

Comments/Response from GE Energy (version May 10, 2011) regarding Tom Adams Report on Quantifying the Benefits of Geographic Diversity.

We took a look at Mr. Adams' assertions, discussed them with our study partners and offer the following comments and clarifications:

- The wind groups in the GE study do not represent single points but collections of wind sites. This may affect the variation of correlation coefficient with distance between the group centers.
- The masts on which the plant output profiles were based were unevenly spaced and distributed among the groups. This was pointed out in the study. The data diversity was further reduced by data filling: gaps in the record of one mast were filled using scaled data from nearby masts.
- We only cited 7 example correlations in the report, for brevity. To get a much better sense of the dependence on distance, one would have to calculate the correlation for all group combinations, which would give 45 points in the plot.
- Mr. Adams plotted the 7 correlations from the GE report in a way guaranteed to call attention to deviations from the expected function. He didn't create a scatter plot with a line of best fit, as he did with the data from other studies. Instead, he drew a line through all the points. In the data on other plots in his report, there are many points that are well off the asymptotic line.

With regard to the one-minute correlations, I went back and ran them again, just to be sure, and they are indeed higher than the ten-minute correlations. Keep two things in mind when you consider the data:

1. The correlations in the report are between plant output, not correlations between deviations (or deltas). Certainly the correlations of one-minute deviations should be smaller than the correlation of 10-minute deviations, but that doesn't mean that the correlations of one-minute output, let alone 10-minute output, should be uncorrelated. On the contrary, the correlation coefficient will depend on variations at much longer time scales – hourly, daily, seasonal – because they are not filtered out of the data. The 10-minute and one-minute fluctuations will act as noise, which to be sure will tend to reduce the overall correlation coefficient, but not necessarily by very much given that the fluctuations at such time scales are normally rather small compared to the mean. Indeed one should expect little difference in the 1-minute and 10-minute *output* correlation coefficients for this reason. Only when you get to the hourly and longer time scales are you likely to see a big effect with increasing time averaging.
2. Recall that we only had 180 hours of one-minute data from the most "interesting" and variable periods of the year. Therefore the analysis windows for the one-minute and ten-minute data are not the same, and direct comparison between the two is probably not appropriate. In other words, cherry-picking the data for the one-minute analysis most

likely skewed the results. This point should have been emphasized in that section 5.6.2.1 of the GE report.

Finally, I do not dispute Mr. Adams' observation "that wind power would breach the current operating reserve threshold at 4.1 GW" since I have no idea what data it's based on. I can only say that the claim in the GE report is based on analysis of large scale penetration of geographically dispersed wind resources. Spatial and temporal diversity would tend to mitigate the size of extreme changes in aggregate wind output. This is discussed at length in the report.

Lavelle A. Freeman  
Principal Engineer/DSTAR Program Manager, GE Energy