

# Energy Systems

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# Handbook of Networks in Power Systems I

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# **Handbook of Networks in Power Systems: Optimization, Modeling, Simulation and Economic Aspects**

This handbook is a continuation of our efforts to gather state-of-the-art research on power systems topics in Operations Research. Specifically, this handbook focuses on aspects of power system networks optimization and is, as such, a specialization of the broader “Handbook of Power Systems I & II,” published by Springer in 2010.

For decades, power systems have been playing an important role in humanity. Industrialization has made energy consumption an inevitable part of daily life. Due to our dependence on fuel sources and our large demand for energy, power systems have become interdependent networks rather than remaining independent energy producers.

Such dependence has revealed many potential economic and operational challenges with energy usage and the need for scientific research in this area. In addition to fundamental difficulties arising in power systems operation, the industry has experienced significant economic changes; specifically, the power industry has transformed from being controlled by government monopolies to becoming deregulated in many countries. Such substantial changes have brought new challenges in that many market participants maximize their own profit.

The challenges mentioned above are categorized in this book according to network type: Electricity Network, Gas Network, and Network Interactions.

Electricity Networks constitute the largest and most varied section of the handbook. Electricity has become an inevitable component of human life. An overwhelming human dependence on electricity presents the challenge of determining a reliable and secure energy supply. The deregulation of the electricity sector in many countries introduces financial aspects such as forecasting electricity prices, determining future investments and increasing the efficiency of the current power grid through network expansion and transmission switching.

The Gas Networks section of the book addresses the problem of modeling gas flow, based on the type of gas, through a pipeline network. The section describes the

problem of long-term network expansion as well as the optimal location of network supplies. Deregulation of the gas sector is becoming common in many countries. The deregulation presents new decisions to the gas industry including determining optimal market dispatch and nodal prices.

Network Interactions are common in power systems. This section of the book addresses the interaction between gas and electricity networks. The development of natural gas fired power plants has significantly increased interdependence between these two types of networks.

This handbook is divided into two volumes. The first volume focuses solely on electricity networks, while the second volume covers gas networks, and network interactions.

We thank all contributors and anonymous referees for their expertise in providing constructive comments, which helped to improve the quality of this volume. Furthermore, we thank the publisher for helping to produce this handbook.

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