Incorporating an Adequacy Standard into Planning Models

RAAC Technical Committee
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Outline

- The PNW Adequacy Standard
- Options to incorporate into RPM
- Calculating deterministic metrics
- Examples of option 2
- Other options

The PNW Adequacy Standard

- Metric: Loss of Load Probability (LOLP)
- Threshold: LOLP ≤ 5 percent
- Model: Monte Carlo
  Chronological
  Hourly simulation
- Method: LOLP = Games with at least one curtailment divided by total number of games

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Options for Planning Models

1. Perform an LOLP assessment in the model
   – Difficult to do and would add run time
   – May be inconsistent (i.e. more random variables)
   + Would not have to be recalibrated
2. Use deterministic metrics and thresholds
   + Based on a power supply with a 5% LOLP
   + Very easy to incorporate
   – Must be calibrated if supply changes significantly

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Option 2: Deterministic Metrics

- Annual Load/Resource Balance (LRB) – for energy
- Peak Planning Reserve Margin (PRM) – for capacity
- Alternative:
  Winter and summer load/resource balance – energy

- Other reasons to use these metrics:
  - LRB and PRM have been used for a long time
  - They fit nicely into existing resource planning methods
  - PRMs are useful when comparing systems in different regions of the U.S. and the world

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Calculating LRB and PRM

1. Begin with a system (loads and resources) that yields a 5% loss-of-load probability

2. Extract load and resource data that go into an LRB and PRM calculation.

3. Defining Load
   - For LRB: annual average non-weather adjusted forecast
   - For PRM: sustained-peak (6 hour) average non-weather adjusted forecast for peak winter and summer months
   - For both: include expected energy efficiency reductions

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Calculating LRB and PRM

4. Wind
   - For LRB: 30% of nameplate capacity
   - For PRM: 5% of nameplate capacity
   - Alternative LRB: "Critical-year" wind instead of average wind generation
5. Hydro
   - For LRB: annual critical hydro generation
   - For PRM: 6-hour sustained-peak hydro capability for the lowest water condition for the peak winter and summer months

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Calculating LRB and PRM

6. In-region market
   - For LRB: average annual energy availability (see below, currently about 2,200 aMW)
   - For PRM: full availability in winter (~3,500 MW) 1,000 MW in summer
7. Out-of-region market
   - For LRB: average annual energy availability
   - For PRM: 2,500 MW for winter
     0 MW for summer

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Calculating LRB and PRM

8. Non-firm hydro
   - For PRM: zero aMW
   - For LRB: zero aMW

9. Thermal resources
   - For LRB: average annual availability
   - For PRM: single-hour generating capability adjusted for average FOR

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Example: LRB Threshold

Annual Loads and Resources	Value (average megawatts)
Non-weather adjusted firm load	**25,987**
Critical hydro	11,866
Non-hydro resources	10,665
In-region market (IPP)	2,156
Out-of-region market	1,820
Non-firm hydro	0
Wind	1500
Total Resources	**28,007**
Resources – Load = LRB Threshold	**2020**

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Example: January PRM Threshold

Sustained-Peak Loads and Resources	Value
Non-weather adjusted sustained-peak firm load	**35,308**
Hydro capacity	22,013
Non-hydro resource capacity	12,000
In-region market (IPP) capacity	3,550
Out-of-region market capacity	2,500
Wind	250
Total Resources	**40,313**
Resources – Load =	5,005
(R – L)/L = PRM Threshold	**14.2%**

Example: August PRM Threshold

Sustained-Peak Loads and Resources	Value
Non-weather adjusted sustained-peak firm load	**28,978**
Hydro capacity	21,480
Non-hydro resource capacity	12,000
In-region market (IPP) capacity	1,000
Out-of-region market capacity	0
Wind	250
Total Resources	**34,730**
Resources – Load =	5,752
(R – L)/L = PRM Threshold	**19.8%**

Imports as a Random Variable

- Should import availability be a random variable?
- What mean and what distribution should be used?
- What values for import should then be used in the LRB and PRM calculation?

Optimizing Import Assumptions

- What if the Regional Portfolio Model could determine the optimal amount of import to rely on (similar to the EE premium)?
- The RPM would choose an import level for each "plan" from a provided distribution
- The amount of import for plans on the efficient frontier would be the amount to rely on and would be fed into GENESYS

Add'l Slides by BPA

Alternative Planning Metrics for RPM Winter & Summer L/R Balance

- PNW loss of load winter driven; modest issues in August
- The hydro system today is more constrained than any time in the past and is unable to substantially move energy between periods
- Variable generation (hydro, wind, and solar) supplies the most energy during the spring and early summer
- A metric that averages winter energy deficits with spring surplus masks reliability problems

Alternative Planning Metrics for RPM
Critical Wind Year

- On an average annual basis, wind energy production is less volatile than hydro
- However, monthly production of wind energy during the winter has much higher volatility than hydro
- If a seasonal energy metric (as opposed to an average annual metric) is used, it maybe appropriate to use a 'critical wind year'
  - Critical hydro similar to a 95% chance of exceedance

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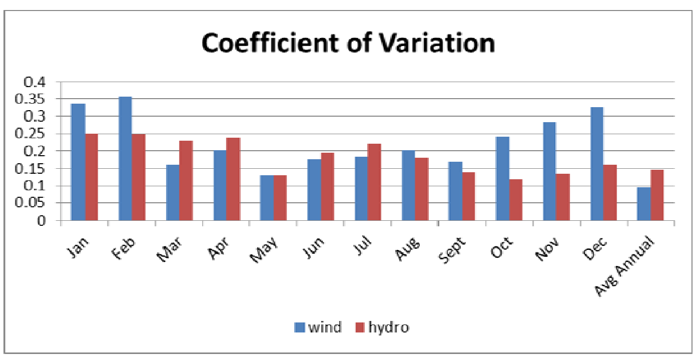
Coefficient of Variation



Coefficient of Variation = standard deviation / average
BPA wind fleet monthly capacity factors 2001 to 2013; regulated and hydro independent generation (1929-2008)

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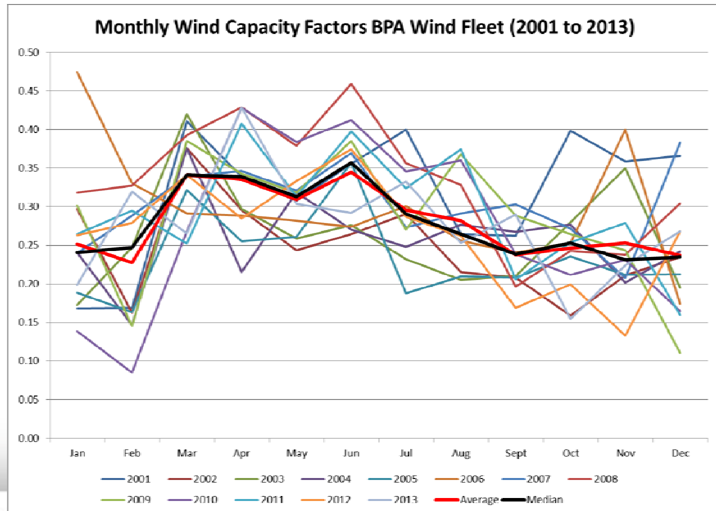
Monthly Wind Capacity Factors



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