

## Abstract

One of the most common causes of power outages in developing countries is a global mismatch between supply and demand. The effects of this phenomenon are especially devastating in the healthcare sector. This paper describes the management of the loads' operation using Demand Response-Fuzzy Inference System Controller (DR-FIS) for the sizing optimization of photovoltaic/wind turbine/battery/supercapacitor and photovoltaic/wind turbine/battery/diesel generator systems operating autonomously in a health center in northern Cameroon using multi-objective particle swarm optimization (MOPSO) and multi-objective genetic algorithm (MOGA) methods. The assessment criteria for this optimization are Loss of Power Supply Probability (LPSP), Net Present Cost (NPC), Cost of Energy (COE), Total Greenhouse gases Emission (TGE), Wasted Energy (WE), and Renewable Generation (REG). Implementing a Demand Response-Fuzzy Inference System controller (DR-FIS) has allowed significant energy savings (15.4130% reduction in energy demand) and increased worldwide supply–demand adequacy. This study highlights the techno-economic and environmental significance of using a supercapacitor (SC) as a backup in contrast to a diesel generator (DG), as well as the validation of its compatibility with storage batteries because of the provision of a robust energy management approach. Finally, in this study, MOGA results in better results than MOPSO after evaluating the outcomes of the various multi-objective optimization methods. This strategy enabled the determination of the ideal configuration for the studied Healthcare Center's power supply. This configuration includes the Demand Response-Fuzzy Inference System. It consists of 20 solar panels (PV), 02 wind turbines (WT), 04 batteries (BT), and 07 supercapacitors (SC) for a COE of 0.1691 \$/kWh, a NPC of 1.1808e + 03 \$, a TGE of 439.7901 Kg, a WE of 4.0066e + 03 Kwh, 100% REG and unfortunately 0.9858 % LPSP.