POWERTECH

NEWSLETTER OF IEEE PES YP

Volume 1 · Issue 3 · December 2021

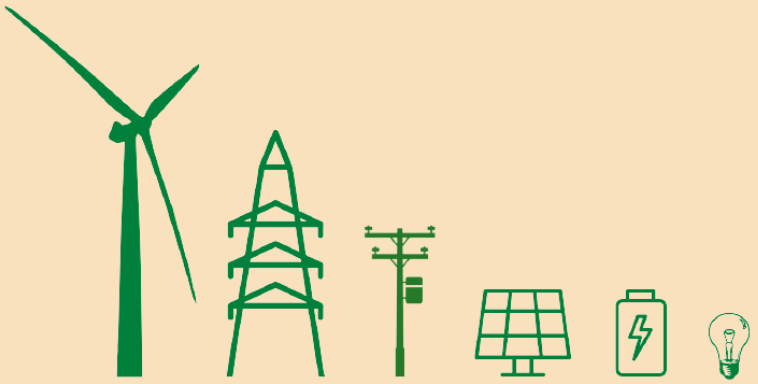
RENEWABLE ENERGY INTEGRATION

POWERTECH NEWSLETTER

Renewable Energy Integration

In December's Newsletter, we bring variated information regarding **Renewable Energy Integration**.

1. Websites
2. Informative Articles
3. Research Articles



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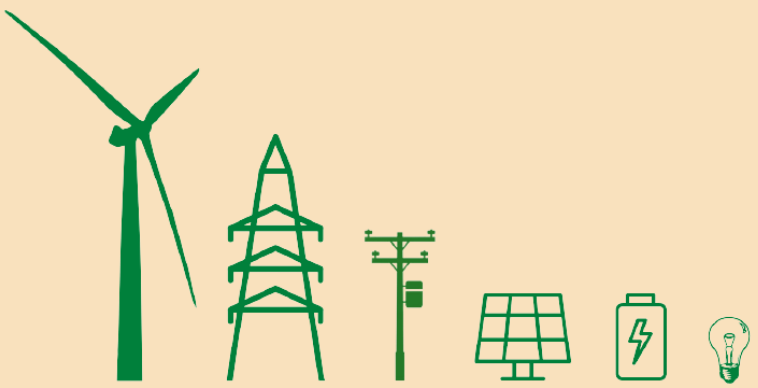
Renewable Energy Integration

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.



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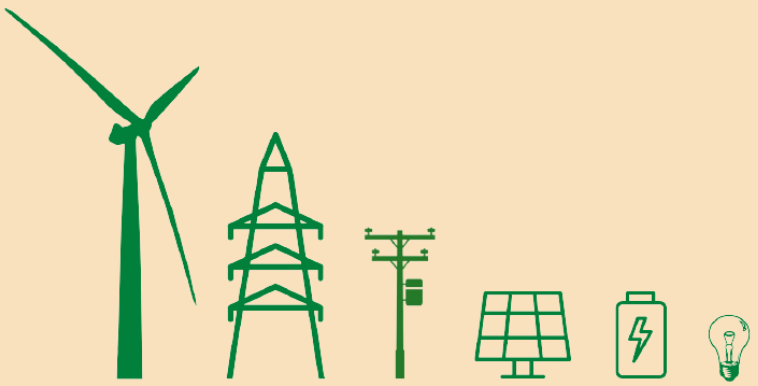
Renewable Energy Integration

Renewable Energy Integration

- **Solutions:** The current renewable energy integration technologies and solutions have been primarily focusing on: cheap, easy-to-use energy storage or, even better, dynamic management of electricity demand. The integration problem can be approached by two fronts, generation management or load management, where each side has its pros and cons. Battery energy storage systems have been critical in managing both generation and load over critical operation scenarios. However, although there are already several energy management algorithms and control techniques developed, energy storage systems for both utility- and customer-scale are still expensive and thus hardly viable.



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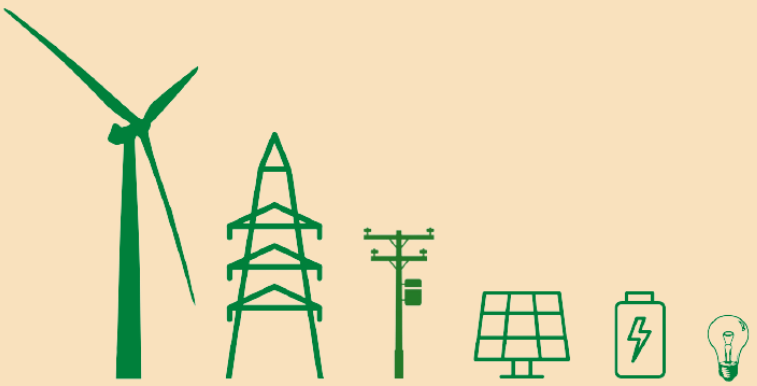
Renewable Energy Integration

1. Websites

- **Name:** North American Renewable Integration Study

  Content: Aims to inform grid planners, utilities, industry, policymakers, and other stakeholders about challenges and opportunities for continental system integration of large amounts of wind, solar, and hydropower to support a low-carbon future grid.

  Website: https://www.nrel.gov/analysis/naris.html



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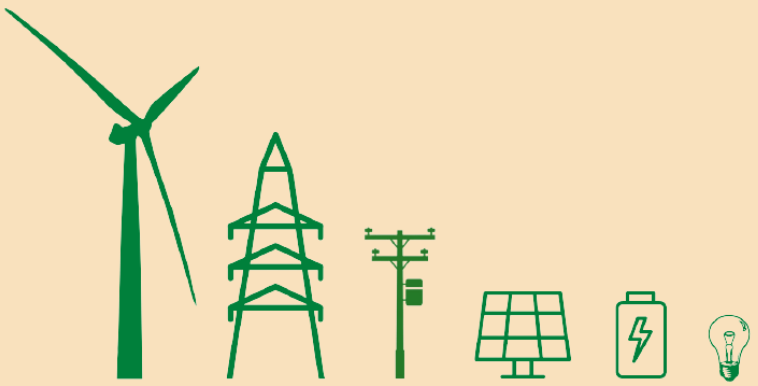
- **Name:** Renewable Energy World

  Content: It is an authoritative source for information on markets, policy and finance covering all renewable technologies—solar, wind, energy storage, geothermal, bioenergy and hydropower. It covers renewable energy from utility-scale to commercial and industrial (C&I), and residential in both the developed and developing world. Topics include power generation, T&D, DER, smart cities, IoT, microgrids, on and off-grid renewables, project and company profiles, market trends, mergers and acquisitions and asset management.

  Website: https://www.renewableenergyworld.com



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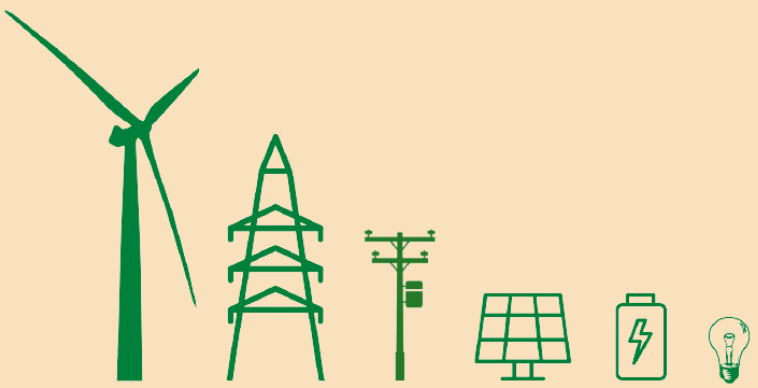
2. Informative Articles

- **Title:** “Tracking Energy Integration 2021”

  Summary: While individual clean energy technologies such as solar, wind, and EVs are the building blocks of clean energy transitions, it is also necessary to employ energy integration technologies to maximize their impact by increasing system flexibility. As the share of variable renewables increases in the Net Zero Emissions by 2050 Scenario, all sources of flexibility, including power plants, grids, demand-side response, and storage, need to be tapped. Further efforts should focus on trialing integration technologies at a large scale under various market conditions.

  Website:
  https://www.iea.org/reports/tracking-energy-integration-2021

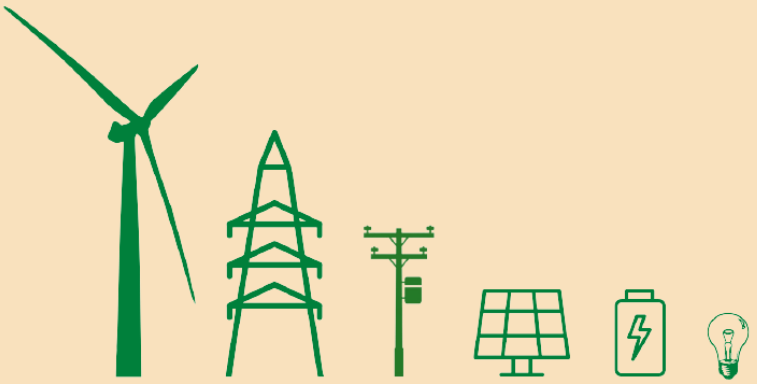


Renewable Energy Integration

- **Title:** “World Bank Group Provides $465 Million to Expand Energy Access and Renewable Energy Integration in West Africa”

  Summary: Countries in the Economic Community of West African States (ECOWAS) will expand access to grid electricity to over 1 million people, enhance power system stability for another 3.5 million people, and increase renewable energy integration in the West Africa Power Pool (WAPP).

  Website:
  https://www.worldbank.org/en/news/press-release/2021/06/10/world-bank-group-provides-465-million-to-expand-energy-access-and-renewable-energy-integration-in-west-africa



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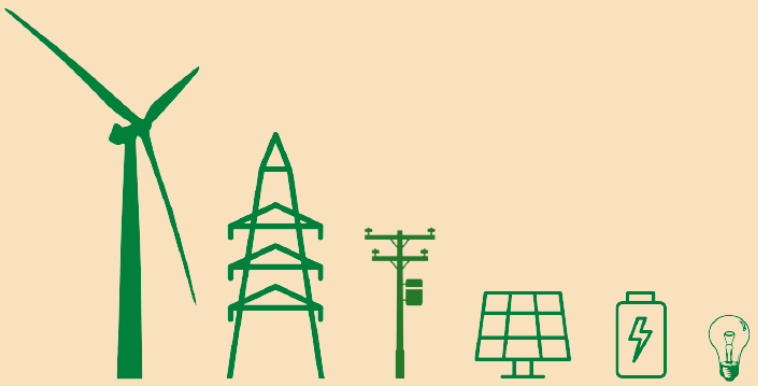
Renewable Energy Integration

- **Title:** “Renewable energy integration in India: Ways to maximize solar, wind power system”

  Summary: The share of solar and wind in India’s ten renewable-rich states — Tamil Nadu, Karnataka, Gujarat, Rajasthan, Andhra Pradesh, Maharashtra, Madhya Pradesh, Telangana, Punjab, and Kerala — is significantly higher than the national average of 8.2%. The Union government is planning to increase renewable generating capacity to 450 GW in 2030 from 175 GW in 2022.

  Website:
  https://www.downtoearth.org.in/blog/energy/renewable-energy-integration-in-india-ways-to-maximise-solar-wind-power-system-78391



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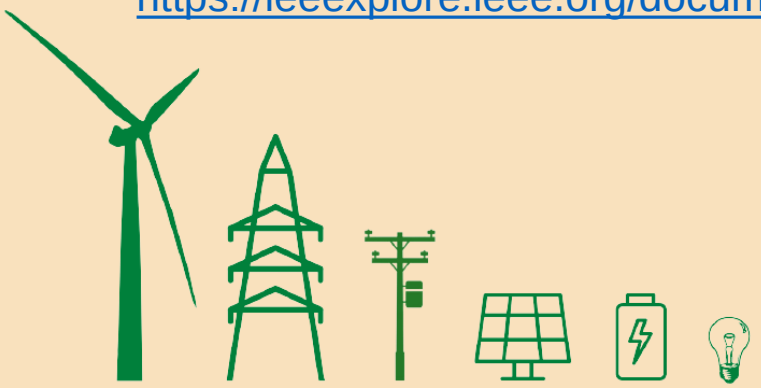
3. Research Articles

- **Title:** “Artificial Intelligence-Aided Model Predictive Control for a Grid-Tied Wind-Hydrogen-Fuel Cell System”

  Contributions: This study develops an improved MPC scheme used with a hybrid energy storage system for optimal power dispatch in a smart grid. The optimization target is to achieve a minimum energy exchange between the power grid and the hybrid renewable energy storage system. Based on actual measured data, the test results have shown that the proposed methodology can maximize the local usage of wind power whilst minimizing the power exchange with the grid. Therefore, this work can minimize the impact of fluctuating renewable energy on the power grid and enhance the uptakes of FC-based energy systems.

  Available at:
  https://ieeexplore.ieee.org/document/9093825

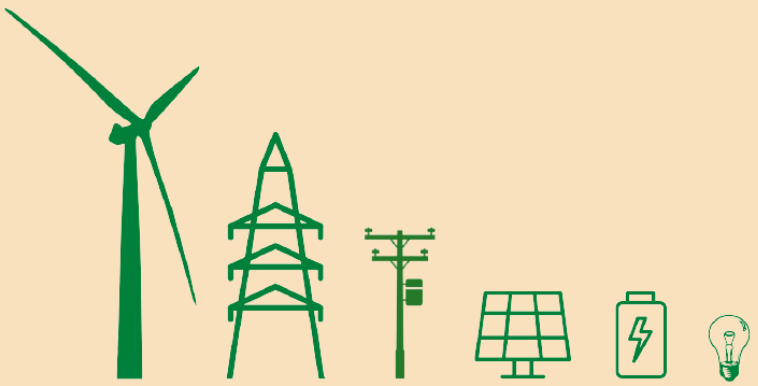


Renewable Energy Integration

- **Title:** “An Interlinking Converter for Renewable Energy Integration Into Hybrid Grids”

  Contributions: This letter proposes an interlinking converter architecture, which enables the flexible integration of renewable energy into hybrid grids. The proposed converter has one ac port and two dc ports, offering a flexible solution to integrating various dc, and ac sources, which can also be versatilely configured as a dc-dc converter, a dc-ac inverter, or a dc-dc/ac multiport converter.

  Available at:
  https://ieeexplore.ieee.org/document/9173714



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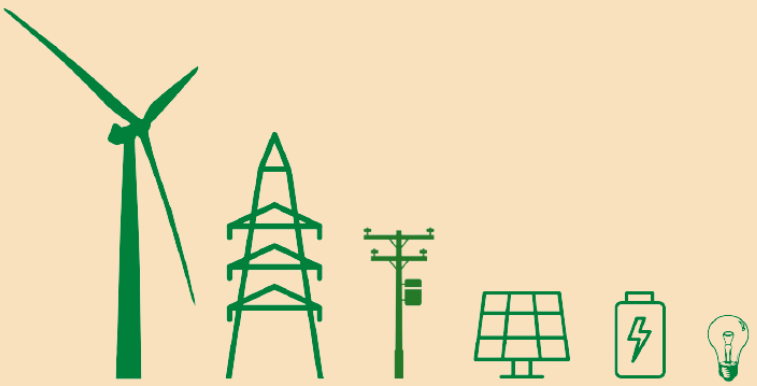
- **Title:** “Robust Current Control of Grid-Tied Inverters for Renewable Energy Integration Under Non-Ideal Grid Conditions”

  Contributions: This paper presents the design of a filtered tracking error-based robust current controller for three-phase grid-tied inverters interfacing distributed renewable resources into the grid. An uncertainty and disturbance modelling-based control law are developed for achieving robustness against non-ideal grid conditions, including the grid impedance variations, grid voltage harmonics, and fluctuations in grid voltage magnitude (symmetrical/asymmetrical), frequency, and phase.

  Available at:
  https://ieeexplore.ieee.org/document/8627961



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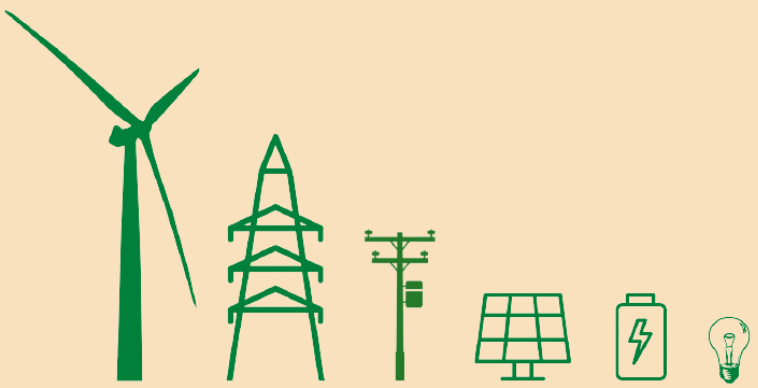
- **Title:** “High-Level Penetration of Renewable Energy Sources Into Grid Utility: Challenges and Solutions””

  Contributions: The utilization of renewable energy sources (RESs) has become significant throughout the world, especially over the last two decades. Although high-level RESs penetration reduces negative environmental impact compared to conventional fossil fuel-based energy generation, control issues become more complex as the system inertia is significantly decreased due to the absence of conventional synchronous generators. Some other technical issues, high uncertainties, low fault ride-through capability, high fault current, low generation reserve, and low power quality, arise due to RESs integration.

  Available at:
  https://ieeexplore.ieee.org/document/9224611



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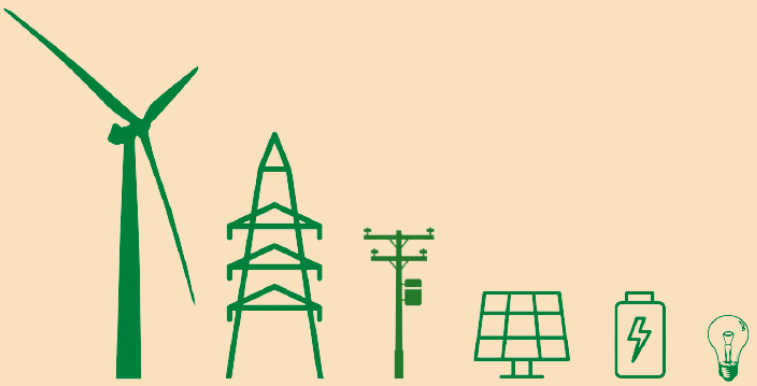
- **Title:** “Blockchain-Based Electric Vehicle Incentive System for Renewable Energy Consumption”

  Contributions: Increase in electric vehicle (EV) penetration level leads to uncoordinated charging loads, which poses significant challenges to operators. In this, we first propose a prioritization ranking algorithm of EV drivers based on their driving and charging behaviors, and then we propose a blockchain-based EV incentive system to maximize the utilization of RE. By incorporating the utilities, EV drivers, EV charging service providers, and RE providers into the proposed incentive system, this brief provides a plan to guide the EV users to charge at the desired time frames with higher RE generation.

  Available at:
  https://ieeexplore.ieee.org/document/9097307



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