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Section

Smart Grids and Microgrids

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Section Information:

The research and development of smart grids and microgrids in the last decades is the way how some countries have modernized their transmission and distribution networks in order to respond to the challenges and problems that the grid has to face, such as the increasing demand or the higher penetration levels of renewable energy resources while keeping high quality standards in an efficient, reliable, safe, economical and robust manner.

The operation and management of such complex system require the use and mix of different technologies of different fields, from advanced communications and information technology to smart metering and monitoring equipment. The need for gathering information from suppliers and consumers is critical to determine the state of the grid and to optimize the operation and management of the system regarding load shedding, storage administration, and strategies to face faults and grid contingencies.

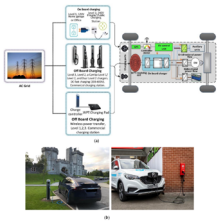
This section is intended to present new contributions, studies and reviews in the area of smart grids and microgrids related to generation, transmission and distribution, storage management, dynamic load leveling, grid smart operation and automated control, self-healing ability, communications, smart metering, IoT integration, smart grid modelling, economic and policy implications, interaction with electricity market, security, and electric vehicle integration.

Featured Papers

DOI: 10.3390/en13102602

Possibilities and Challenges for the Inclusion of the Electric Vehicle (EV) to Reduce the Carbon Footprint in the Transport Sector: A Review

Author: Aritra Ghosh

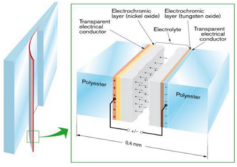


Abstract: To combat global climate change moving towards sustainable, mobility is one of the most holistic approaches. Hence, decarbonization of the transport sector by employing electric vehicles (EVs) is currently an environmentally benign and efficient solution. The EV includes the hybrid EV (HEV), the plug-in hybrid EV (PHEV), and the battery EV (BEV). A storage system, a charging station, and power electronics are the essential components of EVs. The EV charging station is primarily powered from the grid which can be replaced by a solar photovoltaic system. Wide uptake of EVs is possible by improving the technologies, and also with support from the government. However, greenhouse gas emission (GHG) saving potential of the EV is debatable when the required power to charge the EV comes from traditional fossil fuel sources.

DOI: 10.3390/en13061449

Smart Electrochromic Windows to Enhance Building Energy Efficiency and Visual Comfort

Authors: Alessandro Cannavale, Ubaldo Ayr, Francesco Fiorito and Francesco Martellotta



Abstract: Electrochromic systems for smart windows make it possible to enhance energy efficiency in the construction sector, in both residential and tertiary buildings. The dynamic modulation of the spectral properties of a glazing, within the visible and infrared ranges of wavelengths, allows one to adapt the thermal and optical behavior of a glazing to the everchanging conditions of the environment in which the building is located. This allows appropriate control of the penetration of solar radiation within the building. The consequent advantages are manifold and are still being explored in the scientific literature. On the one hand, the reduction in energy consumption for summer air conditioning (and artificial lighting, too) becomes significant, especially in "cooling dominated" climates, reaching high percentages of saving, compared to common transparent windows; on the other hand, the continuous adaptation of the optical properties of the glass to the changing external conditions makes it possible to set suitable management strategies for the smart window, in order to offer optimal conditions to take advantage of daylight within the confined space. This review aims at a critical review of the relevant literature concerning the benefits obtainable in terms of energy consumption and visual comfort, starting from a survey of the main architectures of the devices available today.

DOI: 10.3390/en13030636

A Review of Strategies to Increase PV Penetration Level in Smart Grids

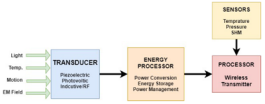
Authors: Sk Abdul Aleem, S. M. Suhail Hussain and Taha Selim Ustun

Abstract: Due to environmental concerns, power system generation is shifting from traditional fossil-fuel resources to renewable energy such as wind, solar and geothermal. Some of these technologies are very location specific while others require high upfront costs. Photovoltaic (PV) generation has become the rising star of this pack, thanks to its versatility. It can be implemented with very little upfront costs, e.g., small solar home systems, or large solar power plants can be developed to generate MWs of power. In contrast with wind or tidal generation, PV can be deployed all around the globe, albeit with varying potentials. These merits have made PV the renewable energy technology with highest installed capacity around the globe. However, PV penetration into the grid comes with its drawbacks. The inverter-interfaced nature of the PV systems significantly impacts the power system operation from protection, power flow and stability perspectives. There must be strategies to mitigate these negative impacts so that PV penetration into the grid can continue. This paper gives a thorough overview of such strategies from different research fields: such as communication, artificial intelligence, power electronics and electric vehicle charging coordination. In addition, possible research directions are given for future work.

DOI: 10.3390/en13215528

Energy Harvesting towards Self-Powered IoT Devices

Authors: Hassan Elahi, Khushboo Munir, Marco Eugeni, Sofiane Atek and Paolo Gaudenzi



Abstract: The internet of things (IoT) manages a large infrastructure of web-enabled smart devices, small devices that use embedded systems, such as processors, sensors, and communication hardware to collect, send, and elaborate on data acquired from their environment. Thus, from a practical point of view, such devices are composed of power-efficient storage, scalable, and lightweight nodes needing power and batteries to operate. From the above reason, it appears clear that energy harvesting plays an important role in increasing the efficiency and lifetime of IoT devices. Moreover, from acquiring energy by the surrounding operational environment, energy harvesting is important to make the IoT device network more sustainable from the environmental point of view. Different state-of-the-art energy harvesters based on mechanical, aeroelastic, wind, solar, radiofrequency, and pyroelectric mechanisms are discussed in this review article. To reduce the power consumption of the batteries, a vital role is played by power management integrated circuits (PMICs), which help to enhance the system's life span. Moreover, PMICs from different manufacturers that provide power management to IoT devices have been discussed in this paper. Furthermore, the energy harvesting networks can expose themselves to prominent security issues putting the secrecy of the system to risk. These possible attacks are also discussed in this review article.

Selected Special Issues list in Section

Power Quality in Smart Grids: Advanced Technology for System Regulation and Analysis
Guest Editors: Dr. Cheng-I Chen and Prof. Dr. Yeong-Chin Chen
Deadline: **20 October 2022**

Operational Optimization of Networked Microgrids
Guest Editors: Dr. Nanpeng Yu, Dr. Mikhail A. Bragin and Prof. Dr. Peng Li
Deadline: **20 October 2022**

New Innovation of Smart Grid in Complex Systems: Design, Technology, and Optimization
Guest Editors: Dr. Guillaume Guérard, Dr. Marc Bui and Dr. Soufian Ben Amor
Deadline: **31 October 2022**

Microgrids and the Integration of Energy Storage Systems
Guest Editors: Dr. Alexander Micallef and Prof. Dr. Zhaoxia Xiao
Deadline: **11 November 2022**

Smart Grids and Renewables
Guest Editors: Prof. Dr. Yanbin Qu and Dr. Huihui Song
Deadline: **20 November 2022**

Optimization and Energy Management in Smart Grids
Guest Editor: Prof. Dr. Germano Lambert-Torres
Deadline: **20 September 2022**

Analysis for Power Quality Monitoring - Second Edition: Power Quality Measurement Systems and Big Data Analytics in the Smart Grid and the Industry 4.0
Guest Editors: Dr. Juan-José González de la Rosa, Dr. Olivia Florencias-Oliveros and Prof. Dr. Sara Sulis
Deadline: **30 September 2022**

Energy Conversion and Operation Technologies for Smart Grid
Guest Editors: Prof. Dr. Joon-Ho Choi and Dr. Truong-Duy Duong
Deadline: **30 September 2022**

Smart Energy Management for Smart Grid
Guest Editor: Dr. Miguel Jiménez Carrizosa
Deadline: **30 September 2022**

New Frontiers for Organizations in Power Markets Applications for Industry 4.0
Guest Editors: Prof. Dr. Radoslaw Miskiewicz and Prof. Dr. Wojciech Drozdz
Deadline: **5 January 2023**

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