

Ocean Thermal Energy Conversion (OTEC) Systems in the Mediterranean Sea: Availability and Cold Water Pipe Effect

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The recent promotion of the Renewable Energy Systems (RES) for the reduction of fossil fuels and CO₂ emissions, is unavoidably connected to the ocean and marine environment as well. So-called Ocean Thermal Energy Conversion (OTEC) systems take advantage of the solar thermal energy stored in the ocean's surface, and exploit (either with the production of electricity or a byproduct – such as clean water) the natural temperature difference ΔT that is formed between the ocean's surface and its bottom at large depths of around 1 km. Because the efficiency of OTEC systems depends on ΔT , their availability and geographical location (i.e., distance from the equator) are their main drawbacks; note that their Carnot efficiency is at only 6.7% for a ΔT of 20°C.

OTEC systems can be utilized in the Mediterranean region, albeit they are more appropriate for usage in tropical countries where there is a significant ΔT between the seabed and the sea surface (for example, in the Caribbean and the Pacific). With relatively high mean values recorded, the Mediterranean region's sea surface temperature, which varies from winter to summer, is comparable to that of the Caribbean. The temperature profiles for various sub-basins of the Mediterranean Sea show a temperature of approximately 13°C at 1 km depths and no significant fluctuations for depths up to 4 km. In addition, various researchers forecast a rise in the Mediterranean Sea temperature owing to climate change and the impact of the sources in the deep seawater. It is hence clear that the primary physical requirement for installing OTEC systems for electricity generation – high enough ΔT between surface and deep seawater – exists in many regions of the world, but, by a preliminary assessment, not in the case of the Mediterranean Sea.

In order to determine how the OTEC systems, could contribute to the EU's climate emissions neutrality, this research seeks to investigate such a potential in the Mediterranean Sea, particularly in the south-eastern Mediterranean area on the island of Cyprus. In particular, a computational investigation on the effect of cold water pipe heat transfer loss is performed on OTEC systems.