

United Nations Development Account Project on Developing the Capacity of ESCWA Member Countries
to address the Water and Energy Nexus for Achieving Sustainable Development Goals

Final Regional Policy Workshop on the Water-Energy Nexus

11- 12 December 2017, Beirut, Lebanon

Economic and Social Commission for Western Asia

Water-Energy Nexus Operational Toolkit: Renewable Energy



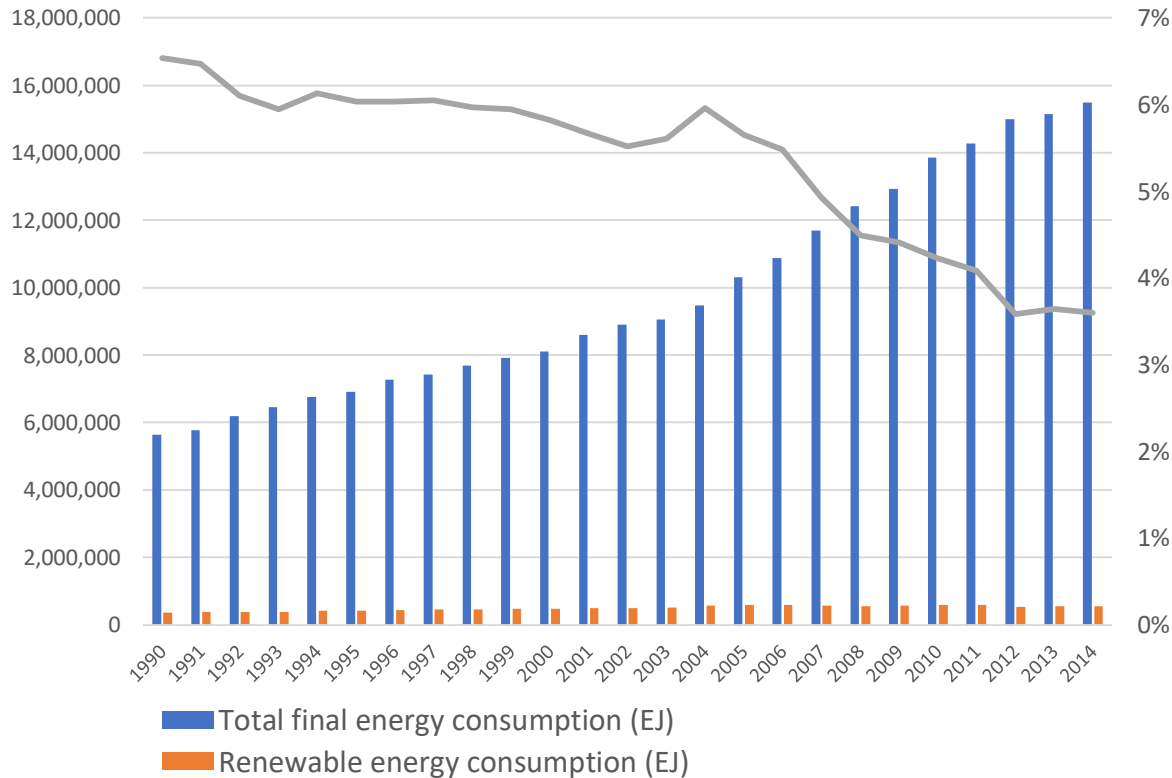
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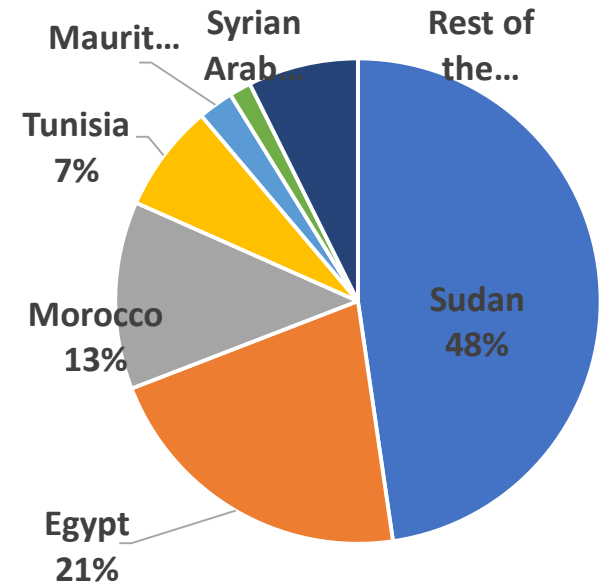
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The share of renewable energy (RE) in the energy mix in the Arab region is one of the lowest in the world

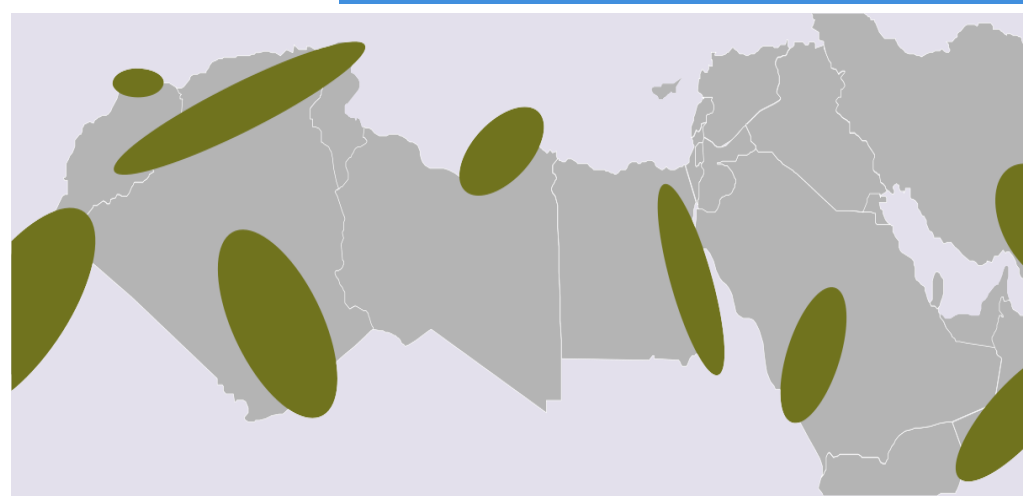
Share of RE in total final energy consumption in the Arab region, 1990–2014



Renewable energy consumption in the Arab region by country in 2014 (total = 557,047 TJ)

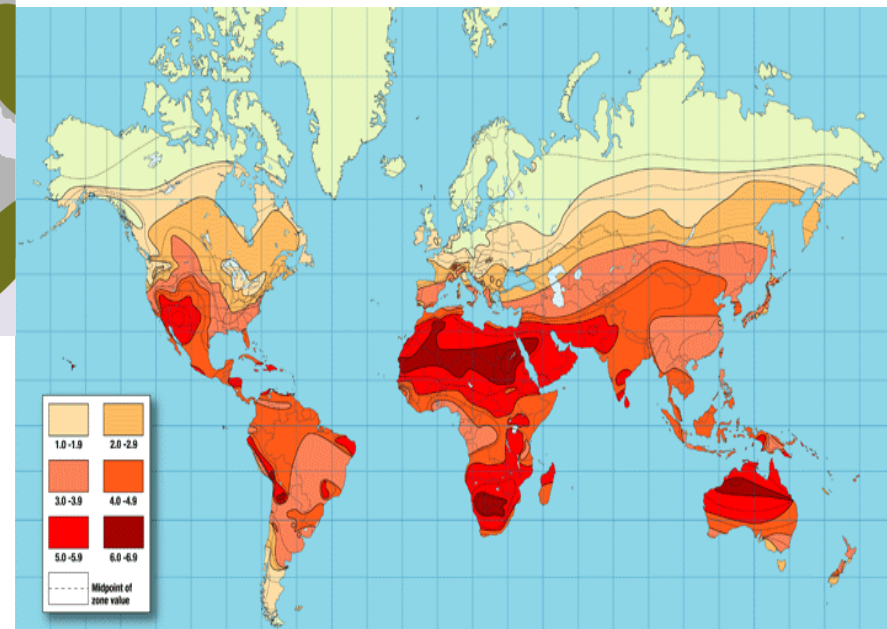


The Arab countries are well endowed with potential for developing renewable energy resources, if adequately used.....



source: MAKE, MENA Wind Power Outlook, 2 April 2015, Joffery Dupuy, P. 8

- Wind speed suitable for the production of electricity in various locations of many countries
- High Solar Irradiance



- Vast desert lands, semi-flat, and mostly uninhabited.
- Pilot and commercial projects, industrial potential, Technical staff and available labor.
- Official interest in RE/ Plans and Policies to diversify the energy mix.
- Contribution to Energy Security.
- A tool to reduce emissions.

W-E Nexus & RE: Aspects and Opportunities

Renewable energy can boost water security by improving accessibility, affordability and safety;

Abstraction and conveyance, Treatment, Distribution, End-use, Wastewater collection and treatment, Constructing, operating and maintaining water-supply facilities



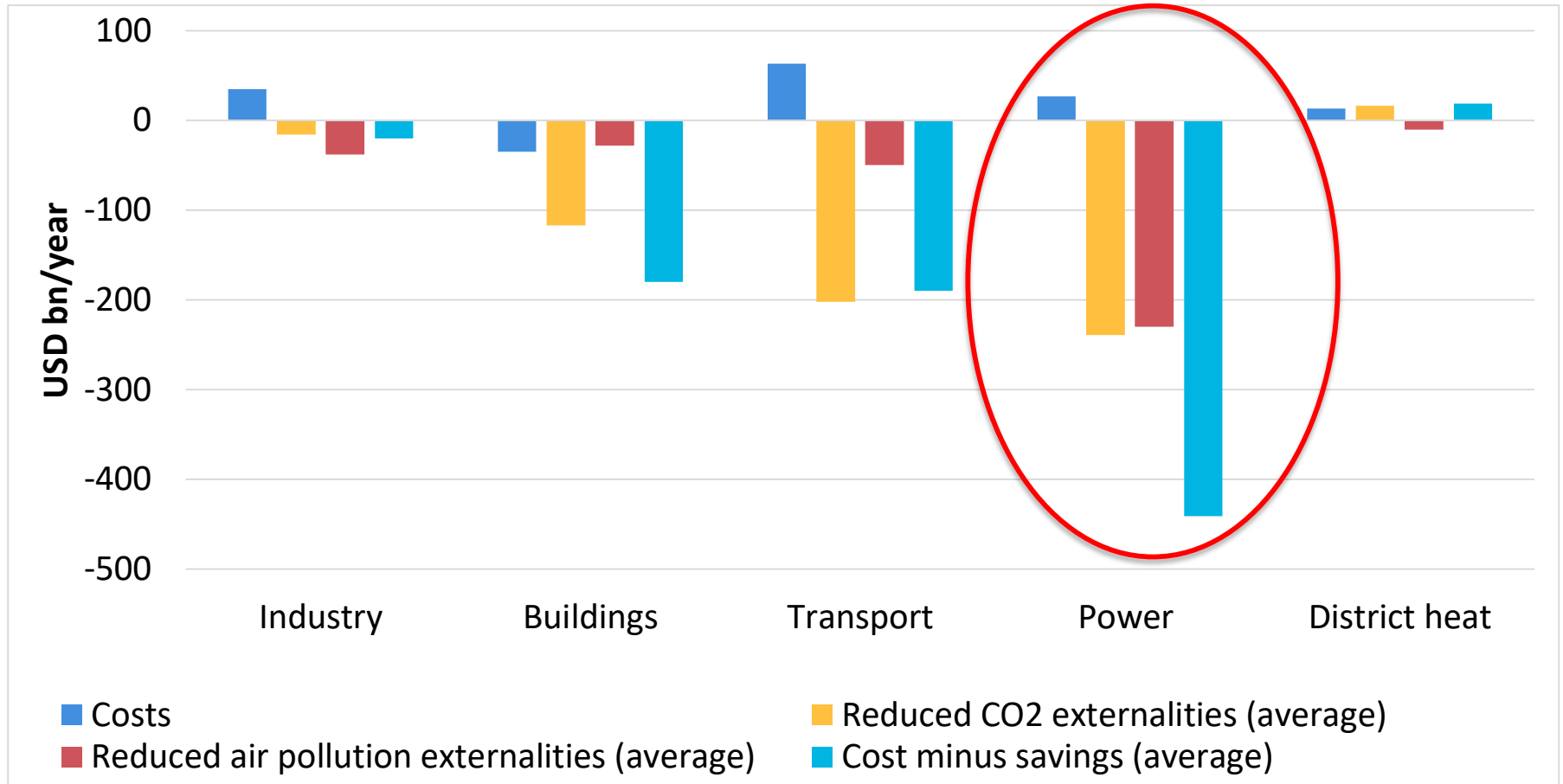
An energy system with substantial shares of renewable energy could be less water-intensive;

Extraction and mining, Fuel processing, Thermoelectric cooling, Transportation, Waste disposal and emission control, Constructing, operating and maintaining energy generation facilities

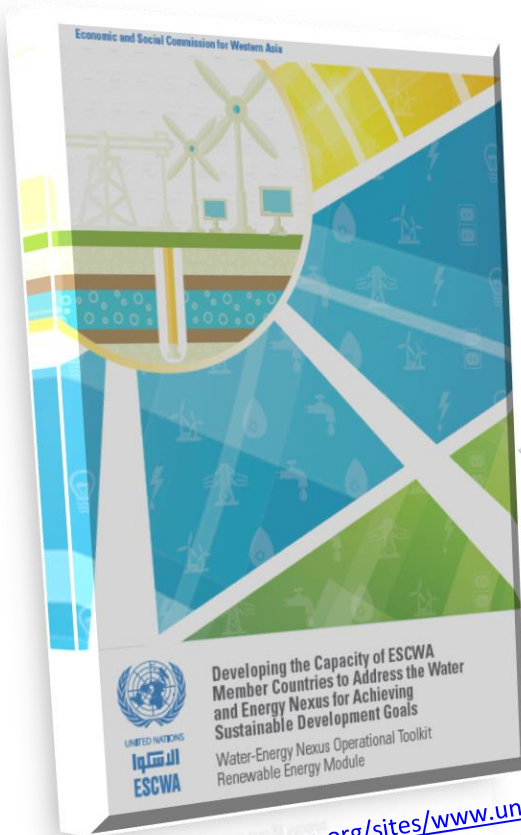
RE opportunities in the water-energy nexus:

- Reduce water-intensity of power sector
- Improve access to water
- Enhance reliability of water supply
- Bridge the water gap in arid regions
- Replace traditional water heating
- Provide different energy sources that use small water amounts and encourages water saving.

Costs and savings of RE by sector in 2030



Water-Energy Nexus Operational Toolkit Renewable Energy Module



<https://www.unescwa.org/sites/www.unescwa.org/files/publications/files/water-energy-nexus-renewable-energy-module-english.pdf>

Renewable energy technologies assessment for water and wastewater applications

Renewable energy technologies assessment for electricity production

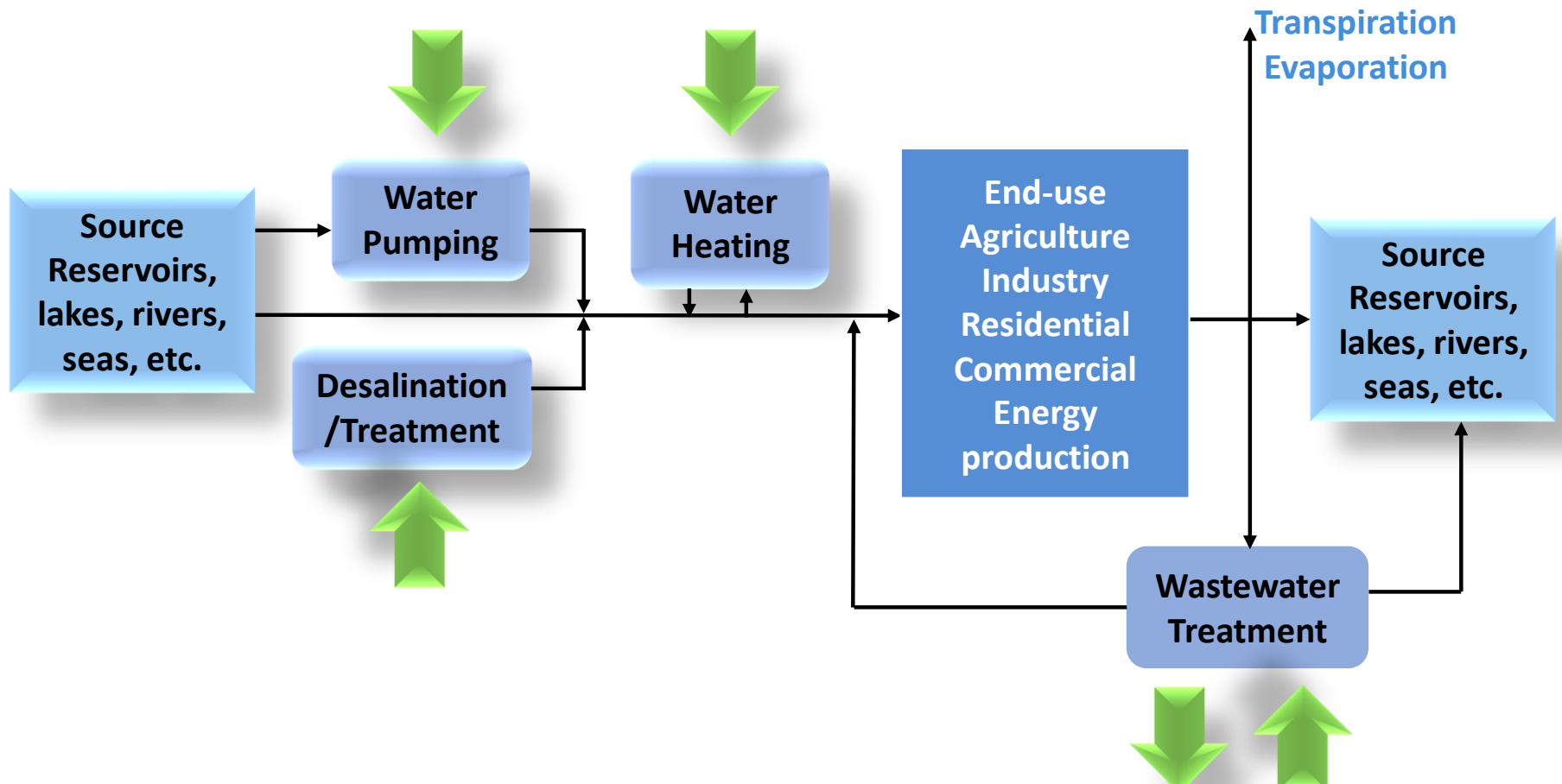
Renewable energy technologies: financial perspective

Key performance indicators for RE technologies



https://www.unescwa.org/sites/www.unescwa.org/files/publications/files/water-energy-nexus-renewable-energy-module-arabic_0.pdf

RE across the water supply chain

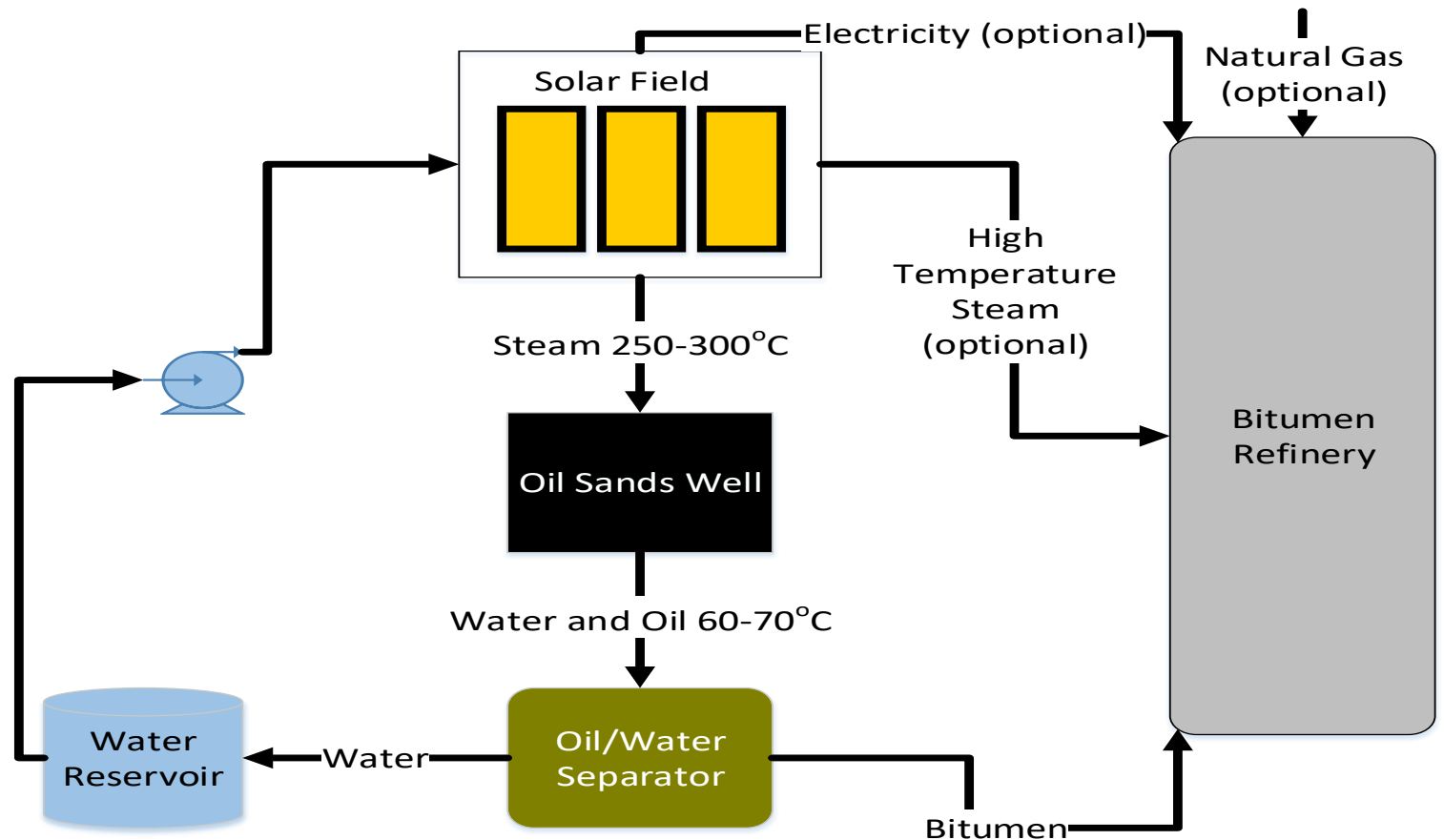


Green arrows indicate potential RE inputs.

RE in the oil & gas sector

By 2035, solar energy is forecasted to provide about 5% of the industry's energy needs (≈ 2 PJ of energy)

Solar EOR system for oil sands



RE in the oil & gas sector

Oil & Gas, Offshore Wind Joint Industry Project Leads to WIN WIN Situation

Most of the major oil companies power their special field applications using PV panels and Shell using combination of wind turbines and PV panels to help power some of its monotower platforms.



The DNV GL-led **WIN WIN** (WIND-powered Water INjection) project, which gathered industry players from oil & gas and offshore wind sectors, including ExxonMobil, ENI Norge, Nexen Petroleum UK Ltd., Statoil, VNG Norge, PG Flow Solutions and ORE Catapult, is on the right track to make the best use of both offshore energy industries in a single project.

(Courtesy of offshorewind.biz website)

RE sources for wastewater treatment processes



Solar



Wind



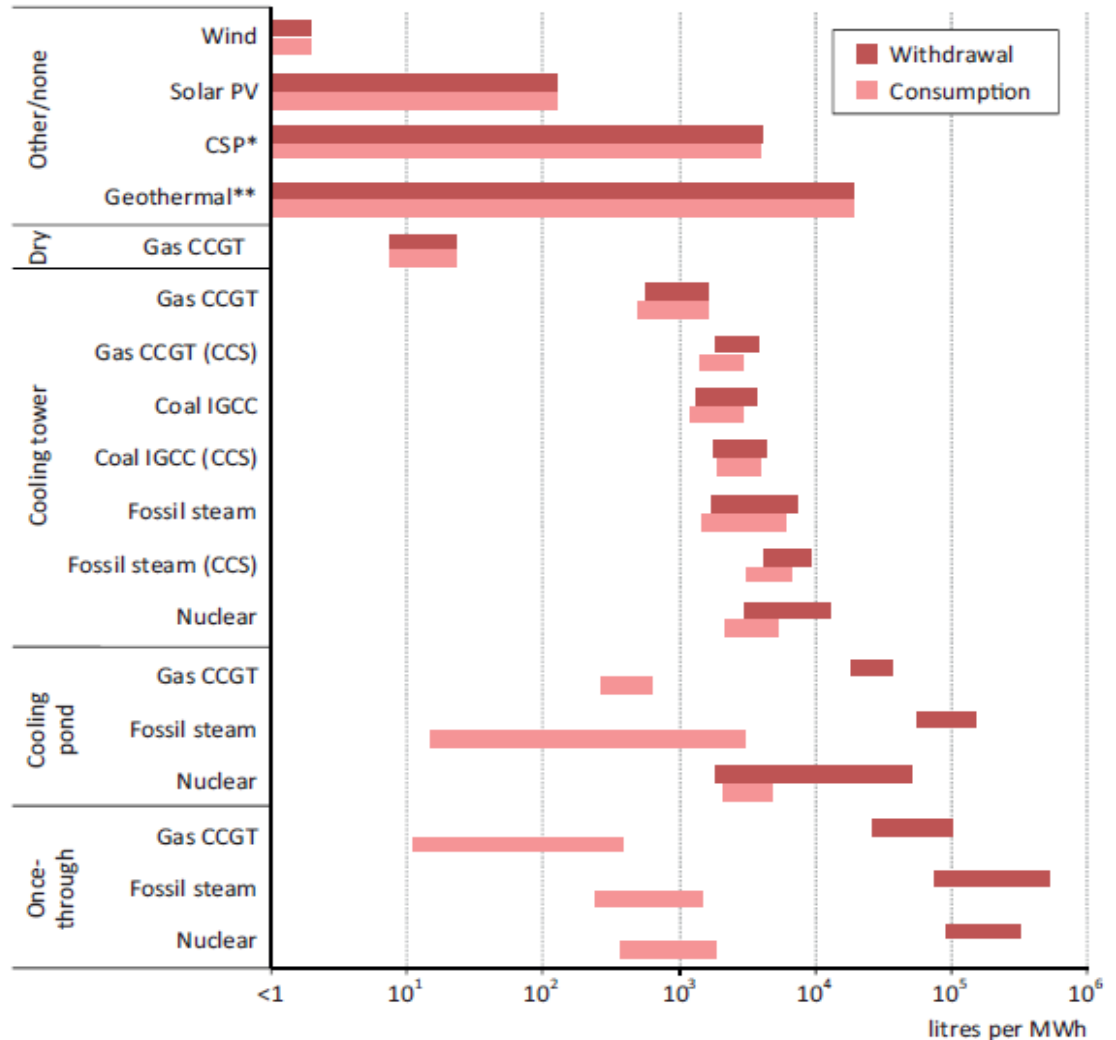
Biomass



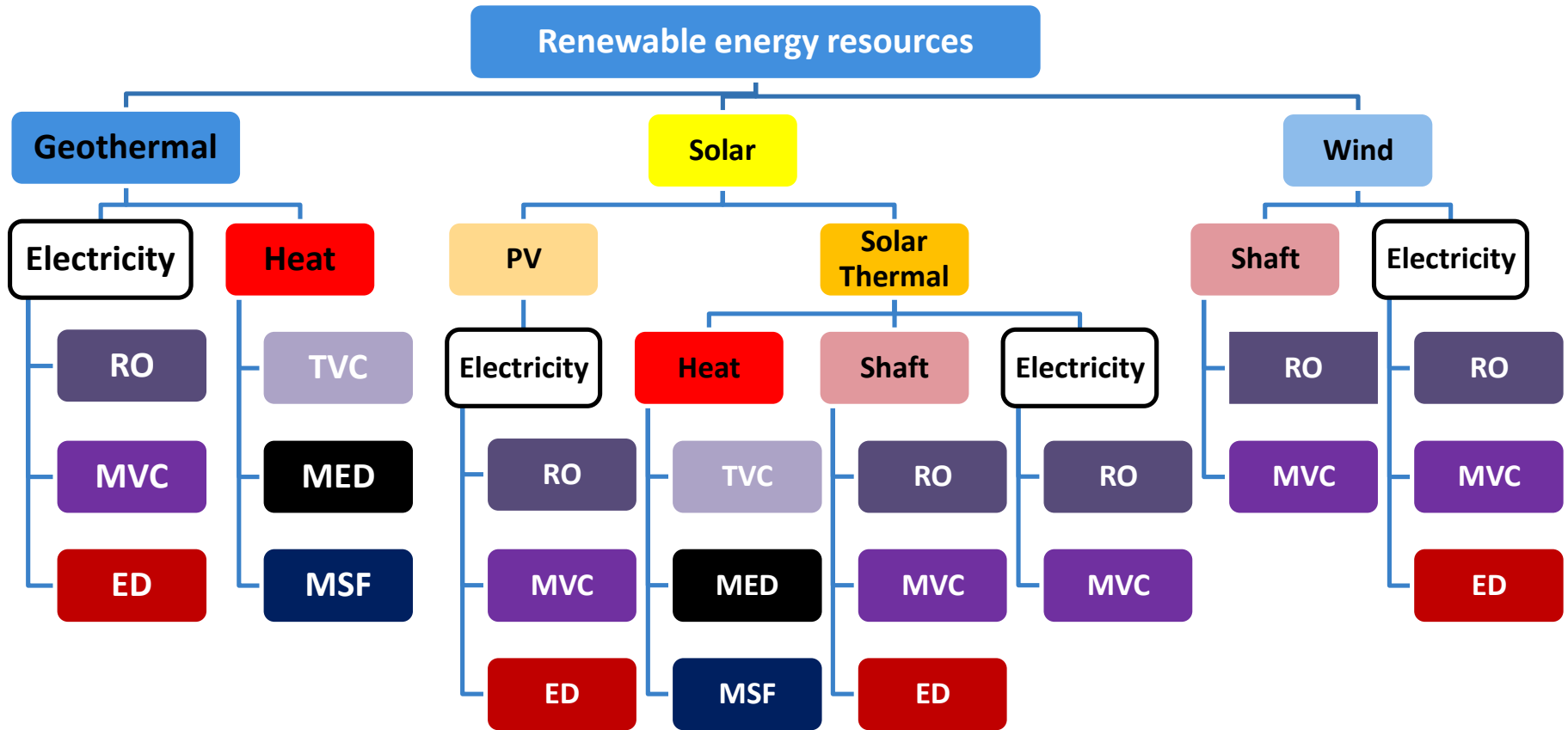
**Digestion
of sewage
sludge**

Water use for electricity generation by cooling technology

- All the RE technologies have the potential to generate electricity with greater amounts of water efficiency, as compared to fossil fuel resources.



Possible pathways for integrating RE resources with different desalination technologies



Source: Al-Karaghoul & Kazmerski, 2011; IRENA, 2015a.

Solar stills, solar-multiple effect humidification, PV-RO, wind-RO, and CSP/MED are the combinations which are currently being applied as RE powered desalination or have more potential to be applied.

Pathways for RE integration with desalination technologies

Solar energy is the most popular type of RE for powering desalination

	Technical Capacity (m ³ /d)	Energy Demand (kWh/m ³)	Development Stage
Solar stills	< 0.1	Solar passive	Application
Solar-Multiple Effect Humidification	1-100	thermal: 100 electrical: 1.5	R&D; Application
Solar- MD	0.15-10	thermal: 150–200	R&D
Solar/CSP-MED	> 5,000	thermal: 60–70 electrical: 1.5–2	R&D
PV-RO	< 100	electrical: BW: 0.5–1.5; SW: 4-5	R&D; Application
PV - Electrodesialysis Reversed	< 100	electrical: only BW:3–4	R&D
Wind- RO	50-2,000	electrical: BW: 0.5–1.5; SW: 4–5	R&D; Application
Wind- MVC	< 100	electrical: only SW:11–14	Basic Research

RE manufacturing in the Arab countries

- Solar water heating systems available in Tunisia and Jordan manufactured locally.
 - **20-30%** of equipment in wind farms in Egypt tends to be provided locally; GE is building a \$200 million wind energy components manufacturing facility in the country and Siemens has also signed similar deals.
 - PV panels are being manufactured in Algeria; two factories producing 75MW and 30 MW panels are already operational.
 - 66 UAE companies took part in the construction of the Shams 1 CSP plant in Abu Dhabi emirate.
 - The CSP plant built in Kuraymat in Egypt obtained 40% of its equipment from local sources.
- Estimated that the MENA countries would have an additional RE capacity of 107 GW by 2030 (compared to 2015).
 - Relatively low capital-intensity of RE technologies.
 - RE components that are more versatile can be used for multiple RE technologies (e.g., cables and electronics).
 - When components are simpler, they tend to be easier to manufacture in different locations and vice versa.

Enabling for encouraging local RE manufacturing in the Arab region

Substantial political support

- Formulate a long-term RE strategy with national targets and a regulatory framework
- Define a national plan for RE equipment manufacturing
- Reform fossil fuel subsidies

Competitive local players

- Conduct awareness-raising initiatives
- Assess the feasibility of production line upgrades
- Foster business links through joint ventures
- Support the structuring of the sector

Strong industry innovation potential and skilled workforce

- Support R&D
- Educate and train high-skilled workforce
- Implement upgrading programs targeting specific industrial actors
- Identify niche technologies and set-up national centers of excellence

Investment and finance

- Encourage financial institutions to grant low interest loans
- Implement financial support mechanisms in the form of price, tax and other incentives

Water - Energy Nexus Operational Toolkit: Renewable Energy

- There are many opportunities for the use of RE technology to strengthen **the security of the water-energy nexus**.
- Water pumps can be powered by solar, wind, or biofuel energy.
- **Solar water heating** has been implemented in the residential sector successfully in various Arab countries.
- The Oil & Gas sector is already using RE sources for certain operational activities.
- The **costs associated with RE technologies have decreased** over the past few years and become comparable with those of fossil fuels.
- Indicators related to RE technology as well for the water-energy nexus, are still being developed.
- The data required for these indicators can be difficult to obtain **depending on the complexity of the indicator**.

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YEARS