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Wave and Tidal Energy Feasibility Study Comments

Additional submitted attachment is included below.

California Energy Commission
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eNGO Comments on Draft Consultant Report *Wave and Tidal Energy: Evaluation of Feasibility, Costs, and Benefits*

1. Introduction

On behalf of the Natural Resources Defense Council (NRDC), California Coastal Protection Network, Ocean Conservation Research and Environmental Protection Information Center (EPIC), we submit these comments to the California Energy Commission's (CEC) draft report on *Wave and Tidal Energy: Evaluation of Feasibility, Costs, and Benefits*.

Our organizations support the CEC's leadership to advance responsible renewable energy development and recognize that marine renewable energy creates an important pathway for combatting climate change and developing a green economy. At the same time, renewable energy must be developed in a responsible manner, minimizing environmental impacts, while protecting biodiversity, cultural resources, public health, and other ocean uses.[1]

Senate Bill 605 requires CEC and Ocean Protection Council to complete a study evaluating "the feasibility and benefits of using wave energy and tidal energy as forms of clean energy in the state."[2] The study must identify a "robust monitoring strategy" that will "gather sufficient data to evaluate the impacts from wave energy and tidal energy projects to marine and tidal ecosystems and affected species, including, but not limited to, fish, marine mammals, and aquatic plants," to "inform adaptive management" of wave and tidal projects.[3] The CEC, in connection with other state agencies and key parties, shall also identify suitable sea space for wave and tidal projects, and in so doing, must consider "[p]rotection of cultural and biological resources with the goal of

[1] Specifically, responsible renewable energy development: (1) avoids, minimizes, mitigates, and monitors for adverse impacts on wildlife and habitats; (2) minimizes negative impacts on other ocean uses; (3) includes robust consultation with Native American Tribes and communities; (4) meaningfully engages state and local governments and interested parties from the outset; (5) includes comprehensive efforts to avoid negative impacts and bring benefits to underserved communities; and (6) uses the best available scientific and technological data to ensure science-based and stakeholder-informed decision making.
[2] Pub. Res. 25996(a).
[3] Pub. Res. 25996(b)(6).

prioritizing ocean areas that pose the least conflict to those resources."[4] Finally, CEC must "identify measures that would avoid, minimize, and mitigate significant adverse environmental and ecosystem impacts and use conflicts," as well as for "monitoring and adaptive management for offshore wave and tidal energy projects."[5] The CEC must submit a report to Governor and the Legislature by January 2025, summarizing its analysis and recommendations, including those on monitoring, sea space planning, and avoidance, minimization, and mitigation measures.[6]

This comment letter provides our recommendations regarding sea space planning, monitoring and management measures, as well as adaptive management principles, and encourages the CEC to include these measures in its final report to the Governor and Legislature.

2. Recommendations

a. Wave and Tidal Energy Should Be Studied Further Before Developing Utility-Scale Projects

California's coastal waters are world renowned for their surfing and recreational value. Wave energy relies on the conversion of ocean wave energy into power; however, little is known about how this harnessing of energy will impact the recreational value of waves. The effects will likely be project specific and will depend on the density and placement of wave energy devices. The alteration of unique wave characteristics including wave shape and quality, which may result from changes in sedimentation and bathymetry due to wave and tidal energy projects, are of concern. Furthermore, all impacts, including wave height reduction, may increase as the technology matures and a greater percentage of energy is extracted. Due to the high recreational and tourism value of wave resources to the California lifestyle and economy,[7] potential impacts in this area warrant careful study and monitoring. Surf monitoring studies have been required of related proposals.[8] Scientific surf monitoring studies with sufficient baseline data and appropriate adaptive management triggers must be required of wave and tidal energy projects as they have been for other coastal development projects.[9]

The wide variety of technology used in both wave and tidal energy will present challenges to understanding impacts and may add complexity to the regulatory process for this nascent industry. Additional study should be conducted to identify environmental standards that ensure any projects proceed with the least environmental impacts. A more uniform approach to implementation would allow for better monitoring and mitigation of impacts.

A cost benefit analysis should be included in the second phase of this feasibility study to examine the potential impacts from wave and tidal energy, including environmental, competing uses and

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4 Pub. Res. 25996(c)(2)(C).
5 Pub. Res. 25996(c)(4).
6 Pub. Res. 25996.1.
7 McGregor, Thomas and Wills, Samuel. (2017). Surfing a Wave of Economic Growth. https://samuelwills.net/wp-content/uploads/2012/10/mcgregorwills2017.pdf
8 FERC_Douglas County_SurferStudy , attached, 20080929-3022 FERC PDF (Unofficial) 09/29/2008
9 Addendum to Item W14b, Coastal Commission Permit Application #6-16-0275 (San Elijo Lagoon Conservancy and Caltrans San Elijo Lagoon Restoration), for the Commission Meeting of December 7, 2016. https://documents.coastal.ca.gov/reports/2016/12/w14b-12-2016.pdf

economics to determine if the potential benefits outweigh potential impacts. Not considering other ocean uses in this feasibility study severely limits its utility. We are concerned that the high cost of these nascent technologies, three times higher than conventional sources and four times higher than other renewables,[10] could negatively affect rate payers and other forms of renewable energy that have not yet been maximized; which also pose fewer impacts. It is possible that distributed installations, as opposed to utility-scale projects, of wave and tidal energy will be the most likely applications based on this report.

b. **Sea Space Planning**

The California Current Ecosystem (CCE) is a unique and highly productive bioregion, supporting high levels of biodiversity.[11] Many species and habitats in the CCE are classified as protected and endangered under federal and state law. These include marine mammals like humpback, blue, fin, and gray whales, northern elephant seals, and southern sea otters; salmon; sea turtles; and seabirds including short-tailed albatross and marbled murrelets.[12] Protected habitats include federally designated critical habitat for multiple species, Habitat Areas of Particular Concern (HAPC) under the Magnuson-Stevens Act,[13] National Marine Sanctuaries, National Wildlife Refuges, and state marine protected areas (MPAs). The area north of Cape Mendocino to Heceta Bank, which includes the Humboldt Bay WEA, is a potential multispecies seabird hotspot in Northern California/Southern Oregon.[14] At the same time, the CCE is facing various stressors, including marine heatwaves, changes to nutrient upwelling patterns, and declines in key fisheries.[15] Our groups' letters to the Bureau of Ocean Energy Management (BOEM), commenting on California wind energy developments, provide additional detail about our concerns.[16]

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10 Aspen Environmental. (2024). Wave and Tidal Energy: Evaluation of Feasibility, Costs, and Benefits, Senate Bill 605 Report. *Prepared for California Energy Commission, pg 29*. https://www.energy.ca.gov/publications/2024/wave-and-tidal-energy-evaluation-feasibility-costs-and-benefits-senate-bill-605.

11 Jacox, M.G., Bograd, S.J., Hazen, E.L., and Fiechter, J. (2015). Sensitivity of the California Current nutrient supply to wind, heat, and remote ocean forcing. *Geophysical Research Letters 42(14)*, 5950-5957. https://doi.org/10.1002/2015GL065147.

12 *See*, National Oceanic and Atmospheric Administration, https://www.fisheries.noaa.gov/species-directory/threatened-endangered; California Endangered Species Act, Cal. Fish & Game Code § 2050 et seq.

13 HAPC are subsets of Essential Fish Habitat that have a particularly important ecological role in fish life cycles or are especially sensitive, rare, or vulnerable to degradation.

14 Nur, N. et al. (2011). Where the wild things are: Predicting hotspots of seabird aggregations in the California Current system. *Ecological Applications 21*(6):2241–2257. https://doi.org/10.1890/10-1460.1

15 National Oceanic and Atmospheric Administration, *2023-2024 California Current Ecosystem Status Report* (March 2024); https://www.pcouncil.org/documents/2024/06/2023-2024-annual-ecosystem-status-report.pdf/

16 *See* Letter from Natural Resources Defense Council, *et. al.,* to Bureau of Ocean Energy Management, Comments in Response to the Bureau of Ocean Energy Management Draft Environmental Assessment for Commercial Wind Lease Grant Issuance and Site Assessment Activities on the Pacific Outer Continental Shelf, Humboldt Wind Energy Area, BOEM-2021-0085 (Jan. 11, 2022); Letter from Environmental Defense Center, *et. al.* to Bureau of Ocean Energy Management, Re: Morro Bay Wind Energy Area Draft Environmental Assessment, BOEM-2021-0044-0128 (May 16, 2022).

As it considers areas that might be suitable for development of wave and tidal energy, CEC should avoid selecting areas with high conflict with marine life, sensitive habitats, and other ocean users. CEC should also analyze how wave and tidal energy development would interact with the development of offshore wind and any potential negative cumulative effects.

c. Monitoring and Management of Potential Impacts

We urge that CEC use the "mitigation hierarchy" as it develops monitoring and management recommendations, to ensure that wave and tidal energy developments first avoid, then minimize and mitigate potential environmental impacts from all stages of development.[17]

Given that many wave and tidal energy technologies rely on bottom anchors and mooring lines, or water passing through turbines or chambers, it is possible that wave and tidal energy technologies will pose similar risks as the floating offshore wind systems that will be used off the California coast, or open loop cooling and desalination systems. The CEC should consider including the monitoring and management recommendations that our groups have provided in those contexts in its final report.[18]

i. Impacts to Benthic Habitat

Because wave and tidal energy systems will use bottom anchors, they could have impacts on important benthic habitats. As we have recommended with offshore wind development, renewable energy systems should be sited to avoid biogenic structural habitat, three-dimensional structures created by slow-growing living organisms (e.g. corals and sponges) that support a high density and diversity of marine species.[19]

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[17] *See* Leon Bennun et al., Mitigating biodiversity impacts associated with solar and wind energy development: Guidelines for project developers, IUCN & THE BIODIVERSITY CONSULTANCY (2021), available at https://portals.iucn.org/library/node/49283. Please note that the IUCN document provides general guidelines on how the mitigation hierarchy could be and has been applied, but its application in each case will be context and site specific, and based on best available scientific information and technologies available at the time.

[18] *See* Letter from Natural Resources Defense Council *et al* to Bureau of Ocean Energy Management, *Comments on Notice of Intent to Prepare an Environmental Impact Statement for Future Offshore Wind Energy Development* (Feb. 20, 2024); Letter from National Wildlife Federation *et al* to Bureau of Ocean Energy Management, *Re: Draft Environmental Impact Statement for SouthCoast Wind Energy Proposed Wind Energy Facility Offshore Massachusetts* (April 18, 2023); Letter from National Wildlife Federation *et al.* to Bureau of Ocean Energy Management*, Re: Notice of Intent to Prepare an Environmental Impact Statement for Proposed Beacon Wind Project on the U.S. Outer Continental Shelf Offshore Massachusetts* (July 31, 2023); Letter from The Nature Conservancy to Bureau of Ocean Energy Management, *Re Notice of Intent to Prepare Environmental Impact Study for Sunrise Wind* (Oct. 4, 2021).

[19] *See* Letter from Natural Resources Defense Council *et al* to Bureau of Ocean Energy Management, *Comments on Notice of Intent to Prepare an Environmental Impact Statement for Future Offshore Wind Energy Development* (Feb. 20, 2024). Biogenic habitats "encompass both a) those living species that form emergent three-dimensional structure, that separate areas in which it occurs from surrounding lower vertical dimension seafloor habitats and b) non-living structure generated by living organisms, such as infaunal tubes and burrows." Source: New Zealand Government Ministry for Primary Industries, "Linking marine fisheries species to biogenic habitats in New Zealand: a review and synthesis of knowledge. New Zealand Aquatic Environment and Biodiversity Report No. 130. May 2014. https://fs.fish.govt.nz/Doc/23651/AEBR_130_2514_HAB2007-01%20(obj%201,%202,%20RR3).pdf.ashx.

The measures used to manage the effects of offshore wind on benthic habitat could also be used to manage the impacts of wave and tidal energy systems. California offshore wind lessees are required, as a condition of their leases, to avoid intentional contact with hard substrate, rock outcroppings, seamounts, or deep-sea coral/sponge habitat.[20] They must also develop an anchoring plan and maintain a buffer of sufficient distance to fully protect sensitive habitat from anchors and related infrastructure, accounting for the possible movements of anchors and cables over time. Where impacts to benthic habitat cannot be avoided, developers are required to submit a mitigation plan to responsible agencies, which includes developing plans for mooring systems with a minimally invasive benthic footprint.

ii. **Vessel Strikes**

Survey, construction, and maintenance vessels transiting to wave and tidal energy sites could pose risks to marine mammals, sea turtles, and other marine life. The risk of serious injury and mortality from vessel collisions increases significantly with vessel speeds of 10 knots or greater.[21] California offshore wind lessees are required to keep vessel speeds to 10 knots or less[22] -- the CEC should apply vessel speed limits to wave and tidal projects. Our groups have also recommended that vessels slow to 4 knots or less to adequately protect sea turtles, such as when there are visible jellyfish aggregations or floating vegetable mats. The same requirement should be applied here as well.

iii. **Noise**

The development of wave and tidal energy systems could produce levels of noise that harass or injure marine mammals and other marine life. Vessel noise can trigger changes in the behavior and stress levels of marine animals and can cause auditory masking that further disrupts their use and reception of natural sounds.[23]

The CEC should recommend that the construction and operations of wave and tidal energy systems avoid harms to marine life. We have provided state and federal agencies with various recommendations to reduce the noise impacts from offshore wind operations, which may also be relevant here, including: requiring survey and construction vessels to maintain minimum distances from marine mammals, employing noise-reduction technologies and other measures to

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[20] *See* Lease OCS-P 0561; Lease OCS-P 0562; Lease OCS-P 0563; Lease OCS-P 0564; Lease OCS-P 0565; *see also,* Condition 1.f.iv. and Condition 2 in conditions adopted by the California Coastal Commission for the Humboldt WEA (Consistency Determination No.: CD-0001-22) and Morro Bay WEA (Consistency Determination No.: CD-0004-22). The Commission describes benthic habitat as "hard substrate, rock outcroppings, seamounts, or deep-sea coral/sponge habitat." *Id.*

[21] Conn, P. B., & Silber, G. K. 2013. Vessel speed restrictions reduce risk of collision-related mortality for North Atlantic right whales. Ecosphere, 4(4), 1-16.

[22] California Coastal Commission, Staff Report re: Consistency Determination No. CD-0004-22 (May 20, 2022) at 65; https://documents.coastal.ca.gov/reports/2022/6/W7a/W7a-6-2022-Report.pdf

[23] Erbe, C., S.A. Marley, R.P. Schoeman, J.N. Smith, L.E. Trigg, and C.B. Embling. (2019). The effects of ship noise on marine mammals – A Review. Front. *Mar.Sci. Vol 6*. https://doi.org/10.3389/fmars.2019.00606; Benhemma-Le Gall, A., P. Thompson, N. Merchant, and I. Graham. (2023). Vessel noise prior to pile driving at offshore windfarm sites deters harbour porpoises from potential injury zones. *Environmental Impact Assessment Review, 103*: 107271.

minimize noise during construction activities, designing infrastructure to produce less operational noise, and requiring project developers to implement plans to reduce operational noise.[24]

The CEC should also consider the cumulative effects of noise from other industrial marine activities and recommend that siting decisions and management measures account for cumulative noise impacts. Research at one of the only existing floating wind farms in the world highlights the importance of considering cumulative noise from floating arrays in environmental impact assessments, especially where projects overlap with each other or other ocean uses.[25]

iv. Entanglement of Marine Mammals, Sea Turtles, and Other Marine Life

The anchoring and mooring lines used by wave and tidal energy systems could create risks of entangling marine life, and CEC should recommend monitoring of wave and tidal facilities to evaluate and track entanglements, as well the application of various measures to reduce entanglement risks.

Anchoring and cabling systems can potentially create different types of entanglement risks.[26] Primary entanglement involves animals directly ensnared in lines and cables. Secondary entanglement refers to ensnaring wildlife by debris or other materials trapped in mooring lines, mid-water cables, or infrastructure. Tertiary entanglement occurs when debris or fishing gear already entangling an animal gets caught on and becomes anchored to project infrastructure.

A wide range of marine species, including seals, sharks, fish, diving sea birds, and sea turtles could be at risk of secondary entanglement with debris ensnared on floating offshore wind or other renewable energy infrastructure.[27] More information is needed to assess the degree of risk of secondary entanglement posed by wave and tidal energy systems, but the severity of its effects in other industrial settings are well established. Entanglement can result in acute and chronic injuries or death; and can have secondary impacts including reduced reproductive success and increased energetic costs that may lead to population-level effects.[28] Additionally, as more

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[24] *See* Letter from Natural Resources Defense Council *et al* to Bureau of Ocean Energy Management, *Comments on Notice of Intent to Prepare an Environmental Impact Statement for Future Offshore Wind Energy Development* (Feb. 20, 2024) at 29-31.

[25] Risch, D., Favill, G., Marmo, B., van Geel, N., Benjamins, S., Thompson, P., Wittich, A., Wilson, B. (2023). Characterisation of underwater operational noise of two types of floating offshore wind turbines. Report by Scottish Association for Marine Science (SAMS). Report for Supergen Offshore Renewable Energy Hub.

[26] U.S. Offshore Wind Synthesis of Environmental Effects Research (2022); https://tethys.pnnl.gov/sites/default/files/summaries/SEER-Educational-Research-Brief-Entanglement-Considerations.pdf

[27] Benjamins, S., Harnois, V., Smith, H.C.M., Johanning, L., Greenhill, L., Carter, C. and Wilson, B. 2014. Understanding the potential for marine megafauna entanglement risk from renewable marine energy developments. Scottish Natural Heritage Commissioned Report No. 791 at 1-2 ____; https://tethys.pnnl.gov/sites/default/files/publications/SNH-2014-Report791.pdf

[28] Moore, M. J. et al. (2013). Criteria and case definitions for serious injury and death of pinnipeds and cetaceans caused by anthropogenic trauma. *Dis. Aquat. Organ. 103*, 229–264. https://doi.org/10.3354/dao02566; Moore, M. J.,

marine renewable energy projects are constructed, the risk of entanglement will likely increase due to the larger footprint of textured surfaces on which both derelict gear and marine life can be snagged.[29]

Various measures could be used to monitor for and reduce entanglement risks, including: siting wave and tidal projects to avoid important habitats, requiring the use of large-diameter mooring lines and avoiding chains and fiber ropes, requiring the use of taut or semi-taut mooring lines, a combination of both continuous and intermittent techniques to monitor mooring lines and other infrastructure to detect ensnared debris or entangled marine life, and requiring project developers to comply with a protocol for responding to entanglements.[30]

v. **Entanglement and Entrainment Impacts from Water Cycling**

Several of the technologies described by CEC – including, oscillating water column wave energy converters (WEC), overtopping WECs, oscillating wave surge converters, axial flow turbines, and crossflow turbines[31] – rely on water cycling through chambers, rotors, or turbines to generate power, which could result in serious injury or death of marine life caught in the water flow.

These processes could create similar risks as those posed by open loop cooling or desalination systems, which also cycle water through their systems. The risks include the entrainment and impingement of marine life, particularly smaller order life, such as eggs, larvae, juvenile fish, marine invertebrates, and other zooplankton.[32] Such systems may also pose risks to larger sea life, like juvenile marine mammals and sea turtles.[33]

The CEC and other state agencies should fully assess entrainment and impingement effects before deploying even pilot-scale wave and tidal energy projects. It should also require project proponents to develop a monitoring and reporting plan assessing any entrainment and impingement effects. And CEC should evaluate whether any measures could reduce these effects, such as siting outside of sensitive areas, or mechanical features to prevent harm to marine life.

vi. **Oceanographic Processes**

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and van der Hoop, J. M. (2012). The painful side of trap and fixed net fisheries: Chronic entanglement of large whales. *J. Mar. Biol.* 1–4. https://doi.org/10.1155/2012/230653; van der Hoop, J. M., Corkeron, P., and Moore, M. (2017). Entanglement is a costly life-history stage in large whales. *Ecol. Evol. 7*, 92–106. (SEER 2022, Benjamins at 4-6, 11-12)https://doi.org/10.1002/ece3.2615

[29] (Maxwell et al. 2022)

[30] *See* Letter from Natural Resources Defense Council *et al* to Bureau of Ocean Energy Management, *Comments on Notice of Intent to Prepare an Environmental Impact Statement for Future Offshore Wind Energy Development* (Feb. 20, 2024) at 22-25.

[31] California Energy Commission, *Wave and Tidal Energy: Evaluation of Feasibility, Costs, and Benefits Senate Bill 605 Report* (July 2024) at 12-15, 18-20.

[32] *Final Environmental Impact Statement for the Port Delfin LNG Project Deepwater Port Application*, Delfin LNG, Appendix I Delfin LNG Ichthyoplankton Report (2016), https://www.energy.gov/sites/default/files/2018/11/f57/final-eis-0531-port-delfin-lng-app-i-2016-11_0.pdf.

[33] SCW COP Version E, Volume II at 6-258 and 6-2292.

Upwelling is an essential contributor to the primary productivity that supports the remarkable biodiversity of the California Current Ecosystem.[34] Offshore wind installations have the potential to alter local and regional hydrodynamics, particularly on coastal and offshore upwelling systems.[35] Preliminary modeling indicates reductions in wind speeds from wind turbine installation off California.[36] These changes could have negative effects on fish and invertebrate distribution, settlement, recruitment, and connectivity, including for key prey species.

It is possible that wave and turbine energy systems could affect upwelling processes in similar ways as offshore wind systems, and these effects should be considered as the CEC evaluates the development of wave and tidal energy.

a. **Adaptive Management**

Given that wave and tidal energy systems are still in the early stages of development and the lack of information about the effects of such systems on marine ecosystems, it is essential that any projects have adaptive management measures in place. Such measures could then be adjusted as more information becomes known. We appreciate the CEC recognizing the need for adaptive management and outlining measures used in pilot-scale wave and tidal projects.[37]

A number of our groups have provided adaptive management recommendations related to offshore wind, many of which would be relevant to managing the effects of wave and tidal energy projects, including: collecting robust baseline data and developing models to evaluate renewable energy impacts on marine life, requiring project-specific adaptive management plans, ensuring robust monitoring of project operations, requiring project developers to use best available technology and periodically review and update their technologies, curtailing operations if marine life mortality crosses unacceptable thresholds.[38]

3. Conclusion

We appreciate the CEC's work to advance renewable marine energy and appreciate this opportunity for comment.

Sincerely,

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[34] Jacox, M.G., Edwards, C.A., Hazen, E.L., & Bograd, S.J. (2018). Coastal upwelling revisited: Ekman, Bakun, and improved upwelling indices for the U.S. West Coast. *Journal of Geophysical Research: Oceans*, *123*, 7332–7350. https://doi.org/10.1029/2018JC014187

[35] Raghukumar, K. et al. (2023). Projected cross-shore changes in upwelling induced by offshore wind farm development along the California coast. *Communications Earth & Environment, 4*, (12). https://doi.org/10.1038/s43247-023-00780-y

[36] "An Assessment of the Cumulative Impacts of Floating Offshore Wind Farms" Agreement Number C0210404, 2021. Prepared by Integral Consulting, Inc. for California Ocean Protection Council. https://opc.ca.gov/wp-content/uploads/2022/02/C0210404_FinalReport_05092022Report.pdf

[37] California Energy Commission, *Wave and Tidal Energy: Evaluation of Feasibility, Costs, and Benefits* at 67-74.

[38] *See* Letter from Natural Resources Defense Council *et al* to Bureau of Ocean Energy Management, *Comments on Notice of Intent to Prepare an Environmental Impact Statement for Future Offshore Wind Energy Development* (Feb. 20, 2024) at 42-45.

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