Northwest Data Requirements and Proposal for Meso-scale Meteorological Wind Simulation for the NWIAP

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Introduction

To adequately quantify the impact of wind generation on the Northwest grid, it will be important to assemble a high-quality data set. Because weather is an important underlying influence on load and wind power, the wind data should come from the same time period as the load data. For example, if hourly loads for 2004 are used in the study, the wind data should also be from 2004.

For the potentially large quantity of wind generation in the NW, it will also be important that the wind generation data represent a realistic generation pattern in the time domain. This means that data from a single anemometer cannot be scaled up to represent the power from a large wind farm. Best practice dictates that multiple anemometers are used to represent large concentrations of wind turbines. Depending on the meteorology, up to about 30-40 MW of wind can be represented by a single anemometer, with appropriate adjustments to ensure that the hourly energy estimates are representative of a real wind plant.

From the response to my earlier data request, it is apparent that there is insufficient existing wind data to do an adequate job of analyzing the various tasks that have been outlined for the NWIAP project. If a good quality data set can't be obtained, any conclusions that might be drawn from the NWIAP would be seriously flawed. Given the importance and visibility of the project and the strong interest among all parties to produce a useful product, creating or otherwise obtaining a high-quality wind data set is critical to the successful outcome of the project.

BPA has entered into an agreement with 3Tier that will recreate historical wind speed data (that will be converted to power data) for some key areas of interest to BPA. Although this data set can be used for the NWIAP, it is not adequate to address the potential build-out of wind in the next several years in the NW. However, the same type of meso-scale modeling approach could be used to create wind generation patterns in the NW so that a reasonable analysis of wind's behavior and system response can be investigated.

I propose that the various entities that are participating in the NWIAP each contribute some money so that a high-quality data set can be developed for the study. NREL has

money this year that can be applied to the overall cost, and depending on the next fiscal year budget may be able to add additional money later this fall.

Proposal

Because of the need to think regionally about wind integration in the Northwest, a cooperative approach to securing a high-quality data set is proposed. The meso-scale modeling suggested below can be improved and informed by some existing wind data that has been offered for use by BPA (existing wind plants), PPM (existing wind generation), and Avista. Although these data cannot adequately represent the wind penetration to be investigated by the NWIAP, it can be used to statistically correct the meso-model output, increasing the accuracy of the simulated wind data sets.

1. Entities in NWIAP each contribute some fair share of $ to a firm that can create 10-minute wind speed using mesoscale weather models in the areas of potential wind development in the NW. The data set should be 3 years long, and should represent the years' load shapes that will be used in the NWIAP analysis. Depending on the timing of the project, this would either be the 3-year period 2003-2005 or 2004-2006. Average wind-speed every 10-minutes and at a 5km-square grid for the NW would be simulated.
2. The data series should adequately represent the geographic dispersion impacts of the various wind scenarios. For one or more scenarios (determined by the project participants and budget) virtual anemometer data would be used to calculate power output in a way that would represent real wind plant output. This implies some limit to the wind capacity that could be represented by a single grid point, to be determined by the meso modeling team and the relevant geographical features of the region.
3. A geographical grid resolution for the meso modeling that would be appropriate for this regional effort is 5 km^2. Although a higher resolution would provide more detail, the cost of producing higher resolution data sets can be significantly higher.
4. The meso data output would be archived at NREL and used for other appropriate analyses of wind integration in the Northwest or the West.
5. NREL offers to do some preliminary analysis on the data sets when they are created, and start analyzing the wind impacts on the system balancing requirements (would also require hourly or 10-min load data from the utilities). This analysis would focus on the impact of wind on the load-balancing requirements, and would not address the physical system response requirements to maintain balance. This analysis could also look at the potential impacts of a regional cooperative approach with various mitigation measures such as ACE-sharing. Additional modeling of the NW power system supply would occur in a subsequent phase of the NWIAP.

Approximate Cost

A rough cost estimate to create a data set has been developed for the meso modeling effort. Because several details have not yet been decided upon for the NWIAP, this estimate is an order of magnitude and can be refined as the project moves forward. The e cost estimate is to complete a 3 year mesoscale numerical weather simulation over the region covering most of WA, OR, ID and northern CA. This region would also include most of western Montana by default as well as a considerable portion of Utah and Nevada. The rough estimate of cost is in the range of $100k to $200k depending on the final size of the simulation area. The lower end of this price range would cover an adequate region with some compromise and the upper end would cover a conservatively large region that could include locations of wind that may deliver to load centers in the NW. This estimate does not include the translation of the data into power estimates at each site, nor does it include statistical correction of the simulation based on observed data. However these last two costs are typically much smaller than the cost of the simulation itself - but the actual cost would depend on the number of sites being investigated and the number of observational records that need to be incorporated into the simulation.

There are opportunities to scale back on this proposal if necessary. For example, a first cut at a 3-4 GW case for a single year could be developed first, with a followup scenario(s) that represent 3 years and more potential wind locations.