Preface

Sustainable development and operation of energy systems are very important problems from the viewpoint of effective energy supply to consumers with required quality and reliability of supply. These problems are the most important for infrastructural energy systems which have developed transmission and distribution network structures. The effective operation of the economy and the life of people strongly depend on sustainable development and operation of energy systems. The objective of this book is to introduce advanced results in the foregoing area.

The following research topics are well covered in this book:

- Energy Management Policy
- Economic Load Dispatch
- Biogeography-Based Optimization
- Heat Supply Complex
- Markov Random Process
- Multi-Loop Optimization Method
- Three Induction motor
- Bi-Level Modeling
- Competitive Market
- Thermal Power Plant
- Heat Network
- Teaching Learning-Based Optimization
- Optimal Power Flow
- Fuzzy Decision
- Hybrid Power Filter
- Evolutionary Optimization
- Artificial Bee Colony
- Greenhouse Gas Emissions
- Valve-Point Loading Effect
- Ground Source Energy

The book is organized into 16 chapters. A brief description of each of the chapters is as follows:

Chapter 1: The chapter presents methods for assessing economic, resource and environmental efficiency of energy supply systems and ways of its improvement, the main of which are the development of cogeneration and renewable energy sources (RES). The problem of allocating fuel and financial costs

in the case of the combined production is solved. The methods allow determining specific indicators of supplied products which makes it possible to compare the efficiency of energy supply systems of different companies and countries, and to define their future target indicators. The technology of introducing RES-based power plants to the energy supply systems by means of using unstabilized RES-based power for direct fuel substitution at thermal power plants is discussed.

Chapter 2: The chapter addresses the issue of optimal expansion and reconstruction of heat supply systems, which includes a set of general and specific problems. Therefore, a comprehensive approach to their solving is required to obtain a technically admissible and economically sound result. Solving the problem suggests search for effective directions in expansion of a system in terms of allocation of new heat sources, their type, output; construction of new heat networks, their schemes and parameters; detection of "bottlenecks" in the system and ways of their elimination (expansion, dismantling, replacement of heat pipeline sections, construction of pumping stations). The authors present a mathematical statement of the problem, its decomposition into separate subproblems and an integrated technique to solve it. Consideration is given to a real problem solved for a real heat supply system.

Chapter 3: In this chapter one of widespread models of the organization of heat supply of consumers presented in the Single buyer format is considered. The scientific and methodical base for its description and research offers to accept the fundamental principles of the theory of hydraulic circuits, bi-level programming, and principles of economics in the energy sector. Distinctive feature of the developed mathematical model is that it, along with traditionally solved tasks within the bilateral relations heat sources – consumers of heat, considers a network component with physics and technology properties of a heat network inherent in it, and also the economic factors connected with costs of production and transport of heat energy.

Chapter 4: This chapter presents new methods and software system SOSNA intended for the parameter optimization of heat supply systems. They make it possible to calculate large-scale systems which have a complex structure with any set of nodes, sections, and circuits. A new methodological approach to solving the problem of the parameter optimization of the heat supply systems is developed. The approach is based on the multi-level decomposition of the network model, which allows us to proceed from the initial problem to less complex sub-problems of a smaller dimension. New algorithms are developed to numerically solve the parameter optimization problems of heat supply systems: an effective algorithm based on the multi-loop optimization method, which allows us to consider hierarchical creation of the network model in the course of problem solving; a parallel high-speed algorithm based on the dynamic programming method.

Chapter 5: This chapter deals with the problem of comprehensive analysis of heat supply reliability for consumers. It implies a quantitative assessment of the impact of all stages of heat energy production and distribution on heat supply reliability for each consumer of the heat supply system. A methodological approach is suggested, in which mathematical models and methods for nodal evaluation of heat supply reliability for consumers are developed and the studies on the impact of different elements of fuel and heat supply systems on its level are described. Mathematical modeling is based on the Markov random processes, models of flow distribution in a heat network, deterministic dependences of thermal processes of heat energy consumption and some other models.

Chapter 6: In the recent attempts to stimulate alternative energy sources for heating and cooling of buildings, emphasise has been put on utilisation of the ambient energy from ground source heat pump systems (GSHPs) and other renewable energy sources. Exploitation of renewable energy sources and particularly ground heat in buildings can significantly contribute towards reducing dependency on fossil

fuels. Energy Research Institute (ERI), between July 2011 and November 2011. This chapter highlights the potential energy saving that could be achieved through use of ground energy source.

Chapter 7: This chapter presents a Fuzzy Random Regression-based model. The proposed method demonstrates the ability to provide coefficient information and consideration of hybrid uncertainties in the evaluation process. The schemes discussed in this work satisfy decision-maker intentions, which address some limitation to determine the coefficient and deals with fuzzy random uncertainties in the multi-objective problem formulation using satisfaction-based optimization.

Chapter 8: Optimal power flow with transient stability constraints becomes an effective tool of many problems in power systems since it simultaneously considers economy and dynamic stability of power system. TSC-OPF is a non-linear optimization problem which is not easy to deal directly because of its huge dimension. This chapter presents a novel and efficient optimisation approach named the teaching learning based optimisation (TLBO) for solving the TSCO-PF problem. The quality and usefulness of the proposed algorithm is demonstrated through its application to four standard test systems namely, IEEE 30-bus system, IEEE 118-bus system, WSCC 3-generator 9-bus system and New England 10-generator 39-bus system. To demonstrate the applicability and validity of the proposed method, the results obtained from the proposed algorithm are compared with those obtained from other algorithms available in the literature.

Chapter 9: This chapter proposes an improved pseudo-gradient search particle swarm optimization (IPG-PSO) for solving optimal power flow (OPF) with non-convex generator fuel cost functions. The objective of OPF problem is to minimize generator fuel cost considering valve point loading, voltage deviation and voltage stability index subject to power balance constraints and generator operating constraints, transformer tap setting constraints, shunt VAR compensator constraints, load bus voltage and line flow constraints. The proposed IPG-PSO method is an improved PSO by chaotic weight factor and guided by pseudo-gradient search for particle's movement in an appropriate direction.

Chapter 10: ICT service-providers are to daily face the problem of delivering ICT services (data processing (Dp) and telecommunication (Tlc) services) assuring the best compromise between Quality of Service (QoS) and Energy Optimization. Indeed, any operation of saving energy involves waste in the QoS. This holds both for Dp and for Tlc services. This chapter introduces models the providers may use to support their decisions in the delivery of ICT services. Dp systems totalize millions of servers all over the world that need to be electrically powered. Dp systems are also used in the government of Tlc systems, which also require Tlc-specific power, both for mobile networks and for wired networks. Research is thus expected to investigate into methods to reduce ICT power consumption. This chapter investigates ICT power management strategies that look at compromises between energy saving and QoS.

Chapter 11: This chapter presents the mathematical model of the thermal power plant in reservoir under different hydrometeorological conditions, which is solved by three dimensional Navier - Stokes and temperature equations for an incompressible fluid in a stratified medium. A numerical method based on the projection method, which divides the problem into four stages. Then qualitatively and quantitatively approximate the basic laws of the hydrothermal processes depending on different hydrometeorological conditions are determined.

Chapter 12: Biogeography based optimization (BBO) is an efficient and powerful stochastic search technique for solving optimization problems over continuous space. Due to excellent exploration and exploitation property, BBO has become a popular optimization technique to solve the complex multimodal optimization problem. However, in some cases, the basic BBO algorithm shows slow conver-

gence rate and may stick to local optimal solution. To overcome this, quasi-oppositional biogeography based-optimization (QOBBO) for optimal reactive power dispatch (ORPD) is presented in this chapter.

Chapter 13: Biogeography Based Optimization (BBO) algorithm is a population-based algorithm based on biogeography concept, which uses the idea of the migration strategy of animals or other spices for solving optimization problems. Biogeography Based Optimization algorithm has a simple procedure to find the optimal solution for the non-smooth and non-convex problems through the steps of migration and mutation. This research chapter presents the solution to Economic Load Dispatch Problem for IEEE 3, 4, 6 and 10-unit generating model using Biogeography Based Optimization algorithm. It also presents the mathematical formulation of scalar and multi-objective unit commitment problem, which is a further extension of economic load dispatch problem.

Chapter 14: A novel hybrid series active power filter to eliminate harmonics and compensate reactive power is presented and analyzed. The proposed active compensation technique is based on a hybrid series active filter using ATS algorithm in the conventional Sinusoidal Fryze voltage (SFV) control technique. This chapter discusses the comparative performances of conventional Sinusoidal Fryze voltage control strategy and ATS-optimized controllers. The ATS-optimized controller has been attempted for shunt active power filter too, and its performance has also been discussed in brief.

Chapter 15: Induction motors have gained its popularity as most suitable industrial workhorse, due to its ruggedness and reliability. With the passage of time, these workhorses are susceptible to faults, some are incipient and some are major. Such fault can be catastrophic, if unattended and may develop serious problem that may lead to shut down the machine causing production and financial losses. To avoid such breakdown, an early stage prognosis can help in preparing the maintenance schedule, which will lead to improve its life span. Scientist and engineers worked with different scheme to diagnose the machine faults. In this chapter, the authors diagnose the turn-to-turn faults condition of the stator through symmetrical component analysis.

Chapter 16: This chapter is devoted to main tendencies of optimization in photovoltaic (PV) engineering showing the main trends in modern energy transition - the changes in the composition (structure) of primary energy supply, the gradual shift from a traditional (mainly based on fossil fuels) energy to a new stage based on renewable energy systems from history to current stage and to future. The chapter shows the gradual shifting optimization from specific quite narrow areas to the new stages of optimization of the very complex energy systems (actually smart grids) based on photovoltaics and also other renewable energy sources and GIS.

The book editors are very grateful to the editorial team and entire staff of IGI Global, for their confidence, interest, continuous guidance and support at all levels of preparation of this book's preparation.

We editors wish all the readers a pleasant and enjoyable, insightful and inspiring lecture of the contributions of this IGI Global book. In fact, we cordially hope that this special issue will present and value IGI Global as a premium publishing house in science, engineering, economics, and finance, which strongly fosters very much needed intellectual advances and their contributions to humanity and mankind in all over the world.

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