Chapter 8
Hybrid Optimization Methods Application on Sizing and Solving the Economic Dispatch Problems of Hybrid Renewable Power Systems

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ABSTRACT

Renewable energy systems are spread all over the world due to the security problems encountered in accessing fossil fuels, the desire to reduce the environmental damage and to respond to the rapid increase in energy demand. However, the problems are experienced in renewable energy technologies in sustainable supply and reduction of production costs. Obtaining the optimum power distribution planning between photovoltaic, wind, biomass, and other systems depending on the relevant parameters and optimizing the distribution of energy supply-demand planning among the same sources can be applied as an effective solution by using several single optimization methods or new updated hybrid versions of them. In this chapter, common methods were evaluated and an application of crow and particle swarm as a hybrid method was examined in a certain region of Libya for a PV/wind hybrid renewable power system.

DOI: 10.4018/978-1-7998-8561-0.ch008

INTRODUCTION

Among all the various resources pursued on earth, electrical energy is the most crucial. Fossil fuels including coal, crude oil, and natural gas are currently being used to satisfy more than 70% of the planet's overall demand for electrical power (Sinha and Chandel, 2014). As economies and national populations simultaneously grow, demands for electricity increase and the consumption of various fossil fuels accordingly increases. Also. the supplies of these traditional fossil fuels are inherently limited, and the available quantities are steadily continuing to decrease, necessitating urgent attention and long-term solutions to prevent a possible energy crisis. At the same time, these conventional fuels are the direct source of various dangerous emissions, such as greenhouse gases, contributing in turn to global warming (Kuang et al 2016; Sinha and Chandel 2015). These issues are currently being addressed in a variety of ways. One popular strategy is focused on raising public awareness regarding the urgency of decreasing energy consumption in residential and industrial sectors and promoting newer technologies that are more energy efficient. One other strategy entails the promotion of renewable energy systems (RESs) and other related technologies with the goal of increasing their levels of dependability, cost-effectiveness, greenness, and accessibility for the broader population for usage at home. Various countries and territories are exerting considerable effort to improve renewable energy capacities, which are also receiving increased attention from researchers, governments, and many different industries(Menanteau et al., 2010). Alternative energy options such as wind, solar, biofuel, biomass, hydro, and geothermal sources of energy, among others, have been widely used to produce power in recent years. Considering the simultaneous consideration of the reliability, cost, and performance, renewable energy-based hybrid systems (REHSs) are clearly more logical and more feasible than systems utilizing a single source of energy in many applications. REHSs can run off one or more energy sources and can operate independently or in grid-connected mode. Various hybrid system combinations are possible, and these can and should be selected considering the specific need and the resources available for each individual location (Sinha and Chandel, 2014).

Most renewable energy sources, including both solar photovoltaic (SPV) systems and wind turbine generators (WTGs), are both clean and environmentally. According to these investigations, HRESs will provide good efficiency at lower costs in comparison to SPV or WTG systems that stand alone (Dawoud et al 2015; Celik, 2002; Beshr 2013).

Hybrid combinations of SPV with WTG may have disadvantages compared to conventional energy sources if they are not designed carefully and appropriately. For increased performance, it is critically important to address the inconsistent patterns of both wind speed and solar radiation, both of which lead to fluctuations in power. This can be easily resolved, for example, with the use of storage units, perhaps in the form of storage battery banks. When such batteries are present within hybrid systems, the storage of extra power becomes possible and thus the supply of loads in the event of shortages is also possible (Barton and Infield, 2004).

The incorporation of storage batteries into such systems also helps prevent oversizing of the SPV and WTG sources. Even after storage batteries are charged to their full capacity, however, excess power from generation units must still be avoided elsewhere. Reducing the amount of unutilized excess power could lower the cost of energy (COE) (Dufo-lo, 2007). As a result, each RES's optimum capacity must be known to confirm the actual load that can be accommodated.

To operate HRESs, it is necessary to maximize their performances; at the same time, it is necessary to keep both physical and technical constraints in mind. As a result, optimization methods, techniques, and