Preface

The water–energy nexus raises a set of public policy questions that go far beyond water and energy. Economic vitality and management of scarce and precious resources in the West, including its magnificent rivers and landscapes, are at stake. For this reason, it is important that the public and decision-makers have a solid foundation of science, economic analysis, and law in order to develop policy strategies. The present work seeks to make a contribution to the body of knowledge and understanding regarding water, energy, and the links between the two in the American West. The contributions to this book indicate that we have choices that allow us to avoid unnecessary harm in the development and management of water and energy systems to meet our needs. Indeed, if thoughtfully designed, new technologies and approaches can help restore damaged environments and provide a range of benefits.

This book approaches the subject in several ways. In Part I (Chapters 1 and 2), the basic methodologies and approaches to analysis of energy inputs to water systems, and conversely, water requirements of different energy systems, are outlined. Opportunities to improve efficiencies in water and energy systems can provide significant economic, social, and environmental benefits. Policy strategies for both water and energy management can and should take advantage of these opportunities and multiple benefits. This introduction is followed by a discussion of environmental issues relating to water management and energy systems with a particular focus on impacts to fish.

Water for energy is the topic of Part II (Chapters 3 through 7). We start with coal, America's largest fuel source, and cover issues relating to conversion of primary energy to electricity, including the prospects for carbon capture and sequestration (CCS). Water uses and impacts from oil shale development are discussed next, with analysis of current and proposed development. Then the tables are turned with a discussion of water produced, rather than consumed, in coalbed methane production. Legal, technical, and scientific issues relating to management of the potential impacts of this produced water are covered. In addition to these important fossil fuel issues, there are water challenges relating to renewable energy. Two chapters address solar thermal power production and biofuels. These

topics illustrate how technology choices lead to vastly different water requirements, and that whole-system analysis of options is critical.

Water systems are major users of energy. Part III (Chapters 8 through 12) addresses a number of key topics and specific cases of energy uses for water. Energy use for the Central Arizona Project (CAP) is the first project discussed. Like the energy-intensive water systems in California, Arizona's pumping requirements consume large amounts of energy. As shown by a review of several major proposed water supply projects, this trend toward more energy-intensive water systems is spreading across the West. Desalination is also increasingly popular and, like many of the proposed interbasin transfers, also requires large amounts of energy. The status of desalination technology and implementation in the West is outlined. Case studies in Arizona and Utah provide further insights with regard to the energy demands of water management, which can vary significantly from region to region.

The final Part of the book (Chapters 13 through 17) examines policies and approaches as we move forward. Adaptive management strategies are outlined, and decision-support tools are presented. Specific plans being developed and implemented by the Western Governors' Association (WGA) are described. An analysis of renewable energy development in the Southwest and its water implications relative to alternative options is presented. Finally, a senior policy-maker describes efforts in California to develop and implement policy initiatives to improve water use efficiency, energy efficiency, and reduce greenhouse gas emissions in an integrated approach.

As this overview suggests, this book covers a lot of ground. Nonetheless, many additional issues exist. For example, we were not able to cover several new challenges such as water use for hydraulic fracturing, or 'fracking' in shale gas extraction, which is emerging as an important issue in regions throughout the country. Nor have we focused on water use in nuclear energy generation, though we note that the use of recycled water in Arizona for nuclear power production is on the cutting edge of both technology applications and policy development. Finally, we did not have space for a proper analysis of hydropower in the West and its role in the water-energy nexus, a subject covered at length in countless other publications.

The contributors to this book have significantly advanced the knowledge and discourse on the water-energy nexus, although there is more to be done. Important public policy questions regarding both water and energy crowd the agenda of federal, state and local decision-making bodies throughout the region. This work highlights key issues and opportunities, as well as methodologies and tools for applying this knowledge.

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