Efficiency

Buildings, appliances, industry efficiency

- Buildings Energy Efficiency
- Transport Efficiency
- Industrial Energy Efficiency

Buildings Energy Efficiency

Source Metadata

Field	Value
source	iea
source_version	ETCS 2025
source_id	IEA-END-001
iea_category	end_use
technology	Buildings Energy Efficiency
technology_readiness	commercial
mitigation	Y
adaptation	N
last_checked	2026-05-26

IEA Technology Definition

The IEA classifies buildings energy efficiency as an end-use technology cluster covering heat pumps, building envelope improvements (insulation, glazing, air sealing), efficient lighting and appliances, and building electrification. The ETP Technology Guide tracks heat pumps as a key technology for decarbonizing space and water heating, alongside deep retrofits and near-zero-energy building standards.

Technology Readiness & Deployment

Heat pumps are commercially mature with global sales reaching approximately 10 million units per year in residential and commercial applications. Air-source heat pumps dominate the market, while ground-source systems serve colder climates. LED lighting penetration exceeds 50% globally. Building energy codes are tightening in advanced economies but remain weak or absent in many developing regions. The IEA considers heat pump deployment broadly on track but flags building envelope retrofit rates as far too low.

Key Metrics & Benchmarks

Heat pumps deliver 3-5 units of heat per unit of electricity consumed (COP 3-5), making them 2-4 times more efficient than gas boilers. Global heat pump stock exceeds 200 million units. Deep building retrofits can reduce

energy consumption by 50-70%. The buildings sector accounts for approximately 30% of global final energy consumption and 26% of energy-related CO2 emissions.

LATAM Relevance

Latin American buildings face growing cooling demand due to rising temperatures and urbanization. Air conditioning adoption is expanding rapidly in Brazil, Colombia, and Mexico, making efficient cooling technologies a priority. Heat pump adoption for heating is relevant in southern Chile and Argentina. Building energy codes exist in Brazil, Colombia, Chile, and Mexico but enforcement and retrofit rates remain low. Urban informal housing presents unique efficiency challenges.

Critical Minerals Link

Heat pumps require copper (heat exchangers, compressors), aluminium (evaporators), and specialized refrigerants. Efficient appliances and LED lighting use silicon, gallium, and indium. The mineral intensity of building efficiency technologies is modest compared to power generation, but volumes are significant given the massive scale of the buildings sector.

Cleantech Taxonomy Crosswalk

Maps to Cleantech Taxonomy sectors: BU (Buildings) — heat pumps, insulation, building codes, efficient appliances; ES (Energy Systems) — demand-side flexibility from smart buildings; XS (Cross-Sectoral) — building-integrated renewables.

Transport Efficiency

Source Metadata

Field	Value
source	iea
source_version	ETCS 2025
source_id	IEA-END-002
iea_category	end_use
technology	Transport Efficiency
technology_readiness	commercial
mitigation	Y
adaptation	N
last_checked	2026-05-26

IEA Technology Definition

The IEA classifies transport efficiency under end-use technologies, encompassing electric vehicles (battery EVs and plug-in hybrids), hydrogen fuel cell vehicles, vehicle lightweighting, and modal shift. The ETP Technology Guide tracks EVs as one of six key clean energy technologies alongside solar PV, wind, batteries, electrolysers, and heat pumps. Hydrogen vehicles target heavy-duty transport, shipping, and aviation where battery electrification faces limitations.

Technology Readiness & Deployment

Battery electric passenger vehicles are commercially mature, with global sales exceeding 17 million units in 2024. Electric buses and two/three-wheelers are scaling rapidly in China and Southeast Asia. Hydrogen fuel cell vehicles remain at early commercial stage with limited fleet deployments, primarily in buses and trucks. The IEA projects the growing EV fleet will displace 8 million barrels of oil per day by 2030 in the Net Zero scenario. Electric heavy-duty trucks are emerging but face range and charging infrastructure challenges.

Key Metrics & Benchmarks

EVs now represent approximately 20% of new car sales globally. Battery costs for automotive applications have fallen below USD 140/kWh. EV energy efficiency is 3-4 times higher than internal combustion engines on a well-to-wheel basis. Charging infrastructure exceeds 4 million public charge points globally. Hydrogen fuel cell costs remain significantly higher than battery electric alternatives for most passenger vehicle applications.

LATAM Relevance

EV adoption in Latin America is growing from a low base, led by Brazil, Colombia, Chile, and Costa Rica. Chile hosts the largest electric bus fleet outside China (over 2,000 units in Santiago). Brazil's auto industry is pivoting from flex-fuel to hybrid and electric vehicles. Colombia has implemented EV purchase incentives and is electrifying its BRT systems. Charging infrastructure across the region remains underdeveloped relative to vehicle sales.

Critical Minerals Link

EVs are the largest driver of lithium, cobalt, and nickel demand growth. Each EV battery contains 8-12 kg of lithium, 5-20 kg of nickel, and 5-10 kg of cobalt (NMC chemistry). Copper usage per EV is 2-4 times higher than for combustion vehicles. LATAM's lithium triangle (Chile, Argentina, Bolivia) and copper belt are critical to global EV supply chains. Hydrogen fuel cells require platinum group metals.

Cleantech Taxonomy Crosswalk

Maps to Cleantech Taxonomy sectors: TR (Transport) — EVs, fuel cells, charging infrastructure, modal shift; ES (Energy Systems) — vehicle-to-grid, transport electricity demand; IN (Industry) — vehicle and battery manufacturing.

Industrial Energy Efficiency

Source Metadata

Field	Value
source	iea
source_version	ETCS 2025
source_id	IEA-END-003
iea_category	end_use
technology	Industrial Energy Efficiency
technology_readiness	commercial
mitigation	Y
adaptation	N
last_checked	2026-05-26

IEA Technology Definition

The IEA classifies industrial energy efficiency as end-use technologies that reduce energy intensity in manufacturing and industrial processes. This includes high-efficiency motors and drives, waste heat recovery, process optimization, industrial heat pumps, and energy management systems. The ETP Technology Guide tracks these as essential for reducing the 37% share of global final energy consumed by industry.

Technology Readiness & Deployment

Most industrial energy efficiency technologies are commercially available. High-efficiency electric motors (IE3/IE4 class) are mandatory in many markets. Waste heat recovery systems are deployed in energy-intensive industries including cement, steel, and chemicals. Industrial heat pumps capable of delivering temperatures up to 150°C are at early commercial stage. The IEA rates industrial efficiency improvement as not on track, with global energy intensity declining at only 1-2% per year versus the 4% needed for net zero.

Key Metrics & Benchmarks

Electric motor systems account for approximately 45% of global electricity consumption. Upgrading to high-efficiency motors and variable speed drives can reduce motor system energy use by 20-30%. Industry accounts

for 37% of global final energy consumption. Best available technologies could reduce energy consumption in many industrial subsectors by 25-40% compared to current averages. Energy management systems (ISO 50001) are adopted by over 50,000 certified sites globally.

LATAM Relevance

Latin American industry faces significant energy efficiency gaps. Mining (Chile, Peru), food processing (Brazil, Colombia), and cement production are major energy consumers in the region. Industrial electricity tariffs in LATAM are relatively high, improving the economic case for efficiency investments. Brazil's PROCEL program and Colombia's PROURE initiative promote industrial efficiency, though adoption of best available technologies remains limited in small and medium enterprises.

Critical Minerals Link

High-efficiency motors use rare earth permanent magnets (neodymium). Power electronics for variable speed drives require silicon carbide and gallium nitride. Industrial heat pumps use copper and specialized refrigerants. The critical mineral footprint of efficiency measures is relatively low, making them cost-effective decarbonization strategies.

Cleantech Taxonomy Crosswalk

Maps to Cleantech Taxonomy sectors: IN (Industry) — process optimization, motors, waste heat recovery; ES (Energy Systems) — industrial demand management; XS (Cross-Sectoral) — energy management systems, circular economy approaches.