Abstract:

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ABSTRACT

The power generation of most islands depends mainly on costly oil. Since the cost of energy is very high so these are the best test place for the implementation of the new technologies. In this research work, a case study of a remote island of India i.e. Lakshadweep Island has been considered. Lakshadweep Island is one of the union territories of India. It has got 36 small Islands out of which only 10 Islands are inhabited. Out of these 10 inhabited Islands, only 5 Islands of Lakshadweep (Agatti, Androth, Kadmat, Kavaratti and Kiltan Island) and Lakshadweep as a whole are considered. In Lakshadweep Island electricity is mainly generated from diesel generator (DG) sets. The aim of this thesis is to reduce the use of diesel generators. In this work, firstly a study has been made to find out the total renewable energy potential mainly for solar energy, wind energy and biomass energy for the selected Islands. The determination of future projected levels of dissemination for SPV power generation in Union Territory of Lakshadweep Island and five Island of Lakshadweep have been done using technology diffusion models. Next aim of the thesis is the feasibility analysis of off-grid hybrid renewable energy in the considered Islands. Renewable energy sources (RES) such as solar and wind energy is abundantly available in the Islands, it is also environment-friendly, hence suitable for providing electricity in these Islands in addition with diesel

generators so that the use of diesel can be reduced. Then, a cost-effective optimization algorithm for optimal sizing of the energy resources and other system components with accurate mathematical models for energy management of the entire hybrid system has been proposed. The final aim is the minimization the proposed hybrid system total annual cost during the project lifetime while considering the reliability of power supply to the Islands and pollutant emission reduction. To this aim, the cost function of PV, wind, diesel generator and battery were derived by considering the Islands load demand, sites meteorological (solar radiation, wind speed) data and diesel price. Findings from the study showed that all Islands are only suitable for small wind applications. Values obtained for solar radiation as well as clearness index, show that all the sites are having considerable solar energy potential suitable for varying degree of solar energy applications. The feasibility simulation carried out with Hybrid Optimization Model for Electric Renewable (HOMER) software indicates that the hybrid system is the best option for all the sites considered in this study. With this optimal hybrid system configuration, there is a huge reduction in CO_2 emission at all Islands. Hence, it was concluded that the abundance of wind and solar resources in the Island create an ideal environment for inclusion of renewable energy systems, such as PV and wind in the design and implementation of standalone power supply systems to improve the Island energy system. The reliability of hybrid systems is found to be enhanced when solar, wind and diesel generator are used together; the size of battery storage is also reduced because there is less dependence on one method of energy production.