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Towards sustainable desalination industry in Arab region: challenges and opportunities

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ABSTRACT

The scarcity of freshwater sources and the increasing gaps between supply and demand are major challenges facing the economic and social development in the Gulf Cooperation Council (GCC) countries. Desalination technology is finding new outlets in supplying freshwater to meet growing demands for future development in the domestic, agricultural, industrial, and economical sectors. More than 8,950 desalination plants in GCC countries have a cumulative capacity of about 38.1 million m^3 d^{-1}. Desalination is energy and capital intensive industry, though technological innovations have reduced production costs. Investments in infrastructure and R&D in innovative technologies and renewable energies can lower desalination costs and make it more sustainable in the future. While desalination can help reducing pressure on conventional water resources, they have negative environmental impacts. The cost of desalted water depends on energy input, depreciation and interest, infrastructure cost, and O&M cost. Desalinated water cost is coming down due to continued technological improvement and innovations in both thermal and membrane desalination processes. In thermal desalination processes, R&D efforts are directed towards utilizing low-grade heat and waste heat as energy input; lowering the chemicals use and the advantage of scale up to higher capacity as a cost reduction strategy. In membrane desalination, new pre-treatment methods like the use of ultrafiltration, energy reduction using energy recovery devices, and higher membrane life from better quality membranes are the future target of R&D programs. The main objective of this paper is to assess several desalination innovative technologies for reducing energy and produce sustainable desalination processes based on renewable energies. The assessment was based on the results of four pilot projects implemented and monitored for two years in Abu Dhabi. Preliminary results indicated that the energy consumption in forward osmosis (FO) membrane technology is only 3.6 kWh m^{-3}, which means that FO membrane technology can make the desalination industry more energy efficient in the near future. Membrane distillation technology is also a thermally driven low-energy that utilizes a hydrophobic microporous membrane to separate freshwater by liquid-vapor equilibrium. Both two technologies can help to improve the sustainability of the desalination industries in the future lowering energy consumption, minimizing environmental impacts, and reducing desalination water cost.

Keywords: Desalination; Forward osmosis; Sustainability; RO; Innovations; Water scarcity

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