Energy Internet with Multi-Energy Complementarity

Overview

Cost-efficient multi-energy management with flexible complementarity. Under the circumstances of the energy internet, an innovative framework for a multi.

Key Takeaways

Energy Internet integrates renewable energy, smart grids, and ICT to enable multi-energy coordination and complementarity for efficient, flexible, and sustainable energy systems.Energy Internet Overview

The Energy Internet is the application of internet technologies, big data, and artificial intelligence to the production, transmission, storage, and consumption of energy. It transforms traditional centralized energy systems into decentralized, interconnected networks that integrate electricity, natural gas, oil, transportation, and information systems into a unified energy-sharing platform . Key features include:

• Intelligent energy production: Using predictive analytics and big data to optimize power generation and energy distribution.

• Distributed energy networks: Primarily based on renewable energy sources, enabling coordination and complementarity among multiple energy types.

• Smart consumption models: Incorporating electric vehicles, user-end intelligence, and carbon trading to enhance energy efficiency and sustainability.

• Core technologies: Modern communication networks, AI, and ICT applied across energy production, transmission, storage, and consumption to improve utilization and promote clean energy adoption .

Multi-Energy Complementarity

Multi-energy complementarity refers to the coordinated operation of diverse energy sources—such as electricity, natural gas, heating/cooling, hydrogen, wind, solar, and hydropower—to balance supply fluctuations and enhance system flexibility . Its main objectives are:

• Integration of intermittent renewables: Mitigating the variability of wind and solar power through complementary energy sources.

• Cross-energy optimization: Coordinating production, storage, conversion, and consumption across multiple energy systems.

• Spatial and temporal coordination: Leveraging cross-regional energy sharing and multi-temporal planning to optimize long-term and short-term energy balance .

• Enhanced reliability and efficiency: Reducing renewable energy curtailment, improving resource utilization, and ensuring stable power supply.

Practical Applications

• Integrated energy bases: Large-scale projects in China aim to combine wind, solar, hydro, thermal, and storage systems for coordinated operation across regions .

• Hierarchical optimization models: Multi-temporal and multi-spatial frameworks use advanced algorithms to optimize energy dispatch, cross-regional mutual aid, and renewable energy accommodation .

• Smart energy services: New market players and energy finance models emerge from the integration of Energy Internet technologies, supporting industrial upgrading and sustainable growth .

Benefits

• Improved energy efficiency: Coordinated multi-energy operation reduces waste and enhances utilization.

• Increased renewable penetration: Complementary energy systems allow higher integration of intermittent renewable sources.

• System flexibility and resilience: Cross-regional and multi-energy coordination mitigates supply fluctuations and enhances reliability.

• Support for sustainable development: Aligns with carbon reduction goals and promotes clean energy adoption . In summary, the Energy Internet provides the technological and operational framework for multi-energy complementarity, enabling a flexible, efficient, and sustainable energy ecosystem that integrates diverse energy sources, advanced ICT, and intelligent management systems.

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Optimizing data center energy consumption via energy complementarity ...

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ENERGY | Special Issues: Multi-Energy Complementarity and Source

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Multi-energy Complementarity Evaluation and Its Interaction with Wind and Photovoltaic Capacity optimization

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Energy Internet

This paper summaries the concept and characteristics of “Energy Internet" and the sustainable urban development;

Optimisation of a Multi-Energy Complementary Integrated Energy

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Request PDF | On Sep 26, 2018, Fangyuan Si and others published Cost-efficient multi-energy management with flexible

A comprehensive overview of framework for developing sustainable energy ...

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Multi-energy Integrated Development Strategy

To strengthen its energy sector and realize the carbon peaking and carbon neutrality goals, China needs to accelerate the

Optimization model of distributed energy supply system based on multi ...

The distributed energy supply system based on multi-energy complementarity is currently a research hotspot in the

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