Bioenergy & Synthetic Fuels

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IEA Technology Definition

The IEA classifies bioenergy as energy derived from biomass sources — including agricultural residues, forestry waste, energy crops, and organic waste — used for power, heat, and transport fuels. Synthetic fuels (e-fuels) are produced by combining green hydrogen with captured CO2 to create drop-in hydrocarbon replacements. The ETP Technology Guide categorizes advanced biofuels and synthetic fuels as key alternative fuels for hard-to-abate sectors.

Technology Readiness & Deployment

Conventional bioenergy (biopower, bioethanol, biodiesel) is commercially deployed globally, accounting for approximately 6% of global energy supply. Advanced biofuels (cellulosic ethanol, bio-jet fuel) are at early commercial stage with limited production capacity. Synthetic fuels remain largely at demonstration or pilot stage, with global production below 1,000 tonnes per year. The IEA flags both advanced biofuels and e-fuels as needing significantly faster deployment to meet net zero targets.

Key Metrics & Benchmarks

Biopower LCOE ranges from USD 50-120/MWh. Bioethanol production exceeds 100 billion litres annually, led by the United States and Brazil. Sustainable aviation fuel (SAF) production reached approximately 1 billion litres in 2024 but needs to scale tenfold by 2030. Synthetic fuel production costs remain high at USD 3-6 per litre, requiring cheaper green hydrogen and CO2 capture to become competitive.

LATAM Relevance

Brazil is the world's second-largest bioethanol producer and a pioneer in sugarcane-based bioenergy, with a mature flex-fuel vehicle fleet and extensive biomass power generation. Colombia has mandated biodiesel and ethanol blending in transport fuels. The region's abundant biomass resources and low-cost renewable electricity make LATAM a potential hub for advanced biofuels and green hydrogen-based synthetic fuel production.

Critical Minerals Link

Bioenergy has low critical mineral intensity compared to other energy technologies. Catalysts for advanced biofuel and synthetic fuel production use platinum group metals (PGMs) and nickel. Electrolyser components for green hydrogen (needed for e-fuel synthesis) require iridium and platinum, with supply chain risks.

Cleantech Taxonomy Crosswalk

Maps to Cleantech Taxonomy sectors: ES (Energy Systems) — biopower and biomass heating; TR (Transport) — biofuels and synthetic aviation fuels; IN (Industry) — biomass for industrial process heat; XS (Cross-Sectoral) — waste-to-energy systems.

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