OFFSHORE WIND ENERGY FREQUENTLY ASKED QUESTIONS

What We Know About Dominion Energy's Coastal Virginia Offshore Wind (CVOW) Project

As the offshore wind industry expands in U.S. waters, it's important to understand both the benefits and impacts offshore wind farms can have on our marine environment, coastal economies, and recreational use areas. Though the Surfrider Foundation (Surfrider) generally encourages the use of renewable energy to prevent the dangerous threats to our coasts and ocean from exacerbated climate change and fossil fuels, offshore wind farms need to be designed carefully to prevent negative ecological, economic and recreational impacts. At this point in the project, Surfrider is most concerned about the impacts to marine wildlife, consideration of cumulative impacts, and need for increased public engagement.

Surfrider is not affiliated with this offshore wind farm proposal, but due to the project's potential to directly impact nearby coastlines and coastal communities, Surfrider developed this list of common inquiries. Answers were assembled by Surfrider staff with help from experts on coastal resources and offshore wind energy. The Block Island Wind Farm is referenced often, as it is the only commercial offshore wind farm currently operating in the U.S. If you have additional questions, please contact Matt Gove at mgove@surfrider.org.

APPROVAL PROCESS QUESTIONS

1. What is Dominion Energy's Coastal Virginia Offshore Wind (CVOW) Project?

Dominion has a small (two 6MW turbines), test project that will be completed by the end of 2020. The rest of the information in this document will be about Dominion's

proposed commercial sized offshore wind power generating project that would place around 215 wind turbines 27 miles offshore from Virginia Beach, adding up to 2600 MW of power to the electricity grid.[1] If Dominion decides to use 12 MW (megawatts) turbines for this project, they will stand about 850 feet above the waterline. The project would power about 780,000 typical homes. The project would put Virginia on the path to its goal of having 100% of the state's electricity sourced from renewable energy by 2050.[2] "Coastal Virginia Offshore Wind Farm" is the official name of the project, and "Dominion Power" is the name of the public utility company proposing the project. Dominion is contracting with Denmark-based Ørsted (formerly DONG Energy) to install the turbines. Dominion has not stated where they plan to land the power cable for this project. Dominion is planning to begin construction in batches of 880MW, starting in 2022, and putting those projects into operation two years after construction begins. The rights to propose development of wind power generating projects in the lease area were purchased by Dominion Power on Nov. 1, 2013 from the federal government.[3] The lease grants Dominion the rights to operate wind turbines in the lease area for up to 33 years once all permits and approvals are acquired.[4]

2. What is Surfrider's role in these proposed offshore wind projects?

Surfrider is not affiliated with the development of offshore wind projects, yet consistent with Surfrider's mission to protect and enjoy ocean, waves and beaches, Surfrider's role is to ensure that coastal and ocean ecosystems and sustainable human uses are protected. We have an official policy about renewable ocean energy development that lays out what Surfrider wants to see in a proposed project. Surfrider is not looking at these projects in a vacuum, but weighing the impacts from offshore wind development with the impacts from climate change. As these projects move forward, Surfrider will provide facts, facilitate dialogue between stakeholders, government agencies, and project developers, and provide public comment on relevant documents to ensure that projects are designed and implemented in a way that protect coastal resources, marine life, and recreation opportunities.

3. What agencies and governments must approve an offshore wind project?

Offshore wind projects generally require the approval of federal, state, and local government agencies and bodies. Federal government agencies have authority past

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[1] Dominion Energy. Coastal Virginia Offshore Wind Project. *Available at*: www.dominionenergy.com/company/making-energy/renewable-generation/wind/coastal-virginia-offshore-wind

[2] Virginia General Assembly. Virginia Clean Economy Act (HB1526). April 12, 2020. *Available at:* lis.virginia.gov/cgi-bin/legp604.exe?201+sum+HB1526

[3] BOEM. November 2013. Commercial Lease of Submerged Land For Renewable Energy Development On the Outer Continental Shelf. OCS-A 0483. *Available at*: www.boem.gov/VA-Lease-OCS-A

[4] Ibid.

three miles from shore, but power cables will need to cross state lands and waters, requiring state approval. States also have some authority beyond three miles offshore through the Coastal Zone Management Act, which could allow them to stop wind projects.[5] Local permits may also be required when power cables come ashore. The Bureau of Ocean Energy Management is the lead federal authority for renewable energy on the Outer Continental Shelf, and the Army Corps of Engineers is the lead federal agency concerning project siting in the Great Lakes. Other federal agencies weigh in with scientific information and other information like National Oceanic and Atmospheric Administration (NOAA), U.S. Department of Defense (DOD), U.S. Department of Energy (DOE), U.S. Coast Guard, and U.S. Fish and Wildlife Service (USFWS).[6]

4. How can the public be involved?

BOEM has a few different public engagement opportunities throughout its offshore wind permit process. Generally, the public can comment when BOEM designates an official Wind Energy Area offshore. A second opportunity occurs when BOEM leases that area to energy companies. A third and fourth opportunity is when a company submits a "Site Assessment Plan", and then finally, a "Construction and Operation Plan".[7, 8] Contact Matt Gove, Surfrider's Mid-Atlantic Policy Manager, for more information about engaging in the public process for this and other offshore wind projects in the Mid-Atlantic Region: mgove@surfrider.org.

5. Why now and why Virginia?

Offshore wind energy development has been successful in Europe for decades, and has been increasingly discussed as a solution to carbon pollution in the U.S.[9] The negative effects and increasing threats of climate change are pushing states to reduce their reliance on fossil fuels, and invest in renewable power. The U.S. East Coast is an economically attractive location for offshore wind energy due to the high winds offshore

[5] NOAA. 2018. Coastal Zone Management Act. NOAA Office for Coastal Management. *Available at*: coast.noaa.gov/czm/act/

[6] Federal Register. Renewable Energy Program Regulations (30 CFR 585). *Available at*: www.boem.gov/uploadedFiles/30_CFR_585.pdf

[7] BOEM. 2016. A citizen's guide to the Bureau of Ocean Energy Management's Renewable Energy Authorization Process. *Available at*: www.boem.gov/KW-CG-Broch/

[8] BOEM. Fact Sheet: Wind energy commercial leasing process. *Available at*: www.boem.gov/Commercial-Leasing-Process-Fact-Sheet/

[9] Gilman, P., Maurer, B., Feinberg, L., Duerr, A., Peterson, L., Musial, W., Beiter, P., Golladay, J., Stromberg, J., Johnson, I., Boren, D. & Moore, A. 2016. National offshore wind strategy: Facilitating the development of the offshore wind industry in the United States. US Department of the Interior & Department of Energy. *Available at*: www.boem.gov/National-Offshore-Wind-Strategy

and large populations that live near the coast.[10] The CVOW project would help Virginia reach its goal of having 100% of the state's electricity sourced from renewable energy by 2050.[11]

6. Why don't we just put the turbines on land?

The main benefits to placing turbines offshore instead of on land include access to higher wind speeds and more open space. Higher and more consistent wind speeds are available offshore, which means offshore production can generate greater amounts of electricity per turbine.[12] Onshore and offshore turbines require a lot of open space, which can be difficult to find in densely populated coastal areas. Additionally, setback rules between private property and wind turbines make finding sufficient space for wind farms on land even more difficult, as many people do not want wind turbines close to where they live.[13] Compared to solar energy, one 10MW offshore wind turbine produces the same amount of energy as about 50 acres of land based solar panels.[14]

7. What kind of scientific studies are being done to record data about the ecosystem before and after installation of these turbines?

Dominion must gather baseline environmental data in the proposed development area (as required by the National Environmental Policy Act and other regulations). The Bureau of Ocean Energy Management (BOEM) is also continually funding research on the effects of wind turbines on their surrounding ecosystems. For example, BOEM is researching a whole host of topics in regards to offshore wind, including the effects of electromagnetic fields on elasmobranchs (sharks, rays, skates); effects of supporting infrastructure on wildlife like birds, bats, and fish, as well as cultural and archaeological resources; and behavioral effects of sound sources on marine mammals and other protected species.[15] For the Block Island Wind farm, Deepwater Wind collected

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[10] Gilman, P. et al. 2016. National offshore wind strategy: Facilitating the development of the offshore wind industry in the United States. US Department of the Interior & Department of Energy. *Available at*: www.boem.gov/National-Offshore-Wind-Strategy

[11] Virginia General Assembly. Virginia Clean Economy Act (HB1526). April 12, 2020. *Available at:* lis.virginia.gov/cgi-bin/legp604.exe?201+sum+HB1526

[12] Kaldellis, J.K. & Kapsali, M. 2013. Shifting towards offshore wind energy- Recent activity and future development. *Energy Policy*: Vol. 53, Pp. 136-148. *Available at*: www.sealab.gr/download/attachments/15565224/Shifting+towards+offshore+wind+energy--Recent+activity+and+future+development.pdf?version=1&modificationDate=1397224788000

[13] WOSU editor. 2017. Citizens debate rules on distance between wind farms and their property. WOSU Public Media, The Ohio State University. *Available at:* radio.wosu.org/post/citizens-debate-rules-distance-between-wind-farms-and-their-property#stream/0

[14] National Renewable Energy Laboratory. Land use requirements for solar power plants in the US. *Available a*t: www.nrel.gov/docs/fy13osti/56290.pdf

[15] BOEM. 2018. Renewable energy research. *Available at:* www.boem.gov/Renewable-Energy-Environmental-Studies/

scientific information two years prior to the construction of the turbines, two years during construction, and two years following construction to record environmental effects.[16]

8. Are there other companies and leasing areas with proposed wind projects? What will the ocean look like in 20 years in terms of wind power?

It is tricky to predict how many offshore wind turbines will eventually be installed on the East Coast, but it appears that around 2000 turbines could be constructed in the next decade. The demand for offshore wind can change due to technology advances, costs of other energy sources, politics, etc. To date, BOEM has issued 15 leasing areas on the East Coast.[17] Leases do not guarantee that those areas will be fully utilized.

HUMAN USE QUESTIONS

9. Will fishermen be able to fish between offshore wind turbines?

Recreational and commercial fishing vessels will be able to fish between the turbines; however, turbines may act as additional hazards for fishing vessels during times of poor visibility and heightened wave energy. To note, during construction safety zones will be in place around each turbine, temporarily restricting access.[18] The United States Coast Guard stated that they will not restrict fishing access around offshore wind turbines and between the turbines.[19] Dominion's lease also prohibits imposing long-term fishing exclusion zones.[20] Dominion's representatives have stated that turbines will be a significant distance apart (estimated to be 1 mile), but the actual details regarding distance between turbines haven't been released.

10. Will I be able to see the turbines from shore?

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[16] Tetra Tech. 2016. Site Assessment Plan: Deepwater Wind North Lease OCS-A 0486. Deepwater Wind New England LLC. *Available at:* www.boem.gov/Site-Assessment-Plan-for-OCS-A-0486

[17] BOEM. 2018. Lease and Grant Information. *Available at*: www.boem.gov/Lease-and-Grant-Information/

[18] Walsh, C. 2017. Fishermen demand answers on wind power plan. *The East Hampton Star*. *Available at:* easthamptonstar.com/Government/20171214/Fishermen-Demand-Answers-Wind-Power-Plan

[19] BOEM. 2015. Fishermen Workshops: Providing input into BOEM's identification of an offshore wind energy area offshore New York. *Available at:* www.boem.gov/NY-Summary-Fisheries-Outreach-Call-Area/

[20] BOEM. Commercial Lease of Submerged Land For Renewable Energy Development On the Outer Continental Shelf. November 2013. OCS-A 0483. *Available at*: www.boem.gov/VA-Lease-OCS-A

A 650 foot turbine placed 23 miles offshore should only be visible on the clearest of days, or about 20% of days in the year.[21] [22] At the closest point, CVOW will be 27 miles offshore from Virginia Beach, using turbines that will be 850 feet tall or taller.

11. Will offshore turbines reduce the swell that arrives on shore?

More research on this topic is needed. Surfrider could not find any anecdotal or scientific evidence of swell reduction from offshore wind turbine arrays. Turbines at this farm will be placed rather far apart, about one mile, so impacts to surfing waves are not expected. One study found that a very large array of turbines (78 thousand turbines) could reduce wind speeds, but that should not affect long-period swell, only wind driven waves.[23] Another study did not find a scientifically significant difference in swell wave structure before and after passing through a turbine array.[24, 25]

ENVIRONMENTAL IMPACT QUESTIONS

12. Will there be impacts to bats and birds?

Wind turbines on land have had substantial negative impacts to birds and bats. Total U.S estimates for bird mortality from collision with terrestrial wind turbines ranges from 140,000[26] to 573,000[27] birds per year. However, there is insufficient data on the effect of *offshore* wind turbines on birds and bats, mainly because recording bird and bat

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[21] Sullivan, R.G., Kirchler, L.B., Cothren, J. & Winters, S.L. 2013. Offshore wind turbine visibility and visual impact threshold distances. *Environmental Practice*: Vol. 15, No. 1, Pp. 33-49. *Available at:* www.cambridge.org/core/journals/environmental-practice/article/research-article-offshore-wind-turbine-visibility-and-visual-impact-threshold-distances/59A51F3CD207849FC7F5BD986F15B2CB

[22] BOEM. Mangi Environmental Group. 2012. Visualization Study for Offshore North Carolina. *Available at:* boem.gov/sites/default/files/renewable-energy-program/State-Activities/NC/NC-Visualization-Task-Force-Pres.pdf

[23] Jacobson, M.Z., Archer, C.L. & Kempton, W. 2014. Taming hurricanes with arrays of offshore wind turbines. *Nature Climate Change*: Vol. 4, Pp. 195-200. *Available at*: www.nature.com/articles/nclimate2120.

[24] Navitus Bay Development Limited. 2014. Navitus Bay Wind Park Physical Processes Assessment: Environmental Statement. Document 6.1.2.5: Vol. B, Ch. 5, Pp. 78. *Available at*: infrastructure.planninginspectorate.gov.uk/wp-content/ipc/uploads/projects/EN010024/EN010024-000802-6.1.2.5%20Volume%20B%20Offshore%20Chapter%205%20Physical%20Processes.pdf

[25] ABP Marine Environmental Research Limited. 2014. Navitus Bay Wind Park Physical Processes Assessment: Technical Appendix. Navitus Bay Development Limited, Report R.2015: Vol B. Ch. 5, Pp. 174. *Available at*: infrastructure.planninginspectorate.gov.uk/wp-content/ipc/uploads/projects/EN010024/EN010024-000843-6.2.2.5.1%20Volume%20B%20Chapter%205%20Physical%20Processes%20Appendix%205.1.pdf

[26] Loss, S., Will, T., Marra, P. 2013. Estimates of bird collision mortality at wind facilities in the contiguous United States. *Biological Conservation*: Vol. 168, Pp. 201–209. *Available at:* www.fws.gov/migratorybirds/pdf/management/lossetal2013windfacilities.pdf

[27] Smallwood, K. 2013. Comparing bird and bat fatality-rate estimates among North American wind-energy projects. *Wildlife Society Bulletin*: Vol. 37, No. 1, Pp. 19-33. *Available at:* onlinelibrary.wiley.com/doi/abs/10.1002/wsb.260

mortality offshore is very difficult (carcasses may sink or be eaten before documented by an observer).[28]

Besides possible direct mortality from turbines, birds and bats may also be negatively affected by avoiding or being displaced by wind farms. However, some species of birds are attracted to wind farms, probably for feeding and resting opportunities.[29] For both birds and bats, the location of the turbines is crucial to understanding impacts, especially considering migratory pathways.[30] Lights placed on turbines could increase mortality as some species of both birds and bats are drawn to them.[31, 32] However, using lights that blink on and off has been shown to mitigate this issue.[33]

When comparing bird mortality to the energy produced per gigawatt hour (GWh), wind farms may be less detrimental than nuclear or fossil fuel power plants. According to one analysis, wind farms kill roughly 0.33 birds per GWh, whereas nuclear and fossil-fueled power stations kill about 0.6 birds per GWh, and 9.4 birds per GWh respectively.[34] For further context, studies have shown that free-ranging domestic cats in the US kill 1.3–4.0 billion birds per year.[35]

13. What are the impacts to ocean animals from increased noise?

Wind farms can increase marine noise levels during surveying, construction, and operation. Noise pollution can negatively impact a wide range of marine animals including mammals, fish, shellfish, and larvae. Depending on the proximity to the noise source and loudness of the sound, responses can range from no reaction, to detection

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[28] Ibid.

[29] Dierschke, V., Furness, R.W. & Garthe, S. 2016. Seabirds and offshore wind farms in European waters: Avoidance and attraction. *Biological Conservation*: Vol. 202, Pp. 59-68. *Available at*: www.sciencedirect.com/science/article/pii/S0006320716303196

[30] Sjollema, A., Gates, J., Hilderbrand, R. & Sherwell, J. 2014. Offshore Activity of Bats Along the Mid-Atlantic Coast. *Northeastern Naturalist*: Vol. 21, No. 2, Pp. 154-163. *Available at*: doi.org/10.1656/045.021.0201

[31] Voigt, C., Roeleke, M., Marggraf, L., Petersons, G., & Voigt-heucke, S.L. 2017. Migratory bats respond to artificial green light with positive phototaxis. *PLOS ONE*. *Available at*: journals.plos.org/plosone/article?id=10.1371/journal.pone.0177748

[32] Manville, A. M. 2000. The ABCs of avoiding bird collisions at communication towers: the next steps. Proceedings of the Avian Interactions Workshop, December 2, 1999, Charleston, SC. Electric Power Research Institute (in press). *Available at:* nctc.fws.gov/resources/knowledge-resources/bird-publications/tower-collisions.html

[33] Gehring, J., Kerlinger, P., & Manville, A.M. 2009. Communication towers, lights, and birds: Successful methods of reducing the frequency of avian collisions. *Ecological Applications*: Vol. 19, No.2, Pp. 505-514. *Available at*: www.opc.ca.gov/webmaster/_media_library/2016/01/Gehring-et-al-2009-Communication-Towers-Lights-and-Birds.pdf

[34] Sovacool, B.K. 2012. The avian and wildlife costs of fossil fuels and nuclear power. *Journal of Integrative Environmental Sciences:* Vol. 9, No. 4, Pp. 255-278; Vermont Law School Research Paper No. 04-13. *Available at:* ssrn.com/abstract=2198024

[35] Loss, S., Will, T., & Marra, P.P. 2013. The impact of free-ranging domestic cats on wildlife of the United States. *Nature Communications*: Vol. 4, No. 1396. *Available at*: www.nature.com/articles/ncomms2380

and behavioral changes, to physical injury and permanent hearing loss. Fortunately there are methods to mitigate the impacts from offshore wind noise pollution. European wind farms have used multiple techniques including seasonal and diurnal restrictions on construction and noise limits.[36] During construction of the Block Island Wind Farm, Deepwater Wind put in place many mitigation measures, including shutting down pile driving if marine mammals were spotted in the area.[37]

During surveying, developers use high resolution geophysical instruments to map the seafloor. Though not as loud, constant, or widespread as seismic blasting used during oil and gas exploration, geophysical surveys for offshore wind still emit loud noises and can negatively affect marine mammals, and cause marine animals to temporarily avoid the area.[38]

Pile driving during construction also produces loud noises. Sensors at the Block Island Wind Farm measured a peak sound pressure level of 188 underwater decibels at 500 meters during pile driving.[39] To put that in context, some marine mammals (particularly harbor porpoise) begin to show avoidance behavior beginning at 120 underwater decibels,[40] and rely on their hearing for navigation, communication, feeding, and general survival.[41] Note than underwater and air decibels have different reference levels, and ears evolved to hear in water have different sensitivities than ears evolved to hear in air. All things being equal, underwater and air levels are about 62 decibels different for the same intensity of sound.

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[36] Reeve, E., Drew-Murphy, J. & Pfeister, D. 2018. Briefing paper: Understanding the effects of offshore wind farms on the natural environment; Part 2. Renewable Consulting Group.

[37] Fiorentino, J. 2014. Issuance of incidental harassment authorizations to Deepwater Wind for the take of marine mammals incidental to construction of the Block Island wind farm and Block Island transmission system. NOAA, National Marine Fisheries Service. *Available at*: https://repository.library.noaa.gov/view/noaa/5007

[38] Southall, B.L., Rowles, T., Gulland, F., Baird, R.W., and Jepson, P.D. 2013. Final report of the Independent Scientific Review Panel investigating potential contributing factors to a 2008 mass stranding of melon-headed whales (*Peponocephala electra*) in Antsohihy, Madagascar. *Available at:* www.cascadiaresearch.org/oldsite/Hawaii/Madagascar_ISRP_Final_report.pdf

[39] Miller, J., Potty, G., Lin, Y., Newhall, A., Raposa, K., Frankel, A., Giard, J., & Mason, T. 2017. Monitoring the environmental effects of construction and initial operation of the first offshore wind farm in the US. *Available at:* tethys.pnnl.gov/tethys-stories/monitoring-environmental-effects-construction-and-initial-operation-first-offshore

[40] National Marine Fisheries Service. 2018. 2018 Revisions to: Technical Guidance for Assessing the Effects of Anthropogenic Sound on Marine Mammal Hearing (Version 2.0): Underwater Thresholds for Onset of Permanent and Temporary Threshold Shifts. U.S. Dept. of Commerce, NOAA. NOAA Technical Memorandum NMFS-OPR-59, Pp. 167. *Available at*: www.fisheries.noaa.gov/resource/document/technical-guidance-assessing-effects-anthropogenic-sound-marine-mammal

[41] Bailey, H., Brookes, K., & Thompson, P. 2014. Assessing environmental impacts of offshore wind farms: lessons learned and recommendations for the future. *Aquatic Biosystems*: Vol. 10, No. 8. *Available at:* www.ncbi.nlm.nih.gov/pmc/articles/PMC4172316/

For land based turbines, operational noise has been measured at 40 air decibels at a distance of 1000 feet.[42] At the Block Island Wind Farm, operational noise is barely detectable at a distance of 165 feet.[43, 44] It is possible that operational noise could cause marine animals to travel outside of their usual migration routes, and potentially away from important nurseries and feeding grounds.[45]

14. What about scouring of the seafloor from the turbines?

Scouring, or erosion of the seafloor, can occur around the base of offshore wind turbines. This is caused by tidal currents, waves, and associated sediment movement around the base of the structure. If severe, scouring can reduce the structural integrity of the turbine and its ability to withstand strong winds, currents, and waves. To prevent this, wind farms have placed stones or concrete pads around turbine bases, but this only prevents scouring at the source, and many will simply experience scouring at the edge of the "bed protection." Generally, areas with stronger currents, energetic wave action, and looser sediment will experience scouring sooner.[46]

15. Will there be impacts from power cable electromagnetic fields?

Power cables that connect offshore turbines to land (and to each other) will produce an electromagnetic field (EMF). There is limited research on the issue, but generally speaking EMF's are only detected by certain ocean wildlife, including some fish species, sea turtles, marine mammals like whales and dolphins, and crustaceans like lobster and crabs. These species are all able to perceive the Earth's geomagnetic field, and it is hypothesized that EMF's could cause disorientation. For instance, preliminary studies indicate that EMF's could interfere with sea turtle hatchlings' ability to navigate to important nurseries, but more information is necessary to confirm.[47] So far, research

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[42] Ellenbogen, J.M., Grace, S., Heiger-Bernays, W.J., Manwell, J.F., Mills, D.A., Sullivan, K.A. & Weisskopf, M.G. 2012. Wind turbine health impact study: Report of independent expert panel. MA Department of Environmental Protection & MA Department of Public Health. *Available at:* https://www.mass.gov/files/documents/2016/08/th/turbine-impact-study.pdf

[43] McCann, J. 2017. The Block Island Wind Farm: What have we learned? URI Coastal Resources Center, Rhode Island Sea Grant. URI Graduate School of Oceanography. Presentation at the Southern New England Offshore Wind Science Forum, December 2017.

[44] Bailey, H., Brookes, K., & Thompson, P. 2014. Assessing environmental impacts of offshore wind farms: lessons learned and recommendations for the future. *Aquatic Biosystems*: Vol. 10, No. 8. *Available at:* www.ncbi.nlm.nih.gov/pmc/articles/PMC4172316/

[45] Ibid.

[46] Whitehouse, R., Harris, J., Sutherland, J., & Rees, J. 2008. An assessment of field data for scour at offshore wind turbine foundations. Fourth International Conference on Scour and Erosion. *Available at*: izw.baw.de/publikationen/tc213/0/b_13.pdf

[47] Normandeau, Exponent, T. Tricas, and A. Gill. 2011. Effects of EMFs from Undersea Power Cables on Elasmobranchs and Other Marine Species. U.S. Dept. of the Interior, Bureau of Ocean Energy Management, Regulation, and Enforcement, Pacific OCS Region, Camarillo, CA. OCS Study BOEMRE 2011-09. *Available at*: www.boem.gov/ESPIS/4/5115.pdf

has not shown significant negative impacts to any marine species, but there are a lot of data gaps, and additional studies need to be conducted.[48] Generally, EMFs for direct current (DC) cables are more powerful compared to alternating current (AC).[49] Additionally, the cumulative impact of multiple power cables is unknown, as many studies assume that mobile species avoid significant impacts by simply moving away from sources of EMF.[50] Some researchers believe that impacts from EMF will be increased for floating turbines, but again, this is not well documented.[51]

16. What are the cumulative impacts from constructing hundreds of turbines?
It is difficult to predict how many offshore wind turbines will eventually be installed, but to date, BOEM has issued 15 commercial leases on the East Coast.[52] Leases do not guarantee that those areas will be fully utilized, but currently it looks like about 2000 turbines will be installed over the next decade. The cumulative impacts of that amount of turbines on ocean species is basically unknown, and highlights the need for adaptive management and continued research and monitoring.

17. How deep will the power cables be under the seafloor and beach?
We don't have all of the details about CVOW, but it is most likely that cables will be placed 4-6 feet under the seafloor using a technique called "trenching". When the cable reaches the shore, it will most likely be directionally drilled under the beach. Temporary habitat loss is experienced for fish, benthic species, sea turtles, and marine mammals during installation of the power cable. Overtime however, there can be habitat gains at the base of the turbine, as is seen at the Block Island Wind Farm and examples in Europe.[53, 54]

18. Aren't wind turbines made from rare-earth metals and GHG intensive materials?
The construction of turbines requires the use of a lot of raw materials and, depending on the turbine selected, some amount of rare-earth metals.[55] The initial extraction of raw

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[48] Ibid.
[49] Ibid.
[50] Ibid.
[51] Reeve, E., Drew-Murphy, J. & Pfeister, D. 2018. Briefing paper: Understanding the effects of offshore wind farms on the natural environment. Renewable Consulting Group.
[52] Lease and Grant Information. BOEM. Available at: www.boem.gov/Lease-and-Grant-Information/
[53] American Wind Energy Association. 2017. Photo evidence: Fish feeding frenzy at Block Island Wind Farm. *Available at:* www.aweablog.org/photo-evidence-fish-feeding-frenzy-block-island-wind-farm/
[54] Slavik, K., Lemmen, C., Zhang, W., Kerimoglu, O., Klingbeil, K. & Wirtz, K.W. 2018. The large scale impact of offshore wind farm structures on pelagic primary production in the southern North Sea. Submitted to *Hydrobiologia*, May 2018. *Available at*: arxiv.org/abs/1709.02386.
[55] Wilburn, D. 2011. Wind energy in the United States and materials required for the land-based wind turbine industry from 2010 through 2030. US Geological Survey. Scientific Investigations Report 2011-5036. *Available at*: pubs.usgs.gov/sir/2011/5036/sir2011-5036.pdf

materials and minerals, especially neodymium oxide, can cause severe environmental and human health impacts. For instance, neodymium oxide is mainly sourced from China (as are 95% of all rare-metals)[56], where there is a lack of environmental laws surrounding mining practices. There have been multiple reports of disastrous impacts to human and environmental health due to exposure to carcinogenic, toxic, and radioactive waste produced during mining.[57] Other raw materials necessary for wind turbines include iron, steel rebar, concrete, copper, and dysprosium. This is an important issue, and more research needs to be conducted on the impacts of mineral extraction for turbines, and assurance that wind energy companies manage their supply chain to ensure that mines use safety protocols to prevent the release of harmful pollutants. To note, other energy sources also require significant use of raw materials for construction--such as nuclear power plants and oil refineries. Life cycle analysis studies found that per kWh of electricity generated, wind energy uses less water, and emits significantly less carbon dioxide, nitrogen oxide, and sulfur dioxide than fossil fuel plants. Though the construction of wind turbines is currently resource intensive, the operational phase of wind turbines results in minimal to no waste or greenhouse gas emissions. In fact, researchers estimate that it takes 5-8 months (and in the worst case, one year) to break even on the amount of energy used in turbine construction and installation.[58] When compared to the construction needs and continual generation of high level radioactive waste from nuclear energy, or greenhouse gas emissions from fossil fuel energy, the wind industry has a much smaller environmental footprint.[59]

ECONOMIC QUESTIONS

19. Will new offshore wind power projects create jobs?

According to a report funded by Oceana, adding 143 GW of offshore wind generation could create 218,000 jobs, which is double the amount expected to be provided from offshore oil drilling development over the same timeframe.[60] The US Department of

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[56] Bourzac, K. 2011. The rare-earth crisis. *MIT Technology Review*. *Available at*: www.technologyreview.com/s/423730/the-rare-earth-crisis/

[57] Rim, K.T., Koo, K.H. & Park, J.S. 2013. Toxicological evaluations of rare earths and their health impacts to workers: A literature review. *Safety and Health at Work*: Vol. 4, No. 1, Pp, 12-26. *Available at*: www.sciencedirect.com/science/article/pii/S2093791113410028

[58] International Journal of Sustainable Manufacturing. Comparative life cycle assessment of 2.0 MW wind turbines. June 2014. *Available at*: www.sciencedaily.com/releases/2014/06/140616093317.htm

[59] Wilburn, D. 2011. Wind energy in the United States and materials required for the land-based wind turbine industry from 2010 through 2030. US Geological Survey. Scientific Investigations Report 2011-5036. *Available at*: pubs.usgs.gov/sir/2011/5036/sir2011-5036.pdf

[60] Oceana. 2016. Offshore energy by the numbers, an economic analysis of offshore drilling and wind energy in the Atlantic. *Available at*: usa.oceana.org/sites/default/files/offshore_energy_by_the_numbers_report_final.pdf

Energy and Department of Interior estimate that the development of 86 GW of offshore wind power by 2050, would provide an increase of 160,000 jobs.[61]

20. Will my electricity rate go up because of offshore wind projects?
Generally, when energy companies build new infrastructure, customers foot the bill; however, many factors affect energy rates, including other energy projects, regulations and policies, subsidies, weather, global energy markets, transmission systems, and power purchase agreements.[62] A 2016 report by the Department of Energy (DOE) found that the cost of offshore wind energy is steadily dropping and is already cost competitive with other energy sources.[63] [64] Currently it is unclear how much the CVOW project will raise rates for Dominion customers.

21. Who is paying for this project?
Dominion will pay the upfront project costs but, as stated above, much of those costs will be transferred to Virginia consumers via rate changes.

ENGINEERING QUESTIONS

23. How big are the offshore turbines?
Dominion has not chosen which turbine they will use, but a popular choice right now is the 12MW GE Haliade turbine, which is about 850 feet tall. The Block Island Wind Farm consists of five, 689 foot tall wind turbines. For comparison, that's twice the size of the statue of liberty, with each producing 6MW of electricity.[65]

24. Won't rough conditions and hurricanes destroy the turbines?

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[61] Departments of the Interior and Energy. 2016. National Offshore Wind Strategy. Available at: www.boem.gov/National-Offshore-Wind-Strategy

[62] US Energy Information Administration. 2018. Electricity explained: Factors affecting electricity prices. US Department of Energy. *Available at:* www.eia.gov/energyexplained/index.cfm?page=electricity_factors_affecting_prices

[63] Musial, W., Beiter, P., Schwabe, P., Tian, T., Stehly, T., & Spitsen, P. 2017. 2016 Offshore wind technologies market report. US Department of Energy, Office of Energy Efficiency & Renewable Energy. *Available at:* energy.gov/eere/wind/downloads/2016-offshore-wind-technologies-market-report

[64] Fares, R. 2017. Wind energy is one of the cheapest sources of electricity, and it's getting cheaper. *Scientific American Unplugged*. *Available at:* blogs.scientificamerican.com/plugged-in/wind-energy-is-one-of-the-cheapest-sources-of-electricity-and-its-getting-cheaper/

[65] Garfield, L. 2017. America's first offshore wind farm launched with GE turbines twice as tall as the Statue of Liberty. *Business Insider*. *Available at*: www.businessinsider.com/ge-wind-farm-block-island-2017-5

A 2017 study showed that current turbine designs cannot survive wind speeds and wind shear from a Category 5 hurricane.[66] Yet onshore turbines used in Texas withstood wind speeds over 130 mph from Hurricane Harvey, a Category 4 hurricane.[67] Surfrider would like to see that the turbines used in this project can easily handle winds speeds that are statistically shown to occur in the region. We should note that turbines are designed to stop operating at a "cut-out" wind speed to prevent unnecessary strain on the rotor blades, but again this varies by turbine type.[68] For example, turbines at the Block Island Wind Farm in Rhode Island shut off when winds exceed 55 mph, and then power back up once winds diminish. Thorough and ongoing maintenance, monitoring, and inspections will be critical to ensure that turbines maintain structural integrity and the ability to handle extreme weather.

25. How often do the turbines require maintenance?

The turbines used in the Block Island Wind Farm require routine maintenance about every two weeks, with larger, yearly maintenance projects occurring in the late summer when wind speeds are low.[69] The maintenance schedule is unknown for the CVOW project.

26. What is the lifespan of each turbine and what happens when they are obsolete?

Generally, turbines are rated by the manufacturers to operate for 25 years.[70] The federal government requires that developers submit a decommissioning plan and post a bond to cover the cost of those decommissioning activities, including removing turbines from the water.[71, 72] At the end of a turbine's useful life, developers have the option to refurbish or repower it (with additional approvals and permits), yet previous plans to refurbish farms in European waters have failed due to technical difficulties and cost concerns.[73] During decommissioning, some structures must be removed-- including the

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[66] Worsnop, P.W., Lundquist, J.K., Bryan, G.H., Damiani,R. & Musial, W. 2017. Gusts and shear within hurricane eyewalls can exceed offshore wind turbine design standards. *Geophysical Research Letters*: Vol. 44, No. 12, Pp. 6413-6420. *Available at*: agupubs.onlinelibrary.wiley.com/doi/full/10.1002/2017GL073537

[67] Cleanenergy.org via Reve. 2017. Texas wind turbines survive hurricane harvey. *Available at*: www.evwind.es/2017/08/30/texas-wind-turbines-survive-hurricane-harvey/60862

[68] US Department of Energy. 2017. How do wind turbines survive severe storms? Office of Energy Efficiency and Renewable Energy. *Available at:* energy.gov/eere/articles/how-do-wind-turbines-survive-severe-storms

[69] Communications with Deepwater Wind. April 2018. September 2018.

[70] Renewables First. 2015. How long does a wind turbine last? *Available at:* www.renewablesfirst.co.uk/windpower/windpower-learning-centre/how-long-do-wind-turbines-installations-last/

[71] BOEM. 2013. Commercial Lease of Submerged Land For Renewable Energy Development On the Outer Continental Shelf. OCS-A 0486. *Available at*: www.boem.gov/Renewable-Energy-Program/State-Activities/RI/Executed-Lease-OCS-A-0486.aspx

[72] BOEM. 2016. Guidelines for Information Requirements for a Renewable Energy Construction and Operations Plan (COP). *Available at:* www.boem.gov/COP-Guidelines/

[73] Vattenfall. 2016. The First Decommission in the World of an Offshore Wind Farm Is Now Complete. Vattenfall Press Release. *Available at:*

turbines, all associated oils and lubricants, and the foundation attachment ("transition piece"). Other structures, like the foundation pads and subsea cables, may only need to be partially removed, pending the environmental or safety hazard associated with leaving or removing them.[74]

27. What happens when it's not windy? How is energy from the turbines stored?
When it's not windy turbines create less energy, and power companies will need to move more energy into the region from other sources using the transmission grid. Energy from wind turbines is not generally stored in batteries, which are currently too expensive and impractical for such an application, however as technology improves batteries might become part of offshore wind energy systems. As with other sources, energy will be balanced in the transmission system and managed on a regional scale.[75]

28. Do turbines have back up generators to provide energy for basic functions when the wind dies?
No.[76] If the turbine cannot create its own power from the wind, energy can be routed from land to the turbine through the power cable. However, if the entire grid fails for some reason, substations will most likely be equipped with diesel generators to provide power to the turbines. Turbines require power to keep out moisture, run lights, and direct the blades into the wind in the event of strong winds.[77]

29. Are there other structures besides the turbines that need to be placed on the seafloor or on platforms, like substations or anything?
Yes. In addition to wind turbines, all offshore wind farms also require transmission lines to transport energy from turbines to the shore. These are referred to as "power cables," and Dominion plans to bury these cables in the seafloor with a technique called trenching. Offshore substations are sometimes used to prevent the loss of energy during this transmission, but the need for offshore substations is dependent on the distance from the coast, quantity of turbines, distance between turbines and amount of

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corporate.vattenfall.com/press-and-media/press-releases/2016/the-first-decommission-in-the-world-of-an-offshore-wind-farm-is-now-complete/

[74]Topham, E. & McMillan, D. 2017. Sustainable decommissioning of an offshore wind farm. Renewable Energy: Vol. 102, Part B, Pp. 470-480. *Available at*: www.sciencedirect.com/science/article/pii/S0960148116309430#bib9

[75] American Wind Energy Association. Nd. Wind Energy and Storage. *Available at*: www.awea.org/wind-energy-storage

[76] US Department of Energy. Nd. The inside of a wind turbine. *Available at*: www.energy.gov/eere/wind/inside-wind-turbine-0

[77] Göksu, O. et al. 2017. Black start and island operation capabilities of wind power plants. *Proceedings of the 16th Wind Integration Workshop*. *Available at*: www.promotion-offshore.net/fileadmin/PDFs/Conference_Paper_Black_Start_and_Island_Operation_Capabilities_of_Wind_Power_Plants_with_note.pdf

electricity generated; with greater distances and quantities increasing the need.[78] Substations would be located on similar foundations as a turbine would, about 60 feet out of the water, with a platform about the size of a small house. Deepwater's Block Island Wind Farm did not require an offshore substation, but it did require the construction of one onshore to help with electricity distribution.[79]

30. Do turbines have any fuel or other toxic materials in them?

Wind turbines do not have any fuel in them; however, bearings within a wind turbine gearbox need lubrication about every 8 to 12 months, either with synthetic or petroleum based oil. Industry recommends the use of synthetic oil[80] (traditionally not derived from petroleum)[81] or biodegradable lubricants, like vegetable oils, for offshore applications.[82] Turbines can also require grease and hydraulic fluid for certain gears, bearings, and hydraulic systems.[83] In total, each turbine could include up to 215 gallons of lubricating oils.[84] If the turbines are "direct drive", they will not require lubrication.[85] A review of chemical contaminants from offshore wind farms in European waters listed accidental spills of lubricating oils or hydraulic fluid and leached metals from "sacrificial anodes" (charged metals brushed onto boat or turbine surfaces to protect against corrosion) as potential sources. These metals include aluminum, copper, and zinc, which can be toxic to marine life pending concentration and oxidation state.[86] It is unclear if lubricant oils are released into the environment during normal operation, and this should be part of the monitoring and evaluation plan for any offshore installation. Additionally, some wind farms have electrical service platforms (ESPs, also referred to as substations) that can contain fuel and oil,[87] but it is unclear if a substation will be developed for this wind

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[78] Barberis, N, Todorovic, J. & Ackermann, T. 2006. Loss evaluation of HVAC and HVDC transmission solutions for large offshore wind farms. *Electric Power Systems Research*: Vol. 76, No. 11, Pp. 916-927. *Available at:* www.sciencedirect.com/science/article/pii/S0378779605002609

[79] Trodson, L. 2018. Wind farm blamed for higher mainland power rates. *Block Island Times*.

[80] Barr, D. 2001. Modern wind turbines: a lubrication challenge. *Machinery Lubrication. Available at*: www.machinerylubrication.com/Read/395/wind-turbine-lubrication

[81] Wright, J. 2011. The basics of synthetic oil technology. *Machinery Lubrication*. *Available at*: www.machinerylubrication.com/Read/28671/basics-of-syntic-oil-technology

[82] Sotaventogalicia. Nd. Non toxic, biodegradable and renewable lubricants for wind turbines. *Available at*: www.sotaventogalicia.com/en/projects/non-toxic-biodegradable-and-renewable-lubricants-for-wind-turbines

[83] Dutta, S. 2017. A positive spin for wind turbine lubricants. *Available at*: knowledge.ulprospector.com/7157/lmf-positive-spin-wind-turbine-lubricants/

[84] BOEM. 2013. Environmental Risks, Fate, and Effects of Chemicals Associated with Wind Turbines on the Atlantic Outer Continental Shelf. *Available at*: www.boem.gov/ESPIS/5/5330.pdf

[85] American Superconductor Corp. 2012. SeaTitan. *Available at:* www.amsc.com/documents/seatitan-10-mw-wind-turbine-data-sheet/

[86] Tornero, V. & Hanke, G. 2016. Chemical contaminants entering the marine environment from sea-based sources: A review with a focus on European seas. *Marine Pollution Bulletin*: Vol. 112, No. 1–2, Pp. 17-38. *Available at*: www.sciencedirect.com/science/article/pii/S0025326X16304957

[87] Moffat & Nichol. 2015. Offshore substation design development of standards. Report developed for Bureau of Safety and Environmental Enforcement & BOEM. *Available at:* www.boem.gov/723AA/

farm. ESPs are generally equipped with collection systems to prevent oil from being released into the environment in the event of a leak from oil-storing equipment.[88]

31. Can offshore wind turbines be converted to oil and gas drilling platforms?
A wind turbine has never been converted to an oil and gas drilling platform. Such an activity would require significant construction and design changes.[89] Additionally, the permits required from state and federal agencies are specific to wind production only.[90, 91] If you look at photos of offshore wind turbines and offshore oil platforms, they are physically very different. Additionally, a "converted turbine" would need to be located in the same vicinity as oil and gas reserves, and accompanied by all the necessary support structures for oil and gas collection and transport.

32. Will there be any structures on land to accompany the project?
Each project is unique, but every offshore wind farm has to land its power cable onshore to connect to the electricity grid. The onshore landing site generally has little physical impact, but it depends on the specifics of each local coastal environment and intertidal zone. Where the connection to the electric grid occurs, a facility is generally needed to house the connection hardware. For the CVOW project, Dominion is not sure where the power cable might connect to the electricity grid onshore.

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[88] BOEM. 2013. Environmental Risks, Fate, and Effects of Chemicals Associated with Wind Turbines on the Atlantic Outer Continental Shelf. *Available at*: www.boem.gov/ESPIS/5/5330.pdf

[89] Fugro Marine GeoServices. 2017. Geophysical and Geotechnical Investigation Methodology Assessment for Siting Renewable Energy Facilities on the Atlantic OCS. US Department of the Interior Bureau of Ocean Energy Management Office of Renewable Energy Programs, OCS Study BOEM 2017-049. Pp. 1.4-1.6. *Available at:* www.boem.gov/G-and-G-Methodology-Renewable-Energy-Facilities-on-the-Atlantic-OCS/

[90] Renewable Energy Program Regulations (30 CFR 585). Bureau of Ocean Energy Management. *Available at:* www.boem.gov/uploadedFiles/30_CFR_585.pdf

[91] BOEM. 2013. Commercial Lease of Submerged Land For Renewable Energy Development On the Outer Continental Shelf. OCS-A 0486. *Available at*: www.boem.gov/Renewable-Energy-Program/State-Activities/RI/Executed-Lease-OCS-A-0486.aspx