



TRI HITA
CONSULTING



Final Report

2025 GHG INVENTORY

PT Indonesia Steel Tube Works (ISTW)

Conducted by:
Tri Hita Consulting
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Preliminary Report on 2025 GHG Inventory

This report was developed by Tri Hita Consulting for ISTW, which marks the third year of the GHG Inventory project. This report presents ISTW's 2025 GHG inventory using the same organisational and operational boundaries as 2024, to ensure consistency and comparability across reporting years. This report also provides a detailed analysis of emissions across Scope 1, Scope 2, and Scope 3, including emissions sources, intensity, and data management practices. The report also evaluates year-on-year emission performance and offers recommendations for emissions reduction and improved reporting to support ISTW's sustainability strategy and long-term ESG commitments.

For more information, please visit:

<https://www.istw.co.id/>

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OUTLINE

OUTLINE	3
GLOSSARY & ABBREVIATIONS	5
EXECUTIVE SUMMARY	6
GHG emissions	6
Intensity Indexes	8
Improvement of Future Reportings	9
Mitigation of GHG Emissions	10
INTRODUCTION	12
CHAPTER 1: GENERAL DESCRIPTION OF THE ORGANISATION GOALS AND GHG INVENTORY OBJECTIVES	13
1.1 Organisation Description	13
1.2 People Responsible and Intended Users	14
1.3 Reporting Period and Frequency of Reporting	15
1.4 Methodology	15
1.4.1 Standards and Methodologies Used for This Inventory	15
1.4.2 List of GHGs Taken into Account	16
1.5 Statements by the Organisation About Verification	16
1.6 Dissemination Policy	17
CHAPTER 2: ORGANISATIONAL BOUNDARIES	18
2.1 Overview of PT Indonesia Steel Tube Works (ISTW)	18
2.2 Organisational Boundaries Included for this Reporting Period	18
2.3 Organisational Business Units Excluded from This Inventory	19
2.4 Chosen Organisational Boundary Approach	19
CHAPTER 3: REPORTING BOUNDARIES	20
3.1 Scope Definition	20
3.2 GHG Emission Source Inclusions	22
3.3 GHG Emission Source Exclusions	25
CHAPTER 4: QUANTIFIED GHG INVENTORY OF EMISSIONS	28
4.1 Emissions Calculation and Result	28
4.1.1 Emissions by Category	28
4.1.2 Emissions by Production Plant	33

4.1.3 Emissions by Type of GHG	36
4.1.4 Biogenic Emissions and Removals	37
4.2 Internal Performance Tracking	38
4.2.1 Energy Intensity Index	39
4.2.2 Emissions Intensity Index	43
4.3 Emission Factors Considered for This Inventory	48
4.3.1 Carbon Sequestration Emission Factors for Planted Trees	49
4.4 Data Uncertainties	50
4.4.1 Scope 1	50
4.4.2 Scope 2	50
4.4.3 Scope 3	50
4.4.4 Out of Scope	51
4.5 Recommendations to Improve Future Reportings	52
4.5.1 Enhance Energy Consumption Recording	52
4.5.2 Improve Data Recording for Transport of Purchased and Distributed Items	52
4.5.3 Standardise Business Travel Data Recording	53
4.5.4 Verification of the Future Inventories	53
CHAPTER 5: PRELIMINARY RECOMMENDATIONS FOR EMISSIONS REDUCTIONS	
54	
5.1 Emissions Reduction Initiatives	54
5.1.1 Current Actions	54
5.1.2 Recommended Future Initiatives	55
REPORT LIMITATIONS AND DISCLAIMERS	58
REFERENCES	61

GLOSSARY & ABBREVIATIONS

Carbon dioxide

CO₂

Electric vehicles

EVs

Greenhouse gas

GHG

Indonesia Steel Tube Works

ISTW

Internal rate of return

IRR

Kilowatt-hour

kWh

Methane

CH₄

Nationally Determined Contribution

NDC

Nitrous oxide

N₂O

Perusahaan Listrik Negara

PLN

Tonnes of CO₂ equivalent

tCO₂-e

EXECUTIVE SUMMARY

In 2025, PT Indonesia Steel Tube Works (ISTW) undertook its third annual greenhouse gas (GHG) inventory, building upon the baseline established in 2023. As a leading manufacturer of steel pipes and tubes, ISTW continues to strengthen its commitment to environmental sustainability by improving the quality, consistency, and transparency of its emissions inventory.

Tri Hita Consulting was engaged to conduct the 2025 GHG inventory for all ISTW plants using the same organisational and operational boundaries as the previous reporting year to ensure consistency and comparability. This includes fuel consumption from both stationary and mobile sources, electricity usage, emission from purchased goods and services, upstream transportation, business travel, and downstream transportation. In addition to quantifying greenhouse gas emissions, the inventory provides an assessment of emission trends, data quality, and opportunities for continuous improvement in emissions management. The findings of this report also support the ESG assessment conducted by Tri Hita Consulting in 2025, providing climate-related insights and recommendations to strengthen ISTW's broader sustainability and ESG strategy.

GHG emissions

The GHG emissions were calculated following the GHG Protocol and ISO 14064-1:2018 standards. The 2025 inventory scope remains identical to that of 2024, encompassing Scope 1, Scope 2, and specific Scope 3 emissions, with a particular focus on purchased goods and services, upstream transportation, business travel, and downstream transportation. Total GHG emissions were reported as follows:

Total Emissions in 2025

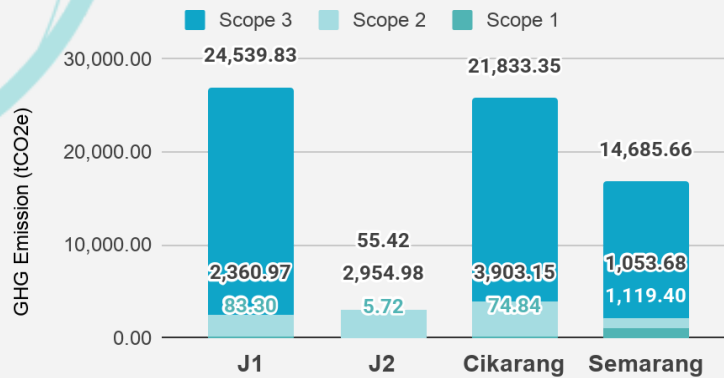


Figure 1. Distribution of the reported emissions by plants per category in 2025 (tCO₂-e)

ISTW recorded total emissions of **72,670.30 tCO₂-e** (tonnes of CO₂ equivalent) from its four plants in 2025. The **Jakarta 1 (J1)** plant was the largest contributor at **26,984.10 tCO₂-e (37%)**, followed by **Cikarang** at **25,811.34 tCO₂-e (36%)**, **Semarang** at **16,858.74 tCO₂-e (23%)** and **Jakarta 2 (J2)** at **3,016.11 tCO₂-e (4%)**. J1, J2 and Cikarang had high Scope 2 emissions due to reliance on PLN electricity, while Semarang's significant Scope 1 emissions stem from machinery and fuel use.

Compared to 2024, total GHG emissions in 2025 decreased significantly by **24.55%**, as shown in Figure 2. This reduction was primarily driven by a **3.87%** overall drop in total production volume across all plants. Crucially, the most significant production decline occurred at the Semarang plant (**-18%**), which is the largest source of emissions. In contrast, production actually increased at the Cikarang plant, the most energy-efficient facility. This operational shift towards a more efficient plant, combined with lower overall activity, led to the substantial decrease in total emissions. Additionally, while 2023 data is presented for reference, it should be noted that its reporting scope was substantially more limited, particularly regarding Scope 3 emissions.

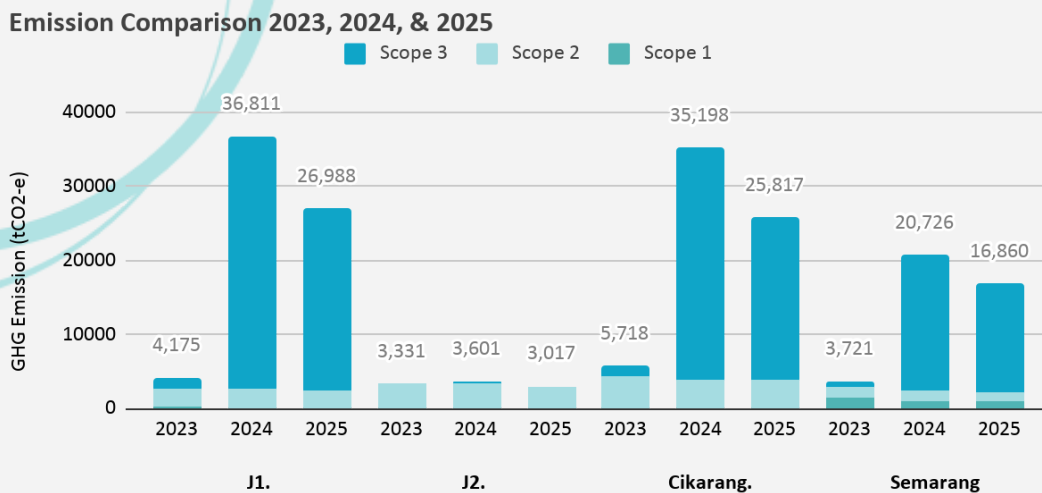


Figure 2. ISTW's emission in 2023, 2024, and 2025 (tCO₂-e)

Intensity Indexes

In comparison with the previous year (2024), the 2025 result exhibits a slight decrease for ISTW energy efficiency by lowering the overall energy intensity from **0.65 GJ/tonne** to **0.63 GJ/tonne**. This progress was mostly driven by decreasing the electricity and fuel consumption for mill machinery and cars mobility, respectively. Across individual facilities, energy intensity trends varied between 2024 and 2025. The combined energy intensity for J1 & J2 slightly increased from 0.64 GJ/tonne in 2024 to 0.67 GJ/tonne in 2025 (a 4.7% increase) due to higher energy consumption. Similarly, the Semarang plant—the most energy-intensive facility due to its specialized galvanisation process—saw its intensity rise from 1.58 GJ/tonne to 1.69 GJ/tonne (a 7.0% increase). In contrast, Cikarang maintained its status as the most efficient plant, further improving its energy intensity from 0.37 GJ/tonne in 2024 to 0.36 GJ/tonne in 2025 (a 2.7% reduction).

In 2025, ISTW's emission intensity was calculated using Scope 1 and Scope 2 emissions only. Although Scope 1 and Scope 2 emissions decreased by 6.58%, production output also declined by 3.87%. As emission intensity is expressed per unit of production, the reduction in production partially offset the decrease in emissions, resulting in an overall emission intensity

reduction of 2.82%, from **119.92 kgCO₂-e/tonne** in 2024 to **116.54 kgCO₂-e/tonne** in 2025.

This drop was driven by proportional reductions in electricity usage, vehicle fuel consumption, and overall production volume. Across individual facilities, performance showed mixed trends when compared against the 2023 baseline: Cikarang maintained its position as the most carbon-efficient plant, achieving a **7.1%** intensity reduction from **82.97** to **77.06 kgCO₂-e/tonne** (driven primarily by electricity). In contrast, J1 & J2 recorded a slight 2.6% rise from **147.90 kgCO₂-e/tonne** to **153.93 kgCO₂-e/tonne**, while Semarang saw the highest growth, increasing 13.0% from 154.73 to 174.90 **kgCO₂-e/tonne** due to CNG-heavy galvanisation and legacy equipment. Compared to industry benchmarks, these results highlight key opportunities for targeted decarbonisation and energy management at J1, J2, and Semarang. These findings suggest that while Cikarang continues to advance its efficiency, the J1, J2, and Semarang sites offer substantial potential for focused decarbonisation and enhanced energy management. Compared with available industry benchmarks, ISTW may have opportunities to further optimise energy management and reduce emissions intensity, while recognising that direct comparisons should consider differences in operational and production profiles.

Improvement of Future Reportings

In preparation for future GHG inventory verification or certification, ISTW should strengthen its data management system for data collection across all plants. Particular attention should be given to activity data with inconsistent formats or units, especially fuel consumption, which should be consistently recorded in volumetric units (e.g.: litres) or mass units, together with the corresponding fuel type, to enable accurate emission factor application. Similar standardisation should be applied to electricity consumption, transportation, and purchased goods and services data to ensure completeness, consistency, and traceability. In addition, formal

QA/QC procedures should be implemented to verify data accuracy, identify inconsistencies, and maintain reliable documentation throughout the reporting process.

It is recommended to build internal capacity in GHG accounting and management. This involves investing in training programs for personnel, fostering a deeper understanding of climate change issues throughout the organisation, and empowering teams to identify and implement emission reduction opportunities.

Mitigation of GHG Emissions

The distribution of the emissions points to the need for the implementation of strategic changes across operations to meet evolving international standards and drive meaningful mitigation actions. Therefore, to further enhance sustainability, ISTW should consider:

1. **Material Efficiency and Implementing Sustainable Procurement Practices:** Optimise raw material usage to minimise waste in production processes and prioritise suppliers with verified green credentials or low-carbon products.
2. **Optimising Transportation and Logistics:** Use the transportation partners that use more fuel efficient vehicles and transition to electric or low-emission fleets.
3. **Renewable Energy Expansion:** Analyse what renewable energy options could be utilised. For example, to install solar panels at additional plants to leverage new regulatory opportunities for larger installations.
4. **Fuel Switching:** Transitioning to biodiesel and bio-CNG, also exploring electric vehicle options for logistics.
5. **Energy Efficiency:** Prioritise energy efficiency improvements at the Semarang plant, particularly in the galvanising process, as it exhibits the highest energy intensity across all facilities.

An energy audit combined with the analysis of the 2024 GHG Inventory highlighted diverse efficiency levels across operations, with the **Cikarang** facility emerging as the most energy-efficient. Conversely, **Semarang**, followed by the **J1 and J2** sites, offers the most significant potential for enhanced energy management and decarbonisation. As described in the 2025 energy audit, ISTW should focus on high-impact initiatives, such as standardising compressed air pressure at **6 bar** for J2 and Semarang, and installing **Variable Speed Drives (VSDs)** on chilled water pumps company-wide. Furthermore, the Semarang plant should modernise production by replacing outdated machinery guided by lifecycle cost assessments and shifting from CNG to **Bio-CNG** in galvanisation, while exploring future electrification. Coupled with expanded **rooftop solar PV** capacity, these strategic measures will drive down emissions and operational costs, advancing ISTW's sustainability commitments and long-term competitiveness.

INTRODUCTION

PT Indonesia Steel Tube Works (ISTW) has been manufacturing steel tubes and pipes since 1971 with various kinds of types and sizes. As a manufacturing industry, ISTW is aware of its greenhouse gas (GHG) emissions produced in its operational activities. ISTW recognises the importance of understanding its carbon footprint and is committed to accurately calculating its GHG emissions. Therefore, ISTW aims to identify key emission sources with a thorough GHG inventory. This activity also intends to develop strategies to reduce them in alignment with Indonesia's Second Nationally Determined Contribution (SNDC), which targets absolute emissions of 1,257,717,000 tCO₂-e (low) and 1,488,866,000 tCO₂-e(high) under the Low Carbon Compatible with Paris Agreement scenario.

Tri Hita Consulting has been hired to conduct a GHG inventory for the operations of ISTW across all plants, including the Jakarta 1, Jakarta 2, Cikarang, and Semarang plants. The result of this GHG inventory should serve to track the emission as well as expanding the scope of calculation. Tri Hita Consulting also created the data trucking system sheet, to accommodate ISTW in data collection.

This 2025 GHG Inventory Report outlines the organisational and operational boundaries of the GHG inventory and calculates the emissions produced by ISTW's four plants, as well as associated facilities and services. The report includes GHG emissions for Scope 1, Scope 2, and four categories of Scope 3 (Categories 1, 4, 6, and 9).

The content of this report follows the requirements of ISO 14064-1:2018. GHG emissions were determined in accordance with ISO 14064-1:2018 and the GHG Protocol to be consistent with international standards and protocols.

CHAPTER 1: GENERAL DESCRIPTION OF THE ORGANISATION GOALS AND GHG INVENTORY OBJECTIVES

1.1 Organisation Description

PT Indonesia Steel Tube Works (ISTW) is a steel tube manufacturer established in 1971, with over 50 years of experience in producing high-quality steel tubes and pipes. The company manufactures a variety of mechanical tubes and pipes for use in industries such as automotive, construction, and general piping. ISTW operates using advanced pipe-producing mills with a production capacity of approximately 140,000 metric tonnes per year and 10 million pieces per month.

The primary shareholders of ISTW include Metal One Corporation, Maruichi Steel Tube Ltd., and PT Respati Djaja, all of whom contribute to ISTW's operational and strategic direction. A visual representation of ISTW's primary shareholders is illustrated in **Figure 3**.



Figure 3. ISTW primary shareholders

ISTW operates from multiple locations, including its headquarters and main facility, the “J1” plant, in the Pulogadung Industrial Area in Jakarta, a

recutting facility, the “J2”, also in Pulogadung. ISTW also has operational facilities in Cikarang (West Java) and Semarang (Central Java). The geographic distribution of ISTW’s facilities is illustrated in **Figure 4**.



Figure 4. Location of ISTW facilities in Jakarta, Bekasi, and Central Java

ISTW is committed to maintaining high production standards, holding certifications such as IATF 16949, ISO 45001, and ISO 14001. The company serves hundreds of customers throughout Indonesia, with ambitions to further increase its output in response to growing demand across various industries.

1.2 People Responsible and Intended Users

This report was created by Tri Hita Consulting on behalf of ISTW. The 2025 GHG Inventory project was managed by Kurniawan, with Verena Streitferdt overseeing Quality Assurance. The consultants involved in this inventory include Diva as Data Analyst.

The GHG inventory was conducted under Ronny Siagian as General Manager, Asep Aswandi as Team Leader of QHSE, and Masayoshi Sawada as the President Director of ISTW.

The intended users for this GHG inventory are ISTW and its shareholders. This report is not intended for publication.

1.3 Reporting Period and Frequency of Reporting

The GHG inventory includes emissions from activities undertaken from 1st of January 2025 until 31st of December 2025. Details are included in the boundary and scope. The reporting will be conducted yearly.

1.4 Methodology

1.4.1 Standards and Methodologies Used for This Inventory

The GHG emissions were determined in accordance with The GHG Protocol: A Corporate Accounting and Reporting Standard (GHG Protocol, 2004) to be consistent with international protocols and standards. The content of this report has been compiled in line with the requirements of ISO 14064-1:2018.

The calculation methodologies and determination of the emission factors follow the IPCC standard (2006, 2019). GHG emissions have been calculated by multiplying the collected activity data by its relevant emission factor:

$$\text{GHG Emissions} = \text{Proposed Activity Data} \times \text{GHG Emissions Factor}$$

Activity data was collected and recorded by ISTW as a quantifiable measure of activity (e.g., litres of fuel consumed). The emission factor is a conversion of the activity data into GHG emissions. Where specific data was not available, assumptions, benchmarks and standard recommendations have been used to fill the gaps. Finally, in the case this was not possible, a qualitative approach was followed to assess GHG

impacts, in line with the second edition of the Institute of Environmental Management and Assessment (IEMA) guidance (2022).

For Scope 3, Category 4 (Upstream Transportation and Distribution), Category 6 (Business Travel), and Category 9 (Downstream Transportation), the **distance-based approach** was used to estimate emissions, accounting for the distance travelled in the transportation of mother coils, business travel, and distribution activities. Scope 3 accounting is based on the Technical Guidance for Calculating Scope 3 Emissions (GHG Protocol, 2013). This approach uses the following formula:

$$\text{GHG Emissions} = \text{Distance Travelled} \times \text{GHG Emissions Factor}$$

Meanwhile, the Category 1 (Purchased Goods and Services) used the spend-based method to estimate emission from the purchased goods and services. This approach uses the following formula:

$$\text{GHG Emissions} = \text{Purchased Price} \times \text{GHG Emissions Factor}$$

1.4.2 List of GHGs Taken into Account

The GHGs reported by ISTW include CO₂, CH₄, and N₂O (mainly from fuel combustion and electricity consumption), as well as HFCs (from fugitive emissions, e.g. air conditioning refrigerant leaks and fire extinguishers). There is no indication that emissions from PFCs, NF₃ or SF₆ occurred through ISTW's operations.

1.5 Statements by the Organisation About Verification

ISTW has no current plans to verify the results of the 2025 GHG Inventory using the GHG Protocol Standard or ISO 14064-1:2018. However, this step may be considered in future reporting periods.

1.6 Dissemination Policy

The 2025 GHG Inventory report is for internal dissemination only.

CHAPTER 2: ORGANISATIONAL BOUNDARIES

This chapter includes the description and explanation of boundaries and consolidation methodologies. It describes ISTW's current activities and plans for the upcoming year.

2.1 Overview of PT Indonesia Steel Tube Works (ISTW)

PT Indonesia Steel Tube Works (ISTW) specialises in the production of steel pipes and tubes for a variety of applications, including general construction, as well as the manufacturing of round, galvanised, oval, square, and rectangular pipes and tubes. ISTW's products are widely used in infrastructure projects, industrial applications, and building constructions.

ISTW's operational process is divided into two main stages: slitting and milling. In the slitting stage, the mother coil is uncoiled, slit into narrower strips, and then recoiled. In the milling stage, these strips are uncoiled, formed into the desired shapes, welded, sized, cut to length, and packed for distribution. This production process allows ISTW to manufacture steel pipes of varying dimensions and specifications to meet the diverse requirements of their customers across multiple industries.

2.2 Organisational Boundaries Included for this Reporting Period

As of 2023, ISTW has four operational facilities, commonly referred to as "plants", that are included in the scope of this GHG inventory. These facilities are detailed as follows:

- Jakarta Office and Factory (J1 plant), located in Pulogadung Industrial Area, Jakarta.
- Jakarta Recutting Factory (J2 plant), also situated in Pulogadung Industrial Area, Jakarta.

- Cikarang Factory (**Cikarang** plant), located in Greenland International Industrial Center, Cikarang, Bekasi.
- Semarang Office and Factory (**Semarang** plant), located in Semarang, Central Java.

2.3 Organisational Business Units Excluded from This Inventory

There was no exclusion as all business units are included in the organisational boundaries.

2.4 Chosen Organisational Boundary Approach

ISTW has full operational control of its offices and plants. For that reason, the operational control approach was used to consolidate emissions of the company.

CHAPTER 3: REPORTING BOUNDARIES

This chapter includes the description and explanation of emissions categories that are considered. In 2023, ISTW calculated GHG emissions across all plants and the result served as a baseline. However, the scope was still minimum from Scope 1, Scope 2, and 2 categories of Scope 3. In 2024, ISTW expanded the inventory by adding more emission scopes and categories to achieve a more comprehensive GHG calculation. Therefore, the 2024 inventory serves as the starting point for broader emissions tracking. This 2025 GHG inventory then serves as a continuation of emissions tracking using the same scope and categories established in 2024.

3.1 Scope Definition

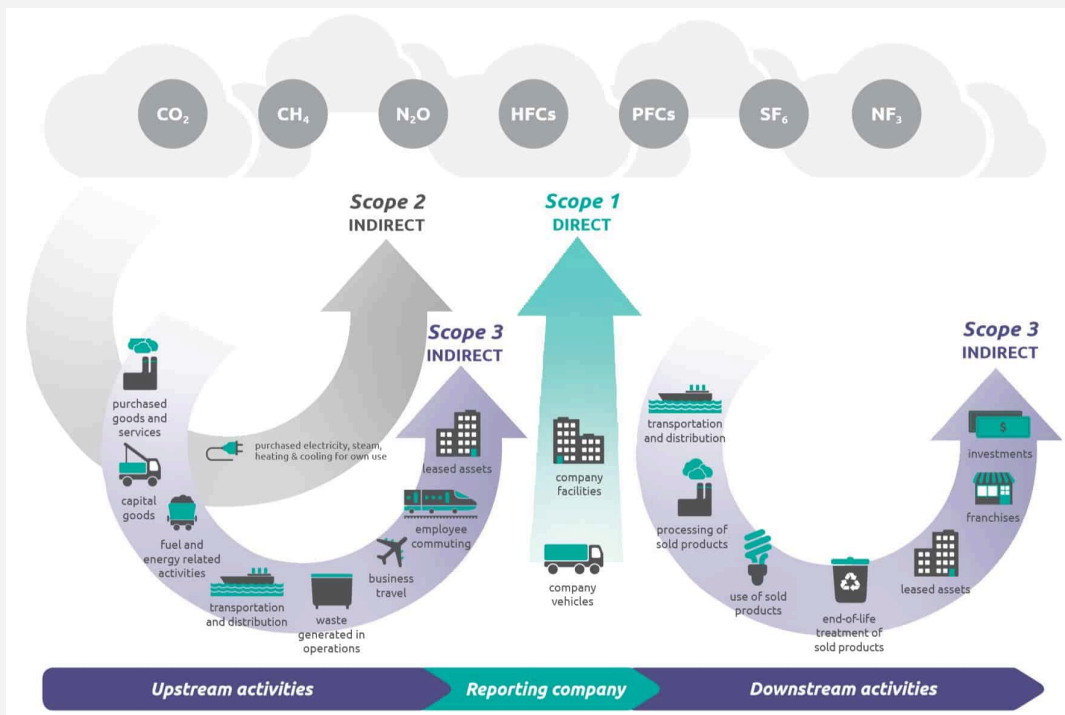


Figure 5. Scope definition according to the GHG Protocol

The GHG Protocol categorises emissions into three scopes (**Figure 4**), namely Scope 1, Scope 2, and Scope 3:

Scope 1: All direct emissions from the activities of an organisation or through sources under its control e.g. on-site fuel combustion such as gas boilers, fleet vehicles, and air-conditioning leaks.

Scope 2: Indirect emissions from electricity and communal energy (for example communal cooling or heating) purchased and used by the organisation. Emissions are created during the production of the energy and eventually used by the organisation.

Scope 3: All other indirect emissions from activities of the organisation, occurring from sources that they do not own or control. Scope 3 emissions are usually the largest share of an organisation's carbon footprint and include emissions associated with the entire supply chain.

From 15 categories of scope 3, the chosen categories in 2025 are 4 categories as listed below, based on the materiality assessment (below the 5% threshold) and the project scope considerations.

- **Category 1 Purchased Goods and Services:** Emission from the purchased goods and services. In this report, only the purchasing of the raw material and other material/services above 50 million was included in the calculation.
- **Category 4 Upstream Transportation and Distribution:** Emissions from the transportation of goods purchased by the organisation. In this report, only the transportation of energy suppliers and mother coils (both local and imported) by road freight and sea freight, respectively, was included in the calculation.
- **Category 6 Business Travel:** Emissions from employee travel for work-related purposes. In this report, the modes of transportation included in the calculations are flights, trains, and cars.
- **Category 9 Downstream Transportation:** Emission from the transportation of the distribution goods by the organisation. In this report, all product transportation modes (both local and exported) by freight and sea freight, were included in the calculation.

Separate Reporting: Following the GHG Protocol standard, all biogenic emissions and reductions, such as combustion of biofuels; and removal from trees, are attributed separately.

3.2 GHG Emission Source Inclusions

All main emissions sources for ISTW are listed in **Table 1** below. The direct GHGs relevant to the company include CO₂, CH₄, N₂O, and HFCs. There is no indication that emissions from PFCs, NF₃ or SF₆ occurred through ISTW's operations.

The calculation includes carbon sequestration from tree planting and nursery activities at its Cikarang and Semarang plants. Selected high-carbon-sequestration species are counted, while those with low quantities or minimal impact are excluded.

Table 1. GHG emissions and reduction sources included in the 2025 GHG Inventory

Business Unit	GHG Emission Source	GHG Emissions Scope	Data Source	Data Collection Unit	Uncertainty (Description)
All business units	Fuel for emergency generators	Scope 1	Consumption data from each business unit	L and minute, type of fuel	It is assumed that the consumption values, time used, and the type of fuel are reported correctly.
All business units	Fuel for own vehicles	Scope 1	Consumption data from each business unit	L, type of fuel	It is assumed that the consumption values and the type of fuel are reported correctly.
All business units	Fugitive emissions from refrigerant leaks	Scope 1	Consumption data from each business unit	Kg, type of refrigerant	It is assumed that the quantity of refrigerant is reported correctly.
Cikarang, Jakarta 1, and Semarang Plant	Fuel for gas used (LPG)	Scope 1	Consumption data from each business unit, except Jakarta 2	kg	It is assumed that the quantity of LPG is reported correctly.
All Plant	Biodiesel B35	Scope 1	<u>65% diesel</u> : Scope 1 <u>35% biogenic</u> : Scope 1 (CH ₄ and N ₂ O) Out of Scope (CO ₂)	L, type of fuel	It is assumed that the consumption values and the type of fuel are reported correctly.
Semarang Plant	Compressed Natural Gas (CNG)	Scope 1	Consumption data from Maintenance department	MMBTU	It is assumed that the consumption values and the type of fuel are reported correctly.

All business units	Grid electricity	Scope 2	Consumption data from each business unit	kWh	It is assumed that the consumption values are reported correctly.
Cikarang, Jakarta 1, and Semarang Plant	Purchased Goods and Services	Scope 3, Cat 1	Purchasing department	Rp	It is assumed that the purchasing values are reported correctly
Cikarang, Jakarta 1, and Semarang Plant	Upstream Transportation	Scope 3, Cat 4	Transportation supplier list of mother coil import and local	multiple	It is assumed that the data source is complete and accurate. The computation of the shipment and road distances have been done with dedicated online platforms and the ones from ferry and truck distances are based on databases; it is assumed that the values are accurate.
All business units	Business travel	Scope 3, Cat 6	List of all business travels	multiple	It is assumed that the data source is complete and accurate. The computation of the direct flight and road distances have been done with dedicated online platforms and the ones from train and ferry distances are based on databases; it is assumed that the values are accurate.
Cikarang, Jakarta 1, and Semarang Plant	Downstream Transportation	Scope 3, Cat 9	Logistic Department	km-tonne	It is assumed that the data source is accurate. For the export data, some of the port distances are estimated based on the nearest based on the dedicated online platforms; it is assumed that the values are accurate.
All business units	Tree planting and nursery	Out of Scope	Data from the HRGA each plant	multiple	It is assumed the tree planting and nursery records are complete and accurate.

3.3 GHG Emission Source Exclusions

While this inventory captures a comprehensive range of GHG emissions, certain sources have been excluded from the 2025 GHG Inventory. **Table 2** summarises the specific GHG emissions and reduction sources that have been excluded from this inventory.

Table 2. GHG emissions and reduction sources excluded in the 2025 GHG Inventory

Business Unit	GHG Emission Source	GHG Emissions Scope	Data Source	Data Collection Unit	Uncertainty (Description)
All business units	Purchased goods and services	Scope 3 Cat 1	List of purchased goods and services below 50 mio IDR	Rp	Excluded due to the insignificant amount
All business units	Capital Goods	Scope 3 Cat 2	Capital goods procurement records	IDR or unit	Excluded from the assessment based on the defined project scope.
All business units	Fuel & Energy Related Activities not included in Scope 1 or 2	Scope 3 Cat 3	Fuel and electricity consumption records	Litre, GJ, kWh	Excluded from the assessment based on the defined project scope.
All business units	Upstream transportation	Scope 3 Cat 4	Transportation supplier list of spare part machine import and local	multiple	Data deficiency

All business units	Waste	Scope 3 Cat 5	Waste generation and disposal records	kg or tonne	Excluded from the assessment based on the defined project scope.
All business units	Business Travel	Scope 3 Cat 6	Business travel with modes of transportation flights, trains, and cars.	km	Other modes of transportation are excluded
All business units	Employee Commuting	Scope 3 Cat 7	Employee commuting survey	Km or employe	Excluded from the assessment based on the defined project scope.
All business units	Upstream leased assets	Scope 3 Cat 8	Leased asset inventory and utility records	multiple	Excluded from the assessment based on the defined project scope.
Cikarang and Jakarta	Downstream transportation	Scope 3 Cat 9	Local and export downstream transportation using trucks	multiple	Some of the trips and weight were not reported
All business units	Processing of Sold Products	Scope 3 Cat 10	Customer processing information	tonne	Excluded from the assessment based on the defined project scope.
All business units	Use of Sold Products	Scope 3 Cat 11	Product use profile	Tonne or unit	Excluded from the assessment based on the defined project scope.
All business units	End-of-Life Treatment of Sold	Scope 3 Cat 12	Product sales and disposal assumptions	tonne	Excluded from the assessment based on the defined project

	Products				scope.
All business units	Downstream Leased Assets	Scope 3 Cat 13	Leased asset records	multiple	Excluded from the assessment based on the defined project scope.
All business units	Franchises	Scope 3 Cat 14	Franchise records	-	Not applicable, as ISTW does not operate franchises.
All business units	Investments	Scope 3 Cat 15	Investment portfolio	IDR	Not applicable, as investments are outside the organisational boundary.

CHAPTER 4: QUANTIFIED GHG INVENTORY OF EMISSIONS

4.1 Emissions Calculation and Result

4.1.1 Emissions by Category

As detailed in **Figure 6** below, in 2025, ISTW emitted a total of **72,670.30 tCO₂-e**. This total does not include biogenic emissions or emission removals, which are discussed in Section 4.1.4 Biogenic Emissions and Removals.

Total Emissions in 2025

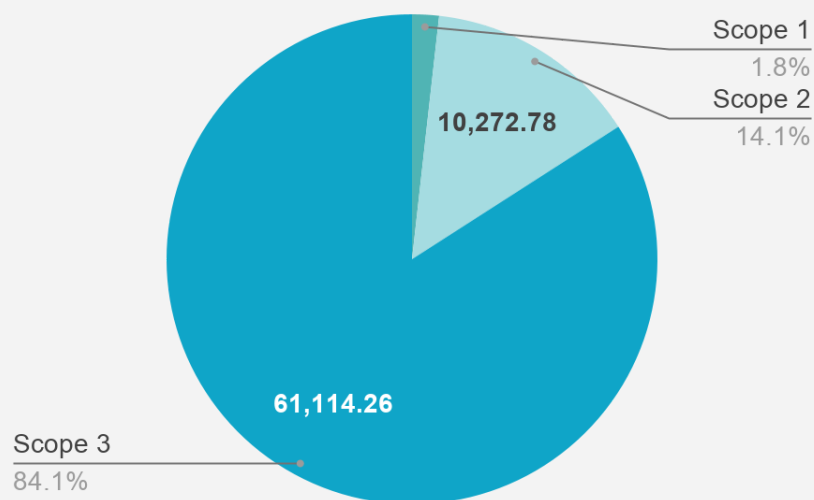


Figure 6. Distribution of the reported emissions by category (tCO₂-e)

Scope 1 emissions, which arise from direct fuel combustion activities (e.g., vehicles), amount to **1,283.26 tCO₂-e**, representing **1.77 %** of total emissions. Stationary fuel combustion contributes 1.34% to emissions from the use of LPG, diesel, Pertamina, CNG, and biodiesel B30 in various industrial equipment and generators. Mobile combustion sources contribute a small percentage by 0.21% to the total emission, this include such as company

vehicles, also release emissions from diesel and Pertamina usage. In addition fugitive emissions from the release of refrigerants (R22, R32, R407C) contribute to 0.22% of the total emissions.

Compared with Scope 1 emissions, Scope 2 represents a more significant source of GHG emissions for ISTW, totalling **10,272.78 tCO₂-e**, representing **14.14 %** of the company's total emissions. These emissions are primarily associated with electricity consumption during the operational processes. Scope 2 emissions occur indirectly when electricity, sourced from PLN (*Perusahaan Listrik Negara*), is produced and supplied to ISTW's facilities. Since PLN's electricity generation is largely based on fossil fuels, it significantly contributes to ISTW's overall emissions profile. Therefore, the result shows that electricity consumption is the most critical source of emissions within the production activities under ISTW's direct control (Scope 2 emissions).

For reported **Scope 3** emissions, ISTW emitted **61,144.26 tCO₂-e (84.10% of the total emissions)**, which includes **Category 1** emission of **52,689.03 tCO₂-e (72.5%)** from the purchased goods and services; **Category 4** emissions of **2,935.11 tCO₂-e (4%)** from the transportation of mother coils (both local and imported) by sea freight. If machine parts transportation were included in this calculation, the total would increase significantly, as most of these parts come from overseas and are transported by air freight; **Category 6** emissions, covering business travel from flights, trains, and cars, contributed **5,339.20 tCO₂-e (7.35%)** to the total Scope 3 emissions. Additionally, **Category 9** emissions, which covers the downstream transportation, emit lower emission at **150.92 tCO₂-e (0.21%)**. Therefore, from the calculated Scope 3 emissions, purchase goods and services is the most significant contributor to ISTW's Scope 3 emissions.

A detailed breakdown of emissions and removals of ISTW in 2025 is presented in Table 3.

Table 3. Emissions and removals of ISTW by plants and category (tCO₂-e)

Emissions Category	ISTW-J1 (tCO ₂ -e)	ISTW-J2 (tCO ₂ -e)	ISTW-CKR (tCO ₂ -e)	ISTW-SMR (tCO ₂ -e)	Total (tCO ₂ -e)	% emissions
Direct Emissions from Stationary Fuel Combustion - Scope 1						
Acetylene (C ₂ H ₂)	0.0	0.0	0.0	0.0	0.0	<1%
LPG	0.07	0.07	0.07	5.22	5.44	<1%
Biodiesel B30	0.00	0.00	0.00	1.53	1.53	<1%
Diesel	2.18	1.09	6.92	0.00	10.20	<1%
CNG	0.00	0.00	0.00	954.66	954.66	1%
Subtotal	2.26	1.16	7.00	961.41	971.82	1%
Direct Emissions from Mobile Fuel Combustion - Scope 1						
Diesel	0.00	0.00	48.56	0.00	48.56	<1%
Pertamax	81.03	4.55	19.28	1.76	106.63	<1%
Subtotal (tCO₂-e)	81.03	4.55	67.85	1.76	155.19	<1%
Direct Fugitive Emissions from Release of Greenhouse Gases - Scope 1						
R22	0.00	0.00	0.00	0.00	0.00	<1%
R410A	0.00	0.00	0.00	0.00	0.00	<1%
R32	0.00	0.00	0.00	156.24	156.24	<1%
R407C	0.00	0.00	0.00	0.00	0.00	<1%
Fire extinguisher CO ₂	0.02	0.00	0.00	0.00	0.02	<1%
Subtotal	0.02	0.00	0.00	156.24	156.25	<1%
Total Scope 1	83.30	5.72	74.84	1,119.40	1,283.26	2%
Indirect Emissions and Removals from Imported Energy - Scope 2						
Electricity from PLN grid	2,360.97	2,954.98	3,903.15	1,053.68	10,272.78	14%
Emergency electricity from building management	0.00	0.00	0.00	0.00	0.00	<1%

Communal chilled water from building management	0.00	0.00	0.00	0.00	0.00	<1%
Refrigerant leaks for cooling of offices	0.00	0.00	0.00	0.00	0.00	<1%
<i>Subtotal</i>	<i>2,360.97</i>	<i>2,954.98</i>	<i>3,903.15</i>	<i>1,053.68</i>	10,272.78	14%
Total Scope 2	2,360.97	2,954.98	3,903.15	1,053.68	10,272.78	14%
Cat 1. Indirect Emissions from Purchased Goods and Services - Scope 3						
Emissions from rent car	0.00	0.00	0.00	30.23	30.2	<1%
Emissions from suppliers goods - spend-based	22,216.53	18.14	20,213.98	9,944.63	52,393.29	72%
Emissions from suppliers services - spend-based	60.15	21.50	171.87	22.59	276.11	<1%
<i>Subtotal (tCO₂-e)</i>	<i>22,276.69</i>	<i>39.64</i>	<i>20,385.85</i>	<i>9,997.44</i>	52,699.62	73%
Cat 4. Upstream Transportation - Scope 3						
Emissions from expeditions and transportation - road transport	35.87	0.00	1,254.43	165.64	1,455.94	2%
Emissions from expeditions and transportation - sea transport	1,066.82	0.00	0.00	412.35	1,479.18	2%
<i>Subtotal (tCO₂-e)</i>	<i>1,102.69</i>	<i>0.0</i>	<i>1,254.43</i>	<i>577.99</i>	2,935.11	4%
Cat 6. Indirect Emissions from Business Travel - Scope 3						
Economy flights	219.94	2.86	2.86	21.19	246.85	<1%
Train trips	326.23	0.35	0.35	757.85	1,084.79	1%
Car and taxi trips	602.48	1.85	139.62	3,263.61	4,007.56	6%
<i>Subtotal</i>	<i>1,148.65</i>	<i>5.1</i>	<i>142.83</i>	<i>4,042.66</i>	5,339.20	7%
Cat 9. Downstream Transportation - Scope 3						
Emissions from expeditions and transportation - road transport	6.10	12.01	22.43	67.90	108.44	<1%
Emissions from expeditions and transportation - sea transport	9.25	0.00	33.23	0.00	42.48	<1%

Subtotal (tCO ₂ -e)	15.35	12.0	55.66	67.90	150.92	<1%
Total Scope 3	24,543.38	56.70	21,838.77	14,685.99	61,124.85	84%
Total Emissions and Removals	26,987.66	3,017.40	25,816.76	16,859.08	72,669.75	100%
	37%	4%	36%	23%	100%	

Note: the values presented in this table are rounded from calculations with a precision of 10^{-6} tCO₂-e. Therefore, apparent sum errors can appear in some cases.

4.1.2 Emissions by Production Plant

In 2025, ISTW's total emissions amounted to **72,670.30 tCO₂-e**, with the emissions distributed among its four plants (**Figure 7**). The largest contributor came from the Jakarta Plant, which combined of J1 and J2, due to the same production facilities, at 41.3% with the **J1 plant** was the largest contributor, emitting **26,984.1 tCO₂-e**, accounting for approximately **37.1%** of the total emissions and The **J2 plant** emitted **3,016.11 tCO₂-e**, representing **4.2%** of the total emissions. The **Cikarang plant** followed closely, with emissions of **25,811.28 tCO₂-e (35.5%)**, while the **Semarang plant** produced **16,858.74 tCO₂-e (23.2%)**.

Total Emissions per Plant

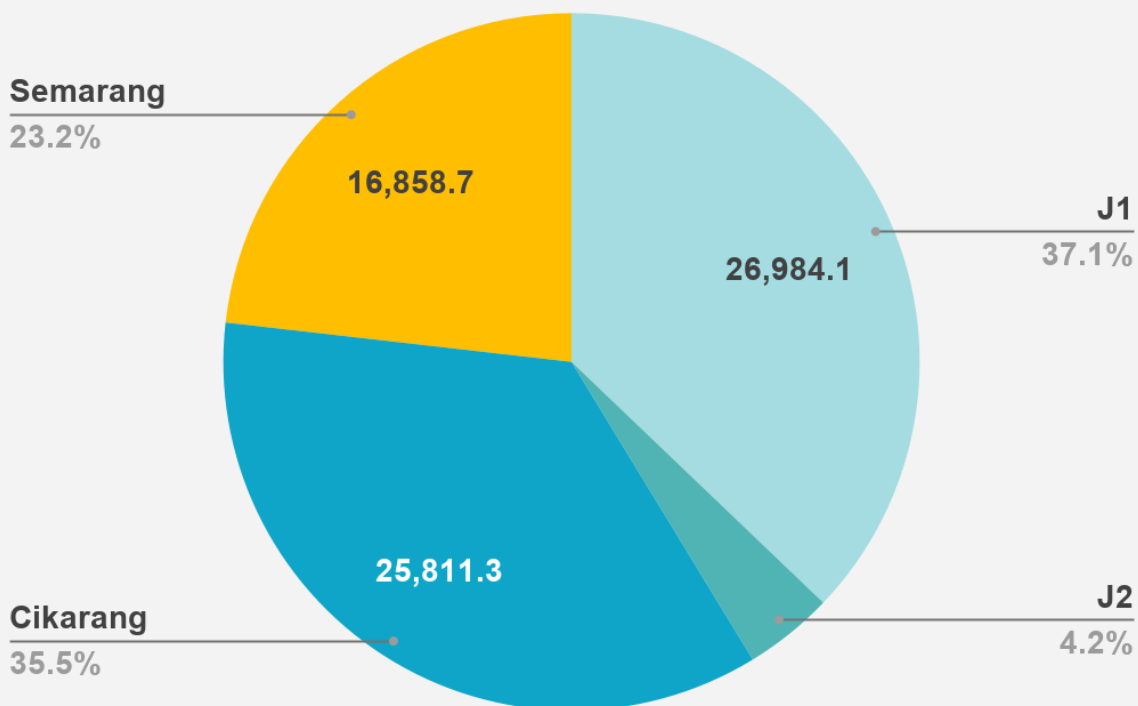


Figure 7. Distribution of the reported emissions by plants (tCO₂-e)

A comprehensive summary of the emissions by plant and category for 2025 is outlined in Figure 8, offering a detailed account of each plant's contributions across various emissions categories.

Total Emissions in 2025

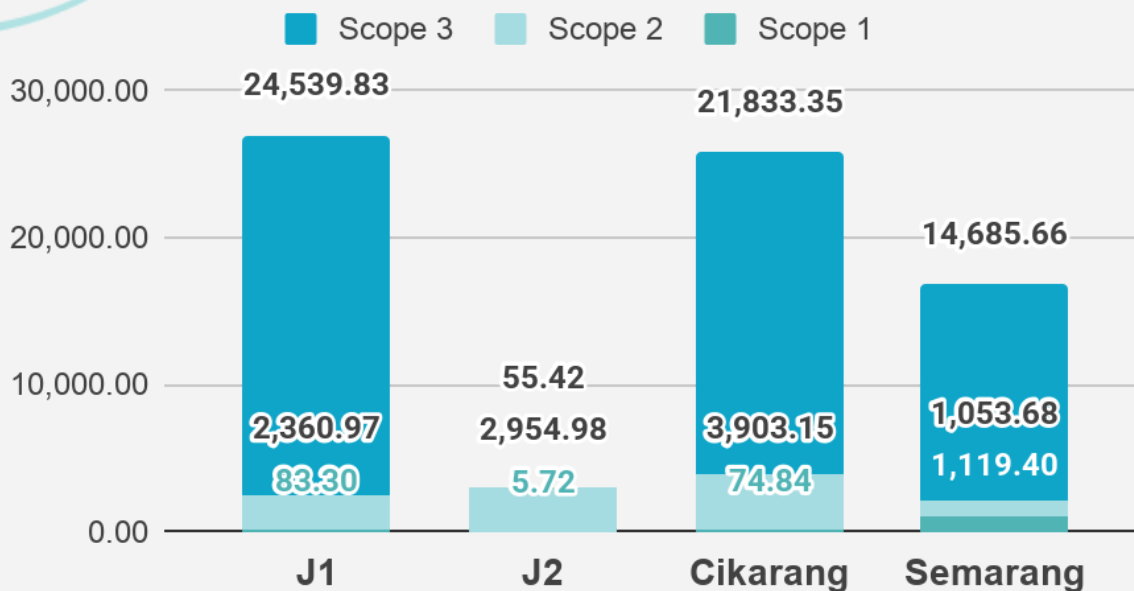


Figure 8. Distribution of the reported emissions by plants per category (tCO₂-e)

This distribution indicates that the Jakarta plant, as the highest production output, is a significant contributor to ISTW's overall emissions. The Jakarta plant consists of two plants, which are J1 and J2. They are considered together as part of the same production process, the combined emissions (**30,000.22 tCO₂-e**) would represent a substantial 41.3% of the total emissions of the company from 35,112.64 tons or 35.41% of 2025 total production. This consolidation emphasises the critical importance of implementing effective management initiatives at these interconnected facilities to drive reductions in ISTW's overall emissions.

At the Jakarta plant, the highest emissions come from the J1 plant, the headquarter of ISTW, that emitted **26,984.19 tCO₂-e** in total, with Scope 1

emissions accounting for **83.3 tCO₂-e** and Scope 2 emissions at **2,360.97 tCO₂-e**. The relatively low Scope 1 emissions indicate that direct fuel combustion is not a major contributor to overall emissions, aligning with its operational model focused on processing mother coils. However, the high Scope 2 emissions suggest a significant reliance on electricity sourced from PLN. Additionally, J1's Scope 3 emissions of **24,539.83 tCO₂-e**, are largely from purchased goods and services, notably raw material from South Korea, China, and other countries.

Meanwhile, J2 plant emitted a total of **3,016.11 tCO₂-e**, with minimal emission coming from Scope 1 at **5.72 tCO₂-e** which reflects limited direct fuel usage and the use of low-carbon fuel. The noteworthy emissions come from the Scope 2 emissions at **2,954.98 tCO₂-e**, revealing a similar dependency on fossil fuel-based electricity as J1. As J2 is directly linked to J1's production process, the operational activity is somehow represented by the activity by J1, which makes the Scope 3 emissions become low with only **55.42 tCO₂-e** that majorly comes from purchased goods and services.

The **Cikarang** emitted a total of **25,811.28 tCO₂-e**, making it the second largest emitter among all facilities. Similar to J1, scope 1 emissions remained relatively low at **74.84 tCO₂-e**, indicating limited direct fuel consumption within the plant. Scope 2 emissions accounted for **3,903.15 tCO₂-e**, reflecting the plant's dependence on grid electricity, which is still predominantly generated from fossil fuel sources. The majority of emissions, however, originated from Scope 3 at **21,833.29 tCO₂-e**, highlighting the significant contribution of upstream transportation activities, particularly the logistics of mother coil transportation, to the plant's overall carbon footprint. This emission profile is consistent with J1, where transportation related activities also represent the dominant source of indirect emissions.

The Semarang plant emitted **16,858.28 tCO₂-e**, with a Scope 1 contribution of **1,119.40 tCO₂-e**, primarily due to relatively old machinery and fuel usage. Its Scope 2 emissions are relatively lower at **1,053.68 tCO₂-e**, indicating less reliance on electricity compared to the other plants. The Scope 3 emissions stand at **14,685.17 tCO₂-e** which indicates some contribution from logistics but significantly lower than Cikarang and J1. This is notably because Semarang sources its mother coils from local West Java whereas J1 and Cikarang source the mother coils from international sources with much higher transport emissions.

4.1.3 Emissions by Type of GHG

Table 4 below presents the results of the 2025 GHG Inventory by type of GHGs. No PFCs, SF₆, or NF₃ emissions have been reported.

Table 4. ISTW 2024 emissions by GHG (tCO₂-e)

Emissions per GHG (t CO ₂ -e)	TOTAL GHG (CO ₂ -e)	Carbon dioxide (CO ₂)	Methan e (CH ₄)	Nitrous oxide (N ₂ O)	HFCs (wavg)	PFCs (wavg)	Sulfur hexafluori de (SF ₆)	Nitrogen trifluoride (NF ₃)
Emissions Category	GWP-100	1	27.9	273	1,499	4,000	25,200	17,400
Scope 1 - Direct Emissions and removals								
Direct Emissions from Stationary Fuel Combustion	971.82	968.38	0.02	0.02	0.00	0.00	0.00	0.00
Direct Emissions from Mobile Fuel Combustion	155.19	161.27	0.19	1.53	0.00	0.00	0.00	0.00
Direct Fugitive Emissions from Release of Greenhouse Gases	156.24	0.00	0.00	0.00	156.24	0.00	0.00	0.00
Total Scope 1 (tCO₂-e)	1,283.25	1,129.64	0.22	1.55	156.24	0.00	0.00	0.00
Scope 2 - Indirect Emissions and Removals from Imported Energy								
Indirect Emissions from Imported Electricity *	10,272.78	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total Scope 2 (tCO₂-e)	10,272.78	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Scope 3 - Other Indirect Emissions and Removals								
Cat 1. Indirect Emissions from Purchased Goods and Services *	52,689.03	30.13	0.03	0.07	0.00	0.00	0.00	0.00
Cat 4. Indirect Emissions from	2,935.11	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Upstream Transportation *								
Cat 6. Indirect Emissions from Business Travel *	5,339.20	4,940.06	36.88	115.41	0.00	0.00	0.00	0.00
Cat 9. Indirect Emissions from Downstream Transportation *	150.92	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total Scope 3 (tCO₂-e)	61,114.26	4,970.19	36.91	115.47	0.00	0.00	0.00	0.00
Total Emissions and Removals (tCO₂-e)	72,670.28	6,099.83	37.13	117.03	156.24	0.00	0.00	0.00
Total Scope 1 & 2 Emissions and Removals (tCO₂-e)	11,556.02	6,099.83	37.13	117.03	156.24	0.00	0.00	0.00

*The emission factor per type of GHG is not known for the electricity purchased on the PLN power grids and for Scope 3 calculations based on LCA EF.

With no reported emissions from high-impact gases such as PFCs, SF₆, and NF₃, ISTW can focus its emissions reduction efforts on the more prevalent greenhouse gases CO₂, CH₄, and N₂O which are directly associated with its operational activities. Although emissions from PFCs, SF₆, and NF₃ have not been identified, refrigerants used in air conditioning systems and process chillers represent a potential source of fugitive GHG emissions due to their relatively high global warming potential (GWP). Therefore, regular inspection, leak detection, preventive maintenance, and proper refrigerant handling should be implemented for all refrigeration and cooling equipment to minimise refrigerant leakage throughout their service life.

4.1.4 Biogenic Emissions and Removals

At ISTW, the use of biodiesel B30 at the Semarang plant resulted in **0.53 tCO₂-e** of biogenic emissions attributed to its 30% biofuel content. In addition, ISTW's tree planting and nursery programme sequestered approximately **180.60 tCO₂-e** from the atmosphere through trees, mainly from Semarang and Cikarang plants. It is to note that the carbon sequestration from trees on ISTW's sites is around 1,000 times smaller than the operational emissions, therefore very minimal.

A detailed account of biogenic emissions and removals from ISTW is shown in **Table 5**.

Table 5. Biogenic emissions from the combustion of biofuels and removals

Emissions Category	J1 (tCO ₂ -e)	J2 (tCO ₂ -e)	CKR (tCO ₂ -e)	SMR (tCO ₂ -e)	Total (tCO ₂ -e)
<i>Emissions from Biofuel Combustion</i>					
Biodiesel (B30) - Stationary Fuel Combustion	0.00	0.00	0.00	0.53	0.53
<i>Subtotal (tCO₂-e)</i>	<i>0.00</i>	<i>0.00</i>	<i>0.00</i>	<i>0.53</i>	<i>0.53</i>
Total Biogenic Emissions	0.00	0.00	0.00	0.53	0.53
<i>Emissions Removal</i>					
Carbon sequestration from tree planting and nursery	-3.5	-4.8	-13.2	-159.1	-180.60
<i>Subtotal (tCO₂-e)</i>	<i>-3.50</i>	<i>-4.80</i>	<i>-13.20</i>	<i>-159.10</i>	<i>-180.60</i>
Total Emissions Removal	-3.50	-4.80	-13.20	-159.10	-180.60
Total Biogenic Emissions and Removal	-3.50	-4.80	-13.20	-158.57	-180.07

4.2 Internal Performance Tracking

Two main indexes can be used to track the performances of the ISTW – the energy intensity and the emissions intensity. For this calculation, only Scope 1 and Scope 2 emissions were considered. When comparing energy intensity and emissions intensity, ISTW's role as a steel pipe and tube manufacturer is particularly significant. Unlike general steel production, which often involves steelmaking in a furnace, **ISTW focuses on transforming mother coils into finished products**. This operational distinction is important, as emissions can vary greatly depending on the production method. Companies engaged in full steelmaking processes typically have higher energy intensity and emissions intensity due to the energy-intensive nature of primary production. Therefore, while industry

averages are informative, it is crucial to consider ISTW's specific operations, which may result in **lower energy intensity and emissions intensity** owing to its current manufacturing approach.

4.2.1 Energy Intensity Index

The energy intensity index (**Figure 9**) is an important metric for evaluating ISTW's operational efficiency, indicating the amount of energy consumed per tonne of steel produced. This index was calculated using total energy consumption across all plants. For 2025, ISTW's overall energy intensity stood at **0.63 GJ/tonne**. A breakdown of energy intensity per plant is detailed below.

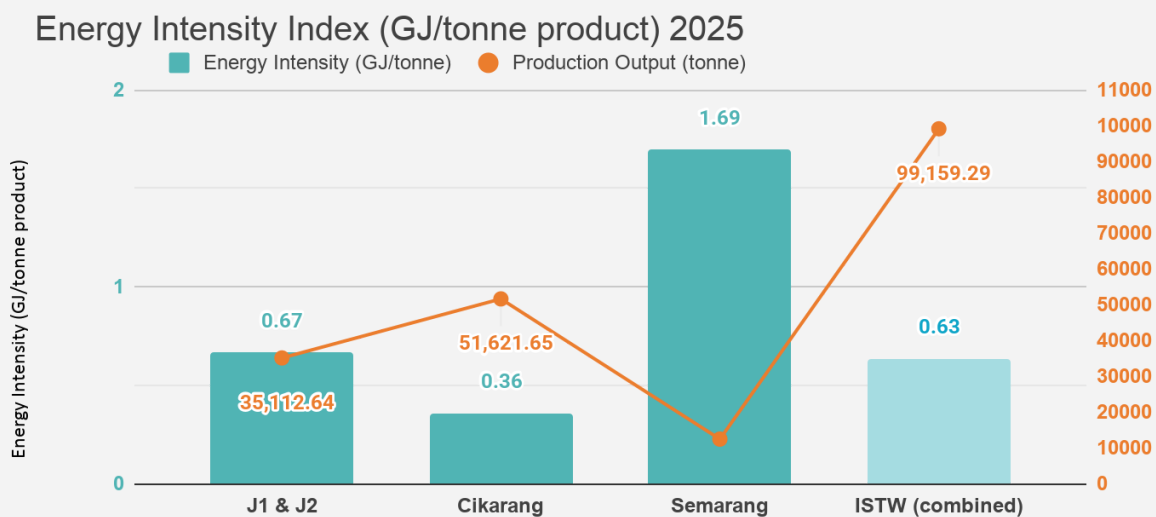


Figure 9. Energy intensity index of ISTW in 2025

J1 and J2 plants exhibited the energy intensity at **0.67 GJ/tonne**, which can be attributed to their energy-intensive production processes. These facilities together consumed **23,355.10 GJ** while producing **35,112.64 tonnes** of steel pipes. The higher energy intensity suggests inefficiencies likely stemming from the reliance on electricity for initial production and

the use of fuel transportation activities, including forklifts and vehicle operations.

Conversely, Cikarang demonstrated a significantly lower energy intensity of **0.36 GJ/tonne**, consuming **18,437.41 GJ** and producing **51,621.65 tonnes** of steel pipes. This lower figure shows the plant's more advanced energy-efficient technologies and processes that maximise production while minimising energy consumption. Cikarang's superior performance in this regard indicates its role as the most efficient plant in ISTW's operations.

The Semarang plant has the highest energy intensity of **1.69 GJ/tonne**, consuming **21,056.28 GJ** for a production output of **12,425.00 tonnes**. The higher energy intensity is primarily associated with the use of older equipment, which presents opportunities for improving operational efficiency through modernisation and process optimisation. In addition, the plant's hot-dip galvanising process, used to produce corrosion-resistant steel, is inherently energy-intensive due to the high temperatures required during production (World Steel Association, 2023). As a result, this process substantially increases the plant's overall energy demand and contributes to its higher energy intensity.

ISTW's energy intensity of **0.63 GJ/tonne** is higher than some front running competitors. For instance, APL Apollo (2025) from India has a notably lower energy intensity of **0.27 GJ/tonne** in 2025*, suggesting advanced operational efficiencies and innovative practices in their production processes. Maruichi Steel Tube Ltd. (2025), a shareholder of ISTW based in Japan, has an even higher intensity of **1.27 GJ/tonne** reported in 2024 for the domestic plants with a certain product*.

However, differences in energy intensity among steel manufacturers are largely influenced by the scope of their production processes. ISTW's

manufacturing activities begin with processing mother coils sourced from external suppliers, whereas many other steel producers include upstream operations, such as ironmaking and steelmaking from raw materials, within their production boundaries. Furthermore, variations in product portfolios, with some companies manufacturing a wider range of steel products and pipes, also contribute to differences in reported energy intensity values.

While ISTW demonstrates a comparatively lower energy intensity, reflecting operational effectiveness, the higher energy intensity observed in the **Semarang** plants (**1.69 GJ/tonne**) and the **J1 & J2** plant (**0.67 GJ/tonne**) highlights areas for improvement. In contrast, the **Cikarang** plant showcases superior energy efficiency of **0.36 GJ/tonne**, suggesting that J1 & J2, and Semarang could benefit from adopting best practices in energy management, upgrading machinery, and optimising production processes to enhance their performance.

Note: The energy intensity values marked with an asterisk () are approximate figures derived from the energy and production output data presented in each company's sustainability reports; actual values may vary significantly.*

In comparison with last year (2024) as shown at **Figure 10**, the 2025 result exhibits slightly decrease for ISTW energy efficiency by lowering the overall energy intensity from **0.65 GJ/tonne** to **0.63 GJ/tonne** by mostly increasing the output product and decreasing the energy consumption such as electricity and fuel which is notably used for mill machinery operation and transportation activities like forklifts and cars. J1 & J2 has experienced a slight increase in energy intensity. Although the total energy consumption decreased from **25,691.74 GJ** in 2024 to **23,355.10 GJ** in 2025, the energy intensity increased from **0.640 GJ/ton** to **0.665 GJ/ton**. This was primarily driven by a larger decline in production volume (approximately 13%) compared with the reduction in total energy consumption (approximately

9%). As a result, the fixed or baseline energy demand required to maintain plant operations was distributed over a lower production output, leading to a higher energy consumption per ton of product. Cikarang Plant showed the most efficient plant with a slight decrease from **0.37 GJ/tonne** to **0.36 GJ/tonne** in 2025. This is mainly caused by the decreasing the production output which then lowers the energy consumption especially the electricity and the mobile and stationary combustion. Similar to J1 and J2, the Semarang plant also experienced a slight increase in energy intensity, from **1.58 GJ/tonne** to **1.69 GJ/tonne**. This increase indicates that the reduction in energy consumption did not keep pace with the decline in production output, leading to higher energy use per tonne of product.

Compared with the 2023 baseline, ISTW's overall energy intensity decreased slightly by **9.7%**, from **0.70 GJ/tonne** to **0.63 GJ/tonne** in 2025. As shown in Figure 10, energy intensity values for all plants exhibited only minor year-to-year variations, indicating generally stable energy performance across the reporting period. At the plant level, Cikarang maintained its position as the most energy-efficient facility, with its energy intensity remaining stable at **0.36 GJ/tonne**. Semarang reduced its energy intensity by **2.55%**, from **1.74 to 1.69 GJ/tonne**, although it remained the most energy-intensive plant due to its ageing machinery and galvanisation process. In contrast, J1 & J2 recorded a slight increase of **0.5%**, from **0.66 to 0.67 GJ/tonne**, suggesting opportunities for further operational optimisation.

ISTW Energy Intensity Comparison

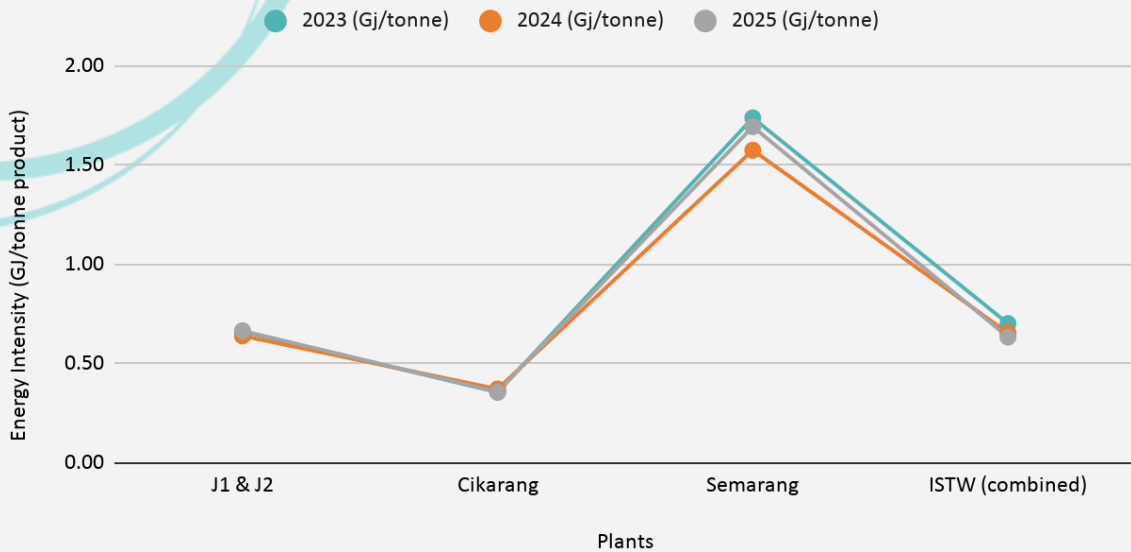


Figure 10. Comparison of the ISTW's energy intensities for 2023 (baseline), 2024, and 2025

4.2.2 Emissions Intensity Index

The GHG emission intensity index is a key performance indicator for ISTW's operations, measuring how much GHG is emitted per tonne of steel pipe produced. ISTW's emissions intensity, with combined emission and output from all plants in 2025, was **116.54 kgCO₂-e/tonne** (Figure 11). Emissions intensity at the Semarang plants reached **174.90 kgCO₂-e/tonne**, while J1 & J2 and Cikarang had lower intensities of **153.93 kgCO₂-e/tonne** and **77.06 kgCO₂-e/tonne**, respectively.

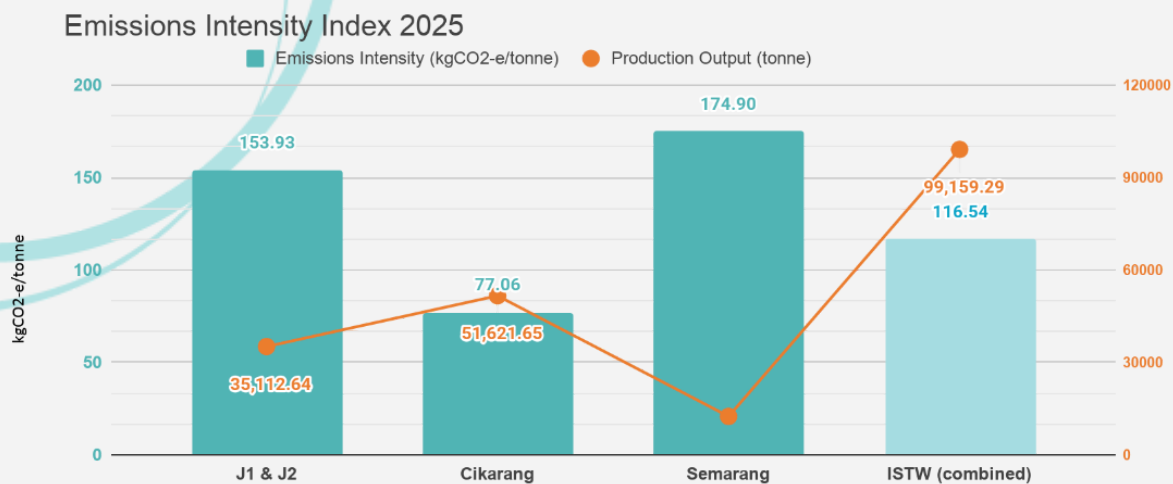


Figure 11. Emissions intensity index of ISTW in 2025

The 2025 emissions intensity data for Semarang exhibits the highest emissions intensity at **174.9 kgCO₂-e/tonne**, which reflects its lower efficiency in managing its carbon output per unit. This plant handles 12.5% of ISTW's production, outputting **12,425 tonnes** of steel pipe, including galvanised pipe, which often requires additional energy-intensive processes that increase emissions. This galvanisation, done through the hot-dip method, aims at producing higher-quality, corrosion-resistant steel, contributing further to the plant's Scope 1 emissions through fuel use in machinery and emissions generated from the galvanisation process itself (World Steel Association, 2023). In addition, the combination of older machinery, transportation-related emissions, and galvanisation processes, despite the plant's lower production output, contributes to its comparatively higher emissions intensity and makes it the most unsustainable plant on a per tonne basis at ISTW.

Based on the 2025 data for the Cikarang facility, a production volume of **35,112.64 tonnes** generated **3,977.99 tCO₂-e** in combined Scope 1 and Scope 2 emissions. This results in an emission intensity of **77.06 kgCO₂-e/tonne**. This lower intensity, when compared to other

manufacturing plants, stems from the adoption of renewable energy to meet electricity demands, showcasing enhanced emissions efficiency. This indicates that the operational processes or energy sources at Cikarang are less carbon-intensive relative to its output.

The **J1 & J2** plants have a moderate emissions intensity of **153.93 kgCO₂-e/tonne**. In 2025, the plants produced **35,112.64 tonnes (35.41%)** of steel products, a slight decrease from 2024's production, while also maintaining the slight decrease in electricity consumption. This exhibits a significant improvement in their operational efficiency, primarily through machinery optimisation as well as reducing the energy consumption, making these plants achieve higher production with lower relative emissions. Therefore, continued focus on those initiatives will further strengthen their sustainability performance.

A closer look at ISTW's emissions intensity against industry competitors showcases marked differences. Similar to energy intensity, ISTW's emissions intensity of **116.54 kgCO₂-e/tonne** is influenced not only by its operational strategies but also by the line of production and the types of steel pipes manufactured. However, ISTW's emissions intensity contrasts with the shareholders Maruichi Steel Tube Group (2025), with **130.57 kgCO₂-e/tonne** in 2024*; and the competitors such as Borusan Mannesmann's emissions intensity of **76.76 kgCO₂-e/tonne** in 2022* (2023) and APL Apollo's notable **38.90 kgCO₂-e/tonne** in 2023* (2024) highlight the impact of production techniques and product offerings.

Note: The emissions intensity values marked with an asterisk () are approximate figures derived from the emissions and production output data presented in each company's sustainability reports; actual values may vary significantly.*

ISTW's relatively higher emissions intensity, particularly with the **J1 & J2** facilities at **153.93 kgCO₂-e/tonne**, indicates a need for targeted operational improvements to address the inefficiencies associated with energy-intensive processes. The **Cikarang** plant, with a more efficient emissions intensity of **77.06 kgCO₂-e/tonne**, highlights best practices that could be adopted by the J1 & J2 facilities to enhance their performance. Similarly, **Semarang's** intensity of **174.90 kgCO₂-e/tonne**, influenced by the use of older machinery and reliance on fuel, suggests that investments in modern technology and process optimisation could yield reductions in emissions.

Compared to 2024, the recent emission intensity showed a marginal decline from **119.92 kgCO₂-e/tonne** to **116.54 kgCO₂-e/tonne**. This steady performance is linked to a proportional reduction in electricity and fuel usage for mill machinery and vehicle mobility, alongside a matching decline in production. In 2024, emission intensities varied across individual sites: the J1 & J2 facilities recorded a significant **149.90 kgCO₂-e/tonne**; Cikarang, operating as the most efficient plant, stood at **82.63 kgCO₂-e/tonne**; while the energy-heavy Semarang plant registered a high intensity of **162.62 kgCO₂-e/tonne** due to its specialised galvanisation workflows.

Compared with the 2023 baseline, ISTW's overall emissions intensity decreased by **2.5%**, from **119.57 to 116.54 kgCO₂-e/tonne** in 2025, indicating a modest improvement in emissions performance. At the plant level, Cikarang recorded the strongest improvement, reducing its emissions intensity by **7.1%** from **82.97 to 77.06 kgCO₂-e/tonne** while maintaining its position as the most emissions-efficient plant. In contrast, J1 & J2 experienced a slight increase of **2.6%**, from **150.08 to 153.93 kgCO₂-e/tonne**. Semarang recorded the largest increase, with emissions intensity rising by **13.0%**, from **154.73 to 174.90 kgCO₂-e/tonne**, primarily

driven by the extensive use of CNG in its energy-intensive galvanisation process. These findings highlight the need for targeted energy efficiency and fuel transition measures, particularly at the Semarang plant.

ISTW Emission Intensity Comparison

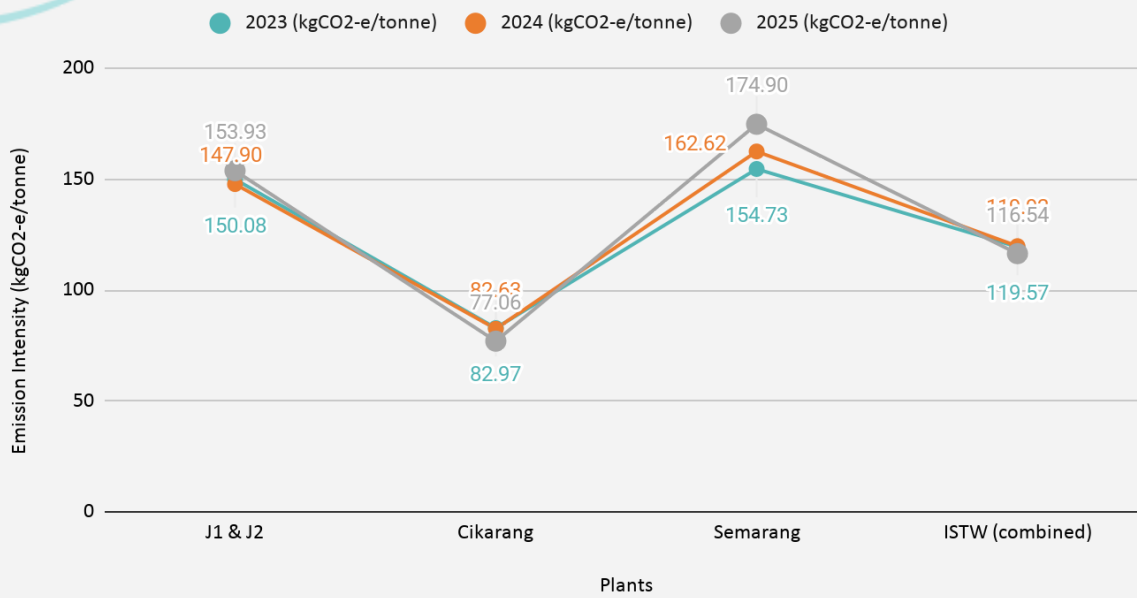


Figure 12. Comparison of the ISTW's emission intensities for 2023 (baseline), 2024, & 2025

Therefore, building on the 2025 energy audit findings, ISTW should focus on implementing the recommended energy efficiency improvements, including optimising compressed air systems, upgrading chilled water pumps with Variable Speed Drives (VSDs), improving the efficiency of ageing equipment, and strengthening energy data management. Together with the gradual adoption of renewable electricity and cleaner fuels, these measures will reduce energy consumption, lower emissions intensity, and accelerate ISTW's transition towards a low-carbon manufacturing operation.

4.3 Emission Factors Considered for This Inventory

The emission factors (EF) have been determined according to IPCC standards. Tier 2 EFs (national/regional data) have been used whenever available, while Tier 1 EFs (IPCC standard data and methods) have been applied for the remaining EFs. These are listed in **Table 6** below.

Table 6. Emission factors used for the computation of the 2024 GHG Inventory

Emission type	Emission source	Overall CO ₂ -e	Unit	Reference
Combustion emissions	Emission gas type	Emission factor		Reference
Stationary combustion	Diesel	2.6975	kg CO ₂ -e/L	Tier 2—ESDM (Indonesia)
	Gasoline	2.4001	kg CO ₂ -e/L	Tier 2—ESDM (Indonesia)
	LPG	2.9925	kg CO ₂ -e/kg	IPCC 2006 Methodology
	B35	1.7533	kg CO ₂ -e/L	Pertamina Patra Niaga
	Pertamax	2.3073	kg CO ₂ -e/L	IPCC 2006 Methodology
	CNG	60.7712	kg CO ₂ -e/MMBTU	IPCC 2006 Methodology
Mobile combustion	Diesel	2.7309	kg CO ₂ -e/L	Tier 2—ESDM (Indonesia)
	Pertamax	2.1500	kg CO ₂ -e/L	Tier 2—ESDM (Indonesia)
	B35	1.7779	kg CO ₂ -e/L	Pertamina Patra Niaga
	B100	2.2261	kg CO ₂ -e/L	IPCC 2006 Methodology
Fugitive emissions	Emission gas type	Emission factor		Reference
Refrigerant leaks	R407C	1,773.9	kg CO ₂ -e/kg	IPCC AR6
	R22	1,960.0	kg CO ₂ -e/kg	IPCC AR6
	R32	771.0	kg CO ₂ -e/kg	IPCC AR6
Fugitive emission	Apar CO ₂	1.00	kg CO ₂ -e/kg	GHG Protocol
	Acetylene (C ₂ H ₂)	0.0045	kg CO ₂ -e/L	IPCC 2006
Grid electricity	Emission source	Emission factors		Reference
Grid electricity from PLN	Electricity	0.870	kg CO ₂ -e/kWh	Tier 2—2019 emission factors per grid (Jamali) published by ESDM
Transportation	Emission source	Emission factors		Reference
Emissions due to flight transport	Economy – short haul	0.09245	kg CO ₂ -e/pkm	GHG Protocol Cross-Sector tool
	Business – short haul	0.13867	kg CO ₂ -e/pkm	GHG Protocol Cross-Sector tool

Emissions due to communal transport	Train or MRT	0.1013	kg CO ₂ -e/pkm	GHG Protocol Cross-Sector tool
Emissions due to private or service transport	Gasoline car	0.2984	kg CO ₂ -e/pkm	Assumption based on Tier 2 values
Varia	Emission source	Emission factors		Reference
Expenses for goods and services	Production Gas - CO ₂	1.00	kg CO ₂ -e/kg	GHG Protocol
	Production Gas - Argon	0.103	kg CO ₂ -e/L	Reccessary
Upstream Transportation	Truck (Land Freight)	0.0164	kg CO ₂ -e/kg	BEIS
	Cargo (Sea Freight)	0.0160	kg CO ₂ -e/kg	BEIS

4.3.1 Carbon Sequestration Emission Factors for Planted Trees

To determine the amount of carbon sequestered by a tree over a specific period, various methods are available. The simplest approach involves measuring the diameter of the tree at breast height (DBH) at a height of 1.30 metres at both the beginning and end of the measurement period. Scientific literature provides allometric equations tailored to different tree species and climatic regions, which define the correlation between DBH and tree biomass. Using these equations, one can derive formulas and ratios that facilitate the calculation of carbon sequestered by the tree during its growth phase, as well as the corresponding CO₂ absorbed to achieve this carbon storage. Some allometric equations have been updated from the previous inventory, which can explain a reduction of certain results, particularly in the case of the Cikarang plant.

In the 2025 GHG Inventory of ISTW, 1,486 trees were considered. If the numbers of trees of one species were lower than thirty, they were excluded.

4.4 Data Uncertainties

As indicated in **Table 1** in Section 3.2, certain datasets exhibit varying levels of uncertainty, which could affect the overall accuracy of the GHG inventory.

4.4.1 Scope 1

For the emissions calculations related to diesel generators, it is assumed that they are operated for a duration of 60 minutes. This assumption may introduce variability in emissions estimates, as actual usage times can differ.

4.4.2 Scope 2

Discrepancies have been observed between the electricity consumption recorded by kilowatt-hour (kWh) metres per machine in each plant. However, some machines lack kWh meters. This may lead to uncertainties in the recorded Scope 2 emissions.

4.4.3 Scope 3

- **Category 1:** The uncertainty emission associated with the purchased goods and services might come from the unavailability of specific supplier emission data, which often necessitates the use of the spend-based method. This approach relies heavily on secondary data, such as industry-average emission factors, which may not accurately represent the specific activities or processes of the suppliers.
- **Category 4:** The emissions associated with the transport of machine parts by air freight have not been calculated due to unrecorded weight data. Additionally, there is a lack of data on the transport of mother coils from the warehouse to the initial port of shipment. Details regarding the type of vessel used (fuel type, etc.) are also

absent. Therefore, standard assumptions were applied in the distance-based calculations between ports and from the arrival port to ISTW's plants.

- **Category 6:** For business travel, the distances flown by staff on planes were calculated using the direct distance between airports. A similar approach was applied for journeys made by train and car, which may not fully capture the actual distance travelled due to varying routes taken.
- **Category 9:** The emission associated to the transported product by truck is not fully calculated due to unrecorded trips of transported product to the customer. Hence, the calculation is conducted partially based on the availability of trip transported data. Additionally, there is a lack of data on the transport of product from the ISTW to the initial port of shipment. Therefore, standard assumptions were applied in the distance-based calculations between ports and from the arrival port to ISTW's plants.

4.4.4 Out of Scope

- **Production values:** In the previous reporting year, production data was sourced from multiple departments, which resulted in data synchronisation challenges. Conversely, for this reporting period, data collection was streamlined to a single department. While this approach enhances consistency in data handling, it has introduced a level of uncertainty regarding historical trend comparability. To mitigate this, it is recommended to standardise data collection protocols across all relevant departments and implement robust quality control processes to ensure the continued accuracy, comparability, and reliability of future reports.

4.5 Recommendations to Improve Future Reportings

4.5.1 Enhance Energy Consumption Recording

ISTW's energy data system currently tracks fuel and electricity consumption on a monthly basis per mill. Nevertheless, due to a lack of individual kWh meters, specific production machinery remains unmonitored, with data dispersed across multiple records. To resolve these discrepancies, it is essential to overhaul ISTW's energy data management system to comprehensively cover all major greenhouse gas (GHG) emission sources and mitigation efforts. Designating a specialised energy manager will support compliance with ISO 50001 standards and optimise energy tracking. Consequently, this initiative will enhance the dependability of ISTW's emissions data and help pinpoint key opportunities for energy efficiency and GHG reductions.

4.5.2 Improve Data Recording for Transport of Purchased and Distributed Items

Based on the analysis of ISTW's trucking database, improving data quality and consistency is essential to enhance the accuracy of Scope 3 Category 4 and Category 9 emissions calculations. Several inconsistencies were identified in the current records and can be improved for future reporting, such as:

- **Standardise Destination Address Recording:** Ensure that all shipment records include complete and specific delivery addresses.
- **Record Actual Shipment Dates:** Use the actual transportation date instead of reporting dates adjusted to monthly targets.
- **Preserve Chronological Sequence of Delivery Notes (Surat Jalan):** Ensure delivery documentation is logged according to its operational order to facilitate the precise reconstruction of vehicle movements and logistics trajectories.

- **Complete Vehicle Information:** Require complete truck identification numbers for every shipment.
- **Separate Export and Domestic Transport Data:** Maintain separate records for export and domestic transportation.

4.5.3 Standardise Business Travel Data Recording

For consistent and accurate tracking of emissions from business travel (Scope 3, Category 6), ISTW's department managing travel should adopt a standardised template across all plants. This template should capture key data points needed for emission calculations, including:

- **Travel Mode:** Air, rail, or road (specify class for air travel).
- **Travel Distance:** Actual kilometres for each trip leg.
- **Travel Frequency:** Number of trips per month/quarter.
- **Accommodation Data** (optional): Hotel type and duration of stay, which can enhance emissions accuracy.

4.5.4 Verification of the Future Inventories

This third GHG Inventory is a significant step towards understanding ISTW's environmental impact. To enhance the credibility of future inventories, obtaining third-party verification of reported figures should be considered. Engaging an independent auditor will increase transparency and stakeholder confidence. As noted in **Table 2** in Section 3.3, the inclusion of any previously missing GHG sources is essential before formal verification can take place.

CHAPTER 5: PRELIMINARY RECOMMENDATIONS FOR EMISSIONS REDUCTIONS

5.1 Emissions Reduction Initiatives

5.1.1 Current Actions

ISTW is already taking several steps to reduce its GHG emissions and improve overall environmental performance. ISTW has installed solar panels at the Cikarang plant in 2024, marking a first step towards renewable energy adoption. During 2025, the solar panel produced 361,150 kWh of renewable energy and reduced emissions by **314.2 tCO₂-e**. While this initiative is a start toward renewable energy integration, its impact is relatively small in comparison to ISTW's total Scope 2 emissions in 2025, as presented in **Table 7**.

Table 7. Summary of ISTW's Scope 2 Emissions in 2024

		Plants				Total
		J1	J2	Cikarang	Semarang	
Emissions (tCO₂e)	Scope 2	2,462.13	3,327.96	3,859.31	1,441.20	11,090.60

In comparison to ISTW's Scope 2 emissions, the solar panel's contribution to reducing Scope 2 emissions remains modest. However the solar panel initiative is a good start, but might need significant upscaling in size to really make a considerable impact to reduce ISTW's GHGs.

The energy efficiency initiatives of ISTW with focus on LED lighting and exchanging inefficient and old air conditioners, is also a good start. However, these measures also will not have significant GHG reduction potential. Focusing on efficiency gains in the operation of the process

machinery might cause much larger emission reductions. E.g. Cikarang, which has the largest electricity consumption of 3,859.31 kWh, plant could be optimised with for instance sensor technology that could reduce up to 10% of electricity consumption which would mean 385.93 tCO₂-e of GHG savings.

5.1.2 Recommended Future Initiatives

Building on its current progress, ISTW should consider the following initiatives to further reduce emissions and enhance its environmental performance:



Recommendation 1: Energy Efficiency and Process Optimisation

ISTW should focus on enhancing efficiency gains in its production processes by assigning dedicated personnel to optimise existing machinery and evaluate the cost-effectiveness of replacing inefficient technology, particularly in the Semarang plant. This approach would help ISTW align with ISO 50001 standards for energy management. Potential energy efficiency measures include:

- Optimise production equipment and processes by replacing ageing machinery with more energy-efficient alternatives, supported by lifecycle cost analyses
- Improve utility system efficiency by standardising the compressed air pressure setting across all plants and retrofitting major chilled water pumps with inverters or Variable Speed Drives (VSDs).
- Transition to cleaner energy sources by expanding rooftop solar PV installations across all plants

- Strengthen equipment operation and maintenance by implementing routine maintenance in accordance with standard operating procedures
- Monitor and evaluate energy performance by regularly reviewing the effectiveness of implemented energy efficiency measures to identify further improvement opportunities and sustain long-term energy savings.



Recommendation 2: Continue Fuel and Refrigerant Switching Activities

To further enhance sustainability, ISTW should promote a shift towards biodiesel and biofuels throughout its operations. In particular, transitioning from conventional diesel to biodiesel at the **J1, J2, and Cikarang** facilities presents a significant opportunity to lower the company's carbon footprint by utilising more renewable energy sources.

Furthermore, the **Semarang** facility is encouraged to maintain its use of biofuel alternatives, such as **B35 biodiesel**, to further mitigate environmental impacts. Beyond fuel switching, integrating electric vehicles (EVs) at the **Semarang and Cikarang** plants for internal logistics and transport, mirroring the electric forklift adoption at J1 & J2, could optimise fuel efficiency and decrease operational emissions. While acknowledging that EVs may involve higher initial capital expenditures, these investments support ISTW's long-term sustainability objectives.

To mitigate environmental impacts at the Semarang facility, transitioning from standard CNG to Bio-CNG is advised for the galvanisation process. Because Bio-CNG features a reduced emission intensity, such an implementation would effectively lower GHG outputs

from these energy-intensive activities, which currently represent a primary consumption source within the plant.



Recommendation 3: Renewable Energy Expansion

To accelerate its transition to cleaner energy, ISTW should prioritise the expansion of renewable energy initiatives by deploying higher-capacity solar PV systems at the Semarang, J1, and J2 facilities.

Following the enactment of the Minister of Energy and Mineral Resources Regulation No. 2/2024, which provides enhanced flexibility for rooftop solar power systems, ISTW is well-positioned to scale its renewable energy integration. These updated provisions eliminate the former 100% capacity restriction on solar installations, allowing the company to leverage available PLN quotas for significantly larger arrays. To facilitate this, ISTW could explore leasing arrangements with independent power producers (iPPPs) to utilise the roof space across its production plants for solar panel installation.



Recommendation 4: Green Policy Procurement

As previously established, several **Scope 3** categories have yet to be quantified within this reporting period. For many manufacturing organisations, these indirect emissions represent the most significant portion of their total carbon footprint. Therefore, a comprehensive

reporting of all relevant indirect sources is essential before ISTW can define specific and actionable emission reduction targets.

Within ISTW's operational profile, **Scope 3** has emerged as the primary source of greenhouse gas emissions, accounting for **84.10%** of the total inventory. Of this figure, **86.21%** is attributed to purchased goods and services, while upstream and downstream transportation contributes **5.05%**. To drive meaningful mitigation across the supply chain, it is recommended that the company adopt a "**Green Procurement Policy**". This policy would phase out engagement with significant suppliers who do not:

- Provide transparent reporting of their own GHG emissions, prioritising **Scope 1** and **Scope 2** data in the initial phase.
- Calculate and disclose the specific percentage of their total emissions that are allocated to the products or services provided to ISTW.
- Establish formal decarbonisation objectives and provide regular updates on their progress toward these targets.

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This report has been prepared by Tri Hita Consulting under agreement between Tri Hita Consulting and PT Indonesia Steel Tube Works (client). Tri Hita Consulting has been requested by PT Indonesia Steel Tube Works to provide the 2025 Greenhouse Gases Inventory Report.

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