Amendment to Onshore Wind ORTP Capacity Factor Assumption

December 6, 2016
Markets Committee

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RENEW Northeast

About RENEW

An association of the renewable energy industry and environmental advocates united to promote renewable energy in New England and New York.

RENEW Northeast

Overview

- We presented this amendment for the first time at the Nov 9 MC.
- CEA/ISO has recommended a capacity factor (CF) assumption of 32% for onshore wind projects
  - Origin: 29% historical CF + 10% technology improvement = 32%
    - Their REC revenue model used this 32% CF
    - Their E&AS model used a 31.7% CF (with no explanation for why this is lower than the 32% recommendation)
- We believe that a 35% capacity factor assumption is the minimum reasonable value based on the available data
  - Can arrive at this number many ways:
  - Average CF of **all** 11 wind farms built in '11/12 excluding 1st year data = 32.1%
    - Add 10% technology improvement = **35.3%**
  - Average CF of the 5 wind farms ISO used filtering out Kingdom and Rollins anomalies (explained later) = 32.3%
    - Add 10% technology improvement = **35.4%**
  - Average CF of the 5 wind farms ISO used excluding 1st year data = 31.8%
    - Add 10% technology improvement = **35.0%** ← **This is the value in our amendment**

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Overview

- ISO's CF assumption is inconsistent with their own latest data
- ISO's technology improvement factor of 10% is extremely conservative
  - We are not challenging it, but feel this must be pointed out
- ISO's reasons why their CF assumption was more reasonable than our amendment do not hold up to scrutiny
- We believe that a 31.8 % historical capacity factor is calculated correctly (and conservatively), leading to a 35% capacity factor assumption for the ORTP models

ISO's CF Calculation Has Changed, but Assumption Hasn't

- Oct MC – ISO proposed 32% CF
  - Based on 5 wind projects with a 29% average "CF" from 2013-2015 plus a 10% technology improvement factor.
    1. Kingdom Community Wind
    2. Groton Wind
    3. Spruce Mountain Wind
    4. Rollins Wind
    5. Bull Hill Wind
  - However, the historical data used to calculate 29% value was actually FCM qualified capacity values, **not capacity factors**.

- Nov MC
  - ISO had corrected their calculation to be a CF instead of FCM qual value
  - For the 5 projects' 2013-2015 operations, excluding periods with severe MPRP construction outages, ISO calculated a CF **"above 29% (closer to 30%)**".
    - E.g., 29.8% historical CF + 10% technology improvement = **32.8%**
  - CF assumption left **unchanged** at 32% despite this increase in their calculation

ISO's CF Calculation Has Changed, but Assumption Hasn't

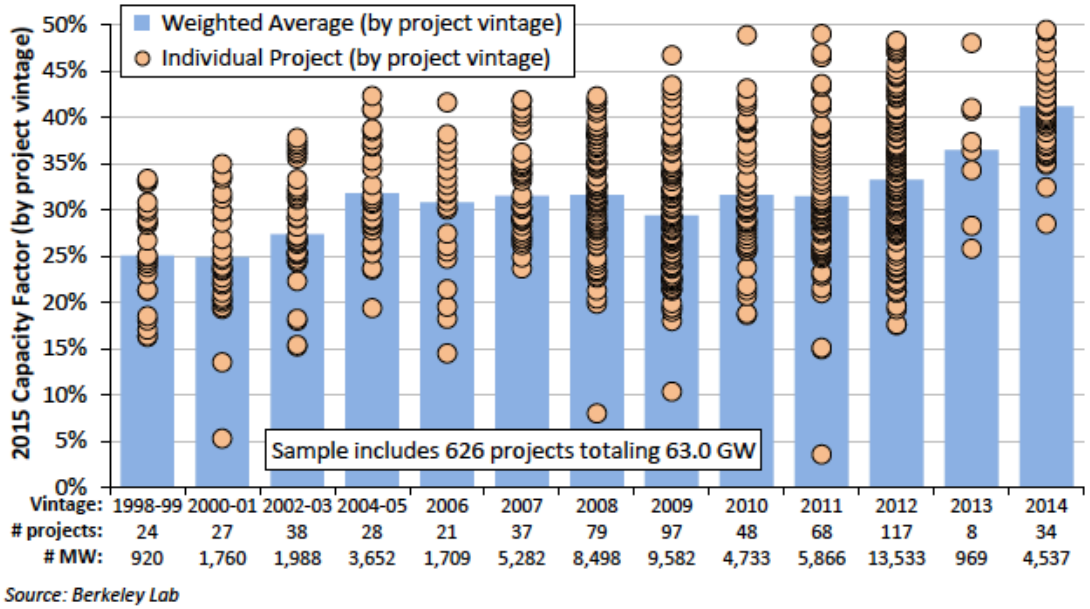
- Nov post-MC
  - ISO identified differences between the nameplate values they were using to calculate their CF value and what the projects themselves state their nameplate value to be.
  - One of the 5 projects in particular had a nameplate value in ISO's calculation that was significantly higher, pulling the average CF down.
  - When ISO updated their calculation to use the project's NRC values, **ISO calculated an average historical CF for the 5 units of 30.4%**.
  - 30.4% plus 10% technology improvement = **33.4%** 

– **ISO has still not changed their CF assumption from 32%, or their documented reasons for their assumption, despite this newly calculated value.**

– There no longer appears to be any factual basis for the assumption of the 29.0% historical capacity factor used in ISO's ORTP calculation. It appears motivated by the ORTP outcome rather than using valid data.

Capacity Factors Are Increasing

- Nationally, CFs have already increased from 31% for projects built in 2011/12 (as in the ISO sample) to 41% for projects built in 2014, **a 32% increase**.
  - Note: There were no wind farms built in ISO-NE in 2013 or 2014
- The ISO assumption (which we have used) only assumes a 10% increase from 2011/12 to 2021. **This is extremely conservative**.



Source: Berkeley Lab

Figure 32. Calendar year 2015 capacity factors by project vintage

https://emp.lbl.gov/publications/2015-wind-technologies-market-report

IMM Response to Our Amendment

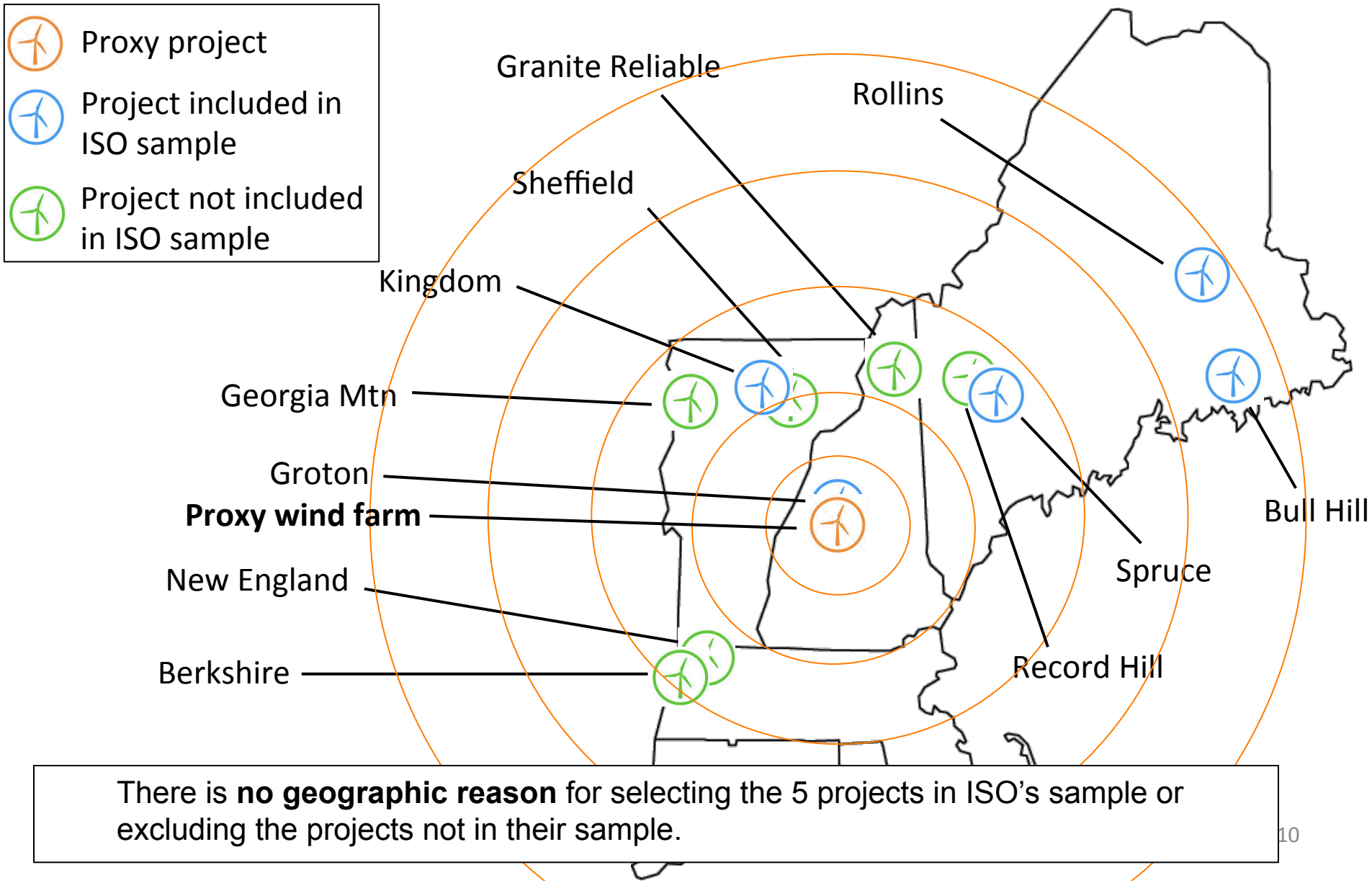
At the last meeting the IMM stated that **our approach to calculating a 35% CF was reasonable** but that they nevertheless supported the ISO assumption for 3 reasons:

1. The resources used in ISO's sample are in a similar geographic location to the proxy unit in central NH, whereas some of the resources we suggested using (e.g., in W. MA) are further away.
2. The resources used in ISO's sample are all 20 MW or larger, and are therefor closer in size to the 52 MW proxy unit.
3. Their data was good: ISO used projects built in 2011/12 (as we had suggested should be the case) and they used their operating data from 2013-2015 (as we had) so their analysis excluded the initial year's production for some projects (we suggested excluding the first year from the analysis).

Reason #1
Resource Location

1. **The resources used in ISO's sample are in a similar geographic location to the proxy unit in central NH, whereas some of the resources we suggested using (e.g., in W. MA) are further away.**
   - First, geographic proximity is not a relevant factor. But ignoring that…
   - The map on the following slide shows the location of all 11 wind farms built in 2011/12 and their distance from the proxy unit in central NH
   - The two projects that are **farthest** from the proxy were **included** in ISO's sample of 5 projects.
   - No other projects built in 2011/12 are significantly farther from the proxy project than the next two farthest projects in ISO's sample.
   - There is therefor no geographically-based reason to include or exclude certain 2011/12 projects from the sample.

Distance from Proxy



There is **no geographic reason** for selecting the 5 projects in ISO's sample or excluding the projects not in their sample.

Reason #2
Resource Size

2. The resources used in ISO's sample (in bold) are all 20 MW or larger, and are therefor closer in size to the proxy unit.

- Wind energy production depends upon two things: the turbine being used and the wind speed
- The number of turbines determines the project size.
  - Neither the turbine characteristics nor the wind speed change as additional turbines are added
  - **There is no fundamental reason** why a 10 MW wind farm would have a capacity factor that is different from a 100 MW wind farm.

Wind Farm Size (MW)
10
15
20
28.5
34
40
48
50.6
60
63
99

Reason #2
Resource Size

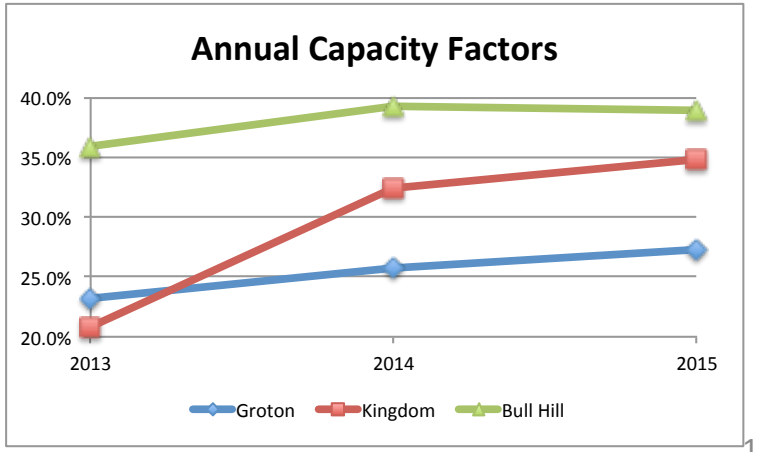
2. The resources used in ISO's sample (in bold) are all 20 MW or larger, and are therefor closer in size to the proxy unit.

- If anything, a project with fewer turbines is likely to have a higher forced outage rate
  - A single turbine out of service has a larger overall impact when there are only 5 turbines than when there are 50.
- What **is** relevant is that the projects being evaluated use utility-scale turbines
  - This is true of all 2011/2012 wind farms that are registered Generators (list to right).
  - **There is no reason to exclude the 10 and 15 MW resources from the analysis**.

Wind Farm Size (MW)
10
15
20
28.5
34
40
48
50.6
60
63
99

Reason #3
Appropriate Data Used

3. **Their data was good: ISO used projects built in 2011/12 (as we had suggested should be the case) and they used their operating data from 2013-2015 (as we had) so their analysis excluded the initial year's production for some projects (we suggested excluding the first year from the analysis).**
   - Rollins and Spruce were built in 2011
     - Their first year of operations was excluded from ISO's analysis.
   - Bull Hill, Kingdom, and Groton reached COD in Q4 2012
     - Nearly all of their first year of operations was included in ISO's analysis.
     - The first year CF of all three was significantly lower than years 2 and 3 (figure to right)
     - The fleet average CF in 2013 was not lower than in 2015, so this was not the effect of a low wind speed year
     - Weighting the 1st year of operations by 1/3 overestimates its contribution towards the expected production over a 20-year project life



ISO's Sample of 5 Includes 2 Extremely Abnormal Situations

- Kingdom
  - Project COD was Nov. 2012
  - Interconnection upgrades protested, not completed until Nov. 2013
  - Project output was severely restricted in interim[1]
  - Developer's expected CF of 33.7%[2] was achieved in 2014 and 2015 after upgrades completed, but CF was only 20.8% in 2013 due to these restrictions
- Rollins
  - In March 2015, owner reported energy lost due to curtailment for transmission limitations (MPRP construction and Keene Rd interface) was about 15% of total energy capability in 2013 and 2014[3]
  - CF of 26% in 2013-2014 would have been 30.6% had it not been for this curtailment
  - This was unexpected (and the construction impacts were temporary). No developer would develop a project if they expected this level of extreme curtailment to persist.

1 iso-ne.com/static-assets/documents/pubs/pubcomm/corr/2013/2013_08_06_response_to_vt_gov_shumlin.pdf
2 greenmountainpower.com/upload/photos/236KCW_QA_Feb_2013_FINAL.pdf
3 terraform.com/mobile.view?c=253464&v=200&d=3&id=10145026

ISO's Sample of 5 Includes 2 Extremely Abnormal Situations

- Even if zero curtailment isn't assumed, the ORTP should not be based on such extremely abnormal and unexpected conditions.

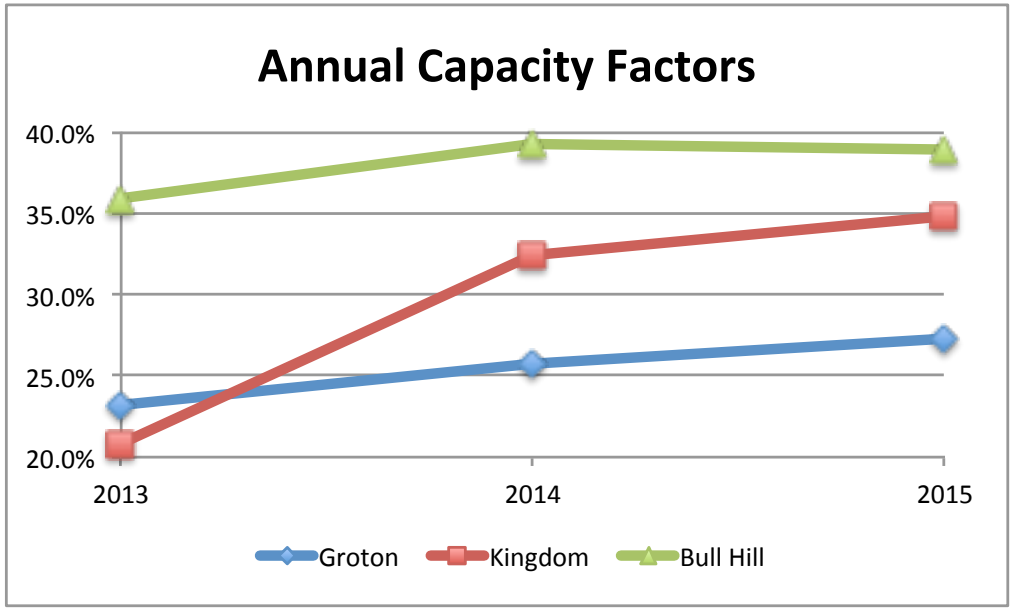
- If these two extremely abnormal conditions are filtered out[1], the average CF from ISO's sample would increase from 30.6% to 32.3%.[2]

- This is even higher than the 31.8% historical value our amendment is based upon.
  - i.e., our amendment is still on the conservative side

1 By excluding Kingdom's 1st year and using Rollins' uncurtailed CF of 31%
2 Note: This still includes the 1st year data for Groton and Bull Hill, as a balance to recognize that there may be some level of curtailment. These numbers are based on the EIA data.

Why Exclude Year 1 Data?

- Many questions at last MC about this.
- Year 1 includes added maintenance outages, startup activities that reduce production
- With only 3 years of operating data, including year 1 in the average over-weights this sub-optimal performance compared to actual weight over 20-30 year project operating lifetime.



Recommended CF

- 6 out of 11 wind farms built in 2011/2012 have CFs above the 32% historical CF assumption we are suggesting.[1]
- 5 out of 11 wind farms built in 2011/2012 have CFs above the 35% **future 2021** CF assumption we are suggesting
- ORTPs are supposed to be a screening tool that represents reasonably optimistic assumptions so that only outliers need to be evaluated in detail for a resource-specific minimum offer price.
- A screening tool that is set up for the vast majority of projects to be reviewed is **not screening for outliers**.
- Without focusing on the ORTP outcome, a 35% CF assumption appears to be the minimum reasonable assumption that could be made for a 2021 project.

1 When you ignore year 1 data. With year 1 data included it's 5.

ORTP Values

- CEA/ISO has recommended a capacity factor assumption of 32%
  - The resulting ORTP is $11.025/kW-mo
- We believe that a 35% capacity factor assumption is the minimum reasonable value based on the available data
  - This would result in an ORTP of $4.496/kW-mo
  - The models posted by ISO were modified as follows (as directed by ISO) to arrive at this number:
    - E&AS wind model – in the revenue tab, scale up the output of the wind plant in each hour by 0.35/0.317, copy the resulting annual revenue values from cells I9 through AB9
    - ORTP model – paste the annual revenue values from the E&AS model into row 6 of the E&AS tab, update the CF number from 32% to 35% in the assumptions tab (cell E17)

Amendment

III.A.21.1.1. Offer Review Trigger Prices for the Twelfth Forward Capacity Auction.

For resources other than New Import Capacity Resources, the Offer Review Trigger Prices for the twelfth Forward Capacity Auction (for the Capacity Commitment Period beginning on June 1, 2021) shall be as follows:

Generation Resources	
Technology Type	**Offer Review Trigger Price ($/ kW-month)**
combustion turbine	$6.488
combined cycle gas turbine	$7.856
on-shore wind	~~$11.025~~ $4.496

Questions

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Appendix – EIA Data

EIA plant-level data is available at:

http://www.eia.gov/opendata/qb.cfm?category=1017

Project Name	Nameplate Capacity (MW)	COD	MWh/yr (from EIA-923) 2013	2014	2015	2013-2015 Avg CF	2013-2015 Avg CF (discarding 1st yr)
Lempster Wind	24	Dec-08	69583	66642	-	32.4%	32.4%
Stetson Wind I	57	Jan-09	139696	136411	151378	28.5%	28.5%
Stetson Wind II	26	Mar-10	53938	55704	60895	25.0%	25.0%
Kibby Wind Power Project	132	Nov-10	268986	307567	341546	26.5%	26.5%
Berkshire Wind Power Project	15	May-11	51700	51207	-	39.2%	39.2%
Rollins Wind Project	**61.2**	Jul-11	134228	137138	151886	**26.3%**	**26.3%**
Sheffield Wind	40	Oct-11	83582	88833	87516	24.7%	24.7%
Granite Reliable Wind	99	Dec-11	222031	236526	240701	26.9%	26.9%
Spruce Mountain Wind	20	Dec-11	59387	63185	-	35.0%	35.0%
Record Hill Wind	50.6	Jan-12	126557	124221	125865	28.3%	28.3%
Bull Hill Wind Project	**34.485**	Oct-12	106923	117098	115845	**37.5%**	**38.6%**
Kingdom Community Wind	**64.575**	Nov-12	114861	179030	192481	**28.7%**	**32.8%**
Georgia Mountain Community Wind	10	Dec-12	25395	32511	-	33.1%	37.1%
New England Wind (formerly Hoosac Wind)	28.5	Dec-12	99905	95197	90308	38.1%	37.2%
Groton Wind Farm	48	Dec-12	97570	108413	114765	25.4%	26.5%
11 Generators Built in 2011/12						**30.4%**	**32.1%**
5 Generators Used in ISO Analysis						**30.6%**	**31.8%**

Note: Nameplate values in bold (and associated CFs) have been increased from the prior version of this table to reflect the NRC on file with ISO