



POWERTECH

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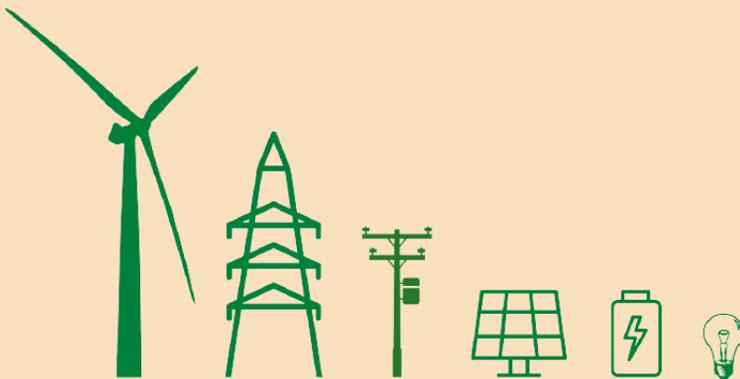
**RENEWABLE ENERGY
INTEGRATION**



Renewable Energy Integration

In November's Newsletter, we bring varied information regarding **Renewable Energy Integration**.

1. Websites
2. Informative Articles
3. Research Articles
4. Standards



Renewable Energy Integration

Renewable Energy Integration

- **Challenges:** Renewable Energy Integration focuses on incorporating renewable energy, distributed generation, energy storage, and demand response, besides other technologies, into the electric system. Renewable resources are known for their intermittent and variable generation behaviors. By this, their integration must respect technical, economic, and regulatory barriers. It is also crucial for grid operators and planning committees to understand how they can reliably integrate large quantities of variable generation energy into system operations, ensuring grid stability and reliability. It is essential to overcome these challenges, as renewable integration can reduce carbon and other air pollutants emissions by increasing the participation of renewable energy and other clean resources.
- **Solutions:** Coming in December's Edition



Renewable Energy Integration

1. Websites

- **Name:** PV Magazine

Content: Monthly independent and technology-focused magazine covering the latest solar PV news, topical technological trends, and worldwide market developments. The magazine includes news from more than ten countries.

Website: <https://www.pv-magazine.com/>

- **Name:** PAC World Magazine

Content: A forum for discussions between protection, automation, control professionals from all over the world. The technical articles focus on developments and application of new protection, automation, control technologies, experiences, analysis of protection operations, local or wide area disturbances.

Website: www.pacw.org



Renewable Energy Integration

2. Informative Articles

- **Title:** “Biden administration says solar energy has the potential to power 40% of US electricity by 2035.”

Summary: The US Department of Energy (DoE) shows that by 2035, solar energy has the potential to power 40% of the nation’s electricity and employ as many as 1.5 million people without raising electricity costs for consumers. The study estimates that wind power could make up 36% of the grid, nuclear could account for around 13%, hydroelectric could make up around 5-6%, and geothermal could account for the remaining 1%.

Website:

<https://www.cnn.com/2021/09/08/politics/solar-energy-doe-report-climate/index.html>



Renewable Energy Integration

- **Title:** “Renewable Energy Market Update 2021”

Summary: In 2020, annual renewable capacity additions increased 45% to almost 280 GW, the highest one-year increase since 1999. Solar PV may have annual additions reaching 162 GW by 2022, nearly 50% higher than the pre-pandemic level of 2019. Global wind capacity additions increased more than 90% in 2020 to reach 114 GW, but the annual market growth is slow in 2021 and 2022.

Website: <https://www.iea.org/reports/renewable-energy-market-update-2021>



Renewable Energy Integration

- **Title:** “Global Energy Review 2021”

Summary: Renewable electricity generation in 2021 is set to expand by more than 8% to reach 8 300 TWh, the fastest year-on-year growth since the 1970s, with two-thirds contributions of PV and wind.

Website: <https://www.iea.org/reports/global-energy-review-2021/renewables>



Renewable Energy Integration

- **Title:** “What the Future of Renewable Energy Looks Like”

Summary: Solar energy will become 35% cheaper by 2024, and its capacity in the world will grow by 600 gigawatts (GW). Besides the onshore wind energy capacity that will increase 57% by 2024. Hydroelectric and geothermal capacity will rise 9% and 28%, respectively, by 2024.

Website: <https://earth.org/the-growth-of-renewable-energy-what-does-the-future-hold/>



Renewable Energy Integration

3. Research Articles

- **Title:** “Energy management and optimization of vehicle-to-grid systems for wind power integration”

Contributions: A energy management and optimization method are proposed to smooth large-scale wind power fluctuations using vehicle-to-grid (V2G). The collaborative optimal dispatch method of vehicle-to-grid (V2G) systems for wind power integration determines the optimal scheduling of EV clusters.

Available at:

<https://ieeexplore.ieee.org/document/9215166>



Renewable Energy Integration

- **Title:** “A Review of Power System Flexibility with High Penetration of Renewables”

Contributions: A complete and consistent review of future power grids’ state of the art and how modern technologies will be integrated into the power distribution grid is presented. Wind, solar, energy storage systems, power electronic converters, and new emerging technologies are introduced. It is discussed how their integration into the grid may positively and negatively impact the system’s operation.

Available at:

<https://ieeexplore.ieee.org/document/8635327>



Renewable Energy Integration

- **Title:** “Future Power Distribution Grids: Integration of Renewable Energy, Energy Storage, Electric Vehicles, Superconductor, and Magnetic Bus”

Contributions: It is necessary to reconsider current system analysis paradigms and plan on how to achieve the most flexible, efficient, and reliable power grid for the future and deliver services to consumers at an affordable cost. This paper focuses on a state-of-the-art review of future power grids, in which new and modern technologies will be integrated into the power distribution grid. In this new era of energy, Renewable energy sources such as wind and solar are being integrated into distribution grids. Emission-free transportation, such as electric vehicles, and energy-efficient technologies, such as superconducting generators and storage systems, are also rapidly emerging and will soon be integrated into power grids.

Available at:

<https://ieeexplore.ieee.org/document/8629960>



Renewable Energy Integration

- **Title:** “Grid Integration Challenges of Wind Energy: A Review”

Contributions: The integration of large-scale wind energy into existing electricity grids poses many operational and control challenges that hamper the reliable and stable operation of the grids. This article aims to review the reported challenges caused by the integration of wind energy and the proposed solutions methodologies. Among the various challenges, generation uncertainty, power quality issues, angular and voltage stability, reactive power support, and fault ride-through capability are reviewed and discussed. Many of the solutions used and proposed to mitigate the impact of these challenges, such as energy storage systems, wind energy policy, and grid codes, are also discussed.

Available at:

<https://ieeexplore.ieee.org/document/8952713>



Renewable Energy Integration

- **Title:** “Adaptive Robust Short-Term Planning of Electrical Distribution Systems Considering Siting and Sizing of Renewable Energy Based DG Units”

Contributions: Short-term planning aims at ensuring the proper performance of electrical distribution systems (EDS) in a short period of time. This paper proposes a mixed-integer linear programming model to find the optimal short-term plan of EDSs. Environmental issues are also considered to promote a low carbon emission system. A new approach to energy distribution networks (EDS) could improve efficiency and mitigate pollutant emissions at the distribution level. A 135-node distribution system is studied under different conditions to assess the performance of the proposed approach. Results show that the planning actions, for each case study, improve the efficiency of EDS.

Available at:

<https://ieeexplore.ieee.org/document/8341816>



Renewable Energy Integration

4. Standards

- **Title:** “IEEE Standards revolutionizing the modern grid”

Contributions: IEEE SA is an organization that has revolutionized the way we live in this modern world. In short, these are voluntary agreements that establish requirements for products, practices, or operations in a given field. They usually form a Working group (W.G) consisting of industry experts, academicians, and other volunteers who will meet periodically to form a draft and finally submit the same to the Standard Committee for approval. Globally there are two major organizations responsible for standard formation- IEEE (mainly in the USA) and IEC (International Electrotechnical Commission) (mainly in the EU). Moreover, each country has an authority responsible for developing its own standards and regulations. These are mostly derived from IEEE and IEC standards.

Available at: <https://standards.ieee.org>



Renewable Energy Integration

- **Title:** “IEEE standard 1547”

Contributions: IEEE Standard 1547 is the standard was the first in the series of standards developed concerning DER interconnection. DER includes distributed generators and energy storage systems etc. and will act as a foundation for future power systems. The key to future power is renewable energy especially solar energy. The interconnect of these distributed energy resources with the grid is associated with constraints. It provides requirements relevant to the performance, operation, testing, safety considerations, and maintenance of the interconnection.

Available at:

<https://standards.ieee.org/standard/1547-2018.html>
or <https://ieeexplore.ieee.org/document/8332112>



Renewable Energy Integration

- **Title:** “IEEE 3000 Standards Collection”

Contributions: The IEEE 3000 Standards Collection™, formerly the IEEE Color Books is a one-time solution for understanding the recommended up-to-date practices for Industrial and commercial power systems. The IEEE Color Books are developed and revised by the technical committees of the IEEE Industry Applications Society (IAS) Industrial and Commercial Power Systems (I&CPS) Department. The Book set comprises of 13 volumes namely Red book, Green book, Grey Book, Buff book, Brown Book, Orange Book, Gold Book, White Book, Bronze Book, Yellow Book, Blue Book, Emerald Book and Violet book each specific to a particular area such as Electric Power Distribution for Industrial Plants, Grounding of Industrial and Commercial Power Systems, etc.

Available at:

<https://site.ieee.org/icps2015/ieee-color-books/>





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IEEE

Power & Energy Society

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