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Powering desalination with renewable energy

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ABSTRACT

Today, the world is facing two challenges, water stress and climate change, for which anthropogenic causes leading to greenhouse gas emissions, are considered responsible to a large extent. One of the ways to mitigate water stress is desalination. Today, renewable energies are being taken up rapidly to reduce greenhouse gas (GHG) emissions; however, newer forms of energy, like ocean energy, need to be taken up seriously to further augment the clean energy quantum. By coupling desalination with renewable energy, we can simultaneously reduce GHG emissions and alleviate the water stress. The paper discusses the possible hybridization strategies and challenges for the same. Each type of renewable, along with the suitable type of desalination method, needs more study, and complexities for constant powering for water generation need to be addressed.

Key words: Ocean energy, Desalination, Hybrid systems, Greenhouse gas emission, Renewable energy

INTRODUCTION

Today the climate change has become a commonly used terminology referring to long term changes in temperatures and weather patterns. Over a period of time, such changes have been occurring naturally due to the sun's activity or the Earth's tectonics and volcanic activity. But in recent times, anthropogenic reasons are considered the main driver of climate change, prevailing due to the burning of fossil fuels like coal, oil and gas. Burning fossil fuels, generates Greenhouse Gas (GHG) emissions, which contribute to increased temperature levels and climate change. Thus, the need for clean and renewable energies is evident. Today, the solar and wind markets are booming because the technologies have matured and are now getting more and more inexpensive. In this context, more renewable energy forms, including ocean energies, need to play a vital role. Apart from the GHG emissions and affiliated issues, climate change is also playing a detrimental role in water-related issues. On the one hand, there is unprecedented rainfall leading to urban flooding, but in many regions, there is severe water stress. Water stress can be mitigated by augmenting water using desalination and water treatment. Desalination and water treatment systems use fossil fuels for their energy requirements. Thus, in trying to mitigate the effect of climate change, we are worsening GHG since we are increasing the use of fossil fuels. The solution to this is the use of renewable energies for powering desalination and water treatment systems. This paper discusses some hybrid solutions and issues related to realising hybridization, especially using ocean energy for desalination.

RENEWABLE ENERGY FORMS AND DESALINATION SYSTEMS

Renewable Energies

The most commonly known renewable energy forms are solar and wind. Solar PV needs large footprint on land for large powers. It is also available for only a few hours per day. Wind turbines are now installed at several locations in the country due to positive policies by MNRE. Again wind energy is intermittent and storage for standalone systems needs to be addressed. Today offshore floating solar is being studied and also attempts are being made to harness offshore wind energy.

Apart from the solar and wind energy, we need to explore other forms like ocean energy as well. Given the long coastline of India and a huge exclusive economic zone (EEZ), towards the efforts for mitigation of climate change, it is important to develop new technologies for harnessing ocean energy. Energies that can be harnessed from the ocean are wave, tidal, thermal gradient or ocean thermal energy conversion (OTEC), offshore wind and floating solar PV. The latter two forms are not considered ocean energies since the motive force is not sea water. Salinity gradient is also a possible form, but not yet viable. Today developing all of these forms is the need of the hour for coastal regions, and remote locations and islands.

Energy from ocean currents can be extracted using submerged turbines that capture energy from hydrodynamic lift and drag forces acting upon them. The Ocean Energy Systems Technology Collaboration Program under the IEA, on its website (Ocean Energy systems n.d.), gives details of tidal turbines being studied around the world. Towards developing these turbines, a small capacity unit has been indigenously developed in the National Institute of Ocean Technology (NIOT) using computational and experimental techniques. Upon successful testing of the turbine in controlled conditions of the laboratory, it was successfully tested in the MacPherson Strait, South Andaman, India, by suspending the turbine from a floating platform specially designed for this purpose (Dudhgaonkar et al., 2017). Modules of 1–5 kW ocean current turbines are in advanced stages of development since off-grid units of these ratings are of great utility in the Andaman and Nicobar Islands, India (Figure 1).