

Water and Energy: Threats and Opportunities

By Gustaf Olsson

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Water and Energy - Threats and Opportunities creates an awareness of the important couplings between water and energy. It shows how energy is used in all the various water cycle operations and demonstrates how water is used - and misused - in all kinds of energy production and generation. Population increase, climate change and an increasing competition between food and fuel production create enormous pressures on both water and energy availability. Since there is no replacement for water, water security looks more crucial than energy security. This is true not only in developing countries but also in the most advanced countries. The western parts of the USA suffer from water scarcity that provides a real security threat. The book does not aim to show "how to design" or to solve some of the very intricate conflicts between water and energy. Instead it systematically lists ideas, possibilities and a number of results. There are a few more technical chapters that act as entry points to more detailed technical literature. Part One of the book describes the water-energy nexus, the conflicts and competitions and the couplings between water security, energy security, and food security. Part Two captures how climate change, population increase and the growing food demand will have major impact on water availability in many countries in the world. Part Three describes water for energy and how energy production and conversion depend on water availability. As a consequence, all planning has to take both water and energy into consideration. The environmental (including water) consequences of oil and coal exploration and refining are huge, in North America as well as in the rest of the world. Furthermore, oil leak accidents have hit America, Africa, Europe as well as Asia. The consequences of hydropower are discussed and the competition between hydropower generation, flood control and water storage is illustrated. The importance of water for cooling thermal power plants is described, as this was so tragically demonstrated at the Fukushima nuclear plants in 2011. Climate change will further emphasize the strong coupling between water availability and the operation of power plants. Part Four analyses energy for water - how water production and treatment depend on energy. The book shows that a lot can be done to improve equipment, develop processes and apply advanced monitoring and control to save energy for water operations. Significant amounts of energy can be saved by better pumping, the reduction of leakages, controlled aeration in biological wastewater treatment, more efficient biogas production, and by improved desalination processes. The water-energy issue is not only about technology. It is our attitudes and our lifestyle that can significantly influence the consumption of both water and

energy. We all have to be reminded that water is energy and energy is water. The book is aimed at various kinds of readers: The politician and decision maker - providing a holistic view; The engineer who wishes to find out about the key issues and to understand the strong driving forces from the increasing population, climate change and the food supply in the world; The student who wishes to get an overview of future challenges and new possibilities; The planner - water and energy have to be planned together; The designer of a water and wastewater system - how does energy come in? The operator of a water or a wastewater treatment plant - what are the possibilities to make the system more efficient; The wastewater treatment manager - what are the possibilities to save and recover energy in a wastewater treatment plant; The researcher - looking for connections between different specialities. What kind of cross-disciplinary research would be needed; The power and energy professional - mostly the water issue is forgotten - until there is water scarcity; The water professional - it is not only a matter of operating water systems efficiently. Water professionals have to be much more engaged in the water quantity and water quality implications of energy generation. It is too late to attack the problems by developing methods for the treatment of contaminated water. The water consumption and the water pollution simply have to be closely watched already at the energy production phase. About the author: Gustaf Olsson, Professor Em. in Industrial Automation, Lund University, Sweden Since 2006 Gustaf is professor emeritus at Lund University, Sweden. Gustaf has devoted his research to control and automation in water systems, electrical power systems and process industries. From 2006 to 2008 he was part time professor in electrical power systems at Chalmers University of Technology, Sweden. Since 2006 he has been guest professor at the Technical University of Malaysia (UTM) and at the Tsinghua University in Beijing, China; about one month per year at each university. He is an honorary faculty member of the Exeter University in UK. Gustaf has served in various positions within IWA, the International Water Association. Between 2005 and 2010 he was the editor-in-chief of the journals Water Science and Technology and Water Science and Technology/Water Supply. From 2007 to 2010 he has been a member of the IWA Board of Directors. Gustaf has guided 23 PhDs and a few hundred MSc students to their exams. He has received the Lund University pedagogical award for "distinguished achievements in the education". The Lund University engineering students have elected him as the "teacher of the year". In 2010 he received the IWA Publication Award. Except in China and Malaysia he has spent extended periods as a guest professor and visiting researcher at universities and companies in the USA, Australia and Japan and has been invited as a guest lecturer in 19 countries outside Sweden. He has authored six books - some of them published in English, Russian, German and Chinese - and about 160 scientific publications. Three PowerPoint presentations are available for Water and Energy - threats and opportunities: Water and Energy: Modelling, Control and Automation Challenges - Part 1, Water and Energy: Modelling, Control and Automation Challenges - Part 2, and Water and Energy: Modelling, Control and Automation Challenges - Part 3. Access them on the WaterWiki here: http://www.iwawaterwiki.org/xwiki/bin/view/Articles/WaterandEnergy

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Editorial Review

Review
"Professor Olsson's book, Water and Energy - Threats and Opportunities, the result of a meticulous multi-year effort, meets an important and growing need: to define and illuminate the critical linkage between water and energy. He explores the water-energy nexus in detail, and carefully discusses its many implications, including for food production and its connection to global climate change. He properly and repeatedly emphasizes the important message that water and energy issues must be addressed together if society is to make wise and efficient use of these critical resources. Given its comprehensive scope and careful scholarship, the book will serve as a valuable addition to the libraries of students, researchers, practitioners, and government officials at all levels." DR. ALLAN R. HOFFMAN, Senior Analyst, Office of Energy Efficiency and Renewable Energy, U.S. Department of Energy, Washington, DC "Water and Energy - Threats and Opportunities by Emeritus Professor Gustaf Olson is a milestone book in the efficient use of two important resources: water and energy. It is remarkable that due to increasing specialization among professionals in the different fields, water and energy are not optimized jointly. The production of energy requires water, while the supply of water services demands energy. Water and energy are the drivers for almost all economic activities, and are of such importance that they are at the origin of conflicts throughout the world." BLANCA JIMENEZ CISNEROS, Universidad Nacional autonoma de Mexico "Gustaf Olsson illustrates the inextricable linkage between water and energy, and demonstrates that an integrated and holistic approach as well as a change of attitude is necessary to solve the complex water and energy challenges we are facing. This book is full of enlightenment." JINING CHEN, Executive Vice Chancellor and Professor, Tsinghua University, Beijing "Gustaf Olsson persuasively demonstrates the need for a fundamental global change. In the world of yesterday, it was tried - rather unsuccessfully - to handle the water and energy challenges separately. In the world of tomorrow, we need to tackle the challenges simultaneously. The historical and comprehensive evidence of the book demonstrates that no comprehensive solution is found without cross-cutting and holistic thinking. I recommend policy makers, researchers as well as water and energy professionals to familiarise themselves with this true and convincing perspective of the water-energy nexus." CARSTEN BJERG, CEO and Group President, GRUNDFOS, Denmark "This book comes at the right time. Decreasing river flows ...aquifer depletion ...growing dependence from seawater desalination for cities in arid areas... these are warning signals that water and energy security are increasingly linked. From Bonn to Marseilles and Rio, in less than one year, governments, professionals, researchers and civil society are discussing these linkages in three big international conferences. Gustaf Olsson's work is for them a reference, encompassing the complexity of the subject and providing a wealth of data. Because he has shared his career between energy and water management, Gustaf Olsson has a balanced and wide ranging perspective." JACQUES LABRE, Co-ordinator of Thematic Priority "Harmonize energy and water", at the 6th World Water Forum (Marseilles, March 2012) "In producing his latest book, Water and Energy, Professor Olsson has put together an extremely valuable compendium of vital information and insights into the highly crucial relationship between two essential in modern life - water and energy. In so doing, Professor Olsson is providing the largely separate communities of both water professionals and energy professional with a foundation for jointly understanding, simplifying and in many cases demystifying the myriad of water and energy interfaces. When one considers the significant carbon footprint of water production, use and treatment and the even more significant water footprint of energy production and use, the contribution of Professor Olsson's book will be greatly appreciated in helping to illuminate the pathway ahead - a pathway that will lead us to conquer the essential challenge of making the use of water and energy both and jointly, an order of magnitude more efficient than today." PAUL D. REITER, Executive Director, International Water Association "...Our most sincere congratulations for this excellent piece of work. It is impressive; the amount of up-dated data, facts, statistics, ideas, relations among them, thoughts, examples,

and case studies... everything fully integrated and justified, where you can not only find theory and technical aspects about the water-energy binomial, but also Gustaf Olsson's openly expressed and sincere vision of the threats and opportunities to water and energy. The book provides a complete and integral view of the water and energy related problems, and moreover in a very pedagogical and intuitive way. Only somebody like Gustaf Olsson with his long experience and knowledge in this field, at local and global scale, and unquestionable prestige, could write such an interesting book." DR. MANEL POCH and DR. IGNASI RODRIGUEZ-RODA, ICRA, Catalan Institute for Water Research, Girona; DR. QUIM COMAS, University of Girona, Catalonia

About the Author
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