Smart Grids & Digitalization

Source Metadata

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IEA Technology Definition

The IEA classifies smart grids and energy system digitalization as cross-cutting technologies that enable the integration of variable renewables, demand-side flexibility, and distributed energy resources. Smart grids encompass advanced metering infrastructure (AMI), distribution automation, real-time monitoring, demand response platforms, and AI-driven grid optimization. Digitalization spans the entire energy value chain from generation forecasting to consumer engagement.

Technology Readiness & Deployment

Smart grid components are at varying readiness levels: smart meters are commercially deployed in many advanced economies, while AI-driven grid optimization and virtual power plants are at early commercial stage. The IEA emphasizes that grid flexibility is essential for accommodating growing penetrations of solar PV, wind, EVs, and heat pumps. Investment in grid modernization needs to accelerate significantly to match the pace of renewable deployment.

Key Metrics & Benchmarks

Global investment in electricity grids reached approximately USD 400 billion in 2024. Smart meter deployment exceeds 1 billion units worldwide. Demand response capacity is growing but represents less than 5% of peak demand in most markets. The IEA estimates that digitalizing grids could reduce curtailment of renewables by 30-40% and defer significant transmission infrastructure investment.

LATAM Relevance

Latin American grids face challenges from rapid renewable growth, long transmission distances, and distribution system losses. Brazil's smart meter rollout is expanding under ANEEL regulation. Chile is investing in grid digitalization for its renewable-rich northern system. Colombia's grid modernization plan addresses integration of distributed solar and regional interconnections. Grid losses in LATAM average 15-20%, significantly above OECD norms, making digitalization economically compelling.

Critical Minerals Link

Smart grid infrastructure requires copper (wiring and power electronics), silicon (semiconductors), rare earth elements (sensors and electronics), and aluminium (conductors). The demand for power electronics components (using silicon carbide and gallium nitride) is growing rapidly with grid modernization.

Cleantech Taxonomy Crosswalk

Maps to Cleantech Taxonomy sectors: ES (Energy Systems) — grid management, flexibility services; IC (ICT) — digital platforms, AI for energy; BU (Buildings) — smart building integration; XS (Cross-Sectoral) — demand response across all end-use sectors.

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