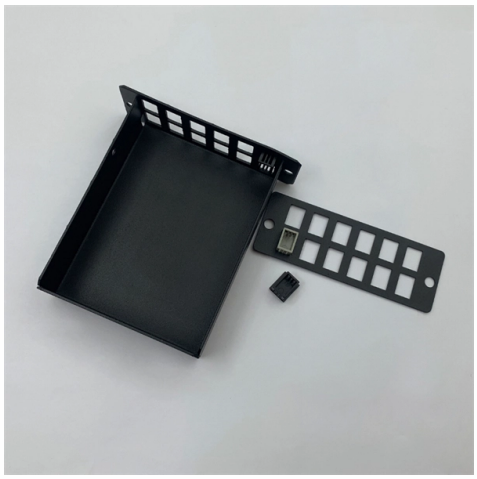
Two Alternatives for the Global Energy Interconnection



Overview

Roadmap for Enabling Flexible Interconnection - The roadmap will outline options for how a utility can perform the technical analysis required for leveraging DER PCS as part of interconnection studies.

Key Takeaways

Global Energy Interconnection (GEI) can be approached either through a centralized ultra-high voltage (UHV) backbone connecting continents or via a decentralized, modular smart grid system integrating regional clean energy resources. 1. Centralized UHV-Based GEIThis approach emphasizes a transcontinental, high-capacity UHV grid as the backbone for global energy transmission.

Key features include: Ultra-High Voltage Transmission: UHV lines allow long-distance electricity transfer with minimal losses, enabling the transport of renewable energy from resource-rich regions to high-demand centers across countries and continents.

Large-

Scale Clean Energy Integration: Centralized deployment of hydropower, wind, and solar farms in optimal locations maximizes efficiency and reduces reliance on fossil fuels. Global Coordination: Requires international standards, agreements, and synchronized operations to ensure stability and interoperability across multiple national grids. Economic Efficiency: Centralized generation and transmission can reduce overall costs per unit of electricity due to economies of scale and optimized resource allocation.

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Advantages: High efficiency, large-scale renewable integration, and potential for global emission reductions. Challenges: High initial investment, complex international coordination, and vulnerability to large-scale disruptions. 2.

Decentralized Smart Grid-Based GEI

This alternative focuses on regional or modular interconnections using smart grid technologies: Distributed Generation: Emphasizes local renewable energy sources, such as rooftop solar, small wind farms, and regional hydro, reducing dependency on long-distance transmission. Smart Grid Integration: Advanced monitoring, automation, and demand-response systems optimize energy flow, balance intermittent generation, and improve grid resilience. Flexibility and Scalability: Modular design allows gradual expansion, easier adaptation to local conditions, and integration of emerging technologies.

Time-

Zone and Seasonal Optimization: Regional grids can exploit differences in peak demand and renewable availability to balance supply efficiently. Advantages: Greater resilience, lower transmission losses locally, and easier incremental deployment. Challenges: Less efficient for large-scale global energy transfer, potential underutilization of high-quality renewable resources, and more complex coordination across multiple smaller grids.

Comparative SummaryFeatureCentralized UHV GEIDecentralized Smart Grid GEIScaleContinental to globalRegional to nationalTransmissionLong-distance UHV linesLocalized, modular interconnectionsRenewable IntegrationLarge-scale, resource-optimizedDistributed, flexibleInvestmentHigh upfront costLower, incrementalResilienceVulnerable to large-scale failuresMore resilient to local disruptionsCoordinationRequires international standardsRequires regional interoperabilityConclusionBoth alternatives aim to maximize clean energy utilization and reduce carbon emissions, but they differ in scale, technical complexity, and deployment strategy.

A hybrid approach combining centralized UHV corridors for bulk energy transfer with decentralized smart grids for regional optimization may offer the most practical path toward a fully interconnected global energy system. This strategy aligns with the GEI vision of “Smart Grid + UHV + Clean Energy” and supports global sustainable development goals, including climate mitigation and equitable energy access.

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GEI Initiative

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