WAVE POWER TO THE PEOPLE

An investigation of potential market opportunities for early stage wave power technologies

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As the world's population continues to grow so does our energy consumption. To satisfy this rising demand in a sustainable manner, leaders around the world are increasingly turning towards clean and renewable energy sources. Wave power represents a huge untapped resource of such clean and renewable energy.

With a total theoretical resource of 32,000 TWh per year [1], out of which 2,000-4,000 TWh is considered to be practically and economically exploitable [2], about 10-15 % of the global electricity production could be provided by wave power. As a result, the long-term objective of the entire wave energy industry is to deliver large-scale wave energy farms feeding electricity to large national utility grids.

In line with this great potential, innumerous concepts for different Wave Energy Converters (WECs) are all competing for a share of this seemingly much attractive opportunity. As of today, no concept has emerged victorious as there are several issues restraining wave power from reaching the state of a commercially viable resource for sustainable energy harvesting. For example, the intermittent nature of wave power makes it hard for any electrical grid to rely on wave energy—or any other renewable and intermittent energy source for that matter—to any greater extent; slow-moving bureaucracy and the monopolistic government controlled structure of most utility grid markets discourage private investments; and most importantly, developers of WEC technology have thus far not been able to design a device that is robust enough to survive the harsh conditions offered by the world's oceans, and at the same time reach the efficiency and cost levels needed to compete with already established energy sources within the utility grid market. So far, WECs have been too large and costly compared to their energy output, and since no WEC developer have yet been able to prove that their design will overcome these difficulties—although they all claim that they will—, the industry is not likely to reach profitable cash flows from the utility grid market within the near future. Thus, it is imperative for the entire wave energy industry to find alternative development paths that can generate income along the way and cover R&D efforts with revenue rather than external investments.

Fortunately, there exist several smaller and more nimble niche markets—often called off-grid markets—where wave power technologies are much more likely to be competitive already at current efficiency and cost levels. This will enable WEC developers to survive long enough for their technologies to mature to a level where they can compete successfully also within the much larger utility grid market.

These off-grid markets can be segmented in many different ways. One possible segmentation is provided by Nilsson (2016) [3] who lists eight distinct off-grid market segments: ancillary, defense and security, direct to product, leisure and recreational,

ocean observing and measurement, portable generation equipment, power grids, and various applications. Additionally, Nilsson evaluates the viability and attractiveness of each of these segments in relation to CorPower Ocean, a Swedish WEC developer based in Stockholm. As a result, three segments are highlighted to be the best fit for CorPower Ocean—although it is not too farfetched to make the generalization that these segments are probably the most interesting also for the wider wave energy industry. The three shortlisted segments are: ancillary, which refers to applications that are connected to and take advantage of already existing offshore structures such as fish farms, offshore wind farms, and oil rigs; direct-to-product, which refers to applications where the electricity feeds straight into producing some kind of product, such as desalinated water or hydrogen, resulting in that all the generated electricity is captured and stored in the finished product; and power grids, which refers to applications were the generated electricity is fed into an electrical grid of some kind—excluding large-scale utility grids, as they already represent the ultimate long-term target market.

Nilsson also provides a framework for how to further assess specific opportunities within the different segments using a structured approach consisting of eight distinct steps (see figure 1). Next, Nilsson uses this framework to perform an in-depth assessment of two sub-segments within the power grid segment. The first sub-segment is called micro-grids and is defined as remote islands and mainland communities that are not connected to any existing large-scale utility grid. The second sub-segment is called resorts and consists of all coastal resorts around the globe regardless of size. Following the analysis of each of the framework's eight steps, Nilsson concludes that both micro grids and resorts represent attractive opportunities for CorPower Ocean and the wave energy industry to pursue.

The ideal market scenarios for both micro grids and resorts are when the current solution is based on small-scale diesel generators operating in a completely isolated and remote location; the micro grids should have an average demand of about 0.5-5 MW and the resorts should be high-end luxury resorts with a strong eco-profile and have about 200 rooms or less. These sizes will allow CorPower Ocean to make a meaningful contribution to the required electricity supply with just a few WEC devices and without having to completely replace the current solution. This is seen as one of the key aspects for making wave power technologies more accessible and attractive for the buyer since it reduces the need for energy storage and helps to keep down the initial investment at the same time as existing diesel generators will continue to run in parallel and provide stability, reliability, and back-up capacity. Lastly, the micro grids or resorts should of course be located in an area with adequate wave power resources and low seasonal variations.

In conclusion, the wave energy industry will have to overcome several technical difficulties that are currently constraining the adoption of WEC technology in order to produce a

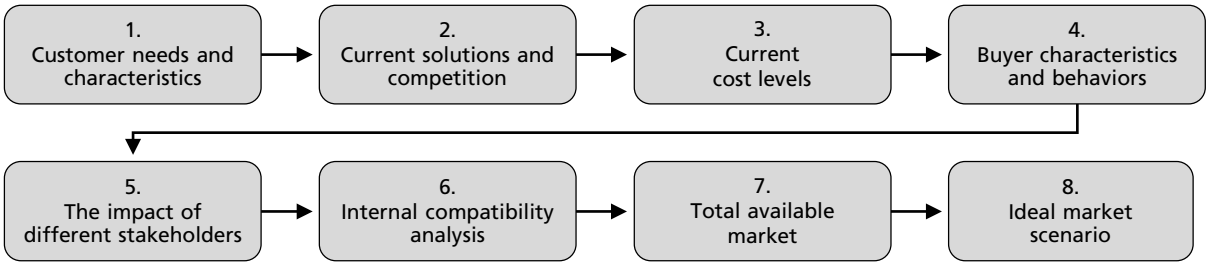

Figure 1: Step-based approach for opportunity assessment [3]

design that can sustain proper operations out in the actual ocean along with reasonable efficiency and cost levels. Provided that the industry will achieve all of this, there definitely exist many attractive off-grid market opportunities for CorPower Ocean or any other WEC developer to capitalize on, and we might finally be on track to establish wave power as an energy source for all of humanity and the earth itself to benefit from.

BIBLIOGRAPHY

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