ABSTRACT

Renewable energy systems have been gaining more importance in developing countries not only due to the increasing concern towards environmental sustainability but also resolving the looming energy crisis that hampers the economic development. The intermittent nature of renewable energy sources has driven hybrid power systems that can provide efficient, reliable power supply, while reducing operational costs. Over the last few years, TamilNadu, which is one of the most industrialized and urbanized states in India, has been facing acute power deficits. Particularly, this power shortage has exacerbated the problems of industries with their production capacity plummeting down. The supply - demand gap needs to be plucked with pragmatic solution. In order to reduce the grid dependence and the most potent pollutants, it is increasingly inevitable for the industries to look for the alternative energy sources. Although considerable attention has been paid to the hybrid power systems to contribute to domestic and rural electrification, their use in industrial applications has received less interest. As a large user of energy, the process industries are most likely responsible for environmental concerns. Process industries are both capital and energy intensive and their energy issues have to be addressed from an economic and environmental perspective. Hence, the aim of the research is to propose sustainable and clean hybrid renewable energy system to meet the energy demand of the chosen industries in TamilNadu, contemplating the availability of renewable energy sources and cost considerations.

The research work is carried out to demonstrate the techno –economic viability of the proposed Hybrid Renewable Energy System (HRES) for energy intensive industries, which can transit from grid / captive power to clean renewable energies from locally available resources. Textile industry in Madurai district, caustic soda industry in Tuticorin district and sugar industry in Sivagangai district are the industries chosen for the feasibility analysis. Hybrid Optimization Model for Electric Renewables (HOMER) software has been used
for the economic and environmental analysis. Several scenarios of renewable mix for the selected site have been evaluated to illustrate the economic viability of solar-PV based HRES with simulation results including a direct comparison to diesel- and grid-connected alternatives.

The main challenge of hybrid power system applications is satisfying the load demand under constraints. Therefore, proper control of the hybrid generation system is vital for effective operation. In this work, a simple control strategy is proposed for the integration of multiple renewable energy sources like Solar-PV, Fuel Cell and Wind energy to the grid via STATCOM to bring about the best utilization of the available resources and improve the stability, reliability of the power system. The coordinated Pulse Width Modulation (PWM) based control strategy for active and reactive power control, voltage stabilization at the point of common coupling (PCC) and power factor correction is analyzed using the conventional PI controller and compared with fuzzy and ANN Controller. The proposed method uses a simple three phase Voltage Source Inverter based STATCOM model for the integration of the renewable sources resulting in reduced number of inverters, no synchronization requirements and effective compensation feature. The analytical performance models of system components have been developed using the MATLAB/Simulink software and simulation results of the performance of hybrid power systems are presented showing the effectiveness of the proposed control method. Hence, the off-grid and grid based hybrid renewable energy system is proposed for the electrification of industries with enough resource potential, considering the economic and environmental sustainability.