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Potential sites for the use of ocean energy in the Mexican Caribbean

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ABSTRACT

Increasing demand for electricity and the need for sustainable energy sources, make ocean energy a viable alternative for its generation in coastal regions. In this study, wave, marine currents and thermal gradient resources were evaluated to identify potential sites for energy harvesting in the Mexican Caribbean. From a techno-economic review of the literature, a marine current turbine from Nova Innovation 100 kW, an OWC (350 kW), and an OTEC (1 MW) plant were considered, examining theoretical energy potentials and the LCOE of each. A potential environmental impact assessment was also carried out, including a study of the regulatory framework and the socio-economic conditions in the region. The results show that energy harvesting from the sources analyzed is viable, especially in the north of the area, where most of the sites that fit the proposed criteria were found, e.g. Cancun for wave energy (power availability of 45.6 MWh/m/yr) and current energy (power availability of 4.4 MWh/m^{2}yr), and the east coast of Cozumel for OTEC deployment (power availability of 1.69 GWh/km^2/yr). Of the three harvesting technologies studied, the best LCOE obtained was for OTEC (862.2 US$/MWh) with a capacity factor of 0.965%. This was expected, given that the technologies analyzed for current and wave energy are not efficient for the resource conditions in the Mexican Caribbean.

KEYWORDS

Quintana Roo; wave energy; marine current energy; thermal gradient energy; environmental impacts

1. Introduction

The state of Quintana Roo, located on the Mexican Caribbean (Figure 1) is one a popular destination for national and international tourists. In 2017, this state received 16.9 million visitors, of whom 11.5 stayed in hotels, equivalent to 27.4 million hotel rooms (79.7% annual occupancy), leaving an economic income of 8,810 million US dollars (SEDETUR (Secretaría de Turismo QR) 2017). By 2019 the number of visitors was over 23 million of which 7.2 million were cruise passengers, bringing in 15 billion US dollars (SEDETUR (Secretaría de Turismo QR) 2020). Such intense activity and so many visitors require electric power, the demand for which has been increasing over time. Figure 2 shows the electrical consumption (GWh/yr) in Quintana Roo from 2004 to 2020. This has increased 4.87% per year from 2004 to 2019, an increase related to the growth of the population (3.5% per year).

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