Hixon Center for Urban Ecology

Student Research Fellows

Water-Energy Nexus: A Critical Review

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Problem Statement

After scientists and decision makers trying to solve energy and water problems separately for several decades, more and more of them begin to realize that the two fundamental resources are not independent from each other. The interconnections between them, called water-energy nexus (Figure 1), are key for both of them to achieve sustainable outcomes. A comprehensive and in-depth understanding of the water-energy nexus is essential to achieve sustainable resource management.

Methodology

Following the structure of hierarchy of knowledge, this paper synthesized existing data and information, identified major research gaps, suggested a methodological framework for prospective research, and acknowledged potential challenges by reviewing over 90 publications in this field throughout the past forty years. System dynamics (SD) and life cycle analysis (LCA), which feature in simulating dynamic behaviors and assessing environmental impacts of interrelated social, managerial, economic, and ecological systems are proposed to be promising research approaches that will facilitate our understanding in the field of water-energy nexus.

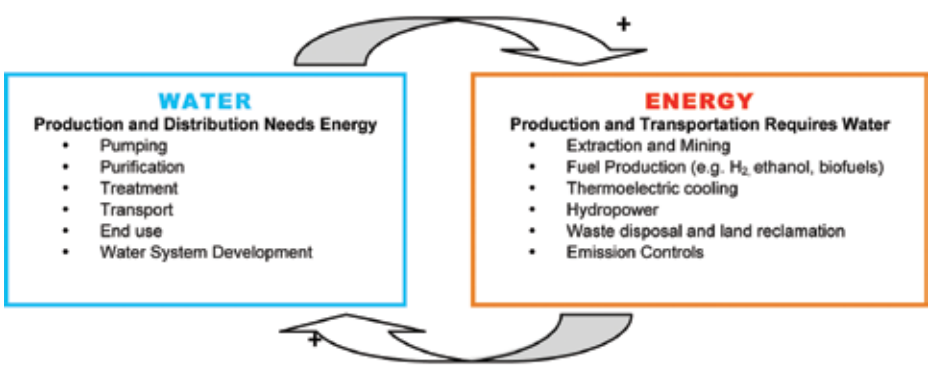

Figure 1
Water-Energy Nexus: the interrelationship between water and energy use (Adapted from Newmark, 2010)

Results

Data & Information Synthesized qualitative information is organized in tables. A spreadsheet data bank is built to document the quantitative information, including energy consumption by water utilities and water-related end users, and water withdrawal and consumption by energy extraction, production and electricity generation. Graphs are created to help analysis and communication (Figure 2 as an example).

Knowledge & Understanding from different perspectives are growing rapidly in this relatively new area. Main methodologies that have been applied to improve our understanding and knowledge are summarized. Their strengths and weaknesses are discussed.

Theory & Optimization In order to reach theory and optimization phase, there is a lot to be accomplished in this young research field. A few potential research topics have been identified by federal research agencies (Hightower 2006, Hoffman 2010). Some of the key words are: **Data quality, Coordination and collaboration, Predictive modeling, Water-efficient technology, System approach, and Water reuse**. Based on existing information, knowledge, and research gaps identified, a methodological framework is proposed by this paper and discussed below.

Framework for Prospective Research

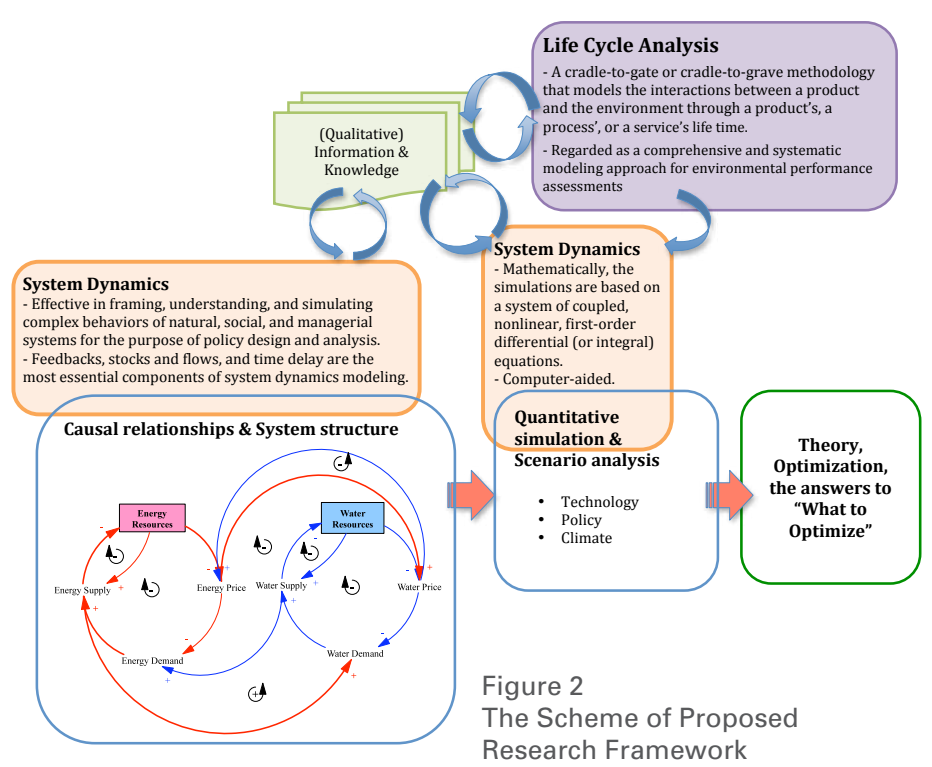

Figure 2
The Scheme of Proposed Research Framework

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