STATE OF RHODE ISLAND AND PROVIDENCE PLANTATIONS
PUBLIC UTILITIES COMMISSION

IN RE: THE NARRAGANSETT ELECTRIC COMPANY d/b/a NATIONAL GRID REVIEW OF POWER PURCHASE AGREEMENT PURSUANT TO R.I. GEN. LAWS § 39-31-1 TO 9	: : : :	DOCKET No. 4929

DEPARTMENT OF ENVIRONMENTAL MANAGEMENT'S ADVISORY OPINION TO THE PUBLIC UTILITIES COMMISSION

On February 7, 2019, under the Affordable Clean Energy and Security Act ("ACES")[1], The Narragansett Electric Company d/b/a National Grid ("National Grid") filed with the Public Utilities Commission ("PUC" or "Commission") a Power Purchase Agreement ("PPA") between National Grid and DWW Rev 1, LLC ("DWW")[2]. In the filing National Grid and DWW are seeking approval of a twenty-year (20) PPA under which National Grid will purchase 100 percent of the energy and environmental attributes associated with DWW's 400 megawatt ("MW") offshore wind facility ("Revolution Wind"). The purchase price for energy and renewable energy certificates is $0.098425 per kilowatt hour ("kWh"). National Grid is also seeking approval of financial renumeration of 2.75 percent of the annual payments under the PPA. On February 13, 2019, pursuant to R.I. Gen. Laws § 39-31-6(a)(1)(vi)(B), the PUC provided notice to the Rhode Island Department of Environmental Management ("DEM") of National Grid's filing and the requirement to file an advisory opinion in this docket. Pursuant to R.I. Gen. Laws § 39-31-6(a)(1)(vi)(A)(I), DEM is required to provide an advisory opinion "on the expected greenhouse gas emissions and statewide environmental impacts resulting from the proposed contract(s)."

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[1] R.I. GEN. LAWS § 39-31-1 *et seq*.

[2] On or about November 7, 2018 Deepwater Wind Holdings, LLC was transferred to Orsted. The surviving entity was renamed Orsted US East Coast Offshore Wind, LLC, and is a wholly-owned subsidiary of Orsted US East Coast Offshore Wind Holdco, LLC, which is a wholly-owned subsidiary of Orsted North America Ind.

I. Project Description

Revolution Wind is a proposed 400 MW offshore wind farm situated on submerged lands of the Outer Continental Shelf in the Bureau of Ocean Energy Management ("BOEM") Lease OCS-A 0486 area. It will be located between Montauk, New York and Martha's Vineyard in Massachusetts, approximately fifteen (15) miles south of the Rhode Island Coast. The project is situated within the Rhode Island Coastal Resources Management Council ("CRMC") 2011 geographic location description ("GLD") approved by the National Oceanic and Atmospheric Administration ("NOAA") Office of Coastal Management and coincident with the CRMC Ocean Special Area Management Plan ("Ocean SAMP") study area boundary. As an applicant seeking a federal license or permit in federal waters within the CRMC 2011 GLD, Revolution Wind must be consistent with the CRMC's enforceable policies, pursuant to 15 CFR Part 930, Subpart E.[3] While the exact number and configuration of wind turbines is presently unknown, Revolution Wind will be comprised of up to fifty (50) offshore wind turbines.

The proposed Revolution Wind Facility was submitted by DWW in response to the June 29, 2017, Request for Proposals for Long-term Contracts for Offshore Wind Energy Projects issued by the Massachusetts Electric Distribution Companies and the Massachusetts Department of Energy Resources ("RFP"). The RFP indicated that in achieving Massachusetts' offshore wind energy generation it would consider the participation of other states so long as that participation has a positive or neutral impact on Massachusetts ratepayers. Upon evaluation, an analysis of the RFP was provided to, among others, National Grid, the Rhode Island Office of Energy Resources ("OER"), and the Rhode Island Division of Public Utilities and Carriers ("DPUC"). Based on this analysis National Grid, in consultation with OER and DPUC, pursued contract negotiations with

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[3] Subpart E pertains to Consistency for Outer Continental Shelf (OCS) Exploration, Development, and Production Activities. See 15 CFR § 930.76 for applicant requirements under this subpart.

DWW. Negotiations ultimately resulted in the PPA that has been filed with the Commission and which National Grid ultimately seeks approval of.

II. Advisory Opinion

i. Expected Greenhouse Gas Emissions resulting from the proposed contract(s).

Historically, the burning of fossil fuels has caused the concentrations of greenhouse gases to significantly increase in our atmosphere. As the concentration of gases continue to rise, this has led to anthropogenic global warming and a rise in the average temperature of the Earth's climate, resulting in an increase in extreme weather and sea level rise. In 2014, the Rhode Island General Assembly passed the Resilient Rhode Island Act and charged the Executive Climate Change Coordinating Council ("EC4") with developing a Plan to meet the greenhouse gas ("GHG") reduction targets laid out in the law. The Act's targets for reducing GHG emissions are ten percent (10%) below 1990 levels by 2020, and forty-five percent (45%) and eighty percent (80%) below 1990 levels by 2035 and 2050, respectively.

The Rhode Island Greenhouse Gas Reduction Plan was completed in December 2016. This plan highlighted that the second most significant source of greenhouse gases in Rhode Island are from the electric consumption sector. Furthermore, in order to meet the Resilient Rhode Island Act's targets, increasing the use of renewable energy is essential.

While a detailed emissions inventory is desirable to develop a comprehensive assessment, sufficient information exists to support our conclusion that the project will reduce air emissions that are harmful to human health and the environment and support the greenhouse gas emissions targets set forth by the 2014 Resilient Rhode Island Act.

DEM has prepared an estimate of the greenhouse gas reductions that can be expected from the Revolution Wind Facility and, in turn, the PPA. The 400 MW of renewable energy generated by this project will replace electricity generated primarily from natural gas fired plants. The estimate was developed utilizing Environmental Protection Agency's ("EPA") web-based AVoided Emissions and geneRation Tool ("AVERT").[4] AVERT is a free tool designed to meet the needs of state air quality planners, energy officials, public utility commission staff, environmental agency staff, professionals in the clean energy field, people working on climate planning, and other interested stakeholders. It evaluates how energy efficiency and renewable energy policies and programs displace emissions from electric power plants.

Based on the outputs provided by AVERT, the 400 MW of wind energy generated is projected to displace approximately 698 gigawatt hour ("GWh") of regional fossil fuel generation over the course of one year. Using the twenty (20) year PPA timeframe, approximately 13,960 GWh in avoided regional fossil fuel generation is expected.

In AVERT, all calculations are in short tons (2,000 lbs.), not metric tons. To ensure direct comparability with the Navigant Consulting, Inc.'s "Advisory Opinion on Environmental and Public Health Benefits of the Proposed Revolution Wind Project in Rhode Island" and other consultant work, the estimated annual emission reductions from fossil fuel energy production in metric tons is provided below[5]:

	NO_x (Metric Ton)	CO_2 (Metric Ton)
Annual Northeast Regional Total	118.4	336,924
Cumulative Reduction for Northeast Regional (20 yrs.)	2,368	6,738,480
Annual Rhode Island Total	4.0	30,891
Cumulative Reduction for Rhode Island (20 yrs.)	80	617,810

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[4] https://www.epa.gov/statelocalenergy/avoided-emissions-and-generation-tool-avert.

[5] This is consistent with the GHG emission reduction schedule presented in the *Resilient Rhode Island Act*.

While the AVERT calculations for emissions benefits are conservative, DEM concludes that the project will reduce CO2 emissions. Over the twenty-year (20) PPA timeframe, the estimated emission reductions will be at least 617, 810 metric tons in Rhode Island and 6,738,480 metric tons in the Northeast Region, supporting the targets in the Resilient Rhode Island Act.

Although the EPA's AVERT is a recognized tool for emissions reductions calculations, it has limitations. The tool does not distinguish between on-shore and off-shore wind which have significantly different characteristics. The emission reductions estimate does not account for emissions that are generated from the construction of the wind farm, on-shore production and assembly of the wind farm components, or long-term emissions from maintenance vehicles servicing the wind farm. Over the life of the project, these emissions are expected to be minimal compared to the tons of avoided emissions resulting from clean energy displacing fossil fuels. In addition, AVERT emission factors are for the US Northeast, which includes New York and New England. The AVERT User Manual acknowledges that AVERT is less sophisticated than the "production cost" type models used by many field consultants. While the AVERT calculations for emissions benefits are conservative, DEM concludes that the project will reduce air emissions that are harmful to human health and the environment, and support the greenhouse gas emissions targets set forth by the 2014 Resilient Rhode Island Act.

In considering the potential emissions reduction impacts associated with Revolution Wind, DEM also consulted with OER and their consultant, Power Advisory. As discussed in OER's advisory opinion, there are other candidate methodologies available to estimate GHG reductions, each with their own strengths and weaknesses. Based upon DEM's review of that data, we conclude that each of the methodologies utilized by OER demonstrate directionally-consistent results that affirm Revolution Wind will result in significant GHG emissions reductions within the electric generation sector.

Conclusion

While the AVERT results may undercount the emissions reductions benefits of the Revolution Wind PPA, in review of the Navigant Consulting, Inc.'s "Advisory Opinion on Environmental and Public Health Benefits of the Proposed Revolution Wind Project in Rhode Island" and in consultation with OER, DEM concludes that the project will reduce air emissions that are harmful to human health and the environment and support the greenhouse gas emissions targets set forth by the 2014 Resilient Rhode Island Act.

Respondent: Laurie Grandchamp
Chief, Office of Air Resources

ii. Statewide Environmental Impacts resulting from the proposed contract(s).

Renewable energy systems are often perceived as environmentally benign when compared to carbon-based energy supplies on a global scale. In particular, offshore wind facilities can be sited well beyond human sight lines and produce no significant land impacts. Nevertheless, at the local scale, offshore wind facilities can significantly affect the coastal marine environment (*1*). Possible negative impacts to marine life may include habitat loss/degradation, submarine or aerial animal collision/entanglement (*2, 3*), noise pollution (*4, 5*), electromagnetic field disruption (*3, 6*–*9*), or sediment dispersal (*10*). However, the turbine foundations may also act as secondary artificial reefs following the initial construction disruption (*2*). Presently, it is not known which of these circumstances or combination of circumstances will result from construction and operation of Revolution Wind.

Prior to the BOEM designation of the RI/MA Wind Energy Area ("WEA"), the CRMC created the Ocean SAMP and corresponding 2011 GLD, through which it receives federal authority under the Coastal Zone Management Act ("CZMA")[6] to review listed actions in federal waters that may result in coastal effects to Rhode Island resources or uses. The Ocean SAMP serves to promote, protect, enhance, and honor existing human uses and natural resources of Rhode Island, while encouraging appropriate marine-based economic development, and facilitating the coordination of state and federal decision making. The Ocean SAMP area covers approximately 1,467 square miles of portions of Block Island Sound, Rhode Island Sound and the Atlantic Ocean where natural and human activities have a reasonable foreseeable effect on the people and ecosystem of Rhode Island (*11*). The Revolution Wind Facility is located within the SAMP

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[6] 16 U.S.C. § 1456(c)(3)(A) (2009).

boundary, where comprehensive studies on the meteorology and the geological, physical, chemical, and biological oceanography have been conducted.

Birds

One hundred and twenty-one (121) species of birds were observed in the Rhode Island Ocean SAMP study area between 2009 and 2010 (*12*). Three federally-listed species – Piping Plover (Threatened), Red Knot (Threatened) and Roseate Tern (Endangered) – have been documented migrating over the RI/MA WEA (*13*). There is great concern about the exposure of these three listed species to offshore wind energy developments as available evidence suggests these three species could migrate within the rotor-swept zone (*13–15*). The areas adjacent to and including the Revolution Wind project area include vital habitat for loons (*16–19*), alcids (*16*, *18*), storm-petrels (*16*, *18*), terns (*16*, *18*), Northern Gannets (*17*, *18*), and seaducks (*17*, *18*, *20*, *21*); thus, these species should be considered when developing construction and implementation plans (*13–15*).

Potential adverse effects of offshore wind energy developments on birds have been categorized as (1) barriers to movement (e.g., between foraging and roosting sites, along migration routes); (2) destruction, modification, or displacement of foraging and roosting habitat; and (3) direct mortality from collisions with infrastructure or pressure vortices (*22–24*). Collision risk could be high for some of these species under adverse weather conditions, as terrestrial birds have been shown to be attracted to illuminated offshore obstacles under poor lighting conditions and some species collide in large numbers (*25*). There have been strategies developed to significantly reduce avian collision risk with lighted structures by using red flashing lights (*26*). However available evidence from Europe suggests that seaducks are able to avoid wind farms, even at night (*27*). Thus, for many marine species that may avoid wind farm areas, habitat displacement and/or increased energetic costs are the larger concern (*3, 28–30*). Consequently, having large scale pre- and post-construction monitoring plans in place to assess displacement and attraction of birds in the project area is vital to understanding the cumulative impacts of offshore wind energy facilities on birds using offshore habitats in North America, as no such research currently exists.

Bats

Little is known about the migration and movements of migratory tree-roosting bat species in North America, though anecdotal observations of migrating bats over the Atlantic Ocean have been reported since at least the 1890s (*31*). Multiple bat species have demonstrated the ability to fly considerable distances (up to 130 km) offshore during migration (*32*). Three species of migratory tree-roosting bats (eastern red bat, the hoary bat, and the silver-haired bat) can be expected to occur in Rhode Island during the summer months and in greater numbers as migrants during the late summer and fall. All three species were documented as mortalities at a land-based, three-turbine facility at the Narragansett Bay Commission facility in Providence between 2015 and 2018 (*33*). Migratory bat species are disproportionately affected by wind turbines, in part because they appear to be attracted to turbine structures (*34*).

Large numbers of bats are being killed at utility-scale on-shore wind energy facilities, which raises concerns about cumulative impacts of proposed wind energy development on bat populations (*35*). Estimated cumulative bat fatalities in the United States and Canada from 2001-2011 ranged from approximately 840,000 to 1,691,000 bats (*36*). Other estimates suggest that the number of bats killed at wind turbine facilities in the United States during 2012 alone was approximately 684,000 and 888,000 respectively (*36, 37*). Given that bats have low reproductive rates, significant cumulative impacts of wind energy development on bat populations are likely (*38*).

Utility-scale wind turbines have the potential to detrimentally affect bat populations, but few well-developed and integrated methods exist for observing bat occurrence and behavior at turbines at multiple spatial and temporal scales (*34*). This is particularly true in the offshore environment. Potential risk of turbine-related impacts could be readily managed through turbine feathering programs, proven effective at terrestrial sites, with such actions necessary during a narrow set of conditions and a brief seasonal period (*32*). Opportunities exist to gain insight and guidance for future development through the use of modern technology, which should be required for any utility-scale proposed facilities, both in offshore and on-shore environments.

Marine Mammals and Sea Turtles

Thirty-six (36) species of marine mammals (30 cetaceans, 5 seals, and 1 manatee) and four (4) species of sea turtles are known to occur in the Ocean SAMP study area; these species therefore may all occur within the area that was designated as the RI/MA WEA and ultimately leased to DWW. Of those species, ten (10) (5 whales, the manatee, and all 4 sea turtles) are listed as Endangered or Threatened under the U.S. Endangered Species Act (*39*, *40*). Of particular concern is the North Atlantic right whale, of which only 450 individuals are estimated to remain (*41*). The species may migrate through the RI/MA WEA twice annually and may utilize the RI/MA WEA for feeding in the spring through the fall. The North Atlantic right whale is further protected under the Marine Mammal Protection Act, which prohibits the taking ("the hunting, killing, capture, and/or harassment") of all marine mammal species (*42*).

Some of these protected species are vulnerable to risk of: entanglement or collision with construction equipment (*2*), disruption of navigation or possible stranding caused by cable-introduced electromagnetic fields (*43*); construction sound-induced injury (*44*), communication masking (*44*), area avoidance (*45*); and general behavioral disruption caused by installed fixed structures (*46*). Sound is of concern primarily during the construction phase, as operation-phase noise is unlikely to mask communication or cause physical injury (*44*, *47*). Behavioral disruption caused by fixed structures and electromagnetic fields ("EMF") generated by the submarine cables are additional issues of concern during the operational phase. The following measures should be taken to reduce impacts to North Atlantic Right Whales and other protected species: 1) seasonal and temporal restrictions on construction; 2) monitoring 1,000 m exclusions zones around turbines under construction; 3) vessel speed restrictions during the life of the project; 4) use of noise reduction and attenuation measures during construction; and 5) continued scientific research and long-term monitoring (*48*).

Fish, Invertebrate, and Marine Habitat Impacts

Revolution Wind is located within essential fish habitat for approximately thirty-three (33) species of interest to the region: longfin inshore squid, Atlantic mackerel, bluefish, Atlantic butterfish, spiny dogfish, ocean quahog, summer flounder, scup, black sea bass, albacore tuna, bluefin tuna, blue shark, basking shark, common thresher shark, sandbar shark, skipjack tuna, shortfin mako shark, white shark, yellowfin tuna, sand tiger shark, Atlantic sea scallop, little skate, ocean pout, Atlantic herring, Atlantic cod, red hake, silver hake, yellowtail flounder, monkfish, windowpane flounder, winter skate, winter flounder, white hake, and pollock (*49*). Each of these species requires RI/MA WEA habitat at some stage in their life history.

The construction phase is the most likely to have negative effects on fish and habitat. Of paramount concern is construction noise, particularly acoustic energy generated by pile driving operations. High sound levels can damage the inner ear sensory cells, cause hearing loss (threshold shifts), elicit stress responses, and alter behavior in fish. Impacts will depend on the exposure sound level and duration (*50*). For example, for one species of particular cultural and economic value (Atlantic cod), noise of frequencies from 100-1000 hertz has been found to reduce reproductive output (*51*). Operational phase noise is not likely to cause permanent damage, but it may mask communication in some fish species (*52*).

In the context of anthropogenic noise, it is important to consider invertebrates separately from vertebrates; invertebrates (e.g., mollusks) hear in a different manner than vertebrates due to their nervous system structure and hearing organs. Their hearing organs, statocysts, work by detecting particle motion instead of sound pressure (*53*). Unfortunately, most previous studies evaluating wind farm noise have measured sound pressure rather than particle motion. Therefore, there is a limited understanding of how invertebrates are affected by construction or operation-phase sound. There may be negative impacts in close proximity to the project, as de Soto *et al*. (2013) suggest that routine anthropogenic noise already decreases recruitment of scallop larvae in wild stocks (*44*). Further, Andre *et al*. (2011) determined that low frequency noise at certain intensities resulted in permanent and substantial alterations to cephalopod statocysts, possibly resulting in hearing damage (*45*).

At present, there is limited evidence that fish are influenced by electromagnetic fields produced by underwater cables from wind turbines (*56*). However, most previous studies have focused on direct current (DC) cables, while the cables proposed in the U.S. have all been alternating current (AC). DC and AC cables should not be treated the same in terms of environmental conditions, as fish may perceive static and alternating magnetic fields differently (*56*). Species of elasmobranchs like smooth dogfish and blue sharks, as well as other fish including sea lamprey, American eels, and Atlantic salmon are all thought to be able to sense electric fields at low levels (*57–61*). It is presently unknown whether behavioral changes will result from detected AC electromagnetic fields, though behavioral responses of American lobster and little skates were documented in response to DC electromagnetic fields emitted by two high-voltage DC cables (*62*). The impacts of induced electromagnetic fields are expected to be greater for cartilaginous fish because they use electromagnetic signals to detect their prey (*3*, *8–10*). Other fish may also be affected by interference with their capacity to orient in relation to the geomagnetic field; potentially disturbing fish migration patterns (*63*).

Habitat disruption and/or loss is another possible outcome of offshore wind development. Construction and decommissioning of offshore wind farms may lead to loss of sediments and consequently, loss of habitats. During any construction, local water turbidity may increase, as suspended solids and contaminants within the sediments may be mobilized and transported by prevailing water movements. These mobilized sediments may also smother neighboring habitats of sessile species, as well as the living organisms themselves (*8*). Suspended sediment poses a threat to fish within the construction area, as it may physically clog their gills and limit oxygen intake (*64*). Larval states are more vulnerable than adult life history stages due to more limited mobility, as well as larger gills and higher oxygen consumption in proportion to body size (*65*, *66*). Sediment dispersal may also smother eggs and benthic suspension feeders by clogging the feeding or respiratory apparatus. Some benthic epifauna and deep-burrowing infauna may also be unable to escape burial by displaced sediment. While sedimentation events are generally brief, seabed communities may be greatly altered and take years to recover (*67*).

Soft sediments are generally preferred for wind farm development, as hard substrates create more challenges to turbine foundation and transmission cable installation. Grabowski *et al.* (2014) suggest that soft sediment habitats have an inherent ability to recover more rapidly from anthropogenic impacts than other substrates. However, Henriques *et al.* (2014) contend that this is not appropriate logic to develop such areas due to the high number of affected species and possible consequences of impacts on those species for ecosystem structure and function (*68*, *69*).

In contrast, offshore wind developments may offer benefits to certain fish and invertebrate species by creating artificial reefs. The turbine foundations may serve as artificial reef structures and increase the amount of hard substrate for recruitment following the construction disturbance (*70*). Increased habitat complexity may in turn result in increased biodiversity and biomass (*2*, *8*, *71*). Wilson and Elliot (*72*) suggest that the potential for habitat creation may even be regarded as compensation for the habitat lost. However, new habitat created by the turbine foundations may not benefit all species that utilized the local habitat prior to construction (e.g., one offshore wind farm assemblage composition of epibiota and motile invertebrates was significantly different from that of adjacent hard substrate; *73*).

Respondent: Julia Livermore
Supervising Marine Biologist

iii. Conclusion

While offshore wind is well established in other parts of the world, there remain substantial data gaps regarding environmental effects. Additional research and long-term, comprehensive monitoring are necessary to understand potential impacts and better inform decision-making, as there are currently limited data on which to base decisions. Alongside monitoring, continued evaluation of mitigation measures over the life of a project will be necessary. It is also important to consider that possible negative effects on fish, invertebrates, or marine habitats may result in changes to commercial and recreational fishing activities. The DEM will recommend mitigation measures to the Coastal Resources Management Council as it conducts its review and imposes requirements under the Ocean SAMP and through its federal consistency review. While localized impacts from the construction and operation of the Revolution Wind Facility to marine and avian organisms may be significant, this project will result in substantial reduction of regional fossil fuel generation and lower emissions of nitrogen oxides and carbon dioxide. Therefore, on balance the overall environmental impact of the Revolution Wind Facility is expected to be positive.

Janet Coit

Janet Coit, Director, DEM
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CERTIFICATE OF SERVICE

I hereby certify that on March 22, 2019, I sent a true copy of the following to the Energy Facilities Siting Board via first class mail, postage pre-paid and electronic mail, and to the parties on the attached service list via electronic mail.

Christina A. Hoefsmit

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