Sustainable Integration of Solar Energy for Desalination

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Situation

"…By 2025, 1.8 billion people will be living in countries or regions with absolute water scarcity, and two-thirds of the world's population could be living under water stressed conditions." [1].

- Water extraction, treatment and distribution accounts for 8% of global energy consumption. Which can be estimated as ~7 MJ/m^3 .
- The main factors affecting solar desalination plant feasibility are technology maturity, economics and environmental impact. Solar desalination is applicable in arid regions where, solar resource abundance and saline water availability are observed to coincide
- Desalination systems remove salts from saline water using one of the following processes: Phase change processes(MSF) , Pressure-driven membrane processes (RO)
- Large scale desalination has been undertaken using methods such as MSF and MEB, but since about 2003, RO has become dominant.

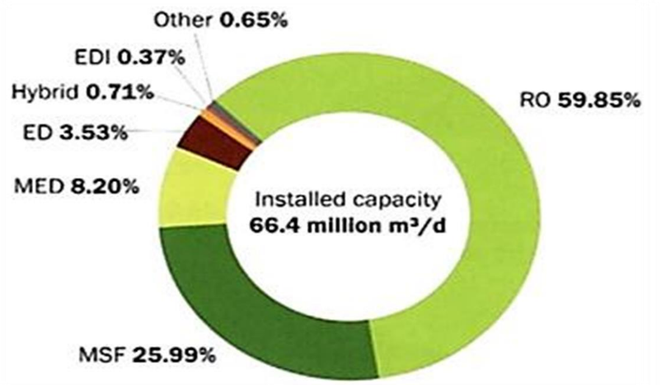

Figure 1: Global desalination capacity (106 m3/day) in 2010 by process type.

How can solar desalination using Reverse Osmosis and Multi-Stage Flash Desalination be optimized for production of potable water?

Problems

Cost

- Construction and the maintenance in the large scale.
- Small solar panels market [2].

Efficiency

- Preservation of thermal energy

Reliability

- Decision of location for a solar desalination station is critical
- Functionality of the panels affected by uncontrolled environmental factors

Environment

- Carbon footprint emission due to solar panels manufacturing process
- Brine management

Solutions

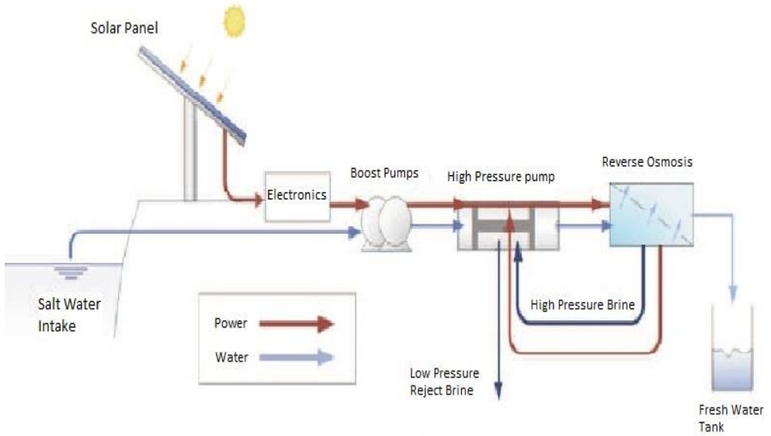

Figure 2: Process flow diagrams of the PV-RO system [3]

Reducing Cost

- Implementing mass production techniques to reduce cost.
- Choosing Optimum type of Desalination System.
- Efficient maintenance system to minimize damage.

Maintaining Power Generation

- Using Parabolic Trough Collector (PTC) reduces the amount of heat lost to around 48% less relative to flat plates [6].
- Heliostat Field Collectors (HFC), that monitors orientation of plates, ensuring collector receives maximum radiation possible [6].
- The Evacuated Tube Collector (ETC) boosts the productivity through eliminating thermal resistance between the solar panels and the water [7].

Reducing Brine and Recovering carbon footprints

- Membrane Distillation
- PV panel will, over its lifespan, produce many times more energy than was required to manufacture the panel.

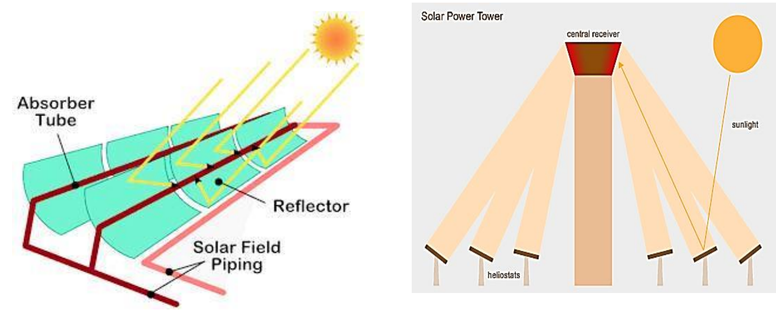

Figure 3: PTC and HFC [4] [5]

Evaluation

- Although methods are cost-effective in the long run, it requires a significantly high amount of capital to initiate.
- Constant alteration by HFC increases chances of dust accumulation contributes to lower power generation.
- Heat transfer fluids were proven to cause corrosion pipes, hence lowering pumping power [8].

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