Basic Architecture of the Energy Internet



Overview

In this paper, the basic concept and characteristics of the Energy Internet are summarized, and its basic structural framework is analyzed in detail.

Key Takeaways

The Energy Internet typically features a multi-layered architecture integrating distributed energy resources, smart grids, and information and communication technologies to enable efficient energy management and bidirectional energy flow.

Overview

The Energy Internet is designed to maximize the efficiency, reliability, and utilization of energy resources by combining the smart grid with advanced information and communication technologies (ICT) such as cloud computing, IoT, and big data analytics. It supports distributed energy generation, including renewable sources like solar, wind, and biomass, and enables prosumers—consumers who also produce energy—to actively participate in energy production and consumption.

Layered Architecture

A widely recognized model of the Energy Internet architecture consists of six layers: Business Layer: Defines market roles, business models, and energy trading mechanisms. It manages contracts, pricing, and interactions between energy producers, consumers, and prosumers. Use Case Layer: Represents specific applications and scenarios, such as demand response, energy storage management, and virtual power plants.

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Operation Layer: Handles real-time energy management, including load balancing, frequency control, and reactive power supply. It ensures the stability and reliability of the energy system. Communication Layer: Provides the ICT infrastructure for data exchange, integrating sensors, smart meters, and communication networks to enable monitoring and control.

Interface Layer: Acts as a bridge between physical devices and higher-level management systems, allowing appliances and energy routers to communicate with the network. Appliance Layer: Includes end-user devices, distributed energy resources, and energy routers (ERs), which manage and route electrical energy similarly to how data routers handle information.

Key Components

Energy Routers (ERs): Devices that direct energy flow between distributed energy resources and the grid, analogous to data routers in the Internet. Prosumers: Users who both consume and generate energy, contributing to a decentralized energy network. Virtual Power Plants (VPPs): Aggregated networks of distributed energy resources that operate as a single power plant to optimize energy supply and demand.

IC

T Integration: Cloud and fog computing, IoT devices, and big data analytics enable real-time monitoring, predictive maintenance, and intelligent energy management.

Operational Features

The Energy Internet supports bidirectional energy flow, allowing energy to move from producers to consumers and vice versa. It also enables dynamic energy trading, demand response, and enhanced grid resilience. By integrating distributed energy resources with ICT, the system can adapt to fluctuations in supply and demand, optimize renewable energy utilization, and improve overall energy efficiency.

Conclusion

The typical architecture of the Energy Internet is multi-layered, ICT-driven, and highly decentralized, combining smart grid technologies, energy routers, prosumers, and virtual power plants. This structure allows for efficient energy management, enhanced reliability, and integration of renewable energy sources, forming the foundation for a sustainable and intelligent energy ecosystem.

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Article Content

Construction of energy internet technology architecture based on ...

Based on electrical power systems, leveraging renewable energy generation technology, and information technology, the energy internet fuses power grids, gas networks, heat/cold supply

A comprehensive review of Energy Internet: basic concept, operation

In this paper, the basic concept and characteristics of the Energy Internet are summarized, and its basic structural framework is analyzed in detail.

Architecture

The Energy Internet architecture is constructed by six layers, shown in Fig. 1. From top to bottom are Business Layer, Use Case Layer, Operation Layer, Communication Layer, Interface Layer and

Energy Internet: A Standardization-Based Blueprint Design

We first depict the basic setting of the Energy Internet: What is the media to be exchanged and who are participants. Subsequently, a holistic architecture of the Energy Internet is presented, closely

Energy Internet: Redefinition and categories

Energy Internet (EI) is an energy ecosystem, with physical layer, information layer and value layer combining energy and carbon emission flows, in which the Internet thinking and emerging

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The article provides an analysis of the concept of the Internet of Energy: the structural elements of the Internet of Energy system, the main components of the architecture and the main

Energy Internet, the Future Electricity System: Overview, Concept ...

First, a comprehensive overview of Energy Internet is presented along with its aptness as a future evolution of electricity system. Second, concepts, architectures, and features that underpin

Energy Internet: Systems and Applications | Springer Nature Link

This textbook provides an ideal resource for students in advanced graduate-level courses and special topics in energy, information and control systems. It comprehensively describes the energy Internet,

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Review of Energy Internet Architecture Based on Energy-Information ...

Based on the research status at home and abroad, this paper reviews the architecture of energy Internet and designs an energy-information-value unified architecture.

The Emerging Energy Internet: Architecture, Benefits, Challenges, and ...

In this paper, a holistic review of the energy Internet evolution in terms of the architecture, types of ERs, and the benefits and challenges of its implementation is presented.

The Emerging Energy Internet: Architecture, Benefits, Challenges, and ...

The benefits of the energy Internet, along with the challenges of its implementation on a large-scale distributed architecture with the inclusion of renewable energy resources, is discussed.

A comprehensive review of Energy Internet: basic concept ...

Abstract With the intensifying energy crisis and envi-ronmental pollution, the Energy Internet and corresponding patterns of energy use have been attracting more and more attention. In this paper,

Construction of energy internet technology architecture based on ...

The energy internet is an important technology for promoting renewable energy integration and improving energy efficiency. However, due to the complexity of multiple energy networks and the

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

Abstract Energy Internet (EI) envisions a future energy system with sustainable concerns of efficiency, economy and environment by achieving flexibility of multi-energy-integrated physical

Energy Internet, the Future Electricity System: Overview, Concept ...

Energy Internet, a futuristic evolution of electricity system, is conceptualized as an energy sharing network. Its features, such as plug-and-play mechanism, real-time bidirectional flow of energy ...

What is Energy Internet? Concepts, Technologies, and Future Directions

The climate change crisis, exacerbated by the global dependency of fossil fuels, has brought significant challenges. In the medium to long term, extensive renewable-energy-based

Recent advancement of energy internet for emerging energy

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This article deals with a thorough investigation of the energy internet towards future emerging technologies for energy distribution and management to

Energy System Architecture Incorporating the Internet of Energy ...

Thanks to digitalization, it is possible to reduce costs during the operation of the energy system and achieve its efficiency and stability. The purpose of this article is to analyze the

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