Handbook of CO_2 in Power Systems: Preface

After the sequels of "Handbook of Power Systems I & II" were published by Springer in 2010, we focused our efforts on specific aspects of power systems, which lead to a series of handbooks such as "Handbook of Networks in Power Systems" and "Handbook of CO_2 in Power Systems." This handbook focuses on the aspects of power systems related to CO_2.

Global warming has become a critical issue to our planet, Earth. The continuing rise in the average temperature of the atmosphere and ocean causes serious problems such as: glacier shrinkage, sea level elevation, species extinction, agricultural output decrease, and extreme weather events. It is an indisputable fact that greenhouse gas concentrations resulting from human activities continue to exacerbate global warming. Although water vapor contributes the most to the greenhouse effect, (i.e., the effect of solar heat remaining on our planet), due to industrialization the dramatic increase of carbon dioxide (CO_2) in the atmosphere accounts for the biggest percentage contribution in the temperature rise. According to historic studies regarding the contents of the atmosphere, the mole fraction of CO_2 has increased around 36% percent from its preindustrial level; the last 40 years account for more than half of the increase.

Many countries, territories, and international organizations have joined together to curb the global warming trend. Among the earliest efforts, the United Nations Framework Convention on Climate Change (UNFCCC), which began in 1992, encompasses the largest number of countries signed to fight climate change. This is despite the fact that the convention is a non-binding treaty with no mandatory limits on emissions. Similar to the UNFCCC protocol, the Kyoto protocol, initiated in 1997, consists of nations around the globe that have signed to reduce their emissions from 1990 benchmark emission levels. Many policies, economic stimuli and technologies have been developed to reduce carbon emissions, considered to be the major factor in global warming. Among the many policies, the three most often debated and tested are that of the carbon tax, the cap-and-trade system, and of renewable portfolio standards. Carbon capture and storage technologies are considered a panacea in reducing the emissions from extensive use of fossil fuels.

World energy consumption has been increasing steadily since industrialization, and especially within the last 30 years; this recent increase is also the major cause for the increase in CO_2 concentration in the atmosphere. Fossil fuels, i.e., oil, coal and natural gas, continue to play a central role in our energy consumption. In order to reduce global warming, it is important to focus on global energy production and consumption. Since the introduction of daily use of electrical bulb for lighting, our society has been increasingly relying on electricity as an energy carrier. Since this reliance, the percentage of electrical power as a total supply of and demand for energy has grown exponentially; this trend is unlikely to be reversed in the short term. It is no doubt that CO_2 policies, technologies, and operations in power systems must play a prominent role in reducing total CO_2 emissions.

This book presents the state of the art on how CO_2 issues are considered in power systems. The book encompasses three major areas: (1) CO_2 policies and markets; (2) the integration of CO_2 mitigation in power systems operations; and (3) CO_2 capture and storage technologies and their impacts on power systems. The main purpose of this book is to promote new studies related to the integration of CO_2 issues in power systems by presenting a collection of articles which provides mathematical modeling, optimization techniques, and economic analysis of these problems.

We would like to thank all the authors for their in-depth studies of CO_2 issues in power systems, all the referees for their careful and constructive reviews, and the publisher for creating this volume.

Qipeng P. Zheng
Steffen Rebennack
Panos M. Pardalos
Niko A. Iliadis
Mario V. Pereira

http://www.springer.com/978-3-642-27430-5

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Zheng, Q.P.; Rebennack, S.; Pardalos, P.M.; Pereira, M.V.F.; Iliadis, N.A. (Eds.)

2012, VIII, 400 p., Hardcover
ISBN: 978-3-642-27430-5