Industrial Wind Action Group

facts, analysis, exposure of wind energy's real impacts

July 9, 2007

Mr. Michael Henderson
Director, Regional Planning and Coordination
ISO New England
1 Sullivan Rd.
Holyoke, MA 01040

Re: Scenario Analysis Stakeholder Working Group -- Final Scenario Analysis Modeling Assumptions

Dear Mr. Henderson:

First, I wish to express our thanks to the ISO-NE for its initiative and hard work that brought us through the Scenario Planning Analysis. Moving forward, regional policymakers, stakeholders, and the public will need to work together to understand the trade-offs necessary in planning for our future electricity needs. Your efforts will provide the essential tools necessary for making informed decisions.

I represent Industrial Wind Action Group, a national organization focused on raising awareness of the negative impacts of utility-scale wind if sited improperly. In this capacity, our organization closely monitors wind energy proposals, development, and post-construction performance and attendant impacts. As you know, we've raised a number of concerns throughout this scenario planning process regarding the reliability and effective capacity of wind energy, particularly for on-shore installations.

We are writing to express our concerns regarding some of the assumptions and results presented in the Final Scenario Analysis Modeling Assumptions. While we understand that, to some extent, this process is as much an academic one as it is a practical effort, there are a number of assertions and assumptions detailed in your draft report which grossly overstate the opportunity for wind development and performance in the region. If the results of this effort are intended to aid our region's policymakers, it is essential that the information provided be as realistic and as accurate as possible. Our areas of concern are outlined below. We recognize that time may be of the essence and regret the lateness of our comments. But given the magnitude of the concerns we raise, we respectfully ask that you take the time to reconsider several of the assumptions pertaining to on-shore wind.

1. The Levitan report grossly overstates the maximum theoretical development potential for onshore wind by as much as 3x or more; fails to consider current NREL methodology and existing empirical data in New England.

In the Levitan report, under the section titled *LAI Analysis,* the authors assert that they relied on the AWS Truewind database to determine those locations with adequate wind speed to site a commercial wind facility. This database includes 200x200 meter grid squares denoted by wind class (1-7). Using the GE 1.5 MW turbine for their onshore calculations, the authors make this statement on page 13 of the report:

> *For each of these acceptable grid squares, the average wind speed was applied to the onshore GE turbine power curve to yield an MT-UCAP value. This value was then multiplied by a factor of 0.50. This adjustment was necessary due to engineering constraints that require turbines of this type be located at least 280 m apart. Rather*

than attempt to optimize the configuration of acceptable grid squares, we applied the 0.5 ratios.

In effect, the authors assume that half a 1.5 MW wind turbine can be installed on each and every grid cell for which AWS Truewind's model estimated the wind power class to be Class 3 or greater (i.e., one turbine per 2 grid cells).

While the authors of the Levitan report acknowledged and listed previous studies that analyzed the Truewind wind grid to determine miles of developable ridgeline, it appears they chose to ignore this more realistic approach and assumed one turbine could be installed for every two grid cells. Since wind turbines installed in New England can be expected primarily to be placed on ridgelines, the 2:1 ratio assumed by Levitan is not unfeasible, nor is it reflective of NREL methodology or of what's happening in New England and elsewhere. We would anticipate the ratio of grid cells to turbines within an area of Class 3+ winds to be on the order of 5 or more to 1 (i.e., at least 5 grid cells per every turbine).

The WinDS model used by NREL to estimate wind development potential of the United States assumes an average of 7.5 grid cells to support a 1.5-MW wind turbine (i.e., 5 MW per square kilometer of Class 3+ windy area) - see: p. 9 in: http://www.nrel.gov/analysis/winds/pdfs/winds_data.pdf.[1] .

The basis of this 7.5:1 ratio can be confirmed empirically by looking at maps of existing or proposed wind facilities here in New England. Appendices A through E of this letter include maps of five sites in New England where a wind facility is either operational, under construction, or proposed to be constructed. Each of these five sites is included in Tables 3 and 4 of the Levitan report. The maps show the AWS Truewind grid cells color-coded by wind class and a black dot denoting each of the wind turbine locations. We determined the turbine locations primarily from the FAA 7460-1 database. As you can see from these maps, the ratio of grid cells to a single 1.5 MW turbine is much greater than the 2:1 ratio assumed by Levitan. We summarized this information in the list below:

1) **Searsburg (VT):**
    a. Number and capacity of turbines: 11 turbines each at 0.550 MW
    b. Nameplate capacity: 6.05[2] MW
    c. Grid cells with Class 3+ winds: 46
    d. Ratio of grid cells to one 1.5MW turbine: >11 to 1

2) **Evergreen Wind (Mars Hill, ME):**
    a. Number and capacity of turbines: 28 turbines each at 1.5MW
    b. Nameplate capacity: 42 MW
    c. Grid cells with Class 3+ winds: about 100
    d. Ratio of grid cells to one 1.5MW turbine: 4 to 1

3) **CEI NH Wind (Lempster, NH):**
    a. Number and capacity of turbines: 12 turbines each at 2.0MW
    b. Nameplate capacity: 24 MW
    c. Grid cells with Class 3+ winds: over 100
    d. Ratio of grid cells to one 1.5MW turbine: >6 to 1

[1] Reference to this same metric of 5 MW per sq. km. can be found in a number of sources on the web, including this report prepared for the Michigan Public Service Commission. See top of p. 3 in: http://www.cis.state.mi.us/mpsc/electric/capacity/cnf/othergen/mi_wind_energy_potentialjun14_2005.pdf.

[2] Table 3 of the Levitan report incorrectly lists Searsburg's nameplate capacity as 6.6MW.

4) **Berkshire Wind (Brodie Mountain, MA):**
   a. Number and capacity of turbines: 10 turbines each at 1.5MW
   b. Nameplate capacity: 15 MW
   c. Grid cells with Class 3+ winds: about 70
   d. Ratio of grid cells to 1-1.5MW turbine: 7 to 1

5) **Hoosac Wind Project (MA):**
   a. Number and capacity of turbines: 20 turbines each at 1.5MW
   b. Nameplate capacity: 30 MW
   c. Grid cells with Class 3+ winds: over 100
   d. Ratio of grid cells to 1-1.5MW turbine: >5 to 1

We are also concerned that Levitan treated small clusters of Class 3+ grid cells as though they were equally as developable as large patches. NREL's WinDS modeling procedure involves the use of a filter to identify and exclude small, isolated patches of windy grid cells. These small clusters cannot realistically be used to site commercial wind turbines. We believe Levitan should have used the same filter as NREL in removing grid cells which represent these unrealistic areas of wind energy development before estimating the onshore wind potential of New England.

Recommendation: The Levitan report should be updated to more accurately reflect a 7.5:1 ratio as used by NREL. On average, this would demonstrate a more realistic 25 grid cells of Class 3+ winds needed to support 5MW of generation. We know that in the WinDS modeling, NREL estimates the nation's potential wind energy development initially by applying their "filters" to the pool of Class 3+ grid cells. They then divide the resulting cumulative number of grid cells by 25 and multiply by 5 MW to derive a more realistic estimate of maximum development potential. *Applying this correction to the LAI MT-UCAP for onshore wind would reduce the MT-UCAP from 60,000MW to around 20,000MW or less.*

2. The Levitan Report asserts capacity figures that are based on too limited a data set to be meaningful.

We continue to be concerned, and frankly amazed, that the ISO and its consultants have been unable to secure generation data from an existing wind energy facility to use for this study. Such data would seem essential to validate the accuracy of estimates of operating performance of wind turbines based on wind speed monitoring information. The Searsburg wind facility was studied for multiple years by NREL. It is difficult to believe this facility's hourly wind and generation data is not publicly available. We know that hourly output and wind speed data was collected at Searsburg. See the section titled Performance Evaluation Plans on p. 9-5 in: http://www.epriweb.com/public/TR-109061.pdf .

Furthermore, hourly wind data is available for all wind energy projects in NY via FERC's EQR database. An examination of these data would aid the ISO in determining how effectively each facility supplied generation during demand periods.

The Levitan report only included wind data from Mt. Tom as a representation of an interior ridge site. Mt. Tom is acknowledged as having Class 2 winds (see p. 31 of the LAI report), and thus is not representative of the Class 3+ sites the report focused on.[3] The only other inland wind

[3] The LAI report also acknowledges that the AWS Truewind database classified Mt. Tom as a Class 3-4 site. Appendix F of this letter shows the coordinates of the Mt. Tom met tower to be in a Class 4 grid cell. *This fact demonstrates that AWS Truewind data may, and does, overstate wind turbine performance.*

measurement site used by Levitan to estimate New England's onshore wind capacity value – Paxton – is situated on a hill, not a ridgeline. Appendix G of this letter shows the USGS topographic map with the met tower labeled as being atop "Asnebumskit Hill" with an elevation of only 1396 feet. Thus, Paxton is also not typical of the vast majority of Class 3+ onshore areas of New England.

Given this, we cannot understand how the authors of the report could possibly assert what appears to be an unsupportable conclusion on page 15:

> *Given that most of the onshore wind sites being developed are in Maine, Vermont and New Hampshire where there are many sites with onshore wind speeds higher than the two Massachusetts sites used for calculating onshore capacity factors, LAI's estimate of the effective FCM capacity ratings understates both the effective FCM capacity ratings and the measured FCM UCAP for onshore New England.*

The authors appear to be assuming that a wind installation that may have higher *average annual* capacity factor will also have a higher average capacity factor during summer afternoon peak demand periods (between 1 PM and 6 PM from June through Sept). Yet, Levitan provides no data or explanation to support this assertion. In fact, their Exhibit 3 tables for Mt. Tom and Paxton provide contradicting evidence (see p. 1 and 2 of 7 in Exhibit 3 appended to the end of Levitan report). The data shown indicates that a wind facility built at the Paxton site supposedly would operate with annual average capacity factor of 39%, compared with the Mt. Tom site's 31.6% annual capacity factor potential, yet the Paxton site is expected to perform with only an 18.5% capacity factor during summertime afternoons - while the Mt. Tom site is projected to operate with a 20% capacity factor during this same period.

The reliance on wind speed data to predict operating performance (capacity factor) of wind turbines is fraught with overestimation.

Recommendation: We strongly encourage the ISO to locate and analyze wind data that is geographically distributed throughout New England and representative of realistic locations of interior wind development. At a minimum, the Final report should highlight the fact that wind speed data are not an accurate predictor of a wind facility's effective capacity factor.

3. The Levitan report ignores the impact of operating conditions on capacity factor and possible curtailment of turbine operation to mitigate for adverse impacts.

The authors state at the bottom of page 12 that they assumed ideal working conditions and thus do not adjust for actual performance conditions that "would significantly reduce the estimate of maximum theoretical wind generation capability in New England." Such adjustments would include ice build-up on the blade, wake effect, etc. Absent specific figures, the ISO should consider the presentation by Clipper Windpower at the 2006 AWEA conference in Pittsburgh, which identified an expected drop of over 5% between what was predicted for a wind facility's operating performance based on wind speed measurements (i.e., gross capacity factor), and the actual operating performance of the same facility after construction (i.e., net capacity factor)[4].

And there are other performance adjustments that we can expect to be implemented as these projects get built in sensitive areas, including mitigation for turbine noise and to reduce bird/bat mortality during periods of peak migration. The conditional State approval on the Lempster Wind project (NH) requires possible operational adjustments should noise levels exceed 45 dba during certain times of the year. The Vermont Agency of Natural Resources (ANR) submitted

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[4] See Slide 7 of this .pdf presentation:
http://www.eere.energy.gov/windandhydro/windpoweringamerica/pdfs/workshops/2006_summit/vaughan.pdf

recommendations to the Vermont Public Service Board in reference to the Sheffield proposal asking that turbine operation be curtailed during peak bat migration when winds drop to 6m/s or under.

Recommendation: We believe there is sufficient information from existing facilities to understand, at a minimum, the effect on capacity factor due to ice build-up and other operating conditions. The Clipper presentation acknowledges a significant overestimate of capacity factor of wind energy development if only wind speed data is used to predict operating performance. Thus, Levitan's 19% estimate for capacity value of onshore wind development in New England is likely also a significant overestimate since it, too, is based only on wind speed information. While it is more difficult to determine impacts to capacity factor if some turbines are turned off to mitigate for adverse impacts, we believe the ISO's final report should at least acknowledge that other human and environmental factors might impact capacity factors.

4. The ISO-NE Final Scenario Analysis does not acknowledge a maximum limit on wind penetration before grid reliance is adversely impacted.

Given the intermittent, unpredictable nature of wind energy, it is recognized that there is a limit to the amount of penetration into a grid system before system reliability is adversely impacted. Yet, there is considerable disagreement as to what this maximum limit should be; such a limit is highly grid dependent. At your May 21 meeting, Henri Daher referenced National Grid's white paper on wind titled "**Transmission and Wind Energy:** *Capturing the Prevailing Winds for the Benefit of Customers*", when he stated an upper limit of 10% penetration was a reasonable number across grids, and that this figure could increase to 15% with accurate wind forecasting implemented. We are not advocating this 10% figure, but cite it to emphasize the following point.

In the all-renewables scenario, the ISO assumes equal weight for the fuel sources, including onshore and offshore wind each with 675 MW and effective capacities of 19% and 26% respectively. In a full build out, the ISO found this would equal 6757 MW of installed capacity representing much more than 10% penetration (assumes 90% mechanical availability and distribution losses).

Recommendation: We encourage the ISO to define an upper limit on wind energy penetration in order to ensure grid reliability. Establishing a limit upfront will serve as a valuable planning tool for policymakers and stakeholders and will help to avoid problems later on. Current State Renewable Portfolio Standards in the region do not comprehend such a limit.

5. The ISO-NE Final Scenario Analysis does not adequately acknowledge transmission costs for wind generation.

On page 36 of the draft scenario analysis, the ISO states that "…onshore and offshore wind resources are assumed to require additional electric transmission facilities costing in the range of $581 million to $3.9 billion." It is important to note that transmission built to a wind facility is similar to building HOV lanes on a highway. Most of the time, the wind project will not produce anywhere near its nameplate capacity. As the Levitan report found, periods of higher production will typically occur at night and during the winter months, the very time when our loads are the lowest. Thus new transmission will typically be underutilized. This is not the case for fuel sources that offer firm capacity.

Recommendation: For purposes of comparing the costs associated with the different scenarios, we encourage the ISO to itemize transmission costs on a per kilowatt-hour basis so as to show the true cost of building extensive transmission to service the intermittent nature of wind.

In closing, wind development is relatively new to the New England area and we have not seen the rate of growth as witnessed elsewhere in the United States. As a result, few in this region have immediate experience with wind projects or how to evaluate performance and land use requirements. This is certainly the case for siting boards, policymakers, and other decision makers. Still, there are many resources that we can draw upon as reflected in these comments.

Industrial Wind Action Group has maintained from the beginning that the ISO is best situated to provide fact-based guidance on wind development. Further, we believe it is in the region's best interest that the ISO-NE take a more conservative, realistic position on wind development. Over-estimating wind's effective capacity value would create exactly the situation the ISO hoped to avoid when it started this initiative – a potential shortage of needed capacity at system peaks.

Thank you for this opportunity to submit our comments. We hope you take the time to consider these important issues. There is no question that New England's policymakers and other stakeholder groups will look to the ISO for guidance and that the Scenario Analysis will serve as an important planning tool. It is for this reason that we are so adamant that the data reflect the most realistic and accurate opportunity for wind energy. If you have any questions, please do not hesitate to contact me by phone at 603-838-6588 or e-mail at llinowes@windaction.org.

Sincerely,

Lisa Linowes
Executive Director
Industrial Wind Action Group

APPENDICES COVER PAGE:

APPENDIX A: SEARSBURG (VT) with AWS Truewind grid cells

APPENDIX B: EVERGREEN WIND (MARS HILL, ME) with AWS Truewind grid cells

APPENDIX C: CEI NH WIND (LEMPSTER, NH) with AWS Truewind grid cells

APPENDIX D: BERKSHIRE WIND (BRODIE MOUNTAIN, MA) with AWS Truewind grid cells

APPENDIX E: HOOSAC WIND PROJECT (MA) with AWS Truewind grid cells

APPENDIX F: MT. TOM MET TOWER LOCATION with AWS Truewind grid cells

APPENDIX G: USGS TOPOGRAPHIC MAP OF PAXTON SITE with met tower labeled

Color-coding for AWS Truewind grid cells:

Class 3 - Gold
Class 4 - Pink
Class 5 - Purple
Class 6 - Red
Class 7 - Blue