

# Solar photovoltaic power generation and seawater desalination

Can solar power power seawater desalination processes?

This study aims to (i) assess the progress of solar energy systems including concentrated solar power (CSP) and photovoltaic (PV) to power both thermal and membrane seawater desalination processes including MSF, MED, and RO and (ii) evaluate the economic considerations and associated challenges with recommendations for further improvements.

What is solar powered desalination?

With solar irradiation ample in regions that heavily rely on desalination, solar powered desalination provides a sustainable solution to meeting water needs. The compatibility of each desalination process with the solar technology is driven by whether the kind of energy needed is thermal or electrical, as well as its availability.

Can solar energy systems be integrated with thermal and membrane seawater desalination methods?

The most associated challenges and possible remediation methods of solar energy systems integrated with thermal and membrane seawater desalination methods are summarised below; To run the desalination plant consistently at static loading, an energy storage device or an auxiliary energy source is essential.

Are solar energy devices used in water desalination?

They reported, that 43% and 27% of water production with the use of photovoltaic cells and concentrated solar power systems, respectively. This demonstrates the lack of use of solar energy devices in the water desalination sector.

Can photovoltaic energy be used for desalination?

The review also shows that there is a development in other desalination technologies that can be powered by photovoltaic energy due to their lower energy consumption.

Are photovoltaic system-powered desalination systems a stand-alone system?

So this paper reviews the photovoltaic (PV) system-powered desalination technologies as stand-alone systems or hybrid systems in the last decade, and this review includes the technologies of reverse osmosis (RO), electro dialysis (ED), reverse electro dialysis (RED), and membrane distillation (MD).

Compared to PV and ST systems, although alternative PVT systems may have varied energy efficiencies, which could lead to different water production performance for desalination, these non-synergistically integrated PVT-desalination systems (in which only one form of energy, either electricity or heat, is used, and let the other energy form for other ...

Obtaining freshwater and important minerals from seawater with solar power facilitates the sustainable development of human society. ... aerospace, and nuclear power generation, further enhancing the fully

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utilization of ocean ... For the solar-powered seawater desalination, 7.31 liter m<sup>-2</sup> of fresh water was collected during 10:00 a.m. to 3: ...

Many authors have studied and researched water desalination systems using RO powered by photovoltaic system, Ndadane & Inambao (Ndadane and Inambao 2022) designed a ...

So far, great research efforts have been made to develop highly efficient solar-powered seawater desalination systems, by improving the light absorption efficiency, optimizing the thermal management, and reducing ...

Abdelslem et al. [40] studied a hybrid technique using SCPPs with cooling towers (the authors termed the technique as Hybrid Solar Chimney Power Plant (HSCPP)) for power generation and seawater ...

Due to the limited freshwater aquifer of 2.5 % availability on the planet, the use of sea water feed for desalination has become critical. This systematic review revealed the potential merits of ...

This work develops a photovoltaic (PV) multistage membrane distillation-evaporative crystallizer (PME), which achieves efficient seawater desalination, electricity ...

This method cleverly combines PV power generation and seawater desalination technology, providing a reference for solar-driven freshwater-electricity cogeneration. Recently, these systems enhanced freshwater-electricity cogeneration performance and are achieved by a reduced PV temperature.

Green energy-driven desalination devices can be classified into three categories: wind, solar (photovoltaic (PV) or solar collector), and geothermal energy (Taner & Demirci 2014). Water can be produced by using these sustainable energy sources in distillation or thermal membrane desalination equipment ( Carpes et al. 2023 ).

Solar seawater desalination is an effective seawater purification method, and many photothermal evaporators have been developed for solar vapour generation based on ...

The growing demand for desalination to augment water supply coupled with concerns about the environmental impacts of powering desalination using fossil fuel have spurred substantial interest in developing desalination systems that are powered by renewable energy (1, 2). Tremendous interest in developing integrated solar-thermal desalination (STD) systems has emerged in the ...

investigate the viability of using a solar collector and a 150 WP solar panel to power a desalination system for seawater. The proposed system will generate heat for seawater evaporation using a

In the direct (distillation) method, a solar collector is coupled with a distilling mechanism. [9] Solar stills of this type are described in survival guides, provided in marine survival kits, and employed in many small

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desalination and distillation plants.. Water production is proportional to the area of the solar surface and solar incidence angle and has an average estimated value of 3-4 ...

Renewable energy sources are also the most suitable in arid places that rely on desalination for fresh water generation [11]. Among the renewable energy sources, solar energy is an amply available free energy source. It can be used to produce both electrical (Solar PV, Solar thermal power plant) and thermal energy (Solar thermal collectors).

from solar photovoltaic and CSP for membrane desalination - is a key solution in ... combining power generation and water desalination can also be a cost- ... energy. Seawater desalination via MSF consumes typically 80.6 kWh of heat energy (290 MJ thermal energy per kg) plus 2.5 to 3.5 kWh of electricity per m<sup>3</sup> of water, ...

This research proposes a seawater desalination system driven by photovoltaic and solar thermal energy for remote regions such as islands and seaside villages where fresh water is not accessible. The performance of this system is demonstrated through experiments, and the main concerns are the output of the photovoltaic power generation system, power ...

Figure 3 shows that Saudi Arabia has a huge potential for photovoltaic (PV) energy, with the best location being in the northwestern region around Tabuk. With rising oil prices and decreasing capital costs for solar projects, the feasibility of pursuing solar energy production grows (Amran et al. 2020). Vision 2030 has set a goal of achieving 58.7 Giga watts (GW) of ...

Freshwater resources have faced serious threats in recent decades, primarily due to rapid population growth and climate change. Seawater desalination has emerged as an essential process to ensure a sustainable supply of freshwater to meet the global demand for freshwater. However, this approach has some shortcomings, such as the disposal of brines ...

Solar photovoltaic (PV) power generation technology has demonstrated that it can be an ideal and clean alternative to fossil fuels, especially in remote and isolated areas where there is no accessibility to power grids, or such accessibility is difficult. ... An electro dialysis sea water desalination system powered by photovoltaic cells ...

The growing interest in combining solar energy with desalination with an emphasis on increasing energy efficiency has been sparked by the rapid advancements in solar energy technology ...

The evolution of materials for solar power generation has undergone multiple iterations, beginning with crystalline silicon solar cells and progressing to later stages featuring thin-film solar cells employing CIGS, AsGa, followed by the emergence of chalcogenide solar cells and dye-sensitized solar cells in recent years (Wu et al. 2017; Yang et al. 2022). As ...

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In an attempt to lower carbon footprint resulting from high-energy consuming desalination processes, attention has shifted to using renewable energy sources to power ...

Renewable energy power reverse osmosis system for sea water desalination plant. Desalination Water Treatment. 2020; 193 : 48-56. doi:10.5004/dwt.2020.25685. Green Energy and ...

Next figure depicts the results about the power generation of the hybrid tidal/PV system as a function of time (in Local Standard Time, LST) for several days of December: behavior of the sea and basin levels ( $H_{sea}$ ,  $H_{basin}$ ); the energy resources namely, available head ( $H$ ) and solar resource at the tilted surface of the PV panels ( $G_{PV}$ ); the respective ...

Additionally, intense day-long sandstorms ( $PM_{10} \geq 2700$  ppb or greater) could reduce the PV power output by as much as 57%. While solar PV and wind energy (i.e. electrical energy) make up the largest percentage of renewable energy installed in the GCC region, thermal desalination coupled with power generation is the predominant technology in the ...

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