RESOURCE EFFICIENCY WITHIN THE WATER-ENERGY INTERLINKAGES:

ESCWA Resource Efficiency Operational Toolkit

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Economic and Social Commission for Western Asia

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UNITED NATIONS
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Expert Group Meeting on “Enhancing capacity building addressing Water and Energy interlinkages for Sustainable Development in the Arab Region”
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Introduction

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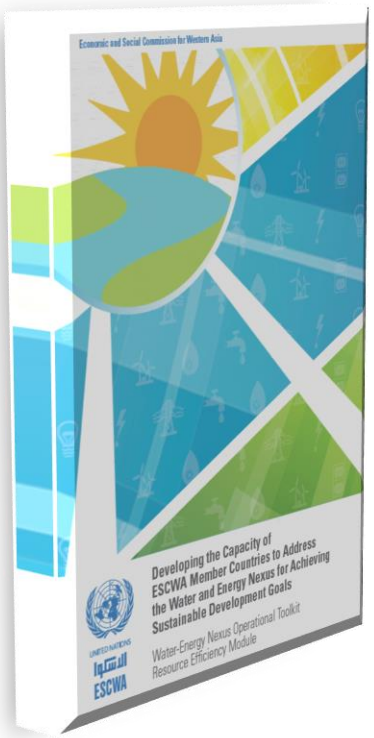
Water-Energy Nexus Operational Toolkits: Resource Efficiency Module



https://www.unescwa.org/sites/www.unescwa.org/files/publications/files/water-energy-nexus-sustainable-development-goals-english_0.pdf

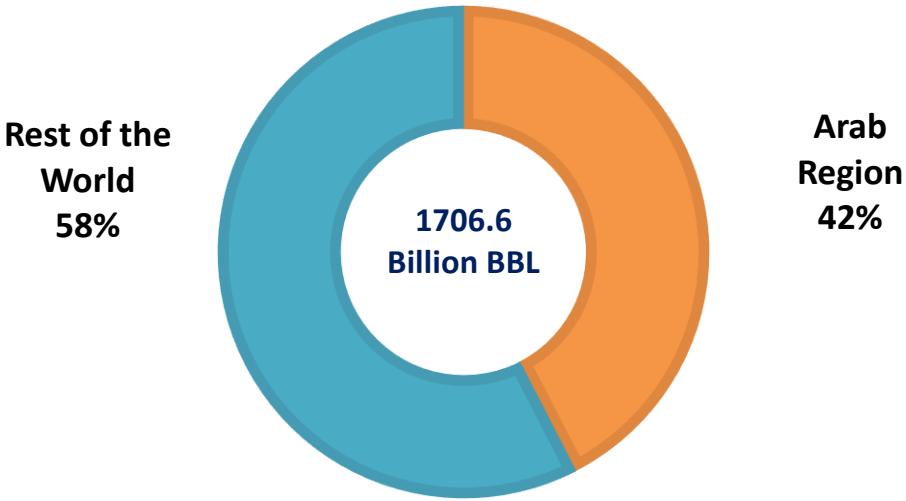
- Technologies to improve water efficiency
- Technologies to improve energy efficiency
- Key performance indicators for the water-energy nexus
- Financial Perspective: Efficiency improving technologies

https://www.unescwa.org/sites/www.unescwa.org/files/publications/files/water-energy-nexus-sustainable-development-goals-arabic.pdf

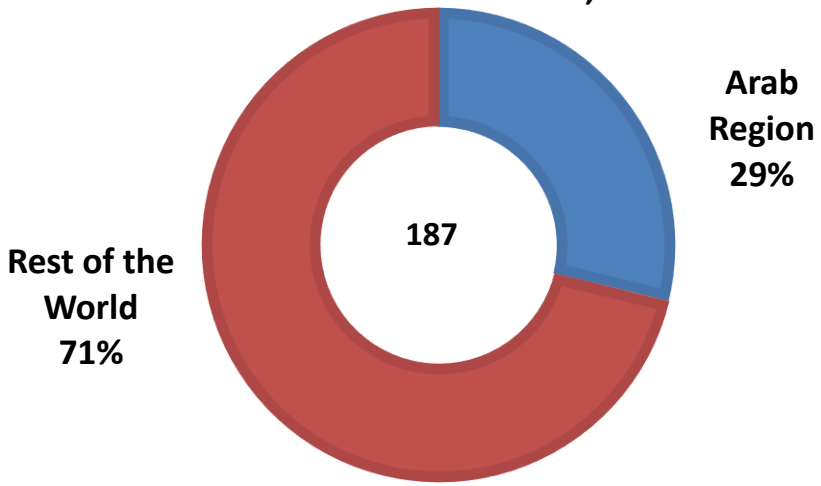
Setting the Context
Energy Reserves Abundance in the Arab Region

Countries in the Arab region exhibit different energy consumption levels, but they share their reliance on fossil fuels for energy sufficiency.

Oil Proven Reserves, 2016



Gas Proven Reserves, 2016



Source: OAPEC, BP statistical Review, 2017

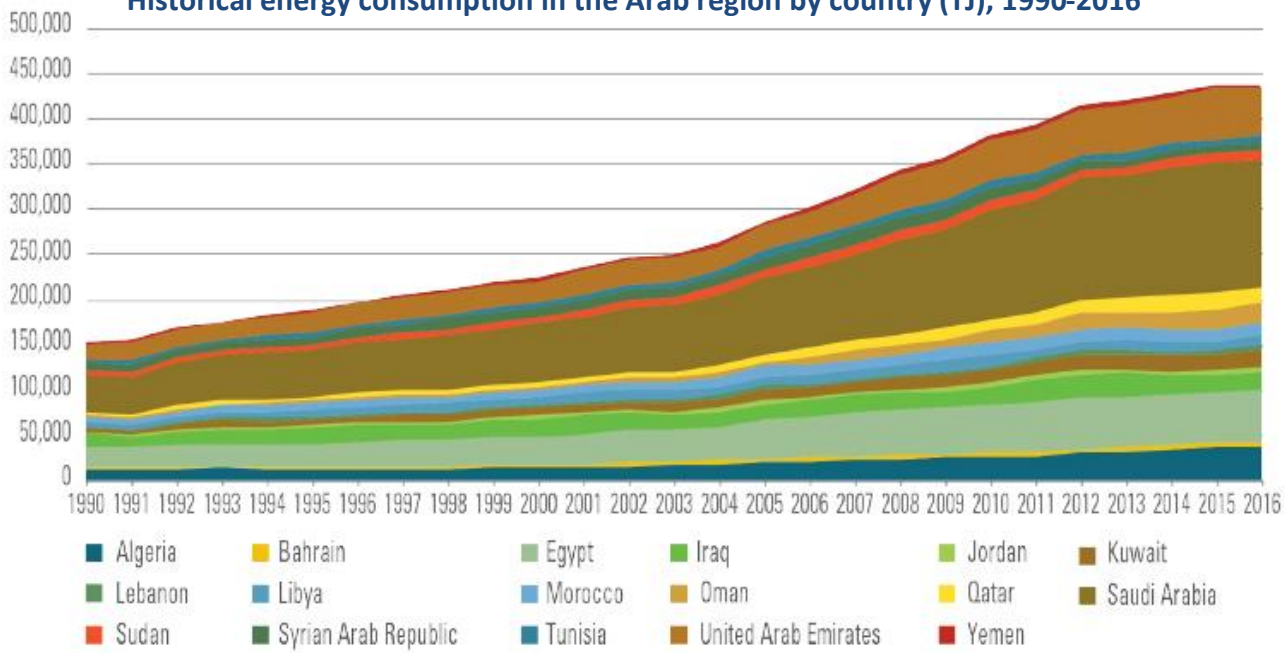
Setting the Context
Energy consumption in the Arab Region

Energy consumption more than doubled in the Arab region since 1990 , with a direct increase in GHG emissions.

The Arab region is the only world region where energy intensity has been increasing, not declining since 1990

- Energy net exporting countries drive the regional trends as they have based their historical industrial growth on fossil fuels and energy-intensive industries.
- Net energy importers have seen fairly low and falling energy-intensity rates.

Historical energy consumption in the Arab region by country (TJ), 1990-2016



Source: IEA, 2018

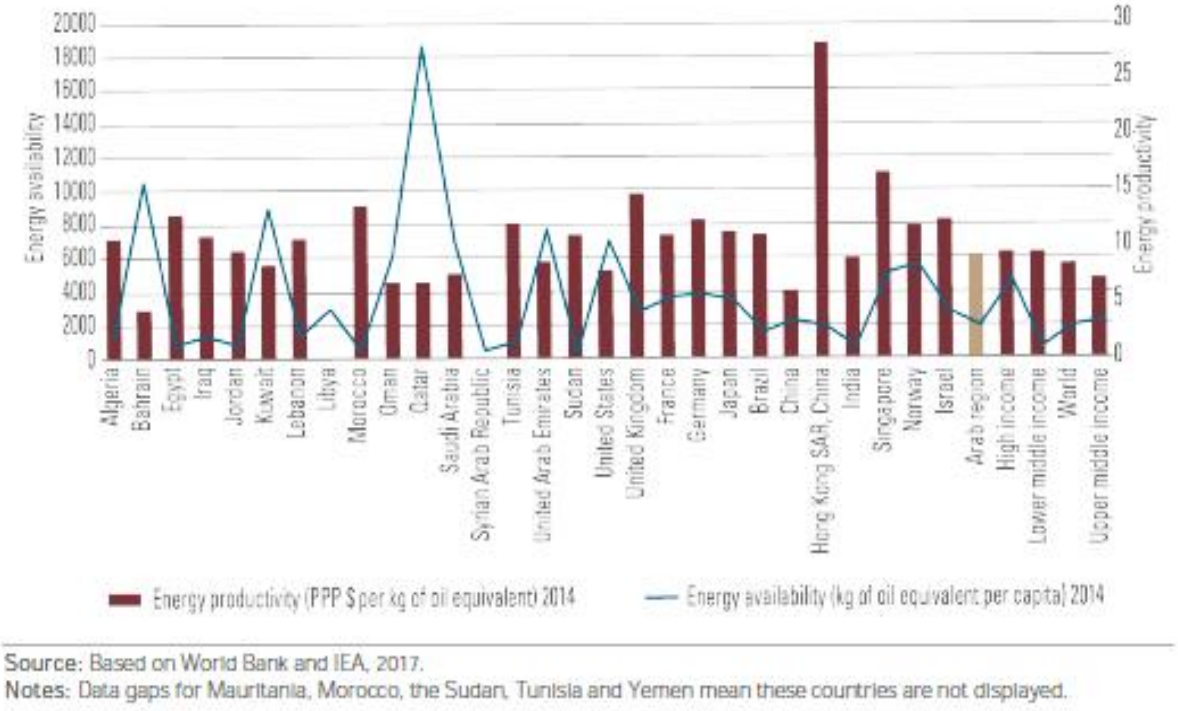
Setting the Context
Energy productivity in the Arab Region

While elsewhere world average energy productivity is increasing by around 2-2.5 %/year, the Arab region is notable as one of the few in the world where several countries are experiencing declining energy productivity.

These include Algeria, Jordan, Lebanon, Oman and Qatar

- Given the differences in economic structure and individual country circumstances, policymakers should focus on the change in energy productivity rather than the absolute level.
- Declining energy productivity is a concern as it suggests less value is being created in the economy for each unit of energy consumed.

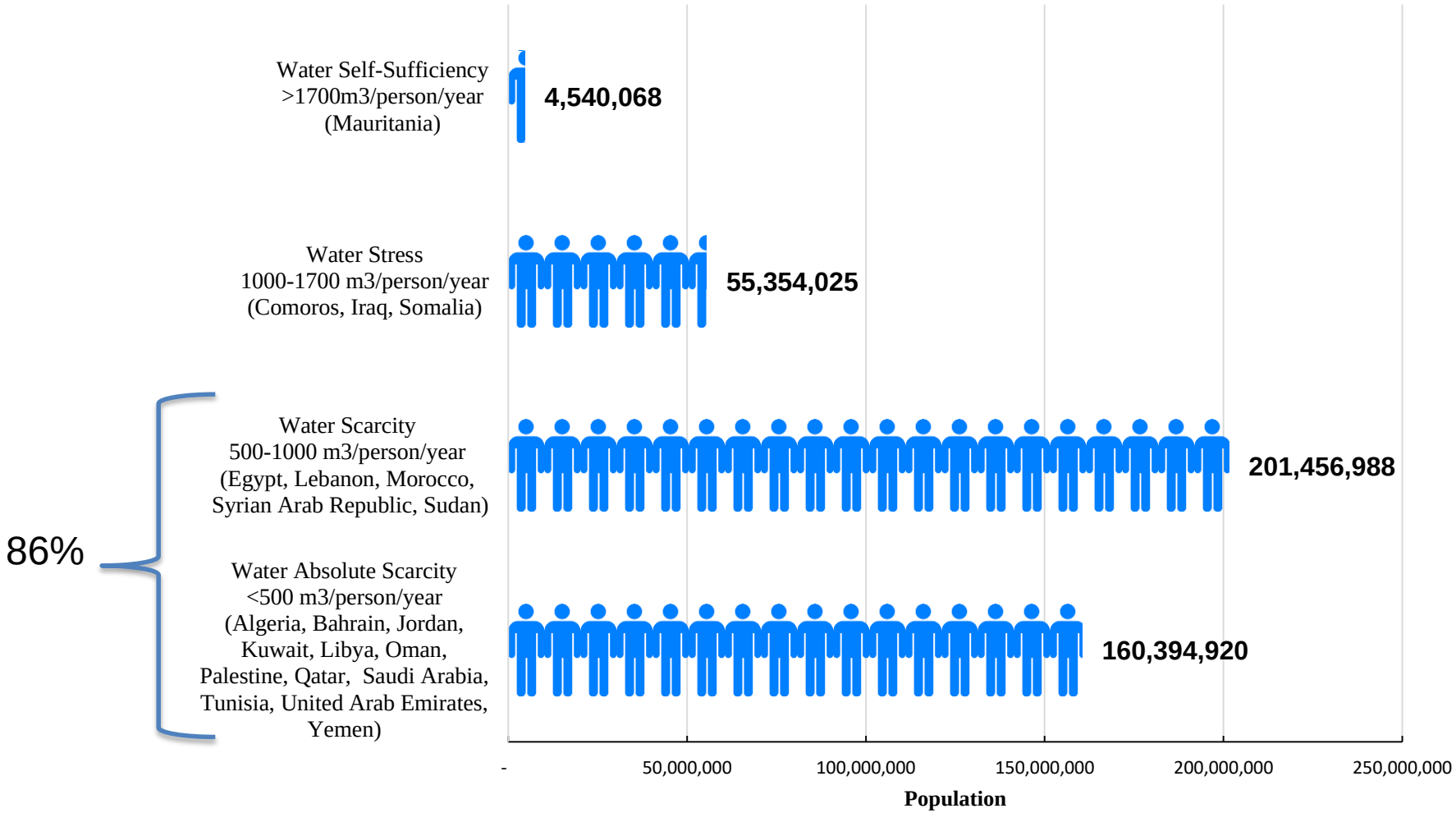
Energy productivity in the Arab region and selected other countries, 2014



Source: Based on World Bank and IEA, 2017.
Notes: Data gaps for Mauritania, Morocco, the Sudan, Tunisia and Yemen mean these countries are not displayed.

Source: ESCWA, 2019. Energy Vulnerability in the Arab Region

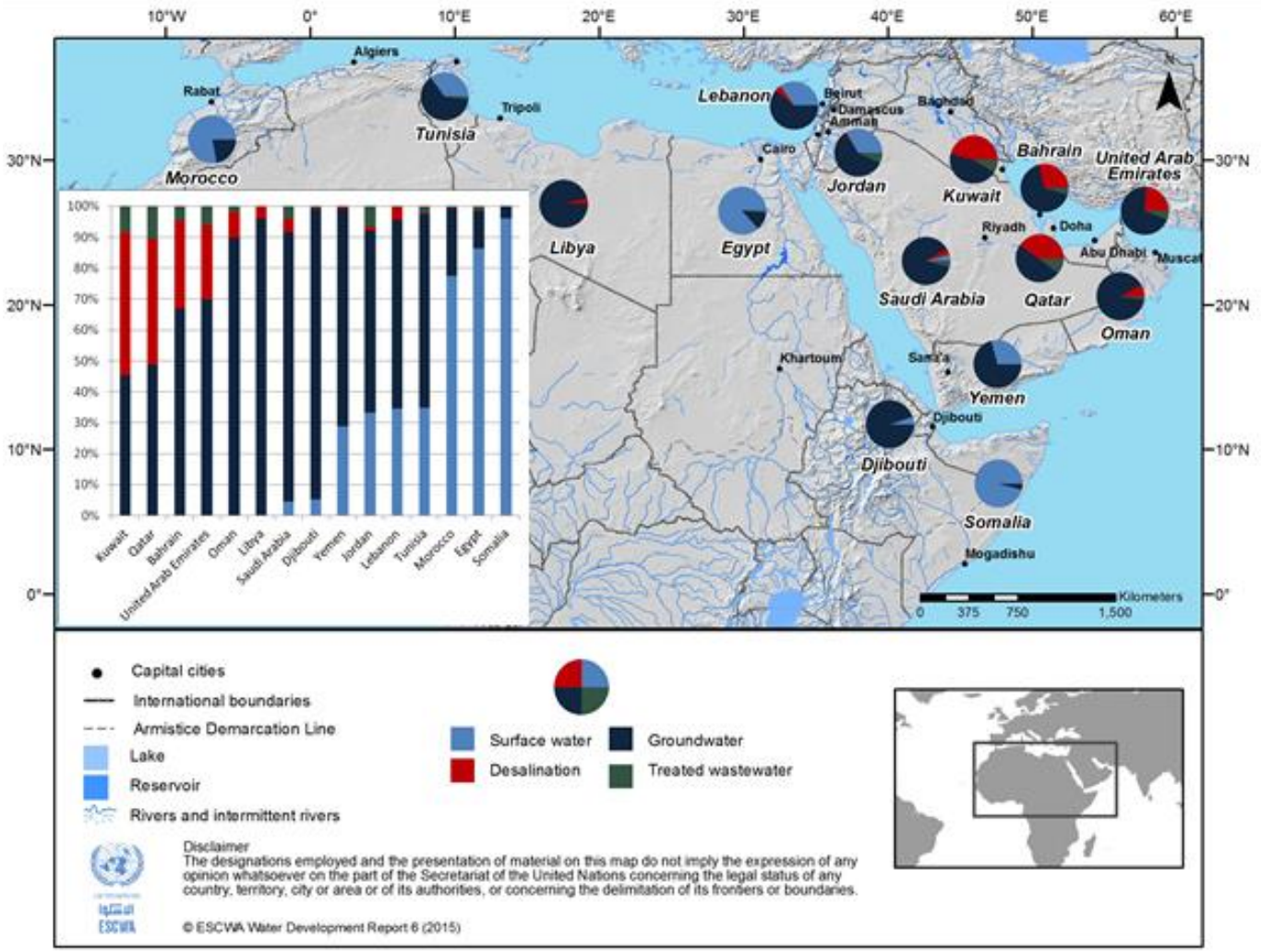
Setting the Context
Freshwater Scarcity in the Arab Region



Source: ESCWA, 2019. Moving towards achieving water security in the Arab Region

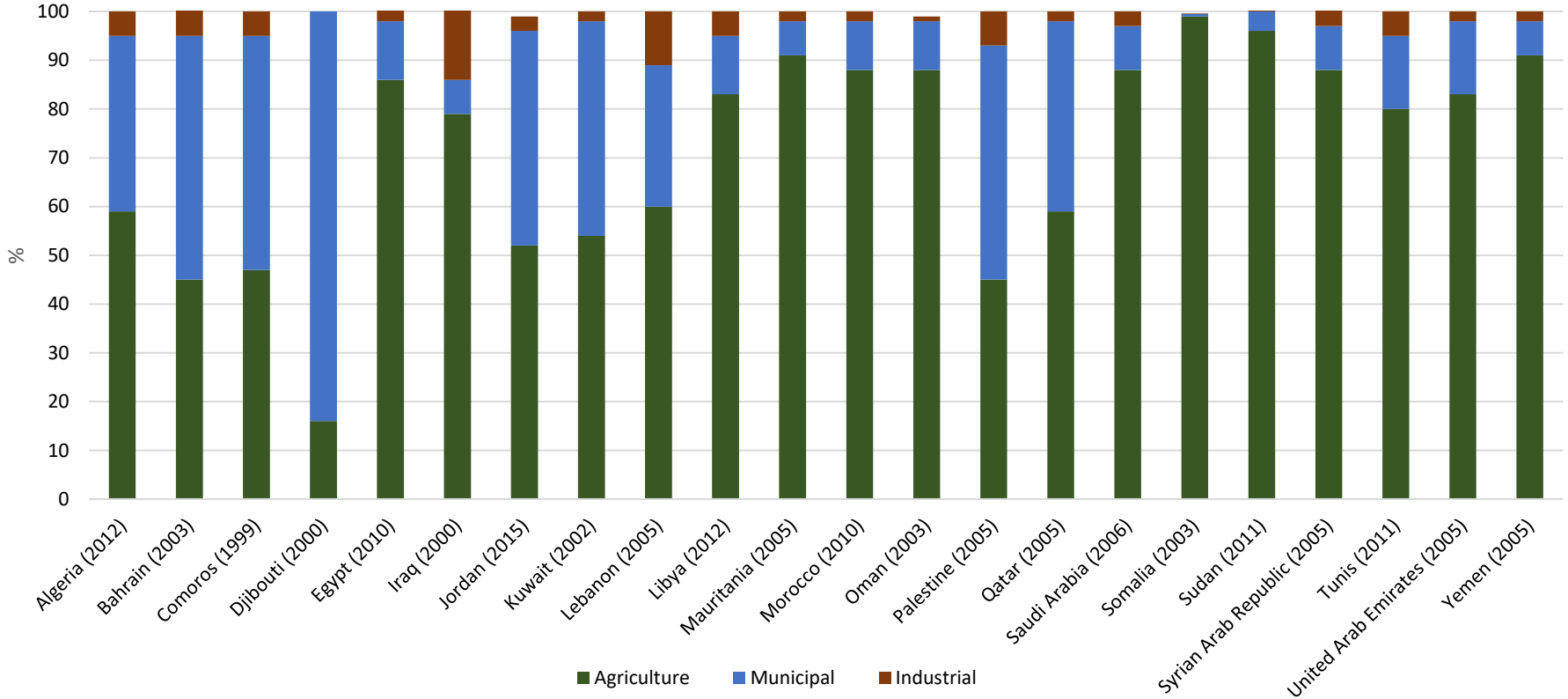
Setting the Context
Water Sources in the Arab Region

- Groundwater is the major source of water in most Arab countries
- Very few countries have an abundance of surface water and are even shifting to rely more on groundwater
- Gulf countries largely depend on groundwater both renewable and **non-renewable/fossil** followed by desalination
- High energy demand for water resources (Water-Energy Nexus)



Setting the Context
Water Sources in the Arab Region

- Local food production and hence the agriculture sector is the biggest consumer of water in the Arab region with 84% of all water withdrawals going to the agriculture sector with average water-use efficiency in regional irrigation systems at approximately 50-60%.



Source: Source: FAO AQUASTAT database – Food and Agriculture Organization of the United Nations (FAO). Available from http://www.fao.org/nr/water/aquastat/main/index.stm. Data for the latest available year. Accessed 17 August 2018.

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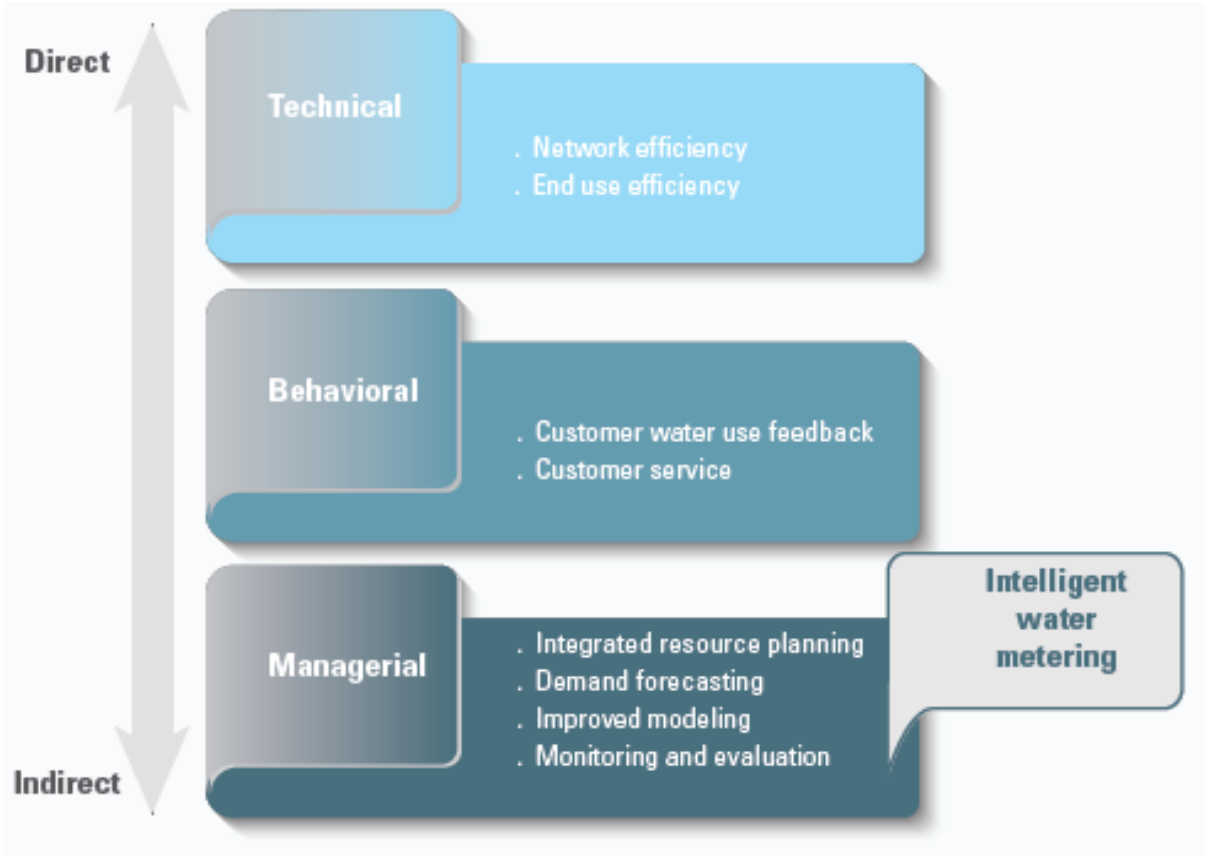
Water-Energy Nexus Operational Toolkit: Resource Efficiency
Technologies to improve water efficiency

- **There is no ideal efficiency solution for all ESCWA member countries.**
  - **Strategies must be assessed with reference to the respective situation.**
- **Reuse of treated wastewater is a strategy that can be implemented by various sectors.**
  - **As environmental standards for discharged waters become more stringent, reuse of treated wastewater becomes more feasible.**
- **The most energy-consuming parts of a process must be targeted.**
  - **For wastewater treatment this is aeration.**
  - **For water distribution systems this is pumping.**
- **Water consumption can be reduced in electricity generation processes by addressing various parameters.**
  - **Cooling types**
  - **Combined cycle arrangements**
- **Several technological options for more water efficient water systems, particularly in the agricultural sector, are becoming more popular.**
- **Intelligent systems have the potential to increase efficiencies.**
  - **They help match supply and demand.**
  - **They can have low capital costs.**

Water-Energy Nexus Operational Toolkit: Resource Efficiency
Technologies to improve water efficiency

Water efficiency strategies

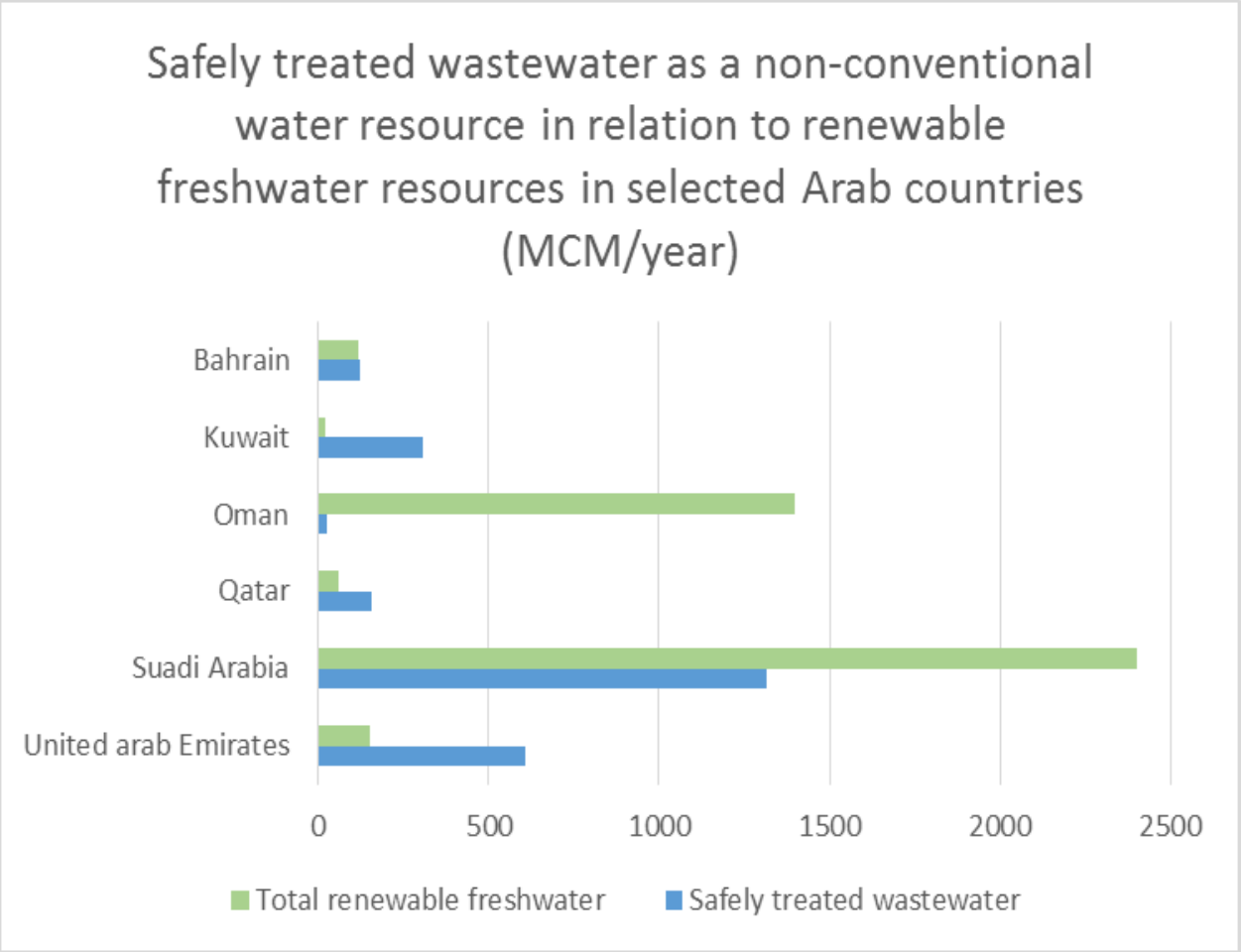


Source: ESCWA, 2017. Water-Energy Nexus Operational Toolkit: Resource Efficiency

- **When considering direct water efficiency improvement strategies, the approach to be implemented can broadly be classified into two categories:**
  - **One focuses on using technologies, which operate more efficiently; and**
  - **The second focuses on water/ treated wastewater reuse so that a smaller footprint is achieved even with regular process efficiencies.**

Technologies to improve water efficiency: Treated wastewater reuse

- **Wastewater treatment and reuse**
  - Gulf countries use a good portion of their safely treated wastewater
  - Jordan is a champion country in terms of reuse of all of its treated waste water



Source: LAS/UNESCWA/ACWUA, 2016, MDG+ Initiative Report 2016; FAO 2016, Aquastat data for 2014. Available from http://www.fao.org/nr/water/aquastat/main/index.stm.

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Water-Energy Nexus Operational Toolkit: Resource Efficiency
Technologies to improve energy efficiency

- **Variation in energy savings and payback period for different strategies for the water sector.**
  - **Such variation shows the potential complexities involved in implementing these strategies due to the many parameters to be considered.**
- **Energy efficiency measures which require the least effort can be very beneficial.**
- **More energy-efficient desalination technologies can play a pivotal role in improving the overall energy consumption of the region.**
  - **RO is currently the technology of choice but there is still room for improvement.**
  - **The use RE for power desalination is rapidly being adopted in the region.**
- **Cost sharing between energy and water utilities must be facilitated in support of efficiency measures.**
  - **Water avoided costs must be considered with embedded energy analysis.**
- **By regulating tariffs more effectively:**
  - **The investment required for the adoption of more energy- and water-efficient technologies can be facilitated**
  - **End-use consumption can be better influenced.**

Technologies to improve energy efficiency: Energy management opportunities in the water and wastewater industries

Energy efficiency and demand response

- Data monitoring and process control
- Water conservation
- High-efficiency pumps and motors
- Adjustable speed drives
- Pipeline optimization

Emerging technologies and processes

- Membrane bioreactors
- Microbial fuel cells
- LED UV lamps

Energy recovery and generation

- Cogeneration using digester biogas
- Use of renewable energy to pump water
- Recovery of excess line pressure to produce electricity

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Water-Energy Nexus Operational Toolkit: Resource Efficiency
SDGs- KPIs for Resource Efficiency

- The 2030 Agenda advances an integrated approach to SD.
- Dedicated goals and targets for water and energy with indicators for monitoring implementation.
- Dedicated indicators for energy and water efficiency with interlinkages with other targets.
- Dialogue is crucial among the various water-energy partners.
- The level of coordination and collaboration between the water and energy sectors in all stages of planning and implementation must be increased to achieve targets.
- Water and energy efficiency indicators **are vital to measure progress with respect to the water-energy nexus in the Arab countries**. **Data required for these indicators is not always available.**
- Sustainability reporting frameworks are a good steppingstone towards addressing the water and energy efficiency indicators.

SDG 6 Clean Water and Sanitation: Targets and Means of Implementation

SDG 6: Ensure availability & sustainable management of water & sanitation for all

Targets:

- **6.1** By 2030, achieve universal & equitable access to safe & affordable drinking water for all
- **6.2** By 2030, achieve access to adequate & equitable sanitation & hygiene for all & end open defecation, paying special attention to the needs of women & girls & those in vulnerable situations
- **6.3** By 2030, improve water quality by reducing pollution, eliminating dumping & minimizing release of hazardous chemicals & materials, halving the proportion of untreated wastewater & substantially increasing recycling & safe reuse globally
- **6.4** By 2030, substantially **increase water-use efficiency** across all sectors & ensure sustainable withdrawals & supply of freshwater to address water scarcity & substantially reduce the number of people suffering from water scarcity
- **6.5** By 2030, implement IWRM at all levels, including through transboundary cooperation as appropriate
- **6.6** By 2020, protect & restore water-related ecosystems, including mountains, forests, wetlands, rivers, aquifers & lakes

Means of Implementation:

- **6.a** By 2030, expand international cooperation & capacity-building support to developing countries in water- & sanitation-related activities & programmes, including water harvesting, desalination, **water efficiency**, wastewater treatment, recycling & reuse technologies
- **6.b** Support & strengthen the participation of local communities in improving water & sanitation management

SDG 7 Affordable and Clean Energy: Targets and Means of Implementation

SDG 7: Ensure access to affordable, reliable, sustainable & modern energy for all

Targets:

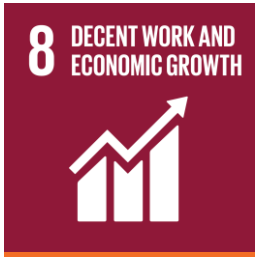
- **7.1** By 2030, ensure universal access to affordable, reliable & modern energy services
- **7.2** By 2030, increase substantially the share of renewable energy in the global energy mix
- **7.3** By 2030, **double the global rate of improvement in energy efficiency**

Means of Implementation:

- **7.a** By 2030, enhance international cooperation to facilitate access to clean energy research & technology, including renewable energy, **energy efficiency** & advanced & cleaner fossil-fuel technology, & promote investment in energy infrastructure & clean energy technology

- **7.b** By 2030, expand infrastructure & upgrade technology for supplying modern & sustainable energy services for all in developing countries, in particular least developed countries, small island developing States & landlocked developing countries, in accordance with their respective programmes of support

Explicit Efficiency Targets - selected



8.4	**Improve progressively**, through 2030, **global resource efficiency** in consumption & production & endeavour to decouple economic growth from environmental degradation, in accordance with the 10-Year Framework of Programmes on Sustainable Consumption & Production, with developed countries taking the lead

9.4	By 2030, upgrade infrastructure & retrofit industries to make them sustainable, with **increased resource-use efficiency** & greater adoption of clean & environmentally sound technologies & industrial processes, with all countries taking action in accordance with their respective capabilities

11.B	By 2020, substantially increase the number of cities & human settlements adopting & implementing integrated policies & plans towards inclusion, **resource efficiency**, mitigation & adaptation to climate change, resilience to disasters, & develop & implement, in line with the Sendai Framework for Disaster Risk Reduction 2015-2030, holistic disaster risk management at all levels

12.2	By 2030, achieve the sustainable management & **efficient use of natural resources**

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Water-Energy Nexus Operational Toolkit: Resource Efficiency

Efficiency-improving technologies: Financial perspective

- There is much variation with regards to the payback of many of the efficiency improving strategies since the effectiveness of these depends substantially on such factors as the location of the plant, specific types of operations,, energy/water pricing schemes, and more.
- A thorough analysis is required on a case-by-case basis.
- Regulating tariffs more effectively will facilitate the investment required for the adoption of more energy- and water-efficient technologies

Thank you

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