Industrial Electrification

Electrification of industrial processes (2025 addition)

- CO? Transport & Storage Infrastructure
- Direct Electrification of Industry
- Hydrogen in Industrial Processes

CO? Transport & Storage Infrastructure

Source Metadata

Field	Value
source	iea
source_version	ETCS 2025
source_id	IEA-CRS-004
iea_category	cross_cutting
technology	CO2 Transport & Storage Infrastructure
technology_readiness	early_commercial
mitigation	Y
adaptation	N
last_checked	2026-05-26

IEA Technology Definition

The IEA classifies CO2 transport and storage infrastructure as the downstream component of the CCUS chain, covering dedicated CO2 pipelines, ship transport, injection wells, and geological storage in depleted oil/gas fields or saline aquifers. The ETP Technology Guide emphasizes that shared CO2 transport and storage infrastructure (hubs and clusters) is critical to reducing unit costs and enabling CCUS deployment at the scale needed for net zero.

Technology Readiness & Deployment

CO2 pipeline transport is commercially proven, with over 8,000 km of CO2 pipelines operating primarily in North America for enhanced oil recovery. Dedicated geological storage (not EOR) is at early commercial stage, with projects like Northern Lights (Norway) and the Alberta Carbon Trunk Line (Canada) demonstrating shared infrastructure models. CO2 ship transport is emerging as an alternative for regions without pipeline access. The IEA identifies infrastructure development as a critical bottleneck for CCUS scale-up.

Key Metrics & Benchmarks

Global CO_2 storage capacity in operation is approximately 50 Mtpa. The IEA Net Zero scenario requires this to exceed 1 Gtpa by 2030. CO_2 pipeline transport costs range from USD 2-15/tCO_2 depending on distance and volume. Ship transport adds USD 10-30/tCO_2. Geological storage site characterization typically takes 3-7 years. Storage costs in well-characterized formations range from USD 5-30/tCO_2.

LATAM Relevance

Latin America has significant geological CO_2 storage potential in sedimentary basins across Brazil, Argentina, Colombia, and Mexico. Brazil's pre-salt formations already store over 10 MtCO_2/year through Petrobras reinjection operations. Colombia's depleted oil and gas fields and Argentina's Vaca Muerta region offer additional storage capacity. Shared infrastructure planning is nascent, and regulatory frameworks for dedicated CO_2 storage are still under development in most LATAM jurisdictions.

Critical Minerals Link

CO_2 transport infrastructure requires large volumes of carbon steel and specialty alloys for corrosion-resistant pipelines and wellheads. Compressor stations use copper and high-performance alloys. The steel demand for building out a global CO_2 pipeline network comparable to natural gas infrastructure would be substantial. LATAM's steel production capacity could serve regional CO_2 infrastructure needs.

Cleantech Taxonomy Crosswalk

Maps to Cleantech Taxonomy sectors: IN (Industry) — CO_2 pipeline and storage infrastructure; ES (Energy Systems) — CCUS-enabled power generation; XS (Cross-Sectoral) — shared infrastructure planning, regulatory frameworks, geological survey and characterization.

Direct Electrification of Industry

Source Metadata

Field	Value
source	iea
source_version	ETCS 2025
source_id	IEA-END-005
iea_category	end_use
technology	Direct Electrification of Industry
technology_readiness	early_commercial
mitigation	Y
adaptation	N
last_checked	2026-05-26

IEA Technology Definition

The IEA classifies direct electrification of industry as end-use technologies that replace fossil fuel combustion in industrial processes with electrical alternatives. This includes electric arc furnaces for steelmaking, industrial heat pumps for low-to-medium temperature processes, electromagnetic heating (induction, microwave, infrared), electric kilns for ceramics and cement, and plasma torches for high-temperature applications. The ETP Technology Guide tracks electrification as a key pathway alongside hydrogen and CCUS for industrial decarbonization.

Technology Readiness & Deployment

Electric arc furnace (EAF) steelmaking is commercially mature and accounts for approximately 30% of global steel production using recycled scrap. Industrial heat pumps delivering temperatures up to 150°C are at early commercial stage, with emerging systems targeting 200°C and above. Electric kilns and high-temperature electrification (above 400°C) for cement, glass, and ceramics remain at demonstration to early commercial stage. The economics of industrial electrification improve as renewable electricity costs decline and carbon prices rise.

Key Metrics & Benchmarks

Industry consumes approximately 37% of global final energy, with about two-thirds as heat. Low-temperature heat (below 150°C) accounts for roughly 30% of industrial heat demand and is most amenable to electrification. EAF steelmaking uses approximately 400-500 kWh per tonne of steel. Industrial electricity's share of final industrial energy consumption needs to rise from approximately 21% today to over 30% by 2050 in the IEA Net Zero scenario.

LATAM Relevance

Latin America's abundant renewable electricity makes industrial electrification economically attractive. Brazil's steel industry already operates significant EAF capacity using hydroelectric and biomass-based electricity. Chile's mining sector is electrifying haul trucks and processing equipment. Colombia's food and beverage industry has potential for industrial heat pump adoption. Low renewable electricity costs in LATAM could attract energy-intensive industries seeking to decarbonize.

Critical Minerals Link

Industrial electrification increases demand for copper (electrical infrastructure, motors), silicon carbide and gallium nitride (power electronics), and rare earth magnets (high-efficiency motors). Electric arc furnaces require graphite electrodes. The overall mineral intensity is lower than hydrogen-based alternatives for many temperature ranges, making electrification a mineral-efficient decarbonization pathway where feasible.

Cleantech Taxonomy Crosswalk

Maps to Cleantech Taxonomy sectors: IN (Industry) — industrial process electrification, EAF steelmaking, electric kilns; ES (Energy Systems) — industrial electricity demand, grid capacity planning; XS (Cross-Sectoral) — sector coupling, demand-side flexibility from industrial loads.

Hydrogen in Industrial Processes

Source Metadata

Field	Value
source	iea
source_version	ETCS 2025
source_id	IEA-CRS-005
iea_category	cross_cutting
technology	Hydrogen in Industrial Processes
technology_readiness	demo
mitigation	Y
adaptation	N
last_checked	2026-05-26

IEA Technology Definition

The IEA classifies the use of green and low-carbon hydrogen in industrial processes as a cross-cutting decarbonization pathway. Key applications include hydrogen direct reduction of iron (H-DRI) for steelmaking, hydrogen as chemical feedstock (green ammonia, green methanol), high-temperature industrial heat via hydrogen combustion, and hydrogen as a reducing agent in non-ferrous metallurgy. The IEA's Global Hydrogen Review tracks these applications alongside hydrogen production and infrastructure.

Technology Readiness & Deployment

Industrial use of hydrogen is well-established in oil refining and ammonia production, but these currently rely on grey hydrogen from natural gas. Green hydrogen applications in industry are at demonstration to early commercial stage. H-DRI steelmaking pilots are operational in Sweden (HYBRIT/SSAB) and several European projects. Green ammonia plants are under construction in multiple regions. The IEA notes a record number of hydrogen technologies advancing in readiness level during 2024-2025, but deployment remains far below net zero requirements.

Key Metrics & Benchmarks

Global hydrogen demand is approximately 95 Mt/year, almost entirely grey hydrogen. Industry consumes about 55% of hydrogen (primarily refining and ammonia). Green hydrogen from electrolysis represented less than 1% of total supply in 2024. H-DRI steel production costs are 20-40% higher than conventional blast furnace route. Green ammonia costs approximately USD 600-900/tonne versus USD 250-400/tonne for conventional ammonia. Cost competitiveness depends on green hydrogen reaching USD 2/kg or below.

LATAM Relevance

Latin America's potential for low-cost green hydrogen makes it well-positioned for industrial hydrogen applications. Chile's green hydrogen strategy targets export-oriented ammonia and steel production. Brazil's large steel and chemicals sectors are natural candidates for hydrogen-based decarbonization. Colombia's refinery sector in Barrancabermeja and Cartagena could transition to green hydrogen feedstock. The region's abundant renewable resources could enable green hydrogen production costs below USD 2/kg, making industrial applications economically viable.

Critical Minerals Link

Industrial hydrogen applications require the same electrolyser minerals as hydrogen production (iridium, platinum, nickel for catalysts). H-DRI steelmaking shifts mineral demand from coking coal to hydrogen and iron ore. Green ammonia synthesis uses iron-based catalysts. The overall mineral footprint of hydrogen-based industrial decarbonization is shaped primarily by electrolyser requirements for iridium and platinum group metals.

Cleantech Taxonomy Crosswalk

Maps to Cleantech Taxonomy sectors: IN (Industry) — H-DRI steel, green ammonia, industrial hydrogen heat; ES (Energy Systems) — hydrogen production and distribution; XS (Cross-Sectoral) — sector coupling, hydrogen economy, trade in hydrogen-based commodities.