Industry & Hydrogen

Industrial decarbonisation, clean hydrogen production

- Green Hydrogen Production (electrolysers)
- Industrial Decarbonization (steel, cement, chemicals)
- Carbon Capture, Utilisation & Storage (CCUS)

Green Hydrogen Production (electrolysers)

Source Metadata

Field	Value
source	iea
source_version	ETCS 2025
source_id	IEA-CRS-002
iea_category	cross_cutting
technology	Green Hydrogen Production (electrolysers)
technology_readiness	early_commercial
mitigation	Y
adaptation	N
last_checked	2026-05-26

IEA Technology Definition

The IEA classifies electrolysers as a key clean energy technology for producing green hydrogen by splitting water using renewable electricity. The ETP Technology Guide identifies electrolysers alongside solar PV, wind, batteries, EVs, and heat pumps as the six pillar technologies of the clean energy transition. Electrolyser types include alkaline (most mature), proton exchange membrane (PEM), and solid oxide (SOEC, at demonstration stage).

Technology Readiness & Deployment

Green hydrogen is at early commercial stage. Global investment in low-emissions hydrogen production climbed to nearly USD 8 billion in 2025, with year-on-year growth of 80%. Electrolyser deployment growth to 2030 is comparable to solar PV's early ramp-up trajectory. A record number of technologies advanced in technology readiness level across the hydrogen value chain during 2024-2025. However, actual deployed electrolyser capacity remains a fraction of announced project pipelines, and the IEA flags the need for faster final investment decisions.

Key Metrics & Benchmarks

Alkaline electrolyser costs range from USD 500-1,400/kW, while PEM systems cost USD 1,000-2,000/kW. Green hydrogen production costs range from USD 3-8/kg depending on electricity costs and utilization rates. The IEA projects costs could fall to USD 1.5-3/kg by 2030 in regions with excellent renewable resources. Global electrolyser manufacturing capacity is expanding rapidly, with China dominating production.

LATAM Relevance

Latin America is positioned as a potential green hydrogen export hub due to abundant low-cost renewable resources. Chile's National Green Hydrogen Strategy targets becoming a top-three exporter by 2040. Colombia, Brazil, and Uruguay have also launched hydrogen strategies. The Atacama region's solar resources and Patagonia's wind resources offer some of the world's lowest-cost renewable electricity, potentially enabling competitive green hydrogen production below USD 2/kg.

Critical Minerals Link

PEM electrolysers require iridium and platinum catalysts, creating supply chain risks given concentrated production in South Africa and Russia. Alkaline electrolysers use nickel electrodes. SOEC systems require rare earth elements. Electrolyser stacks also use titanium, zirconium, and specialty steels. Reducing platinum group metal loading is a key research priority.

Cleantech Taxonomy Crosswalk

Maps to Cleantech Taxonomy sectors: ES (Energy Systems) — hydrogen production, power-to-gas; IN (Industry) — electrolyser manufacturing, industrial hydrogen supply; TR (Transport) — hydrogen for fuel cells; XS (Cross-Sectoral) — sector coupling, energy storage via hydrogen.

Industrial Decarbonization (steel, cement, chemicals)

Source Metadata

Field	Value
source	iea
source_version	ETCS 2025
source_id	IEA-END-004
iea_category	end_use
technology	Industrial Decarbonization (steel, cement, chemicals)
technology_readiness	demo
mitigation	Y
adaptation	N
last_checked	2026-05-26

IEA Technology Definition

The IEA classifies industrial decarbonization technologies as solutions targeting the three hardest-to-abate industrial sectors: steel, cement, and chemicals. These sectors produce approximately 70% of industrial CO2 emissions. Key technology pathways include hydrogen-based direct reduction of iron (H-DRI), electrification of process heat, alternative cement chemistries (including supplementary cementitious materials), catalytic process innovation in chemicals, and circular economy approaches.

Technology Readiness & Deployment

Most deep industrial decarbonization technologies are at demonstration or early commercial stage. Hydrogen-based steelmaking (H-DRI) is being piloted by SSAB/HYBRIT in Sweden and others in Europe. Low-clinker cements and supplementary materials are commercially available but adoption is slow. Green ammonia and methanol production from green hydrogen are at pilot to early commercial scale. The IEA rates heavy industry decarbonization as not on track for net zero, requiring massive scale-up of investment and innovation.

Key Metrics & Benchmarks

Steel production accounts for approximately 7% of global CO_2 emissions, cement for 7%, and chemicals for 4%. H-DRI steel currently costs 20-40% more than conventional blast furnace steel. Global steel production exceeds 1.9 billion tonnes annually. Cement production reaches approximately 4.2 billion tonnes. The IEA estimates that reaching net zero requires near-zero-emission steel and cement to reach commercial scale by 2030.

LATAM Relevance

Brazil is the world's ninth-largest steel producer and a major cement and chemicals market. Colombia and Peru have significant cement industries. LATAM's access to low-cost renewable electricity and green hydrogen potential positions the region for low-carbon industrial production. Brazil's charcoal-based steelmaking (using planted eucalyptus) is already partially decarbonized. Carbon pricing mechanisms in Chile, Colombia, and Mexico create incentives for industrial decarbonization.

Critical Minerals Link

Industrial decarbonization increases demand for hydrogen (requiring electrolyser minerals), advanced catalysts (platinum group metals for chemical processes), and specialty alloys for high-temperature electrification. Circular economy approaches in industry can reduce overall mineral demand by improving recycling rates of steel, aluminium, and copper.

Cleantech Taxonomy Crosswalk

Maps to Cleantech Taxonomy sectors: IN (Industry) — steel, cement, chemicals decarbonization; ES (Energy Systems) — industrial hydrogen demand; XS (Cross-Sectoral) — circular economy, carbon pricing, green procurement.

Carbon Capture, Utilisation & Storage (CCUS)

Source Metadata

Field	Value
source	iea
source_version	ETCS 2025
source_id	IEA-CRS-003
iea_category	cross_cutting
technology	Carbon Capture, Utilisation & Storage (CCUS)
technology_readiness	early_commercial
mitigation	Y
adaptation	N
last_checked	2026-05-26

IEA Technology Definition

The IEA classifies CCUS as a cross-cutting technology covering the capture of CO2 from industrial processes or power generation, its transport, and permanent geological storage or utilization in products. The ETP Technology Guide includes post-combustion capture, pre-combustion capture, oxy-combustion, and direct air capture (DAC). CCUS is considered essential for decarbonizing hard-to-abate sectors and delivering negative emissions when combined with bioenergy (BECCS).

Technology Readiness & Deployment

Average annual investment in CCUS has grown more than 15-fold since 2020 to over USD 5 billion in 2025, with several landmark projects reaching final investment decisions. However, almost 90% of announced CCUS projects have not yet reached final investment decision. Chemical absorption from industrial sources (natural gas processing, hydrogen production) is at early commercial stage. Post-combustion capture from power generation and direct air capture remain at demonstration stage. The IEA rates CCUS as not on track, requiring major acceleration.

Key Metrics & Benchmarks

Global operational CO_2 capture capacity is approximately 50 Mtpa across about 40 facilities. Capture costs range from USD 15-25/tCO_2 for natural gas processing to USD 40-120/tCO_2 for power generation and USD 250-600/tCO_2 for direct air capture. The IEA Net Zero scenario requires CCUS capacity to reach over 1 Gtpa by 2030. The United States leads in operational capacity, supported by the 45Q tax credit.

LATAM Relevance

CCUS deployment in Latin America is nascent but has significant potential. Brazil's Petrobras operates CO_2 reinjection in pre-salt oil fields at a scale exceeding 10 MtCO_2/year, one of the world's largest CO_2 storage operations. Colombia, Argentina, and Mexico have identified geological storage potential in depleted oil and gas fields and saline aquifers. LATAM's large industrial base in steel, cement, and petrochemicals provides capture opportunities. Policy frameworks for CCUS remain underdeveloped in most LATAM countries.

Critical Minerals Link

CCUS technologies require specialty steels and alloys for high-pressure CO_2 transport pipelines. Capture solvents and sorbents use various chemical compounds. Direct air capture systems require significant quantities of potassium hydroxide or solid sorbent materials. The mineral intensity of CCUS is moderate but the steel demand for CO_2 pipeline networks is substantial.

Cleantech Taxonomy Crosswalk

Maps to Cleantech Taxonomy sectors: IN (Industry) — industrial carbon capture, BECCS; ES (Energy Systems) — power sector CCS, DAC; XS (Cross-Sectoral) — CO_2 transport infrastructure, carbon utilization, negative emissions.