Hybrid Renewable Energy Systems: A Review

by

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Outline of Presentation

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- Introduction
- Design, Modelling and Optimisation of Hybrid Solar/PV systems
- Controls and Power Management
- Energy storage
- Environmental impacts
- Conclusions
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Abstract

- Availability of renewable energies occur at different times of the day and year
- Hybridization of different energy systems will ensure dependability and reliability of these sources
- Hybrid renewable energy system (HRES) – Fast developing worldwide
- Review of design and optimization, control systems, energy management reliability, storage and environmental impacts of HRES
Introduction

Why Renewable Energy in India?

- Domestic coal supply is limited and poor quality
- Foreign supply of hydrocarbons have serious impact on country’s energy security/finance
- Renewable Energy (RE) sources are not depleted
- RE is non-polluting
- Reinvestment can be used for many decades without affecting the environment
Renewable Energy (RE) Development Potential for India

India has Abundant Solar Energy Resources:

- *> 100,000 MW by 2020* (5 years)
- *> 200,000 MW by 2025* (10 years)
- Harness **Wind Energy near the sea shore** and other windy sites
- *> 50,000 MW by 2020* (5 years)
- *> 100,000 MW by 2025* (10 years)
- Additional potential for to tap Small Hydro Power plants, Biomass, Biogas, Geothermal, etc.

*Assuming favorable Policy, Incentives, Tariffs, and Financing is provided*
Projected power requirement

Energy requirement is expected to increase by 200% from FY 15 to FY 30

Estimated Power Requirement till 2030

GEF National Workshop in India • MNRE

Source: 18th EPS, CEA
Assumption: Based on average PLF @ 50% prevailing at FY 11, FY 12, FY 13

13 April, 2015
Introduction –Contd.
Indian Energy Scenario

- Total Installed Capacity- 44.2 GW

- Solar, 7.8, 18%
- Wind, 27.2, 61%
- Biomass, 5, 11%
- SHP, 4.3, 10%

Source: MNRE 30.06.2016
Introduction-Contd.

WHY HYBRID?

- Integration of two renewable energy system that will give continuous power
- Use any one source and keep another source as a stand by unit.
- Affordable cost
- Clean energy sources
- Reliability improves
- Life span is more and less maintenance cost
Solar PV/wind Hybrid System
## Design, Modelling and optimisation of Hybrid systems

<table>
<thead>
<tr>
<th>Authors</th>
<th>Title</th>
<th>Contribution</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Sunil Patel, Nayana Prajapati and Tapan Patel (IJIRST Issue 12/May 2016)</td>
<td>Grid Connected Solar and Wind Hybrid System</td>
<td>This paper presented the modeling, simulation and Control of a grid connected PV and Wind Hybrid Power System, using MATLAB/SIMULINK.</td>
</tr>
<tr>
<td>2. Q Hassan, M Jaszczyk and J Abdulateef (Journal of Physics: Con. Series 745 (2016))</td>
<td>Optimization of PV/WIND/DIESEL Hybrid Power System in HOMER for Rural Electrification</td>
<td>Modeling, computer simulation and optimization of hybrid power generation system in the rural area in Iraq by simulation using HOMER software was carried out and found feasible.</td>
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LITERATURE REVIEW
### LITERATURE REVIEW

#### Controls and Power Management

<table>
<thead>
<tr>
<th>Authors</th>
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<tbody>
<tr>
<td>Himanshu Sharma, Nitai</td>
<td>A control strategy of hybrid solar-wind energy generation system</td>
<td>In this paper, the design of a DC-DC converter for a PV/wind hybrid system was covered and dynamic performance analysis of designed controller at different situations was studied, including variations of ambient conditions at renewable energy sources.</td>
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<tr>
<td>pal, Pankajkumar, Ashwini</td>
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<tr>
<td>Authors</td>
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<tr>
<td>U. Bahadır Önen and others</td>
<td>A Review of Energy Storage Systems for Wind Power Plants</td>
<td>In this paper, emerging methods of ESS, such as PHES, CAES, Batteries, HES and FES, are discussed and steps to overcome the problems that occurs due to the intermittent and variable nature of WPPs integration on the grid</td>
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## Energy Storage

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<tr>
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<tbody>
<tr>
<td>World Energy Resources E-Storage</td>
<td>World Energy Council report 2016</td>
<td>Various discussions about categorization of energy storage systems, current and emerging technologies, applications and potential, Economics and markets, socio economic impacts , and environmental impacts are high lighted by Energy storage Council in their report</td>
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## Environmental Impacts

<table>
<thead>
<tr>
<th>Authors</th>
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<tbody>
<tr>
<td>Alexandros Gasparatosa, Christopher N.H. ollb, Miguel Estebanc, Abubakari Ahmedc, Tabitha A. Olang</td>
<td>Renewable energy and biodiversity: Implications for transitioning to a Green Economy</td>
<td>Discussions on the impacts of different renewable energy pathways on ecosystems and biodiversity, and found that renewable energy sector can affect ecosystems and biodiversity</td>
</tr>
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Renewable and Sustainable Energy Reviews 70 (2017) 161–184
# Environmental Impacts

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<tr>
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<tbody>
<tr>
<td>SchusterE, Bulling L, Köppel J.</td>
<td>Consolidating the state of knowledge: a synoptical review of wind energy's wildlife effects</td>
<td>An assessment of wind farms on bird spices and environmental impacts of wind turbines on wildlife effects specifically on bird and bat collision with wind turbines was studied in detail.</td>
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Environ Management 2015:300–31
Conclusion

- A summary on the recent developments of hybrid renewable energy systems (HRES) with specific reference to solar photovoltaic and wind energy systems
- Wind-hybrid energy systems are one of the best feasible options for the electrification of remotely located, electricity deprived areas since it is cheap and available in abundance
References


References-Contd.


Thank You