Northwest Power and Conservation Council

September 13, 2011

MEMORANDUM

TO: Power Committee Members

FROM: John Fazio, Senior Power Systems Analyst

SUBJECT: Progress Report on Council/PNUCC Wind Impacts Analysis

Council staff is working with PNUCC and BPA to analyze the effects of wind resources on the Northwest's power supply. In particular, the analysis focuses on two issues; 1) oversupply and 2) system adequacy. Oversupply refers to conditions when the power system's minimum generation (hydro, wind and must-run thermal resources) is greater than firm load requirements and the non-firm demand market. System adequacy refers to the capability of the power supply to serve load in an uninterrupted manner.

This work began late in 2010 and initial results were presented to the Council's power committee earlier this year. Since then, staff has acquired new resource and load data and has made significant improvements to its power system simulation model (GENESYS). This latest set of results is still narrowly focused; in that wind capacity was added without load growth and no SW demand market was assumed. However, some conclusions can be drawn.

The largest oversupply conditions occur in May and June, with April and July also showing problems but in smaller amounts. For 6,000 megawatts (MW) of installed wind capacity (close to current status), analysis indicates that the north-to-south intertie capacity will likely be exceeded about 5% of the time in both May and June. As more wind is added, this likelihood will grow. Furthermore, each additional 1,000 MW of installed wind is expected to increase oversupply generation from 125,000 to 150,000 MW-hours, again in both May and June. A more detailed study that includes load growth and a SW market is required to more precisely estimate the size of the oversupply problem. Complementing this work, the Wind Integration Forum is developing a set of mitigation actions to offset increases in oversupply.

This analysis also calculates three new adequacy measures and determines how they change as more wind is added to the system. However, in this context (i.e. no load growth), these results don't provide much insight into the effects of wind on supply adequacy.

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WIND IMPACTS ANALYSIS

PROGRESS REPORT

Power Committee Meeting
Astoria, Oregon
September 13, 2011

Northwest Power and Conservation Council

PNUCC

Outline

- Purpose of Study
- Preliminary Conclusions
- Methodology
- Initial Results
- Comparison to BPA studies
- Next Steps

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Purpose of Study

1. Quantify how increasing amounts of installed wind affect conditions when minimum generation exceeds firm load
2. Quantify how increasing amounts of installed wind change power supply adequacy

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Preliminary Conclusions

- Oversupply problems occur during the peak runoff period, usually May and June
- Adding wind exacerbates the problem
- With no add'l load, each add'l GW of installed wind increases the oversupply by 125 to 150 GW-hours during the runoff period
- Need a more detailed study to better estimate the amount of oversupply
- Need to develop a set of mitigation actions to offset oversupply conditions (Wind Integration Forum is working on this)

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Methodology and Assumptions

- Case 1: 2015 loads, existing resources 6th power plan conservation, No wind
- Cases 2-6: add wind in 2K increments No change to loads
- For each case, add appropriate wind balancing reserves
- 2008-10 historical wind capacity factors for the BPA wind fleet were used
- No SW purchase market is assumed

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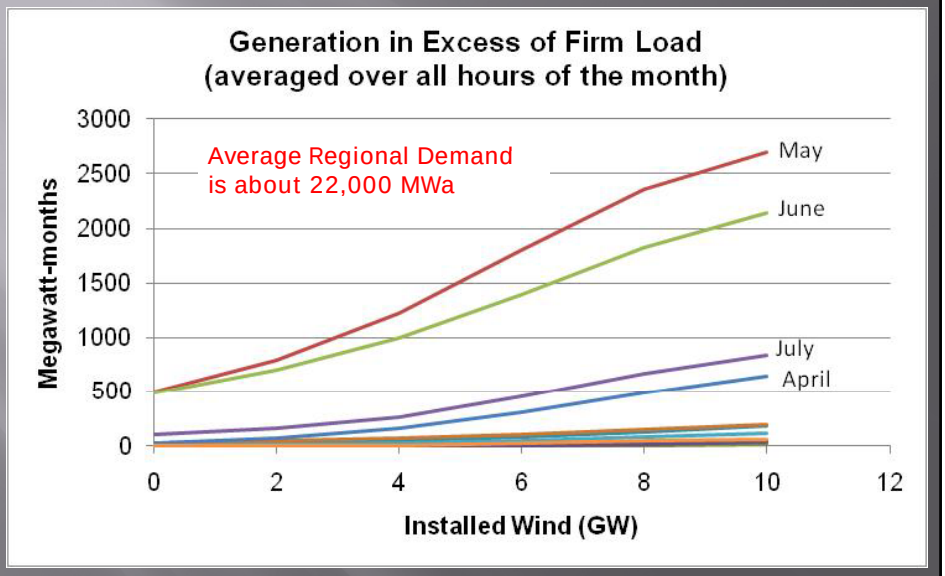
Monthly Average Oversupply*



*Unfortunately, average values don't often provide intuitive insights.

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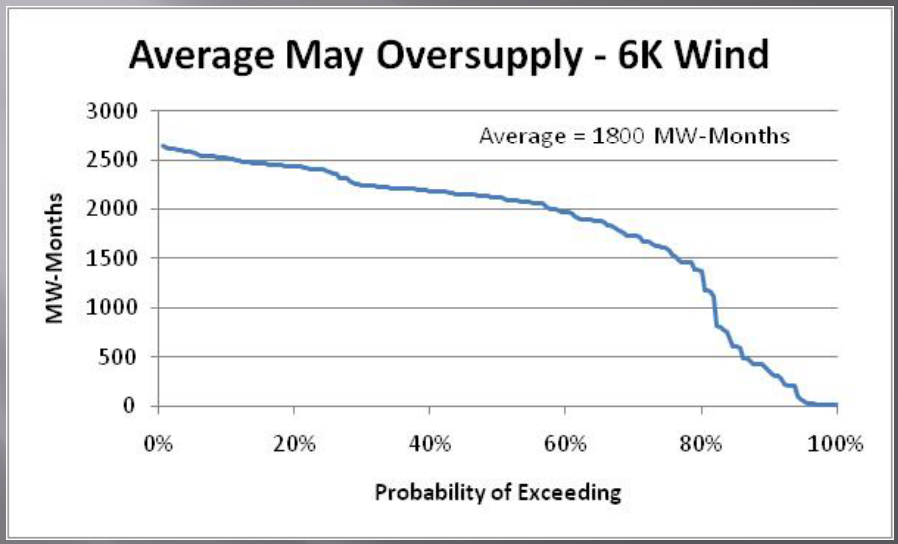
Monthly Average Probability Curve



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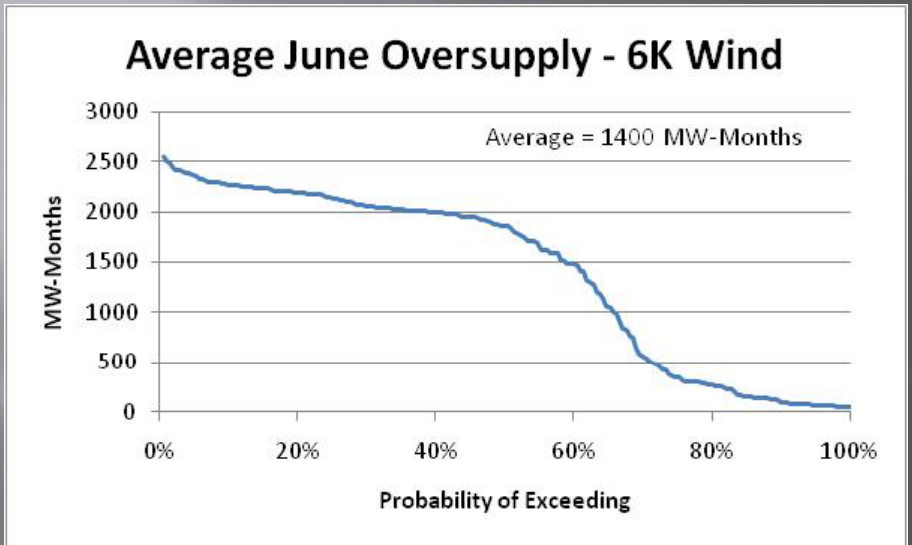
Monthly Average Probability Curve



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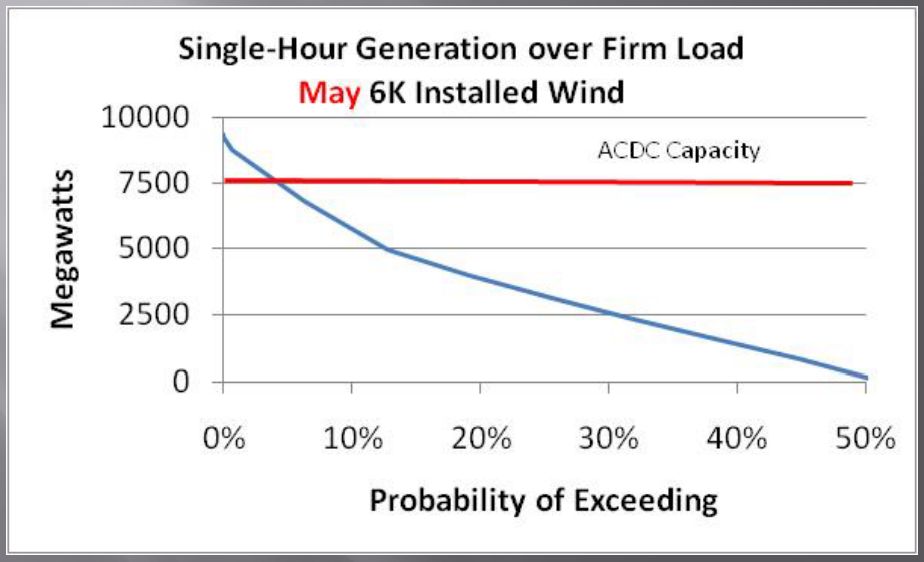
Hourly Probability Curve



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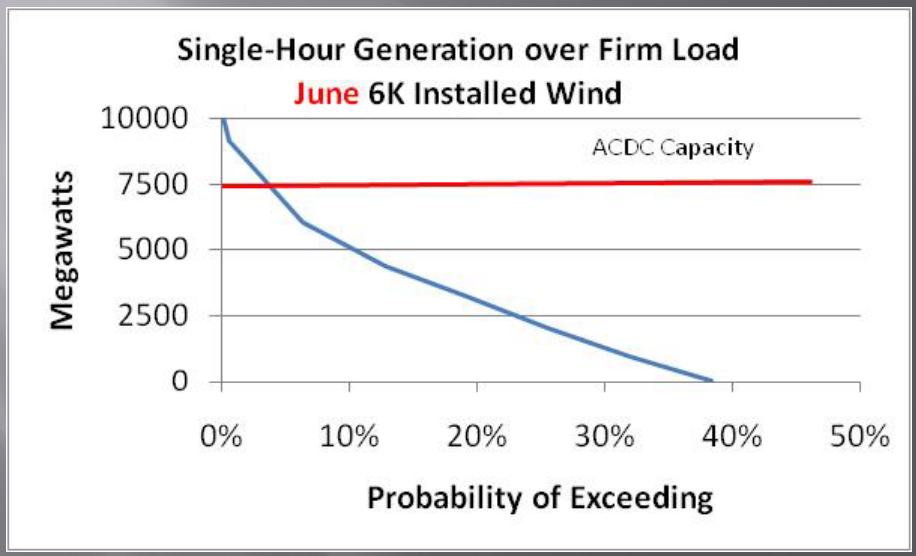
Hourly Probability Curve



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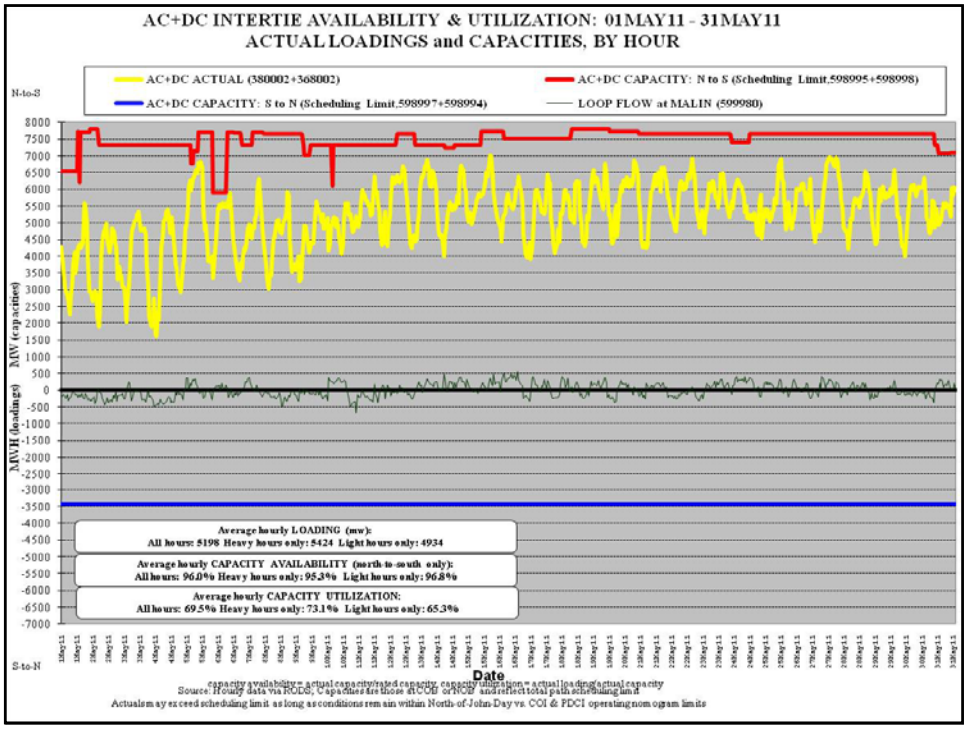

Three Adequacy Measures

- Likelihood of using standby resources
  - Similar to LOLP but counts use of standby resources instead of curtailment
- Total annual curtailment (mw-hours) averaged over the 5% worst years
  - Also known as the CVaR95 metric
- Expected number of hours of curtailment per year
  - Also known as LOLE
  - Some utilities use 2.4 as a threshold

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Wind and Supply Adequacy

Installed wind (GW)	Prob of using standby generation (%)	Annual curt size for 5% worst years (MW-hours)	Expected number of curtailment hours/year
0	11.9	95101	4.5
2	7.1	53119	2.4
4	6.7	31629	1.3
6	5.2	20174	0.9
8	4.8	16715	0.6
10	3.8	9579	0.5

These results are meaningless in this context. Adding wind with no additional load will improve adequacy. A more valuable measure is wind's load carrying capability, that is, how much add'l load can an increment of wind serve while keeping adequacy constant.

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Comparison to BPA Studies

- Council/PNUCC studies show lower magnitude of generation in excess of load
- BPA and the Council are currently crosschecking data and results
- Methods differ but yield similar results when same data is used
- Expect to resolve differences in the near future

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Next Steps

- Resolve differences between Council and BPA studies
- Check sensitivity to wind data by using synthetic wind data sets
- Continue to work with BPA on developing temperature correlated synthetic wind data

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