Abstract

Ocean Thermal Energy Conversion (OTEC) is a promising, yet underdeveloped Renewable Energy technology, which can provide sustainable base-load electricity by utilizing the temperature difference between warm surface water and cold deep water layers in tropical oceans using a Rankine cyle heat engine. The main purpose of this thesis was to develop suitable methodology to determine the economic potential of OTEC on a regional scale in order to provide actionable output immediately useful to identify the most promising locations for the deployment of the technology. The existing body of literature is focused on the assessment of the total global OTEC potential rather than the best specific locations. The main research question is: **How can a regional modeling approach for economic potential mapping be used to efficiently identify and assess viable locations for OTEC deployment?** This study uses the geographic approach to solve the spatial problem at hand, since OTEC is highly dependent on location specific parameters, such as ocean temperature, and spatial proximity of the OTEC resource to potential demand regions. The main research contribution of this study is the first identified GIS based siting model for OTEC, designed to identify suitable specific configurations for the construction of an OTEC plant, starting out from areas with sufficient electricity demand which are connected to OTEC resources in their vicinity. The identified configurations are assessed using two plant designs, a 3MW onshore and a 10MW floating offshore OTEC p lant. Their configuration and plant design specific economic potential is determined by quantifying their Levelised Cost of Electricity (LCOE), using both a conservative cost estimate for the first plant constructed and an optimized cost estimate including projected cost savings achieved for the 10th plant constructed. A general threshold of economic viability of LCOE<0.2€/kWh is used to identify locations which are potentially economically viable. This threshold is considered to be sensible for areas with high electricity rates such as Caribbean island states but less applicable to continental countries with lower rates. The best OTEC potential in the study area of the Greater Caribbean and Gulf of Mexico was found along the coast of countries in the inner Caribbean, including Colombia, Haiti, Jamaica and Cuba. Given a threshold for economic viability of 0.20€/kWh, in a total of 564 locations in 26 countries, even the first 10MW plant built could be economically viable, with estimated LCOE rates close to 0.16€/kWh in the top countries. Including the projected cost savings a total of 776 unique locations in 34 countries could produce electricity using a 10MW plant for LCOE below 0.15€/kWh, with LCOE rates close to 0.11€/kWh in the top countries. No 3MW configuration was identified, which are expected to be economically viable using the cost estimate for the first plant constructed, with the lowest LCOE rates ~0.22 €/kWh. Even including the projected cost reductions only 59 locations in 15 countries were found to have potentially economically viable configurations, with the lowest LCOE rates being ~0.175 € /kWh. Therefore, it is recommended to focus the effort for constructing the first pre-commercial OTEC pilot plant on a MW scale using larger 10MW offshore plant designs in areas with high electricity rates, such as the Caribbean island states. This recommendation is based on the large number of locations for this design, which provide a convincing business case for sustainable base-load electricity production using OTEC today. The economic competitiveness and number of locations increase drastically with cost reduction rates commonly associated with new energy technologies. It is strongly recommended to determine the local cold water availability at any location considered for the development of an OTEC project, as it was found to be a potentially limiting factor for pre-commercial plant sizes as small as 10MW. In addition to the results, this study provides an efficient framework for preliminary site selection and economic potential assessment for OTEC. It can be readily applied to other studies areas, as well as recalculated using improved data or adapted to different plant designs.