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Hybrid Forecasting System of Renewable Energy with Smart Grid for a Sustainable Future

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Solar and wind energy systems are considered as promising power generating sources due to its availability and topological advantages in local power generations. However, a drawback, common to solar and wind options, is their unpredictable nature and dependence on weather changes. Wind and solar energy resources, unlike dispatchable central station generation, produce power dependable on external irregular source and that is the incident wind speed which does not always blow and solar radiation which does not always emission when electricity is needed. This results in the variability, unpredictability, and uncertainty of wind and solar resources. Therefore, the forecasting of wind and solar energy present a major challenge to power system. Both of these energy systems would have to be forecasted accurately to make them completely reliable.

Fortunately, the problems caused by variable nature of these resources can be overcome by integrating these two resources as a hybrid system. However, with the increased complexity in comparison with single energy systems, optimum forecasting of hybrid system becomes most challenging and complicated. Such hybrid forecasting has significant impact on the optimum power flow, transmission congestion, power quality issues, system stability, load dispatch, and economic analysis.

Therefore, this study aims to develop a novel hybrid system for wind and solar energy forecasting with smart grid for a sustainable future. The proposed model is dedicated to short-term forecasting (three-hour ahead). Two separate modules, one for wind and another for solar will be developed for the purpose of hourly forecasting of wind speed and solar radiation as well as converting the speed and radiation to wind and solar energy respectively based on the delivered data. Each of these modules is consisting of several trained networks for hourly wind and solar energy forecasting based on the supplied historical weather data. The third module is connected to the two earlier mentioned modules. The later module will play the role to merge the forecasted wind and solar energy output provided by those two connected modules. Eventually the output from the system is the hourly hybrid forecasting of energy where the renewable energy sources of that hybrid system are wind and solar. Since the hybrid forecasting system is quite a novel approach, the accuracy of the system will be revealed

by comparing the results with the corresponding values of a reference forecasting model referred to as the persistent model.

By statistically investigating the long-term hourly solar and wind data, subtropical climate areas are found to have favourite solar and wind power resources compared with other areas, which validates the practical applications in subtropical climate area.

It is anticipated that the outcome of the research will provide noteworthy contribution to the Australian energy industries that will facilitate the most to implement smart grid with renewable energy replacing conventional grid for a sustainable future.

Volcanic Rock Filters in Decentralised Wastewater Treatment

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Water scarcity has increased the use and acceptance of recycled water in the Australian community. The high cost of transporting recycled water is one of the last major inhibiting factors to the more widespread usage of treated effluent. The use of decentralised wastewater treatment systems which are constructed in-situ eliminates the need for recycled water to be transported from off-site locations. A decentralised treatment system allows for the wastewater produced at a location to be treated and recycled within the site. The most common purpose for recycled water is as irrigation water. Recycled water applied to soil as irrigation water may have long term sustainability issues in regards to salinity and sodicity concentrations. Traditional desalination techniques, such as reverse osmosis membranes, are capital and operationally expensive, which may make them economically unsustainable to produce irrigation water. This project examines the use of volcanic rock filter media, such as zeolite and scoria, which can reduce salinity and sodicity concentrations via cation exchange processes. The volcanic rock filter media have been trialed with wastewater from eco-villages, special events venues, and coal seam gas mines.