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## A novel software package for the robust design of off-grid power systems.

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### Abstract

Off-grid power systems represent one of the key solutions for rural electrification. Most of the analyses or tools already present in literature do not consider the final users' energy needs as the starting point of the process nor they consider the inherent uncertainties about loads and resources. Comprehensive stochastic procedures that look at the atypical features of rural contexts and include estimation errors into the design phase are strongly required. In this paper, we present Poli.NRG (POLItecnico di Milano - Network Robust desiGn): a novel software package for the robust design of off-grid electric power systems. Poli.NRG is composed of four blocks which separately face the different design phases: (i) the *data inputs gathering* block provides a methodology to collect field data as regards weather condition and load demand; (ii) the *inputs processing* block elaborates the inputs to obtain load and sources profiles over the entire lifetime of the plant; (iii) the *system modeling and simulation* block simulates different off-grid system configurations and evaluates the related techno-economic performances; (iv) the *output formulation* block finds the most *robust design* for the targeted context through specific optimization methods. After a comprehensive description of the software, we have applied it to size a PV+BESS microgrid system to supply power to a peri-urban area of Uganda. The results confirm that parameters' uncertainties deeply affect the design of the system and motivate the robust design approach proposed. Poli.NRG is devoted to map those uncertainties and provide information for decision makers.

### Keywords

Microgrids, Rural electrification, Developing countries, Renewable energy, Simulation, Optimization

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