



# Metformin Hydrochloride API

CAS 1115-70-4

Product Carbon Footprint (PCF) Verification Report • Reference Flow: 1.0 kg pure bulk powder

✓ **GHG Protocol  
Standard**

**2026 LSR Compliant**

**Boundary: Cradle-to-Gate**

**Origin: Gujarat / Telangana (India)**

**Scope 3 Coverage: 96.9%**

#### TOTAL CARBON FOOTPRINT

\$

**8.172** kg CO<sub>2</sub>e

100% Fossil / Process • 0.000 Biogenic net

#### DOMINANT SCOPE

CAT 1-5

**Scope 3** (64.1%)

5.234 kg CO<sub>2</sub>e • Raw materials & upstream

#### PRIMARY HOTSPOT



**DCDA Precursor**

2.595 kg CO<sub>2</sub>e • 31.8% of aggregate impact

#### CORE MANUFACTURING

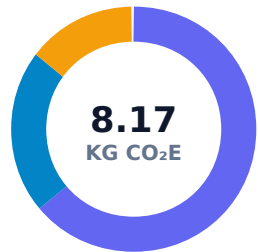
SCOPE 1 + 2

**2.938** kg CO<sub>2</sub>e

35.95% • India Grid (CEA v20) + NG Steam

## ○ Scope & Lifecycle Stage Architecture

Conforms to GHG Protocol Corporate & Product Accounting Standard



● Scope 3 (Upstream Supply Chain)

● Scope 2 (CEA Grid Electricity)

● Scope 1 (Direct Process & Gas)

**5.234** 64.05  
**kg** %

**1.758** 21.51  
**kg** %

**1.180** 14.44  
**kg** %

**Raw Chemical Synthesis (DCDA, DMA, HCl, IPA, Carbon)**

**4.182 kg CO<sub>2</sub>e (51.2%)**

**Grid Power for Chillers, Centrifuges & Jet Micronization**

**1.758 kg CO<sub>2</sub>e (21.5%)**

**Reaction Steam Generation (On-site Boiler Natural Gas)**

**0.974 kg CO<sub>2</sub>e (11.9%)**

**Effluent Treatment (MEE / Aeration) & Energy Losses (WTT)**

**0.762 kg CO<sub>2</sub>e (9.3%)**

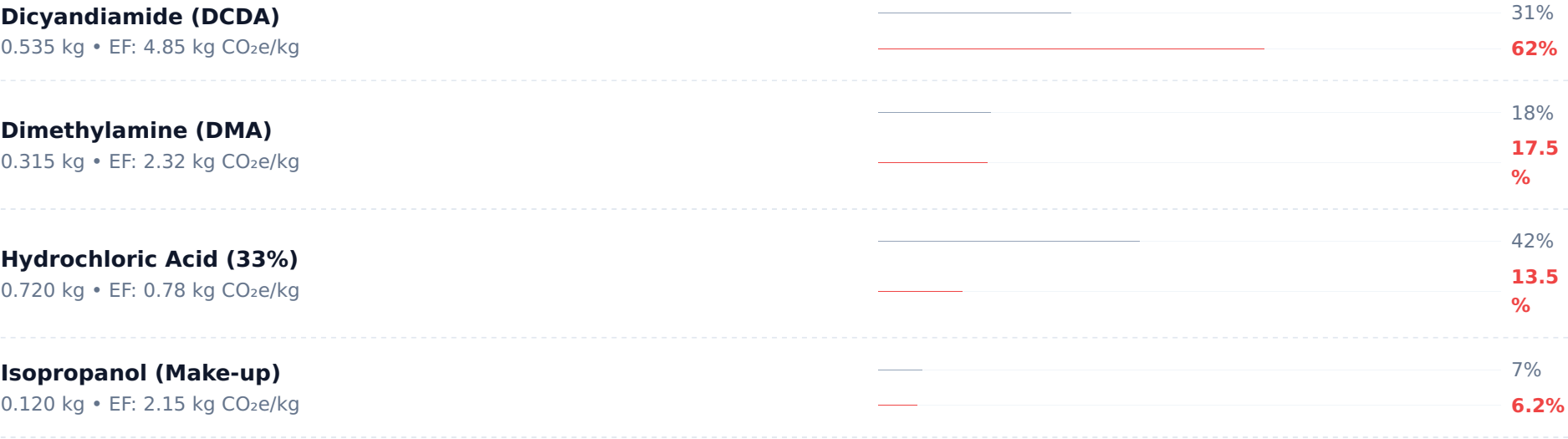
**Maritime / Heavy Truck Logistics & Packaging Drums**

**0.280 kg CO<sub>2</sub>e (3.4%)**

 **Precursor Mass vs. Impact Divergence**

Evaluating carbon intensity ratios per kg stoichiometric input

■ Mass % ■ CO<sub>2</sub> %



**Data Quality Rating (DQR)**

**Composite: 1.34 / 5.0 (High Precision)**

|  |                            |
|--|----------------------------|
|  | <b>TeR</b><br>1.5 (Good)   |
|  | <b>GeR</b><br>1.2 (V.High) |
|  | <b>TiR</b><br>1.3 (High)   |
|  | <b>C</b><br>1.1 (Excell.)  |
|  | <b>P</b><br>1.6 (Good)     |



## Executive Carbon Findings

### 1. Upstream DCDA Arc-Furnace Dominance

DCDA synthesis relies on the electro-thermal calcium carbide route ( $>2,000^{\circ}\text{C}$ ) linked to coal-fired regional grids. It generates **2.595 kg CO<sub>2</sub>e/kg API** (31.8% of the entire footprint) despite accounting for only 0.535 kg of input mass.

### 2. Grid Emission Intensity in Crystallization

On-site electricity accounts for **1.758 kg CO<sub>2</sub>e** (21.5% of total) due to high Indian grid carbon intensity (0.718 kg CO<sub>2</sub>e/kWh). Mechanical agitators,  $-5^{\circ}\text{C}$  crystallization chilling, and micronization are primary utility consumers.

### 3. 2026 LSR & Scope 3 Coverage Compliance

Zero biogenic carbon removals or unverified carbon credits are included (100% synthetic profile). Scope 3 upstream screening captures **96.9%** of lifecycle inputs, easily beating the mandatory  $\geq 95\%$  GHG Protocol 2026 threshold.



## Decarbonization Action Roadmap

**Total Potential: -42.0%**



### Group Captive Solar / Wind PPA

**-16.5% (-1.55 kg)**

Contract 100% renewable open-access wheeling to eliminate Scope 2 emissions from plant motor drives, chillers, and micronization lines.



### Low-Carbon DCDA Procurement

**-12.0% (-0.98 kg)**

Partner with suppliers utilizing captive zero-carbon hydropower (e.g. Sichuan/Yunnan) and modern closed-loop electric arc furnaces.



### Biomass Briquette Boiler Conversion

**-9.5% (-0.78 kg)**

Replace natural gas combustion with certified agro-residue biomass (groundnut shells / mustard husk abundant in Gujarat/Telangana).



### Mechanical Vapor Recompression (MVR)

**-4.0% (-0.32 kg)**

Upgrade solvent distillation recovery columns with MVR systems, slashing saturated steam consumption by up to 40%.

**Source Model:** PCF-API-MET-2026-IN01 • Ecoinvent v3.11, CEA Baseline v20 & DEFRA 2025/2026

Framework  
Compliance:

**GHG Protocol Product**

**ISO 14067 Aligned**

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