and pull back the transmission line would be located in a transition vault on New Hampshire Avenue, adjacent to the Englewood Beach recreation area (Exhs. CW-1, at 1-8; EFSB-L-31).

The Company estimated that the L_{max} for the HDD would be 78 dBA at 50 feet,[109] and that the average sound levels ("L_{eq}") would be approximately 73 dBA at 50 feet, and 61 to 67 dBA at 200 feet (Exh. EFSB-L-31). The Company estimated that, absent mitigation, L_{max} noise levels at the closest residence to the northwest would be 79 dBA, and L_{max} noise levels at the closest residence to the southwest would be 77 dBA (Exh. EFSB-RR-29).[110]

The Company stated that, if it were to use HDD at the New Hampshire Avenue landfall, it would use good engineering practices, such as sound barriers, to mitigate noise impacts in a reasonable manner (Exh. EFSB-RR-31). The Company stated that a typical sound barrier, such as those used in highway sound attenuation, is solid wood and 10 feet high (id.).[111] It estimated that the use of sound barriers could reduce L_{max} noise levels from 79 dBA to 74 dBA at the nearest residence to the northwest, and from 77 dBA to 69 dBA at the nearest residence to the southwest (Exh. EFSB-RR-29).

iv. Analysis

In its initial filings in this proceeding, Cape Wind indicated that it intended to use horizontal directional drilling at the New Hampshire Avenue landfall in order to minimize impacts to coastal wetlands in the near-shore area. Since that time, the Company has concluded that any reduction in impacts to coastal wetlands would be outweighed by significant traffic and noise impacts on New Hampshire Avenue residents. The Siting Board agrees with this conclusion. Most of the wetland impacts that would result from jet plowing at the New

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109 The Company noted that the sound levels for the HDD rig are comparable to those for the excavators and backhoes (80 to 84 dBA at 50 feet) (Exhs. EFSB-L-31; EFSB-SS-22-S, Att. at 5-124).

110 The Company noted that noise impacts at the residences were modeled for a second floor window (Exh. EFSB-RR-29).

111 The Company stated that the average cost of materials and installation for a sound barrier is \$140 per linear foot for a 10-foot high wall; \$185 per linear foot for a 12-foot high wall; and \$235 per linear foot for a 14-foot high wall (Exh. EFSB-RR-54).

Hampshire Avenue landfall site, described in Section III.C.2.a, above, would be temporary; moreover, the coastal bank that would be left undisturbed if HDD techniques were used is a man-made concrete wall with limited ecological value. The noise and traffic impacts on New Hampshire Avenue residents, on the other hand, would be significant.

The record indicates that use of HDD at the New Hampshire Avenue landfall would result in the four-to-six week closure of a portion of New Hampshire Avenue that is more heavily traveled than the smaller, southern portion that would be closed for construction of the transition vault using the jet plow method. Further, a recreation area and two residences front onto the transition vault location; direct access to these properties would be blocked or limited during construction.

In addition, for four to six weeks, residents would be affected by continuous nighttime construction noise, based on an expected 20-to-24 hour construction day, at a noise level comparable to that generated by a backhoe or excavator. The Company has estimated that the use of a 10-foot high noise barrier would reduce expected noise levels by 5 dBA to 8 dBA, depending on the distance from the transition vault. However, even with the use of the sound barriers, the resultant L_{max} noise levels would range from 69 dBA to 74 dBA at the nearest residences for nighttime construction.

Given the significant disruption that would be associated with use of HDD at the New Hampshire Avenue landfall, the Siting Board cannot find, on this record, that construction traffic and noise impacts would be minimized along the primary route if HDD were used to make landfall. Should the Company choose, either for technological reasons or because of restrictions imposed by another agency, to pursue use of HDD at the New Hampshire Avenue landfall, additional proceedings before the Siting Board would be required to determine whether and how that approach could be undertaken consistent with minimizing noise and traffic impacts. Specifically, to allow use of HDD to achieve landfall at New Hampshire Avenue, the Siting Board would require the Company to make a project change filing, providing: (1) an analysis of both existing and predicted construction period L_{eq}, L_{90} and L_{max} noise levels at affected residences, and proposed and possible mitigation to minimize residential noise impacts; and (2) an analysis of proposed and possible mitigation to minimize traffic impacts on residents, particularly for those homes in close proximity to the transition vault. Necessary mitigation might include: (1) for noise, the use of noise barriers of different heights and widths or temporary enclosures surrounding the HDD operations, and limitations on hours of nighttime construction; and (2) for traffic, development of an ingress and egress plan, including detailed notification procedures that would be applied in advance of the construction period, and specific measures addressing the residences located on New Hampshire Avenue between Shore Road and Berry Avenue.

e. Conclusions on Environmental Impacts

In Sections III.C.2.a, III.C.2.b, and III.C.2.c, above, the Siting Board has reviewed the record evidence regarding the marine construction impacts, the land-based construction impacts, and the permanent impacts of the proposed transmission lines, and has imposed mitigation where necessary to minimize the environmental impacts of the proposed transmission lines. Based on its review of the record, the Siting Board finds that Cape Wind has provided sufficient information regarding environmental impacts and potential mitigation measures to allow us to determine that it has achieved the proper balance among environmental impacts.

In Section III.C.2.a, above, the Siting Board found that, with implementation of the stated conditions, the marine construction impacts of the proposed transmission lines along the primary route would be minimized, and that the primary route would be preferable to the alternative route with respect to marine construction impacts. In Section III.C.2.b, above, the Siting Board found that, with implementation of the stated condition, the land construction impacts of the proposed transmission lines along the primary route would be minimized, and that the primary route would be preferable to the alternative route with respect to land construction impacts. In Section III.C.2.c, above, the Siting Board found that the permanent impacts of the proposed transmission lines along the primary route would be minimized, and that the primary route would be preferable to the alternative route with respect to permanent impacts. Consequently, the Siting Board finds that the environmental impacts of the proposed transmission lines along the primary route would be minimized, and that the primary route would be preferable to the alternative route with respect to environmental impacts.

3. Cost

a. Description

The Company initially estimated the cost of the proposed transmission lines along the primary route to be $79,510,000, and the cost of the proposed transmission lines along the alternative route to be $68,610,000 (Exh. CW-1, at 5-67 and Table 4-4). The Company stated that these cost estimates would be subject to refinement as plans for the proposed project are developed (Exh. CW-1, at 5-67). The Company attributed the higher cost of the primary route primarily to the longer length of in-street cable required for that route (id.). However, the Company stated that it considered the costs of the proposed project along the primary and alternative routes to be comparable (id.).

During the proceeding, the primary route evolved in a number of ways that could affect the cost of construction. First, the initial cost estimates assumed an 11-mile submarine cable and the use of HDD at the New Hampshire Avenue Landfall (id. at Table 3-1). As discussed above, the anticipated length of the submarine cable is now approximately 12.2 miles, and the Company intends to use jet-plowing, rather than HDD, at the landfall. The Company asserted that the increased length of the submarine cable would increase costs slightly, but did not provide a revised cost estimate (Exh. EFSB-RR-84).[112] The Company stated that the use of jet plowing rather than HDD at the landfall would reduce costs by approximately $460,000 (Exhs. EFSB-RR-55; EFSB-RR-56).[113]

Second, the initial cost estimates for both the primary and alternative routes assumed the use of two switched shunt reactors, at a cost of $600,000 each (Exh. CW-1, at Table 4-4; Tr. 11, at 1497-1500). However, NSTAR indicated that the proposed transmission line, if built along the primary route, may need additional reactive power compensation in the form of more switched shunt reactors; additional switched shunt reactors would not be required for the

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112 The Company has assumed a cost of $3.7 million per mile for the submarine cable (Exh. CW-1, at 3-4, Tables 3-1, 4-4).

113 In addition, as discussed in Section III.C.2.b, above, the cost of installing a sound barrier at the New Hampshire Avenue landfall in conjunction with the use of HDD could range from $14,000 to $23,500, assuming a 100-foot long wall (Exh. EFSB-RR-54).

alternative route (Tr. 11, at 1495-1500).

The Company stated that it likely would use a jack-up barge, rather than the cable-laying vessel, for cable installation inside Popponesset Bay on the alternative route, due to the shallow and narrow characteristics of Popponesset Bay (Exh. CW-1, at 5-51). The Company stated that the cost estimates for the routes included a built-in cost for specific installation and design difficulties that would affect the cost of installing the transmission lines (id. at 4-28).[114]

Save Popponesset Bay asserted that cable installation through Popponesset Spit and Popponesset Bay would be difficult and expensive (SPB Brief at 3). Specifically, Save Popponesset Bay argued that the shallow waters of Popponesset Bay would make installation difficult and costly, noting that the Company had recognized that installation would be challenging due to the size of the cable-laying vessel and the size and depth of Popponesset Bay (SPB Brief at 4, citing Exh. CW-1, at 4-11, 4-13, 5-51). Save Popponesset Bay asserted that the Company's cost estimates ignored the higher construction costs that would result from the slower rate of installation, mitigation of adverse impacts, and time-of-year restrictions (SPB Brief at 6). Specifically, Save Popponesset Bay pointed to the use of a standard unit price per foot for installation on both routes, which it argued led to an underestimate of the costs associated with installation in Popponesset Bay (id.). Save Popponesset Bay stated that it is not unreasonable to assume that, due to the difficulty of installation in Popponesset Bay, the length of cable installed per day would be half that estimated for the overall route, potentially doubling the cost of cable installation in Popponesset Bay (Exh. SPB-PJW at 4).[115]

In response, the Company stated that it has factored in the appropriate cost estimates for the alternative route (Tr. 10, at 1454-1457). However, the Company acknowledged that unanticipated time-of-year restrictions would add cost to the proposed project (id. at 1454).

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114 Table 4-4 of the Petition lists the following for marine installation costs for the primary and alternative routes: (1) quantity of cable at $3.7 million per mile (landfall HDD included); (2) one 1000-foot HDD for the alternative route at $1.5 million (Exh. CW-1, at Table 4-4).

115 Based on the estimates of the marine portion of the transmission lines along the alternative route, the increase in cost would be on the order of $5 to $6 million dollars (Exh. CW-1, at Table 4-4; Tr. 10, at 1473).

b. Analysis

The Company's initial cost estimates indicate that the cost of constructing the proposed transmission project along the primary route is approximately $11 million higher than the cost of construction along the alternative route. However, the initial estimates of project costs along the primary route appear low in light of later testimony. Specifically, the expected length of the marine portion of the primary route has increased by approximately 1.2 miles from original estimates, likely resulting in additional costs of approximately $4.4 million. Further, the possible need for a third switched shunt reactor could increase the cost of the proposed project along the primary route by an additional $600,000. Partially offsetting these increases, the decision to use jet plowing rather than HDD at the New Hampshire Avenue Landfall should reduce construction costs along the primary route by $460,000. Overall, the cost of the proposed project along the primary route is likely to be approximately $4.5 million higher than the original estimate, or approximately $15.5 million more than the estimated cost of the proposed project along the alternative route.

The Siting Board notes that it is quite likely that the construction cost estimates provided by the Company for the alternative route, through Popponesset Bay and underneath Popponesset Spit, have been underestimated. In particular, the record suggests that the potential difficulties associated with construction through Popponesset Bay and under Popponesset Spit are significantly greater than those likely to be encountered along the marine portion of the primary route. For example, the burial of cables in shallow water between the two HDDs adds complexity to the construction process, and may extend the construction period for that portion of the project beyond what was originally anticipated. Moreover, as discussed in Section III.C.a., above, there is the possibility of seasonal restrictions to protect the piping plover, terns, fish and shellfish during vulnerable time periods. Aside from the cost of the additional HDD, the Company's cost estimates do not reflect such challenges.

Although the increased costs associated with the construction of the proposed project along the alternative route are not known at this juncture, and may be significant, it is not likely that they would approach the approximately $15.5 million difference between the current cost estimates for the two routes. Accordingly, the Siting Board finds that the alternative route is slightly preferable to the primary route with respect to cost.

4. Reliability

a. Description

The Company noted that the primary and alternative routes both provide an interconnection with the Barnstable Switching Station, the main bulk power substation on Cape Cod (Exh. CW-1, at 5-68). However, the Company asserted that the primary route has a reliability advantage over the alternative route, both because it would be entirely underground and because its initial point of interconnection is closer to the Barnstable Switching Station (id.). Specifically, the Company noted that the primary route interconnects directly with the Barnstable Switching Station, while the alternative route interconnects on the Mashpee ROW and then continues for a considerable distance before ultimately delivering power to the Barnstable Switching Station (Tr. 11, at 1515-1517).

The Company asserted that the risk of outages is significantly less on an underground transmission line than on an overhead line, because underground lines are less exposed to the elements (Tr. 11, at 1490). However, the Company noted that when a failure does occur on an underground line, it is more difficult to locate the source of the failure and it therefore may take longer to correct the problem (id. at 1491). Overall, the Company suggested that the primary route, which is entirely underground, is less susceptible to interruptions and thus more reliable than the alternative route (id. at 1506).

The Company noted that the primary route has more miles of underground cable than the alternative route, and thus would supply a higher level of reactive power and require a greater number of switched shunt reactors to compensate for the additional reactive power (id. at 1495). However, the Company stated that, after voltage compensation, the reliability of the system would be the same regardless of whether the primary or alternative route is selected (id. at 1502).

The Company asserted that the reliability of the marine portions of the primary and alternative routes would be essentially the same (Tr. 11, at 1507). Specifically the Company noted that the design, trenching, and installation methodologies for the cable would be the same for either route, and that the same standard repair method would be used along either route (id. at 1507-1508).

As discussed in Section III.C.2.a.ii(b), above, Save Popponesset Bay asserted that Popponesset Spit is susceptible to breaching during severe storms and that a breach at the location of the submarine cable crossing could damage the cable (Exh. SPB-PJW at 7).

b. Analysis

The record shows that underground transmission lines typically experience fewer outages than overhead lines, as they are less exposed to weather and other hazards. However, once an outage has occurred, underground lines may take longer to repair, as it is more difficult to isolate the source of the problem. Thus, the reliability of the underground primary route and the overhead alternative route may not be substantially different. In addition, the record indicates that additional switched shunt reactors may be needed along the primary route to compensate for the higher levels of reactive power produced by the longer underground cables; however, with such mitigation in place, the reliability of the two routes would be similar. Accordingly, the Siting Board finds that the primary route and the alternative route are comparable with respect to reliability.

5. Conclusions on Transmission Line Routing

In Section III.C.2, above, the Siting Board found that the primary route would be preferable to the alternative route with respect to environmental impacts. In Section III.C.3, above, the Siting Board found that the alternative route would be preferable to the primary route with respect to cost. In Section III.C.4, above, the Siting Board found that primary and alternative routes would be comparable with respect to reliability. Based on its review of the record, the Siting Board finds that Cape Wind has provided sufficient information regarding costs, reliability, and environmental impacts to allow the Siting Board to determine whether it has achieved the proper balance between environmental impacts, cost and reliability.

To make this determination, the Siting Board must weigh the environmental advantages of the primary route against the cost advantages of the alternative route. In its analyses in Section

III.C.2, above, the Siting Board identified several key advantages of the primary route over the alternative route. In particular, the Siting Board determined that the transmission lines along the primary route would have no permanent visual impacts, while the twelve-mile overhead segment of the transmission line along the alternative route potentially would be visible from backyards, side yards, and street crossings, and the eight miles of clearing required could increase views of existing transmission lines on the NSTAR right-of-way; that construction in Popponesset Bay would take longer than in Lewis Bay, would potentially affect sensitive barrier beach and estuary areas, and would have a greater potential for impacts on fish, coastal shorebirds, and navigation; and that construction noise and wetlands impacts potentially were greater along the alternative route than along the primary route. In Section III.C.3, the Siting Board was unable to identify the extent to which the costs of constructing the transmission lines along the primary route would exceed those of constructing along the alternative route; however, the differential would not exceed $15.5 million, and likely would be considerably less. Overall, the Siting Board concludes that the elimination of the potential for permanent visual impacts, coupled with lower overall construction impacts both on land and under water, outweighs the less clearly defined cost benefits of the alternative route. Accordingly, the Siting Board finds that the primary route is preferable to the alternative route with respect to providing a reliable energy supply for the Commonwealth with a minimum impact on the environment at the lowest possible cost.

IV. DECISION

The Siting Board's enabling statute directs the Siting Board to implement the energy policies contained in G.L. c. 164, §§ 69H to 69Q, to provide a reliable energy supply for the Commonwealth with a minimum impact on the environment at the lowest possible cost. G.L. c. 164, § 69H. In addition, the statute requires that the Siting Board determine whether plans for the construction of energy facilities are consistent with current health, environmental protection, and resource use and development policies as adopted by the Commonwealth. G.L.c. 164, § 69J.

In Section II.A.4, above, the Siting Board found that, to establish that there is a need for additional transmission resources to interconnect the wind farm with the regional transmission grid, Cape Wind shall submit to the Siting Board copies of all permits required for Cape Wind to begin installation of wind farm equipment in Nantucket Sound.

In Section II.B, the Siting Board found that the Barnstable Interconnect is preferable to both the Harwich Alternative and the New Bedford Alternative with respect to providing a reliable energy supply for the Commonwealth, with a minimum impact on the environment at the lowest possible cost.

In Section III.A, above, the Siting Board found that Cape Wind and NSTAR developed and applied a reasonable set of criteria for identifying and evaluating alternatives to the proposed project in a manner which ensures that it has not overlooked or eliminated any siting options which, on balance, are clearly superior to the proposed project. The Siting Board also found that Cape Wind and NSTAR identified a range of practical transmission line route alternatives with some measure of geographic diversity. Consequently, the Siting Board found that Cape Wind and NSTAR have considered a reasonable range of practical siting alternatives.

In Section III.C, above, the Siting Board found that the primary route would be preferable to the alternative route with respect to providing a reliable energy supply to the Commonwealth with a minimum impact on the environment at the lowest possible cost. The Siting Board also found that with the implementation of the proposed mitigation and conditions, the environmental impacts of the proposed facilities along the primary route would be minimized with respect to marine construction impacts, land construction impacts and permanent impacts.

In Section III.C.2.d, above, the Siting Board reviewed trade-offs of use of HDD in lieu of jet plowing to install the transmission lines at the New Hampshire Avenue landfall along the proposed route. The Siting Board held that, should the Company choose, either for technological reasons or because of restrictions imposed by another agency, to pursue use of HDD at the New Hampshire Avenue landfall, additional proceedings before the Siting Board would be required to determine whether and how that approach could be undertaken consistent with minimizing noise and traffic impacts. Specifically, to allow use of HDD to achieve landfall at New Hampshire Avenue, the Siting Board would require the Company to make a project change filing, providing: (1) an analysis of both existing and predicted construction period L_{eq}, L_{90} and L_{max} noise levels at affected residences, and proposed and possible mitigation to minimize residential noise impacts;

and (2) an analysis of proposed and possible mitigation to minimize traffic impacts on residents, particularly for those homes in close proximity to the transition vault.

In Sections I.C.2 and III.C, above, the Siting Board reviewed the environmental impacts of the proposed transmission lines in light of related regulatory or other programs of the Commonwealth, including programs related to wetlands and riverfront protection, water supply wellhead protection, rare and endangered species, tidelands and waterways, water quality certification, marine fisheries, coastal zone management, ocean sanctuaries, historic preservation, and underwater archeology. As evidenced by the above discussions and analyses, the proposed transmission lines along the primary route would be generally consistent with the identified requirements of all such programs.

Accordingly, the Siting Board APPROVES the proposal of Cape Wind and NSTAR to construct two approximately 18-mile, 115-kilovolt underground electric transmission lines along the primary route identified by Cape Wind and NSTAR. This approval is subject to compliance by Cape Wind and NSTAR with the following conditions:

(A) No wind turbines will be built in state waters.

(B) There shall be no construction in Yarmouth between Memorial Day and Labor Day, unless permission is given in writing in advance by the Town of Yarmouth.

(C) Construction in Yarmouth shall not occur prior to 7 a.m. or after 5 p.m., unless permission is given in writing in advance by the Town of Yarmouth.

Prior to the commencement of construction:

(D) To establish that there is a need for additional transmission resources to interconnect the wind farm with the regional transmission grid, Cape Wind shall submit to the Siting Board copies of all permits required for Cape Wind to begin installation of wind farm equipment in Nantucket Sound.

(E) To minimize marine construction impacts on eelgrass beds, the Siting Board directs Cape Wind to aerially photograph the entrance to Lewis Bay in the month of July, immediately prior to jet-plowing, under conditions conducive to documenting the extent of eelgrass beds, to use the photographs in finalizing the exact location of jet-plowing, and to provide such photographs to the Siting Board. The Siting Board also directs Cape Wind to provide this documentation to the Yarmouth Shellfish Warden. Also, Cape Wind shall file a Notice of Intent with the Yarmouth Conservation Commission and fully consult with the Yarmouth Division of Natural Resources prior to commencing with construction.

(F) To minimize marine construction impacts on protected coastal shorebirds, the Siting Board directs Cape Wind to work with the ACOE, NHESP, and MDMF, and with Mass Audubon, if Mass Audubon wishes to participate: (1) to determine whether seasonal restrictions, or some other protective measures, are appropriate to minimize potential impacts on protected coastal shorebirds and their habit along the primary route and, if so, to develop appropriate seasonal restrictions and/or other protective measures; and (2) to determine whether protected coastal shorebirds should be included in the Company's comprehensive environmental monitoring plan and, if so, to develop an appropriate monitoring protocol. Cape Wind shall file with the Siting Board, prior to the commencement of marine construction, documentation of the seasonal restrictions, any additional protective measures, and any monitoring protocol.

(G) To help ensure that potential navigational impacts on all individuals or groups, including commercial fishermen and recreational boaters, would be avoided or minimized, the Siting Board directs Cape Wind to consult with the Harbormasters of the Towns of Barnstable and Yarmouth, in order to coordinate the scheduling of marine construction activities, or to arrange other mitigation measures.

(H) To minimize construction traffic impacts, the Siting Board directs Cape Wind, and NSTAR as appropriate, to submit a draft Traffic Management Plan to Yarmouth officials and school administrators at least six months prior to the commencement of construction.

(I) To minimize impact to potential historic sites on Berry Avenue, the Siting Board directs Cape Wind to consult with the Yarmouth Historical Commission prior to commencing construction.

(J) Prior to applying for a street opening permit, Cape Wind shall provide detailed noise and traffic management information to the Town of Yarmouth.

Because the issues addressed in this Decision relative to this facility are subject to change over time, construction of the proposed facility must commence within three years of the date of the decision**.**

In addition, the Siting Board notes that the findings in this Decision are based upon the record in this case. A project proponent has an absolute obligation to construct and operate its facility in conformance with all aspects of its proposal as presented to the Siting Board. Therefore, the Siting Board requires Cape Wind and NSTAR to notify the Siting Board of any changes other than minor variations to the proposal so that the Siting Board may decide whether to inquire further into a particular issue. Cape Wind and NSTAR are obligated to provide the Siting Board with sufficient information on changes to the proposed project to enable the Siting Board to make these determinations.

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M. Kathryn Sedor
Presiding Officer

Dated this 11th day of May, 2005

APPENDIX A

ALTERNATIVE NEED ANALYSIS

In Section II.A.1, above, the Siting Board adopted a new standard of review for transmission lines that interconnect power plants with the electric transmission system, and analyzed the need for the proposed lines under that standard. As discussed in Section II.A.1, above, the Siting Board adopted this new standard in response to statutory changes that have been enacted since the Turners Falls/MECo/NEPCo precedent was last used. However, parties developed a record and briefed the case assuming the use of a standard similar to that used in two earlier Siting Board cases, Turners Falls and MECo /NEPCo.[116] Therefore, in this section, the Siting Board reviews need for the proposed transmission lines using Turners Falls and MECo/NEPCo as guidance.[117]

A-I. Scope of Review

In this section, the Siting Board considers whether the proposed transmission line is needed using its Turners Falls/MECo/NEPCo precedent as guidance. Because the standards of review are stated differently in the two relevant Siting Board decisions, and because Cape Wind and the Alliance have offered additional interpretations of the standards, the Siting Board finds it appropriate, as a preliminary matter, to clarify the scope of the analysis under this precedent.

As discussed in Section II.A.1, above, the Siting Board in Turners Falls reviewed a proposal to construct a 1.2-mile, 115 kV transmission line which would interconnect a non-jurisdictional 20 MW coal-fired cogeneration plant with the transmission grid. Turners Falls Decision, 18 DOMSC 141. In that decision, the Siting Board required the proponent to show: (1) that there was a need within New England for the power generated by the non-jurisdictional

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116 At the close of evidentiary hearings, the Siting Board issued briefing questions regarding the appropriateness of using Turners Falls and MECo/NEPCo as precedent.

117 The Siting Board notes that the need analysis in Section II.A, above, is independent of the analyses in other sections of the decision. Thus, if need were analyzed using Turners Falls and MECo/NEPCo as guidance, the findings in Sections I, II.B, III, and IV, above, would not change.

generating facility; and (2) that the transmission facility would provide benefits to Massachusetts. Id. at 153-155. The Siting Board found a need for the power from the plant based on a power sales contract between Turners Falls Limited Partnership (the developer of the power plant) and UNITIL (a bulk power purchaser for two New Hampshire electric utilities). Id. at 155-156. The Siting Board found benefits to Massachusetts based on: (1) economic benefits to Strathmore Paper Company, a local employer that would purchase steam from the power plant; and (2) conveyance of an easement along the proposed transmission right-of-way to the DEM for use as a bike path. Id. at 160-164.

In MECo/NEPCo, the Siting Board reviewed a proposal to construct a 3.2-mile, 69 kV transmission line which would interconnect a non-jurisdictional 40 MW gas- and oil-fired cogeneration plant with the transmission grid. In this case, the proponent was required to show that: (1) power from the non-jurisdictional plant was needed on either economic efficiency or reliability grounds; and (2) the existing transmission system was inadequate to support the new power source and additional energy resources were necessary to accommodate it. Id. at 395. The Siting Board found need for the power plant based on a power sales contract between Pepperell Power Associates (the developer of the power plant) and Cambridge Electric Light Company (a Massachusetts electric utility). Id. at 396-397. The Siting Board also found that the existing transmission system was inadequate to support this new power source, and that additional energy resources (the proposed transmission line) were necessary to accommodate the new power source. Id. at 397-403.

Cape Wind argues that the Siting Board should use the principles set forth in MECo/NEPCo, slightly modified, to review the need for the Company's proposed transmission lines. Cape Wind proposes that the Siting Board adopt the following analysis:

> Whether the proponent is a utility or a non-utility developer, the proponent must first establish that the power from the non-jurisdictional cogeneration plant is needed on either reliability, economic efficiency [or environmental] grounds. If it can be established that the cogeneration plant is needed, the proponent must then show that the existing transmission system is inadequate to support this new power source and that additional energy resources are necessary to accommodate this new power source

(Cape Wind Brief at 21). [118]

The Alliance argues for more extensive modifications to the MECo/NEPCo standard (Alliance Brief at 36-38). The Alliance accepts that the proponent of an interconnecting transmission line may show need for the power from a non-jurisdictional power plant on reliability, economic efficiency, or environmental grounds (id. at 36-37). However, it argues that the Siting Board should consider the positive and negative attributes of the power plant as potentially offsetting each other, and require a petitioner to show:

> (1) a need for the transmission line by demonstrating that there is a need for the specific power to be produced by the power plant on reliability, economic efficiency, or environmental grounds; and (2) there is a net positive contribution in at least one of these areas which is not offset by negative effects in the others

(id. at 37-38). In response, Cape Wind argues that this "netting of individual need bases" is contrary to statute and applicable precedent, and could lead to the rejection of facilities shown to be needed on reliability or economic grounds in accordance with the Siting Board's mandate (Cape Wind Reply Brief at 24-25).

The Siting Board agrees with Cape Wind and the Alliance that a modified version of the standard articulated in MECo/NEPCo is appropriate for the purposes of this review, and that the standard should allow for a showing of need for the power from the Cape Wind generator on reliability, economic, or environmental grounds. In addition, the Siting Board will consider other bases for establishing need for the power from the wind farm, examining on its merits any argument that does not fit easily into the three established bases for a finding of need.

However, the Siting Board will not adopt the Alliance's proposal for a more extensive reworking of Turners Falls and MECo/NEPCo. Historically, the Siting Board has never required project proponents to show need for a facility on more than one basis, for the very good reason that many facilities have been needed primarily, or entirely, for a single purpose – typically, for reliability. The fact that such projects had costs and environmental impacts was a given, and did

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[118] Cape Wind notes that, since MECo/NEPCo, the Siting Board's review of need has evolved to include environmental objectives as a possible basis for a need determination (Cape Wind Brief at 21, n.8).

not alter the need analysis. Similarly, a facility could be required for a single purpose unrelated to reliability – for example a project required to comply with the environmental regulations of another agency. It is therefore sufficient to show need for a project on *one* basis, so long as that basis is adequately supported.[119]

The Alliance recognizes that its proposal goes beyond existing Siting Board precedent,[120] and argues that the Siting Board should "strengthen" its precedent specifically for offshore power plants to fill a perceived regulatory gap (Alliance Brief at 35-36). The Siting Board does not believe that the Turners Falls/MECo/NEPCo precedent, and our jurisdiction over the proposed transmission line, can be interpreted to serve the purpose suggested by the Alliance. In addition, in Section II.A.1, above, the Siting Board has explained why the Turners Falls/MECo/NEPCo analysis is no longer consistent with the Siting Board's mandate and practice, and has established a new standard of review that will be used in the future for transmission lines that interconnect power plants, including offshore power plants. Thus, there is no need to strengthen Turners Falls and MECo/NEPCo in anticipation of future cases.

Therefore, in the following sections, the Siting Board will review the need for the proposed transmission line using the following standard adapted from MECo/NEPCo, which is adopted *for the purpose of this section only*:

In order to demonstrate the need for a jurisdictional transmission line which would

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119 In cases where the benefits provided by a proposed project are modest, the Siting Board may separately consider whether the costs or impacts of the project outweigh its benefits. For example, in the MMWEC Decision, 12 DOMSB 18, at 71, the Siting Board found environmental and economic need for a natural gas pipeline, but noted that, because the identified benefits might be modest, it was possible that the benefits of the proposed pipeline could be outweighed by its other environmental impacts. After reviewing the environmental impacts of the proposed pipeline, the Siting Board concluded that these impacts did not outweigh the economic and environmental benefits of the project. Id. at 149.

120 The Siting Board notes that, in Turners Falls, it found need for the energy from a coal plant without tabulating the plant's environmental impacts, and that, in MECo/NEPCo, it found need for the energy from a gas- and oil-fired plant based solely on a signed and approved contract for the plant's output. Turners Falls, 18 DOMSC at 151-165; MECo/NEPCo, 18 DOMSC at 11-12.

> interconnect a non-jurisdictional power plant, the proponent must establish: (1) that the power from the non-jurisdictional power plant is needed on reliability, economic, environmental or other grounds; and (2) that the existing transmission system is inadequate to interconnect this new power plant and, thus, that additional transmission resources are necessary to accommodate this new power plant.

Cape Wind has advanced reliability, economic, and environmental need arguments for the power that would originate at the wind farm and that would be transported by the proposed transmission lines. These are general classes of need arguments that fit Siting Board precedent. In addition, the Company has argued that the power is needed to meet the Commonwealth's Renewable Portfolio Standard ("RPS"). Each of these arguments is outlined and evaluated below.

A-II. Need for Energy: Reliability

A. Wind Farm Capacity

1. Company

The Company stated that the wind farm's maximum potential delivery of energy at Barnstable Switching Station would not exceed 454 MW (Tr. 3, at 418-419). The Company projected that the wind farm would produce 420 MW or more approximately 15% of the year; between 100 MW and 420 MW approximately 42% of the year; and less than 100 MW approximately 43% of the year, including periods of no power amounting to approximately 10% of the year (Exhs. EFSB-RR-9; EFSB-RR-10). The Company expected that power production generally would be highest in the months of December through March and lowest during early morning hours in the summer months (Exh. EFSB-RR-17). On average, the Company expects the wind farm's MW output to be 36% of its total capacity (Exh. APNS-N-11; Tr. 3, at 422-423; Tr. 4, at 539).

The Company stated that the wind farm's capability rating would be less than its maximum output, but asserted that it would make a significant capacity contribution to regional supply adequacy (Exh. CW-DCS-2-R at 10). The Company initially stated that the wind farm would provide approximately 100 MW of summer-rated capacity, based on the Independent System Operator of New England's ("ISO-NE") then-existing policy of assigning wind farms a capacity rating of 25% as an initial value counted towards total Installed Capacity ("ICAP") (Exh. CW-1, at 2-7; Tr. 3, at 413-415). The Company later indicated that ISO-NE had altered its policy, and would now accept engineering projections for the first year and actual seasonal operating history data for time periods when ISO-NE needs capacity thereafter (Tr. 3, at 413-415). The Company did not update its anticipated capacity rating in light of the new ISO-NE procedures (Exh. CW-DCS-2-R at 10).

2. Alliance

Jeffrey Byron, a witness for the Alliance, testified that wind-generated power does not contribute to system reliability because the system operator cannot rely on wind plants to be available when needed (Exh. APNS-JB-1, at 11, 15). Mr. Byron contended that adding generating capacity or new transmission lines does not necessarily improve the reliability of the grid (id. at 4).

Mr. Byron accepted the hypothesis that there could be a peak in demand in the future, for which the contribution of the wind farm could prevent loss of load; however, he argued that the energy could not be counted on in such a situation (id. at 11; Tr. 14, at 1874-1877). Mr. Byron also asserted that the turbines to be used in the wind farm are substantially untested and that previous wind generator designs have not met manufacturers' expectations for life span (Exh. APNS-JB-1, at 22). Finally, the Alliance argued that the Siting Board has never found that power from a generating plant that cannot be dispatched is needed for reliability purposes (Alliance Reply Brief at 7).

3. Company Rebuttal

In rebuttal, Cape Wind asserted that any facility with a capability rating greater than zero can be expected to make a contribution to resource adequacy (Exh. CW-DCS-2-R at 10). In response to the assertion that the turbines themselves would be unreliable, the Company stated that the 3.6 MW turbines it has selected have markedly improved operating reliability, relative to previous generations of wind turbines (Exh. CW-CO-2, at 2). The Company asserted that the availability factor of General Electric's previous generation of 1.5 MW turbines is over 97%

(id. at 3).

4. Analysis

In prior cases where it has reviewed the need for generating facilities to meet regional capacity needs, the Siting Board has required proponents to determine the year in which there would be a need for the nameplate capacity of the facility, on the assumption that this capacity typically would be available to meet capacity needs. See, e.g., ANP Bellingham Energy Company, 7 DOMSB 39, at 76-78 (1998) ("ANP Bellingham"); ANP Blackstone, 8 DOMSB 1, at 33-35. In this instance, however, the record indicates that the wind farm is projected to deliver on average approximately 36%, or 163 MW, of its maximum output of 454 MW. The record also indicates that generation would tend to be lower than average in the summer, when New England electric demand is at its peak; thus, the summer capacity rating of the wind farm is likely to be less than 163 MW, and substantially less than its nameplate capacity.

The Alliance has argued that the Siting Board may not find a reliability need for the wind farm, as its output is intermittent, and cannot be assured at any particular point in time. The Siting Board notes that, because all generating facilities are subject to unplanned outages, no generating facility can be relied on absolutely to be available at times of peak demand. The Siting Board notes the expertise of ISO-NE in the matter of developing capacity factors for intermittent facilities such as hydro-electric projects and wind generators, and concludes that it is appropriate to find reliability need for intermittent facilities based on their likely summer capacity rating, rather than the higher nameplate capacity. Here, the record demonstrates that ISO-NE intends to assign capacity ratings to wind farms based initially on engineering projections, and later on actual seasonal operating history data. The Company's original projection of a capacity rating of 100 MW was based on ISO-NE's capacity rating policies at the time of filing; the Siting Board accepts it for purposes of this review.

B. Regional Need

1. Company

The Company argued that additional generating capacity will be needed in New England to meet anticipated growth in the demand for electricity, to replace retirements of existing generation, and to maintain capacity reserve margins (Exh. CW-1, at 2-7). The Company predicted that 110 MW of capacity would be needed for reliability purposes beginning in summer 2007, with higher levels of capacity needed in later years (Exh. EFSB-N-9-S; Tr. 3, at 472-479). The Company also predicted that, under a high growth scenario or a hot weather scenario, there could be a capacity shortfall before 2007 (Tr. 3, at 483).

In support, the Company provided an analysis prepared by La Capra Associates, LLC ("La Capra") of the need for additional generating capacity in New England (Exhs. CW-1, at 2-4; EFSB-N-9-S). The Company stated that it used methods consistent with ISO-NE's Resource Adequacy Assessment to prepare this analysis, reviewed ISO-NE documents, and considered more recent developments that may affect supply and demand for power (Exh. CW-1, at 2-9, 2-13; Tr. 3, at 467-468).

As a basis for its analysis, the Company developed five forecasts of summer peak load, each based on the April 2003 NEPOOL Forecast of Capacity, Energy, Loads, and Transmission ("CELT Report") (Exhs. CW-1, at 2-10; EFSB-N-9-S). Three of these forecasts – a base case, a high load growth case, and a low load growth case – incorporate differing assumptions as to load growth while assuming normal summer weather (Exhs. APNS-N-7; APNS-N-7(b), Att.; EFSB-N-9-S). For its base case, the Company assumed an annual growth rate in peak demand of 1.74%, consistent with assumptions in the 2003 CELT Report (Exh. EFSB-N-9-S). For its high growth rate case, the Company assumed that peak demand would grow 2.65% annually (id.). For its low growth case, the Company used a "low economic growth" scenario from NEPOOL that reflected an average annual growth rate of approximately 0.41% (id.). In addition, the Company provided two forecasts to reflect extreme weather conditions: a hot weather case having a 10% chance of being exceeded, and a mild weather case having a 90% chance of being exceeded according to the 2003 CELT Report (id.).

The Company assessed the need for additional capacity under each of the five forecast scenarios by adjusting for the effects of demand-side management programs and net purchases and sales from other regions, adding in a 15% installed capacity reserve requirement,[121] and comparing the resulting demand with the capacity projected to be available from existing and developing generation (Exh. CW-1, at 2-9, 2-10, 2-11; Tr. 3, at 472-479). The Company took its estimates of the effects of demand-side management and net purchases and sales from ISO-NE (Exh. CW-1, at 2-11).

To develop estimates of available generating capacity, the Company obtained an initial inventory of regional supplies from the 2002 CELT Report; it then identified unit-specific supply assumptions that warranted adjustments through May 2003, and adjusted further for expected attrition (id. at 2-8 to 2-16; Exh. EFSB-N-9-S; Tr. 3, at 473, 477). In its modeling, the Company assumed the announced retirement of New Boston Unit 1, and assumed that 25% of plants with an operating life over 40 years would be retired, and that 50% of plants with an operating life over 50 years would be retired (Exhs. CW-1, at 2-15; APNS-N-7(d), Att.). In comments made subsequent to its modeling, the Company noted the decision by Exelon to retire Mystic Units 4, 5, and 6, and noted pressure on Salem Harbor Units 1, 2, and 3 as perhaps representative of increased pressure to retire plants; the Company asserted that additional generation may be needed sooner than anticipated by the La Capra model (Exh. EFSB-N-9-S). The Company's demand, supply, and need projections for 2004 through 2010 are shown in Table A-1, below.

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[121] The Company asserted that the 15% reserve requirement has historically been linked to a one-day-in-ten-years loss-of-load expectation adopted by the Northeast Power Coordinating Council ("NPCC") (Exhs. EFSB-N-1, Att. at 45; EFSB-N-8, Att. at 12; Tr. 3, at 476-478).

Table A-1
Need for Capacity in New England, 2004-2010, Summer Capacity (MW)

BASE CASE	2004	2005	2006	2007	2008	2009	2010
Peak Demand	25,690	26,000	26,290	26,620	26,990	27,390	27,820
Required Capacity	29,544	29,900	30,234	30,613	31,039	31,499	31,993
Available Supply	31,284	31,153	30,562	30,503	30,845	30,502	30,495
Surplus / (Need)	1740	1253	328	**(110)**	**(194)**	**(997)**	**(1498)**
HIGH LOAD GROWTH CASE	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**
Peak Demand	26,130	26,730	27,330	27,990	28,710	29,460	30,280
Required Capacity	30,050	30,740	31,430	32,189	33,017	33,879	34,822
Available Supply	31,284	31,153	30,562	30,503	30,845	30,502	30,495
Surplus / (Need)	1234	413	**(868)**	**(1686)**	**(2172)**	**(3377)**	**(4327)**
LOW LOAD GROWTH CASE	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**
Peak Demand	25,230	25,250	25,220	25,230	25,270	25,330	25,420
Required Capacity	29,015	29,038	29,003	29,015	29,061	29,130	29,233
Available Supply	31,284	31,153	30,562	30,503	30,845	30,502	30,495
Surplus / (Need)	2269	2115	1559	1488	1784	1372	1262
HOT WEATHER CASE	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**
Peak Demand	27,710	28,050	28,370	28,730	29,130	29,560	30,020
Required Capacity	31,867	32,258	32,626	33,010	33,500	33,994	34,523
Available Supply	31,284	31,153	30,562	30,503	30,845	30,502	30,495
Surplus / (Need)	**(583)**	**(1105)**	**(2064)**	**(2537)**	**(2655)**	**(3492)**	**(4028)**
MILD WEATHER CASE	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**
Peak Demand	24,620	24,910	25,190	25,510	25,860	26,250	26,660
Required Capacity	28,313	28,647	28,969	29,337	29,739	30,188	30,659
Available Supply	31,284	31,153	30,562	30,503	30,845	30,502	30,495
Surplus / (Need)	2971	2506	1593	1166	1106	314	**(164)**

"Peak Demand" estimated by La Capra; "Required Capacity" assumes an additional 15% reserve margin; "Available Supply" estimated by La Capra as "Base Supply." Selected years shown here. Source: Exh. EFSB-N-9-S.

2. Alliance

The Alliance argued that the proposed wind farm would produce power at a time of an unprecedented surplus of supply in New England (Alliance Reply Brief at 10). The Alliance argued that there is no need for the power that would be produced by the wind farm (id. at 10).

3. Analysis

The Company has provided an analysis, similar to those accepted by the Siting Board in generating facility cases prior to the 1997 restructuring of the electric industry, of the need for additional generating capacity in New England for the years 2003-2011. The Company provided three demand scenarios based on load growth: a base case scenario, representing a demand case with a 50% chance of being exceeded, a high load growth scenario, and a low load growth scenario representing essentially static electric demand. The Company also provided cases that reflect extreme and mild weather scenarios. The Siting Board finds that the three demand scenarios presented represent a reasonable range of load growth scenarios for purposes of this review, and that the extreme and mild weather cases provide indicators of the sensitivity of supply adequacy to weather contingencies. The Siting Board further finds the Company's reliance on NEPOOL projections of demand-side management and net purchases and sales, and its use of a 15% reserve margin, to be appropriate for purposes of this review.

The Company has projected available supplies by adjusting resource levels listed in the 2002 CELT Report to account for retirement and project cancellation decisions made through May 2003, and for anticipated future retirements. The Siting Board has previously accepted the assumption of 25% retirement, by capacity, of fossil fuel plants in operation over 25 years. ANP Bellingham, 7 DOMSB 39, at 75. The Siting Board concludes that the Company's assumption that 25% of plants with an operating life over 40 years would be retired, and that 50% of plants with an operating life over 50 years would be retired, is consistent with current trends, and thus reasonable. Therefore, the Siting Board finds that the Company's estimate of available supplies is appropriate for purposes of this review.

As shown in Table A-1, additional capacity would be needed in New England by 2007 for reliability purposes under the base load growth case, and by 2006 in the high load growth case.[122] Under the base case, 110 MW of power would be needed by the New England system in 2007, 197 MW would be needed in 2008, 997 MW would be needed in 2009, and 1498 MW would be needed in 2010. Based on the record, the Siting Board finds that there is a need in New England for at least 110 MW of energy resources beginning in 2007 and beyond.[123] The Siting Board therefore finds that there is a need for the capacity provided by the wind farm beginning in 2007 for reliability purposes.

C. Other Reliability Benefits

1. Company

The Company asserted that the wind farm would improve local reliability by providing an additional source of energy at the Barnstable Switching Station (Exh. CW-1, at 2-5). At present, the Canal Electric power plant is the only source of generation located on Cape Cod (Tr. 1, at 139). NSTAR maintained that under certain contingencies, the availability of the proposed wind farm could forestall localized outages that otherwise would occur (Tr. 3, at 377-387). For example, NSTAR stated that if the Canal Switching Station were lost to service, the Cape Cod

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[122] Under the extreme weather case, there would be inadequate capacity to meet load and maintain the 15% reserve margin requirement beginning in 2004.

[123] Historically, the Siting Board has analyzed the need for new generating capacity both within New England and within Massachusetts. ANP Blackstone, 8 DOMSB 1, at 26-35; ANP Bellingham, 7 DOMSB 39, at 60-83; Altresco Lynn, Inc., 2 DOMSB 1, at 19-92 (1993). The Siting Board notes that, following the enactment of the 1997 Electric Restructuring Act, Massachusetts electric distribution companies are no longer allowed to own generation, and generally do not enter into long-term supply contracts to serve the load within their service territories. Thus, the Siting Board can no longer identify generating units that are dedicated over the long term to serving Massachusetts load, and therefore cannot project the need for additional capacity to meet the requirements of Massachusetts electric customers. However, we note that Massachusetts is part of a tightly interconnected regional power grid, and constitutes approximately 40% of New England load. A regional shortage of power thus is very likely to affect Massachusetts electric customers. The Siting Board therefore concludes that, if additional energy resources are needed in New England for reliability purposes, these additional energy resources also are needed to reliably serve Massachusetts load.

region would be interconnected to the grid only through the Bourne Switching Station, which does not have sufficient capacity to supply all of Cape Cod (id. at 378-380). NSTAR stated that under this scenario, an outage could be avoided if the wind farm were generating at least half its capacity; if the wind were lighter and output lower, power from the wind farm would help limit the extent of outages (id. at 379-385). Similarly, NSTAR noted that energy from the wind farm would improve reliability in the Cape Cod area under the contingency of the loss of a double-circuit tower between Canal Electric and the Bourne Switching Station (id. at 504). NSTAR noted that both contingencies have a low probability of occurrence (id. at 383-384, 503-504).

NSTAR indicated that demand growth on Cape Cod would create a need for voltage support within the next few years (id. at 386-387). Cape Wind stated that the proposed transmission lines would provide approximately 120 megaVAR ("MVAR") of reactive power on a continuous basis (Exhs. CW-DCS-2-R at 20; EFSB-RR-12; EFSB-RR-65).[124] NSTAR noted that this new source of reactive power would allow it to postpone planned voltage support projects such as the installation of 20 to 60 MVAR of capacitor banks (Tr. 3, at 387-389). Cape Wind acknowledged that the reactive power from the transmission lines may not always be needed, and that Cape Wind may need to provide a switched shunt reactor for the NSTAR system to compensate for unneeded reactive power (Tr. 1, at 147; Tr. 3, at 512-513).

In addition, Cape Wind stated that the turbines themselves would be able to produce or absorb reactive power, as needed, thus providing bidirectional reactive power under electronic control (Tr. 1, at 124, 143, 145). The Company stated that the wind turbine generators would produce from 0 MVAR to 226 MVAR, depending on wind power output and on power factor setting (Exh. EFSB-RR-65).

Cape Wind further asserted that the wind farm would improve electric system reliability by supplying renewable energy during peak winter periods (Exh. CW-DCS-2-R at 44-45). In support, Cape Wind asserted that New England is highly dependent on natural gas for power generation, citing a 2003 ISO-NE study which concluded that 42% of New England generating capacity will be fueled by natural gas by 2005 (id. at 43). Cape Wind noted that the ISO-NE

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[124] Transmission lines buried underground or undersea provide reactive power, unlike overhead lines (Tr. 1, at 119, 147-148).

report indicated that natural gas production levels in North America have leveled off; the Company therefore suggested that significant additional pipeline capacity is unlikely, and asserted that gas supply constraints may adversely affect the reliability of gas-fired generation during the coldest part of the heating season (id. at 44-45).

2. Alliance

Mr. Byron, a witness for the Alliance, asserted that wind-generated resources cannot provide reactive power (Exh. EFSB-APNS-6). The Alliance argued that any reliability benefit of fuel diversity, per se, should be reflected in the reliability characteristics of the plant itself (Alliance Reply Brief at 30).

3. Analysis

The record shows that, under certain scenarios, the availability of energy from the wind farm could limit or forestall an electric outage on Cape Cod. However, NSTAR has stated that such contingencies are very low probability events; in addition, NSTAR has not provided an analysis demonstrating that additional energy resources are needed, or will be needed, to meet ISO-NE reliability standards. The Siting Board concludes that, while the wind farm may provide local reliability benefits under certain contingencies, these benefits, in and of themselves, would not be sufficient to establish need for the energy from the wind farm.

In addition, the record shows that the proposed transmission cables would generate a steady supply of reactive power, obviating or delaying the need for NSTAR to install capacitors. The record shows that the wind farm turbines can supply or absorb reactive power as required and indicates that at times there is some need for additional reactive power to provide voltage support. Thus, the proposed transmission lines will consistently provide needed reactive power to the grid on Cape Cod and the wind turbines will be able to provide reactive power when they are operating. Although the net effect of providing voltage support is positive, NSTAR's alternative of installing capacitors has not been shown to have substantial costs. The Siting Board concludes that these modest voltage support benefits, in and of themselves, would not be sufficient to establish need for the energy from the wind farm.

The record shows that the wind farm would act as a hedge against risks associated with the availability of natural gas and other fossil fuels. The record suggests that gas supply constraints may adversely affect the reliability of gas-fired generation during the coldest part of the heating season. Therefore, there is a possibility that the wind farm could improve system reliability during peak winter electricity use in the future, although the likely extent of any such improvement was not established. Thus, while agreeing that the wind farm may be beneficial by reducing reliance on gas-fired generation, the Siting Board concludes that these benefits, in and of themselves, would not be sufficient to establish need for the energy from the wind farm.[125]

D. Effect of Variable Output on Grid Reliability

1. Alliance

The Alliance argued that interconnection of the wind farm would degrade, rather than improve, the reliability of the New England electric grid. Specifically, the Alliance asserted that generation levels from the wind farm would regularly change or cease unexpectedly, placing additional challenges on the system operator, which is required to balance electric supply and demand (Exh. APNS-JB-1, at 10). The Alliance asserted that wind-generated electricity is intermittent, constantly changing, and relatively unpredictable (id.); however, it did not quantify the level of intermittence or unpredictability. The Alliance stated that ISO-NE would have to procure an increased amount of regulation services from other generators to compensate for the lack of operator control over the wind farm's output (id. at 13).

2. Company

The Company asserted that its project would not cause risks to reliable operation of the electric system (Exh. EFSB-RR-2). The Company acknowledged that volatility can present challenges to the system operator (Exh. CW-1, at 2-8). As an indicator of the likely volatility of output from the wind farm, the Company provided information from its meteorological test tower

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[125] The Siting Board notes that the diversity benefits of renewable energy facilities generally are reflected in the legislature's enactment of the RPS statute. The need for energy from the wind farm to meet RPS is addressed in Section A-III, below.

for April, May, and June 2003 showing that the average wind speed is 19 miles per hour (mph), and that hour-to-hour variations in wind speed average about 1 meter per second (m/s), or 2.2 mph (Exhs. EFSB-RR-49; EFSB-RR-50). The Company concluded that the median error in its day-ahead forecast would be approximately 10% of the wind farm's capacity, or less than 0.002% of peak load in New England, and that the median error in its hour-ahead estimate of power generation would be less than 5% of the wind farm's capacity (Exhs. CW-DCS-2-R at 14; EFSB-RR-7).

The Company noted that electric grids must routinely contend with varying and uncertain demand, and with unexpected outages (Exh. CW-DCS-2-R at 13). The Company stated that ISO-NE must plan for an unexpected loss of Units 8 and 9 at Mystic Station in Everett, totaling 1400 MW; the Company therefore argued that ISO-NE would be prepared to respond to the unexpected loss of the 452 MW wind farm (id. at 19). The Company also argued that ISO-NE is experienced in dealing with variability caused by unpredictable levels of system demand, noting that the peak hourly load record of 25,715 MW in New England on August 14, 2002, exceeded the normal weather condition peak load summer outlook by more than 6% (Exh. CW-1, at 2-8). The Company noted that the wind farm's annual output represents approximately 1% of the region's power supply (Tr. 3, at 445).

The Company stated that ISO-NE and various New England transmission owners are conducting a System Impact Study to assess system performance impacts of the proposed interconnection of the wind farm, to ensure no degradation of reliability (Tr. 1, at 143-155; Tr. 3, at 464).

3. Analysis

The record demonstrates that the electric power generated by the wind farm would be variable and not wholly predictable, and suggests that the ISO-NE may need to procure an increased amount of regulation services from other generators to compensate for this variability. However, the record also demonstrates that the margin of variability in wind farm output would be smaller than certain other generation contingencies. In addition, the record indicates that any reliability issues will be identified in the forthcoming System Impact Study, and that the wind farm will not be permitted to interconnect to the New England transmission grid until it is shown that interconnection will not adversely affect the reliability of the transmission grid. Therefore, the Siting Board finds that the variability or unpredictability of the energy generated by the wind farm is unlikely to adversely affect the reliability of the electric system. The cost implications of the need for increased regulation services are discussed in Section A-IV, below.

E. Conclusions on Reliability Need

In the sections above, the Siting Board has found that: (1) there is a need in New England for at least 110 MW of energy resources beginning in 2007 and beyond; (2) there is a need for the capacity provided by the wind farm beginning in 2007 for reliability purposes; and (3) the variability or unpredictability of the energy generated by the wind farm is unlikely to adversely affect the reliability of the electric system. Consequently, the Siting Board finds that there is a need for the power provided by the wind farm beginning in 2007 for reliability purposes.

A-III. Need for Energy: Qualified RPS

A. Company

The Company argued that the renewable energy from the wind farm is needed for compliance with Massachusetts and Connecticut renewable portfolio standards (Company Brief at 32-39). The Company noted that Massachusetts and Connecticut have recently enacted statutes requiring retail electric suppliers to acquire increasing percentages of energy from specified renewable energy sources over time (Exh. CW-1, at 2-18; Tr. 4, at 610). In both Massachusetts and Connecticut, wind power is among the technologies that may be counted towards RPS targets (Exh. CW-1, at 2-18). The Company reported that Massachusetts enacted its RPS statute based on an understanding that renewable power provides fuel diversity and technology diversity, consumes no fossil fuel, and has air emission benefits (Tr. 4, at 610-611).

The Massachusetts RPS requires each retail electricity supplier to obtain RPS "new renewable" attributes[126] corresponding to a minimum of 1.0% of electricity consumed in 2003;

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[126] In the RPS context, "new renewables" are energy projects that meet specific criteria with (continued...)

the requirement increases by one-half percentage point each year until the requirement is 4.0% in 2009, then increases to 5.0% in 2010 (Exh. CW-1, at 2-19, Table 2-4).[127] Combining these percentages with forecasted electric consumption, the Company projected that compliance with the Massachusetts RPS will require approximately 733 gigawatt-hours ("GWh") per year of new renewable power in 2004, increasing to 1256 GWh per year in 2006 and 2658 GWh per year by 2010 (Exh. EFSB-RR-18, Att.). The Company indicated the Connecticut RPS would require additional renewable energy, rising from an estimated 237 GWh in 2004 to 2408 GWh in 2010 (id.).

The Company also anticipated market-driven demand for green attributes in Massachusetts, Connecticut, Rhode Island, and Maine by 2005 (Exh. CW-1, at 2-20). The Company projected that this market demand for "green power" would rise from zero in 2003 and 76 GWh in 2004 to 757 GWh in 2010 (Exh. EFSB-RR-18, Att.). Combining the Massachusetts and Connecticut RPS requirements with anticipated demand for green energy attributes, the Company predicted that total demand for new renewable energy in New England would increase from 636 GWh in 2003 to 2468 GWh in 2006, and 5822 GWh in 2010 (id.).

The Company projected that new renewable power sources currently approved by the Massachusetts Division of Energy Resources ("DOER") will provide approximately 447 GWh annually from 2004 through 2010 (id.).[128] The Company projected that known sources that have

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126 (...continued)
respect to source of energy and date of commercial operation (Exh. CW-1, at 2-18). Generators of electricity sell the attributes of their power separately from the electrical output itself (Exh. PO-1).

127 Eligibility under Massachusetts rules as a new renewable energy source is an attribute tracked through certificates in the NEPOOL Generation Information System ("GIS") (Exh. CW-1, at 2-18; Tr. 4, at 609-613). In Massachusetts, a load-serving entity that fails at the end of the year, and after the various trading periods in the NEPOOL GIS, to procure sufficient renewables is assessed an "alternative compliance mechanism," which is $50 per megawatt-hour ("MWh") of shortfall measured against its RPS requirement (Tr. 4, at 623-624).

128 The largest contributors listed by the Company are Indeck West Enfield, a biomass plant, producing 167 GWh annually, and four landfill gas plants, each producing 42 to 46 GWh
(continued...)

not yet applied to DOER for certification could provide an additional 33 GWh annually (id.; Exh. EFSB-N-9-S).

Based on these estimates, the Company concluded that New England would need an additional 1989 GWh of renewable resources to meet statutory and market demand in 2006, increasing to 5343 GWh in 2010 (Exh. EFSB-RR-18, Att.). The Company estimated the total energy production of the wind farm to be 1437 GWh (Exhs. CW-1, at 2-17; EFSB-RR-49).

B. Alliance

The Alliance challenged the level of need for renewable energy in Massachusetts, noting that applications for interconnection of nearly 300 MW of onshore wind projects have been filed with NEPOOL since May 2003 (Exh. APNS-JB-1, at 38). In addition, the Alliance argued that the Siting Board may not consider an argument based on the need for renewable energy to meet the requirements of the Massachusetts RPS (Alliance Reply Brief at 7). In support, the Alliance argued that the Siting Board has never found that power from a generating plant is needed for reliability based on the plant's impact on a market other than the electricity market (id.). The Alliance also argued that the Siting Board's G.L. c. 164, § 69H mandate with respect to an "energy supply for the commonwealth" concerns energy and not green credits, which the Alliance considers to be a separate product (id. at 11).

C. Analysis

General Law c. 25A, § 11F, the Renewable Energy Portfolio Standard for Retail Electricity Suppliers, requires that every retail supplier of electricity provide a minimum percentage of kilowatt-hour sales to end-use customers from renewable energy generating sources. 225 CMR § 14.07 requires retail electricity suppliers serving Massachusetts customers to hold increasing levels of renewable energy in their energy supply portfolios, beginning at 1.0%

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128 (...continued)
annually (Exh. EFSB-N-9-S). The Company excluded from its calculation the Indeck Jonesboro plant, which was mothballed in January 2003; the facility had eligible generation which the Company had estimated at 192 GWh (id.; Exhs. CW-1, at Table 2-6; EFSB-N-6 and -6(a), Att.; EFSB-RR-18, Att).

in 2003 and increasing to 5.0% in 2010. This requirement, by design, creates a need for renewable energy attributes that is separable from the need for capacity or energy to serve New England load. Because the RPS is an energy policy of the Commonwealth, established by statute, with clear relevance to the Siting Board's mandate to provide for "a reliable energy supply for the commonwealth with a minimum impact on the environment at the lowest possible cost," the Siting Board concludes that it is appropriate to examine the need for renewable energy to meet the requirements of the Massachusetts RPS.

Table A-2, below, summarizes forecasts of demand for new renewable energy to meet RPS and green demand, and lists supplies available from DOER-approved sources and other potential sources of renewable energy. As shown in Table A-2, the record demonstrates that Massachusetts electric suppliers will be required to obtain 991 GWh of new renewable energy attributes in 2005, rising to 2658 GWh in 2010 in order to comply with G.L. c. 25A, § 11F. The record also shows that 671 GWh annually are available from DOER-qualified projects, if the mothballed Indeck Jonesboro biomass plant is included. That leaves a shortfall of 320 GWh in 2005, and 1987 GWh in 2010. Including the additional 300 GWh of possible new renewable energy identified by the Alliance, the shortfall would be reduced to 20 GWh in 2005 and 1687 GWh in 2010. By this more conservative analysis, the full 1437 GWh of the proposed wind farm would be needed beginning in 2010. The Siting Board therefore finds that there will be a need for additional renewable resources to meet the requirements of the Massachusetts RPS beginning in 2005, and that there will be a need for the full renewable output of the wind farm to meet the requirements of the Massachusetts RPS beginning in 2010.

Because Massachusetts is not the only New England state with a renewable portfolio standard, the Siting Board also considers the regional need for new renewable resources. The record indicates that the level of new renewable resources needed to comply with both the Massachusetts and Connecticut RPS will rise from 1473 GWh in 2005 and 2150 GWh in 2006, to 5066 GWh in 2010. Under this analysis, the full 1437 GWh of the wind farm would be needed beginning in 2005 to meet regional demand; if the additional 300 GWh of new renewable energy identified by the Alliance materializes, the 1437 GWh from the proposed wind farm would be needed beginning in 2006. Consequently, the Siting Board finds that there will be a need for the renewable resources provided by the wind farm to meet regional RPS requirements beginning in 2006.

Table A-2
Need for Renewable Energy in New England, 2004-2010 (GWh per year)

DEMAND	2004	2005	2006	2007	2008	2009	2010
MA Percentage Required [1]	1.5%	2.0%	2.5%	3.0%	3.5%	4.0%	5.0%
MA RPS Demand [2]	733	991	1256	1528	1808	2095	2658
CT RPS Demand [2]	237	481	894	1401	1839	2204	2408
Regional RPS Demand (CT + MA) [2]	970	1473	2150	2930	3647	4299	5066
Green Demand [2]	76	186	319	474	654	737	757
RENEWABLE SUPPLY	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**
Available "New" Renewables [2, 4]	671	671	671	671	671	671	671
Recent Wind Projects Applied to NEPOOL [3]	300	300	300	300	300	300	300
SURPLUS / (NEED)	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**
MA RPS Demand vs. Available Renewables	62	**(320)**	**(585)**	**(857)**	**(1137)**	**(1424)**	**(1987)**
MA RPS Demand vs. Available Renewables + Applications	362	**(20)**	**(285)**	**(557)**	**(837)**	**(1124)**	**(1687)**
Regional RPS Demand vs. Available Renewables	**(299)**	**(802)**	**(1479)**	**(2259)**	**(2976)**	**(3628)**	**(4395)**
Regional RPS Demand vs. Available Renewables + Applications	1	**(502)**	**(1179)**	**(1959)**	**(2676)**	**(3328)**	**(4095)**

(1) Exh. CW-1, at Table 2-4. (2) Exh. EFSB-RR-18, Att. (3) Exh. CW-JB-1, at 38.
(4) Includes DOER-approved renewables (including the mothballed 192 MW Indeck Jonesboro plant), and other renewables identified by Cape Wind (Exhs. EFSB-N-6; EFSB-N-9-S; EFSB-N-15).

A-IV. Economic Need

The Company asserted that the power from the wind farm would be needed for economic purposes, arguing that the power would displace more expensive generation, lowering the clearing price in the New England spot market. The Company also argued that the dispatch of the wind farm would help reduce the price of natural gas during periods of peak gas demand, and that availability of renewable attributes from the wind farm would reduce the overall price of renewable portfolio certificates. The Alliance asserted that operation of the proposed wind farm would cause the system operator to pay more to manage variability in the supply and demand for electricity. The Siting Board examines these arguments below.

A. Displacement Savings

1. Company

The Company asserted that dispatch of the wind farm would provide economic benefits for the Commonwealth and the New England region by increasing competition in the wholesale electrical power market (Exh. CW-1, at 2-4, 2-5, 2-17). The Company asserted that, when operating, the wind farm would displace generating units at the top of the dispatch queue and cause cheaper units to set the New England spot market clearing price (id. at 2-5, 2-23). Cape Wind asserted that the wind farm would be self-scheduled and a price taker in the region's energy market; consequently, its dispatch would lower market clearing prices (Exh. DCS-2, at 36).

The Company engaged La Capra to model the effect on wholesale electricity prices of adding the wind farm's power to the New England electric supply (Exh. CW-1, at 2-24). The La Capra model is based on the idea of bid stack displacement, in which energy provided by the wind turbines would displace energy from the highest successful bidder in the bid stack at any specific time (Exh. APNS-N-15, Att.; Tr. 4, at 563). The Company stated that the wind farm would have an operating advantage over fossil-fuel-fired generating plants, because its short-run variable operating costs are near zero (Exh. APNS-N-15, Att.). The Company stated that whenever the wind turbines generate power, the wind farm will be called on-line before fossil units with higher operating costs (id.). The Company stated that, when its operation displaces a generating unit at the top of the bid stack, a unit offering a lower bid will set the clearing price (id.).

The Company used PROSYM, a utility dispatch simulation program, to simulate the hourly dispatch of generators and the operation of the electric system in New England, New York, the Pennsylvania/New Jersey/Maryland Interconnection, and adjacent Canadian provinces including Quebec and Ontario (id.).[129] PROSYM's dispatch algorithm selects the lowest cost combination of bids from generators and available imports (id.). Wheeling charges and congestion charges are included in the model (id.). The model generates hourly clearing prices, total generation by technology, total emissions, and total fuel consumption (id.). The Company asserted that the model approximates the actual spot markets in the northeast (id.).

The Company used the PROSYM model to simulate the effect of the wind farm on the annual average energy clearing price in each of four load zones in New England,[130] for the years 2005 through 2009 (Exhs. APNS-RR-1; APNS-RR-1, Att.). The Company then multiplied the price effect by the anticipated total load for each zone for each year (Exhs. APNS-RR-1; APNS-RR-1, Att.).[131] The Company's model projected regional savings of approximately $4 million in 2005, $28 million in 2006, $28 million in 2007, $17 million in 2008, and $22 million in 2009, or an average of $19.8 million per year for the first five years of operation (Exhs. APNS-RR-1; APNS-RR-1, Att.). The Company adjusted its initial projection of

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129 The modeling was performed in Spring 2001 (Exh. EFSB-N-13; Tr. 4, at 573).

130 The Company defined the four load zones as Maine, NEMA-Boston, Connecticut, and the rest of New England (Exh. APNS-RR-1, Att.).

131 The Company asserted that, while the most immediate effect of the Cape Wind project would be on clearing prices in the spot market, the lower clearing prices would reduce prices in the forward market and thereby lead to price reductions for all customers (Exh. APNS-N-15, Att.; Tr. 4, at 563; Tr. 18, at 2364-2365). In support, the Company argued that forward prices are, to a large extent, expectations for spot prices, and that market participants will take the Cape Wind project into account when developing prices for forward power (Tr. 18, at 2465). In addition, the Company noted that power for most Massachusetts load is procured through short-term forward purchases, rather than through long-term contracts which would be slow to reflect the Cape Wind project due to less frequent contract renewals (id. at 2367).

$19.8 million per year up to an estimated $25 million per year, arguing that because prices and the price suppression effect both increase disproportionately when the market is tight, average savings under variable conditions would be higher than savings calculated for average conditions (Exh. APNS-RR-1). The Company also argued that higher prices should be weighted more heavily to account for the typically higher prices that accompany higher load (id.). In addition, the Company noted that fuel prices in October 2003 were 25% to 50% higher than prices widespread in early 2001, when the modeling was performed, and suggested that an analysis assuming the fuel prices prevailing in late 2003 would have yielded economic benefits 25% to 50% higher than the estimate of $25 million (i.e., $31 to $38 million) (id.; Tr. 18, at 2366-2367).

The Company stated that customers in southeastern Massachusetts would have savings slightly greater than customers elsewhere, due to transmission constraints on the export of wind farm output from the area (Tr. 4, at 553-554). Since over 40% of NEPOOL's total energy output is consumed in Massachusetts, the Company estimated that savings to Massachusetts consumers would likely be at least 40% of $25 million, or $10 million annually (Exhs. EFSB-RR-14; CW-DCS-2-R at 29; Tr. 4, at 555).[132]

2. Alliance

Mr. Byron, a witness for the Alliance, asserted that the wind farm could distort the electricity market in Massachusetts and New England, and reduce overall economic efficiency (Exh. APNS-JB-1, at 3). Mr. Byron stated that long-run marginal cost is the best measure of the economic efficiency of a generating plant (id. at 27). He estimated costs of various types of generators and concluded that, on a cost per MWh basis, the proposed offshore wind project would have higher long-run marginal costs than a combined-cycle natural gas-fired plant (id. at 23-37). Mr. Byron expressed doubt as to whether the wind farm would be constructed without the federal production tax credit and credits from the Massachusetts RPS, and indicated the two

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132 In addition, the Company asserted on a conceptual basis that by displacing fossil fuel generating plants, the wind farm would put downward pressure on regional natural gas prices, providing savings to natural gas customers, and lowering costs of fossil fuels generally (Exhs. APNS-N-10; CW-DCS-2-R at 38). The Company did not attempt to quantify such an effect (Exhs. APNS-N-10; CW-DCS-2-R at 38).

sets of credits would provide revenue of about 1.8 cents per kWh and about 2.5 cents per kWh, respectively, to the project (id. at 30). Mr. Byron then asserted that a zero-bid plant distorts the market if it is not more economically efficient than a plant it displaces (id. at 28).

Mr. Byron also expressed concern that electricity producers with lower overall costs may be forced out of the market by the wind farm, which would sell electricity by bidding its short-term marginal operating cost, which is close to zero (id. at 37). Mr. Byron stated that the proposed wind farm must eventually cover its capital and operating costs or go out of business, and questioned whether the wind farm would in fact cover its costs (id. at 37-38).

On brief, the Alliance questioned whether a reduction in wholesale energy prices would have any effect on "wholesale sellers who provide power to the retail supplier who actually serve[s] retail customers" (Alliance Reply Brief at 24). The Alliance also argued that the Siting Board is not permitted to find that a self-scheduling plant brings economic efficiency benefits based solely on its potential impact on the wholesale clearing price in certain hours (id. at 22).

3. Company Rebuttal

In response, Cape Wind stated that its economic need argument focused primarily on the cost to consumers, noting that recovery of the fixed costs of the wind farm would be a risk taken on by project developers (Tr. 18, at 2316). Cape Wind noted that, historically, the Siting Board's analysis of economic need has focused on whether consumer benefits would be achieved in NEPOOL's energy market (Exh. CW-DCS-2-R at 28; Tr. 18, at 2317-2318). The Company asserted that in ANP Bellingham, the Siting Board accepted the results of an analysis of cumulative energy price savings as evidence of "economic efficiency" (Exh. CW-DCS-2-R at 28). The Company asserted that its analysis of the economic benefits created by displacement within the wholesale energy market is similar to that accepted by the Siting Board in prior proceedings (id.).

4. Analysis

The Company has argued that need for the energy from the wind farm can be demonstrated based on economic benefits, and has provided, in support, a dispatch analysis showing the extent to which the wind farm, operating as a price taker, would reduce clearing prices in the New England energy market during its first five years of operation. In the past, the Siting Board has determined that, in some instances, utilities need to add energy resources primarily for economic efficiency purposes. Specifically, in Massachusetts Electric Company, 13 DOMSC 119, at 178-179, 183, 187, 246-247 (1985), and in Boston Gas Company, 11 DOMSC 159, at 166-168 (1985), the Siting Board recognized the benefit of adding economic supplies to a specific utility system. The Siting Board also noted in Eastern Energy Corporation Remand, 1 DOMSB 213 (1993) ("Eastern Energy Remand"), that because G.L. c. 164 requires a necessary energy supply to be provided with a minimum impact on the environment at the lowest possible cost, it is reasonable to conclude that a proposed facility may be necessary even if there is no additional need for supply capacity or transmission reasons. We stated that, in such a case, an applicant would be required to establish a record that supported a finding that the Commonwealth's energy supply would have lower costs or reduced environmental impacts with the addition of the proposed facility than it would have without the addition of the proposed facility. Eastern Energy Remand, 1 DOMSB 213, at 411-412.

More recently, in ANP Blackstone, the Siting Board found need for a generating facility based on cost savings as calculated using a dispatch model. ANP Blackstone, 8 DOMSB at 1, at 49-57. In MMWEC, the Siting Board found need for a natural gas pipeline based on likely economic benefits in the form of lower electric rates for MMWEC customers. MMWEC Decision, 12 DOMSB at 29, n.3, and at 60.

Here, the Company has provided a dispatch analysis similar to those accepted in ANP Blackstone and in MMWEC, projecting average annual savings of $19.8 million for New England customers over the first five years of operation of the wind farm. For purposes of estimating economic benefits, the Siting Board accepts the assumption that the wind farm will be a price taker in the energy markets, and thus will fall at or near the bottom of the regional dispatch queue whenever it is operating. The Siting Board also finds credible the Company's assumption that energy price reductions and anticipated price reductions in the spot market will be reflected in longer-term contracts for energy after standard offer service ceases in March 2005.

Cape Wind argued that its modeling protocol was conservative, and asserts that average annual savings actually would be at least $25 million, with $10 million per year of this savings accruing to Massachusetts customers. The Siting Board agrees that savings may well be higher than those modeled based on average market conditions, and notes further that because the savings are sensitive to fossil fuel prices, savings would be higher than modeled if future fuel prices are higher than those prevailing in Spring 2001.

The Alliance has not challenged the Company's modeling techniques or assumptions. Rather, it has argued that economic efficiency should be analyzed based on a generator's long-run marginal cost as compared to those of other generators, rather than by its effect on energy prices. However, in past decisions, the Siting Board has evaluated economic need based on the actual costs that electric utilities or customers in Massachusetts and New England pay for the electricity they consume, not the long-run marginal cost of a project. The wind farm may be a project with relatively high capital costs and may receive government support;[133] however, its cost structure is relevant to the Siting Board's need analysis only insofar as it has cost implications for electric customers.

The record shows that the wind farm will tend to reduce market clearing prices for electricity because it typically will be bid into that market at its marginal operating costs, which are close to zero, and displace power plants with higher marginal costs. The savings resulting from this displacement would accrue to electric customers, and are estimated to be $25 million per year for New England customers, including $10 million annually for Massachusetts customers over the first five years of operation. Consequently, the Siting Board finds that operation of the wind farm would provide average annual savings of $25 million for New England customers, including $10 million annually for Massachusetts customers, during the first five years of operation.

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133 The Alliance characterizes this support as a market distortion; however, it also can be viewed as government intervention to remediate market failures. The Siting Board shares the Commonwealth's commitment to the development of new renewable energy resources, and views the implementation of renewable portfolio standards as an important part of that commitment. To the extent that the marketplace is influenced by these requirements, the Siting Board accepts such influence as presumptively warranted.

B. Other Economic Benefits

1. Company

The Company offered two additional arguments regarding regional economic benefits provided by the wind farm.[134] First, the Company asserted that the additional diversity provided by the wind farm would provide a hedge against financial risks associated with the availability of natural gas and other fossil fuels (Exh. CW-1, at 2-6). Although Cape Wind asserted that generating unit resource diversity has economic value and that increasing the use of renewable sources of energy is wise from a power supply portfolio perspective, it did not provide a quantitative estimate of that value (Exh. CW-DCS-2-R at 41, 46). However, the Company suggested that the Siting Board consider such a benefit qualitatively (id. at 46).

To illustrate indirect price benefits from renewable energy, La Capra noted that when hydroelectric production in the Pacific Northwest is poor, natural gas units run more frequently, gas storage is depleted, and upward pressure is placed on natural gas prices (Tr. 3, at 511). The Company predicted that the addition of non-fossil-fuel-fired resources in New England would leave more natural gas available for electric generation, domestic heating, and industry (id.). Lower consumption would tend to reduce fuel prices for electric generation, thus lowering electric prices and the price of fuels for other purposes as well (Tr. 4, at 565-567). The Company asserted that the extent of renewable generation is one of the key factors influencing the availability and price of natural gas in the next few years (Tr. 3, at 512). The Company also predicted that displacement of fossil-fuel plants by the wind farm would tend to reduce the volatility of fuel prices and argued that the wind facility's projected high winter output would help offset tight winter gas supplies (Tr. 4, at 567-568).[135] The Company asserted that, because

[134] The Company initially asserted that operation of the wind farm would provide economic benefits for Cape Cod by lowering the locational prices paid by Cape Cod consumers under the ISO-NE congestion management pricing system (Exh. CW-1, at 2-4, 2-5, 2-17, 2-25). However, after further analysis, the Company concluded that it was unlikely that the wind farm would reduce locational prices specifically for Cape Cod customers (Exh. EFSB-RR-14).

[135] Cape Wind stated that the facility's output would be greatest from December through (continued...)

natural gas prices are sensitive to supply-and-demand conditions, a relatively small reduction in consumption in New England could result in a large price reduction (Tr. 18, at 2391).

Second, the Company asserted that development of the wind farm would increase the supply of new renewable power assigned RPS certificates, thus tending to reduce the price paid by consumers for compliance with the Massachusetts RPS (Exh. CW-1, at 2-5; Tr. 4, at 625-637). The Company stated that the upper bound on plausible bilateral prices for Massachusetts qualified RPS certificates would be $50 per MWh (Tr. 4, at 624). The Company estimated that increasing the supply of RPS certificates would lower the price of Massachusetts qualified RPS certificates by at least $5 per MWh (id. at 625-637). Using this estimate of $5 per MWh, the Company projected savings for Massachusetts customers of just over $40 million, for the period 2007 through 2010 (Exh. EFSB-RR-19; Tr. 4, at 644).

2. Alliance

The Alliance argued that the wind farm is too small to exert any significant downward pressure on fuel prices (Tr. 14, at 1907-1908). Further, the Alliance argued that there is no evidence that construction and operation of the Cape Wind generator would reduce the number of hours that the price-setting plant would be fossil-fueled, and argued that electricity prices will continue to be closely tied to fossil fuel prices in New England (Alliance Reply Brief at 31, n.24). In addition, the Alliance argued that fuel diversity does not offer benefits with regard to cost, but rather comes at a high price through subsidies (id. at 32).

3. Analysis

The Siting Board agrees with the Alliance that operation of the wind farm is unlikely to change the extent to which fossil-fueled plants set the market clearing price for electricity. However, the record indicates that the addition of non-fossil-fueled resources such as the wind farm to the regional energy supply could reduce demand for fossil fuels during periods of high electricity demand, and thus marginally reduce fuel prices during periods when gas and oil prices

[135] (...continued)
March (Exh. EFSB-RR-17).

are elevated due to high demand. The Company has not analyzed regional energy prices in sufficient detail to allow the Siting Board to determine the probability and likely magnitude of any ratepayer savings resulting from such an effect. The Siting Board therefore makes no finding regarding the economic benefits of the resource diversity provided by the wind farm.

With respect to the Company's second argument, the Siting Board notes that the RPS program imposes costs on load-serving entities in order to promote the use of renewable sources of energy. However, the supply and demand figures provided by the Company suggest that for several years there will be an insufficient number of RPS certificates whether or not the wind farm is built, so the estimated $40 million savings to Massachusetts customers is fairly speculative. The Siting Board therefore makes no finding regarding the level of consumer savings that would derive from the increased supply of RPS certificates provided by the wind farm.

C. Offsetting Costs

1. Alliance

The Alliance stated that ISO-NE would need to procure an increased amount of automatic generation control or other regulation services from existing generators, if the proposed wind farm were in operation, in order to compensate for the variability in output from the wind farm (Exh. APNS-JB-1, at 13, 19). The Alliance stated that electric customers would bear the cost of these regulation services (id. at 19).

2. Company

The Company stated that ISO-NE obtains regulation services to handle intra-hour variations in the load and resource balance on the electric system (Tr. 3, at 445). The Company explained that these intra-hour variations reflect both load and generation variations (id.). ISO-NE needs to be able to dispatch certain generators that can cover variations in demand and supply within an hourly period (id.).

The Company stated that the median error in its hour-ahead estimate of power generation would be about 10% of its capacity, or about 0.002% of New England peak load

(Exhs. CW-DCS-2-R at 14; EFSB-RR-7). The Company asserted that the wind farm would increase New England's regulation services requirements by 2% at most; it estimated that this additional cost would be a few million dollars per year, and thus much less than the estimated $25 million savings in wholesale electric costs (Exhs. CW-DCS-2-R at 26; EFSB-RR-11; Tr. 18, at 2289).

3. Analysis

The record indicates that ISO-NE may need to procure an increased level of automatic generation control or other regulation services if the wind farm is added to the grid, but that these additional costs would not exceed a few million dollars per year. The Siting Board finds that the cost of any additional regulation services made necessary by the wind farm would be significantly less than the expected displacement savings.

D. Conclusion on Economic Need

In the sections above, the Siting Board has found: (1) that operation of the wind farm would provide average annual savings of $25 million for New England customers, including $10 million annually for Massachusetts customers, during the first five years of operation; and (2) that the cost of any additional regulation services made necessary by the wind farm would be significantly less than the expected displacement savings. The Siting Board therefore finds that there is a need for the power generated by the wind farm for economic purposes during the first five years of operation.

A-V. Need for Energy: Environmental

A. Scope of Environmental Need

Cape Wind asserted that operation of the wind farm would provide the New England region with substantial benefits in the form of reduced system-wide emissions of pollutants, due to the displacement of fossil-fuel generators (Company Brief at 72). In support, the Company provided a dispatch analysis comparing regional emissions of sulfur dioxide ("SO_2"), nitrogen oxides ("NO_X"), and carbon dioxide ("CO_2"), with and without the wind farm (Exhs. CW-1, at

2-26 to 2-28; EFSB-RR-21).

The Alliance has argued that such an analysis is incomplete, in that it does not recognize other environmental impacts of constructing and operating the wind farm (Alliance Brief at 39). In support, the Alliance presented testimony on the noise impacts, fisheries impacts, and avian impacts of the proposed wind farm. Cape Wind also presented testimony on these impacts, as well as limited testimony on visual impacts, while arguing that Siting Board precedent limits the scope of the environmental need analysis to an analysis of comparative air emissions (Company Brief App. A at 8-10). Therefore, as an initial matter, the Siting Board must determine the scope of its review of environmental need for the wind farm.

Cape Wind accurately represents the Siting Board's precedent in this area. The Siting Board found need for a proposed facility for environmental purposes in four prior decisions – three involving generating facilities, and one involving a natural gas pipeline intended to provide an increased supply of natural gas to an existing generating facility. MMWEC Decision, 12 DOMSB 18, at 61-70; ANP Blackstone, 8 DOMSB 1, at 57-63; ANP Bellingham, 7 DOMSB 39, at 91-97; U.S. Generating Company, 6 DOMSB 1, at 43-45 (1997). In each of these cases, the need finding was based entirely on an analysis of the net reduction in air emissions that would result from the operation of a new generating facility, or from the increased use of natural gas at an existing generating facility, as documented by dispatch analyses showing expected emissions with and without the new power plant or fuel source.[136] Thus, in the past, the Siting Board has found environmental need based on an analysis of comparative air quality, without further analysis of other environmental impacts.

The Alliance has proposed expanding the environmental need analysis to include other impacts of the wind farm. An expanded environmental need analysis has not been warranted in past cases. However, the Siting Board notes that an expanded environmental need analysis may be useful in this case, because the wind farm's impacts likely would differ significantly both in

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[136] As mentioned earlier, after noting in the MMWEC Decision, 12 DOMSB 18, at 149, that identified economic and environmental benefits appeared modest, the Siting Board considered whether these benefits were outweighed by the environmental impacts of MMWEC's proposed pipeline project, and concluded they were not. See n.118, above.

type and extent from those of the generators that it would displace. However, the Siting Board notes that the environmental need analysis is a comparative analysis – it looks, not just at the impacts of the new facility, but at changes in regional impacts with and without the new facility. Therefore, an analysis of the impacts created by the operation of a new generator must be considered in the context of any changes in impacts caused by the displacement of other generators. For example, any analysis of the noise that would be produced by the operation of a new generator should be considered in the context of the possible reduction in noise at other locations caused by the less frequent dispatch of other generation facilities. In addition, a full comparative environmental analysis should take into consideration all important classes of environmental impacts, although impacts that either are minor, or are likely to be similar for the new and displaced generators, may be excluded.

In the following sections, the Siting Board considers the evidence provided by Cape Wind and the Alliance, placing it, where appropriate, into this comparative framework, and evaluating it on its merits and completeness.

B. Air Quality Impacts

1. Company

The Company stated that energy from the wind farm would be produced without perceptible air emissions, and would displace production of energy by fossil-fuel fired facilities in the region, thereby reducing regional emissions of criteria pollutants and CO_2 (Exh. CW-1, at 2-26, 2-27). To estimate the expected level of emissions displacement, the Company first estimated the annual energy output of the wind farm as 1437 GWh per year (id. at 2-17; Tr. 4, at 614). The Company then obtained marginal emission rates developed by ISO-NE in its NEPOOL Marginal Emission Rate Analysis for the year 2000 (Exh. CW-1, at 2-27; Tr. 5, at 657). The Company used these marginal emission rate data for SO_2, NO_X, and CO_2 to estimate the project's impact on state and regional emissions (Exhs. CW-1, at 2-27; EFSB-RR-21). The Company calculated that, had the wind farm been operating in 2000, regional air emissions in that year would have been reduced by approximately 4480 tons of SO_2, 1323 tons of NO_X, and 1,062,554 tons of CO_2 (Exhs. CW-1, at 2-28; EFSB-RR-21). The Company estimated that approximately 40% of these emissions reductions, including 1792 tons of SO_2, 529 tons of NO_X, and 425,022 tons of CO_2, would have been released by facilities within Massachusetts (Exh. EFSB-RR-20).

The Company estimated that future regional reductions would be substantial but would gradually decline as the mix of generation changes (Tr. 5, at 665-668, 694). The Company also claimed that operation of the wind farm would result in reductions in regional mercury and particulate emissions, but did not quantify these reductions (Exh. CW-1, at 2-28; Tr. 5, at 694-695).

2. Analysis

Cape Wind has estimated reductions in emissions based on the average emissions of power producers at the margin for dispatch in 2000, and the total amount of power expected to be delivered from the wind farm. The Company did not attempt to predict marginal emissions rates for future years, but argued that in the short term, emissions reductions generally would be comparable to those in 2000. In prior cases involving proposed generating facilities, the Siting Board has accepted analyses based on expected displacement of other generators and on ISO-NE data on marginal emissions rates, similar to those presented here by Cape Wind, as evidence of the facility's potential to reduce regional air emissions of certain pollutants. Sithe Edgar Development LLC, 10 DOMSB 1, at 21, 26 (2000); see also Brockton Power, 10 DOMSB 157, at 187-188, and Sithe Mystic, 9 DOMSB 101, at 132. However, we note that the marginal emissions rates will change over time with the retirement of older, less efficient generation, and the development of newer, primarily gas-fired units. Consequently, the Siting Board finds that, in the near term, operation of the wind farm would reduce regional air emissions by approximately 4480 tons of SO_2, 1323 tons of NO_X, and 1,062,554 tons of CO_2 annually, and would reduce Massachusetts air emissions in Massachusetts by approximately 1792 tons of SO_2, 529 tons of NO_X, and 425,022 tons of CO_2 annually. The Siting Board also finds that, given its zero-emissions profile, operation of the wind farm will result in long-term reductions in regional and Massachusetts air emissions of unknown size.

C. Noise

1. Company

The Company's noise witness, Peter Guldberg, asserted that operational noise from the proposed wind farm would not be audible from onshore locations or to boaters (Exh. CW-PHG-1, at 5). Mr. Guldberg also asserted that underwater noise would "disappear into the ambient background sound levels of the sea" at distances over 110 meters (360 feet) and that it is unlikely that project operation would be audible to seals or porpoises (id. at 6, 7).

In support, Cape Wind presented a preliminary draft of its analysis of baseline and project noise levels. The Company indicated that it had collected baseline sound data at two offshore locations and at three coastal locations (Exh. EFSB-SS-22-S, Att. at 5-114). The two offshore locations were at Buoy G5 in the North Shipping Channel, about one mile north of the edge of the proposed wind farm, and at Buoy R20 at the edge of the Main Channel, about 1/3 mile south of the proposed wind farm (id. at 5-116). The three coastal locations were: 100 feet inland from the high water mark of a south-facing beach at Point Gammon in Yarmouth, 4.7 miles from the closest turbine; 80 feet inland from the high water mark at Oregon Beach in Cotuit, specified in the draft as 5.5 miles from the closest turbine; and 40 feet inland from an east-facing beach at Cape Poge in Edgartown, specified as 5.4 miles from the closest turbine (id. at 5-116, 5-120, 5-121).

The Company stated that it collected baseline sound levels from the two offshore buoy locations under conditions of clear skies, light winds, and light seas for periods of 20 minutes each between 10 a.m. and 12 noon on October 22, 2002 (id. at 5-118, 5-119). The time-averaged sound levels ("L_{eq}") at Buoys G5 and R20 were 46 and 51 dBA, respectively (id. at 5-119). Sound levels exceeded 90% of the time ("L_{90}") at Buoys G5 and R20 were 35 dBA and 37 dBA, respectively (id. at 5-119; Tr. 19, at 2586). Identified sources of the sound measured at the offshore buoys included aircraft, vessels, and waves slapping on the hull of the boat used for monitoring (Exh. EFSB-SS-22-S, Att. at 5-119; Tr. 19, at 2624).

The Company stated that it selected Point Gammon, Oregon Beach, and Cape Poge for background monitoring because they are coastal locations remote from high traffic areas (Exh. EFSB-SS-22-S, Att. at 5-119, 5-120). Measurements were collected over periods of four to seven days in November and early December 2002 under a variety of wind conditions (id. at 5-120, 5-121).[137] At the lowest wind speed at which the turbines would generate power ("cut-in wind speed"), one-hour average L_{eq} sound levels ranged from 41 to 63 dBA (id. at Table 5-19). L_{eq} sound levels with an on-shore wind at the design wind speed were higher, ranging from 54 to 71 dBA (id. at Table 5-19). L_{90} sound levels ranged from 27 to 70 dBA, including a range of 34 to 66 dBA at the cut-in wind speed, and a range of 50 to 67 dBA with an on-shore wind at the design wind speed (id. at Table 5-19). Identified sources of sound at various locations included wave noise, wind, birds, aircraft, motor vehicles, and vessels (id. at 5-120, 5-121, 5-125).

The Company presented data provided by the prospective turbine manufacturer, General Electric, indicating that the total sound energy emitted by a single turbine ("sound power") would be 95 dBA at the cut-in wind condition, and 107 dBA at the design wind condition (id. at 5-115; Exh. CW-PHG-1-R, Att. A). For comparison, the Company indicated that an outboard motorboat or a typical diesel fishing boat could have a sound power level as high as 122 dBA (Exh. EFSB-RR-77; Tr. 15, at 2591). The Company indicated that the sound power of 130 turbines would be similar in magnitude to the sound power of a single powerboat, but that the distribution of sound frequencies could be very different (Tr. 19, at 2592-2594).

The Company modeled sound attenuation between 130 operating turbines located on Horseshoe Shoal and several locations (including the five baseline noise monitoring locations) under various wind conditions (Exh. CW-PHG-1-R, Att. A). The predictions were based on hemispherical sound wave divergence and atmospheric absorption of sound (Exh. EFSB-SS-22-S, Att. at 5-115; Tr. 19, at 2617).[138] The Company claimed that, excepting very low frequency

[137] The Company measured sound levels in a series of frequency bands and also provided A-weighted sound levels for various wind conditions, including baseline sound levels at a cut-in wind speed (8 mph at the turbine height, or about 5 mph at 10 feet above the ground at Hyannis Airport) (Exh. EFSB-SS-22-S at 5-121; Tr. 19, at 2572). Among conditions when the turbines operate, ambient noise would be lowest at the cut-in wind speed (Tr. 19, at 2574).

[138] The Company included cylindrical spreading in its model, starting 2 kilometers

(continued...)

sound, any relative enhancement of sound resulting from a temperature inversion and/or downwind receptor location is necessarily less than the excess diminution of sound caused by other factors (Exh. CW-PHG-1, at 4; Tr. 18, at 2406-2416).[139] The Company therefore did not make any separate prediction for enhanced propagation attributable to temperature or wind gradients (Tr. 18, at 2414).

The Company noted that turbine noise would be greater at the design wind speed than at the cut-in wind speed, but that background noise would generally increase by as much or more (Exh. EFSB-SS-22-S, Att. at Table 5-27). The Company predicted that the sound level from the wind turbines would be 30 dBA and 34 dBA at Buoys G5 and R20, respectively, at the cut-in wind speed, and 40 dBA and 45 dBA at design wind speed (id. at 5-125, 5-126). The Company predicted that the sound level from the wind turbines, as measured at Point Gammon, the closest point of land, would be 18 dBA at the cut-in wind speed, and 26 dBA at the design wind speed, with onshore winds (id. at figs. 5-40, 5-50). The data show that the modeled sound most closely approaches background levels in the frequency band around 80 cycles per second (Hz) (id.). In the 80 Hz band, the sound level at Point Gammon would be 34 dB at the cut-in wind speed

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138 (...continued)
downwind from turbines, only for low frequencies outside the range of human hearing (below 20 Hz), and only for times when winds exceed 20 mph (Exh. EFSB-SS-22-S, Att. at 5-115).

139 The Company provided ANSI and EEI descriptions of how sound waves can be bent toward a low-elevation receptor when the wind speed near the surface is lower than wind speeds aloft and the wind is toward a receptor, and/or when air temperatures near the surface are lower than air temperatures aloft (Exhs. CW-PHG-1-R, Att. E; EFSB-RR-78, Att.). However, the Company asserted that any tendency for sound to carry long distances due to temperature gradients and/or wind gradients is always overwhelmed by additional attenuation attributable to factors such as absorption by surfaces and turbulence (Exh. CW-PHG-1, at 4; Tr. 18, at 2406-2416). The Company's witness identified these other factors as: (1) imperfections in the reflectivity of the sea surface when it is not glassy smooth; (2) upward bending of sound waves due to cooler temperatures aloft in high wind conditions; (3) excess attenuation due to turbulence; and for inland receptors, (4) sound absorption by grass, trees, structures, and other barriers (Tr. 18, at 2415-2416).

(id. at Fig. 5-40).[140] At the location with the quietest (average) background level, Cape Poge on Martha's Vineyard, the Company predicted 17 dBA, with 33 dB in the 80 Hz band, as the maximum continuous level from project operation at the cut-in wind speed (id. at Fig. 5-48).

Table A-3, below, compares the Company's modeling and monitoring results for the cut-in wind speed, at which wind turbine noise is more likely to be noticeable, for representative locations.

Table A-3
Comparison of Modeled Sound Levels to Baseline Sound at Cut-In Wind Speed

MODELED SOUND RECEPTOR LOCATION	Distance from Wind Farm (miles)	Baseline Sound at Cut-In Wind Speed: Lower Range of L_{90}		Modeled Turbine Noise at Cut-In Wind Speed		Wind Farm Sound Level as Compared to Baseline	
		Full Spectrum (dBA)	80 Hz band (dB)	Full Spectrum (dBA)	80 Hz band (dB)	Full Spectrum (dBA)	80 Hz band (dB)
Buoy G5	1	35	NA	30	43	-5	NA
Buoy R20	0.37	37	NA	34	46	-3	NA
Point Gammon	4.7	39.6	39	17.8	34	-22	-5
Oregon Beach*	NA	34	20	17	34	-17	14
Cape Poge	5.4	40	29	17	33	-22	4

* Baseline monitoring data from Oregon Beach in Cotuit are compared to sound levels modeled for Wianno Beach. Data sources: Exhs. CW-PHG-1, at 6; EFSB-SS-22-S; EFSB-RR-76, Att. (Rounding and subtraction by EFSB staff).

The Company asserted that a sound would be inaudible if its full spectrum L_{eq} sound level were less than the baseline sound level, unless a pure tone situation were to result (Exh. EFSB-SS-22-S, Att. at 5-122; Tr. 19, at 2629-2630).[141] The Company concluded that the turbines would be inaudible on the basis that the Company's modeled A-weighted sound levels

140 The Company indicated that the project sound spectrum has an energy peak at 80 Hz (Exh. EFSB-RR-76).

141 Within the context of audibility, the Company defines a pure tone as a 1/3-octave band that is 5 to 15 decibels higher than the mean of the two adjacent 1/3-octave bands (Exh. EFSB-SS-22-S, Att. at 5-122).

from the wind farm are lower than its measured average baseline sound levels (Exh. EFSB-SS-22-S, Att. at 5-122).

The Company stated that there are four planned perimeter foghorns which would operate during foggy conditions only (Tr. 19, at 2596). Sound power levels of the foghorns were not provided but the Company asserted that the foghorn sound has a range of one-half mile and would not be audible from shore (Exh. EFSB-SS-22-S, Att. at 5-127; Tr. 18, at 2386-2387).

2. Alliance

Erich Bender, Sc.D., the noise witness for the Alliance, contended that operational noise from the proposed wind farm would be audible both by boaters and from onshore locations, under some meteorological conditions (Exh. CW-APNS-EB-1, Att. at 3). Dr. Bender stated that the spherical spreading model used by Cape Wind would apply only in the absence of temperature inversion and wind gradients (Tr. 12, at 1593). Dr. Bender contended that the Company was incorrect in its assertion that wind and temperature gradients could not effectively focus sound and that any such effect would be overwhelmed by other types of attenuation (Exh. APNS-EKB at 3, 4; Tr. 12, at 1592-1598, 1677). Specifically, Dr. Bender suggested that cylindrical spreading would be more appropriate than spherical spreading as a model for the geometric dispersion of sound power at distances beyond about 300 or 600 feet from a source, for downwind receptors under certain meteorological conditions (Tr. 12, at 1618-1619, 1672). Dr. Bender stated that spherical spreading causes a reduction in sound pressure of 6 decibels with each doubling of distance, whereas cylindrical spreading reduces sound pressure by 3 decibels with each doubling of distance from a sound source (id. at 1597-1598). For instance, the difference between cylindrical spreading and spherical spreading between 1 km (3300 feet) and 8 km (5 miles) would be 9 decibels since there are three doublings of distance (id. at 1615). Using noise data collected in the late 1980s for a variety of turbines, and assuming cylindrical spreading beyond 300 meters, Dr. Bender estimated that turbine sound levels in shoreline residential areas would be 45 dBA to 55 dBA (Exhs. APNS-EKB at 4; EFSB-APNS-21; CW-APNS-EB-1, at 5; CW-APNS-EB-1-C at 3; EFSB-RR-59; Tr. 12, at 1603, 1618, 1634, 1642, 1649).

3. Analysis

The Company has provided modeling that predicts that the noise contribution of the wind turbines would be less than background sound levels at representative onshore and offshore locations. The Company's analysis predicts that wind farm noise would be 17 to 22 dBA less than background at onshore locations, and 3 dBA less than background at offshore receptors. The Company's modeling also predicts that noise from the wind turbines may surpass background sound levels in a low frequency band around 80 Hz at some coastal locations.

The Company's calculations reflect an assumption that sound in frequencies within the range of human hearing would spread hemispherically. The Alliance has challenged Cape Wind's assumption, arguing that a cylindrical dispersion model is more appropriate for certain meteorological conditions.[142] The Company asserts that, even when meteorological conditions enhance downwind sound propagation, other effects (e.g., air turbulence) would provide enough sound attenuation to keep noise from the wind farm at or below modeled levels.

The Siting Board notes that, since there is little to block or absorb sound traveling over open water, it is likely that sound will travel better than predicted by the Company at times when enhanced by wind or pressure gradients. Thus, actual sound levels at onshore receptors may occasionally exceed the sound levels listed in Table A-3, above. The extent to which these levels may be exceeded has not been established in this record. However, the Alliance's testimony suggests that, at times when sound spreads cylindrically beginning at 1 kilometer from the wind farm, actual sound levels at onshore receptors could temporarily exceed the levels listed in Table A-3 by up to 9 dBA; this would result in onshore noise levels that are 8 dBA to 13 dBA below background levels. These figures do not account for absorption of sound by the water surface, turbulence of the air, or other factors that would affect sound levels at receptor locations.[143]

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142 The record shows that sound propagation may be enhanced by: (1) temperature inversion, where air near the ground is cooler than air aloft; (2) wind blowing towards receptor locations; and (3) relatively calm water.

143 The Siting Board notes that there are several unquantified effects, including the

(continued...)

The Company asserts that sound sources are inaudible if their A-weighted sound level is less than background, except in cases where a pure tone results. The Siting Board has never assessed thresholds of audibility; however, in prior cases where the Siting Board has reviewed projected ambient increases in the L_{90} sound level, witnesses have testified that increases in ambient sound of less than 3 dBA would not be perceptible as an increase in noise. See ANP Blackstone, 8 DOMSB 1, at 159; Nickel Hill Energy LLC, 11 DOMSB 83, at 181 (2000). Even the enhanced sound levels discussed above would not result in a 3 dBA increase in sound levels at onshore receptors. The Siting Board therefore concludes that total sound levels at the onshore monitoring locations selected by the Company would not be appreciably increased. However, because sound levels in the 80 Hz (low frequency) band are modeled as exceeding background levels at certain coastal locations, and because modeled levels may be exceeded, we conclude that low-pitched sound from the turbines might be distinguishable from background noise under certain meteorological conditions. It also appears likely that turbine noise would be heard by some boaters.

Based on the record, the Siting Board finds that, while the wind farm may be audible onshore when meteorological conditions permit, the noise levels produced by the wind farm would be lower than background noise levels onshore, and would not result in a perceptible increase in the overall noise levels at shore locations. The record does not contain information on the potential changes in noise levels at other locations that would result from the less frequent operation of generators displaced by the wind farm. However, the Siting Board notes that many fossil-fueled generators are located in close proximity to residential areas and result in significant increases in overall noise levels when operating. Therefore, the Siting Board finds that the noise impacts of the wind farm are likely to be less than those of many of the generators it would displace.

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[143] (...continued)

potential range of actual sound wave spreading geometries, any variations in turbine sound output over time, absorption due to air turbulence, and absorption by the water surface, that would cause sound levels to differ from any predictions made here.

D. Fisheries

1. Company

The Company asserted that benthic habitat conditions are very similar throughout much of Nantucket Sound (Exh. CW-CJN/SBW-2-R at 10). The Company asserted that adult and juvenile finfish are considerably mobile in the water column and would be capable of moving away from construction activities (id. at 11-12). The Company therefore asserted that finfish would be able to go elsewhere while marine construction activities are occurring (id. at 10-11).

The Company characterized the seabed as having lower invertebrate diversity than other areas off southern New England, but having high biomass and density (id. at 18).

The Company commissioned and provided a scour analysis which found that scour around the turbine pilings could reasonably be expected to a depth of 4.1 feet, with scour extending laterally as much as 33.1 feet from a pile (Exh. EFSB-SS-22, App. 5-B, at 7). The scour analysis concludes that it is not realistic to conclude that the pilings will have long-term, far-field effects on the composition of Horseshoe Shoal (id. at 7). To mitigate near-field effects, the Company proposes to install scour control mats (id. at Fig. 4).

Cape Wind asserted that criticism by Dr. LeGore and Mr. Weissman of the extent of its fisheries studies was based on information provided in the ENF for the project, rather than on the full case record (Exh. CW-CJN/SBW-2-R at 2, 4, 10, 15-16). Cape Wind contested some of Mr. Weissman's assertions about studies being inadequate. The Company qualitatively characterized investigations it had undertaken as numerous, extensive, and comprehensive (id. at 8, 17).

2. Alliance

Richard S. LeGore, Ph.D., provided testimony on potential benthic (sea-bottom) impacts of the wind farm. Dr. LeGore estimated that over 2 million cubic yards of sediment would be fluidized during project construction, and asserted that the habitat alteration associated with rearranging sediments by jet plow had not been properly characterized (Exh. APNS-RSL at 13-15; Tr. 17, at 2157). Dr. LeGore asserted that analysis is needed of the marine effects of construction noise, anchor line sweep during the construction of pilings, and scouring around the base of pilings (Exh. APNS-RSL at 15, 17-18).

Dr. LeGore estimated that over 245,000 square feet of new hard surfaces would be created for colonization on piling surfaces, plus an unknown amount of hard surfaces in riprap (Exh. APNS-RSL at 16). This would affect local biological communities, which Dr. LeGore asserted should be characterized, whether positive or negative (id. at 16-17). Specifically, Dr. LeGore asserted that the level of environmental impact analysis for the project has been inadequate (id. at 4-19).[144] Dr. LeGore indicated that the characterization of existing benthic life was inadequate and criticized the characterization of bottom sediments (id. at 4-11; Tr. 17, at 2178).

Mark Weissman, also an Alliance witness, provided testimony on the value of fisheries habitat in Nantucket Sound. Mr. Weissman pointed out that the area supports a high level of fishing and boating (Exh. APNS-MW at 4). Mr. Weissman stated that Nantucket Sound has been designated EFH for sea clam (*Spisula solidissima*), long-finned squid (*Loligo pealei*), short-finned squid (*Illex illecebrosus*), blue shark (*Prionace glauca*), Atlantic mackerel (*Scomber scombrus*), king mackerel (*Scomberomorus cavalla*), Spanish mackerel (*S. maculatus*), bluefin tuna (*Thunnus thynnus*), Atlantic cod (*Gadus morhua*), winter flounder (*Pleuronectes americanus*), yellowtail flounder (*P. ferruginea*), windowpane (*Scopthalmus aquosus*), fluke (*Paralichthys dentatus*), Atlantic butterfish (*Peprilus triacanthus*), scup (*Stenotomus chrysops*), and black sea bass (*Centropristus striata*) (id. at 5-6; Tr. 12, at 1683-1684).[145] Mr. Weissman stated that long-finned squid are believed to spawn on Horseshoe Shoal, and that individuals tend

144 Dr. LeGore's criticisms include inadequate description of sampling, possibly too coarse sampling, lack of replicates, lack of description of heterogeneity and spatial variations, lack of seasonal stratification in sampling, inadequate particle size analysis, inadequate statistical analysis of diversity, taxonomic imprecision, and lack of analysis of larger mobile species such as whelks, crabs, and lobster, and incomplete statistical evaluation of the data (Exh. APNS-RSL at 4-11; Tr. 17, at 2159-2162, 2194-2199). Dr. LeGore asserted further that the evidence presented by the Company does not include the linear feet of jet-plowing that would be required to join turbines to the ESP (Exh. APNS-RSL at 13).

145 The Company also listed shortfin mako shark (*Isurus oxyrhinchus*) and cobia (*Rachycentron canadum*) as species with EFH in the project area (Exh. CW-2, at 7-16).

to return to their hatch location as spawning adults (Exh. APNS-MW at 17). Mr. Weismann asserted that bluefish (*Pomatomus saltatrix*), striped bass (*Morone saxatilis*), tautog (*Tautoga onitis*), bonito (*Sarda sarda*), herring, and alewives (*Brevoortia tyrannus*) are present in large numbers, as well (id. at 9).

Mr. Weissman stated that, compared to Georges Bank, Nantucket Sound has lower biomass levels but a more intensive recreational fishery (id. at 7). On the commercial side, Mr. Weissman stated that a majority of the state's 40 permitted spring squid draggers, 58 permitted fluke draggers, and 32 black sea bass potters work Nantucket Sound, and also that 11 of the State's weirs are in Nantucket Sound (id. at 11). Mr. Weissman asserted that the fish surveys conducted by Cape Wind were inadequate to characterize the fishery (id. at 7-10). Aside from effects on fish habitat, Mr. Weissman expressed concern about the ability of draggers and trollers to maneuver among the turbines while towing their nets and lines (id. at 19).

Mr. Weissman characterized Horseshoe Shoal as a large, well-established fish aggregating structure with considerable physical stability (id. at 14; Tr. 12, at 1696-1697). Mr. Weissman stated that the catch in Nantucket Sound annually returns some tens of millions of dollars to local fishermen and is important to the economy of Cape Cod and to Massachusetts (Exh. APNS-MW at 13). Mr. Weissman asserted that construction activities would cause mortality of benthic fauna, eggs, and juvenile fish, and would also cause dispersal of juvenile and adult fish and invertebrates (id. at 17).

Mr. Weissman asserted that the proposed turbine pilings would likely create continuous turbulence, erosion, and gullying due to strong tidal currents moving across Horseshoe Shoal (Exh. APNS-MW at 16; Tr. 12, at 1689-1690). He asserted that the existing shoal structure would likely be disrupted and replaced by large gullies and ridges (Exh. APNS-MW at 16, 18). Also, Mr. Weissman asserted that some fish species are attracted to vertical structures but that others avoid them (Tr. 12, at 1691). Mr. Weissman asserted that the import of such changes cannot be determined at this time but could be detrimental or beneficial (Exh. APNS-MW at 16, 18).

3. Analysis

As highlighted by Dr. LeGore, field studies of sea bottom life at Horseshoe Shoal have been limited, at least as reflected in the record of this case. The Company's argument that benthic habitat conditions are homogeneous is difficult to confirm without an extensive analysis of many sampling locations. However, it is not the role of the Siting Board to determine the scale and design of studies of the risk to fisheries posed by the proposed turbines, which are located outside of state waters. Benthic and fisheries studies will be evaluated by the ACOE as part of its review of the wind farm.

It is difficult to predict the scope of benthic and fishery implications of installing the turbines and connecting cables. The installation may alter the species composition in the area immediately surrounding the monopiles; however, the record does not demonstrate that the benthic and fishery impacts of the wind farm would extend beyond the area of the turbines. Mr. Weissman points out that Horseshoe Shoal in its present configuration is a beneficial feature from the point of view of fish and fisheries; consequently, any alteration carries with it some risk of disturbance to the existing marine community. However, the record provides no clear indication whether and to what extent any changes caused by the project would be, on balance, beneficial or harmful to the marine benthic community, shellfish, finfish, or fisheries.[146] The Siting Board therefore makes no finding with respect to the wind farm's impact on fisheries.

E. Birds

1. Company

The Company's witness, Paul Kerlinger, Ph.D., stated that he participated in a number of field and literature studies related to avian risk associated with the proposed wind farm (Exh. CW-PK-1-R, Att. A at 3). Dr. Kerlinger contended that avian risks would be low because: (1) bird use of Horseshoe Shoal is relatively low; and (2) the bird species that are present are not

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[146] The Siting Board notes that a small number of fossil-fueled generators, primarily those that use once-through cooling, have significant negative fisheries impacts. However, since these plants are only a fraction of the New England generating fleet, we do not include off-setting fisheries impacts from displaced generation in our analysis of the environmental need for the wind farm.

likely to collide with the turbine rotors (id. at 4). Dr. Kerlinger also contended that generating electricity with wind power would have advantages for birds, compared to combustion of coal, oil, and natural gas (id. at 4 to 8).

Dr. Kerlinger contended that among a dozen or more wind power facilities in the United States, excluding Altamont Pass, California, estimated avian fatalities have averaged about two birds per turbine per year (id. at 10). Dr. Kerlinger stated that bird mortality was low at wind power sites in Minnesota and Montana that he characterized as having relatively high use by waterfowl and raptors (id. at 11). Dr. Kerlinger indicated that wind turbines in California and in Spain had high raptor mortality (id.; Tr. 20, at 2704). He stated that these areas had dense resident and/or migratory populations of raptors that used the areas of the turbines (Exh. CW-PK-1-R, Att. A at 12; Tr. 20, at 2704). Dr. Kerlinger speculated that the high bird mortality at the Altamont Pass wind power site may be due to the close spacing of turbines, the irregular topography of the site, and unusually high level of site use by raptors (Exh. CW-PK-1-R, Att. A at 13, 15). Dr. Kerlinger stated that migrating songbirds have had large-scale fatality events from communication towers (Tr. 20, at 2693-2694). He stated that the vast majority of avian fatalities from communication towers have occurred at towers taller than 500 feet with guy wires and Federal Aviation Administration ("FAA") lighting that does not blink; some fatalities also occur at other types of towers which have associated spotlights or sodium vapor lamps (Exh. CW-PK-1-R, Att. A at 21). Dr. Kerlinger indicated that the FAA requires flashing lights on wind turbines, rather than steady lighting (id. at 22)

The Company described the Cape Wind turbines as having blades extending from 75 feet above the water surface to 416 feet high, and as being spaced at least 1400 feet apart (id. at 15). The Company calculated the collision probability for birds flying through the plane of the rotor of a single turbine, for representative species. The Company calculated that the chance of a blackpoll warbler being hit by a blade is less than one percent, while a much larger black-backed gull flying through the same area would have a 5.6 % chance of being hit by a blade; these calculations assume no evasive action by the birds (Exh. EFSB-RR-71).

Dr. Kerlinger discussed the likelihood of collision risk among various orders of birds, in the context of the Horseshoe Shoal site. Birds that might be present include various groups of waterbirds including seabirds, waterfowl, and shorebirds; raptors; and migrating landbirds. He stated that loons, grebes, and alcids are not common in the area, and furthermore tend to fly low over water, suggesting that these birds would not be struck by a blade (Exh. CW-PK-1-R, Att. A at 15, 20). Among pelagic seabirds, Dr. Kerlinger indicated that gannets tend to fly as high as the rotor-swept area, but these birds are not generally abundant in Nantucket Sound (id. at 22; Tr. 20, at 2691).

Dr. Kerlinger stated that a quarter million long-tailed ducks roost in Nantucket Sound in the winter but conceded that the nocturnal location of long-tailed ducks within Nantucket Sound is not well established (Tr. 20, at 2708-2713). He stated that long-tailed ducks and other sea ducks such as scoters and eiders fly low over water, generally below 50 feet, and that some of these species have been observed in Europe to fly around wind turbines (Exh. CW-PK-1-R, Att. A at 15, 20; Tr. 20, at 2688-2689). On the other hand, he stated that brant tend to migrate at a very high elevation (Tr. 20, at 2691).

Dr. Kerlinger indicated that shorebirds coming off the east coast of North America generally reach altitudes above 1000 feet within a few miles of the shoreline (id. at 2697). He asserted that piping plover and least terns, which are protected species, do not forage in the area and rarely fly over Horseshoe Shoal, based on species habitat preferences (Exh. CW-PK-1-R, Att. A at 18). He also asserted that these species have not been shown to be collision prone (id.). Dr. Kerlinger indicated that there is some overlap between the height at which foraging terns fly and the lower end of turning blades (Tr. 20, at 2714-2715). He indicated that roseate terns departing staging areas at Monomoy Island at the end of the summer would tend to fly out over the Atlantic, and would therefore tend to miss Horseshoe Shoal (id. at 2686). However, Dr. Kerlinger did not offer information on the arrival time or direction of arrival of terns in the spring (id. at 2686-2687). Gulls, which are common in the area, and cormorants tend to fly higher over water than most other waterbirds; consequently, they would be at the height of blades more often than other birds; however, Dr. Kerlinger indicated that these birds typically do not collide with turbines or towers in other locations (Exh. CW-PK-1-R, Att. A at 34-35; Tr. 20, at 2691).

Dr. Kerlinger stated that raptors rarely migrate across Horseshoe Shoal, preferring to take routes over land as much as possible (Exh. CW-PK-1-R at 15; Tr. 20, at 2681-2683).
Dr. Kerlinger stated that migrating songbirds tend to fly higher over water than over land (Tr. 20, at 2697). Dr. Kerlinger predicted that because the wind turbines and the ESP would lack steady and intense lighting, would lack guy wires, and would be less than 500 feet tall, the turbines would not attract significant numbers of night flying migratory birds (Exh. CW-PK-1-R, Att. A at 21; Tr. 20, at 2719-2720).

Dr. Kerlinger stated that data from the National Wind Coordinating Committee indicate that an average of about 2 birds are killed per turbine per year (Exh. EFSB-RR-80). He stated that turbines at the Waddensee, a coastal lake in the Netherlands with a high level of bird activity, kill an average of 0.04 to 0.14 birds per turbine per day, which is 8 to 25 times higher than the North American average (Tr. 20, at 2706). He indicated that in his opinion, the wind farm would have mortality rates lower than those at the Waddensee (id. at 2705-06). Allowing for uncertainties, Dr. Kerlinger expressed confidence that bird mortality from the wind farm would not exceed 4 birds killed per turbine per year (id. at 2708).

Asked for comparisons, Dr. Kerlinger provided estimates based on research conducted by others (Exh. EFSB-RR-80). He cited information that free ranging cats kill many birds, with an estimate from Wisconsin of between 3.9 and 143 birds killed per cat per year (id.). He cited studies of bird mortality from collisions with windows, yielding estimates ranging from 0.65 to 33 birds killed per house per year (id.). As an average among a thousand television broadcast towers over 800 feet in height, Dr. Kerlinger provided an estimate of 1250 birds killed per tower per year (id.).

Dr. Kerlinger indicated an understanding that fossil fuel use was detrimental to bird populations (Exh. CW-PK-1-R, Att. A at 6-8; Tr. 20, at 2719).

2. Alliance

The Alliance's witness, Michael Morrison, Ph.D., also provided testimony on potential impacts to birds. Dr. Morrison indicated that wind turbines at Altamont Pass, California, have a high incidence of bird kills (Exh. APNS-MLM at 2). He asserted that there are virtually no data on the impact of offshore wind developments on birds, and no data on wind farms of the size proposed (id. at 2). Dr. Morrison also asserted that standard guidelines recommend multiple years of intensive, rigorous avian data collection prior to wind farm construction (id. at 3). Dr. Morrison contends that insufficient data have been collected in the project area on bird abundance, bird movement, and bird behavior, and that the data that have been collected are flawed (id. at 3, 4).

Dr. Morrison asserted that Dr. Kerlinger's statements about a lack of mortality from towers less than 500 feet tall are untested due to an absence of long-term studies of such towers (id. at 27). Dr. Morrison also indicated that existing data on bird collisions at wind farms in North America come primarily from the west, which, he suggested, would not represent conditions in the east (id. at 27, 28).

Dr. Morrison stated that studies from Altamont Pass indicate that turbines with a larger rotor-swept area tend to kill more birds than do smaller turbines (Tr. 19, at 2470). He also stated that most of the bird fatalities occur at a small number of turbines in particular locations, usually near the end of a ridge (id. at 2474). Dr. Morrison said studying bird mortality at offshore wind parks in Europe was difficult because stricken birds sink or get eaten immediately (id. at 2476).

Dr. Morrison indicated that he was unable to estimate the potential hazard to birds from the Cape Wind turbines due to inadequate data (id. at 2555-2556). In response to additional questioning, Dr. Morrison stated that avoidance of air pollution would be beneficial to birds, and that extraction of fossil fuels has potential negative impacts on bird habitat (id. at 2527-2529).

3. Analysis

Cape Wind has provided evidence leading to a conclusion that bird mortality associated with operation of the wind farm would be no more than four birds per turbine per year, which is relatively low compared to some other hazards to birds. The Alliance has challenged this estimate, arguing primarily that the available bird studies were not sufficiently thorough to make accurate projections.

As of the close of the record, actual field studies of bird usage of Horseshoe Shoal were limited. Nevertheless, the record does contain an evaluation of potential risks of avian mortality based on a combination of field visits, historical knowledge of regional bird activity, characteristic behavior of birds using the area, and observed mortality due to structures including wind turbines at other locations. The record shows that there is high raptor mortality at the Altamont Pass wind turbines associated with high raptor use of the area. The record shows that circumstances at Horseshoe Shoal would differ from those at Altamont Pass, so that high raptor mortality would not be expected. The witness for Cape Wind provided information sufficient to support an estimate of mortality of no more than four birds per turbine per year; this translates to no more than 520 birds per year in aggregate. The record shows that this mortality rate is relatively low compared to some other hazards faced by bird life.

However, there are some factors that have not been adequately determined to date. Specific uncertainties identified during the hearings include the circumstances of tern arrival in the spring; the vulnerability of foraging roseate and common terns to rotor collisions; and the spatial distribution within Nantucket Sound of the large winter population of roosting long-tailed ducks. Behavior of brant around turbines may need to be investigated as well. Also, there is uncertainty as to the possibility of high mortality events in atypical weather conditions. Some of these issues may well be resolved in ongoing proceedings before other federal and state regulatory agencies.

Based on the record, the Siting Board finds that the wind farm would cause avian mortality, but that the mortality would be modest relative to some other causes of avian mortality. Uncertainty remains as to the wind farm’s likely effects on several avian species. The Siting Board notes that the record contains only qualitative information on the potential benefits to birds of reduced operation of existing fossil-fueled generating facilities, based on air emissions and oil spills. Moreover, in past reviews of generating facilities, the Siting Board has not investigated adverse impacts on birds either from emissions or fuel handling; therefore, it cannot draw on its findings in those cases. The Siting Board therefore makes no finding as to the extent of any benefits to bird populations resulting from the displacement of other power plants by the wind farm.

F. Visual Impacts

1. Company

The Company indicated that the proposed wind farm would consist of 130 wind turbines, each approximately 420 feet in height from the water to the top of the blade, arrayed over an approximately 24 square mile area of Horseshoe Shoal in Nantucket Sound (Exhs. CW-1, at 1-3; CW-2, at 2-2 to 2-3; EFSB-SS-22-S, Att. at Table 5-6; EFSB-RR-22; EFSB-RR-23). The closest land locations in different directions from the wind farm include Point Gammon in Yarmouth, 4.7 miles to the north, Cape Poge on Martha's Vineyard, 5.5 miles to the southwest, and points in Nantucket approximately 11 miles to the south and southeast (Exhs. EFSB-RR-22, Att.; EFSB-RR-23, Att.).

The Company stated that the theoretical maximum distance of visibility of a 420-foot structure located at sea, from a point 10 feet above sea level, is approximately 27.1 nautical miles, or 31.2 statute miles, based on standard visibility charts (Exh. EFSB-RR-22). Charts provided by the Company show that all of Nantucket Sound is within 27.1 nautical miles of Horseshoe Shoal (Exh. EFSB-1).

The Company asserted that a number of factors would affect the visibility of the wind farm, including sky cover, curvature of the earth, color of the turbines, and presence of line-of-sight obstructions (Exh. EFSB-RR-22). The Company provided visual simulations from twelve representative locations on Cape Cod, Martha's Vineyard and Nantucket, at distances from the wind farm ranging from 5.4 miles to 14.1 miles (Exh. EFSB-RR-22, Att.). Wind turbines are generally visible in the simulations, although their appearance varies based on the context of respective views (id.).[147, 148] The Company stated that the simulations are

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[147] The vertical and horizontal scale of the wind farm, as it appears in the view simulations, varies based on the distance from the vantage point to the wind turbines (Exh. EFSB-RR-22, Att.). For example, in the views from the closest vantage points, the wind turbines along the horizon generally extend to all or nearly all of the view field, while in the most distant views they generally extend to a portion of the view field (id.). The varying width of the wind farm, as seen from different vantage points measured perpendicular to the line of sight, also affects how much of the view field in each simulation is encompassed by the array of wind turbines (id.). The total view field of (continued...)

conservative, in that the sky cover conditions are assumed to be clear in all of the views (Exh. EFSB-RR-22).

2. Analysis

The Company has provided visual simulations indicating that the wind farm's turbines would be visible from points on the surface of Nantucket Sound, excepting some shoreline embayments, and from points on Cape Cod, Martha's Vineyard, and Nantucket with water views toward Horseshoe Shoal. The Company's simulations suggest that the appearance of the wind farm would vary based on distance and other factors. As seen from the nearest vantage points in the Company's analysis – generally coastal points located five to seven miles away in Barnstable and Yarmouth on Cape Cod and on the northeast side of Martha's Vineyard – the wind farm would appear as extending over a substantial portion of the seaward horizon in each simulation, creating significant visual impacts.

The Company argued that visual impacts have been analyzed assuming clear conditions – a worst-case assumption. While it is true that clear conditions are present only part of the time, no evidence has been provided as to the percent of time visibility might be less than shown, or the extent to which visual impacts might be reduced under conditions of impaired visibility. Consequently, the Siting Board finds that the wind farm turbines would be visible from onshore and offshore locations, and that their appearance would vary based on distance and other factors, including weather.[149]

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147 (...continued)
each of the simulations in the Company's analysis is identified, and ranges from 38.7 degrees to 44 degrees (id.).

148 The Company stated that the wind turbines would be blue-gray (Exh. EFSB-RR-22, Att.; Tr. 20, at 2756). However, the Company noted that the wind turbines appear black in several of the views with the position of the sun behind the facilities, and white in several of the views with the position of the sun behind the vantage point (Exh. EFSB-RR-22, Att.; Tr. 20, at 2756-2757).

149 The Siting Board notes that operation of the wind farm could reduce the frequency with which steam plumes from existing power plants are seen, and could preclude or delay the (continued...)

G. Conclusions on Environmental Need

In the sections above, the Siting Board has considered certain direct and indirect environmental impacts of the construction and operation of the wind farm, with a view towards determining whether the energy from the wind farm is needed for environmental purposes.[150] The record clearly documents significant and lasting air quality benefits resulting from the wind farm's displacement of other, primarily fossil-fueled, generators.

However, to conclude that the wind farm project will provide environmental benefits, these air quality benefits must be balanced with identified noise, visual, avian, and fisheries impacts, and with the potential for other impacts and benefits. As discussed above, the onshore noise impacts of the wind farm would be minimal, as it would not result in a perceptible increase in overall noise levels at onshore locations. Simulations contained in the record suggest that the wind farm would result in significant visual impacts in nearby waters and some onshore areas under clear conditions; the extent, if any, to which visual impacts might be less than simulated (e.g., in reduced-visibility weather) was not demonstrated. Operation of the wind farm would result in relatively modest avian mortality. The direct impacts of the wind farm on fisheries are unknown, and could be positive or negative.

The wind farm may have other indirect benefits, although these are not well-defined in the record. As discussed above, operation of the wind farm may result in the less frequent operation of existing generators with significant noise impacts, and may indirectly benefit bird populations by reducing impacts on birds from fossil-fueled generation (e.g., impacts from spills related to fuel delivery). However, the extent of these benefits cannot be assessed based on the

149 (...continued)
development of a new power plant with associated visual impacts in another location. However, based on the current record, no assessment was made of the extent to which visual impacts from generation in other locations might be reduced.

150 The Siting Board notes that the environmental benefits of renewable energy facilities generally are reflected in the legislature's enactment of the RPS statute. The need for energy from the wind farm to meet RPS is addressed in Section A-III, above.

existing record.[151]

Overall, the Siting Board concludes that the air quality benefits of the wind farm are significant, and important for Massachusetts and New England. Available evidence indicates the air quality benefits of the wind farm likely would outweigh its noise and avian impacts. Several other indirect benefits are likely to favor the wind farm, although they cannot be given any significant weight in light of the limitations of the record. Beyond these, the potential for significant visual impacts from the wind farm remains, and there is uncertainty regarding the nature and extent of direct impacts on fisheries. The Siting Board notes that, with further analysis clarifying uncertainties as to fisheries impacts and fully addressing visual impacts,[152] a finding that environmental benefits outweigh other environmental impacts might well be supportable. However, on this record, the Siting Board can reach no conclusion as to whether, overall, the environmental benefits of the wind farm outweigh its environmental impacts. The Siting Board therefore makes no finding with respect to the need for the energy from the wind farm for environmental purposes.

A-VI. Conclusion on Alternative Need Analysis

The Siting Board has found that there is a need for the power provided by the wind farm beginning in 2007 for reliability purposes. The Siting Board also has found that: (1) there is a need for additional renewable resources to meet the requirements of the Massachusetts RPS beginning in 2006; (2) there is a need for the full renewable output of the wind farm to meet the requirements of the Massachusetts RPS beginning in 2010; and (3) there is a need for the renewable resources provided by the wind farm to meet regional RPS beginning in 2006.
The Siting Board further has found that there is a need for the power generated by the wind farm

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151 In addition, certain impacts that would seem important to a broad-based environmental need analysis (e.g., indirect water use or water quality benefits) were not developed in this record. The absence of record evidence on these impacts and benefits hinders the analysis in this case.

152 Such further analysis may be developed by other permitting agencies in their environmental analysis of the wind farm.

for economic purposes during the first five years of operation. Finally, the Siting Board has made no finding with respect to the need for the energy from the wind farm for environmental purposes. Based on the findings above, the Siting Board finds that the power from the wind farm is needed on reliability and economic grounds, and to meet the requirements of Massachusetts and regional renewable portfolio standards.

In Section II.A.4, above, the Siting Board has found that the existing transmission system is inadequate to interconnect the wind farm. Accordingly, the Siting Board finds that additional energy resources are necessary to accommodate this new power plant.

The Company has established that: (1) the power from the non-jurisdictional wind farm is needed on reliability, economic, and other grounds; and (2) the existing transmission system is inadequate to interconnect the wind farm and, thus, that additional energy resources are necessary to accommodate this new power plant. Consequently, the Siting Board finds that the Company has established need for the proposed transmission line, consistent with our Turners Falls/MECo/NEPCo precedent.

APPROVED by a majority of the Energy Facilities Siting Board at its meeting of May 10, 2005, by the members and designees present and voting. Voting for approval of the Tentative Decision, as amended: Paul G. Afonso (Chairman, DTE/EFSB), W. Robert Keating (Commissioner, DTE); David L. O'Connor, (Commissioner, Division of Energy Resources); James Stergios (for Ellen Roy Herzfelder, Secretary of Environmental Affairs) and Louis A. Mandarini, Jr., Public Member. Voting against the approval of the Tentative Decision, as amended: Judith F. Judson (Commissioner, DTE) and Deborah Shufrin (for Ranch Kimball, Secretary, of Economic Development).

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Paul G. Afonso, Chairman
Energy Facilities Siting Board

Dated this 10th day of May, 2005