

IN-SET

BOLETÍN DE VIGILANCIA TECNOLÓGICA

ELECTRIC POWER SYSTEMS

Resumen de la actualidad tecnológica en transición energética, que recoge tendencias en energías renovables, almacenamiento y materiales, combustibles sostenibles, procesos térmicos y de combustión, infraestructura eléctrica e inteligencia artificial, así como su aplicación en los distintos sectores de consumo.

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PREFACIO



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Esta edición muestra que uno de los principales desafíos de la transición energética va más allá de incorporar capacidad renovable al sistema. El crecimiento de la generación conectada mediante convertidores, el almacenamiento y las cargas de gran escala desplaza el reto hacia la capacidad de las redes para transportar esa energía y mantener la estabilidad bajo condiciones operativas cada vez más variables. En conjunto, los avances recopilados indican que la expansión física de la red debe acompañarse de nuevas formas de control, planificación y regulación.

Una tendencia dominante es la consolidación de la transmisión en corriente continua de alta tensión para integrar recursos renovables alejados de los centros de consumo. La presencia simultánea de hojas de ruta tecnológicas, documentos de patente, proyectos y esfuerzos de estandarización muestra que la tecnología HVDC está adquiriendo un papel cada vez más relevante en la expansión de los sistemas eléctricos. Un hito representativo es la entrada en operación comercial del Champlain Hudson Power Express, un enlace de 1.250 MW entre Quebec y Nueva York que, a plena capacidad, podría cubrir cerca del 20 % de la demanda de la ciudad. Este proyecto demuestra cómo un enlace HVDC puede aprovechar la complementariedad entre regiones para transportar grandes bloques de energía renovable desde las zonas de generación hasta un gran centro de consumo.

El segundo eje es la evolución desde el predominio de los inversores seguidores de red hacia una mayor incorporación de inversores formadores de red, conocidos como grid-following y grid-forming, respectivamente. Las publicaciones científicas, patentes y anuncios comerciales recopilados en esta edición muestran que este concepto avanza hacia aplicaciones de mayor escala. En este ámbito destaca un estudio que evaluó, mediante simulaciones en el dominio del tiempo, una planta fotovoltaica de 100 MW integrada con un sistema de almacenamiento mediante baterías de 35 MW de potencia y 60 MWh de capacidad. En los escenarios analizados, el inversor del sistema de almacenamiento, operado con control formador de red, proporcionó soporte inmediato al sistema mediante su respuesta de potencia activa y reactiva, favoreciendo la recuperación de la tensión y la frecuencia ante perturbaciones. Aunque se trata de resultados obtenidos mediante simulaciones, estos indican que un sistema de almacenamiento equipado con un inversor formador de red puede contribuir a mejorar la estabilidad transitoria del sistema eléctrico ante perturbaciones.

Estos desarrollos son complementarios, ya que los corredores HVDC transportan grandes bloques de energía desde zonas con abundantes recursos renovables, mientras que los sistemas de almacenamiento equipados con inversores formadores de red aportan soporte rápido de tensión y frecuencia para facilitar la integración de esos recursos sin comprometer la estabilidad del sistema. Los contenidos sobre grandes cargas, asignación de costos y estandarización muestran además que la madurez tecnológica no basta por sí sola, porque la coordinación regulatoria y la planificación de largo plazo son necesarias para articular estas inversiones a escala de sistema.

Para Chile, estas tendencias son pertinentes por la extensión del sistema eléctrico, la distancia entre parte de los recursos renovables y los centros de consumo y la creciente presencia de tecnologías conectadas mediante convertidores.

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NOTICIAS

Edición n°2 | julio de 2026 | set.usm.cl

Prysmian to Use Recycled Copper on EGL2 Cable

Etiqueta: Grid-enhancing technologies | Publicada el 02/07/2026

Prysmian Group announced on 2 July 2026 that Eastern Green Link 2 will become the first high-voltage direct current cable to use 100% recycled copper in its conductor, sourced from La Farga Yourcoppersolutions. The 505km, 2GW, ± 525 kV subsea and underground HVDC link connects Peterhead in Aberdeenshire to Drax in North Yorkshire and is being developed as a joint venture between SSEN Transmission and National Grid Electricity Transmission.

[ver más...](#)



Grid-forming BESS to enhance stability in utility-scale PV

Etiqueta: Stability-constrained operation | Publicada el 24/06/2026

Scientists have simulated a 100 MW solar PV plant and a 35 MW / 60 MWh BESS with grid-forming control. In all cases, the grid-forming control provided immediate active/reactive support. Research: we provide quantitative evidence that grid-forming control strategies can support the transition to inverter-dominated power systems.

[ver más...](#)



CAISO's 2025-26 Transmission Plan: Outlines \$7 billion investment to integrate new loads

Etiqueta: Electric power grids | Publicada el 15/06/2026

California's electricity demand is projected to rise sharply – by around 15 GW by 2035 and 20 GW by 2040 – driven by the rapid expansion of large data centres, industrial growth, as well as transport and building electrification. Meeting this demand will require installed capacity additions of over 74 GW and 107 GW, respectively. These additions are also critical to achieving the state energy goals established under the Senate Bill (SB) 100, which mandates a renewables share of 50 per cent by 2026, 60 per cent by 2030 and 100 per cent by 2045. To meet the forecast demand and state energy goals cost-effectively, in April 2026, the California Independent System Operator (CAISO) released its draft 2025-26 Transmission Plan, recommending 38 transmission upgrades with an estimated total cost of USD7 billion, phased in over lead times of up to 8-10 years and translating to approximately 0.5 cents per kWh over the life of the projects.

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Huawei launches grid-forming PCS for utility-scale energy storage

Etiqueta: Grid-forming inverters | Publicada el 09/06/2026

uawei Digital Power launched a new generation of smart string grid-forming PCS at SNEC 2026 in Shanghai, expanding its grid-forming technology portfolio across energy storage, PV and load-side applications. The company presented the solution during its FusionSolar strategy and product launch event on June 3. The announcement also covered the FusionSolar Agent energy AI architecture.

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PUBLICACIONES CIENTÍFICAS

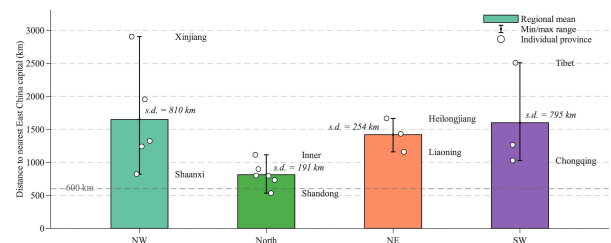
Edición n°2 | julio de 2026 | set.usm.cl

China's HVDC development for large-scale renewable integration: A system-level technology roadmap

Etiqueta: Converter-dominated power systems | Publicada el 21/06/2026

Large-scale renewable integration requires transmission systems that can move electricity from remote resource bases to distant load centers while maintaining stability in increasingly converter-dominated grids. Using China as a reference case, this review presents a technology roadmap for High Voltage Direct Current (HVDC) across three layers: system drivers, converter and system architectures, and power semiconductor devices, traced through China's Five-Year Plan phases.

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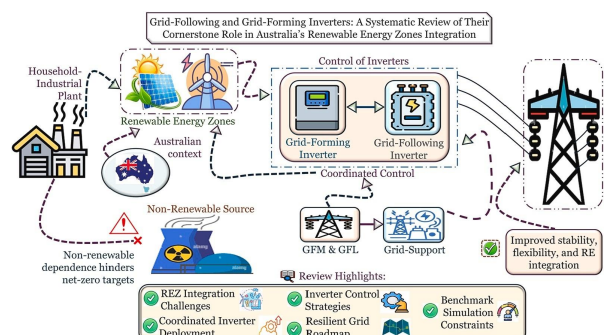


Grid-following and grid-forming inverters: A systematic review of their cornerstone role in Australia's renewable energy zones integration

Etiqueta: Grid-forming inverters | Publicada el 21/06/2026

The environmental and economic limitations of non-renewable energy sources are accelerating Australia's transition towards Renewable Energy Zones (REZs). However, integrating REZs into weak transmission networks introduces stability challenges that jeopardize overall system reliability. Inverter-based resources (IBRs), particularly grid-forming inverters (GFMI) and grid-following inverters (GFLI), have emerged as pivotal technologies to address these issues.

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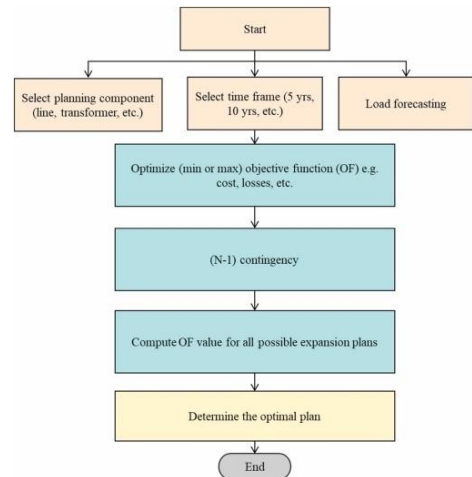


A comprehensive review of modern transmission expansion planning

Etiqueta: Renewable generation uncertainty | Publicada el 25/05/2026

The objective of this paper is to summarize, classify, and critically evaluate recent advances in TEP modeling, highlighting how stochastic, robust, hybrid, and data-driven methods manage uncertainties in load growth, renewable generation, and system contingencies. It also examines the incorporation of resilience, reliability, environmental constraints, and policy considerations into planning frameworks.

[ver más...](#)

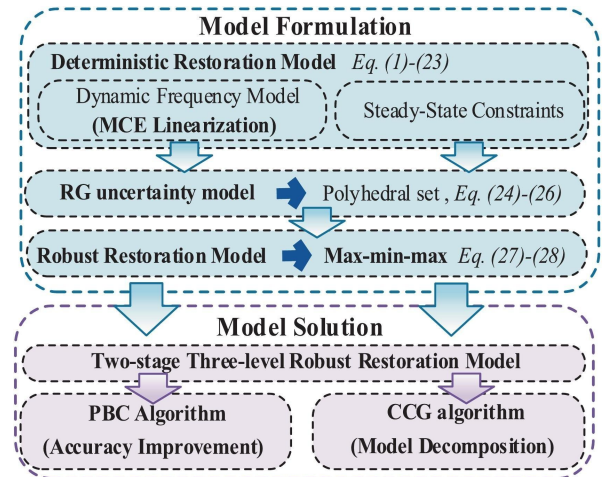


Dynamic frequency-robust restoration for renewable-penetrated transmission systems

Etiqueta: Frequency regulation | Publicada el 21/05/2026

Renewable generation (RG) has been empirically validated as both technically essential and operationally viable for active participation in power system restoration processes. However, the large-scale integration of RG poses significant challenges to system restoration due to the inherent characteristics of the RG, including the low inertia, weak frequency regulation and randomness, which are not comprehensively addressed in the traditional restoration method.

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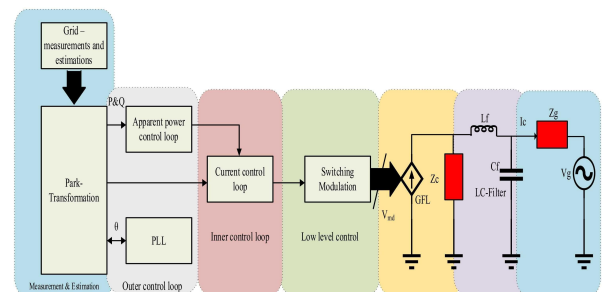


The evolution of grid-following to grid-forming inverters and the quest for power system stability

Etiqueta: Grid-forming inverters | Publicada el 21/05/2026

This paper provides a comprehensive review of the paradigm shift from GFL to Grid-Forming (GFM) inverters—the key to stabilizing future power systems. We analyze the core control architectures, operational limitations, and stability mechanisms of both paradigms, with a focused examination of synchronization instability in GFL units, including a precise small-signal impedance model explaining the negative incremental resistance effect and its impact on critical SCR thresholds in multi-inverter systems.

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PATENTES

Edición n°2 | julio de 2026 | set.usm.cl

System and method for operating grid-following inverter-based resource

Etiqueta: Electric power grids | Publicada el 02/07/2026

A method for operating a grid-following inverter-based resource (IBR) connected to a power grid. The IBR has a controller. The method includes receiving, via the controller, a frequency feedback signal representative of an electrical frequency of the power grid. The method also includes determining, via the controller, a power support signal based on applying a function to the frequency feedback signal.

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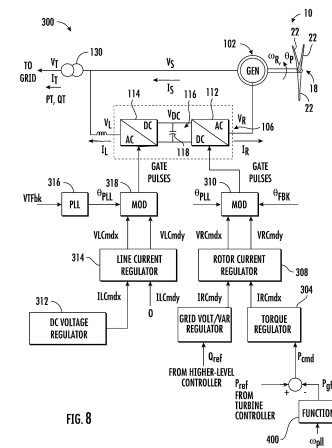


FIG. 8

System for the generation and transmission of high-voltage direct current

Etiqueta: Advanced voltage control | Publicada el 25/06/2026

The present invention relates to a system, comprising a high-voltage direct current (HVDC) transmission line carried by pylons, a high-voltage (HV) photovoltaic (PV) generator electrically connected to the high-voltage direct current transmission line, a power

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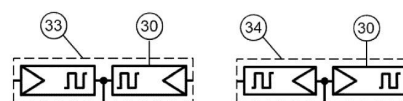


Fig. 4a

Fig. 4b

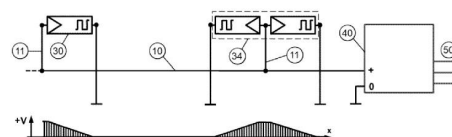


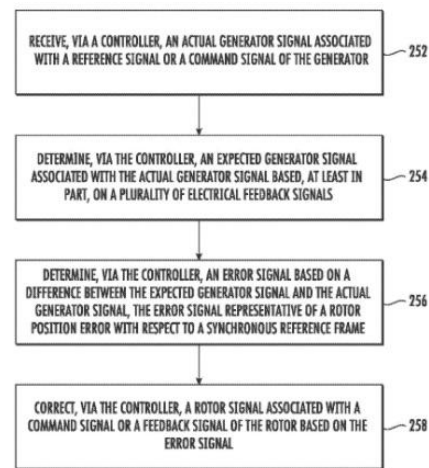
Fig. 5

System and method for operating generator of grid-forming inverter-based resource

Etiqueta: Grid-forming inverters | Publicada el 18/06/2026

A method for operating a generator of a grid-forming inverter-based resource. The generator has a rotor and a stator. The method includes receiving, via a controller, an actual generator signal associated with a reference signal or a command signal of the generator. The method also includes determining, via the controller, an expected generator signal associated with the actual generator signal based, at least in part, on a plurality of electrical feedback signals.

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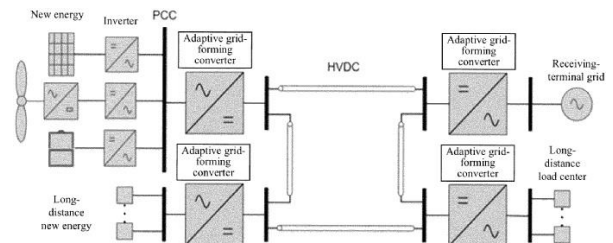


Multi-terminal flexible direct-current adaptive grid-forming control system, method, device, and medium

Etiqueta: Grid-forming inverters | Publicada el 21/05/2026

Provided are multi-terminal flexible direct-current adaptive grid-forming control system and method, a device, and a medium. Power set values of a first adaptive grid-forming converter and a second adaptive grid-forming converter are set according to loss of a high-voltage direct-current line. An adaptive grid-forming control model is constructed, and an alternating-current voltage instruction is determined based on the adaptive grid-forming control model.

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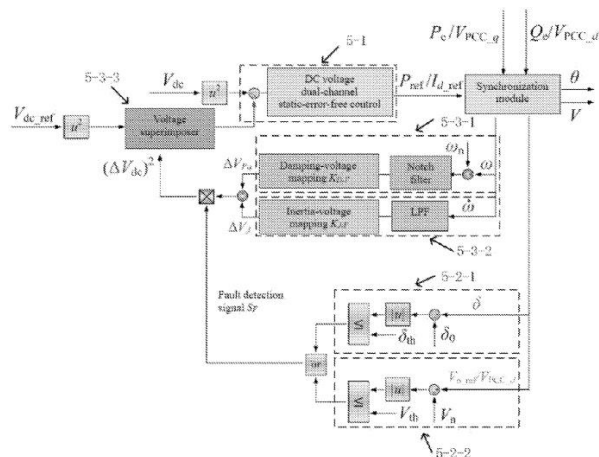


Direct current voltage control method and system for enhancing transient stability of grid-connected converter

Etiqueta: Converter-dominated power systems | Publicada el 07/05/2026

A direct current (DC) voltage control method for enhancing transient stability of a grid-connected converter includes the steps of: processing a control signal of a synchronization control loop by a DC-link transient energy correction module (DC-TECM) when either a power angle limit violation-based fault diagnosis module (PAV-FDM) or a voltage limit violation-based fault diagnosis module (VLV-FDM) determines that a voltage sag or phase jump fault has occurred.

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PROYECTOS

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EIB Commits €1.6 Billion to Bay of Biscay HVDC Subsea Link

Etiqueta: System integrity protection schemes | Publicada el 25/06/2026

The European Investment Bank (EIB) has announced a €1.6 billion financing package to support the construction of the first submarine high-voltage direct current (HVDC) electricity interconnection between Spain and France, the 'Biscay Gulf' HVDC interconnector. This landmark Bay of Biscay project is set to nearly double the electricity exchange capacity between the two nations, advancing the integration of the Iberian Peninsula into the broader European power grid.

[ver más...](#)



Champlain Hudson Power Express Enters Commercial Operation Early

Etiqueta: Renewable curtailment mitigation | Publicada el 15/05/2026

The Champlain Hudson Power Express (CHPE) high-voltage direct current transmission line officially reached its commercial operational date shortly after midnight on 13 May 2026, making the 1,250 MW link from Canada to New York City available for scheduling transactions on the wholesale electricity market. At full capacity, the line is capable of supplying roughly 20% of New York City's power demand, enough to serve around one million homes.

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MERCADO

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HVDC Transmission System Market Size, Share & Industry Analysis

Etiqueta: Electric power grids | Publicada el 29/06/2026

The global HVDC transmission system market size was valued at USD 11.7 billion in 2025 and is projected to grow from USD 12.6 billion in 2026 to USD 22.29 billion by 2034, registering a CAGR of 7.39% over the forecast period. Asia Pacific dominated the HVDC transmission system market with a market share of 67.65% in 2025.

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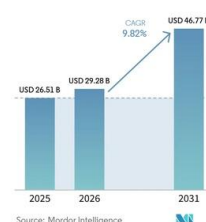
Smart grid network market size & share analysis

Etiqueta: Renewable generation uncertainty | Publicada el 01/06/2026

The Smart Grid Network Market size is expected to increase from USD 26.51 billion in 2025 to USD 29.28 billion in 2026 and reach USD 46.77 billion by 2031, growing at a CAGR of 9.82% over 2026-2031.

[ver más...](#)

Smart Grid Network Market
Market Size in USD Billion



Market Overview

Study Period	2021 - 2031
Market Size (2026)	USD 29.28 Billion
Market Size (2031)	USD 46.77 Billion
Growth Rate (2026 - 2031)	9.82% CAGR
Fastest Growing Market	Asia Pacific
Largest Market	North America
Market Concentration	Low
Major Players	

EVENTOS

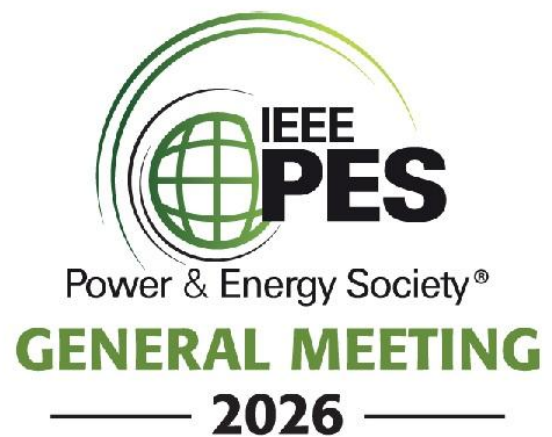
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2026 IEEE PES

Etiqueta: Congestion management | Publicada el 21/06/2026

The 2026 IEEE Power & Energy Society General Meeting will be held 19–23 July 2026 in Montréal, Canada. This premier power engineering conference will bring together practicing power engineers and academics from all over the world. The aim of the conference is to provide an international forum for experts to promote, share, and discuss various issues and developments in the field of electrical power engineering.

[ver más...](#)



Microgrid & Energy Storage Innovation Forum

Etiqueta: System integrity protection schemes | Publicada el 21/05/2026

The 21st edition of the Microgrid & Energy Storage Innovation Forum, December 1-2, 2026 in Chicago brings together global leaders, utilities, developers, and innovators shaping the future of energy systems – where microgrids and energy storage are redefining how power is generated, managed, and delivered.

[ver más...](#)



Paris Session 2026

Etiqueta: Electric power grids | Publicada el 21/05/2026

Every two years, CIGRE delivers the world's foremost collaborative knowledge development and sharing programme for the power system sector. Through extensive remote collaboration and periodic face-to-face events, experts from around the globe contribute to advancing the industry. This unique programme culminates in the Paris Session – the leading international gathering for power system expertise.

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REPORTES

Edición n°2 | julio de 2026 | set.usm.cl

Northeast US States Release Offshore HVDC Standardization Roadmap

Etiqueta: Renewable curtailment mitigation | Publicada el 16/06/2026

Ten jurisdictions publish three interconnected reports setting out technical standards, procurement strategies, and reliability frameworks for a coordinated Atlantic Coast HVDC transmission network.

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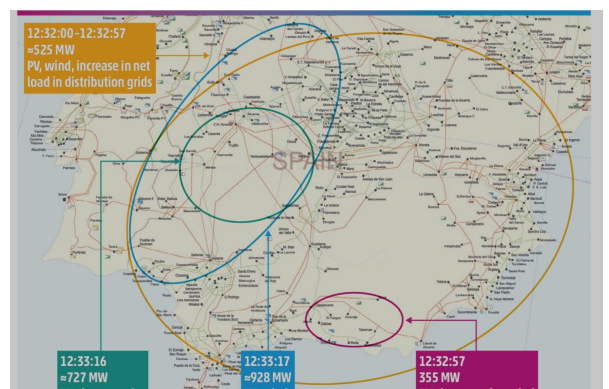


ENTSO-E releases 2026 Summer Outlook Report

Etiqueta: Renewable curtailment mitigation | Publicada el 29/05/2026

The Summer Outlook report is designed to inform national and European authorities on system risks. No systemic adequacy risks are identified for the rest of the European power system this summer. Specific risks exist in Ireland, Malta, and Cyprus because of planned generation outages, limited import capacity, and low availability of backup resources.

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NORMATIVAS

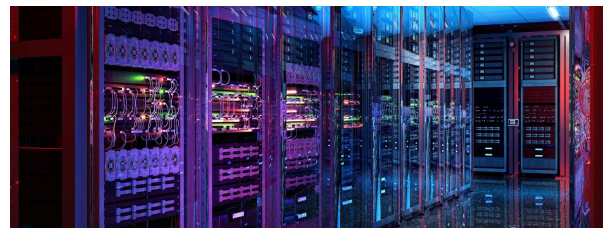
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FERC orders grid operators to promptly revise or justify interconnection rules for data centers and large loads

Etiqueta: Renewable curtailment mitigation | Publicada el 25/06/2026

On June 18, 2026, the Federal Energy Regulatory Commission (FERC) issued six show cause orders initiating proceedings under Section 206 of the Federal Power Act (FPA) for all jurisdictional regional transmission organizations (RTOs) and their respective transmission owners (TOs).¹ Stemming from a directive by the United States Department of Energy (DOE),² the orders instruct the RTOs and TOs to explain why their existing open access transmission tariffs (OATTs) are just and reasonable with respect to interconnection processes for large loads.

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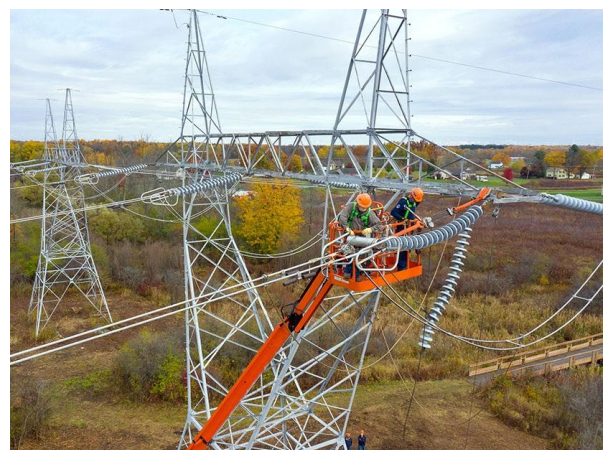


FERC Receives Dozens of Order 1920 Compliance Proposals

Etiqueta: System integrity protection schemes | Publicada el 14/06/2026

FERC has received more than three dozen proposals to comply with Order 1920's rules on long-term transmission planning and cost allocation.

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GERC Releases Draft Gujarat Electricity Grid Code 2026 To Strengthen Grid Reliability And Renewable Integration

Etiqueta: Electric power grids | Publicada el 19/05/2026

The Gujarat Electricity Regulatory Commission (GERC) has released the draft Gujarat Electricity Grid Code (GEGC), 2026, introducing a new regulatory framework for managing the planning, development, operation, and maintenance of the state's electricity system. The draft has been prepared under the provisions of the Electricity Act, 2003, along with relevant state laws. Once officially notified in the Gujarat Government Gazette, the new regulations will replace the existing Gujarat Electricity Grid Code that has been in force since 2013.

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Von der Leyen Grids Package Agreement Targets Summer 2026 Implementation

Etiqueta: Renewable curtailment mitigation | Publicada el 14/05/2026

European Commission President Ursula von der Leyen's recent call for von der Leyen grids package agreement by summer 2026 represents more than policy rhetoric. It acknowledges that Europe's energy transition security faces a critical bottleneck where inadequate transmission capacity threatens to strand renewable investments worth hundreds of billions of euros. The proposed legislation aims to address systematic failures in cross-border electricity trading, permitting challenges affecting over half of major transmission projects, and coordination gaps between national grid operators.

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