



# Water and Energy: Threats and Opportunities

*Gustaf Olsson*

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## **Water and Energy: Threats and Opportunities** Gustaf Olsson

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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