

Green Energy and Technology



Sudipta De · Santanu Bandyopadhyay
Mohsen Assadi · Deb A. Mukherjee
Editors

Sustainable Energy Technology and Policies

A Transformational Journey, Volume 2

 Springer

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Preface

Questions related to energy security, energy access, energy poverty, emissions related to energy usage, climate change, and above all issues related to overall sustainable development are forcing a rapid transformation in the energy sector worldwide. Existing energy scenario is primarily fossil fuel dominated. With the fast depletion of limited fossil fuel reserve, climate change problems due to emissions from fossil fuel sources, unavailability of fossil fuels in the remote corners of human settlements, and nonuniform distribution of the fossil fuel reserves making sustainable development a difficult proposition. Simultaneously, energy demand is always increasing with population growth and an increase of life standard of people over time. Transforming the present energy systems toward renewables is the most promising alternative. Meeting increasing energy demand and simultaneously increasing renewable share brings new challenges. Transformation to renewable-based energy system not only depends on the invention of new technology but is constrained by several socioeconomic and political constraints. For example, large capital is already locked in a large number of fossil fuel (mostly coal)-based power plants with matured technology over a long period. Phasing out of these plants must be properly planned to minimize social and economic impacts. Similarly, transport sector mostly depends on oil which is available mostly in some parts of the world. This has led to specific political issues all over the world. Thus, the issue of sustainable energy needs multidisciplinary analysis for possible future solution. Development of new technology is the key issue, but proper assessment of socioeconomic and political aspects is also critical for a sustainable energy solution. In two volumes of this book, these multidisciplinary aspects are reported and analyzed in several chapters by experts from all over the world.

In this volume 2 of the book, several aspects of transformation of sustainable energy are addressed in 18 chapters. Natural gas is expected to play a very critical role during transition from mostly coal-based power to renewable power as it can be used with better efficiency and lower environmental impacts than coal-based systems. Safari et al. discuss this future role of natural gas in two chapters. The first chapter explains the stimulus, enablers, and barriers of use of natural gas, and the

second one explains these in more details with case studies. Carbon capture and storage is considered as the only feasible option of using reserve fossil fuels in the long run. Dutta discusses both the technology in brief and the current status of development worldwide. Distributed small-scale generation has several advantages as sustainable energy option. Somehsaraei and Assadi report the experimental performance of micro-turbine-based combined heat and power (CHP) plants. They also include better monitoring of these plants using artificial neural network tools. With several constraints, decision-making is complex, specifically for new technologies. The transportation sector is currently responsible for about a quarter of global energy demand and emissions. Managing transportation sector in a proper way is a big challenge for future energy sustainability. The next chapter by Lopez et al. discusses a life-cycle-based cost-benefit analysis framework for decision-making by policy-makers regarding low-carbon vehicle technology. Andiappan and Ng propose a framework for design operability and retrofit of energy systems through Disruption Scenario Analysis (DSA), Feasible Operating Range Analysis (FORA), and debottlenecking analysis. Geothermal energy is site-specific renewable energy. A systematic analysis using thermodynamic models of cogeneration using geothermal energy is reported by Parham and Assadi. Optimum energy conservation in batch plants using mathematical model is presented by Majazi. The perception of corporate sector about energy security of India is reported by Ghosh in the following chapter. It includes multidimensional socioeconomic and environmental perspectives of one of the largest industry groups of India, Mahindra. Finding alternative fuels for the transport sector is a big challenge of energy sustainability. It includes socioeconomic issues in addition to technology development. Ghosh and Roy report an overview of strategic niche management of national mission on bio-diesel in India. Rural electrification is a mission of India though the complete implementation is yet to achieve. A possible option with hybrid distributed generation using biomass and other local renewable resources is proposed by Palatel. Feasibility of producing oil and other value-added products from two nonedible oil seeds widely available in India as the feedstock is highlighted by Mishra and Mohanty. Shinde et al. present a study on possible sustainable renewable resources of India. They identify these resources as solar and biomass through technology and life-cycle assessments. Challenges and prospects of distributed electricity from renewable resources in India are discussed by Gon Choudhuri and Krishnan. These include both stand-alone and grid-connected options. Different aspects of “virtual power plants” with intermittent renewable resources in Indian context are reported by Mondal and Mukherjee. Use of new types of fuels needs modification of combustion devices to accommodate the new fuel. Bhattacharyya and Datta review the available literature on laminar burning velocity for fuels derived from biomass. They also explain the significance of it on combustion applications. Modeling of energy systems is useful to estimate expected performance and to obtain optimum design of the overall system. Sathisha and Dalal report an unsteady model of all vanadium redox flow battery to study effects of several important parameters. Electronics plays a critical role in any

modern system including energy systems. Recent developments in electronics of strongly correlated electron systems are reported by Chanda et al.

This book in two volumes is for practicing professionals, policy-makers, and researchers in the field of sustainable energy with an interdisciplinary approach. This is developed in close collaboration with academia and industry under an ongoing Indo-Norwegian Cooperation Program (INCP-2014-10086). Editors acknowledge the support of their respective Institutes/organizations: Jadavpur University, Indian Institute of Technology Bombay, the Bengal Chamber of Commerce and Industry, and University of Stavanger of Norway. Thanks to the authors and reviewers from different parts of the globe for their contribution to this book. Editors also thankfully acknowledge the support of Springer throughout the editing and publishing process.

Kolkata, India
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About the Editors

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Mohsen Assadi is Professor at Faculty of Science and Technology, University of Stavanger (UiS), Norway; Head of energy efficiency group for clean energy network at UiS; Head of monitoring and maintenance hub at CIAM, UiS; and Visiting Professor at Sheffield University and London City University. Developing methods and tools for identification of optimized instrumentation for cost-effective monitoring and control of various types of power plants have been one of the focus areas for the conducted R&D activities during the past years. Assadi has been project leader for several national and European-funded projects, dealing with performance monitoring and concept evaluation for conventional combined cycle plants using industrial gas turbines from various original equipment manufacturers (OEMs); a hybrid plant using combination of biomass-fueled steam cycle and natural gas-fired gas turbine with heat recovery steam generator (HRSG) delivering steam to a common steam turbine; an innovative cycle utilizing the humid air turbine concept, small-scale combined heat and power (CHP) units using mixtures of various gas fuels; an integrated gasification combined cycle plant, etc.

Deb A. Mukherjee is an entrepreneur, professionally qualified as a lawyer, with over 33 years of work experience in diverse business domains, engineering systems, information technology solutions, and later in energy services for the last 15 years. He was Executive Chairman of Eaga Energy India Pvt. Ltd. (subsidiary of Eaga plc UK FTSE 250 company) until 2012. Currently, he is an Investor and Country Director for Big Solar Ltd UK and also Managing Director of Cenergist Ltd UK—India Operations, an energy services business with operations in the UK, Spain, Germany, Italy, and now India. He is also incubating an IT start-up Teknowlegion Pvt. Ltd. in Kolkata, India. He has served on various trade committees in India and the UK and spoken at several international seminars on Sustainability Issues, Energy Efficiency, Renewables, Water Management, and Business Strategies. Currently, he is the Vice President of Bengal Chamber and Member of the Executive Board of the Chamber and the Chairperson of the Energy and Environment Committee of the Chamber.