Chapter 5
Application of Optimization to Sizing Renewable Energy Systems and Energy Management in Microgrids:
State of the Art and Trends

Khaled Dassa
University of Boumerdes, Algeria

Abdelmadjid Recioui
https://orcid.org/0000-0001-9028-3910
University of Boumerdes, Algeria

ABSTRACT

The smart grid is the aggregation of emerging technologies in both hardware and software along with practices to make the existing power grid more reliable and ultimately more beneficial to consumers. The smart grid concept is associated with the production of electricity from renewable energy sources (RES). For the distant isolated regions, microgrids (MG) with RES are offering a suitable solution for remote and isolated region electrification. The improper sizing would lead to huge investment cost which could have been avoided. The objective of this chapter is to review the state-of-the-art studies on the use of optimization techniques to renewable energy design and sizing. The chapter reviews the optimization techniques employed at different components of the microgrid including the energy sources, storage elements, and converters/inverters with their control systems.

INTRODUCTION

The traditional power grid is made up of synchronous machines, power transformers, transmission lines, transmission substations, distribution lines, distribution substations, and various types of loads that are

interconnected altogether. They are located far from the power consumption area and electric power is transmitted through long transmission lines. Traditional power grids have served us for decades because they are predictable and reliable however, Due to the growing concern about the climate change caused by greenhouse gas emissions and the escalating increase in electricity demand (2% per year until 2040) which exceeds the demand for any other form of final energy globally, there is a tendency to replace fossil fuels by renewable sources such as wind and solar (Baimel et al., 2016). Figure 1 shows the growth of renewable energy penetration into total energy generation over next three decades across the world. The Europe will take the maximum share of 44% of renewable generation in their total energy production (Ramesh Babu, 2017).

Figure 1. Percentage growth forecast in renewable energy generation
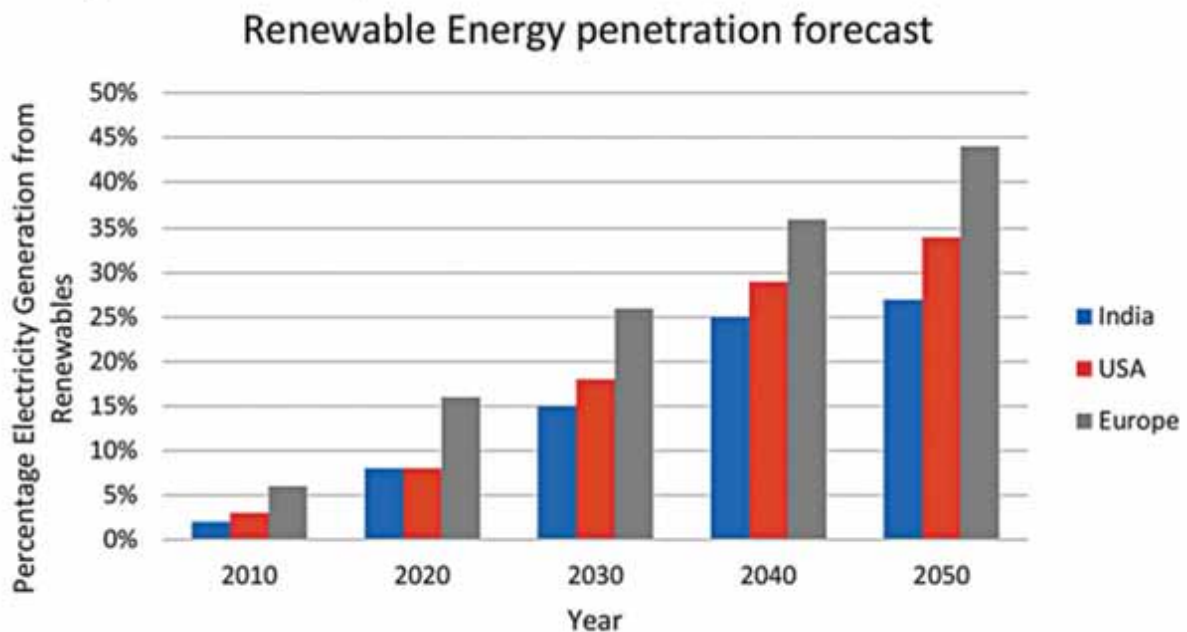
Built on top of an intelligent communications infrastructure, the smart grid is a combination of hardware, management, and reporting software. Consumers and utility corporations alike have capabilities to manage, monitor, and respond to energy challenges in the smart grid era. The transfer of electricity from the utility to the consumer becomes a two-way conversation, saving consumers money and energy while also providing greater transparency in terms of end-user usage and lowering carbon emissions. (Ramesh Babu, 2017).

A smart grid is an electricity network monitors and manages the delivery of power from all generation sources to satisfy the variable electricity demands of end-users using digital and other modern technology. Smart grids coordinate the demands and capacities of all generators, grid operators, endusers, and electrical market stakeholders to run the system as efficiently as possible, reducing costs and

Related Content

Concept Drift Adaptation in Intrusion Detection Systems Using Ensemble Learning
Deepa C. Mulimani, Shashikumar G. Totadand Prakashgoud R. Patil (2021). *International Journal of Natural Computing Research (pp. 1-22).*
www.irma-international.org/article/concept-drift-adaptation-in-intrusion-detection-systems-using-ensemble-learning/308258

AI-Based Cyber Defense for More Secure Cyberspace
Dimitar Stevo Bogatinov, Mitko Bogdanoskiand Slavko Angelevski (2017). *Nature-Inspired Computing: Concepts, Methodologies, Tools, and Applications (pp. 1471-1489).*
www.irma-international.org/chapter/ai-based-cyber-defense-for-more-secure-cyberspace/161079

Interval Type 2 Fuzzy Fireworks Algorithm for Clustering
Juan Barraza, Fevrier Valdez, Patricia Melinand Claudia I. Gonzalez (2020). *Handbook of Research on Fireworks Algorithms and Swarm Intelligence (pp. 195-211).*
www.irma-international.org/chapter/interval-type-2-fuzzy-fireworks-algorithm-for-clustering/252909

Models of Self-Replicators
Eleonora Bilottaand Pietro Pantano (2010). *Cellular Automata and Complex Systems: Methods for Modeling Biological Phenomena (pp. 282-314).*
www.irma-international.org/chapter/models-self-replicators/43224

Acquiring Knowledge in Extended Hierarchical Censored Production Rules (EHCPRS) System
Sarika Jainand N.K. Jain (2010). *International Journal of Artificial Life Research (pp. 10-28).*
www.irma-international.org/article/acquiring-knowledge-extended-hierarchical-censored/49681