

Article Overview

The Energy Internet is a decentralized, intelligent electricity system that integrates distributed energy resources, bidirectional energy flows, and digital communication networks to create a flexible, efficient, and resilient energy distribution network.

Concept of the Energy Internet

The Energy Internet is envisioned as a next-generation electricity system that functions similarly to the Internet, enabling real-time, bidirectional flows of energy, information, and financial transactions between producers and consumers (prosumers) of electricity . It integrates small-scale renewable energy systems, storage devices, electric vehicles, and smart loads, allowing energy to be shared efficiently across a network of interconnected nodes . Key features include plug-and-play connectivity, decentralized control, and automated energy management, which collectively enhance system flexibility and resilience .

Distributed Energy Networks

Traditional electricity grids, often called Plain Old Grid Systems (POGS), rely on centralized generation and one-way power flows. In contrast, distributed energy networks under the Energy Internet model support bidirectional power flows, accommodating rooftop solar, battery storage, and electric vehicles at the grid edge . This requires advanced sensors, two-way communication, and distributed control systems to monitor and balance supply and demand in real time . The network becomes more resilient and efficient by dynamically routing energy where it is needed and enabling local energy markets.

Communication and Control Infrastructure

A critical component of the Energy Internet is the communication network that connects all devices and nodes. This network must provide high bandwidth, low latency, and secure two-way communication to ensure reliable operation . Technologies such as IoT, cloud computing, and blockchain facilitate real-time monitoring, automated control, and secure energy transactions . Distributed intelligence allows local controllers to optimize energy use while coordinating with the broader network, enhancing both economic efficiency and grid stability .

Emerging Technologies and Applications

- o Vehicle-to-Grid (V2G): Electric vehicles can act as mobile energy storage, feeding electricity back into the grid during peak demand .
- o Blockchain and Smart Contracts: Enable secure, transparent energy trading between prosumers and utilities .
- o Demand-Side Management: Intelligent controllers adjust consumption patterns to match supply, reducing

stress on the network and improving efficiency .

o Edge Data Centers and AI: Support real-time analytics and predictive control, optimizing energy flows and reducing losses .

Benefits

The Energy Internet and distributed networks offer multiple advantages:

- o Enhanced reliability and resilience through decentralized control and local energy clusters.
- o Integration of renewable energy and reduction of fossil fuel dependence.
- o Economic efficiency via real-time energy trading and demand response.
- o Environmental benefits by optimizing energy use and reducing emissions associated with centralized generation . In summary, the Energy Internet transforms the traditional distribution network into a dynamic, intelligent, and interconnected system, leveraging digital technologies and distributed energy resources to meet the growing demands of modern electricity consumers while supporting sustainability and resilience goals.

This algorithm proposes that a community-scaled power network is realized, where energy storage, RESs, and loads

The contribution is a coherent, open, and testable blueprint for software-defined, decentralized energy distribution,

Our networks therefore have to become more digitalised, decentralised and flexible. With

EnergyNet, an open-architecture framework developed by ViaEuropa and documented in a 2025 arXiv paper by Birgersson et al.,

The Smart Grid, regarded as the next generation power grid, uses two-way flows of electricity and information to create

The Internet of Energy (IoE) is a distributed paradigm that leverages smart networks and distributed system

The multi-integrated and highly resilient power grid is the core carrier of the Energy Internet. It is a power grid with massive resources

Energy Internet has caught an attention of the global academic community, and it is being implemented actively. This paper

At present, the research results of the network networking mode and network characteristics are mainly "HUHM" and

The Energy Internet represents a transformative paradigm integrating advanced power systems, distributed

More precisely, the Energy Internet refers to a large-scale cyber-physical system built upon packetized energy

Energy sources are important material basis of social development, while reliable power supply is a crucial support for

In this paper, we propose the redefinition of EI, based on a comprehensive literature review, some latest trends and

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

Abstract With the intensifying energy crisis and envi-ronmental pollution, the Energy Internet and corresponding patterns of energy

To realize renewable-energy-based electri cation goals, a new concept the Energy Internet (EI) has been proposed, inspired by the

Web: <https://bssoda.pl>

