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A Levelized Cost Analysis for Solar Energy Powered Sea Water Desalination in the Arabian Gulf Region

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Abstract : A levelized cost analysis of solar energy powered seawater desalination in The Emirate of Abu Dhabi is conducted to show that clean and renewable desalination is economically viable. The Emirate heavily relies on seawater desalination for its freshwater needs due to limited freshwater resources available. This trend is expected to increase further due to growing population and economic activity, rapid decline in limited freshwater reserves, and aggravating effects of climate change. Seawater desalination in Abu Dhabi is currently done through thermal desalination technologies such as multi-stage flash (MSF) and multi-effect distillation (MED) which are coupled with thermal power plants known as co-generation. Our analysis indicates that these thermal desalination methods are inefficient regarding energy consumption and harmful to the environment due to CO_2 emissions and other dangerous byproducts. Therefore, utilization of clean and renewable desalination options has become a must for The Emirate for the transition to a sustainable future. The rapid decline in the cost of solar PV system for energy production and RO technology for desalination makes the combination of these two an ideal option for a future of sustainable desalination in the Emirate of Abu Dhabi. A Levelized cost analysis for water produced by solar PV + RO system indicates that Abu Dhabi is well positioned to utilize this technological combination for cheap and clean desalination for the coming years. It has been shown that cap-ex cost of solar PV powered RO system has potential to go as low as to 101 million US $ (1111 $/m³) at best case considering the recent technological developments. The levelized cost of water (LCW) values fluctuate between 0.34 $/m³ for the baseline case and 0.27 $/m³ for the best case. Even the highly conservative case yields LCW cheaper than 100% from all thermal desalination methods currently employed in the Emirate. Exponential cost decreases in both solar PV and RO sectors along with increasing economic scale globally signal the fact that a cheap and clean desalination can be achieved by the combination of these technologies.

Keywords : solar PV, RO desalination, sustainable desalination, levelized cost of analysis, Emirate of Abu Dhabi
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