

Optimal Design of a PV/Diesel Hybrid System for Decentralized Areas through Economic Criteria

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Abstract : An innovative concept called "Flexy-Energy" is developing at 2iE. This concept aims to produce electricity at lower cost by smartly mix different available energies sources in accordance to the load profile of the region. With a higher solar irradiation and due to the fact that Diesel generator are massively used in sub-Saharan rural areas, PV/Diesel hybrid systems could be a good application of this concept and a good solution to electrify this region, provided they are reliable, cost effective and economically attractive to investors. Presentation of the developed approach is the aims of this paper. The PV/Diesel hybrid system designed consists to produce electricity and/or heat from a coupling between Diesel gensets and PV panels without batteries storage, while ensuring the substitution of gasoil by bio-fuels available in the area where the system will be installed. The optimal design of this system is based on his technical performances; the Life Cycle Cost (LCC) and Levelized Cost of Energy are developed and use as economic criteria. The Net Present Value (NPV), the internal rate of return (IRR) and the discounted payback (DPB) are also evaluated according to dual electricity pricing (in sunny and unsunny hours). The PV/Diesel hybrid system obtained is compared to the standalone Diesel gensets. The approach carried out in this paper has been applied to Siby village in Mali (Latitude 12 ° 23'N 8 ° 20'W) with 295 kWh as daily demand. This approach provides optimal physical characteristics (size of the components, number of component) and dynamical characteristics in real time (number of Diesel generator on, their load rate, fuel specific consumptions, and PV penetration rate) of the system. The system obtained is slightly cost effective; but could be improved with optimized tariffing strategies.

Keywords : investments criteria, optimization, PV hybrid, sizing, rural electrification

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