Ocean Energy Development: Obstacles to Commercialization

Abstract

Ocean energy technologies are currently competing for a scarce amount of resources, without a great number of commercial successes. Practical Ocean Energy Management Systems (POEMS) conducted a survey, questioning experts from four main categories of ocean energy, including: ocean thermal energy conversion (OTEC), tidal energy, wave energy, and current energy. It was the hopes of the survey to find consensus, or non-consensus, as to obstacles that have prevented the commercial success of ocean energy technologies. The questions were related to the problems associated with the specific technologies, and potential solutions. The questions represented a broad spectrum of related areas, from problems within the political sphere, to problems with the actual technologies themselves. Upon completion of the survey, it became evident that certain agreement did occur across technology bounds. With a consensus found, POEMS constructed a list of objectives that will be vital to push ocean energy into a competitive commercial phase.

Introduction

As fossil fuel externality-related awareness grows throughout the world, it is becoming ever apparent that clean renewable energies must be utilized to sustain our way of life. In a time when foreign fossil fuel demand dictates dire global policy, the United States must learn to tap its own domestic resources to their full potential. Solar, wind, geothermal, and hydro-electric energies have already seen a modicum level of commercialization. Ocean energy, while possessing a potentially greater reservoir of power, and equal technical feasibility as other renewables, has not witnessed many commercial successes. The main reason for this is that it is overlooked for funding from the Federal Government, as the Department of Energy does not list it as a major renewable energy source. Nonetheless, ocean energy still maintains a committed group of experts, mostly at the university level.

Ocean energy is actually a very broad term, encompassing four main production technologies. They include: ocean thermal energy conversion (OTEC), tidal energy, wave energy, and current energy. As with many other renewable sources, the aforementioned sources are very site specific. OTEC, tidal, wave and current technologies command groups of engineers and potential developers dedicated to his or her specific technology. Although similar in commercial potential, a climate of limited funding has generated heavy competition among the different technologies, resulting in stagnation for all involved. In any broad embryonic industry, the benefits of collusion often outweigh competition, especially in the realm of information dissemination, where the majority of the public has no knowledge of ocean energy. In addition, when knowledge is scarce, a success for one technology could potentially benefit all others by increasing awareness. In a perfect world of plentiful funding, each

technology would not necessarily be put in competition, due to their very site-specific nature. In our world of limited to zero funding, a false claim for a site installation could set back all the technologies, as it would only serve greater skepticism. In essence, although each technology would be fond of standing on its own, the laurels do not as yet exist.

Purpose of the Survey

In November 2002, a survey was conducted to determine if any consensus existed among experts in the field of the ocean energy. These experts polled represented diverse backgrounds in ocean energy, with representation from the four main technologies. The survey addressed seven principle categories: the present situation, problems with available technology, problems with political will, problems with social support, problems within the industry, problems with evaluation methods, and solutions. When the responses came back, and a consensus or lack of consensus had been determined, POEMS compiled a prioritized list, or general scaffolding of steps necessary to take all forms of ocean energy to commercialization.

The survey was conducted in two different parts. First, experts were requested to comment on the abovementioned categories, in a broad open-ended written format. Second, upon completion of the first part, the experts were emailed again with the results of the first, including a compiled summary, or consensus. In addition, they were given a number with which they could cross-reference their responses for increased accuracy. The experts were asked to respond again, this time to the summary, in an agree/disagree format, with any comments greatly welcomed.

Survey Results

Upon completion of the survey, it became obvious that on some questions, consensus, did in fact, occur. A summary of the responses follows:

Table 1. Points of Consensus/Non-Consensus

Current Situation:	Much more than in the past, now is the moment to begin commercialization of ocean energy technology.
Problems with Available Tech:	Ocean Energy has its own unique challenges. It has had false technical starts. Construction costs can be too high for wave energy, required to be able to resist the worst storms. The turbines and moorings also have problems. Submerging in-place working systems and placing them on the sea floor is new technology. There needs to be a greater

	focus on technology that will compare different ocean energy applications. The technology gaps in the employment of ocean energy systems can be transferred from other industries, especially the present offshore industry. There is a need to focus on the technology of building systems, not refining devices.
Problems with Political Motivation:	There is a need gain the government subsidy required for ocean energy technology to attract outside investors. The heavy lobbying for existing renewables and fossil fuel based power generation overshadows any attempts to gain political support. There is a great amount of government skepticism towards the economic and technological viability of ocean energy technologies due to poor performance in the past. In order for ocean energy technologies to gain a foot hold, there must be some sort of political backing, even if at a more local level.
Problems with Social Support:	Public skepticism towards ocean based technology detracts from its ability to attract investors. There is a need for greater public awareness about ocean energy. There are contradictions from the public concerning sentiment on clean energy, economic policy, and aesthetics.
Problems within Industry:	The present industry attempts to gain funding for and implement systems that are too large. The industry in a sense does not really exist. There is not enough focus from the industry in the compilation of systems for the utilization of the present technology, and too much focus on the ocean energy technology itself, i.e. the large number of patents. The industry needs to gain a political voice, and investor confidence. There is a great need for the construction of actual working systems.
Problems with Evaluation:	Evaluation of the different technologies comes from too green a perspective. There is a relatively small installed base and technical

	track record. Evaluation methods need to be able to compare the different technologies with a standardized set of tests. Evaluation needs to focus more on commercial viability. Evaluation of projects must address maintenance issues such as biofouling, as these types of issues relate to the economic reality of a project.
Solution:	Create a vision for how ocean energy can compete with and complement other renewables. Identify specific areas of ocean management (desalinization, shoreline stabilization, fuel cell and battery provisioning, ocean observatories and climate change) to achieve industry foundation. Attain government support, which will, in turn, attract investment. Establish detailed costing, evaluation, and impact methodologies. Attract existing offshore industry to ocean-based energies. Educate public to enable them as discriminative utility consumers. Establish an industry library, best practices and knowledge bases. Focus energies towards business sphere to create operational systems.

Commercial Significance of Consensus

Given the very limited amount of operational facilities worldwide, (most are experimental) there truly is not a great foundation of knowledge with which to develop more. Therefore, it is imperative that if ocean energy based technologies are to witness fruition, knowledge must be compiled and accessible. Within the United States, the Program Administrator of the Energy Innovations Small Grant (EISG) program has expressed interest in a compiled consensus, as well as a scaffolding, or list of objections that are required to take ocean energy to a commercially practical level.

Objectives to Reach Full Commercialization

Once a summary of consensus had been completed, the prioritized list of objectives was created. It became evident that this list must be formulated in a somewhat chronological manner, with clear and attainable goals existing for each step or phase. That is not to say that if a commercial installation can gain the required funding to be built tomorrow, it should not be constructed, as US

installations are now in the making. However, by following a clear-cut outline to commercialization fruition, the previously discussed track record will have a sound rooting.

The first phase is to spread the word. The foundation must begin with an educated public. Not only is this necessary to attract national recognition, i.e. funding, but to attract attention on local levels as well, creating a much-needed demand for small community based projects. A political voice is also necessary, as Ocean Energy has recently become a platform for the Reform Party. The goal of this phase is to be included as a listed renewable source by the Department of Energy. However, this is very technologically dependent, as is probable that one ocean energy technology will make the list before others. One particular educative focus should be the existing worldwide facilities and the ones cropping up in the United States. Knowledge of the existing facilities would not only demonstrate the functionality of the technologies, but particular environmental benefits could be witnessed as well. An industry library, which will function throughout every phase, needs to be created. This library needs to compile a list of worldwide commercially viable sites for development. This will help create a standard for what it actually means to be commercially practical. A vision for commercial competitiveness for each technology must be formulated during this phase.

In addition to targeting existing facilities as a resource for education, positive externalities and additional implementation (besides energy production) associated with the different technologies should be conveyed. Some of these include: desalinization, erosion control, shoreline stabilization, climate control and hydrogen production. These are important for community adoption.

Once a particular ocean energy technology is fully recognized by the DOE, the aforementioned projects should be capitalized, thus beginning the second phase of smaller-scale commercialization. It will also be important to attract investors towards hybrid projects in this phase, which are probably viewed as more secure. During this phase it is vital that communications with the present offshore industry be fully established, as this will be the key to the creation of larger scale projects, within every ocean energy technology. As community based projects are being erected, best practices and standards can be created. This will evolve a positive track record, which is integral for attracting investors. As more projects are developed, systems should be compared on a real (non-theoretical) basis. These comparisons should be carried out not only within an ocean energy technology, but different technologies should be compared as well. By comparing different technologies, a true sense of viability can be seen, which in turn will aide the technologies in finding a market niche.

The final phase (phase three) begins with ocean energy and the offshore industry ready to cooperate to build large, high energy producing facilities. By this time, different problems such as mooring and biofouling should have been worked out by the induction of the small-scale facilities. Siting and zoning issues will have been dealt with before and the best practices can be fully instituted to work out any problems. In essence, any foreseen problem will have already been encountered, so these large projects, which require so much investment,

should be able to acquire funding and build successful facilities without the kind of strain that would occur if no foundation had been built.

Problems Associated with Survey

One main problem with the survey was that it was very open-ended, leading to incomplete answers, requiring further emails for completion. However, this open-ended style was also the strength of the entire survey. One cannot see the entire picture and reach any kind of natural consensus with yes or no answers. This format was necessary for later implementation of objectives, discussed earlier.

Conclusion

Ocean energy technologies are now in a “Catch-22” phase. There is not much funding because they have not truly proven themselves through existing facilities, yet in order to prove the technology viable through building operational facilities, funding is required. In order to detach itself from an uncertain future, a clear plan must be developed, beginning with education, and ending with the building of large commercial projects.