frontiers | Frontiers in Energy Research

TYPE Editorial
PUBLISHED 11 January 2023
DOI 10.3389/fenrg.2022.1121574

OPEN ACCESS

EDITED AND REVIEWED BY
ZhaoYang Dong,
Nanyang Technological University,
Singapore

*CORRESPONDENCE
Fengji Luo,
fengji.luo@sydney.edu.au
Yunfei Mu,
yunfeimu@tju.edu.cn

SPECIALTY SECTION
This article was submitted
to Smart Grids,
a section of the journal
Frontiers in Energy Research

RECEIVED 12 December 2022
ACCEPTED 27 December 2022
PUBLISHED 11 January 2023

CITATION
Luo F, Mu Y, Liang G, Zhang Y and Yang L (2023), Editorial: Planning and operation of integrated energy systems with deep integration of pervasive industrial internet-of-things.
Front. Energy Res. 10:1121574.
doi: 10.3389/fenrg.2022.1121574

Editorial: Planning and operation of integrated energy systems with deep integration of pervasive industrial internet-of-things

Fengji Luo[1]*, Yunfei Mu[2]*, Gaoqi Liang[3], Yongxi Zhang[4] and Linfeng Yang[5]

[1]School of Civil Engineering, The University of Sydney, Darlington, NSW, Australia, [2]School of Electrical and Information Engineering, Tianjin University, Tianjin, China, [3]School of Science and Engineering, The Chinese University of Hong Kong, Shenzhen, China, [4]School of Electrical and Information Engineering, Changsha University of Science and Technology, Changsha, China, [5]School of Computer Electronics and Information, Guangxi University, Nanning, China

KEYWORDS

smart grid, internet of things, energy system, power engineering, power system

Editorial on the Research Topic
Planning and operation of integrated energy systems with deep integration of pervasive industrial internet-of-things

Introduction

Modern energy systems have been evolving toward complex cyber-physical systems. As with many other industrial systems, modern energy systems are characterized by the pervasive integration of Internet-of-Things (IoT) devices. The IoT devices include smart meters, phasor measurement units, and sensors installed in demand-side devices (e.g., appliances). Deep penetration of IoT facilities enables the different stakeholders in energy systems to monitor the system's status on a granular level; in the meantime, this also imposes significant challenges and complexities on the development of planning and operation strategies to optimize the energy system's efficiency. With this context in mind, this Special Article Research Topic has been set up to solicit the most recent and original contributions to the planning and operation of integrated energy systems with deep integration of industrial IoT.

Ten papers are collected in this special article Research Topic, covering several important problems in industrial IoT-supported management technologies for integrated energy systems. The articles are categorized as follows.

Architectural design and analysis of IoT-enabled infrastructure for energy systems

The architectural design of integrated IoT and energy platforms plays an important role in modern energy systems. Two papers in this Research Topic are devoted to studying this aspect. Liu et al. provide a comprehensive review of the application of edge computing in the Ubiquitous Power Internet of Things (UPIoT). The article introduces the concept of

UPIoT and edge computing, investigates the architectural design of edge computing platforms for UPIoT, and discusses the potential multi-fold challenges. Shen et al. propose a Narrow Band Internet of Things (NB-IoT)-based demand-side data management framework for smart grades. The framework provides encrypted data transmission, management, and intelligent analysis services to support upper-level energy applications.

Advanced demand-side management

The pervasive IoT devices enable fine-grained energy data aggregation, and this creates new opportunities to develop data-driven demand-side management techniques. Three papers are collected in this direction, providing solutions for utilizing fundamental IoT facilities to improve demand-side energy efficiency.

Yang et al. propose an industrial IoT-enabled low-carbon demand response (LCDR) scheme. The scheme analyses the carbon cost on both the generation and demand sides; allowing the demand-side energy resources to be managed in an environmental-economic dispatch problem. Hou et al. study the visualization technique for the security risk analysis of vehicle networks. They develop a dynamic attack graph generation method to identify and visually display the security risks caused by the vulnerabilities in an Internet-of-vehicle system. This technique can help the system operator gain a better situational awareness of the vehicle network's security and perform better risk management. Zheng et al. develop a data-driven electricity theft detection technique that can effectively identify the abnormal energy metering data collected by edge computing devices.

Forecasting for renewable energy and power load

One direct advantage the pervasive IoT devices can provide to energy systems is more accurate forecasting for renewable power generation and power consumption. Two papers are collected on this Research Topic. Wang et al. propose a probabilistic forecasting method for industrial loads. The method utilizes a convolutional long-short-term memory network and a mixture density network to predict the probability density of the load. Liu et al. postulate a new wind power forecasting technique that uses super-resolution perception technology to detect errors in historical meteorological and wind power data collected by industrial IoT devices. The method will then correct any errors, recover the data from low- to high-frequency, and generate wind power predictions. These forecasting techniques can be used to assist upper-level energy system applications.

Planning and control of smart grids

IoT facilities have been playing an increasingly important role in optimizing the operation of smart grids. Three papers are collected in this special article Research Topic, which proposes innovative methods for planning and controlling the energy resources in smart grids. Cai et al. propose a planning model for grid-integrated energy storage systems (ESSs). The model determines the installation location and capacity of ESSs in the grid to minimize the workload in high-voltage transmission network reconfiguration, thereby mitigating transmission congestion. Zhao et al. develop a cluster partition-based zonal voltage control technique for power distribution networks with highly penetrated photovoltaics (PVs). The method partitions a distribution network into multiple clusters, and it designs algorithms to optimize the voltages in the clusters. Zhang et al. propose a control technique for solid oxide fuel cell (SOFC) hybrid direct-current microgrids. The technique analyzes the thermal and electrical characteristics of the microgrid; based on this, it regulates the current and voltage of the SOFC system to realize high efficiency and steady-state thermal safety of the system.

We hope the papers collected in this special article Research Topic can provide useful references to researchers and engineers and can advance knowledge in power and energy systems and ubiquitous computing.

Author contributions

All authors listed have made a substantial, direct, and intellectual contribution to the work and approved it for publication.

Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Publisher's note