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POLICY BRIEF

THE WATER-ENERGY NEXUS: THE PATH TO SOLVING THE WATER CRISIS IN THE MIDDLE EAST AND NORTH AFRICA

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MENA faces a severe water crisis, with 12 of the world's 17 most water-stressed countries. Climate change, population growth, inefficient water management, and weak governance drive this challenge. Water production, treatment, and distribution require high energy inputs, while energy generation depends on water for cooling and refining.

The region must integrate renewable energy, especially solar power, into water solutions like desalination. Inaction could shrink GDP by up to 14% by 2050, while a $500 billion investment over the next decade could secure water resources.

Key solutions include renewable-powered desalination, modernized water networks, large-scale wastewater recycling, and innovative financing through green bonds, public-private partnerships, and sovereign wealth funds. Regional collaboration on transboundary water management and shared desalination projects remains essential.

MENA must act now. By integrating sustainable water-energy strategies, the region can secure its future and drive stability and growth.

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INTRODUCTION

Water scarcity is one of the most critical challenges confronting the Middle East and North Africa (MENA) region, posing significant threats to economic stability, food security, and social cohesion. Of the world's 17 most water-stressed countries, 12 are located within MENA, meaning the crisis is already shaping economic policies, political stability, and regional security frameworks (World Bank, 2023). Water scarcity in the region is exacerbated by a confluence of factors, including climate change, rapid population growth, inefficient water management practices, and outdated governance structures. However, an often-overlooked part of MENA's water crisis is its intrinsic linkage to energy systems. The water-energy nexus—the interdependence of water and energy resources—presents both challenges and opportunities for sustainable solutions (Sadoff et al, 2015).

Water production, distribution, and treatment require substantial energy inputs, while energy generation depends heavily on water for cooling, refining, and production processes. While some MENA countries (e.g., Gulf states) have vast oil and gas reserves, others (e.g., Jordan, Lebanon, Morocco, Tunisia) rely heavily on energy imports, making them vulnerable to price fluctuations and supply disruptions. In a region where both water and energy are scarce, addressing one crisis without exacerbating the other requires a holistic and integrated approach. MENA has vast solar potential, (the key word here is potential), which could alleviate the energy burden of desalination and water distribution. However, investment in large-scale solar projects and grid integration remains a challenge. MENA, endowed with abundant solar energy potential and a growing desalination infrastructure, stands at a critical juncture. The region must decide whether to leverage technological advancements and policy reforms to establish a sustainable water-energy framework, or risk deepening the crisis through mismanagement and short-term fixes.

This paper explores the pivotal role of the water-energy nexus in addressing MENA's water crisis. It examines the current landscape of water scarcity, the interdependence between water and energy systems, the potential of desalination and renewable-energy technologies, the economic rationale for bold action, and innovative financing mechanisms to drive a new water strategy. Additionally, the paper delves into case studies, opportunities for regional cooperation, and the role of technology and innovation in shaping the future of water security in MENA.

THE MAGNITUDE OF MENA'S WATER CRISIS

Climate Change: A Regional Threat Multiplier

The MENA region is disproportionately affected by climate change, with rising temperatures, erratic precipitation patterns, and increasing evaporation rates placing immense pressure on already limited freshwater resources. MENA is the most water-scarce region globally, holding only 1% of the world's freshwater resources, while containing nearly 6% of the global population (World Bank, 2023). The region's per-capita renewable water availability is well below the threshold of absolute water scarcity, defined as 500 cubic meters per year. Countries including Jordan, Yemen, and parts of the Gulf are experiencing extreme water shortages, with per-capita water availability falling below 100 cubic meters annually (UN Water, 2023). By 2030, water demand in MENA is projected to outstrip supply by 50%, exacerbating an already precarious situation (World Bank, 2022).

Several structural factors contribute to this crisis:

1. Climate Change and Rising Temperatures: Extreme weather events, including prolonged droughts, are exacerbating water scarcity, undermining agricultural productivity and forcing rural communities to migrate. Higher temperatures increase evaporation rates and reduce surface water availability. Climate models predict that rainfall in North Africa and the Levant will decline by 10%-20% by mid-century (IPCC, 2022). For instance, Morocco has experienced a 30% reduction in rainfall over the past two decades, severely impacting its agricultural output and water reserves (World Bank, 2021).

2. Population Growth and Urbanization: MENA's population, projected to exceed 500 million by 2050, is raising water demand across urban centers and rural areas. Urbanization compounds this pressure, because cities require vast amounts of water for domestic, industrial, and agricultural use. This phenomenon is particularly striking in cities including Cairo, Riyadh, and Dubai, where rapid urban growth has placed immense pressure on existing water infrastructure, leading to inefficiencies and inequities in water distribution (UNDP, 2022). Refugee movements, particularly in Jordan and Lebanon, have further strained limited water resources. For example, the influx of Syrian refugees caused Jordan's water demand to rise by 20% over approximately five years, from 2011 to 2016 (World Resources Institute, 2023).

3. Agricultural Overuse: Agriculture accounts for nearly 85% of MENA's total freshwater withdrawals, with inefficient irrigation practices wasting up to 60% of the water used (FAO, 2021). In countries such as Egypt, where agriculture is a cornerstone of the economy, outdated flood irrigation methods continue to deplete the Nile River's resources (World Bank, 2020). Without modernization, the agricultural sector will continue to exacerbate water stress, threatening food security and rural livelihoods.

4. Groundwater Depletion: Over-extraction of non-renewable aquifers has led to alarming depletion rates (Gleick, 2018). Countries including Saudi Arabia and Jordan are rapidly exhausting their underground reserves. For instance, Saudi Arabia's fossil aquifers, which took millennia to form, are being drained at an unsustainable rate to support agricultural exports such as wheat (World Bank, 2022).

5. Political Instability and Poor Governance: Conflicts in Syria, Iraq, and Yemen have damaged water infrastructure, leaving millions without access to clean water (World Bank, 2023). In Yemen, the ongoing civil war has destroyed water-treatment facilities, leading to widespread cholera outbreaks (UNICEF, 2021). Additionally, shared rivers including the Tigris, Euphrates, Jordan, and Nile have seen reduced flows caused by climate variability and upstream diversions (FAO, 2022). The Tigris-Euphrates basin, shared by Iraq, Syria, and Turkey, is projected to experience a 30% decline in flows by 2050, threatening agriculture and domestic water supplies. Similarly, the Jordan River, vital to Jordan, Israel, and Palestine, has suffered from overuse and pollution, exacerbating shortages. The Nile River, critical to Egypt, is under increasing stress because of upstream developments, such as Ethiopia's Grand Renaissance Dam, heightening geopolitical tensions.

The Economic Cost of Inaction

The consequences of failing to address water scarcity are severe. Water stress could reduce MENA's GDP by up to 14% by 2050, leading to economic instability, forced migration, and heightened conflict (World Bank, 2023). Reduced water availability in Iraq and Syria

has driven significant agricultural declines, forcing rural populations to migrate to urban centers, creating social and economic strain. In Egypt, disruptions to Nile flows could undermine food production, hydropower generation, and economic stability, with ripple effects across the region.

As natural water sources dwindle, countries are increasingly turning to technological and energy-intensive solutions, particularly desalination. The water-energy nexus highlights the interdependence between water and energy systems. Water is essential for energy production, while energy is required to extract, treat, and distribute water.

WATER-ENERGY NEXUS: THE KEY TO MENA'S WATER SECURITY

Integrating Renewable Energy for Sustainable Water Management

The water-energy nexus in MENA is characterized by a paradox: the region's water crisis requires energy-intensive solutions, yet its energy systems often depend on significant inputs of water (Siddiqi and Anadon, 2011). Addressing water scarcity, therefore, cannot be decoupled from energy policies. In MENA, where both water and energy are scarce, integrating renewable energy into water systems provides a pathway for sustainable resource management. This approach reduces environmental impacts, enhances efficiency, and mitigates climate risks, creating a resilient framework for addressing the region's water challenges.

Some countries in the region have already taken steps to address this challenge. In Morocco, the Noor Ouarzazate Solar Complex powers desalination plants, providing clean water to rural communities while reducing carbon emissions (World Bank, 2022). Similarly, Jordan's Disi Water Conveyance Project highlights the challenges of balancing water and energy needs. While the project provides 100 million cubic meters of water annually, it consumes a significant portion of the country's energy supply (World Bank, 2021). These examples demonstrate both the potential and the trade-offs of integrating energy and water policies in MENA.

The Economic Imperative for Investment

Solving MENA's water crisis will require an estimated $500 billion over the next decade—equivalent to just 1.2% of the region's annual GDP (World Bank, 2022). In contrast, failing to act could shrink MENA's GDP by 6%-14% by 2050 as a consequence of declining agricultural productivity, rising water costs, and economic instability (Sadoff et al., 2015). Investing in sustainable water management would not only secure MENA's water future but also yield significant economic returns.

What Can $500 Billion Achieve?

- Renewable-Powered Desalination: Integrating solar and wind energy into desalination plants can reduce energy costs by 50%-60% (IRENA, 2018). The UAE's Mohammed bin Rashid Al Maktoum Solar Park is a pioneering example, powering desalination plants with renewable energy (World Bank, 2023).

- Modernized Water Networks: Upgrading aging infrastructure can reduce water losses, which currently account for 30%-50% of total supply in many MENA countries (World Bank, 2023).
- Wastewater Recycling at Scale: Expanding wastewater treatment facilities can provide a reliable source of non-potable water for agriculture and industry. Israel recycles 90% of its wastewater, setting a benchmark for the region (World Bank, 2021).

Beyond improving water security, these investments would have broader economic benefits. Every $1 billion invested in water infrastructure creates between 15,000 and 20,000 high-skilled jobs (ILO, 2020). By prioritizing long-term solutions that integrate energy and water strategies, MENA can build a more resilient and sustainable future.

FINANCING THE FUTURE: MOBILIZING $500 BILLION

To bridge the financing gap, MENA must leverage a mix of public and private capital. Potential funding mechanisms include:

Public and Private Financing Mechanisms

1. Public-Private Partnerships (PPPs): Attracting private investors to finance renewable-powered water projects. For example, Morocco's Noor Ouarzazate Solar Complex was developed through a PPP model (World Bank, 2022).

2. Green Bonds: Tapping into the $1.6 trillion global sustainable investment market (Climate Bonds Initiative, 2021). Egypt issued its first green bond in 2020, raising $750 million for renewable energy and water projects (World Bank, 2021).

3. Multilateral Development Banks: Engaging institutions such as the World Bank and the Green Climate Fund to provide concessional financing (World Bank, 2023).

4. Sovereign Wealth Funds (SWFs): Gulf nations can lead by allocating resources to water resilience projects. Saudi Arabia's Public Investment Fund has already invested in renewable energy and water desalination projects (World Bank, 2022).

5. Innovative Islamic Finance: Green Sukuks: The recent issuance of green sukuks (Islamic bonds) in the UAE and Saudi Arabia presents an innovative financing tool that can be expanded to support water-energy nexus projects (IMF, 2022). For example, the UAE's Dubai Electricity and Water Authority (DEWA) issued a $1 billion green sukuk in 2022 to fund renewable energy and water projects (World Bank, 2023).

Regional Collaboration and Policy Reforms

Water is a shared resource in MENA, with major rivers and aquifers crossing national boundaries. Effective management of these resources requires cooperation, yet geopolitical tensions often impede progress. Regional collaboration is not only an environmental necessity but also a geopolitical imperative to prevent resource-driven conflicts.

- **Transboundary Resource Agreements**

Shared rivers such as the Nile, Jordan, and Tigris-Euphrates require equitable management frameworks to ensure sustainability and stability. The World Bank's MENA Water Security Initiative fosters dialogue and trust among riparian states, enabling data sharing and conflict resolution (Zawahri and Mitchell, 2020).

- **A Regional Desalination Partnership**

A MENA Regional Desalination Partnership, supported by the World Bank, could pool resources to develop solar-powered desalination plants along the Mediterranean and Red Sea. This approach enables economies of scale, reducing costs while ensuring reliable water supplies for participating countries.

- **Policy Reforms for Sustainability**

Beyond financial investments and technological innovation, policy reforms play a crucial role in ensuring long-term sustainability. Decentralizing water governance by empowering municipalities fosters accountability and responsiveness, allowing local governments to implement solutions tailored to their specific needs (Al-Zu'bi, 2021). Reforming water tariff structures can incentivize conservation and ensure financial stability for utilities, provided that transparent communication mitigates public resistance. Additionally, fostering innovation through targeted subsidies, training programs, and strategic partnerships with the private sector can accelerate the adoption of efficient irrigation systems, wastewater recycling, and real-time monitoring technologies.

CONCLUSION: THE PATH FORWARD

MENA's water crisis cannot be solved in isolation from its energy challenges. The region's heavy reliance on energy-intensive water solutions, particularly desalination, requires a strategic shift toward renewables and efficiency-driven policies. By integrating solar energy into desalination, advancing wastewater reuse, and reforming water governance, MENA can chart a sustainable path forward.

However, none of this will be possible without bold financial strategies. Mobilizing $500 billion through green bonds, PPPs, and sovereign wealth funds is imperative. The water-energy nexus presents an opportunity: if managed wisely, it can drive technological innovation, economic diversification, and regional stability. The choices MENA leaders make today will determine whether the region can secure water for future generations, or if it will plunge deeper into crisis.

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The Policy Center for the New South (PCNS) is a Moroccan think tank aiming to contribute to the improvement of economic and social public policies that challenge Morocco and the rest of Africa as integral parts of the global South.

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