Renewable Desalination: A Methodology for Cost Comparison

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Water Supply Scenario for MENA

- **Opening gap between water demand and sustainable water availability**
- **Decreasing renewable water resources** (effect of climate change)

Source: MENA Regional Water Outlook
Energy Cost for Conventional Desalination
(Example: RO)

Annual cost structure of a RO plant
Fuel Cost = 30 US$/MWh_{th}

- Annual capital cost: 34%
- O&M cost: 28%
- Electricity cost: 38%

LWC: 1.23 US$/m³

Annual cost structure of a RO plant
Fuel Cost = 60 US$/MWh_{th}

- Annual capital cost: 48%
- O&M cost: 22%
- Electricity cost: 30%

LWC: 1.58 US$/m³
Fossil fuels cost 2002 - 2012

- Coal (Australia)  
  x 4.2

- Crude Oil (Brent)  
  x 5.6

- Natural Gas (Russia)  
  x 4.4
Energy Cost Development of RE-Technologies

Note: qualitative trends only!
Typical Electricity Generation Profiles of RE

Large desalination plants require continuous operation

→ Conflict with the intermittent nature of renewable energies

→ CSP offers the option of thermal energy storage

→ Hybrid operation is possible in the same power block (no backup power plant required)
Comparison Methodologies

Typical Electricity Generation Profiles - PV

Typical Electricity Generation Profiles - RE-Mix (Fixed Power Export Tariff)

Annual Energy Balance of Load and Supply

- Options have unequal quality
- Cost externalization
  - Fossil backup
  - Grid management cost
→ Cheap, fluctuating RE

Direct Energy Balance of Load and Supply

- Options have equal quality
- No cost externalization
→ RE-Mix including backup and storage
Energy Cost as Function of RE-Share and Fuel Cost

- Direct RO electricity supply (RE and fossil)
- Pre-defined number of configurations (no optimization)

- **2 fossil fuel prices:**
  - Low: 30 US$/MWh\text{th}
  - High: 60 US$/MWh\text{th}
Effect of different Feed-in Tariff Values for Power Export

- RO supply / 80 % EE-Share / Fossil fuel price: 60 US$/MWh\text{th}

High sensitivity of optimal plant configuration on economic boundary conditions!
Conclusions (1/2)

- Among other measures, new desalination plants will be required in MENA in order to cover the increasing water demand.

- For this purpose, new power plants need to be installed in order to supply firm capacity to the desalination plants.

- Fossil fuel prices are prone to high volatility and a clear upward trend.

- On the contrary, Renewable Energies (RE) represent a key element for an environmentally friendly, cost stable and low-risk energy supply.

- When comparing different supply options, the right question to ask is: Which is the most effective technology mix to secure the supply? Rather than Which is the cheapest technology?
Conclusions (2/2)

- A fair comparison between options should consider configurations which guarantee equal quality of supply (consideration of externalities):

- The optimal energy supply for desalination plants will probably consist of a combination of low cost variable power (PV, Wind) and slightly more expensive balancing power (CSP with thermal energy storage)

they do not compare!
Thank you for your attention!

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