

**Simulation and Economical Study of a
Photovoltaic System to Power a Reverse
Osmosis Desalination System in Port Sudan**

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ABSTRACT

In general, seas and oceans water is one of the most important sources of water on the face of the earth, but it is not suitable for use (drinking and irrigation) unless it is treated. Desalination by reverse osmosis (SWRO) is one method that can be applied to produce fresh water. This requires electricity to operate the reverse osmosis unit.

In this study the design of the photovoltaic system of a reverse osmosis unit designed to produce 7 m³/h was evaluated, four cases with different operating conditions were studied by simulation in the PVsyst software; The first scenario is based on operating for 8 hours without energy storage, the second for the same period of operation with energy storage in batteries, and in the third scenario it works for 10 hours without energy storage, and the fourth scenario for the same period but using batteries.

The results showed that the cost of producing a ton of fresh water in the first case 0.878 USD/m³, in the second case 1.249 USD/m³ which the highest cost, in the third case it was 0.711 USD/m³ which the lowest cost compared to the rest of the cases, as for the last case is 0.995 USD/m³.

Although this study was conducted on the available data for the city of Port Sudan, its results can be extended to all areas located on the seacoast and areas with similar climate.

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5.2 Conclusion

This study was conducted to design a photoelectric system to operate a desalination plant operating by reverse osmosis instead of the electricity grid in Port Sudan to produce 7m³/h of fresh water. The design was based on the design capability of the factory. Four different models were evaluated to produce the amount of energy required to operate the plant: the first model operated for 8 hours without batteries, the second model operated for the same period of operation but using batteries, and the third model operated for 10 hours without batteries. Using batteries, the fourth model works for the same period, but with the use of batteries.

These models were simulated by PVSyst, and the number of PV panels and batteries were estimated, along with construction cost, operational cost and production cost per cubic meter of water for each model.

5.3 Recommendations

- Further studies need to be done to demonstrate how the use of photovoltaic energy helps reduce dependence on fossil fuels, and reduces traditional energy costs.
- Lifetime evaluation of the system to determine its cost-effectiveness of solar energy systems, reverse osmosis for saving energy and water.
- Evaluate the performance of tracking systems in comparison with fixed systems.

- Conducting practical experiments similar to this study to compare the performance results between the simulation and the actual experiments.
- Conducting studies to evaluate the economic feasibility of solar energy systems linked to the grid and stand alone systems.
- Study the actual losses of connecting photovoltaic panels and batteries and their economic impact.