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Comment of Professor Jeremy Firestone on SB1058 and HB1135

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My name is Dr. Jeremy Firestone. I am a Professor in the College of Earth, Ocean and Environment, School of Marine Science and Policy. I also am the Director of Center for Carbon-free Power Integration. I hold a Ph.D. in Public Policy Analysis from the University of North Carolina at Chapel Hill (2000), a Juris Doctorate from the University of Michigan Law School (1986) and a Bachelor of Science in Cellular and Molecular Biology from the University of Michigan (1980).

My primary research focus since 2003 has been on renewable energy, and more specifically wind power and offshore wind power. I have published in the peer review literature on numerous facets of offshore wind power, including social acceptance, economic valuation of associated visual dis-amenities, pricing, coastal tourism effects, resource assessment, economic tradeoffs in spatial planning, and regulation. These articles primarily appear in peer review energy, economic, environmental planning, and policy journals; a few appear in law journals. See https://scholar.google.com/citations?user=831LSZ8AAAAJ&hl=en. I also undertake reviews for many journals of manuscripts submitted for peer review publication and am on the editorial board of the journal, *Energy Research and Social Science*. Presently, I am working on three studies; ratepayers' willingness to pay a premium for an offshore wind power project; the economic effects of offshore wind power development on beach tourism; and perceptions of land-based wind, with a focus on process fairness. I also teach courses on renewable energy law, offshore wind power, climate change policy and ocean and coastal law.

My comment responds to concerns that have been raised regarding the potential tourism effects of offshore wind power projects adjacent to the Maryland and Delaware coasts. More specifically, I understand concerns have been raised regarding the findings in two studies: (a) Lutzeyer, et al., "The Amenity Cost of Offshore Wind Farms: Evidence from a Choice Experiment," unpublished manuscript (August 2017), North Carolina State University. https://cenrep.ncsu.edu/cenrep/wp-content/uploads/2016/03/WP-2017-017.pdf and (b) Dissertation of Jenna Toussaint, The Effect of Offshore Wind Power on Beach Use and Tourism: A Contingent Behavior Analysis on the East Coast of the United States, University of Delaware. It is worth noting that neither of these studies have been published in a peer review journal nor even been accepted as a government report.

The Lutzeyer study is in some respects a fine study, however, given its methodological oddities, it has little to no validity to Ocean City, Maryland—that is, its findings should not be extrapolated here. In that study:

a. They sampled only overnight visitors (no day visitors).
b. The rental stock is limited to a few beach communities in North Carolina and is almost all single-family dwellings.
c. They sampled only those individuals who either rented (i) ocean front property or (ii) non-ocean front property that nonetheless had an ocean view. And between the two, they sampled the ocean front properties a higher rate.
d. The properties typically rent out at $2,000 to $10,000 per week.
e. The visuals were created using a software package rather than by an expert in visual impact graphics. As a result, the night-time visuals in particular are not the best.[1]
f. They spaced the turbines 6.39 rotor diameters from one another in the photo-simulations, which is more tightly packed than any development that will occur off the Delmarva Peninsula.[2] If spacing was more realistically based on at least 8 rotor diameters, and assuming the similarly-sized wind turbines, their study packed approximately three wind turbines into the same space as one would expect to find two wind turbines. Moreover, at 10 rotor diameters—the spacing I understand US Wind may use—means, that for similarly-size wind turbines, the Lutzeyer study has approximately 5 turbines in the same space area as one would expect to find two wind turbines.[3]
g. For even a correctly rendered simulation to be an accurate portrayal, it must be of sufficient size and held a precise distance from the eyes. The simulations appear to have been smaller than desirable (only 8"x11") and no directions appear to have been provided to survey respondents about how to view the simulations.
h. They never asked if visible turbines would result in a trip loss or a trip gain.

Jenna Toussaint's dissertation grew out of work which a colleague and I are doing for the US Bureau of Ocean Energy Management (BOEM) as well as in response to a grant from the NOAA/Delaware Sea Grant. This work looks at offshore wind power tourism effects from South Carolina to Cape Cod and includes beachgoers and non-beachgoers and those taking day trips, short overnight trips and long overnight trips. Only a portion of the data was analyzed by her in the dissertation. Although the dissertation has been accepted, the overall research project

[1] See Lutzeyer, S. (2013). *Essays in Offshore Wind Development*, PhD Dissertation, North Carolina State University at pp. 317, 338, 400 405-408.
[2] Turbines are spaced because of what is referred to as the "wake effect" where an upstream turbine affects the wind available to those downstream.
[3] Because, as I understand it, US Wind now intends to use larger capacity turbines with larger rotors, spacing will be even greater in absolute terms.

analysis is ongoing. As a result, the analysis is being refined and extended using additional data that we collected. BOEM is expected to issue a report in about a month.

In the study, several parameters were measured, including:

(1) Whether the presence of offshore wind turbines at different distances would have made beach experiences better or worse
(2) The "loss" (in "consumer surplus") experienced by those individuals who indicated they would have visited another beach or done something else (e.g., read a book or gone duckpin bowling) if offshore wind turbines were present during their last beach trip.
(3) The "gain" experienced by those individuals who indicated they would have visited a beach adjacent to offshore wind turbines rather than the beach they last visited.
(4) Special trips that people would have taken to see the offshore wind turbines.
(5) Boat tours of the offshore wind power project.

The Toussaint dissertation monetized trip losses[4] (2) but not trip gains (3); It thus tells only a portion of the story. The gain, although it exists, was simply not part of the work required for the dissertation. As a result, the dissertation does not provide the net economic effect, and reliance on it for total economic effects is misplaced. Moreover, while the dissertation analyzes special trips (4), it does not monetize economic gains associated with those special trips nor does it calculate the economic benefits associated with boat tours (5). This is not a criticism of the dissertation; rather, it is merely a recognition that like with all natural and social science studies, one has to be careful in extracting insights.

In addition, the economic effect measured by the Toussaint dissertation is likely not what many think it is. The study measures "consumer surplus" associated with a beach trip, which is the difference between what a person is willing and able to pay for a beach trip and the amount they actually pay for a trip. Take the Orioles, it might cost you $125 for an opening day ticket, low down near third base, but you might have been willing to pay up to $150 for the ticket, so that your consumer surplus is $25.

The dissertation does not measure how the rental market would adjust—that is, it does not measure whether the loss would, for example, ultimately be borne solely by those same visitors in terms of a "loss" in consumer surplus (where they would simply value the beach trip they pay for as providing them with less value, although it costs them the same out-of-pocket) or by landlords, in terms of lower rental rates, which would work to encourage either those same visitors to continue visiting or attract new visitors, or whether it would be shared by visitors and

[4] The dissertation refers to these as "cancellations," although they are better thought of as losses since the survey question did not ask whether someone would have cancelled a trip they had already booked, which is a more dramatic action than simply choosing to go to another beach or doing something else in the first instance.

landlords. Had the dissertation measured trip gains, it would have measured gains in consumers surplus, which would work their way through the markets in a similar fashion, albeit in the other direction. Finally, it should be noted that these are "stated preferences" rather than "revealed preferences" that have been observed, for example, in actual markets in response to the Block Island offshore wind power project.

The dissertation does provide data on whether a trip would be made better or worse by the presence of offshore wind turbines (1). When the turbines are 15 miles from shore, the net effect is zero. Beyond 15 miles, the net effect is positive. If those individuals who indicated "somewhat better" or "somewhat worse" are excluded, and the analysis is confined to only those who selected "better" or "worse," the equilibrium point is even closer, about 14 miles from shore. See Dissertation Figures 6.1 and 6.2. In addition, it is important to recognize that in addition to distance, the angle of view also may be important—that is, if the project is directly offshore or whether it is to the north or south of the viewer.

Finally, on a related note, I attach a memorandum I recently prepared for the Delaware Offshore Wind Working Group ("Summary of Public Opinion Surveys 2006-2015: Development of wind power off of Delaware's coast"). It summarizes the opinion of Delaware residents of offshore wind power over the past decade. Support for offshore wind power in 2006 was at high levels and has increased since that time. This is true statewide, among coastal residents, and among those with a view of the ocean in Delaware.

Although not reported there, the 2015 survey also measured opinions of Maryland residents. It finds (unpublished) 87% support statewide, 78% support among those who live in census tracts or block groups bordering the ocean, and 73% support among those who will have a view of the project from their home. As we have seen in a published nationwide study[5] of land-based wind projects, supporters and opponents (on average) tend to speak up in approximately equal numbers at meetings, although supporters of local wind projects tend to vastly outnumber opponents (again, on average).

I would like to close by thanking the Committee Chairs and Members for providing me with the opportunity to submit this comment and provide some context and for your thoughtful consideration of the same.

[5] Firestone, J., Hoen, B., Rand, J., Elliot, D., Hubner, G., & Pohl, J. 2017. Reconsidering Barriers to Wind Power Projects: Community Engagement, Developer Transparency and Place *Journal of Environmental Policy & Planning*, DOI: https://doi.org/10.1080/1523908X.2017.1418656, pre-print available at https://emp.lbl.gov/publications/reconsidering-barriers-wind-power.

Summary of Public Opinion Surveys (2006-2015): Development of wind power off of Delaware's coast

By: Jeremy Firestone

December 5, 2017

Executive Summary

In a series of surveys of pubic opinion since 2006, Delawareans overwhelmingly supported offshore wind power development, with percentages approaching 90%. This was true as well for Delawareans who live along the coast. In addition, support among those with an ocean/project view approached 70%. This contrasts with public opinion in the state being split more generally (e.g., 2016 Presidential election). Importantly, offshore wind power opinion remained high (and even increased) after the Bluewater Wind Power Purchase Agreement (PPA) was approved—a PPA that was more expensive on a per-kWh-basis than the recently accepted bids by Maryland (Deepwater Wind/Skipjack and US Wind).

1. Background. In 2008, four state agencies and the General Assembly approved a PPA between Bluewater Wind and Delmarva after an unprecedented show of citizen support for offshore wind. According to a master's thesis by Jacki Piero, during the proceedings, 429 individuals submitted unique comments supporting offshore wind power compared to 77 who submitted unique comments opposing offshore wind power. Additionally, approximately 2000 individuals submitted form or solicited letters in support of offshore wind power.

What did the regulators and legislators approve? They approved a 25-year, 200 MW PPA that included separate prices for energy, capacity and RECs, and an annual escalator. The all-in blended price was $120.92/MWh in 2007$. Taking this forward, with the 2.5% escalator, the price would have been $179.51/MWh in 2023$, which is higher than the $2023 OREC price for Skipjack approved by Maryland. Assuming a 2015 start for Bluewater, the Bluewater PPA would have been $70MWh more than Skipjack in 2040 given the OREC price escalates by only 1% a year. Moreover, Bluewater Wind PPA was a 25-year contract, which all other things being equal, would result in a lower per-MWh price than a 20-year contract—the length of the OREC. Finally, Bluewater Wind was awarded an additional 2.5 RECs for each MWh generated that it could then sell on the market.

2. Public Opinion Surveying. There have been four surveys of Delaware residents' public opinions regarding offshore wind power: 2006, 2009, 2013 and 2015, the first of which was undertaken before Bluewater Wind's bid on the request for proposals. The surveys are described and the results summarized in Table 1. Trends can be seen in Figure 1. Each survey was accompanied by photomontages that depicted how the wind projects were expected to look and instructions on how to view them so that they would provide a realistic representation. The survey respondents were drawn from random samples and the results weighted by strata (area) and demographic characteristics such as age, sex, and education, to reflect the population as a whole.

The surveys found consistent high levels of support among Delaware residents, with statewide support varying from 78% to 89%, with a trend toward higher levels of support over time. While support was slightly less in census tracts that border the ocean, it shows even more dramatic increases over time from 65% in the 2006 to 77% in 2009 to 83% in 2013 to 86% in 2015. Support was high even among those with an ocean/project view—55% in 2006, 68% in 2009, 89% in 2013, and 74% in 2015. Interestingly, the public opinion data were not affected in any substantial way by distance of the proposed or hypothetical project from shore. In sum, while public support was high at the time the Bluewater project was being considered, it was higher in the year after its approval, and was even higher in 2013 and 2015.

Interestingly, residents also expressed a willingness to pay premiums to move the turbines further from shore, although after about 6 to 9 miles the public was not willing to pay additional amounts (The Bluewater Wind project was to be sited about 13 miles from the coast). Finally, tourism effects are likely small and may even be positive. For a hypothetical project at 14 miles from shore, 94% of out-of-state tourists indicated that they would continue going to the same beach and another 4% to another Delaware beach while 66% were somewhat or very likely to take at least one curiosity trip to a different or new beach to see the wind turbines and 44% were somewhat or very likely to take a boat tour.

Table 1. Summary of Delaware offshore wind power survey results

Survey Year	Peer Reviewed	Viewed Images	Survey Size	Survey Description	Pertinent Findings
2006	Yes	Yes	935	Random sample of Delaware residents regarding hypothetical project located six miles from shore with coastal residents oversampled	**Support** 1. 78% statewide 2. 65% border the ocean 3. 55% if ocean view **Distance from shore** 1. Willing to pay more for offshore wind power if turbines further from shore, although little benefit beyond 6-9 miles. 2. Prefer offshore wind over natural gas or coal expansion somewhere in Delaware if turbines greater than 1 mile from the beach
2007	Yes	Yes	1076	Random sample of **out-of-state tourists** on Delaware beaches and boardwalks	1. 86% says offshore wind power should be allowed or encouraged; another 6% tolerated and only 3% prohibited 2. At 14 miles offshore, 94% would go to the same beach, 4% would go to a different Delaware beach. 3. 66% somewhat or very likely to visit different beach at least once to see offshore wind project 4. 44% somewhat or very likely to take a boat tour
2009	Yes	Yes	595	Random sample of Delaware residents regarding Bluewater Wind project (13 miles from shore), with coastal residents over-surveyed to increase size	**Support** 1. 80% statewide 2. 77% border the ocean 3. 68% project view **Change in likelihood of support among undecided if project was the first of 300 similar projects** 1. 57% more supportive; 9% less supportive
2013	Yes	Yes	458	Random sample of coastal Delaware residents regarding 6 turbine (30-35MW) project, 3 miles from shore	**Support** 1. 90% coastal support 2. 83% border the ocean 3. 89% ocean view
2015	Not yet submitted for publication	Yes	337	Random sample of Delaware residents regarding 300 MW project in MD Wind Energy Area, 11 miles from the coast, with coastal oversampling	**Support** 1. 89% statewide 2. 86% border the ocean 3. 74% project view

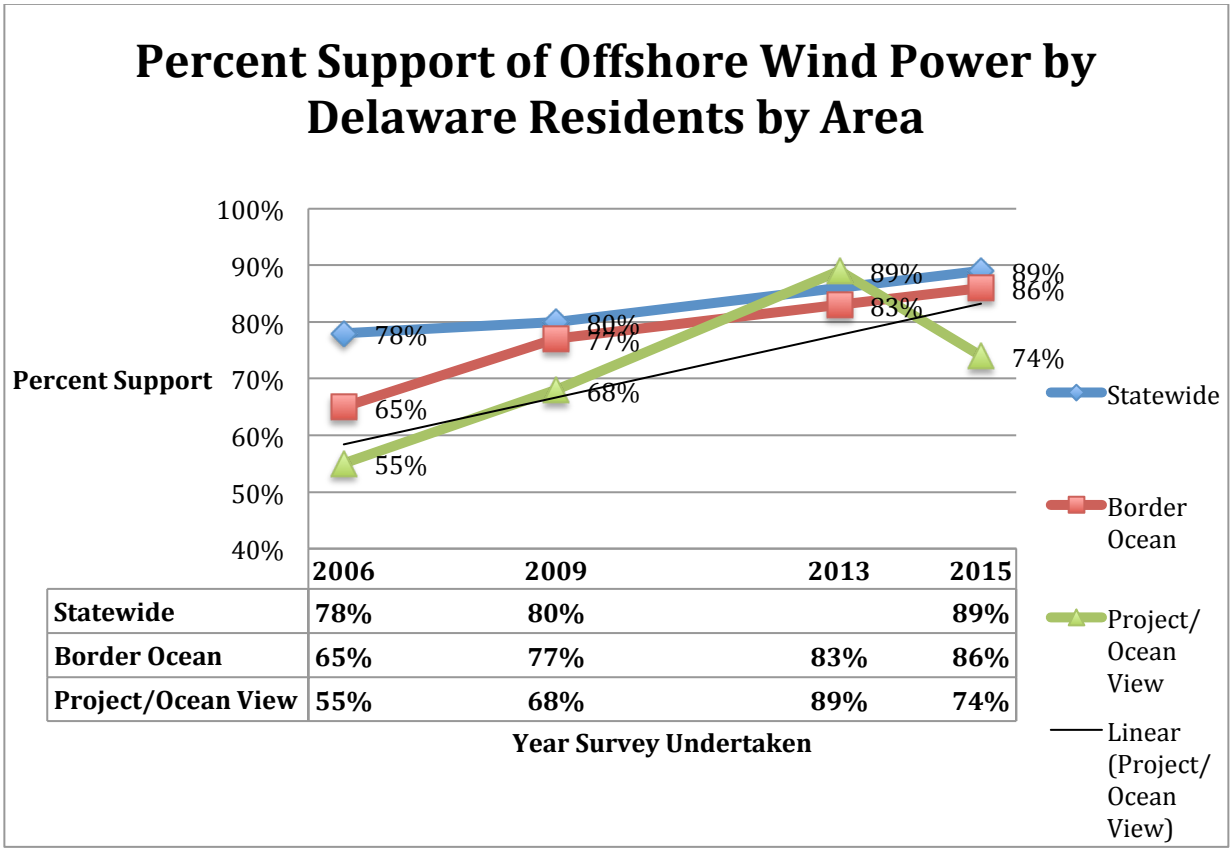

Figure 1. Percent support of offshore wind power among Delaware residents over time: Statewide; in census tracts/block groups that border the ocean; and who have an ocean/project view

3. Other surveys of note. Two other US studies are also noteworthy. First, a longitudinal study of public opinion of residents proximate to the United States' first and only operating offshore wind project found high public support (83-88%) (Project A below). Second, a national study found residents who live proximate to US land-based wind power projects would rather live near their local project than (a) a coal, natural gas or nuclear facility (by approximately 20:1) and (b) a commercial-scale solar project (by more than 4:1) (Project B below). The wind power project(s) characteristics, the research characteristics, and pertinent results are summarized next.

A. Block Island Offshore Wind Project

- Project Characteristics
  - Only operating offshore wind project in the United States
  - Located 16 miles to the mainland Rhode Island coast; 3 miles to Block Island
  - 30 MW total (five, 6MW General Electric wind turbines)
  - PPA between National Grid and the developer
    - Price: 24.4 cents/kWh in year 1, increasing at 3.5%/year for 20 years
      - Price in year 20 is over 48 cents/kWh.
      - Does not include cost of transmission between Block Island and mainland Rhode Island
- Research Characteristics
  - 420 Block Island and coastal Rhode Island respondents to a longitudinal study
    - First survey in 2016 prior to wind turbine installation
    - Second survey in 2017 after project commissioning/operation commenced
  - Publication Status: Manuscript undergoing peer review

- Pertinent Results

Table 2. Level of support for Block Island Offshore Wind Power Project

	Pre-installation	**After operation commenced**
Block Island, Rhode Island	82.9%	82.6%
Mainland (coastal) Rhode Island	88.1%	87.6%

B. National land-based wind survey

- Project Characteristics
  - US project with one or more wind turbines (a) with a nameplate capacity of at least 1.5MW; (b) that is at least 364 feet high and (c) installed through 2014
    - These projects cumulatively represent 50GW of installed capacity

- Research Characteristics
  - Study led by US DOE Lawrence Berkeley National Lab
    - Jeremy Firestone served as a consultant
  - Sample: People living within 5 miles of a "qualifying" US wind power project
  - Survey undertaken in 2016
  - 1705 individuals competed the survey
  - Status: Manuscript submitted for peer review. Re-submitted after only very minor modifications requested

- Pertinent Results

Table 3. Among residents who had moved into their home prior to project construction, do they prefer living near their local project or living near a coal, natural gas, nuclear or commercial-scale wind facility (no preference omitted)

Other Project	**Prefer local wind power project**	**Prefer Other**
Coal	91%	4%
Natural Gas	89%	4%
Nuclear	84%	6%
Commercial-scale solar	52%	14%

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