Ocean Energy: A New Wave in Renewable Energy

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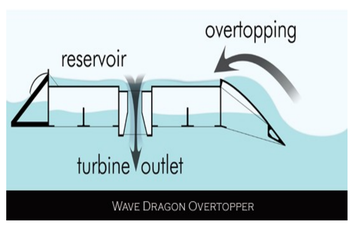
Abstract:

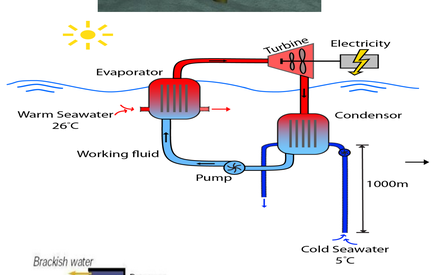
The conversion of the ocean's natural movements and chemical variations into electricity, known as ocean energy, is a renewable energy source which could be used to ease dependence on foreign oil, reduce fossil fuel emissions, fight climate change, and contribute in the diversification of the global electricity sector. Unlike similar industries such as wind and solar, the ocean energy industry remains largely unknown, undeveloped, under-funded, and untested in any long-term commercial environment. Initial research has shown that while the ocean energy industry is steadily expanding, critical barriers exist within the industry which act to cripple commercial development, heighten industry uncertainty, and delay economic viability. Therefore, a study was conducted to answer the questions: How is electricity generated from the oceans, what are the barriers to the future development of the ocean energy industry, and what actions can be taken to overcome these barriers? In order to stimulate the growth of the ocean energy industry, global leaders must make a firm commitment to further industry development through regulatory alterations, economic incentives, and further investment in environmental research and technological development. Using Ireland and the United States as case studies, it was concluded that government tax incentives, streamlining of regulation strategies, and continued financial investment are key steps in making the oceans a competitive source of energy.

Forms of Ocean Energy Technology:

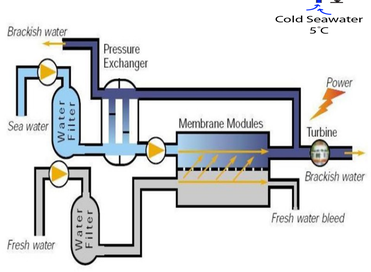


Wave Energy Conversion (WEC). This particular technology, called the Wavedragon, generates electricity through the release of stored sea water in an elevated reservoir to rotate a turbine as the water flows back to normal sea level.

Tidal technologies are most comparable to underwater wind turbines. They use the flow of water past angled blades to rotate a central hub and power a generator.



Ocean Thermal Energy Conversion (OTEC) technology uses warm surface water to boil liquid argon under low pressure, which then rotates a turbine before being condensed using cold deep water.



Salinity Gradient devices use the differences in dissolved salt concentrations to generate electricity by diffusing fresh water through a semi-permeable membrane.

Industry Barriers:

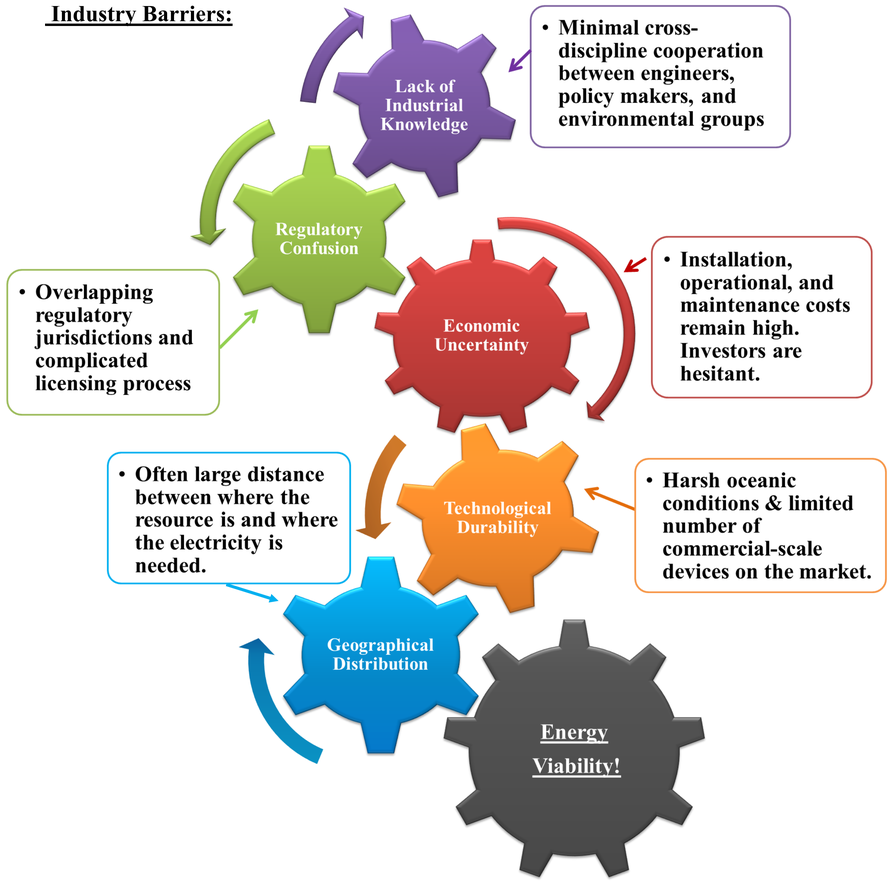


Figure 1: The five leading barriers to the viability of global ocean energy and the primary issue(s) associated with each barrier. The connectivity within the system is important to note; working to overcome just one of these barriers induces progress in the entire system .

Methods:

In order to complete the study, a literature review was conducted which sought to gather information from a variety of academic fields including economics, political science, mechanical engineering, environmental science, and others. Information was gathered using a variety of sources including academic journals, primary and secondary literature, and online academic literature and video. An overview of the variety of ocean energy capture methods was conducted by summarizing the four most frequently encountered forms of technology found in previously available research. Case study analysis using Ireland and the U.S. demonstrate original research, which included a study of the leading ocean energy companies, their technologies, and a critique of the policy and regulatory regimes currently in place in each country. Finally, barrier solutions were determined via external literature using author suggestions.

Case Study Analysis:

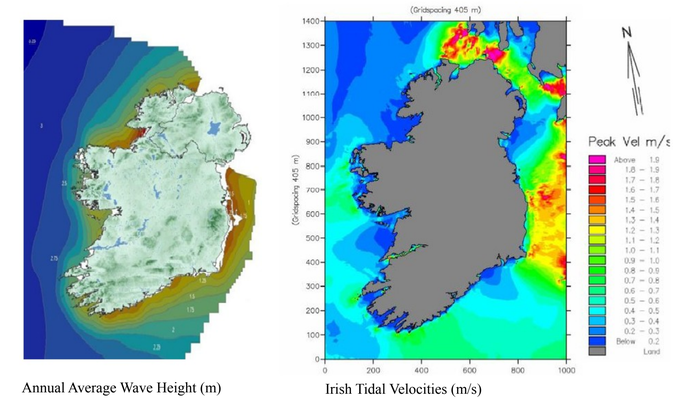


Figure 2: Displays the location of the ocean energy resource surrounding Ireland. The best wave resource [left] lies to the west of the island, while the tidal resource [right] is highly concentrated on the north and east coasts.

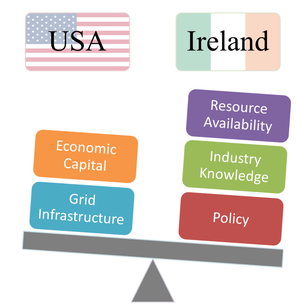


Figure 3: Presents the strengths of ocean energy development within both Ireland and the US. As it stands today, better policy and continued cooperation with the UK is allowing more rapid industry development in Ireland.

Conclusion:

Ocean energy certainly has the potential to be a contributing global technology in electricity production. The International Energy Agency (IEA), a worldwide energy cooperation program, estimates that the global wave resource alone could provide anywhere from ten to fifty percent of the world's electricity demand of 15,000 TWh/yr. In order for the electricity to achieve economic viability however, several prominent barriers must be addressed and overcome quickly. It is the responsibility of global leaders to make a firm commitment to the development of ocean energy through a series of key actions. Firstly, industry knowledge must be improved through the spread of cross-industry information and continued cooperation between engineers, environmentalist groups, utilities, and leaders in other industries such as wind and solar. Industry regulators need to work to streamline the license acquisition process, create industry-wide standards, and generate better policy using forms of existing successful policies as guidelines. Economic viability can be achieved by creating industry incentives (such as feed-in tariffs) to drive down initial costs and attract outside investment. More capital would cause an increase in technology research and development, which would produce a greater number of robust, dependable, and efficient forms of technology. Finally, more efficient technology would foster a stronger electrical infrastructure and minimize energy losses within the grid over large distances.

Acknowledgements:

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