

**COMMONWEALTH OF MASSACHUSETTS
ENERGY FACILITIES SITING BOARD**

Petition of Vineyard Wind LLC Pursuant)
to G.L. c. 164, § 69J for Approval to)
Construct, Operate, and Maintain)
Transmission Facilities in Massachusetts) **EFSB 17-05/18-18**

**FINAL COMMENT ON PETITION OF VINEYARD WIND LLC
PURSUANT TO G.L. c. 164, § 69J**

In EFSB/DPU 18-18 and 18-19, Vineyard Wind (VW) asks that the Energy Facilities Siting Board (EFSB) approve its plan to interconnect its offshore wind turbines with cables and related onshore facilities. In its Filing, VW presents alternate cable landing, routing and grid termination locations, and proposes landfall on Cape Cod. We are submitting a Final Comment in which we express support for the project but recommend that EFSB give stronger consideration to landfall at Brayton Point. As background, the Independent Evaluator (IE) Report (Peregrine, August 2018) identified VW as the preferred initial offshore wind bid under the “Green Communities Act” (Section 83C of Chapter 188, the “Energy Diversity Act”). The IE Report provides only limited data for competing bids. The margin of VW’s winning bid was *apparently* due to two effects the use of the current Federal Investment Tax Credit Act (ITC) which expires in 2020, and VW’s proposal for grid interconnection on the Cape rather than at Brayton Point. An Amended Second Comment was submitted on Nov. 28, 2018, and added limited text to the Second Comment; these appeared only on the last two pages and were shown in *italics*; this Final Comment adds or edits text to the Amended Second Comment, and these appear in *underlined italics* in the last two pages.

We offer several comments. First, VW has used inconsistent standards to evaluate the desirability of alternate grid interconnection sites. VW rejected grid interconnection at the Barnstable switchyard near Oak Road because termination facilities would be close to nearby residences, However, VW proposed grid interconnection near Independence Drive despite its proximity to an LIHTC (Low Income Housing Tax Credit) project named “Village Green”¹, a school and another rental project. Although the Town of Barnstable did submit initial comments on the potential impact of VW’s proposed grid interconnection near Independence Drive on the Town’s water supplies, the Town did not include the potential impact of these interconnection facilities on the nearby residents. Eversource, the interconnecting transmission grid utility, did

¹ The Town of Barnstable unwisely allowed residential, commercial and industrial zoning in Independence Park which created the background for inconsistent land use and the Barnstable ZBA allowed the Village Green project to proceed as a 40B project although 40B was *clearly* intended to address (i.e., lessen) opposition to the location of low income housing only in *residential* areas, not in commercial and industrial areas. At least initially, neither the Town, EFSB nor VW submitted Data Requests which addressed the impact of the location of VW’s termination facilities on nearby residents.

submit some local data regarding potential risks to the water supply. However, VW and Eversource should use national data (e.g., from NARUC sources) to assess the potential risks to the water supply and to nearby residents.²

Second, VW has not provided the analysis by which it compared transmission grid interconnection costs between Brayton Point and Cape Cod. Brayton Point is the site of a retired coal plant with about 1600 MW take-away capacity at its transmission grid interconnection. ISO-NE apparently has considered this site as a candidate for interconnection for offshore wind. VW dismissed interconnection at Brayton given the longer offshore distance from its BOEM (Bureau of Offshore Energy Management) tract to landfall (although Brayton has a shorter onshore distance), but VW did not provide the details of the comparison. A complete comparison should include the cost of interconnection facilities for *both* onshore and offshore cables.³ VW has apparently not revealed details for its electrical design generally (i.e., turbines and blades) or specifically for its undersea cables and interconnection. A proprietary claim is much weaker for cables and interconnection data than for turbine and blade data. The Federal Energy Regulatory Commission (FERC) requires that a wind turbine must meet several performance standards.⁴ The EFSB should require VW to submit to the public its interconnection comparison data to allow a more open evaluation of VW's analysis of its route selection, given this is the central subject of this hearing.

VW's analysis should have considered both circuit choice and economies of scale. An offshore wind facility faces a choice between transmitting its output from the turbines to landfall using alternating current (AC) or direct current (DC) undersea cables. High voltage DC (HVDC) has a lower variable (cable) cost than High Voltage AC (HVAC) while HVAC has a lower fixed cost, given HVDC requires conversion at line termination. As the distance from the wind farm to landfall increases, HVDC becomes more cost effective (all else equal). One study shows the crossover point occurring at about 75 KM (or about 50 miles).⁵ Moreover, with the size of the VW project, economies of scale rest more in the laying of the undersea cables and less in interconnection facilities or cables themselves. VW likely included these considerations in its analyses and the EFSB should order them provided to the public.

Third, the IE analysis recognizes the test in Section 82C which requires that for a contract to be accepted in a subsequent solicitation it must have a lower levelized price:

² The Town has recently filed a "host" Agreement with VW which addresses the impact of the release of toxic chemicals on the Town's water supply. However, the Agreement is not explicit on the responsibility if a leak occurs, particularly if caused by faulty construction. VW agrees to pay The Town to be a "host" community; but given the Town's concern for its water supply, those funds should be used, if necessary, to reinforce construction and prevent leakage or if necessary supplement the decommissioning fund for hazardous waste disposal after shutdown. The Agreement also attempts to preclude use of VW's onshore transmission capacity to serve potential wind turbines sited in Nantucket Sound but it is not clear that the drafting will survive a challenge under FERC's *Alta* Decision 134 FERC 61, 108.

³ Eversource referenced but refused access to even a redacted version of the Interconnection study.

⁴ FERC Standard Large Generator Interconnection Procedures, Appendix 6 LGIA, Article 9 generally and Article 9.6 on plant-based Reactive Power specifically. There are alternative designs for a Double Fed Induction Generator (DFIG) wind turbine generator to maintain low voltage ride through (LVRT). Tohidi and Behnam, "A comprehensive review of low voltage ride through of doubly fed induction wind generators," *Renewable and Sustainable Energy Reviews* 2016, vol. 57, p 412.

⁵ Van Eckhout, et.al, "Economic Comparison of VSC HVDC and HVAC as Transmission System for a 300MW Offshore Wind Farm", *European Transaction on Electrical Power*, 2009, vol. 10,p. 359.

A staggered procurement schedule developed by the department of energy resources, if applicable, shall specify that a subsequent solicitation shall occur within 24 months of a previous solicitation; provided, however, that the department of public utilities shall not approve a long-term contract that results from a subsequent solicitation and procurement period if the levelized price per megawatt hour, plus associated transmission costs, is greater than or equal to the levelized price per megawatt hour plus transmission costs that resulted from the previous procurement. (MA. Green Communities Act, Section 83 C (b).)

This provision does not define “transmission” costs. In power market regulation, “transmission” usually means capacity under FERC jurisdiction although this legislative usage here is likely informal and refers to generic “transmission costs” of cable which connects the wind farm to the transmission grid. However, even if the latter interpretation applies, a successful future bid must at least bid to offset the effect of the current Investment Tax Credit.

The net effect of these factors was that the cost of a future 400 MW offshore wind project (2025 in-service date), including the cost of the generator lead line, was forecast to be *about the same* as that of Vineyard Wind’s 400 MW proposal in real levelized \$/MWh. (IE, p. 22). (Emphasis added.)

Thus, the IE concludes there is an *even* chance that a future bidder will not meet this test and that the IE should have strongly considered accepting bids in this solicitation for the full 1600MW.⁶

Fourth, the IE substituted market analysis for bidding contrary to Section 83C. Section 83 requires that the DPU and the Department of Energy Resources (DOER) oversee the evaluation of the offshore wind bids. To reduce the appearance of a conflict of interest if an affiliate were to bid, the DPU contracted with the Independent Evaluator (IE) to oversee the bidding process. The IE, in turn, subcontracted with TCR (Tabors, Caramanis, Rudkevich) to evaluate the future power market and grid interconnection; TCR, in turn subcontracted with Mott MacDonald to evaluate future wind power costs. (It is not clear if there was an open bidding process to select Peregrine, TCR or Mott MacDonald and it is not clear if the IE solicited input from the National Renewable Energy Laboratory, NREL.) The DPU and the IE conducted a workshop to develop the rules for the bidding process (Report, DPU 17-32). Many comments revealed the complexities of the bidding process and specifically asked that the DPU make the evaluation criteria and their weighting more explicit, but the DPU refused (p. 65) which increased the inefficiency of the bidding process. Bidders were to submit a purchased power agreement (PPA) proposal for a single generation lead Line (GLL) project and an expandable transmission network (ETN) bid alone or with others (including a transmission provider) to meet all or part of 1600 MW objective of Section 83C. Selected passages from the IE Report reveal some of the complexity of evaluating the bids:

Providing the basis for making, or not making, a determination, as set forth in RFP Section 2.4, that “a larger-scaled proposal is both superior to other proposals submitted in response to this RFP and is likely to produce significantly more economic net benefits to ratepayers compared to the alternative of procuring the additional MWs in a future solicitation after taking relevant risks into consideration... Development of the quantitative evaluation protocol and base case took place over several months. It was decided that the base case would include 800 MW of OSW generation with in-service dates of 2027 and 2029. This was based on expected third and fourth tranches of

⁶ This provision that the accepted levelized cost in a subsequent solicitation be no greater was likely included to address not only the expected decline in offshore turbine costs (which has occurred in onshore turbine costs) but also to limit potential market power given the requirement to meet the 1600MW target of offshore wind capacity and the large BOEM tract size which limits the potential number of competitors.

OSW procurement of 400 MW each under 83C. Tranches 3 and 4 of 83C OSW generation were assumed to be interconnected at Brayton Point in the base case. However, the evaluation protocol specified that “[t]his assumption will be revised if the model runs do not produce fair and reasonable results.

(IE Report p. 11)

The phrase “fair and reasonable results” does not follow directly from mathematical modeling.

In order to incorporate this approach, the Evaluation Team would develop cost estimates translated to \$/MWh of future costs of 400 MW of OSW generation that would be procured in a second 83C solicitation. This would involve consideration of future projections of costs from a variety of sources, the cost and generation profiles of bids submitted in the 83C solicitation and the impact of a phase-out of the ITC applicable to OSW generation. Importantly, the starting point for the projected costs and performance of the Tranche 2 proxy unit would be based upon the characteristics of the most favorable 400 MW bid received (initially, the lowest unit cost of energy and RECs bid and, at the end of Stage 2, the highest ranked 400 MW bid, if different) adjusted by agreed upon estimated improvements in offshore wind capacity construction costs and performance. As part of this effort, the Evaluation Team would also estimate the cost of the generator lead line associated with the Tranche 2 OSW project. (IE Report, p. 12)

The indirect benefits (or costs) associated with a proposal included: The impact of changes in LMPs (locational marginal prices) to Massachusetts Distribution Company customers as a result of the proposed project (or portfolio of projects) ⁷; The cost reductions to Massachusetts EDC customers in RPS/CES compliance costs due to reductions in REC/CEC market prices as a result of purchases of RECs/CECs from the proposed project (or portfolio of projects); The net value of a proposal's contribution toward meeting GWSA requirements over and above the value of compliance with RPS and CES (IE Report p. 14)

Moreover, it was uncertain how any decision in this solicitation would affect the selection of future generation and build out of transmission. The uncertainties associated with this comparison caused consternation among members of the Evaluation Team. It was even suggested that the Evaluation Team not complete the evaluation of the expandable transmission proposals. (IE Report p. 22)

These statements from the IE Report reveal the considerable uncertainty in its analysis because the analysis was tasked to predict not only future market conditions and transmission states but also future offshore wind bidding. Section 83C (b.) refers to a “competitive bidding process” to acquire offshore wind resources, and does not refer to a study to supplant the bidding process. It states that the “method for solicitations of long-term contracts shall be proposed jointly by the distribution companies and DOER using a competitive bidding process, and shall be subject to review and approval by the department of public utilities”. In Section 83C (e.) the DPU has the responsibility of review: to “consider” the “costs and benefits” of any contract and approve if “cost-effective” although the effectiveness is left undefined. Neither the DPU nor the IE has the authority to supplant the bidding process with a study but that is what they did. This occurred because the bidding process was improperly designed. With the relatively short horizon of the

⁷ LMPs or locational marginal prices are notoriously difficult to forecast. The Report could be referring to a negative LMP if offshore wind could generate output which exceeds the grid's ‘takeaway’ capacity at the interconnection point(s), but the Report does not reconcile this with any ISO-NE DNE (Do Not Exceed) rule for wind. In any event, LMPs should over an extended period (year) net-out over the grid in the absence of consistent under-bidding for financial transmission rights so the Report should explain this conclusion.

ITC and the uncertainty of the outcome of future “solicitations”, the DOER and the Electric Distribution Companies (EDCs) should have employed recognized experts in auction design which would have made it more likely than not that this initial solicitation revealed the market value of offshore wind from 2018 through 2027.⁸

Fifth, the IE simulated the effect of accepting or deferring acceptance of bids which did not resolve the uncertainties. The IE Report states that TCR used a proprietary model, Enelytix, offered by Newton Energy, whose website offers only summary PowerPoint descriptions.⁹ The IE should have prepared a report (if necessary redacted) which explains the methods and assumptions of this modeling which includes the details of the cost and conditions of grid interconnection.

The IE Report states its conclusions regarding wind deliveries at Brayton Point:

Another important issue was the assumed location of the delivery point for Tranche 3 and 4 generation for each of the GLL proposals. The quantitative evaluation protocol provided that Brayton Point would be the assumed point of interconnection with the onshore grid, but allowed the Evaluation Team to revise the assumption in order to produce fair and reasonable results. As it turned out, proposed delivery at Brayton Point. In order to avoid what would likely be unrealistic—injecting all or almost all of 1600 MW of OSW generation at Brayton Point—and the accompanying congestion, which would be unfair to the evaluation of, it was decided that the Tranche 3 and 4. OSW generation for all the proposals would be assumed to be spread out over the SEMA/RI region generally, rather than being delivered at Brayton Point. However, this caused significant congestion when evaluating the Vineyard Wind 800 GL, which proposed delivery at Barnstable on Cape Cod. It was considered likely that after injecting 800 MW on Cape Cod that additional OSW generation would be injected off-Cape at locations, such as Brayton Point. Hence for these Vineyard Wind proposals, the Evaluation Team reverted back to Brayton Point as the delivery point for Tranches 3 and 4. For the other ETN proposals, the points of onshore interconnection for Tranches 3 and 4 would be based on the bidder’s proposals— for Vineyard Wind, for Bay State Wind, and for Revolution Wind. (IE Report, p. 22-23)

This discussion is odd. First, it refers to “fair and reasonable results”, which is not a conclusion which comes from a production costing model like Enelytix. Second, it refers to a delivery of “all or almost all of 1600MW of OSW (offshore wind) generation [delivered] at Brayton Point” as “unrealistic”, but does not provide support. Third, it refers to “congestion” but does not identify

⁸ For example, in allocating spectra, the FCC used experts such as Paul Milgrom of Stanford. Like other ISOs, ISO-NE conducts a Forward Capacity Auction (FCA) which uses a combined declining clock auction (DCA) with sealed bids to address potential market power. A wind capacity auction including transmission could use more than one bid round with standard rules for inter-round bid improvement and no late entry between rounds with the *objective* of acquiring a commitment to the full 1600 MW in the initial solicitation. A more complex auction design could allow a second phase with stepped delivery horizon and/or joint bids to encourage ETN cost minimization.

⁹ By *inference* from these PowerPoint presentations, Enelytix is a production costing model which optimizes dispatch for a period (e.g., a peak hour) or sequence of periods from a database of generation resources (both renewable and non-renewable) and demand. It is unclear how the model treats uncertainty: does it apply a multivariate sampler (e.g., Gibbs) across a set of stochastic distributions of outage, renewable availability, demand, etc. or does it use fixed forced outage rates and input prices? The extent of grid detail is also unclear: its graphical representation of the WSCC for its review of California’s SB350 to export renewable power suggests that the model uses a highly simplified grid representation so a LMP (locational marginal price) does not reflect Day Ahead information asymmetry, but instead apparently reflects a ‘long’ term cost difference across a regional inter-tie (major interconnection) but in the case at hand, it is not clear how this occurs. Also, the IE Report does not describe how TCR simulations differ from those of ISO-NE for the SEMA/RI area.

the specific cause. Fourth, spreading delivery out over the SEMA/RI area will increase the interconnection cable cost. Thus, the conclusions are either incomplete or unjustified; the IE Report should have provided sufficient detail to support its conclusions.

However, there is a broader point. The analysis was difficult given the objectives stated in Section 83C are often phrased in ways which can be conflicting and not readily measured.

The prime example of vague standards is the following from Section 83C (d) (5):

“a developer under the proposal meet the following criteria: (i) provide enhanced electricity reliability; (ii) contribute to reducing winter electricity price spikes; (iii) are cost effective to electric ratepayers in the commonwealth over the term of the contract, taking into consideration potential economic and environmental benefits to the ratepayers; (iv) avoid line loss and mitigate transmission costs to the extent possible and ensure that transmission cost overruns, if any, are not borne by ratepayers

Simply adding capacity, even if intermittent renewable, *could* satisfy such vague standards.

Moreover, Section 83 C (c) offers an economic test which seems clear, “the contracts shall...not increase costs” but the definition of “increase” is relative: does it mean that the contract price of the offshore wind generation should be less than the current book cost of generation or less than the cost of generation which offshore wind displaces in a future period? (If so, what is the extent of *actual* displacement given the increasing requirement for renewable energy?)

distribution company shall take all reasonable actions to structure the contracts, pricing or administration of the products purchased under this section in order to prevent or mitigate an impact on the balance sheet or income statement of the distribution company or its parent company, subject to the approval of the department of public utilities; provided further, that mitigation shall not increase costs to ratepayers.

(In the extreme, it is possible that this language is meant to impose a price cap on the cost of the EDC’s power supply, but that seems an unlikely interpretation.) Effectively, there are no clear standards to accept or reject any specific proposal in Section 83C.

Sixth, the above analysis shows the uncertainty in the IE analysis of future bidding and the lack of clear standards in Section 83C. The above analysis also reveals that the lapse of the current ITC will likely raise the price of future bids. *To reinforce the point made earlier about the extent of potential for future competition in a bid competition to supply electric energy from offshore wind facilities, the limited number of BOEM lease tracts implies a limited number of potential bidders to supply offshore wind which will likely imply higher prices in future bidding.* Moreover, it appears that terminating offshore wind at Brayton Point will yield economies of scale at least in the laying of cable from more than one BOEM tract south of Marth’s Vineyard.

*In its filings, VW alleges cost disadvantages of making its interconnection at Brayton Point without providing detailed cost information to support its position; but in these filings, VW also notes that other offshore wind energy bidders from adjacent BOEM lease sites could find such interconnection attractive and does not explain this apparent inconsistency. (VW does **not** claim that the IE bid rank ordering changes if VW bears the additional cost to terminate at Brayton Point.) The EFSB should require VW to submit a cost comparison which includes offshore cable laying costs and compares the total of both onshore and offshore cabling costs as well as a comparison of AC versus DC offshore cabling. In its data request response on the issue of the Brayton Point interconnection, VW does not indicate that other parties supersede VW in the*

*interconnection queue at Brayton Point.*¹⁰ As a result, the EFSB should consider accepting the VW application conditional on DOER and DPU approaching the non-accepted bidders in this solicitation (2017-8) and assessing the current availability of their proposals in order to consider negotiating the acceptance of some or all of their remaining bid capacity, particularly given that the value of *some other* bids (e.g., 2-4) in the Appendices of the IE Report appears competitive with VW, *all to terminate at Brayton Point.*

*Seventh, before entering a host agreement with VW, the Town of Barnstable submitted Testimony which included the Testimony of Anne Marie Petricca, Director of Geosciences, Environmental Partners Group, Quincy, MA. This Testimony raised several issues with respect to the potential for contamination of the Town's water supply through leakage of the dielectric fluid which VW proposes to use to cool its transformers at its substation. Such contamination could affect the water supply of the Town of Barnstable and possibly other towns on the Cape, given that the entire Cape relies on a single aquifer. Unfortunately, the Town withdrew this Testimony after signing the host agreement with VW, which includes the payment of funds to the Town which could be used to drill wells 'upstream' of the VW substation. VW sponsored a witness, Dr. Peter Zeeb, who disputed many of the assumptions, analyses and conclusions of the Town's witnesses, including Ms. Petricca. Dr. Zeeb stated catastrophic plant failure, releasing all of its dielectric fluid is very unlikely. Also, given the properties of the dielectric fluid (i.e., its relative density, its non-miscibility in water, its viscosity) and the nature of the soil and soil structure, its soil diffusion rate is low, less than ten percent of water, which implies that if released into the soil, the fluid would reach the nearby Mary Dunn well in "between 50 to 500 years" according to Dr. Zeeb (Testimony VW PZ- 1, p. 17); and that if the fluid did reach a well, treatment with granular activated carbon is possible. This stark difference in testimony supports the value of full litigation. (Note that both Ms. Petricca and Dr. Zeeb refer to the occurrence of a one in one hundred year rainfall event as if that were necessarily a well-defined value; it is **not**, given model and parameter uncertainty.¹¹)*

Finally, under Section 93C, the DPU and DOER with the EDCs designed the solicitation while the DOER and the Attorney General chose the IE who evaluated the bids and identified the winning bid of VW using vague Section 83C standards subject to considerable forecast uncertainty. Now the EFSB, which is part of the DPU, is reviewing the facility proposal of VW. There is a clear lack of independence in this review process. *Moreover, acceptance of the VW application to interconnect at the Barnstable switchyard, rather than Brayton Point, uses a two bay 'excess' capacity at the Eversource interconnection, which VW notes was available for a provider such as CapeWind proposing to install wind turbines in Nantucket Sound. VW's use of these bays likely increases the cost of interconnection for a successor to CapeWind which reduces the likelihood of wind turbines in Nantucket Sound which eliminates the political contention CapeWind created and implies FERC will not disallow inclusion of that investment in the Eversource rate base.*

In conclusion, the Commonwealth can add value to this process by simplifying it as described above if it aggregates offshore bids from this initial round to meet its 1600MW objective and then applies its strategy of working with one transmission provider (as with Hydro Quebec imports) to connect aggregated bids from the BOEM lease boundary to landfall at Brayton Point.

¹⁰ A request to ISONE on this last point of queue size at Brayton Point went unanswered.

¹¹ "Anticipating Catastrophes through Extreme Value Modeling" Coles et.al. *Applied Statistics* 2003 p. 405. Coles is among the most prominent statisticians publishing in the area of extreme value modeling.

This strategy realizes economies at least in laying cable and dominates separate provision of transmission.

We are strong supporters of renewable power to lower the emission of greenhouse gases. The comments here oppose the acceptance of *only* the VW bid and selection of a Cape Cod landfall.

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