The Water-Energy Nexus in the GCC Countries

Evolution and Related Policies

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Overview

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Introduction

- GCC countries are situated in one of the driest regions of the world with limited endowment of water resources
- Limited water resources and escalating sectoral water demands
- **A major challenge**: Efficient water management and its sustainable provision to accelerating socio-economic activities
- Many pressing driving forces: high population growth, increasing food demand, anticipated climate change impacts, heavy financial/economic burden and low cost recovery, ...
- Challenge is compounded by multiple nexuses: water and health, water and environment, **Water and Energy**, water and food, ....
- We need to think beyond the boundaries of the classical water sector, understand these nexuses, and find opportunities for the efficient planning and management of water resources.
The Water-Energy Nexus

- Water and Energy in the GCC countries are strongly inter-linked and are highly inter-dependent (not always recognized)
  - **Energy is used in almost every stage of the water cycle:** extracting groundwater, feeding desalination plants and producing freshwater, pumping, conveying, and distributing freshwater, collecting wastewater and treatment and reuse
  - **Water is needed for water** production (CPDPs), cooling, energy exploration & production, refining, and EOR

Schematic of the Water-Energy Relationships (WCSBD, 2009)
Scarcity of natural freshwater resources a major factor for the increase in energy demand

Availability of fossil fuel in the GCC an important factor in (Desalination) providing water and modifying per capita water share

Distribution of water and energy resources in MENA (Haering and Hamhaber, 2011 )

Per Capita “Available” Water Share in GCC, 1950-2010

Water Poverty

Acute Water Poverty
Desalination: the Heart of the Water-Energy Nexus

- GCC countries own 40% of world total capacity
- Current desalination capacity 9.5 billion m³/y, by 2016 it will reach 18 billion m³/y; annual rate of increase is expected to be maintained over the next decade
- In some GCC CPDPs consumes >50% of total energy consumption; cost of energy = 87% of the running cost

Accumulated current and near term total contracted capacity in GCC countries (GWI, 2010)
Understanding the Water-Energy Nexus

- Considerable number of researches and studies (more than 20,000) on the relation between water and energy; starting from the 1990s

- However, researches on the nexus itself (i.e., dealing explicitly with, and recognizing the water-energy nexus from a planning and management perspectives) is very limited (27 publications) is available; started in the mid 1990s, increased in the last 5 years
Awareness & Policies

GCC Abu Dhabi Declaration 2010

- Recommendations related to Water, Energy, and Food as the most important issues in the region
- Called for a long-term comprehensive strategy for water resources in the GCC
  - To take into account inter-dependencies between water, energy and agriculture, impacts of climate change, and environmental impacts of desalination
  - To emphasis water demand management and conservation
- Many recommendations on water and energy use efficiency and conservation (economic, technological, legislative, and societal awareness)
- Linked water security with energy security, both as a crucial strategic priority for the future of the GCC
Called for more integrated approaches between water and energy.

Efficiency measures in both water and energy promise to have multiple advantages (every unit of water conserved is a unit of energy saved, and vice versa).

Both large scale technological options and small scale decentralized technologies are important.

Understanding the governance options (social, managerial, technical, etc.) of both resources is key for sustainable solutions.

Need for research to understand the water-energy nexus.

Exploring the options for demand side management in both, water and energy systems, is paramount (including technological and behavioral innovations).
WSTA 10th Gulf Water Conference
“Water in the GCC…the Water-Energy-Food Nexus”

- The sustainable provision of water, energy, and food under the current accelerating population and economic growth rates in the GCC countries represents one of the major challenges faced by these countries.

- An integrated planning and management approach for water, energy, and agriculture, is an important and vital task to meet the demand on these resources and their future sustainability in these countries.

- A knowledge gap on the water-energy nexus in the GCC need to be bridged by concentrated research.

- Directing of universities and research institutes of their academic and research programs towards understanding the nexus and their interdependencies and inter-linkages, as well as renewable energies (solar) and desalination.
IGCM on the Water-Energy Nexus in ESCWA 2012

- Determination and Prioritizing the Water-Energy Nexus issues in the region and for future work program of the Water and Energy Committees based on a set of criteria
  - Increasing Knowledge and Awareness Raising
  - Increasing Water and Energy Policy Coherence
  - Examining the Water-Energy Security Nexus
  - Increasing Water and Energy Use Efficiency
  - Informing Technology Choices
  - Promoting Renewable Energy
  - Climate Change and Natural Disasters (Driver)
Arab Regional Implementation Meeting (RIM) for the 20th Session of the Commission for Sustainable Development (CSD-20), Dubai, 2013 (this month)

- In the updated “Sustainable Development Initiative in the Arab Region”
  - The Water Energy Nexus is placed as a priority for the region
Initiatives on the Water-Energy Nexus

- Many initiatives in the region addressing the Nexus (QNFSP, MASDAR, MEDRC, ...)

- **King Abdullah Initiative for Solar Water Desalination (2010)**
  - All Desalination of sea water in the Kingdom to be done completely by Solar Energy in 9 years starting 2010

- Initiative objectives (Al Saud, 2010):
  - Desalinate seawater by solar energy at low cost to contribute to the Kingdom’s water security and support the national economy
  - Applying nanotechnologies developed in the field of Photovoltaic and RO membrane systems
  - Build advance industries advocated by the Industrial strategy of the Kingdom;
  - Develop clean energy and protect the environment
King Abdullah Initiative for Solar Water Desalination (2010)

Three Phases (implemented by King Abdulaziz City for Science and Technology (KACST) over nine years:

- **Phase I**: Construction of a solar-powered desalination plant (10 MW and RO) at Al-Khafji Town (30,000 m³/day).
- **Phase II**: Construction of another solar-powered desalination plant (300,000 m³/day)
- **Phase III**: Construction of several solar plants for desalination in all parts of the kingdom
Conclusion & Recommendations

- The knowledge gap in the water-energy nexus in the GCC need to be bridged by concentrated active research to identify
  - Inter-dependencies (e.g., efficiency relationship in both resources)
  - Current and future challenges
  - Opportunities (e.g., potential of energy capture from wastewater treatment plants)
  - Appropriate and effective governance, institutional, and organizational frameworks

- Exploring the options for demand side management in both water and energy systems is more promising than the supply side management (including technological and behavioral)

- Water and Energy are strongly interlinked and warrant close cooperation/coordination in planning and management, even joint planning to achieve efficient management of both