

**Western Wind Integration Study Stakeholders Meeting**  
May 23, 2007, 10am-3pm  
National Wind Technology Center, NREL, Boulder, CO

Attendee list is attached: 56 participants in person and by phone.

Debbie Lew of NREL presented ([http://westconnect.com/init\\_wwis.php](http://westconnect.com/init_wwis.php)) the motivation for the study, which is to support the Western Governor's Association and President's clean energy initiatives by helping decision-makers in several western utilities understand the cost of operating impacts due to the variability and uncertainty of wind and solar power on their grid, as well as potential mitigation options or strategies. The study differs from previous studies in its breadth and scope and will compare in-state to out-of-state resources; geographical diversity of resources; balancing area cooperation; wind/hydro integration; large penetrations of renewables in the rest of WECC; etc. The main tasks of the study include: wind and solar mesoscale modeling and utility data collection; preliminary analysis and scenario design; modeling and simulations; and preparation of draft and final reports.

Nick Miller of GE presented (presentation on website) examples of previous studies in CA, NY and Ontario that have looked at up to 33% renewables penetration (by energy) on the grid. GE's analysis includes: statistical analysis for different time intervals; production cost modeling with MAPS to simulate grid operations for 3 years; quasi-steady-state simulation with PSLF; and can also include transient stability simulation with PSLF. Nick showed results from earlier studies and insights gained.

Charlie Smith of UWIG facilitated discussion. Key topics discussed included: expanding study footprint to include most of WestConnect or at least add Colorado; use lower penetration levels than 30% wind/5% solar to show the impacts of RPS levels and not threaten other generators; what to assume for the basecase, including transmission; how storage would be included; the difficulties of modeling hydro and how much detail is needed; whether detailed quasi-steady-state analysis with PSLF is necessary; whether results should be presented as costs of operating impacts due to wind/solar or benefits/savings due to wind/solar on the grid; how to discriminate between costs due to market impacts of additional generation versus operating impacts due to variability/uncertainty; how this study feeds into the WestConnect Virtual Control Area project and ensuring coordination; whether other metrics besides CPS2 should be used; economic dispatch used in modeling; comparison of system with wind and system with flat block.

Wind and solar mesoscale modeling – This is the first step of the study. Wind data at a 10 minute interval for 3 years (likely to be 2004-2006) at 80-100m hub heights at a 2 km resolution will be generated for all of WECC (excluding Canada). Solar data will be modeled at a 10 km resolution for the same years. 1-minute wind and solar data will be modeled for selected periods. This data will be made publicly available. NREL is requesting actual measured wind or solar data or wind or solar plant output to validate the mesoscale modeling and ensure accuracy.

Utility data collection – The study will start with WECC load and generator databases and be supplemented by proprietary data from utilities as appropriate. Utilities will need to provide hour-ahead and day-ahead load forecast or forecast error data. We will obtain transmission load flows and anticipated transmission plans from WECC TEPPC. A conference call will be held with utilities to coordinate data collection in June/July.

Preliminary analysis and scenario design – Significant analysis is needed before model runs, due to the large number of options. We will be modeling significant amounts of renewables in all of WECC. We will group resource sites into regions, conduct statistical analysis with spatial and temporal slices to examine spatial correlation and wind/load correlation. Based on this analysis, capacity factors, and transmission, we will construct a high renewables scenario that balances low costs with low variability and design other scenarios to answer specific questions. A stakeholder meeting will be held to present this analysis and proposed scenarios.

Modeling and simulations – Production cost modeling for all hours of three years of WECC with MAPS and transmission load flows with PSLF. These simulations show the operating impact of renewables on the grid and mitigation options can be simulated as well. Different scenarios will show the benefits of geographical diversity, sites that are best correlated with load, long-distance transmission versus in-state resources, and mega-projects versus dispersed projects, etc. Effective load carrying capability and loss of load probability analysis will be modeled for selected scenarios. For selected events that stress the system (e.g., load load and high wind), we will examine intra-hour variability for 3 hour blocks. Detailed ‘dives’ can be done where appropriate; value of forecasting can be determined.

Reporting – A draft report will be prepared following the modeling and simulations. A stakeholder meeting will be held to review the draft results and provide feedback. A final report will be released to discuss final results and address comments.

Revisions made to study as result of stakeholder input:

- Expanding study footprint to include most of WestConnect: APS, SRP, TEP, Sierra Pacific, Nevada Power, PNM, and likely Tri-State/WAPA, Xcel, and El Paso Electric.
- We will consider more diverse penetration levels in the preliminary analysis. This will include 10%, 20%, and 30% wind with solar levels (by energy) possibly at 1, 2, and 5%. We can examine many options in the preliminary (statistical) analysis. It is the selection of scenarios to be modeled and simulated that will be limited.
- Virtual Control Area – we will examine costs for each control area individually and then combine control areas and see what costs would be if there were control area cooperation. The WestConnect Virtual Control Area project will be completed in 2007 but this study may help refine those results.
- For intra-hour variability, quasi-quasi-steady-state analysis will suffice. Running PSLF and solving a load flow for each minute of a 3-hour block will be overkill. Instead we will validate and use a simpler, spreadsheet-based approach.

- Costs of renewables or benefits from renewables – we will work to separate out variability/uncertainty costs from market competition effects due to additional generation. We plan to look at costs at a regulation, load following and unit commitment time frame.
- Transmission inputs – this is not a transmission study or stability study, rather it is an operations study. But we will have to do some rough (crayon-level) transmission analysis to build different scenarios. We will use WECC/TEPPC's 2017 transmission planning as a baseline. This should include the most likely transmission projects being planned now.
- Hydro constraints and hydro modeling will be tricky. We're setting up a small task force of water experts, Bureau of Reclamation, WAPA, and others to look at this in more detail.
- Study completion likely to be pushed back slightly to accommodate revisions. We will have firm dates once subcontracts are officially in place.

WestConnect will post information about the study on their website (<http://www.westconnect.com/>) under Regional Planning Initiatives.

## Participant list

Tom Acker, Northern Arizona University  
Bob Anderson, West Wind Wires  
Greg Blue, EnXco  
Steve Brown, CO PUC  
Donald Bryce, Bureau of Reclamation  
Tom Carr, Western Interstate Energy board  
Vladimir Chadliev, Nevada Power  
Dave Corbus, NREL  
Craig Cox, Interwest Energy Alliance  
Tom Darin, Western Resource Advocates  
Paul Denholm, NREL  
Linda Desmond, National Grid  
Bob Easton, WAPA  
Hugo Gill, 3 Tier  
Mark Graham, Tri-State  
Tom Green, Xcel  
Stew Jenkinson, TransCanada  
Bob Johnson, Xcel  
Gary Jordan, GE  
Rob Kondziolka, Salt River Project  
Rich Krauze, 3 Tier  
Doug Larson, Western Interstate Energy board  
Ron Lehr, American Wind Energy Association  
Debbie Lew, NREL  
Larry Mansueti, DOE  
Mark Mehos, NREL  
Richard Mignogna, CO PUC  
Nick Miller, GE  
Michael Milligan, NREL  
Brad Nickell, WAPA on detail to DOE Wind  
Brett Oakleaf, Xcel  
Kevin Porter, Exeter  
Charlie Reinhold, WestConnect  
Orlando Reyes, WAPA  
Paul Schmidt, Sierra Pacific  
Brennan Smith, Oak Ridge National Laboratory  
Jerry Smith, Westconnect  
Bob Smith, Arizona Power  
Charlie Smith, Utility Wind Integration Group  
Gerry Stellern, Xcel  
Gary Trent, Tucson Electric Power  
Jerry Vaninetti, TransElect  
Bob Wilson, WAPA  
Morey Wolfson, Governor's Energy Office

Megan Wood, USE  
Michael Wood, USE  
Tom Wray, SunZia  
Karl Wunderlich, Bureau of Reclamation

On phone

Jeff Anthony, AWEA  
Harvey Boyce, AZ Power Authority  
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Tom Hanson, Tucson Electric Power  
Dave Hawkins, CAISO  
Brendan Kirby, ORNL  
Michael McDiarmid, NMEMRD