Critical Assessment of Implementing Desalination Technology
[Project #4006]

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OBJECTIVES:
The objective of the study was to identify and evaluate the full range of water quality, energy, environmental, economic, social, and regulatory aspects of implementing desalination technologies. This was accomplished through a comprehensive literature review, a survey of facilities, an expert workshop, case studies, and analysis, and resulted in the development of guidance to critically assess the implementation of desalination technologies.

BACKGROUND:
There are a number of technical, environmental, economic, social, and institutional implications associated with the implementation of desalination technologies. These factors are critical to planning and implementing desalination projects. However, there is not a well developed and disseminated knowledge base on the critical issues affecting the implementation of these systems, and an in-depth analysis was needed to identify the broad spectrum of challenges associated with desalination technologies.

HIGHLIGHTS:
Based on a comprehensive literature review, utility surveys, expert workshop, and interviews, the criteria identified as the major challenges in implementing desalination planning are associated with the following elements:

- Intake systems and pretreatment
- Product water quality and post-treatment
- Concentrate management and disposal
- Energy consumption
- Associated costs
- Environmental impacts
- Social, political, and institutional perspectives

The report describes each of these elements, and also includes an academic review of the multiple criteria decision analysis (MCDA) process and highlights its use as a potential tool for assessing desalination projects.

APPROACH:
This research was conducted in three phases: data collection, case study analysis, and MCDA review. The data collection included a literature review, utility surveys, and an expert workshop. The literature review included grey and peer-reviewed literature, reports from government agencies, and ongoing desalination projects. Surveys examined membrane desalination facilities at varying stages of planning and operation in the United States, Europe, Asia, and Australia. Issues encountered during the implementation of desalination projects were discussed
in-depth through workshop and interviews with stakeholders and utility representatives. Seven desalination case studies representing projects in California, South Florida, Colorado, Arizona, Australia, the United Kingdom, and Israel were conducted. The information collected was further used to develop an academic MCDA decision support framework to evaluate the sustainability of desalination. The framework was not tested in this study.

RESULTS/FINDINGS:
- Intake and pretreatment systems are key technical components that are important in controlling membrane stability and efficiency, product water cost, and environmental impacts such as impingement and entrainment.
- Membrane systems produce high water quality, but require appropriate post-treatment to address the side effects such as lack of basic micronutrient minerals, as well as corrosivity and compatibility problems in blending and distribution.
- Concentrate disposal management and its associated environmental concerns represent the largest challenge to inland desalination and may incur challenging permitting conditions and exorbitant costs.
- The energy demands of desalination technologies cause concerns of energy cost increases, as well as associated greenhouse gas emissions. Ways to lower energy demand through more efficient design and incorporating carbon neutral schemes such as renewable energy or carbon offset programs are desired.
- Despite its higher costs, economic considerations should include the externalities of desalination projects such as diversifying water resources, decreasing water-overdraft, and providing a more constant and/or better water source. Highlighting such values can present desalination as an investment.
- Social, political, and institutional issues are important in perception and regulatory action. Social perceptions and regulatory actions are typically regional and have site-specific concerns.

IMPACT:
The study provides water utilities and decision makers with a comprehensive documentation and knowledge base on implementing desalination technology. Four main recommendations were formulated to improve the implementation of desalination:
- Conduct a thorough feasibility study and pilot testing
- Address environmental concerns early and effectively
- Lead a collaborative, open, and transparent dialogue with the general public, special interest groups, political parties, and regulatory agencies
- Consider a MCDA approach to evaluate the full aspects of desalination projects, and to support the decision making process

RESEARCH PARTNER:
Drinking Water Inspectorate

PARTICIPANTS:
Project participants included utilities, companies, governmental organizations, and universities from the United States, United Kingdom, Australia, and Israel.