CONSIDERING A SECTOR OR NEXUS APPROACH TO THE WATER-RELATED SDGs IN THE ARAB REGIONAL CONTEXT

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Table of Contents

Introduction: Nexus Approach

The Water-Energy-Food Security Nexus in the Arab Region

The Nexus Approach to SDGS

Developing the capacity of ESCWA Member Countries to address the Water –Energy Nexus for achieving Sustainable Development Goals
The Sector or Nexus Approach

- **Sector approach**: Independent management of water, energy and food sectors with minimal considerations for interactions and interdependencies → Independent approach to each SDG

- **Nexus approach**: is a systems based approach that aims to reduce trade-offs and build synergies across sectors by considering interactions and dependencies between sectors at all stages

- The Nexus approach aims at **enhancing the efficiency** of the entire system rather than increasing the productivity of specific sectors often at the expense of other sectors

- Nexus approach to SDGs would identify potential trade-offs and synergies among Goals and Targets → Consider systemic not only sectoral progress
Elaborating a WEF security nexus within the context of sustainable development

The WEF security nexus within the context of SDGs

2. **ZERO HUNGER**

End hunger, achieve **food security** and improved nutrition and promote **sustainable agriculture**

6. **CLEAN WATER AND SANITATION**

Ensure availability and **sustainable management** of water and sanitation **for all**

7. **AFFORDABLE AND CLEAN ENERGY**

Ensure access to **affordable, reliable, sustainable and modern energy** **for all**
Energy for Water

Energy

Abstraction
0.36 kWh is needed to lift 1m\(^3\) of groundwater a vertical distance of 100m

Transmission
0.04 kWh is needed to pump 1m\(^3\) of surface water a horizontal distance of 100km

Wastewater Treatment
- Primary treatment 0.1 to 0.3 kWh/m\(^3\)
- Secondary Treatment 0.27 to 0.59 kWh/m\(^3\)

Water Treatment
Varies depending on water quality, up to 0.3 kWh/m\(^3\)
# Energy for Water: Desalination

<table>
<thead>
<tr>
<th>Seawater Desalination Technology</th>
<th>Electrical energy use (KWh/m³)</th>
<th>Thermal energy – stand-alone (MJ/m³)</th>
<th>Thermal energy – cogeneration (MJ/m³)</th>
</tr>
</thead>
<tbody>
<tr>
<td>RO (brackish)</td>
<td>0.5-2.5</td>
<td>None</td>
<td>None</td>
</tr>
<tr>
<td>RO (sea)</td>
<td>5-9</td>
<td>None</td>
<td>None</td>
</tr>
<tr>
<td>Multi-effect distillation (MED)</td>
<td>1.5-2.5</td>
<td>150-220</td>
<td>100</td>
</tr>
<tr>
<td>Multi-stage Flash (MSF)</td>
<td>3.5-5</td>
<td>250-300</td>
<td>160-170</td>
</tr>
</tbody>
</table>

Energy for Water: Treated Wastewater Reuse

Energy Demand of Water in the Arab Region

- Jordanian water sector accounts for ~15% of total annual electricity generated

- Saudi Arabia: Groundwater pumping accounts for 10% of total fuel consumption

- Libya: Groundwater pumping accounts for 14% of total fuel consumption

- Bahrain: 30% of total energy use is for desalination
Water for Energy: Hydropower

- On the Euphrates River Basin 8,580MW installed capacity
- On the Nile River Basin, hydropower potential is ~20GW, only 26% is currently used
Water for **Energy**: Cooling Systems

- Cooling systems advantages and disadvantages

<table>
<thead>
<tr>
<th>Cooling Type</th>
<th>Water Withdrawal</th>
<th>Water Consumption</th>
<th>Capital Cost</th>
<th>Plant Efficiency</th>
<th>Ecological Impact</th>
</tr>
</thead>
<tbody>
<tr>
<td>Once-Through</td>
<td>Intense</td>
<td>Moderate</td>
<td>Low</td>
<td>Most efficient</td>
<td>Intense</td>
</tr>
<tr>
<td>Wet Cooling</td>
<td>Moderate</td>
<td>Intense</td>
<td>Moderate</td>
<td>Efficient</td>
<td>Moderate</td>
</tr>
<tr>
<td>Dry Cooling</td>
<td>None</td>
<td>None</td>
<td>High</td>
<td>Less efficient</td>
<td>Low</td>
</tr>
</tbody>
</table>

- Comparison of consumptive water use of various power plant technologies using various cooling methods.

<table>
<thead>
<tr>
<th>Technology</th>
<th>Cooling Technology</th>
<th>Consumptive Water Use (m³/MWh)</th>
<th>Performance Penalty</th>
<th>Cost Penalty</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coal / Nuclear</td>
<td>Once-Through</td>
<td>87 – 102</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Recirculating</td>
<td>1.5 – 2.8</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Dry cooling</td>
<td>0.19 – 0.25</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Natural Gas</td>
<td>Recirculating</td>
<td>0.76</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Power Tower</td>
<td>Recirculating</td>
<td>1.9 – 2.8</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Combination Hybrid Parallel</td>
<td>0.34 – 0.95</td>
<td>1 – 3 %</td>
<td>5 %</td>
</tr>
<tr>
<td></td>
<td>Dry cooling</td>
<td>0.34</td>
<td>1.3 %</td>
<td></td>
</tr>
<tr>
<td>Parabolic Trough</td>
<td>Recirculating</td>
<td>3</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Combination Hybrid Parallel</td>
<td>0.38 – 1.7</td>
<td>1 – 4 %</td>
<td>8 %</td>
</tr>
<tr>
<td></td>
<td>Dry cooling</td>
<td>0.3</td>
<td>4.5 – 5 %</td>
<td>2 – 9 %</td>
</tr>
<tr>
<td>Dish / Engine</td>
<td>Mirror Washing</td>
<td>0.08</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fresnel</td>
<td>Recirculating</td>
<td>3.8</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Water for **Energy:**

Selected examples for water-induced cuts in hydro, coal and nuclear power generation

<table>
<thead>
<tr>
<th>Country</th>
<th>Fuel</th>
<th>Year</th>
<th>Impact</th>
</tr>
</thead>
<tbody>
<tr>
<td>Brazil</td>
<td>Hydro</td>
<td>2015</td>
<td>Electricity rationing and rolling power cuts</td>
</tr>
<tr>
<td>USA, California</td>
<td>Hydro</td>
<td>2015, 2014</td>
<td>Hydro generation in 2014 at 50% of its value in 2013</td>
</tr>
<tr>
<td>India</td>
<td>Hydro</td>
<td>2012</td>
<td>Blackouts lasting two days and affecting over 600 million people</td>
</tr>
<tr>
<td>China</td>
<td>Hydro</td>
<td>2011</td>
<td>Strict energy efficiency measures, electricity rationing</td>
</tr>
<tr>
<td>Vietnam, Philippines</td>
<td>Hydro</td>
<td>2010</td>
<td>Reduced generation, electricity shortages</td>
</tr>
<tr>
<td>Ecuador</td>
<td></td>
<td>2009</td>
<td>Electricity crises, blackouts across Ecuador</td>
</tr>
<tr>
<td>Uganda</td>
<td></td>
<td>2006, 2004</td>
<td>Reduced generation, supply stress, price increases</td>
</tr>
<tr>
<td>Kenya</td>
<td></td>
<td>2002, 1999</td>
<td>Reduced generation by 25%</td>
</tr>
<tr>
<td>Poland</td>
<td>Coal</td>
<td>2015</td>
<td>Restrictions on industrial demand due to reduced coal power generation</td>
</tr>
<tr>
<td>Germany</td>
<td></td>
<td>2015</td>
<td>Reduced generation from two coal power plants</td>
</tr>
<tr>
<td>Australia</td>
<td></td>
<td>2009, 2007</td>
<td>Reduced generation and electricity price peaks</td>
</tr>
<tr>
<td>USA, Connecticut</td>
<td>Nuclear</td>
<td>2012</td>
<td>One of two reactors shut down due to high sea-water temperatures</td>
</tr>
<tr>
<td>USA, Illinois</td>
<td></td>
<td>2012</td>
<td>Operation beyond cooling pond temperature limits</td>
</tr>
<tr>
<td>USA, Alabama</td>
<td>Nuclear</td>
<td>2011, 2010, 2007</td>
<td>Reduced generation</td>
</tr>
<tr>
<td>France, Germany, Spain</td>
<td>Nuclear</td>
<td>2006</td>
<td>Reduced generation due to high river water temperatures</td>
</tr>
<tr>
<td>France</td>
<td></td>
<td>2003</td>
<td>Reduced generation equivalent to the load of 4 to 5 reactors; operation beyond temperature limits</td>
</tr>
</tbody>
</table>

Water for Energy

Extraction/Processing of fuels
- 16.7 to 46 litres of water per barrel of extracted oil
- 2.6 to 4 barrels of water to produce one barrel of oil from oil shale
- Processing requires 200 to 800 litres of water per ton of crude oil

Produced water
- Oman has highest water-oil ratio of between 6:1 and 10:1
- UAE has the lowest water-oil ratio of 0.35:1
Water and Energy for Food

- Indirect
  - Fertilizers (W+E)
  - Pesticides (W)

Energy embedded in global annual food loses can reach up to 38% of the total energy used in the entire food value chain.

Note: Data for the State of Palestine is not available.
Food for Water

Water quality
- Siltation
- Contamination
  - Pesticides
  - Fertilizers

Cover Crops

Mulching

Landscape management (runoff capture)
Food for Energy

Biomass power

Biofuels

Food
Case Study From the Disi Aquifer System

**Water-Energy-Food Security Nexus**

- Disi Aquifer is non-renewable
- High energy cost of pumping and transferring of water
- **Disi water conveyance project** pumps water over 325km with a total energy requirement of 2% of Jordan’s annual energy consumption
- Competition between end users, Agricultural-Domestic
- Technical MoU signed between the two countries which included a no drill zone
- Future agreements in light of the Water-Energy-Food Security Nexus
Climate change and the WEF security nexus

- ESCWA is coordinating the Regional Initiative for the Assessment of the Impact of Climate Change on Water Resources and Socio-Economic Vulnerability in the Arab Region (RICCAR) which is being implemented in partnership with the League of Arab States and 11 regional and international organization and three climate research institutes.

- The effects of climate change do not hit a particular sector and country, but much rather resonate across a wide spectrum.

- Consistent warming trend with a general increase in the frequency of warm days and longer summer periods across the Arab region

- The WEF security nexus approach has the potential to effectively harmonize these interactions across sectors and countries.
RICCAR Partnerships

Implementing Partners (11)

ESWA
UNEP
WMO
ACSAD
LAS
SMHI
UNESCO
UNISDR

Donors

SWEDEN

Collaborating Research Institutes

- Center of Excellence for Climate Change Research/ King Abdulaziz University (CECCR/KAU) - KSA
- King Abdullah University of Science and Technology (KAUST) - KSA
- Climate Services Center 2.0 (CS2.0) - Germany
ESCWA Water Development Report 6 (2015), addresses:

- ESCWA’s vision for a water-energy-food security nexus for the Arab region within the context of sustainable development
- The Nexus from a shared basin perspective
- Energy and water interdependencies for improved services
- Water and energy for food security
- Recommendations for improved integrated natural resources management

Available at: https://www.unescwa.org/our-work/water
Considering a nexus approach to the water-related SDGs in the Arab regional context

- **Participatory** systems based approach that aims to **reduce trade-offs** and build synergies across sectors by considering interactions and dependencies between sectors at all stages and levels.

- When goals are the starting point, stakeholders in different sectors have little occasion to interact and coordinate their efforts → Goal-focused approach may lead to often redundant and even conflicting targets.

- A key principle of the SDGs is **universal**ity – that the goals will be relevant to all countries, and all will contribute to achieving them, but with differentiated targets and actions. The nexus approach is entirely compatible with this principle.

- Identify potential trade-offs and synergies among **Targets** → Consider systemic not only sectoral progress.
Considering a nexus approach to the water-related SDGs in the Arab regional context

- To be successful, a nexus approach will have to go beyond just clustering related targets and actually examine the interactions. Develop methods for monitoring and accountability that will make it possible to recognize trade-offs and act to avoid them.

- Targets can be seen as building blocks that each country or region will cluster in its own way, balancing the need for ensuring access to resources, efficiency, and long-term sustainability to fit the local context and capabilities. A nexus approach can facilitate selection of a suitable set of actions for a specific country or region.

- Regional specific indicators that monitor systemic progress and not only sectoral progress?

- Maintain focus on improving lives
ESCWA Nexus Related Activities

Developing the capacity of ESCWA Member Countries to address the water and energy nexus for achieving sustainable development goals

ESCWA secured funding from the United Nations Development Account to implement a project on developing the capacity of ESCWA member countries to address the water and energy nexus for achieving sustainable development goals, starting December 2014 and lasting until December 2017

The project aims to:

- Build the capacity of ministries and public service providers who are responsible for water and energy in the region, so that they adopt the nexus approach and address water and energy issues in an integrated manner.
- Assist ESCWA member States in bringing the nexus approach to the sustainable development goals in a post-2015 development framework.
ESCWA Nexus Related Activities
Developing the capacity of ESCWA Member Countries to address the water and energy nexus for achieving sustainable development goals

The project will be pursued through 2 complimentary capacity building interventions:

- High level officials in Ministries
  - Preparation of a regional policy toolkit
  - Regional Policy training workshop
  - Three pilot projects
  - Regional knowledge exchange workshop
  - Resource efficiency training workshop
  - Technology transfer training workshop
  - Renewable energy training workshop

- Public service providers
  - Preparation of 3 technical toolkits
THANK YOU

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