Comment Received From: CorPower Ocean
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CorPower Ocean Comments - CorPower Ocean Docket Response - Wave and Tidal Energy

Re-filling the docket response from CorPower Ocean

Additional submitted attachment is included below.

August 21st, 2024

Chair David Hochschild
Vice Chair Siva Gunda
California Energy Commission
Docket Unit, MS-4
Docket No. 24-IEPR-04
715 P Street Sacramento, CA 95814-5512

Subject: Comments on the 2024 IEPR Update – Wave and Tidal Energy

Dear Chair Hochschild and Vice Chair Gunda,

CorPower Ocean is grateful to the California Energy Commission and its consultants for the extraordinary work on implementing SB 605 to-date. The recently released Draft Consultant Report Wave and Tidal Energy: Evaluation of Feasibility, Costs, and Benefits is a thorough, useful, and encouraging milestone on the path to the full SB 605 report to be delivered next year. As one of the leading wave energy technology developers we aim to support the process by providing technical and commercial input where we can contribute.

We encourage CEC to prioritize the inclusion of marine energy as part of California's future mix to help the state reach 100 percent renewables by 2045, lower costs for ratepayers, and create qualified and sustainable jobs in California.

In this docket submission we provide recommendations that we hope can be helpful to maximize the impact wave energy can have on the Californian energy system and the transition to net-zero, and in the second part we provide comments on the Draft Consultant Report.

CorPower Ocean works in coordination with AltaSea, the National Hydropower Association, Calwave and additional developers in reviewing and providing feedback. In September 2023 CorPower Ocean and AltaSea partnered to support wave energy deployment on the US west coast. We support the recommendations and comments provided in the docket submissions by AltaSea, NHA and Calwave, and will not repeat the same points here.

I. Recommendations

1. Energy system value. Quantify potential savings for California ratepayers resulting from the integration of marine energy technologies into the California grid.

   Numerous studies confirm that adding the consistent and complimentary power profile of wave energy can deliver lower cost net-zero energy systems. By providing a more consistent generation mix, 24/7 clean electricity can be delivered by an energy system having less required generation capacity, less transmission and less storage capacity.

Supporting studies

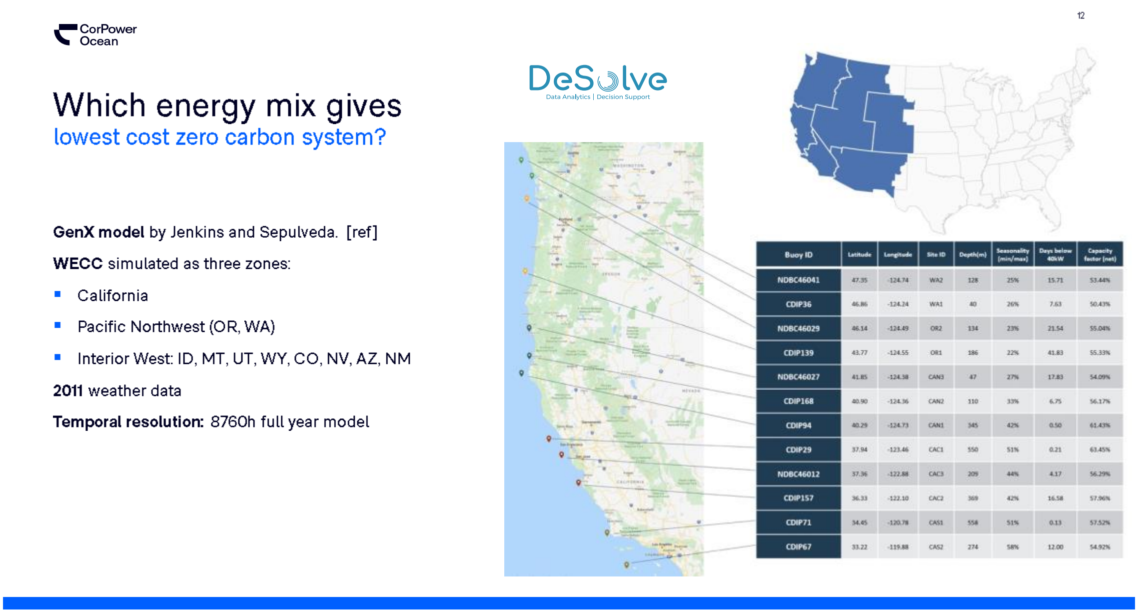
Pacific Northwest National Laboratory (PNNL) grid value of marine energy. The study concludes that the lowest-cost option for building storage occurs when 50 to 60 percent of the renewable energy portfolio comes from marine energy

Breyer et al http://doi.org/10.1049/rpg2.12840 found that for other coastal regions including Ireland and Scotland having similar wave resource as California, wave energy can make up the single largest energy source in the lowest cost zero-carbon energy system by 2050.

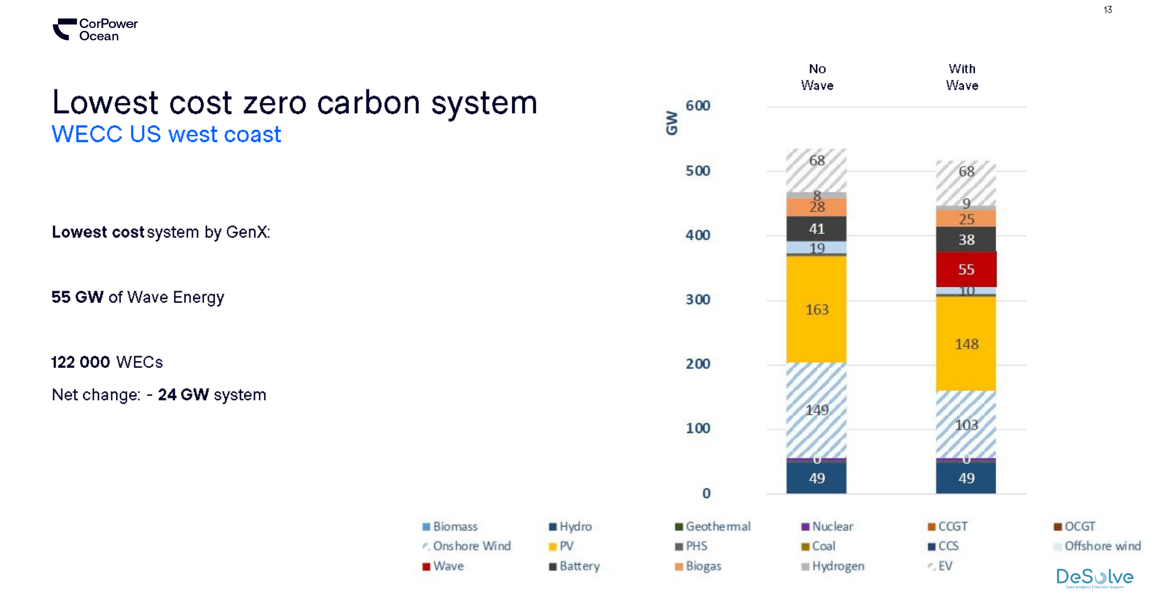
Another study modelling zero-carbon 2050 energy systems for the UK has resulted in 12.6GW of marine energy (~6GW each of wave and tidal stream) making up part of the least-cost net zero electricity mix. Compared with a non-marine scenario, this 12.6GW results in a £1.03bn ($1.35bn) reduction in dispatch costs, due to a reduction in peaking generation and storage requirements. This study also found this magnitude of deployment would result in a Gross Value Added (GVA) to the UK economy of up to £8.9bn ($11.65bn).

Further system value studies in Europe have found similar results for the UK, Portugal and Ireland, with future energy modelling scenarios including wave and tidal found to consistently reduce dispatch costs and storage requirements, due to offsetting with wind and solar resource.

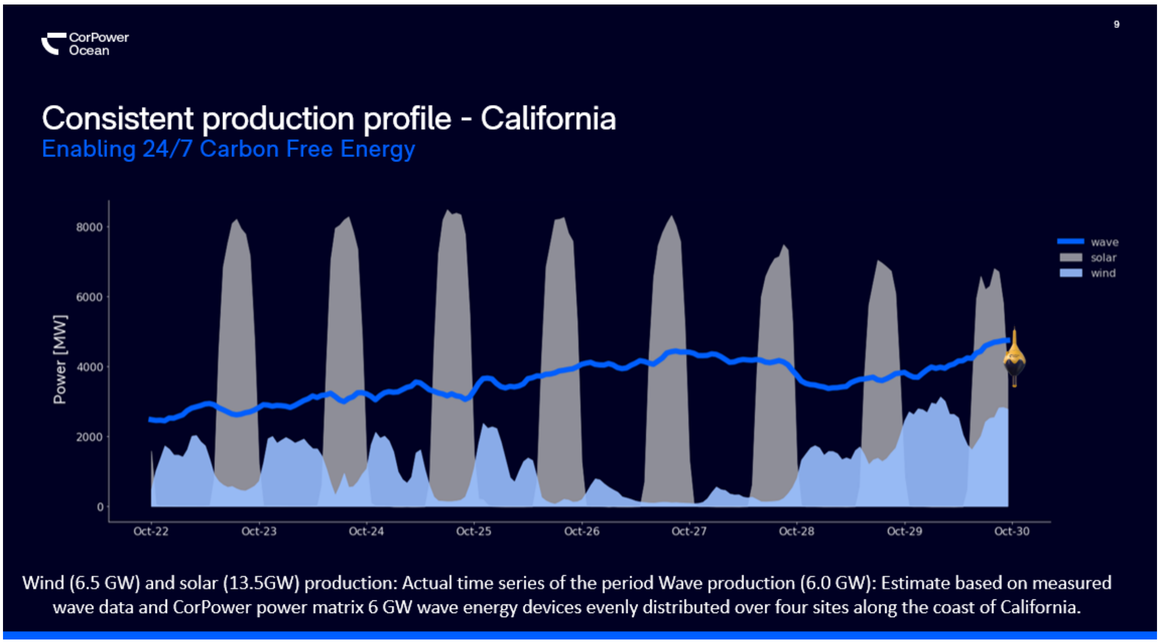
Jenkins and Sepulveda performed a study on the lowest cost zero-carbon WECC system with 2050 cost and performance projections using the GenX system model. A total installed wave power generation capacity of 55GW was found for California, Oregon and Washington state combined, to deliver the lowest cost clean energy system with hourly balancing of supply to demand. This study is summarized in the two slides below, and further information on this study can be shared on request.



Buoy ID	Latitude	Longitude	Site ID	Depth(m)	Seasonality (min/max)	Days below 40kW	Capacity factor (net)
NDBC46041	47.35	-124.74	WA2	128	25%	15.71	53.44%
CDIP36	46.86	-124.24	WA1	40	26%	7.63	50.43%
NDBC46029	46.14	-124.49	OR2	134	23%	21.54	55.04%
CDIP139	43.77	-124.55	OR1	186	22%	41.83	55.33%
NDBC46027	41.85	-124.38	CAN3	47	27%	17.83	54.09%
CDIP168	40.90	-124.36	CAN2	110	33%	6.75	56.17%
CDIP94	40.29	-124.73	CAN1	345	42%	0.50	61.43%
CDIP29	37.94	-123.46	CAC1	550	51%	0.21	63.45%
NDBC46012	37.36	-122.88	CAC3	209	44%	4.17	56.29%
CDIP157	36.33	-122.10	CAC2	369	42%	16.58	57.96%
CDIP71	34.45	-120.78	CAS1	558	51%	0.13	57.52%
CDIP67	33.22	-119.88	CAS2	274	58%	12.00	54.92%

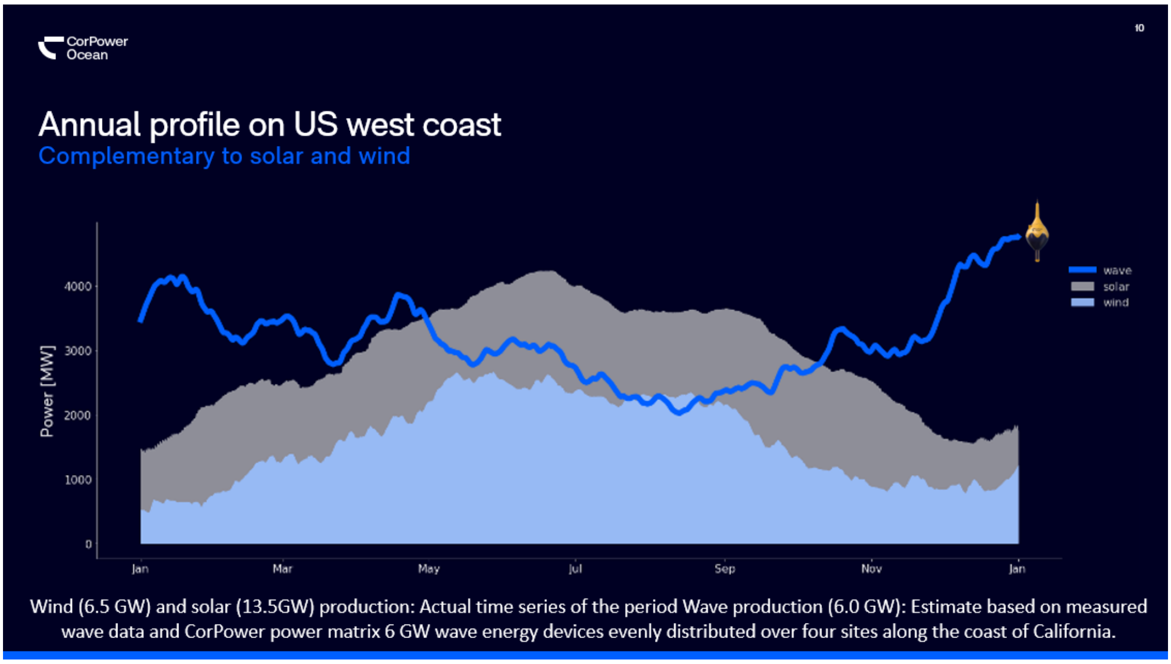


2. Energy Security. Quantify the value from an energy security perspective of adding wave energy to the Californian energy mix. Creating a more balanced mix together with wind and solar PV resource to achieve close to 24/7 carbon-free energy supply while *removing the dependency of imported energy*. The two figures below illustrate the daily and seasonal complementarity between wave, wind and solar PV in California.



Delivering local wave energy directly to the main consumption centres along the Californian cost can offer a very resilient and secure source of supply. The highly distributed and modular approach with many installations along the coast, with each farm built up from clusters or many relatively small units can further contribute to a fault-proof and secure energy system.

While offshore wind farms in Californian waters (with relatively long distance to shore) may need to be relatively large to reach acceptable cost levels, the ability to locate wave arrays close to shore in a more distributed manner (similar to distributed battery deployment) is a potential benefit that should be considered.



3. Economic development and local content. Building a major new industry in California. Quantify the significant economic value of building out this nascent industry, with long-term development of coastal communities and the creation of new qualified, sustainable and well-paid jobs.

   Wave energy in general and in particular CorPower's modular approach with local manufacturing in particular supports a high local value add and economic development in the areas of wave farms are deployed. Existing studies have shown up to €2.79M/MW ($3.10M/MW) in GVA from a 10MW deployment of CorPower wave energy converters, with 54.27 job years per MW.

4. Co-development of offshore wind & wave resource. Encourage further legislation to create the same pathway for marine energy as offshore wind.

   We recommend that "marine energy" is added to the activities currently specific to offshore wind, as wind + wave farms being co-located and/or sharing electrical infrastructure and port facilities can have a significant positive impact on the growth of the marine energy sector in California while also benefiting the offshore wind sector.

   Legislation intended to accelerate the scale-up of marine energy technologies in California beyond SB 605 should be swiftly introduced. AB 525 has resulted in the adoption of an Offshore Wind Strategic Plan, state deployment targets, requests from CPUC for offshore wind centralized procurement, and investments in the state's port infrastructure, among other things. By enacting similar legislation for marine energy, which should include mechanisms to cover cost share for contracts with federal agencies like DOE, we can ensure that California sets the course for the scale-up of another crucial renewable energy sector.

   Partner with the U.S. Bureau of Ocean Energy Management (BOEM) for deployment of marine energy in both federal and state waters off the coast of California, including the potential of expanding offshore wind lease areas for multi-use opportunities to include marine energy.

   Recent European studies have shown that co-locating wave and floating offshore wind farms can reduce costs compared with individual deployments, and reduce variability in power generation, as well as reducing the ocean area required for offshore renewable developments.

Co-locating offshore wind with wave energy systems off the coast of California is therefore expected to significantly reduce variability in power generation. Since these projects may share infrastructure like offshore substations and power export cables, balance-of-plant costs may decrease and ultimately lower costs for ratepayers. By partnering with BOEM, the state of California can help shape marine energy leasing processes from a relatively early stage and can ideally advocate for a combined offshore wind and marine energy leasing process.

5. Utilize State waters. Maximize the value California can have from its state waters with respect to wave farm deployment.

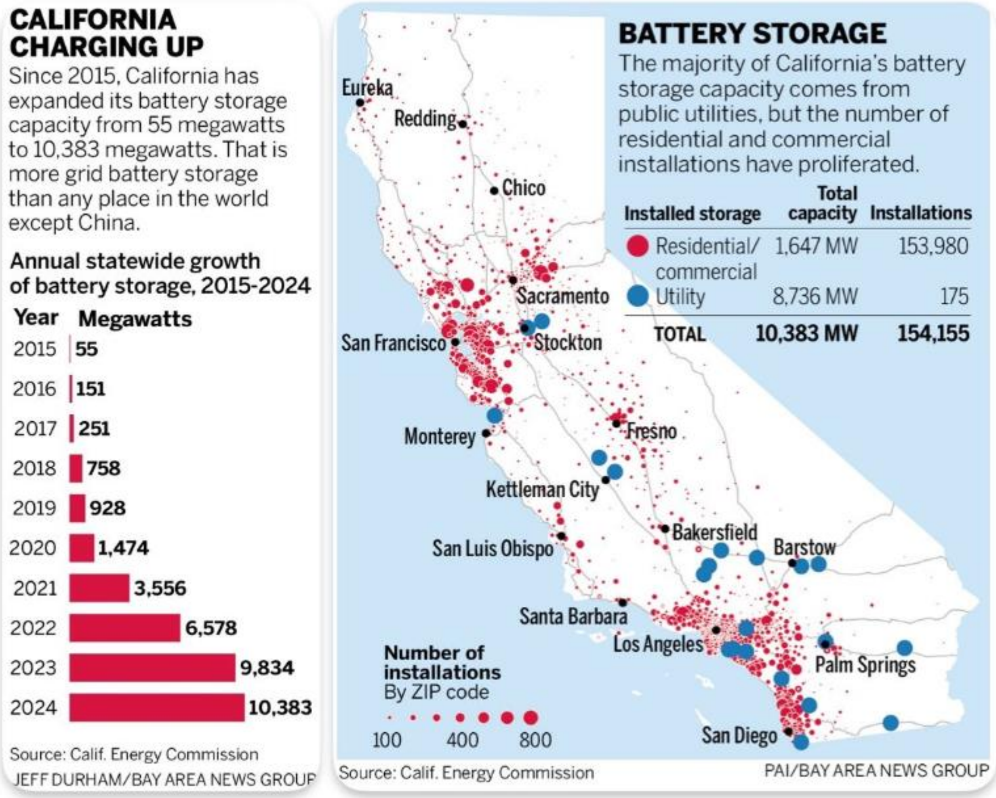
   Wave energy offers a unique solution having minimal visual impact even if located relatively close to shore This combined with benign environmental impact can allow a large portion of the available wave resource to be utilized in state waters. From a ratepayer's perspective, the lowest cost electricity from wave farms can in many cases be delivered from installations that are located just a few miles offshore, with relatively short cable routes to grid connection points, suitable depth (40-200m) and short vessel trips from on-land O&M facilities providing efficient O&M with low cost and minimized emissions.

6. Efficient consenting. Clarify and streamline state regulatory processes for deployment of marine energy projects, and encourage the appropriate federal agencies to clarify federal regulatory processes for deployment of marine energy projects.

   We recommend that the learnings from evaluating and implementing marine energy consenting processes in other geographies can be directly incorporated to achieve an efficient Californian process from the start. One of the most effective processes we are aware of is the 'one-stop-shop' process implemented by Marine Scotland, a description can be found here. Imposing maximum response times for the authorities involved in the respective step is key to maintain certainty of the overall timeline to consent.

7. Implement statewide marine energy deployment targets of 100 MW by 2030, 1000 MW by 2035, and 5,000-7,000 MW by 2040.

   With utility scale grid-connected wave energy devices now being demonstrated and proven in other exposed sites, California should pursue integrating full-scale marine energy projects into its electricity mix starting in the late-2020s to avoid overbuilding energy storage and transmission infrastructure at an unnecessarily high cost. With 100 MW of marine energy capacity by 2030 and a growth rate thereafter similar to that of battery deployment in California, the state should have at least 5-10GW of marine energy capacity by 2040.



8. Work with the California Public Utilities Commission (CPUC) to implement an explicit price per MWh for as part of the Renewable Market Adjusting Tariff (ReMAT).

   Marine energy currently qualifies for the ReMAT in California, but only wind, solar, hydro, geothermal, and bioenergy receive an explicit price per MWh (recalculated annually). To facilitate market-pull for marine energy technologies, we recommend that the CEC work with CPUC implement an explicit price per MWh for marine energy and fully benefit from this market-pull mechanism while lowering costs for California ratepayers. The price per MWh can be structed to reduce with increasing cumulate deployment volumes to minimize the cost of such support system. In Europe, the UK has secured a vast majority of the current marine energy project pipeline thanks to the ring-fenced CfD system that has given developer and investor confidence to invest there. A CfD-like scheme is seen as one of the most effective policy tools to encourage private investments while maintaining competitive pressure on the respective sectors being supported in the early days of deployment.

9. Provide matching funds for U.S. Department of Energy (DOE) and other federal awards and investments for Demonstration, and Deployment of early stage pre-commercial marine energy projects.

   The NHA has requested that BOEM identify "challenges and potential solutions to streamline the permitting and leasing processes for co-located marine energy deployments with offshore wind." Co-locating offshore wind with wave energy systems off the coast of California is expected to significantly reduce variability in power generation. Since these projects may share infrastructure like offshore substations and power export cables, balance-of-plant costs may decrease and ultimately lower costs for ratepayers. By partnering with BOEM, the state of California can help shape marine energy leasing processes from a relatively early stage and can ideally advocate for a combined offshore wind and marine energy leasing process.

II. COMMENTS ON THE SB 605 DRAFT REPORT

The following comments respond to the SB 605 draft report released on July 23, 2024.

Executive summary:

“Challenges”:

There have historically been two main challenges preventing commercial adoption of wave energy. 1. Survivability in storm conditions 2. Efficient generation in regular ocean conditions. These two challenges have led to wave energy equipment either being damaged in storms and/or becoming large, heavy and expensive in relation to the amount of electricity they could generate. Significant progress has been made in R&D over the last decade, with recent commercial scale machines demonstrating robust operation in storms and delivering high structural efficiency (Energy delivery / tonnes and Energy/volume). Such technological breakthrough now makes wave energy ready for the first stage of farm deployment in pre-commercial projects.

“Project permitting and licensing processes are complex and lengthy” here we would suggest:

“Project permitting and licensing processes can complex and lengthy, unless implementing an efficient process based on the learnings provided by wave energy permitting in other places. (one-stop shop, regulatory sandbox approach, taking in the results of the significant environmental studies already performed, published and peer-reviewed.)”

“Greater deployment …. can be expected when cost competitiveness” here we would suggest:

“As for most new technologies, the cost of early generations deployed in small volumes is relatively high, while rapid cost reduction can be expected by volume deployment - driven by cycles of learning and economies of scale.”

“Transmission…” in this section we would suggested adding a description in line with this:

A key advantage of wave farms can be low visual impact , which can allow deployment relative close to shore without significant visual impact. This can allow for relatively short transmission distance, and deployment in lower water depth (eg 30 to 200m) compared to floating wind. Many sites in state waters can be suitable for wave energy farms offering the lowest cost-of-energy and life-cycle-carbon-content due to efficient near-shore operations (shorter vessel trips, increased farm availability), short transmission and reduced cost of mooring and cabling in moderate water depths. (floating substations etc may not be required if deployed in 40-50m depth)

Chapter 1: Technology and Economic Feasibility of Wave and Tidal Energy

Section 1.5 on pages 28 through 30 of the draft report considers “Challenges to Developing Marine Energy.” Here are some additional points to keep in mind when considering the six challenges included:

1. Technology Development

SB 605 largely exists to set in motion the scale-up from immature technologies to large commercial projects offshore California. The lack of long-term demonstrations should be seen not as a challenge, but as simply the current stage of technology commercialization. CorPower has completed several successful pilot installations, with the most recent commercial scale C4 device that has shown storm survivability and efficient power production to the national grid in Portugal. Deployments at Pacwave are expected to bring similar proof points in US waters in the coming years.

Under 1.2.2. we can offer a description of CorPower Ocean’s point absorber technology:

CorPower has developed a Point Absorber type of WEC technology with a heaving composite buoy on the ocean surface that absorbs the wave energy. The buoy is connected to the seabed using a proprietary universal mooring, anchor & connectivity kit (UMACK). A unique phase control technology allows the WEC to be tuned and detuned, altering the system’s response to ocean conditions. In operational tuned mode, phase control makes the device oscillate in phase with incoming waves, amplifying the WEC’s motion and thereby the power capture. In storms, the detuned state makes the WEC transparent to incoming waves for enhanced survivability, similar to the blade-pitching function in wind turbines for protecting them from overload. A structured product verification process according to IEA-OES recommendations has been followed since 2012, resulting in the technology and supply-chain being successfully proven with commercial scale device (CorPower C4) since 2023.

2. Resource Variability

Marine energy resources are generally more consistent and predictable than solar and wind energy resources, and deploying marine energy technologies may lower total energy system costs given this consistency and predictability.

3. Grid Integration

Marine energy can be quite applicable to distributed energy. Considering the high emissions, high costs, and energy dependence associated with importing diesel fuel to run generators, we contend that marine energy projects are well worth considering for remote coastal communities to decarbonize, reduce costs, and create energy independence. Starting with smaller deployments in markets with higher energy costs should help the industry drop down the cost curve and ensure that larger utility-scale projects are de-risked, bankable, and cost-saving for ratepayers.

4. Environmental Impact

We agree that the OES-Environmental 2024 State of the Science Report should be consulted, and risks that are deemed very low or retired in this report should not slow the process of scaling the marine energy sector in California.

5. Cost Competitiveness

Using the proven design and supply chain of the first generation commercial scale equipment of CorPower, we estimate that wave energy can be competitive with wind and solar after 500-600MW cumulative deployment. Being competitive to our understanding means reducing the total cost of firmed clean electricity. By having a higher average value per MWh due to the consistent and complimentary power profile delivering also at times with high prices in the market, wave energy can be competitive at a higher LCOE compared to wind or solar PV. Solar and wind have reached low LCOEs, but their variability implies overbuilding storage and transmission to meet decarbonization targets. The consistency, predictability, and proximity of marine energy resources can significantly reduce the amount of generation capacity , energy storage and transmission capacity required to decarbonize our electricity system and ensure low costs for ratepayers.

The sector needs to be supported to drive the first 500-1000MW of cumulative deployment into the market. After this point the cost reduction based on similar learning rates as previously demonstrated in wind, solar and batteries can be expected to deliver wave energy with a cost-of energy that can compete with no further support. Reaching this stage a self-propelled continued cost-reduction can be expected when the technology is deployed from the first 500-1000MW towards the suggested deployment targets for 2040 in California.

Chapter 2: Factors Contributing to Increased Use of Wave and Tidal Energy in California

Other factors that may contribute to the increased use of wave and tidal energy in California include, but are not limited to, the following:

- Opening of PacWave off the coast of Oregon, where wave energy technology developers will soon start deploying their devices
- Satisfying SB 100 and reaching 100 percent renewables by 2045 without overbuilding generation and storage capacity, which is mentioned in the CPUC sensitivity analysis discussion in Part I
- Increasing curtailment of intermittent renewable energy resources in California and the resulting “Duck Curve” now turning into a “Canyon Curve”
- Increasing energy demand from the datacentre and artificial intelligence boom
- Alignment of supply chains and port infrastructure with offshore wind
- Availability of new transmission infrastructure, both onshore and offshore, once offshore wind is built out
- Potential to increase capacity factors of offshore renewable energy projects by co-locating wave and offshore wind projects

Chapter 3: Transmission Needs and Transmission Permitting Requirements

Section 3.2.2 on page 44 says that “Offshore wave and tidal configurations are used at greater than 25 meters (82 feet) of water depth and can be beyond 100 km (62 miles) from shore.” This statement is misleading. Most wave energy converters (WECs) meant for integration with onshore grids will be deployed much closer to shore than this, as costs increase with distance to shore; that WECs can be deployed much closer to shore than offshore wind is one of its major advantages. We strongly encourage CEC and any stakeholders working on the output(s) of SB 605 to instead emphasize that offshore configurations will be concentrated in an area several km from shore to minimize costs for transmission and other balance-of-plant infrastructure.

Chapter 4: Permitting Requirements for Wave and Tidal Energy Projects

The Marine Energy toolkit developed by Kearns and West outlines permits required for wave energy projects at the federal and state levels. Having experience from successfully going through consenting processes in various geographies we encourage CEC to aim for a consenting process as close as possible to Marine Scotland (description found here), that we have find highly efficient.

Chapter 5: Economic and Workforce Development Needs

Communicating the significant workforce and economic development impacts of constructing, installing, and operating marine energy projects is an important aspect of SB 605, and this section should be highlighted in the final output(s). However, while the report considers the impacts made by projects of 10 MW and 100 MW, it does not consider any sort of roadmap to get to projects of those sizes. We cannot assume the sector will get there on its own, and we certainly cannot assume the sector will get there on its own by 2027, the benchmark year the report uses to model these scenarios. More than just about anything else, technology developers, project developers, investors, and stakeholders across the board are interested in figuring out how we are going to go from systems rated at hundreds of kW to projects rated at tens to hundreds of MW. Only then can we start to build an industry that will create the sort of workforce and economic development impacts the report predicts.

Chapter 6: Monitoring Strategies to Gather Data for Evaluation of Environmental Impacts

The OES-Environmental 2024 State of the Science Report summarizes findings of the environmental effects of marine renewable energy developments around the world. This report should be considered and its contributors consulted when identifying a monitoring strategy to ensure that work is not unnecessarily duplicated.

Chapter 7: The Future of Marine Energy in California

There were six requirements for the outputs of SB 605 included in the scoping order for the 2024 IEPR:

1. Evaluate factors that may contribute to the increased use of wave and tidal energy in California.
2. Provide findings on latest research about the technological and economic feasibility of deploying offshore wave and tidal energy off the coast of California in state and federal waters.
3. Evaluate wave and tidal energy project potential transmission needs and permitting requirements.
4. Evaluate wave and tidal energy project economic and workforce development needs.
5. Identify near-term actions related to investments and workforce for wave and tidal projects, to maximize job creation and economic development, while considering affordable electricity rates and bills.
6. Identify a monitoring strategy to gather sufficient data to evaluate impacts to marine and tidal ecosystems and inform adaptive management.

Requirements 1, 2, 3, 4, and 6 are each covered by at least one chapter in the SB 605 draft report. Requirement 5, which may hold significant influence over the future of the marine energy sector in California, is not explicitly covered. It makes sense that "near-term actions" should be covered in Chapter 7, which focuses on the future of marine energy in California.

There are critical and urgent actions the state of California should take in the near-term to establish itself as a center of the marine energy sector's scale-up. As the marine energy sector matures from pre-commercial demonstrations to full commercialization, the most impactful lever the CEC can pull is to match-fund federal investments into the sector, specifically funding opportunities by the DOE Water Power Technologies Office (WPTO). The WPTO is working to position the U.S. at the forefront of the global marine energy sector.

California should build workforce development programs in tandem with the floating offshore wind industry, ensuring as much cross-industry collaboration as possible. Ocean Energy Systems (OES) has forecasted that reaching 300 GW of marine energy capacity across the world by 2050 could create 680,000 jobs and contribute $340 billion in gross value added. Highlighting the potential for job creation and increased economic output, especially as the state begins to establish itself as a global center for floating offshore wind, may encourage significant additional investment in the state. While some are slightly outdated, there are existing regional and global strategic roadmaps that CEC can draw from to set strategies for economic and workforce development, among other areas. These roadmaps include the following:

- NHA Marine Energy Council: Commercialization Strategy for Marine Energy
- IRENA: Scaling up investments in ocean energy technologies
- OES: Ocean Energy and Net Zero
- Ocean Energy Europe: 2030 Ocean Energy Vision

As the conclusion of the report, Chapter 7 should include recommendations and concrete next steps that the state of California can take to support the responsible scale-up of the marine energy sector.

Yours Sincerely,

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