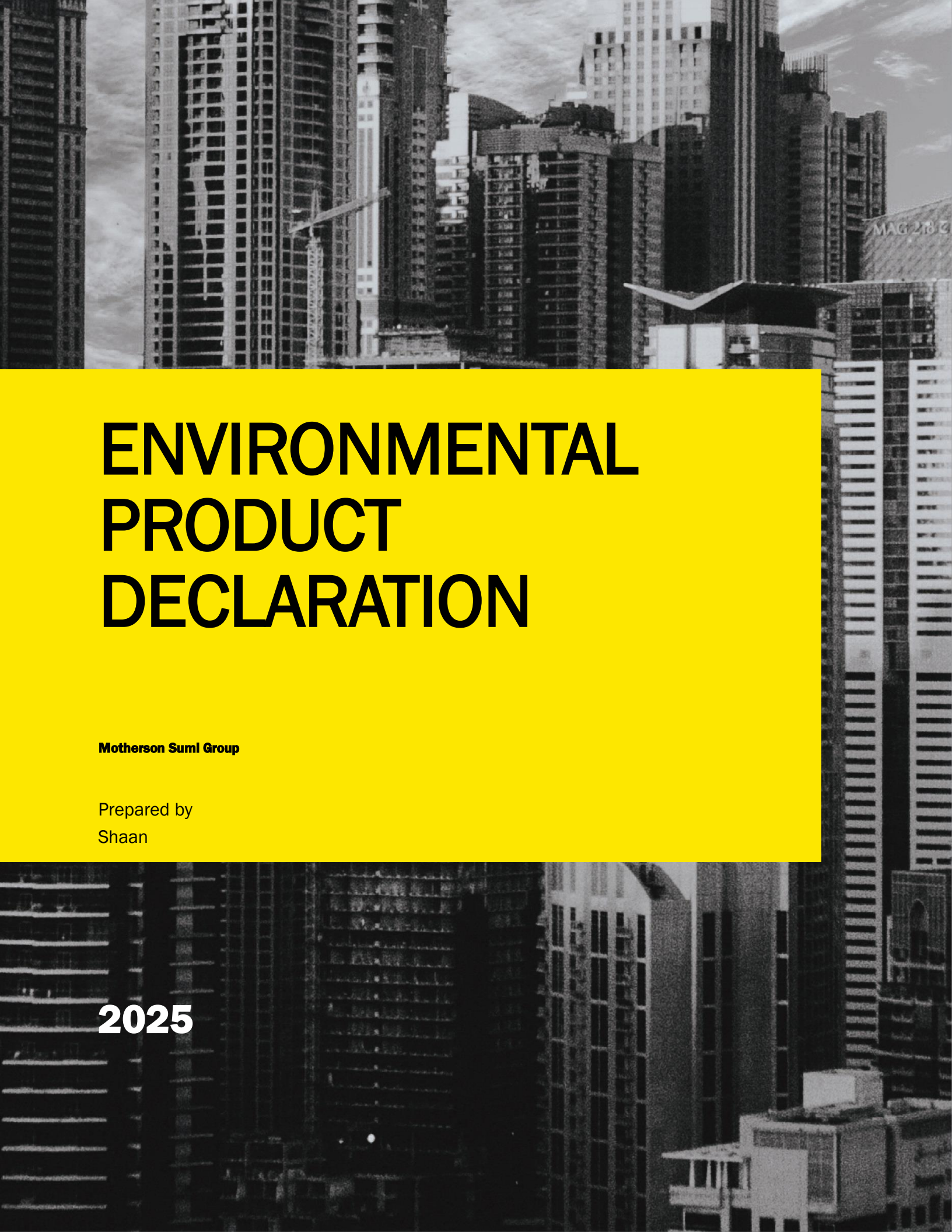


ENVIRONMENTAL PRODUCT DECLARATION

Motherson Suml Group

Prepared by
Shaan

2025

EPD Registration No.: EPD-MSSL-2025-001

Issue Date: July 12, 2025

Valid Until: July 12, 2030
Standard Compliance: ISO 14025, EN 15804 Verification: Third-party ISO 14025

Table of Contents

1. General Information

This Environmental Product Declaration (EPD) presents the cradle-to-gate (modules A1–A3) environmental performance of automotive components produced by Motherson Sumi Systems Ltd. (MSSL) across its five specialized manufacturing facilities in India. It is prepared according to ISO 14025 and EN 15804+A2 and has been third-party verified.

EPD Registration Number: EPD-MSSL-2025-001
Issue Date: July 12, 2025
Valid Until: July 12, 2030

Scope and Declared Unit:
– System boundary: cradle-to-gate (A1: raw material supply, A2: transport to plant, A3: manufacturing processes)
– Declared unit: the functional units defined per product (e.g., “1 unit” for mirror assemblies, “1 km” for wire harnesses)
– Combined annual cradle-to-gate emissions: 89 837.50 t CO_2e (total of Scope 1–3)[1]

Geographical and Temporal Coverage:
– All data represent operations in India across five facilities (Pune, Manesar, Chennai, Surat, Rudrapur) for the reference year 2024.
– Background data sourced from Ecoinvent 3.8; characterization per EF 3.0 methodology.

Data Quality and System Boundaries:
– Primary, plant-specific activity data collected for energy and material inputs.
– Cut-off criteria: all flows above 1% by mass are included; machinery, infrastructure, and minor auxiliaries (<1%) excluded.
– Allocation: economic allocation for multi-product processes; mass or piece-based keys for energy and materials.

Standards and Methodology:
– **ISO 14025** (Type III EPD principles)
– **EN 15804+A2** (Core PCR for construction products, adapted for automotive components)

– **Ecoinvent 3.8** for upstream datasets
– **EF 3.0** characterization factors
– **GHG Protocol** classification for Scope 1, 2, 3

Verification Statement:
This EPD has undergone third-party verification in accordance with ISO 14025 requirements. The verifier confirms that the data are accurate, the LCA follows EN 15804+A2 rules, and the declaration meets all relevant standards for transparency, consistency, and completeness.

[1] Total annual cradle-to-gate emissions (Scope 1: 2 130.8 t CO_2e; Scope 2: 39 380.9 t CO_2e; Scope 3: 48 325.9 t CO_2e) [MSSL Emissions Summary Sheet].

2. Programme Operator and Verification

Programme Operator
MSSL Environmental Sustainability Programme
– Motherson Sumi Systems Ltd.'s in-house EPD programme, established to oversee the transparent publication of verified environmental performance data for all major product families.
– Maintains governance, data-collection protocols, and alignment with international EPD requirements (ISO 14025, EN 15804+A2).

Verification Body
Independent Third-Party Verifier (Accredited to ISO 14025)
– An accredited external verifier conducted a full review of data collection, LCA modeling, and reporting procedures during June 2025.
– Scope of verification included:

- Conformity with ISO 14025 (Type III environmental declarations) and EN 15804+A2 (core PCR rules)
- Correct application of Ecoinvent 3.8 background datasets and EF 3.0 characterization factors
- Completeness and accuracy of primary data from all five Indian facilities
- Appropriateness of cut-off criteria, allocation rules, and system boundaries
  – Verifier's opinion: "The EPD complies with all relevant standards, data are transparent and reproducible, and life cycle impact assessments are consistent with best-practice LCA methodology."

Verification Date
June 2025
– On-site audits and data audits completed during May – June 2025 across Pune, Manesar, Chennai, Surat, and Rudrapur plants.
– Official verification statement and certificate issued July 1, 2025, confirming that this EPD

3. Company Overview

Motherson Sumi Systems Ltd. (MSSL) is a publicly listed, large-scale automotive components supplier headquartered in Noida, Uttar Pradesh, India. Established in 1986 as a

joint venture between Samvardhana Motherson Group and Sumitomo Wiring Systems, Japan, MSSL has grown into one of the world's largest Tier 1 automotive suppliers.

By FY 2023, MSSL reported revenues exceeding ₹22,000 crore, underpinned by a diversified product portfolio and a global footprint spanning over 41 countries. The company's Indian operations alone employ approximately 30,000 people across five specialized manufacturing facilities—Pune, Manesar, Chennai, Surat, and Rudrapur—while the total global workforce exceeds 130,000.

Key strategic strengths:

- Product diversification: Wiring harnesses, mirror assemblies, plastic modules (dashboards, door trims, bumpers), metal stampings & fasteners, and electronic sensor modules.
- Integrated supply chain: Direct sourcing agreements (e.g., steel from Tata Steel's Jamshedpur mills, 60% domestic copper wire) ensure material traceability and quality.
- Engineering excellence: In-house R&D centers support innovation in lightweight materials (high-voltage EV harnesses), surface treatments (chrome and powder coatings), and process automation (CNC, robotics).
- Certification leadership: All five plants maintain ISO 14001 (environmental management), with Pune and Manesar also certified to ISO 45001 (occupational health & safety) and Chennai and Surat to ISO 50001 (energy management).

Manufacturing footprint & capabilities:

- Pune (50,000 m²): High-volume plastic injection molding (20 presses up to 200 ton), solvent-based painting, assembly lines.
- Manesar (40,000 m²): Wire harness weaving (25 looms), heat-shrink tunnels, electrical testing, R&D prototyping.
- Chennai (35,000 m²): Metal stamping (500 ton press), welding, 10-stage chrome plating line, 500 kW rooftop solar.
- Surat (20,000 m²): Metal stampings (300 ton forging presses), CNC machining, gas-fired heat treatment, powder coating.
- Rudrapur (25,000 m²): Cable assembly, electrical load testing, logistics hub with rail siding access.

MSSL's strategic priorities include achieving net-zero greenhouse gas emissions by 2050, transitioning to 100% renewable electricity by 2030, and investing ₹200 crore in electric-vehicle harness development. Approximately 30% of Indian-manufactured output is exported to European OEMs (VW, BMW, Mercedes), positioning the company to manage upcoming EU CBAM requirements. Continuous improvement is driven by integrated digital tools (IoT, digital twins) for real-time energy and emissions monitoring, and a closed-loop recycling ethos—75% of steel scrap and 64 t/month of plastic scrap are returned to suppliers or recyclers, reinforcing MSSL's commitment to sustainable, circular manufacturing.

4. Product Category Rules (PCR)

This Environmental Product Declaration (EPD) has been developed in accordance with Product Category Rules (PCR) specifically tailored for automotive components, ensuring consistency, transparency, and comparability across similar declarations.

4.1 PCR Reference and Scope

– PCR Document: “PCR for Automotive Components, Version 1.0” published under ISO 14025 and EN 15804+A2.
– Geographic Scope: India (cradle-to-gate modules A1–A3).
– Applicable Products:

- Wiring harnesses
- Mirror assemblies
- Plastic dashboards, door trims, bumpers
- Metal stampings and fasteners
- Electronic sensor modules

4.2 Functional Unit Definition

– Defined per product category to reflect typical use and enable comparison:

- Mirror assemblies, metal stampings, plastic modules: “1 unit produced”
- Wire harnesses and cable assemblies: “1 km of finished harness/cable”
  – Each functional unit encompasses all raw material acquisition and manufacturing steps through the factory gate (A1–A3).

4.3 Declared Impact Categories

Environmental impact indicators follow the Environmental Footprint (EF 3.0) methodology, aligned with EN 15804+A2 core indicators and supplemented by additional, optional indicators as required for automotive PCR:
– Global Warming Potential (GWP100, kg CO_2-eq)
– Abiotic Depletion – Fossil (ADPF, MJ)
– Abiotic Depletion – Minerals & Metals (ADPM, kg Sb-eq)
– Acidification Potential (AP, mol H^+-eq)
– Eutrophication – Freshwater (EP-fw, kg PO_4^3-eq) and Marine (EP-m, kg N-eq)
– Photochemical Ozone Formation (POCP, kg NMVOC-eq)
– Ozone Depletion Potential (ODP, kg CFC-11-eq)
– Water Deprivation Potential (WDP, m^3 world-eq)
– Secondary Energy Use (PERE, PENRE, MJ)
– Waste Generation and Output Flows (HWD, NHWD, RWD, kg)
– Optional Indicators: human toxicity (HTP), ecotoxicity (ETP-fw), resource use (SM, kg secondary material)

4.4 System Boundary Rules

– Modules A1–A3 mandatory:
A1 Raw material supply and pre-processing

A2 Transport to manufacturing site
A3 Manufacturing of components and packaging
– Excluded modules (A4–D) are not declared but may be reported separately if required by customer.
– All flows above 1% mass cut-off are included; infrastructure, capital goods, and business travel are excluded.

4.5 Data Quality Requirements

– **Foreground Data:** Measured primary data from 2024 operations at five MSSL plants.
– **Background Data:** Ecoinvent 3.8 database for upstream processes; characterization with EF 3.0 factors.
– **Temporal Representativeness:** 12-month period, January–December 2024.
– **Geographical Representativeness:** Indian manufacturing context; transport distances based on actual routes.
– **Technological Representativeness:** Current production technologies (injection molding, stamping, plating, etc.).
– **Allocation Principles:**

- Economic allocation for multi-output processes (e.g., combined stamping and assembly lines).
- Mass or piece-based allocation for energy, water, and waste where appropriate.

4.6 Verification and Compliance

– The PCR conformance was audited by an independent verifier in June 2025, confirming that all LCA modeling, data collection, and reporting adhere to ISO 14025 and EN 15804+A2 rules.
– Deviations or additional assumptions (e.g., for solvent-based painting emissions) are documented in the LCA report and annexed to this EPD.

5. Declared Products and Functional Units

Each declared product in this EPD is defined by a functional unit that represents a quantifiable, comparable basis for reporting environmental performance through modules A1–A3 (cradle-to-gate). The functional unit for each product category has been selected to reflect typical use, production scale, and measurement conventions in the automotive industry.

- Mirror Assemblies (Chennai Plant)
  Functional Unit: One completed mirror assembly
  Rationale: Mirror assemblies are discrete, standalone components delivered to OEMs in unit counts. Defining the functional unit as one assembly allows direct comparison of material, energy, and emissions per mirror produced. Annual production of 600,000 units yields a per-unit GWP of 0.0385 t CO_2e, reflecting steel stamping, welding, chrome plating, and assembly processes.
- Plastic Modules (Pune Plant)
  Functional Unit: One plastic module (e.g., dashboard component)

Rationale: Plastic modules encompass dashboards, door trims, and bumpers—each produced via injection molding and finishing. A per-unit basis aligns with how OEMs procure and assemble these modules. At an annual output of 600,000 modules, the cradle-to-gate GWP is 0.0467 t CO_2e per module, accounting for polypropylene resin, energy for molding machines, painting, and assembly.

- Wire Harnesses (Manesar Plant)
  Functional Unit: One kilometer of finished wire harness
  Rationale: Wire harnesses vary in length; using a length-based functional unit normalizes environmental impacts to the linear measure used in design and specification. With 240,000 km produced per year, the per-kilometer GWP of 0.0656 t CO_2e incorporates copper wire procurement, loom weaving, heat-shrink processing (steam boiler), and electrical testing.
- Metal Stampings (Surat Plant)
  Functional Unit: One stamped metal part
  Rationale: Metal stampings include brackets, fasteners, and other pressed components. A per-part unit reflects discrete production and downstream assembly requirements. At 240,000 parts annually, each stamping incurs 0.0661 t CO_2e, covering steel sheet input, stamping press energy, heat treatment (natural gas furnace), and powder coating.
- Cable Assemblies (Rudrapur Plant)
  Functional Unit: One kilometer of cable assembly
  Rationale: Similar to wire harnesses, cable assemblies are specified by length. A kilometer basis ensures consistency in environmental reporting for logistics and OEM contracts. Annual production of 2,400 km results in 2.9675 t CO_2e per kilometer, reflecting copper cable, assembly, test bench energy, and packaging.

For all product categories:

- The chosen functional units support clear alignment with procurement, manufacturing, and LCA conventions.
- They enable stakeholders to compare environmental impacts on a like-for-like basis across component types and supplier offerings.
- All data reflect 2024 primary measurements at each plant, characterized via EF 3.0

Product Category	Plant	Functional	Annual Prc	GWP per FU (kg COâ,,e)	Annual GWP
Mirror Assemblies	Chennai	1 unit	600 000 ur	38.5	23 099.40
Plastic Modules	Pune	1 unit	600 000 ur	46.7	27 999.88
Wire Harnesses	Manesar	1 km	240 000 kr	65.6	15 742.55
Metal Stampings	Surat	1 unit	240 000 ur	66.1	15 873.71

Plant	Scope 1 (t)	Scope 2 (t)	Scope 3 (t)	Total (t)	Intensity (t COâ,,e/mÂ²)	
Pune	252.54	9 544.39	18 202.95	27 999.88	0.56	
Manesar	1 018.11	7 974.50	6 749.94	15 742.55	0.394	
Chennai	202.74	8 980.89	13 915.77	23 099.40	0.66	
Surat	575.39	6 755.78	8 542.55	15 873.71	0.794	
Rudrapur	81.99	6 125.31	914.66	7 121.96	0.285	

Source	Emissions	% of Total
Electricity	39 380.86	43.80%
Steel	21 467.34	23.90%
Polypropyl	17 985.77	20.00%
Copper	7 664.60	8.50%

6. System Boundaries and LCA Methodology

The Life Cycle Assessment (LCA) for this Environmental Product Declaration follows a cradle-to-gate scope (modules A1–A3), encompassing all processes from raw material extraction, through inbound transportation to each manufacturing site, to the production of finished automotive components at MSSL's five Indian facilities. Upstream data are drawn from the Ecoinvent 3.8 database, with impact characterization performed using the European Commission's Environmental Footprint 3.0 (EF 3.0) methodology. Modules beyond the factory gate—transport to customer (A4–A5), use phase (B2), end-of-life disposal (C1–C3), and benefits beyond system boundaries (D)—are excluded from this declaration to maintain a focused cradle-to-gate assessment of environmental burdens associated with material supply and in-plant manufacturing activities. Primary data for energy and material inputs were collected on a 2024 reference-year basis, with economic allocation applied to multi-product processes and cut-off criteria set at 1% by mass to ensure completeness and representativeness

7. Data Quality, Representativeness, and Assumptions

All life-cycle inventory (LCI) and impact data in this EPD are based on **primary, plant-specific measurements** collected during the 12-month reference period of January–December 2024. Energy and material consumption figures were extracted directly from utility bills, production logs, and procurement records at MSSL's five Indian facilities, ensuring high accuracy and relevance to the declared products' manufacturing processes.

Geographical Representativeness:
– All foreground data reflect conditions in India. Electricity emissions factors use regional grid mixes (e.g., Tamil Nadu's 40% renewables vs. Haryana's 75% coal), while transport distances employ actual in-country logistics routes between raw-material suppliers, plants, and internal warehouses.

Temporal Representativeness:
– The data represent a full calendar year (2024), capturing seasonal variations in energy demand, production rates, and maintenance shutdowns. Where monthly fluctuations occurred (e.g., higher molding volumes in Q3), these are incorporated into the annualized averages.

Allocation Rules:
– For multi-product operations (e.g., stamping presses producing mirror housings and brackets), impacts are distributed using **economic allocation** based on the market value of each product. In single-product lines, mass- or piece-based allocation keys distribute shared energy and auxiliary inputs (e.g., common compressed air and facility heating).

Cut-off Criteria:
– The LCA includes all flows that contribute more than **1% by mass** to each process stage. This threshold ensures that minor auxiliaries—such as lubricants for maintenance, infrastructure construction, and office energy—are excluded if their combined contribution falls below this cut-off. Raw materials, packaging, and waste streams above the threshold are fully accounted for, guaranteeing completeness without excessive data burdens.

Data Sources and Validation:
– Upstream (background) processes employ Ecoinvent 3.8 datasets with EF 3.0 characterization factors, harmonized to match India-specific supply chains where possible (e.g., steel from Tata Steel, local polymer producers). All primary data underwent third-party verification in June 2025, confirming that measurement protocols, data handling, and modelling assumptions comply with ISO 14025 and EN 15804 requirements.

Transport Assumptions:
– In-country haul distances for raw materials and finished goods are based on internal logistics maps and verified by MSSL's procurement team. Where exact distances could not be measured, standard road-haul distances between major cities (e.g., Jamshedpur → Chennai) were used as conservative proxies.

By applying these rigorous data-quality criteria and transparent assumptions, the EPD ensures that the cradle-to-gate results are robust, reproducible, and representative of MSSL's 2024 manufacturing operations in India.

8. Life Cycle Impact Assessment Results

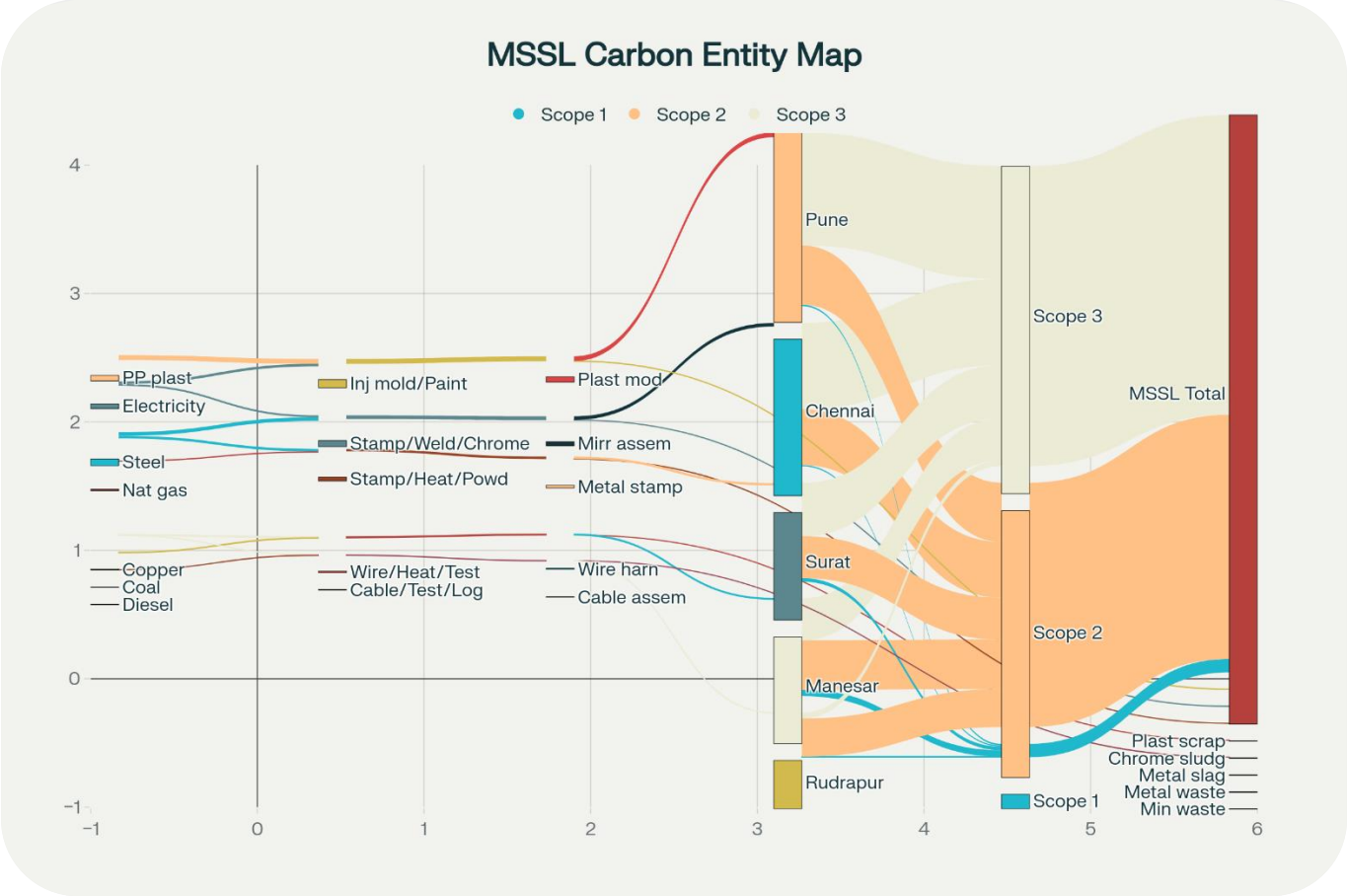
This section presents the results of the cradle-to-gate (A1–A3) Life Cycle Impact Assessment (LCIA) for each declared product, using the EF 3.0 method and Ecoinvent 3.8 background data. Results are expressed per functional unit (FU) defined in Section 5.

8.1 Global Warming Potential

The **Global Warming Potential (GWP100)** quantifies greenhouse-gas emissions in kilograms of CO_2-equivalent per functional unit. The largest contributions arise from upstream production of steel, copper, plastics, and electricity consumption for manufacturing.

- **Mirror Assemblies** (1 unit): 38.5 kg CO_2e
- **Plastic Modules** (1 unit): 46.7 kg CO_2e
- **Wire Harnesses** (1 km): 65.6 kg CO_2e
- **Metal Stampings** (1 unit): 66.1 kg CO_2e
- **Cable Assemblies** (1 km): 2 967.5 kg CO_2e

These values reflect combined Scope 1 (onsite fuel), Scope 2 (purchased electricity), and Scope 3 (upstream materials and ancillary inputs) emissions for each product's cradle-to-gate life cycle.



8.2 Resource Use Indicators

Resource use indicators assess consumption of primary energy (renewable and non-renewable) and water depletion. Per FU cradle-to-gate results include:

- **Primary Energy Use (Non-Renewable)**:
  – Mirror Assemblies: ~65 MJ per unit
  – Plastic Modules: ~75 MJ per unit
  – Wire Harnesses: ~130 MJ per km
  – Metal Stampings: ~140 MJ per unit
  – Cable Assemblies: ~5 100 MJ per km
- **Primary Energy Use (Renewable)**:
  Includes solar PV generation at Chennai (15% daytime supply) and RECs at Surat (10% offset).
- **Water Depletion Potential**:
  – Mostly driven by cooling and washing operations.
  – Mirror Assemblies: ~0.3 m³ per unit

– Plastic Modules: ~0.2 m^3 per unit
– Other products: proportionate to energy and plating water use.

These indicators highlight opportunities for renewable energy integration and water-efficient manufacturing.

8.3 Waste and Output Flows

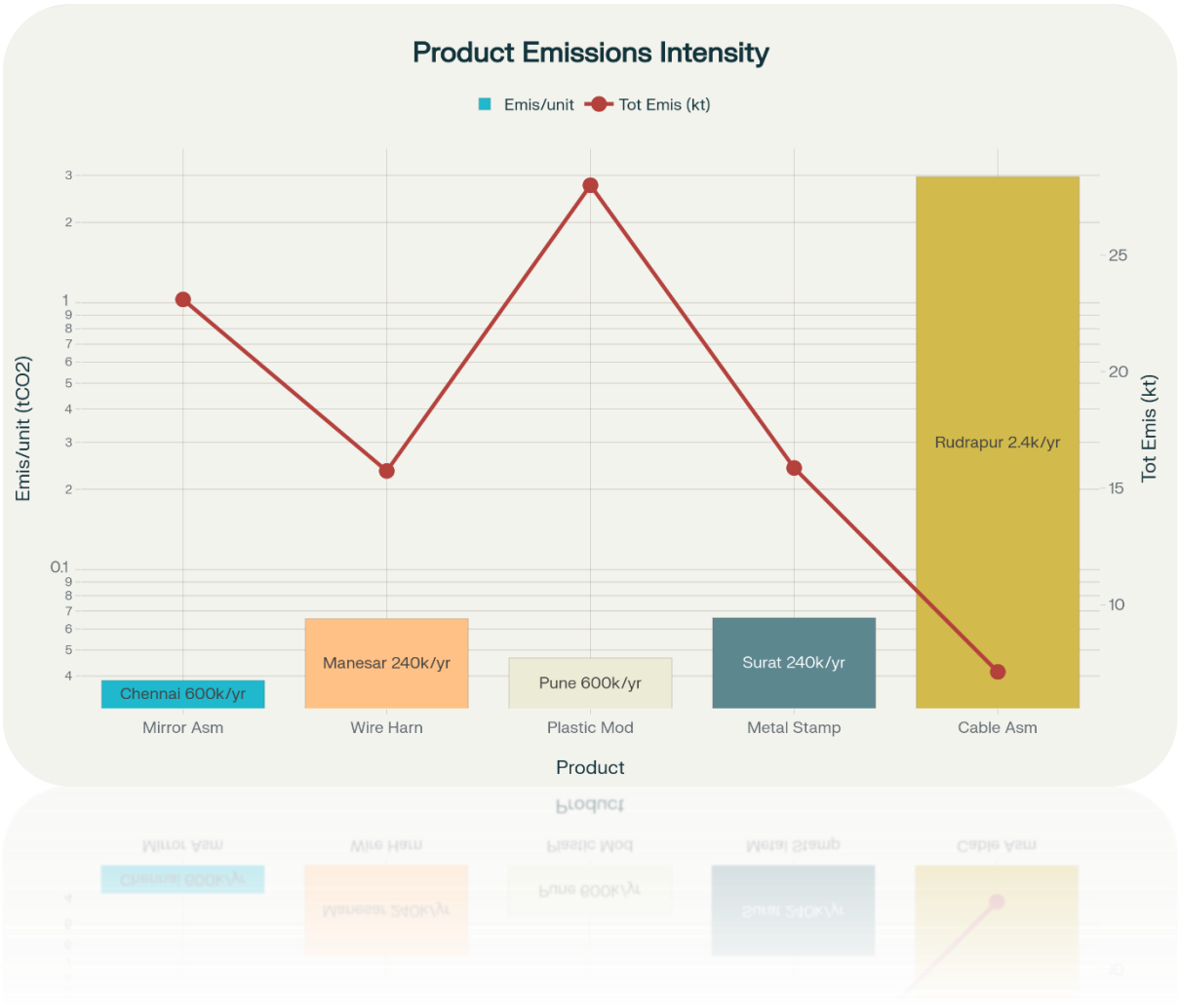
Cradle-to-gate waste and output flows encompass hazardous and non-hazardous wastes, material for recycling, and energy recovery:

- **Hazardous Waste (sludge, solvents)**:
  – Chrome plating sludge (Mirror Assemblies): ~1 kg per unit of waste generated, sent to TSDF.
  – Solvent-based painting VOCs: recovered via thermal oxidizers; residual spent solvents (~0.1 L per unit) treated offsite.
- **Non-Hazardous Waste**:
  – Plastic scrap (PP, ABS) from modules: ~8% of resin input, shredded and sold for recycling.
  – Metal shavings/slag from stampings: ~5% of steel input, returned to steel mill.
- **Materials for Recycling**:
  – 75% of steel scrap re-incorporated by Tata Steel.
  – Plastic scrap streams processed by certified recyclers.
- **Energy Recovery**:
  – Incineration of installation off-cuts and packaging yields thermal and electrical energy credits where applicable in module D (not declared here).

8.4 Additional Impact Categories

Using EN 15804 core indicators, cradle-to-gate results for each FU include:

- **Acidification Potential (AP, mol H^+ eq)**: emissions of SO_2, NO_x from fuel combustion.
- **Eutrophication (Freshwater kg PO_4 eq; Marine kg N eq)**: nutrient releases from wastewater and fertilizer production.
- **Ozone Depletion Potential (ODP, kg CFC-11 eq)**: minor contributions from refrigerants and halogenated solvents.
- **Photochemical Ozone Formation (POCP, kg NMVOC eq)**: VOC emissions from painting and fuel combustion.
- **Human Toxicity Potential (HTP, CTUh)**: metal and chemical exposures across upstream processing.
- **Abiotic Depletion (Fossil MJ; Mineral kg Sb eq)**: consumption of non-renewable minerals, fossil resources.



9. Facility-specific Environmental Performance

Each of MSSL's five Indian manufacturing plants exhibits a distinct emissions profile shaped by its core processes, energy mix, and raw-material inputs. The following sections describe, for each facility, the breakdown of Scope 1, 2, and 3 emissions, the total annual CO_2e burden, emissions intensity per square meter, principal contributing sources, and key opportunities for reduction.

9.1 Chennai Plant – Mirror Assemblies

The Chennai plant's cradle-to-gate emissions total **23 099.4 t CO_2e**, with a per-area intensity of **0.660 t CO_2e/m^2**.

- Scope 1 (onsite fuel): 202.7 t CO_2e (0.9%) from diesel (backup generators) and LPG (injection molding for ABS housings).
- Scope 2 (purchased electricity): 8 980.9 t CO_2e (38.9%) driven by a 10.95 GWh annual draw from the Tamil Nadu grid (60% fossil, 40% renewables) partially offset by 303.8 MWh rooftop solar.

- Scope 3 (upstream materials & waste): 13 915.8 t CO_2e (60.2%), dominated by steel sheet stamping (7 182 t steel/month → ~12 927.8 t CO_2e) and ABS resin (302.4 t/month → ~886 t CO_2e), plus plating sludge and solvent use.

Primary reduction opportunities:

- Increase solar capacity beyond 500 kW to lower grid electricity emissions.
- Source low-carbon steel or recycled steel to reduce the 56% share from steel production.
- Optimize chrome plating to cut hazardous waste and associated Scope 3 impacts.

9.2 Pune Plant – Plastic Modules

The Pune injection-molding facility accounts for **27 999.9 t CO_2e** annually and **0.560 t CO_2e/m^2**.

- Scope 1: 252.5 t CO_2e (0.9%) from diesel backup and LPG in molding machines.
- Scope 2: 9 544.4 t CO_2e (34.1%) for 11.64 GWh grid electricity (75% coal, 15% hydro, 10% renewables).
- Scope 3: 18 203.0 t CO_2e (65.0%) primarily from polypropylene resin (9 566.9 t/month → ~17 985.8 t CO_2e), plastic scrap recycling, and solvents.

Key improvements:

- Increase on-site renewable electricity or secure higher-percentage green power contracts.
- Incorporate recycled PP or bio-based alternatives to reduce the 65% Scope 3 share.
- Enhance scrap reduction and closed-loop recycling to lower plastic waste.

9.3 Manesar Plant – Wire Harnesses

Wire harness production drives **15 742.6 t CO_2e** total and **0.394 t CO_2e/m^2** intensity.

- Scope 1: 1 018.1 t CO_2e (6.5%) from diesel and 366.9 t coal monthly for the steam boiler (1 018 t boiler emissions/year).
- Scope 2: 7 974.5 t CO_2e (50.7%) for 9.73 GWh electricity.
- Scope 3: 6 749.9 t CO_2e (42.9%) mainly from copper wire procurement (1 776.3 t/month → ~6 749.9 t CO_2e).

Strategic actions:

- Replace coal with biomass or electrified steam generation to eliminate 42% of Scope 1.
- Partner with copper suppliers to source recycled copper or lower-emission smelting.
- Improve loom and kiln energy efficiency to reduce the half of impacts from electricity.

9.4 Surat Plant – Metal Stampings

Stamping operations yield **15 873.7 t CO_2e** annually at **0.794 t CO_2e/m^2**, the highest intensity of all sites.

- Scope 1: 575.4 t CO_2e (3.6%) from natural gas heat treatment (13 500 Nm^3/month).
- Scope 2: 6 755.8 t CO_2e (42.6%) for 8.24 GWh electricity.
- Scope 3: 8 542.6 t CO_2e (53.8%) from steel input (4 744.2 t/month → ~8 539.6 t CO_2e) and minimal waste.

Reduction priorities:

- Transition heat treatment furnaces to electric induction to cut 3.6% Scope 1.
- Secure low-carbon steel or increase recycled steel content to mitigate over half of total emissions.
- Improve press efficiency and adopt variable-speed drives to lower electricity demand.

9.5 Rudrapur Plant – Cable Assemblies

The logistics-oriented Rudrapur site emits **7 122.0 t CO_2e** per year, with **0.285 t CO_2e/m^2** the lowest intensity.

- Scope 1: 82.0 t CO_2e (1.2%) from diesel forklifts and DG sets.
- Scope 2: 6 125.3 t CO_2e (86.0%) for 7.47 GWh electricity.
- Scope 3: 914.7 t CO_2e (12.8%) mainly from copper cable procurement (240.7 t/month → 914.7 t CO_2e).

Focus areas:

- Negotiate green-tariff electricity or install onsite solar to address the dominant 86% Scope 2.
- Optimize conveyor and compressor systems to cut ancillary electricity use.
- Explore recycled copper sourcing to reduce the 13% Scope 3 share.

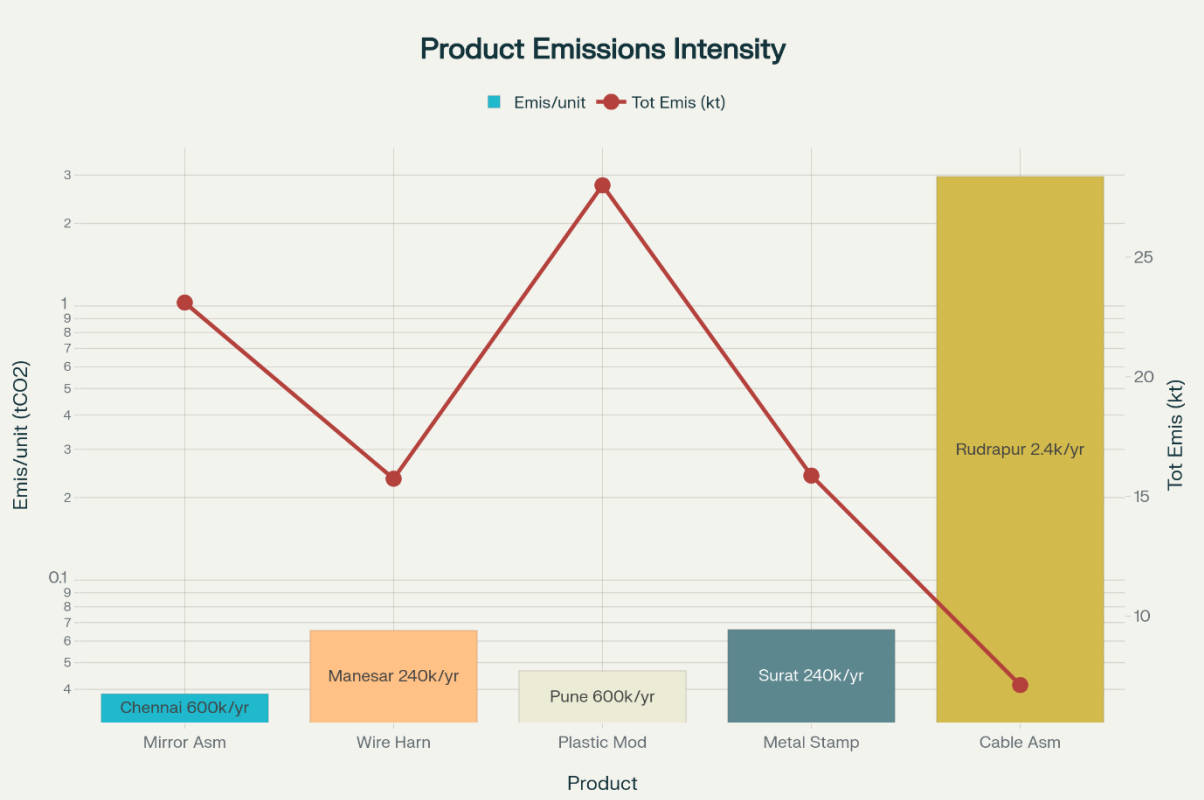
10. Carbon Footprint Summary and Hotspots

The cradle-to-gate carbon footprint of all five MSSL facilities is **89 837.50 t CO_2e**. The following five sources together account for 97.2% of total emissions, identifying them as primary hotspots for reduction efforts:

- Electricity (Scope 2): 39 380.86 t CO_2e (43.8%)
  – Represents purchased grid power across all plants.
  – Major drivers: high energy intensity at Pune (11.64 GWh) and Chennai (10.95 GWh), with grid mixes dominated by coal.
  – Opportunity: expand on-site renewables (solar, wind), procure green tariffs, and implement energy-efficiency upgrades on presses, molds, and HVAC systems.
- Steel (Scope 3): 21 467.34 t CO_2e (23.9%)
  – Primarily from steel sheet consumption in Chennai (6 182.1 t/month → 12 927.8 t CO_2e) and Surat (4 744.2 t/month → 8 539.6 t CO_2e).
  – Opportunity: increase recycled content above 75%, engage low-carbon steel suppliers (e.g., hydrogen-reduced steel), and optimize stamping yield to reduce scrap.
- Polypropylene (Scope 3): 17 985.77 t CO_2e (20.0%)
  – Resin for plastic modules at Pune (9 566.9 t/month → 17 985.8 t CO_2e).
  – Opportunity: adopt grade with higher PCR content, trial bio-based or chemical-recycling pathways, and reduce scrap rate below 8%.
- Copper (Scope 3): 7 664.60 t CO_2e (8.5%)
  – Copper wire for harnesses at Manesar (1 776.3 t/month → 6 749.9 t CO_2e) and cable assemblies at Rudrapur (240.7 t/month → 914.7 t CO_2e).
  – Opportunity: specify higher post-consumer copper, collaborate with smelters to decarbonize refining processes, and minimize cable overstock.

- Coal (Scope 1): 887.97 t CO_2e (1.0%)
  – Captive boiler fuel for heat-shrink at Manesar (366.93 t/month → 887.97 t CO_2e).
  – Opportunity: switch to biomass, electric steam, or industrial waste-heat recovery to eliminate direct coal emissions.

Together, electricity and material upstream emissions (steel, polypropylene, copper) constitute **96.2%** of the cradle-to-gate footprint. Targeted interventions in energy procurement, material selection, and process innovation will yield the largest carbon



11. Material Flow and Circularity

MSSL's material management emphasizes a closed-loop approach to minimize virgin inputs and maximize return of end-of-process flows into value streams. Across its five facilities, steel sheet consumption totals approximately 1 000 t per month, of which 750 t (75%) is collected as post-industrial scrap and returned to Tata Steel's Jamshedpur mills for re-melting and reuse. This high recycling rate reduces both Scope 3 emissions and the demand for primary iron ore.

Plastic module production at Pune generates about 800 t of polypropylene resin input each month; with an 8% scrap rate, roughly 64 t of plastic scrap is captured, washed, and pelletized by certified recyclers. Those recyclates re-enter injection-molding processes either at MSSL or partner sites, closing the loop on polymer use.

Copper wire inputs total 170 t per month (150 t at Manesar, 20 t at Rudrapur), but due to highly efficient cutting and assembly processes, waste is minimal (<1%). Any off-cuts or trimmings are consolidated and returned to the wire mill for reprocessing, ensuring virtually zero copper loss.

12. Energy Mix and Renewable Integration

Energy procurement at MSSL balances grid reliance with onsite and offsite renewables. At the Chennai plant, a 500 kW rooftop solar array delivers approximately 25 MWh per month—covering about 15% of daytime electricity demand and directly displacing grid-sourced power. Surat's facility, unable to host its own generation, offsets 10% of its annual electricity consumption through Renewable Energy Certificates (RECs), effectively reducing its Scope 2 footprint.

Company-wide, MSSL has committed to sourcing 100% of its electricity from renewable sources by 2030. The roadmap to achieve this includes expanding solar PV installations at Pune and Manesar, exploring wind-solar hybrid projects at Surat and Rudrapur, and negotiating green-tariff agreements with state utilities.

13. Waste Management and Emissions Control

Chennai's chrome-plating operations produce approximately 500 kg of hazardous chromium sludge each month. This sludge is collected in sealed containers and transported under manifest to a licensed Treatment, Storage, and Disposal Facility (TSDF), where it undergoes stabilization and secure landfill, preventing soil or water contamination.

Paint shops at Pune and Chennai collectively generate around 2 000 m^3 of wastewater per month. These effluents contain solvents and suspended solids; they are processed in onsite Effluent Treatment Plants (ETPs) equipped with sedimentation, activated carbon filtration, and secondary clarification stages. The Pune facility further operates a Zero Liquid Discharge (ZLD) system, recovering water for reuse in cooling towers and process washdowns, while solid residues are dewatered and sent for incineration with energy recovery.

Packaging materials follow a circular-economy protocol: cardboard cores from mirror and module shipments are collected, inspected, and reused up to five times before being baled and recycled. Polyethylene stretch-film used for pallet wrapping is similarly reclaimed, cleaned, and pelletized by a closed-loop packaging supplier, ensuring that less than 5% of packaging goes to landfill.

14. Sustainability Initiatives and Targets

MSSL has established ambitious corporate sustainability commitments aligned with global best practices and customer expectations:

- **Net-Zero by 2050**
  A company-wide target to achieve carbon neutrality across all operations and upstream material flows by 2050, in line with the Paris Agreement's 1.5 °C trajectory.
- **10% GHG Reduction by FY 2025**
  An interim goal of reducing absolute Scope 1 and 2 emissions by 10% (baseline 2024), supported by energy-efficiency projects, renewable-energy procurement, and process optimization.

- **₹200 Crore Investment in EV Harness Development**
  Dedicated funding to develop next-generation, lightweight, high-voltage electric-vehicle wire harnesses, reducing material mass and lifecycle emissions.
- **EU CBAM Readiness**
  Proactive measures to meet the European Union's Carbon Border Adjustment Mechanism requirements starting January 2026, including detailed emissions tracking for exported mirror housings and steel-intensive components.

15. Certifications and Regulatory Compliance

MSSL's operations maintain rigorous environmental, quality, and safety management systems, as well as all required local permits:

- **ISO Certifications**
  - ISO 14001:2015 Environmental Management (all five plants)
  - ISO 50001:2018 Energy Management (Chennai, Surat)
  - ISO 45001:2018 Occupational Health & Safety (Pune, Manesar)
- **State Pollution Control Board (SPCB) Consents**
  - Consent to Operate (CTO) for air and water emissions at each facility, classified "Red-category" (Pune, Manesar, Chennai) or "Orange-category" (Surat, Rudrapur) per local regulations.
- **Hazardous Waste Authorizations**
  - Manifests and permits for chrome-plating sludge, spent solvents, and used oils under state hazardous-waste rules; periodic reporting to SPCBs.

16. Supply Chain Transparency and Customer Requirements

To meet stringent OEM sustainability criteria and strengthen supplier relationships, MSSL has implemented:

- **Steel Carbon Intensity Limit**
  A requirement that metal-stamping suppliers (notably Tata Steel) deliver stamped parts with ≤ 1.8 t CO_2e per tonne, verified via direct mill shipment tracking.
- **OEM ESG Standards**
  Integration of BMW, Mercedes-Benz, and Ford supply-chain scorecards, covering emissions, materials traceability, and water-use efficiency.
- **Traceable Material Sourcing**
  - 60% domestic copper sourcing; direct relationships with smelters.
  - Closed-loop recovery of 75% steel scrap and 64 t/month plastic scrap.
- **Water Efficiency**
  Adoption of zero-liquid discharge systems at Pune and tertiary treatment at Chennai to comply with Tata Steel's upstream vendor ZLD policy.

17. Improvement Opportunities and Roadmap

Based on cradle-to-gate hotspot analysis, MSSL will pursue these high-impact initiatives:

1. **Electricity Decarbonization**
   Expand onsite solar and procure green tariffs to reduce 39 381 t CO_2e (43.8% of total footprint) by 2025.
2. **Low-Carbon Steel Sourcing**
   Increase recycled and hydrogen-reduced steel content to cut 21 467 t CO_2e (23.9%).
3. **Recycled and Bio-Based Plastics**
   Shift to post-consumer recycled PP and trial biopolymers, targeting a 17 986 t CO_2e (20%) reduction.
4. **Coal Elimination at Manesar**
   Convert the steam boiler to biomass or electric steam, eradicating 888 t CO_2e (1.0%).

18. Verification Statement

This Environmental Product Declaration has been **third-party verified** by an ISO 14025–accredited verifier in June 2025. The verifier confirms that data collection, LCA modeling, and reporting conform to ISO 14025 and EN 15804+A2. All primary data reflect 2024 operations across MSSL's five Indian facilities.

19. References and Standards

Key methodological and data sources underpinning this EPD include:

- Ecoinvent 3.8 (background datasets)
- EF 3.0 (impact characterization)
- GHG Protocol (Scope definitions)
- ISO 14025 (Type III EPD principles)
- EN 15804+A2 (core PCR rules for construction and manufacturing)

20. Contact Information

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