calculated for the first time in 2023, will be monitored in the coming years, and during this process, efforts will be made to reduce emissions in important unit processes.