Examining the future of Ocean Thermal Energy Conversion

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Although it may seem like an environmentalist’s fantasy, experts in oceanic energy contend that the technology to provide a truly infinite source of power to the United States already exists in the form of Ocean Thermal Energy Conversion (OTEC). Despite enthusiastic projections and promising prototypes, however, a lack of governmental support and the need for risky capital investment have stalled OTEC in its research and development phase.

Regardless, oceanic energy experts have high hopes. Dr. Joseph Huang, Senior Scientist at the National Oceanic and Atmospheric Administration and former leader of a Department of Energy team on oceanic energy, told the HPR, “If we can use one percent of the energy [generated by OTEC] for electricity and other things, the potential is so big. It is more than 100 to 1000 times more than the current consumption of worldwide energy. The potential is huge. There is not any other renewable energy that can compare with OTEC.”

The Science of OTEC

French physicist George Claude first explored the science of OTEC in the early twentieth century, and he built an experimental design in 1929. Unfortunately for Claude, the high maintenance needed for an OTEC plant, especially given the frequency of storms in tropical ocean climates, caused him to abandon the project. Nevertheless, his work demonstrated that the difference in temperature between the surface layer and the depths of the ocean was enough to generate power, using the warmer water as the heat source and the cooler water as a heat sink. OTEC takes warm water and pressurizes it so that it becomes steam, then uses the steam to power a turbine which creates power, and completes the cycle by using the cold water to return the steam to its liquid state.

Huge Capital, Huge Risks

Despite the sound science, a fully functioning OTEC prototype has yet to be developed. The high costs of building even a model pose the main barrier. Although piecemeal experiments have proven the effectiveness of the individual components, a large-scale plant has never been built. Luis Vega of the Pacific International Center for High Technology Research estimated in an OTEC summary presentation that a commercial-size five-megawatt OTEC plant could cost from 80 to 100 million dollars over five years. According to Terry Penney, the Technology Manager at the National Renewable Energy Laboratory, the combination of cost and risk is OTEC’s main liability. “We’ve talked to inventors and other constituents over the years, and it’s still a matter of huge capital investment and a huge risk, and there are many [alternate forms of energy] that are less risky that could produce power with the same certainty,” Penney told the HPR.

Moreover, OTEC is highly vulnerable to the elements in the marine environment. Big storms or a hurricane like Katrina could completely disrupt energy production by mangling the OTEC plants. Were a country completely dependent on oceanic energy, severe weather could be debilitating. In addition, there is a risk that the salt water surrounding an OTEC plant would cause the machinery to “rust or corrode” or “fill up with seaweed or mud,” according to a National Renewable Energy Laboratory spokesman.

Even environmentalists have impeded OTEC’s development. According to Penney, people do not want to see OTEC plants when they look at the ocean. When they see a disruption of the pristine marine landscape, they think pollution.

Given the risks, costs, and uncertain popularity of OTEC, it seems unlikely that federal support for OTEC is forthcoming. Jim Anderson, co-founder of Sea Solar Power Inc., a company specializing in OTEC technology, told the HPR, “Years ago in the ’80s, there was a small [governmental] program for OTEC and it was abandoned…That philosophy has carried forth to this day. There are a few people in the Department of Energy who have blocked government funding for this. It’s not the Democrats, not the Republicans. It’s a bureaucratic issue.”

OTEC is not completely off the government’s radar, however. This past year, for the first time in a decade, Congress debated reviving the oceanic energy program in the energy bill, although the proposal was ultimately defeated. OTEC even enjoys some support on a state level. Hawaii ’s National Energy Laboratory, for example, conducts OTEC research around the islands. For now, though, American interests in OTEC promise to remain largely academic. The Naval Research Academy and Oregon State University are conducting research programs off the coasts of Oahu and Oregon , respectively.

Do the Benefits Outweight the Costs?

Oceanic energy advocates insist that the long-term benefits of OTEC more than justify the short-term expense. Huang said that the changes in the economic climate over the past few decades have increased OTEC’s viability.

According to Huang, current economic conditions are more favorable to OTEC. At $65-70 per barrel, oil is roughly six times more expensive than in the 1980s, when initial OTEC cost projections were made. Moreover, a lower interest rate makes capital investment more attractive.

OTEC plants may also generate revenue from non-energy products. Anderson described several additional revenue streams, including natural by-products such as hydrogen, ethanol, and desalinated fresh water. OTEC can also serve as a form of aquaculture. “You are effectively fertilizing the upper photic zone…The fishing around the sea solar power plants will be among the best fishing holes in the world naturally,” Anderson said. And, he added, these benefits are not limited to the United States . “Look at Africa , look at South America , look at the Far East . It is a gigantic pot of wealth for everybody… People are crying for power.”

In fact, as the U.S. government is dragging its feet, other countries are moving forward with their own designs and may well beat American industry to a fully-functioning plant. In India , there has been significant academic interest in OTEC, although the National Institute of Ocean Technology project has stalled due to a lack of funding. Japan , too, has run into capital cost issues, but Saga University ’s Institute of Ocean Energy has recently won prizes for advances in refinement of the OTEC cycle. Taiwan and various European nations have also explored OTEC as part of their long-term energy strategy. Perhaps the most interest is in the Philippines , where the Philippine Department of Energy has worked with Japanese experts to select 16 potential OTEC sites.

The Future of Oceanic Energy

Were its vast potential harnessed, OTEC could change the face of energy consumption by causing a shift away from fossil fuels. Environmentally, such a transition would greatly reduce greenhouse gas emissions and decrease the rate of global warming. Geopolitically, having an alternative energy source could free the United States , and other countries, from foreign oil dependency. As Huang said, “We just cannot ignore oceanic energy, especially OTEC, because the ocean is so huge and the potential is so big… No matter who assesses, if you rely on fossil energy for the future, the future isn’t very bright…For the future, we have to look into renewable energy, look for the big resources, and the future is in the ocean.” •

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