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California Energy Commission
Dockets Office, MS-4
1516 Ninth Street
Sacramento, CA 95814-5512

**Subject: Docket No. 12-EPIC-01 – Marine Renewable Resources**

To the California Energy Commission:

I appreciate the thoughtful study plan that you have put together and, in particular, I am excited about your support for moving marine energy forward in California. California is blessed with an enormous wave and offshore wind potential, which could make a significant contribution to meeting the State's energy demand in the future. Given the substantial difficulties that have been encountered with the siting of other renewables (wind, solar, geothermal, etc.), it is critical for the Energy Commission to seriously consider marine energy technologies and pursue them aggressively as an option to meet strategic renewable energy goals.

The combined technical potential for electricity generation from offshore wind and wave energy exceeds California's electricity consumption and is in close proximity to California's load centers. Harnessing even a small percentage of that total potential could make a significant contribution to meeting the aggressive renewable generation targets of this state. Technologies that tap into this enormous potential have matured significantly over the past few years. Technology maturity is important, because it will allow California to focus on deployment and siting of these marine energy devices, without having to build an extensive research base (which takes a long time).

Given the significant potential for wave power and offshore wind in this state, I believe that a significant portion of the R&D funding allocation should be directed toward these emerging technologies and I urge the commission to allocate at least $20 million to this area over the coming three years. This level of funding would be consistent with the challenges faced and allow California to establish itself as a leader in this emerging sector.

I provided verbal comments on this topic to the CEC on 9-27-12. One concern was raised by Commissioner Weisenmiller stating that it would be difficult to site such marine power plants

because of concerns by the US military that offshore wind plants would interfere with their weapons systems. While I am not specifically aware of these concerns, I know that the US Navy has a strong interest in marine renewables and is actively pursuing them to be used on their bases worldwide. However, we understand that specific siting issues such as these may preclude deployment in certain coastal areas. These types of siting constraints are typically considered during the planning phases of a project and are not in any way different than any other renewable energy project. Oregon has addressed this by developing a comprehensive marine spatial plan that incorporates the needs of marine renewables. Evaluating those siting constraints is an important area of research and the Ocean Protection Council has made great progress in the identification of such spatial constraints within California.

A second concern was raised that the California Energy Commission does not have the expertise to develop utility-scale testing sites. I would contend that most organizations do not have these capabilities, and thus develop such projects through a competitive bidding process and the involvement of consultants. I would envision a site development in California to be no different.

We are a small R&D company located in California and are doing a tremendous amount of research on marine renewables for Federal agencies including the US Department of Energy. Small businesses in California are responsible for much of the innovation in this State, are inherently effective at performing R&D, and tend to be able to provide superior value per research dollar spent when compared to larger organizations. We ask that any competitive solicitation process would provide the opportunity for small businesses to compete on all the research funding spent by the program. California has tremendous intellectual and entrepreneurial capabilities and, if properly stimulated, will establish California as a leader in ocean energy.

The following comments are specific to the EPIC plan in its sub-sections, and outline the type of studies that should be carried out in order to move the industry forward. S4.4 and S4.5 are primarily focused on R&D activities. Judging by similar activities at the federal level, most of the R&D studies can be carried out at a level of $500K - $1M.

**S.4.4 – Proposed Funding Initiative – Investigate the Economic, Environmental and Technical Barriers to Offshore Wind in California (page 66)**

<u>Offshore Wind Measurements</u>

The offshore wind resource in California has been assessed through various state and federal programs. However, actual in-situ measurements are virtually non-existent in the offshore environment. These measurements are required to: (1) validate existing models, (2) better understand vertical shear profiles in the offshore environment, and (3) understand the level of turbulence – typically a design-driver for wind turbines. Traditionally such measurements require a met-tower, which can be a very costly undertaking in deep water. However, in recent years, laser-based wind velocity measurements have made significant progress, allowing the characterization of the boundary-layer up to significant heights at low cost.

Using these new measurement technologies in combination with an autonomous platform could aid significantly in developing the data-sets required to fully characterize the wind resource offshore California.

Techno-Economic Assessments of Deep-Water Wind-Turbine Foundation Concepts

Offshore wind is an emerging technology sector, which is characterized by a wide range of technical approaches in respect to the foundation design. This is not unlike onshore wind technology during its early development 20-years ago. In order to accelerate the development of these technologies and develop a clear understanding of the technological capabilities in the California context, techno-economic assessments need to be carried out. Techno-economic assessments are an effective tool to baseline different technology platforms, benchmark their cost effectiveness, and evaluate cost reduction pathways. California has unique characteristics in respect to its rapidly dropping coastlines, making it necessary to perform these assessments in a California context to complement federal efforts.

Deployment Scenarios for Offshore Wind to Identify Navigation and Environmental Issues

Offshore wind is an emerging technology sector and the understanding of the technologies themselves (footprint, moorings, size, etc.) is largely unknown to the wide range of stakeholder groups. It is therefore inherently important to develop realistic deployment scenarios at various deployment scales. These can then be used to evaluate navigation and environmental effects in the California context. A similar effort was carried out by our company for wave and tidal power. The three final reports can be downloaded from our website at http://www.re-vision.net/projects.shtml (under Scenario-based Assessment of Navigation and Environmental Effects of Wave & Tidal Technologies).

**S4.5 – Proposed Funding Initiative - Investigate the Economic, Environmental and Technical Barriers to Wave Energy Conversion in California. (page 67)**

Techno-Economic Assessments of Various Wave Energy Conversion Systems

Wave energy is an emerging technology sector and is characterized by a wide range of technical approaches. This is not unlike onshore wind technology during its early development 20 years ago. In order to accelerate the development of these technologies and develop a clear understanding of the technological capabilities in the California context, techno-economic assessments need to be carried out. Techno-economic assessments are an effective tool to baseline different technology platforms, benchmark their cost effectiveness, and evaluate cost reduction pathways. California has unique characteristics in respect to its rapidly dropping coastlines, making it necessary to perform these assessments in a California context to complement federal efforts.

Wave Resource Assessment with a High Spatial Resolution

A wave resource assessment was recently completed by EPRI under a DoE-funded initiative. The report is available at the following link:
http://www1.eere.energy.gov/water/resource_assessment_characterization.html

The assessment was a great step forward in developing the first nationwide resource assessment in this country. However, it was based on Wavewatch III data, a global third generation wind/wave model run by NOAA which has limited validity in shallow water or sheltered sites and suffers from poor spatial resolution. This makes it difficult to assess the performance of wave energy machines at their actual deployment sites.

A California-wide resource assessment should be carried out that provides a higher resolution in the near-shore environment and provides the resulting data in a format that can be easily used in the performance assessment of wave energy converters. This effort could leverage the previous national effort to define the boundary conditions for the statewide effort. It could also leverage recent, very detailed, bathymetry mapping efforts carried out in California, which would improve the accuracy of the results.

**S4.4 and S4.5 – Overlapping R&D topics. (page 67 and page 67)**

Ocean Current Characterization to Determine Current-Induced Load Conditions on Marine Energy Installations

Marine currents are important design drivers. Recent radar-based mapping of the offshore currents in California could be used to characterize these currents and put them into a marine energy context. This may require re-processing of the data and statistical treatment to establish the data in the appropriate format.

Extreme Loading Event Characterization

Extreme events (typically 50- or 100-year return events) are important design considerations when evaluating the structural loads on marine energy installations. Such loads are induced by winds, currents, waves, tsunamis, and seismic activities. These events need to be properly characterized using existing data to form the design basis for marine energy installation in California.

Infrastructure Characterization

California’s infrastructure to support wave and offshore wind installation needs to be properly characterized. This includes: ports, transmission infrastructure, transportation infrastructure, and marine vessels. This data will form the basis for any device developer coming into the state.

Development of Supply Curves

Ocean wave energy could potentially meet a substantial portion of California's electricity needs, is located close to coastal population centers, and, although variable in nature, may be more consistent and predictable than some other renewable generation resources. In addition, the output characteristics of these technologies may complement those of other renewable technologies.

However, there are various spatial and resource constraints and characteristics that will affect how much energy can be extracted, and at what cost. This type of analysis is best captured with

Supply Curves that characterize the cost of electricity from the resource as a function of deployed capacity. Re Vision recently carried out a nationwide study for the US Department of Energy, which is available for download at http://www.re-vision.net/projects.shtml (fourth project on the list). However, the study does not consider the many local constraints that are unique to California. We would encourage carrying out a similar study for California.

Environmental Studies

There is a solid body of knowledge forming around the environmental impacts of marine renewable technologies. However, many of these findings need to be brought into a California context and addressed in a comprehensive way.

Mooring Design Studies

Mooring design is dependent on the types of sediments, water depth, seabed slope, etc. encountered at any particular site. To provide a solid understanding for the siting of these power plants, it is important to fully characterize the seabed and sedimentation with a view to the mooring requirements. While much of the data is already available, it needs to be put into a format that is suitable for mooring design studies.

**S10.2 – Proposed Funding Initiative – Support Demonstration Testing and Verification Centers to Accelerate the Deployment of Pre-Commercial Clean Energy Technologies (page 104)**

Developing a testing site in California is probably the most important component in addressing the technical, commercial, environmental, and public perception issues of marine energy in this state. It is also the most expensive item and will take time to fully develop. However, most of the expenses will occur during construction and operation of the facility. A three-year time horizon may be appropriate to fully permit the facility and get it 'shovel-ready'.

There are several oil & gas platforms offshore in southern California that could be used as an electrical take-off point for establishing such a pilot site. Leveraging this existing infrastructure could significantly reduce the total cost of such a site and also reduce the permitting hurdles, because most environmental baseline studies can be leveraged.

Given the cost for the development of any site in California, it is important that infrastructure cost is shared between a deep-water offshore wind testing site and an offshore wave testing site. Hence, they should be co-located and, in fact, there are numerous sites that would make excellent candidates for doing exactly that.

There are several entities in California that would be capable of executing and contributing to this effort, including ourselves. It is important that this project development effort is broken down into smaller individual efforts with specific goals and milestones, and that all data developed under this effort will become public domain.

Assuming that existing subsea cabling infrastructure can be leveraged, the construction cost will be dominated by the procurement of full-scale machines, their installation and operation. Funding for this could come from a number of mechanisms, including: (1) capital grants, (2) sale of electricity, (3) tax incentives, and (4) federal research dollars (DoE and Navy). Such activities

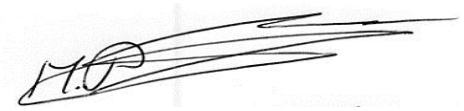
are likely going to be beyond the three-year time horizon, due to the duration of permitting and environmental study activities necessary to lead up to that point.

Developing such a project in collaboration with the US Department of Energy and the Navy would make it possible to share the financial burden of such a project and leverage expertise. However, it is important to understand that these agencies operate at a federal level and will allocate their dollars to sites that have existing local support. Unless the EPIC program provides the funding and support to develop such a site, it is unlikely that California will make it onto these organization's priority lists. Setting the precedence of a strong support for marine energy will allow California to leverage these federal initiative dollars and become a leader in this field.

**Establish a Marine Energy Sector Advisory Group - (Page 165)**

Bringing together California's enormous technical, intellectual, and industrial capabilities will be important to fully develop this technology sector. This effort is needed to coordinate and bring together the wide-ranging intellectual and industrial capabilities. The effort will produce a comprehensive assessment of California's capabilities to address the needs of the emerging marine industry. This group could also be charged with developing a strategic roadmap for marine energy in California.

Thank you for the opportunity to provide my comments,



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