Northwest Power and Conservation Council

March 6, 2012

MEMORANDUM

TO: Power Committee members

FROM: John Fazio, Senior Power System Analyst

SUBJECT: Analysis of Electricity Oversupply

Electricity oversupply occurs when the minimum generation of a power system exceeds firm load and secondary sales markets. The minimum generation for the NW power system is set by minimum turbine flow constraints, snow-melt runoff volume and must-run non-hydro resources. Secondary sales include the displacement of more expensive non-hydro resources in both the Northwest and the Southwest.

Oversupply conditions are not new to the Northwest. Because of the sometimes high volume of runoff (usually in spring) and limited storage behind dams, the region has often experienced times when the power supply has more energy than it needs. Once secondary markets are satisfied, river flows are reduced as much as possible. If oversupply remains, some flow can be diverted through spillways but only up to the biological opinion limits that prevent excessive gas super-saturation.

The focus of this work is to assess the timing and size of potential oversupply conditions. The Wind Integration Forum is working on a set of actions to alleviate oversupply conditions. Possible actions could include turning off wind generators, finding other markets or "storing" excess energy in existing water heaters or boilers. All of these actions come at a cost.

Preliminary analysis for 2013 indicates that April, May and June are the most likely months for oversupply. After turning off all displaceable NW resources, the expected monthly-average size of excess energy ranges from 1,500 to 3,000 megawatt-months. At face value this does not seem to be a problem because expected sales to the Southwest are often greater than this. However, a look at the hourly oversupply numbers presents a different conclusion.

On an hourly basis, oversupply in excess of the Northwest secondary market, will exceed the *expected Southwest market* 8% of the time in April, 20% of the time in May and 16% of the time in June. Oversupply will exceed the *intertie capacity* 5%, 12% and 9% of the time for these months. The expected amount of oversupply energy beyond the intertie capacity is about 60,000 megawatt-hours for April, 135,000 megawatt-hours for May and 110,000 megawatt-hours for June. Analysis also shows that as more wind resources are added, the expected amount of oversupply will increase.

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Analysis of Electricity Oversupply

Power Committee Meeting
March 6, 2012
Portland, Oregon

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Defining Oversupply

Oversupply conditions occur when minimum system generation exceeds the amount of firm load and secondary sales market.

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Components of the Secondary Sales Market

- Displaceable NW resources (thermal)
- Displaceable out-of-region resources[1]

[1](Firm imports and exports are combined with NW firm load.)

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Methodology and Assumptions

- Genesys (Monte Carlo) simulation
  - 1929-98 historic water conditions
  - 1929-2008 historic temperature profiles
  - 2008-10 historic wind data (BPA fleet)
  - Random forced outages
- 2013 operating year (Oct 2012-Sep 2013)
- Hourly loads from our short-term load forecasting model include expected level of conservation from the 6th plan

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Methodology and Assumptions

- Within-hour wind balancing reserves for 6,000 MW of installed wind applied to hydro capability for the BPA area
- 7,887 MW of regionally installed wind
- Genesys will automatically displace NW resources
- Genesys will not automatically spill additional water (up to the BiOp spill caps)
- No out-of-region secondary market assumed

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Results

- Results on the following slides show the amount of oversupply after displacement of NW regional resources

- But before sales into the out-of-region market
- Also, no additional spill was allowed

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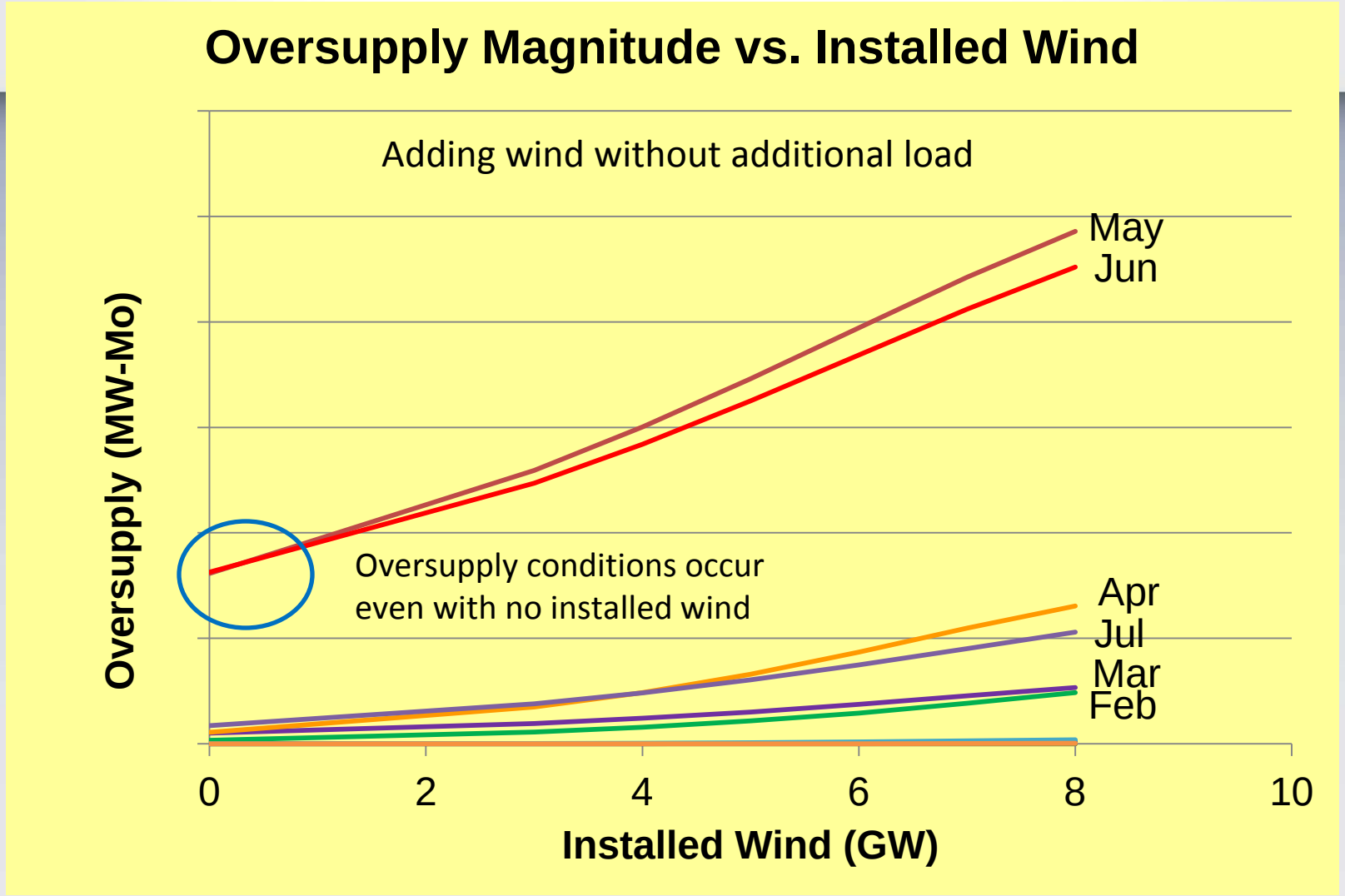
Impact of Wind Generation on Oversupply



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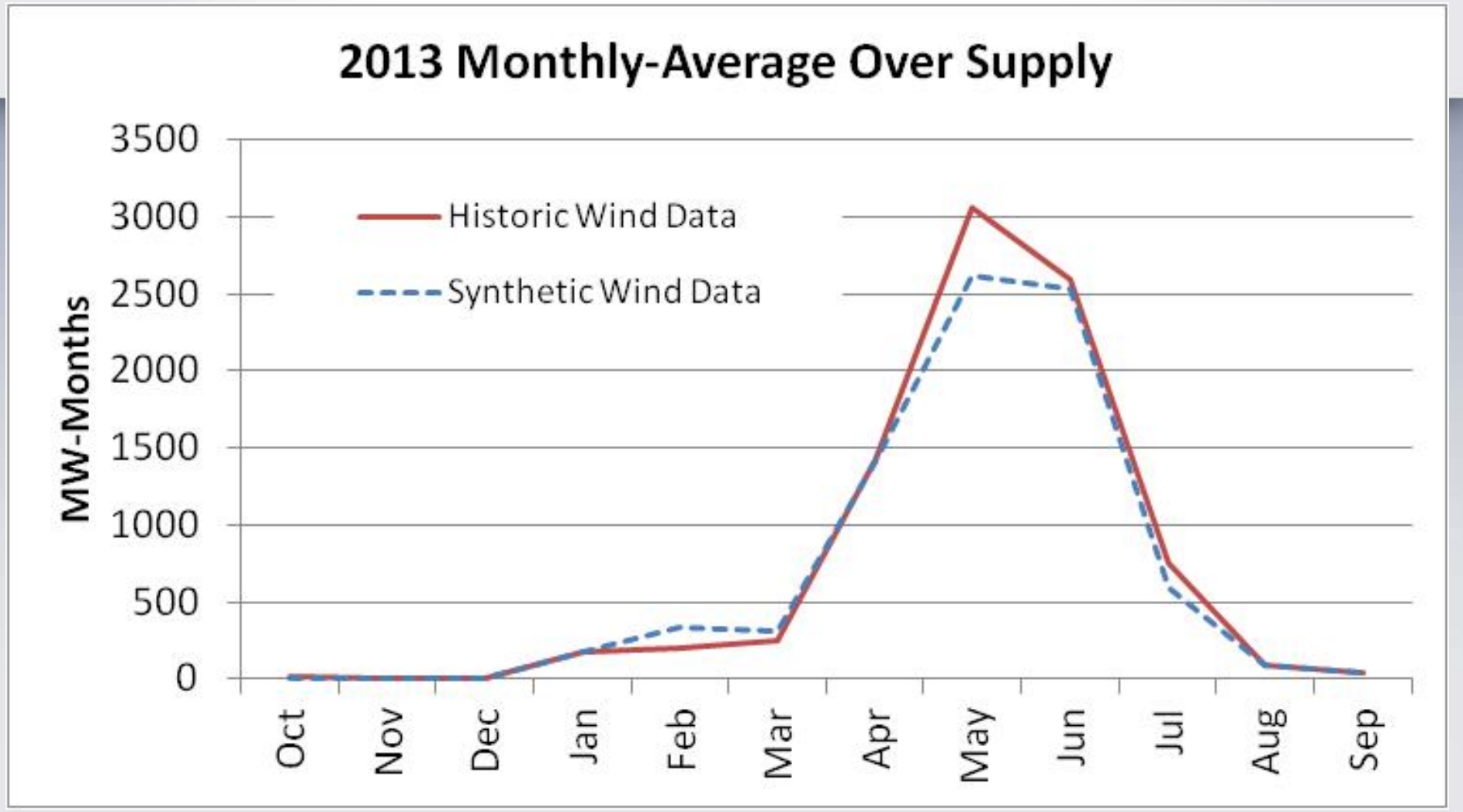
For Illustration Only



No SW secondary market, no additional spill

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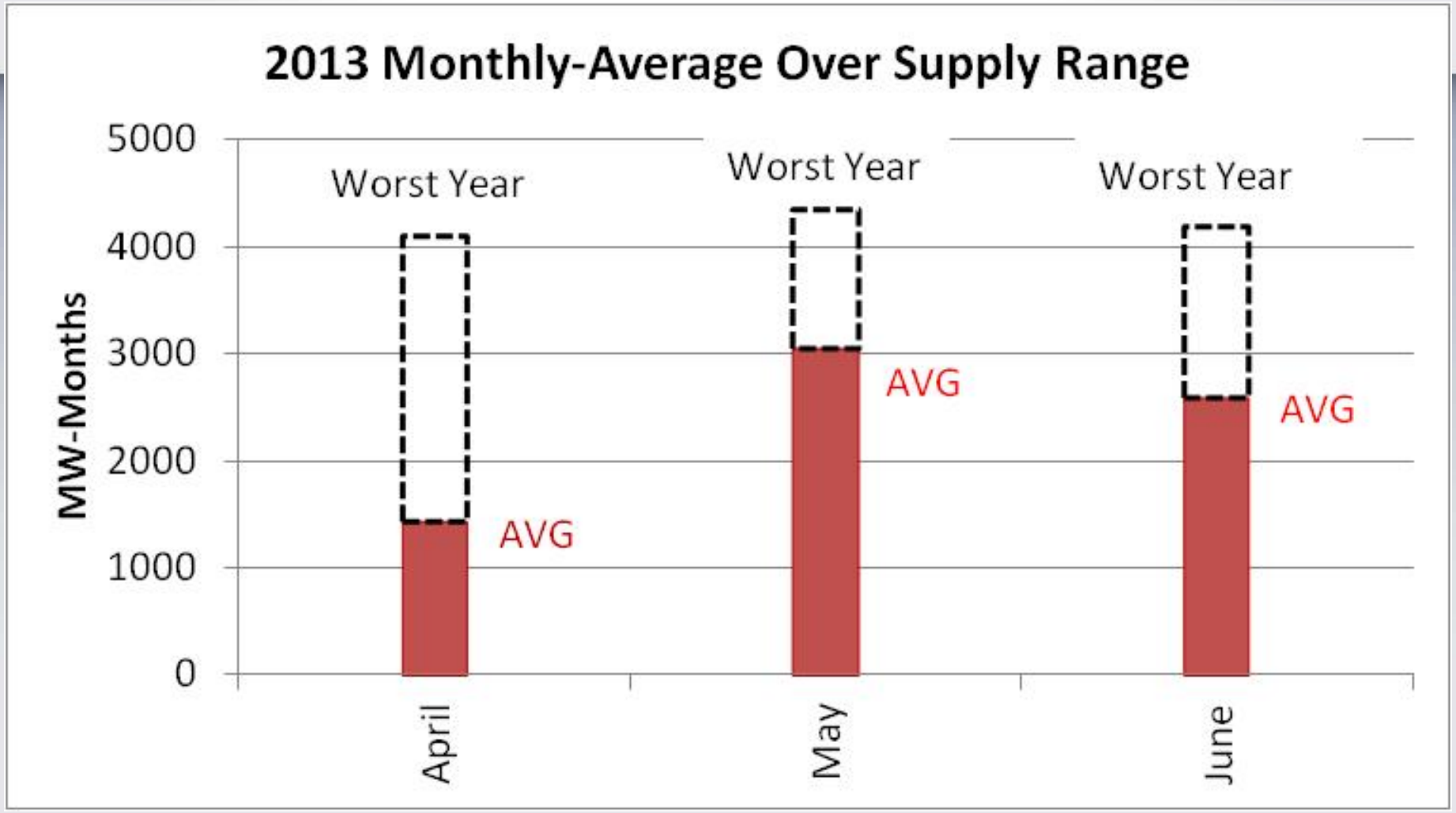

No SW secondary market, no additional spill

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Determining the Likelihood and Size of Oversupply

- Rank hours with oversupply
- Count the number of hours when oversupply exceeds the SW market
- Calculate the likelihood of oversupply (hours w/oversupply > SW market divided by the total number of hours simulated)
- Calculate the average size of oversupply greater than the SW market

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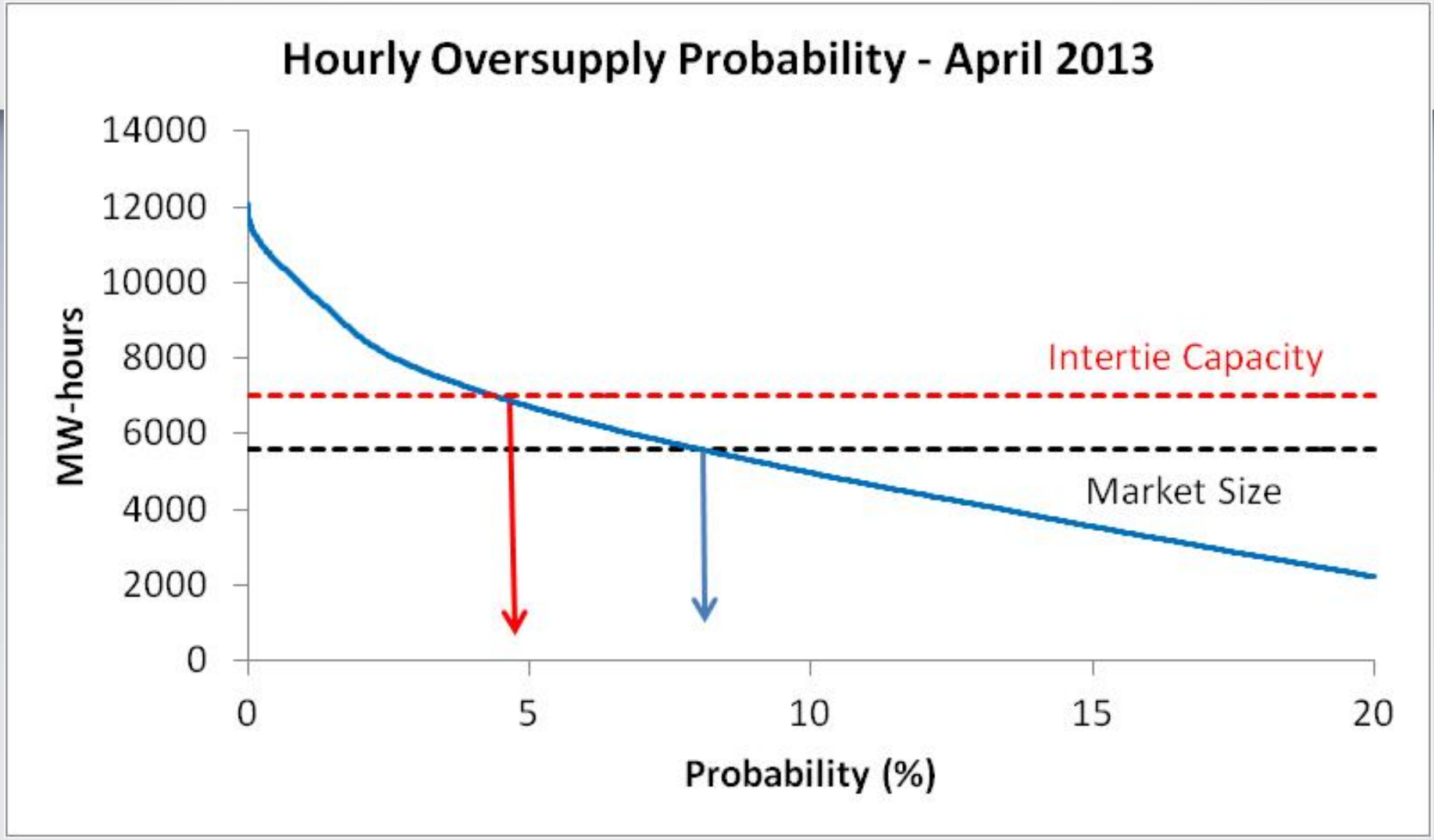

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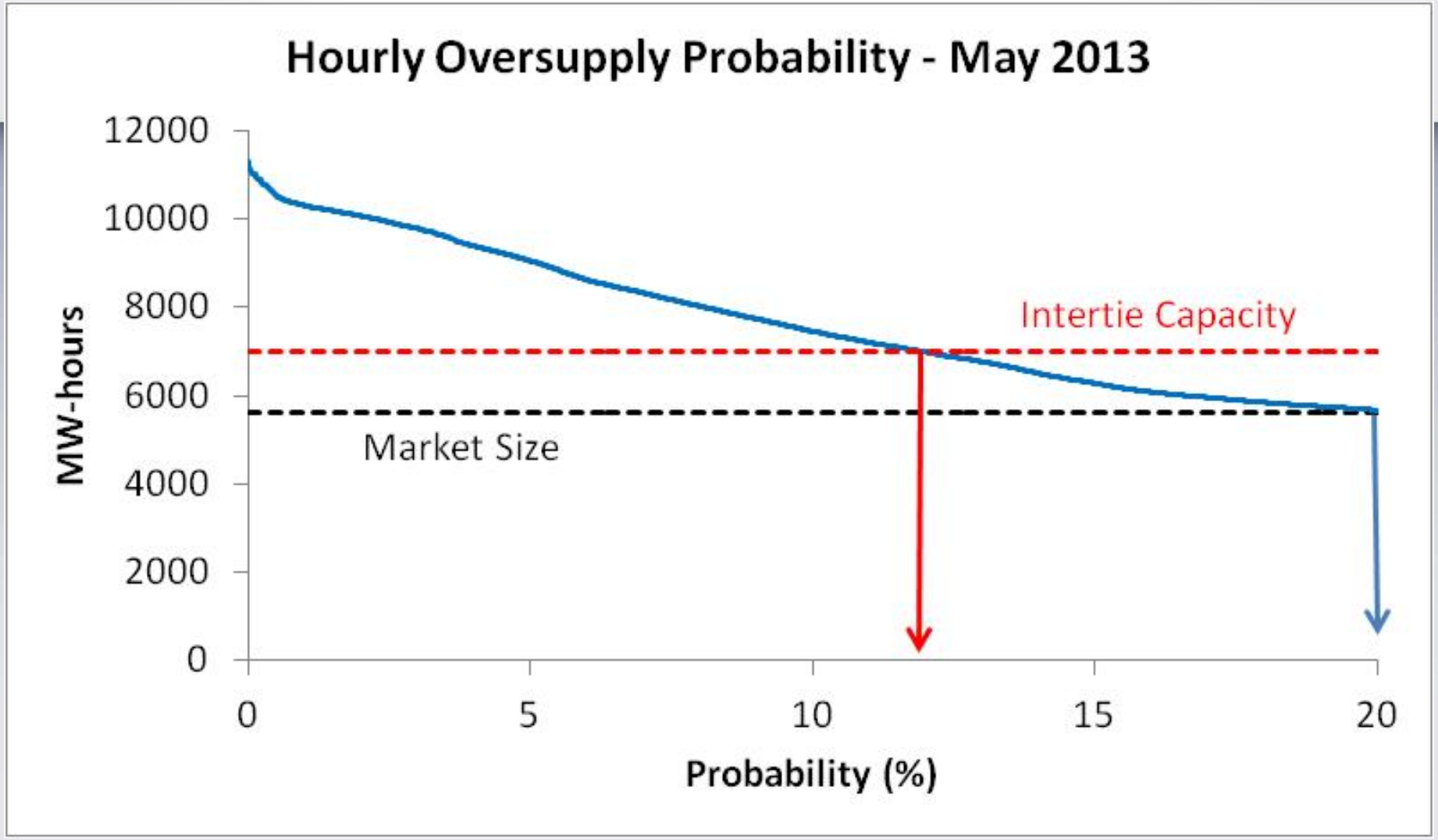

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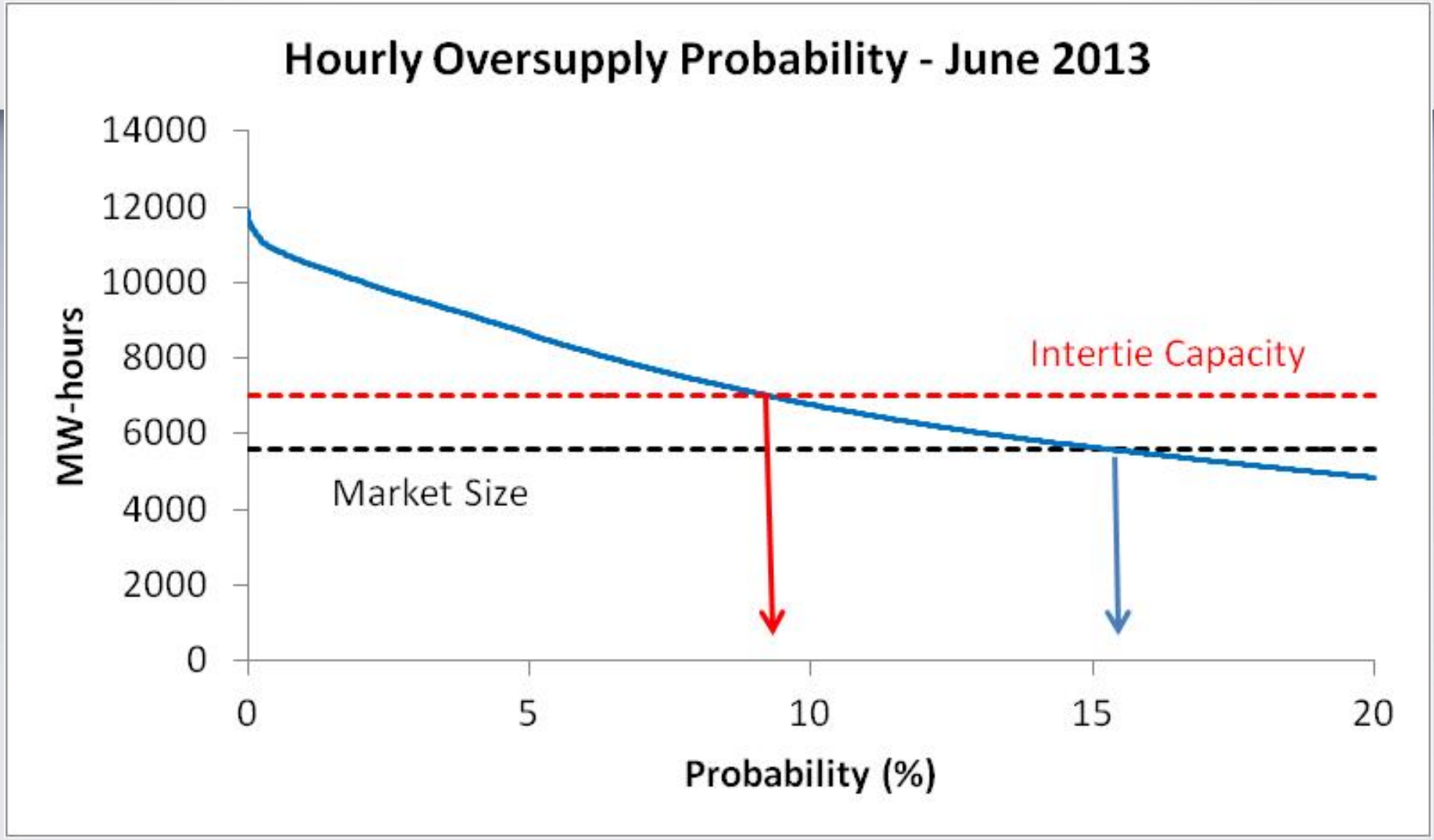

No SW secondary market, no additional spill

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Likelihood and Size of Oversupply for 2013

% of Time Greater	than Zero	than SW Market	than Tie Capacity
April	29%	8%	5%
May	62%	20%	12%
June	50%	16%	9%
Size (MW)	**April**	**May**	**June**
Over SW (Avg)	1,900	2,100	2,100
Over SW (Max)	6,200	5,100	5,700
Over Tie Cap (Avg)	1,600	1,500	1,700
Over Tie Cap (Max)	4,800	3,700	4,300

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Likelihood and Size of Oversupply for 2013

	% > Market	% > Intertie	Avg > Market	Avg > Intertie
April	8%	5%	110,000 MW-hrs	58,000 MW-hrs
May	20%	12%	312,000 MW-hrs	134,000 MW-hrs
June	16%	9%	242,000 MW-hrs	110,000 MW-hrs
Total			554,000 MW-hrs	302,000 MW-hrs

No additional spill included

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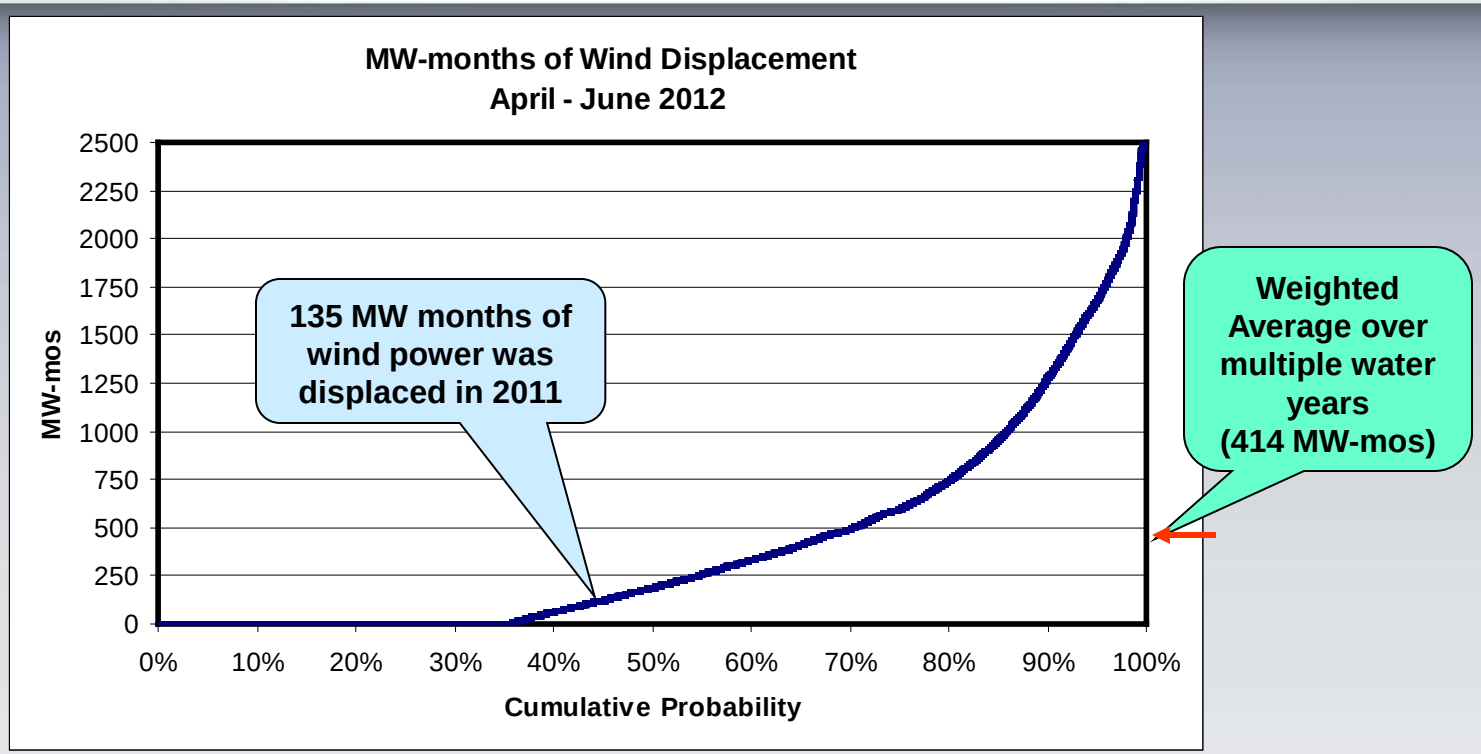
BPA's Analysis

- BPA's use of displacement in 2011 was modest relative to expectations based on the analysis in BPA's February 2011 Overgeneration Analysis, *Northwest Overgeneration: An assessment of potential magnitude and cost*.
- BPA refined its oversupply analysis modeling based on its spring 2011 experience. The refined modeling, using forecasted load and resource information for 2012 were then combined with:
  - 70 water years (1929 – 1998)
  - 15 hydro shapes (1996 – 2010)
    - Weekly HLH/LLH shapes
  - 30 synthetic wind generation patterns
    - Consistent with those used in BPA rate case
- Above combinations result in 31,500 games or potential outcomes
- BPA's oversupply modeling estimated the amount of displacement we might expect in 2012 using our forecast of the size of the wind fleet and loads. Modeling of a large number of different water and wind conditions resulted in an average estimate of 414 MW-months (302,000 MW-hr), about **three times** what occurred in 2011. (Conditions have been drier than average since that modeling was done, so this estimate may be somewhat high – but conditions can change significantly and quickly.)
- This amount is approximately **3-4%** of total wind generation expected in 2012.
- Based upon preliminary displacement cost data provided by a portion of the wind fleet, the expected value of lost contract revenue, PTCs (29% of wind fleet), and RECs (valued at $16/MW-hr) of this amount of curtailment is estimated to be **$12 million.**

BPA Forecast for 2012



- 35% probability that in 2012, conditions will not result in oversupply conditions.
- There is a low probability that extreme conditions could lead to significantly greater amounts of oversupply than experienced in 2011.

135 MW-months = 98,500 MW-hrs

414 MW-months = 302,000 MW-hrs

Possible Mitigation Actions

- Other markets?
- Other loads?
- Additional spill, up to BiOp gas super-saturation limits

- Wind Integration Forum subcommittee is working on this

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Additional Slides

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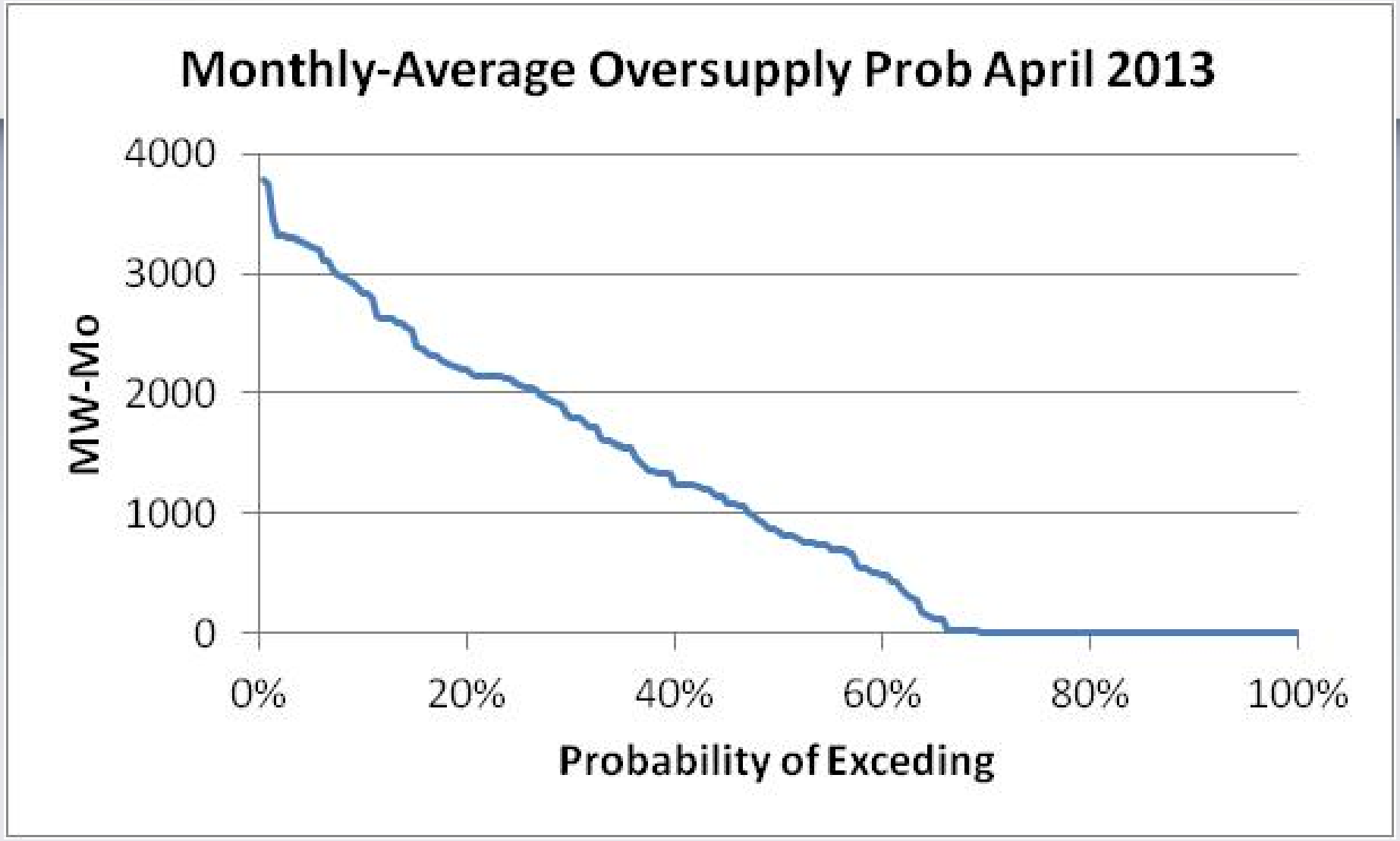

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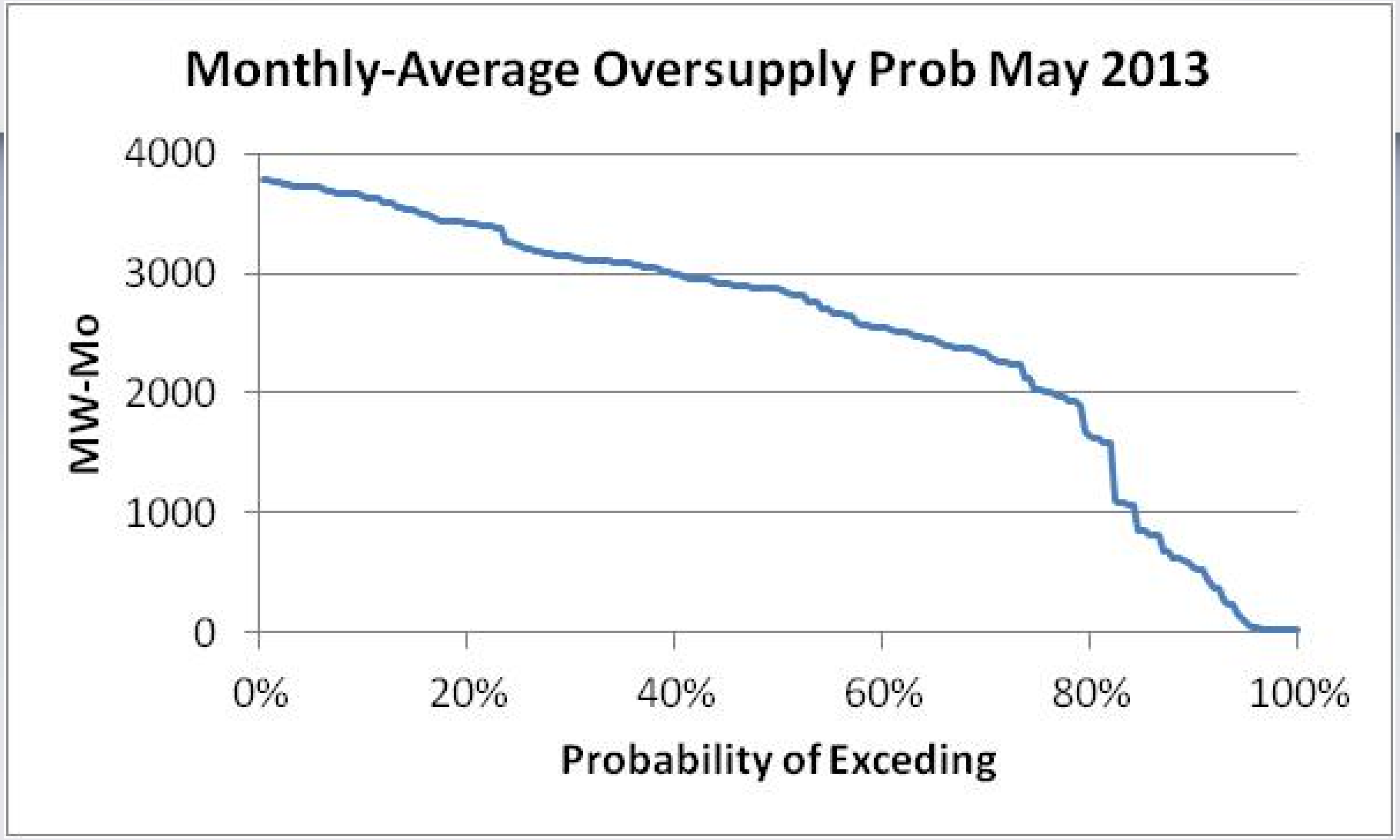

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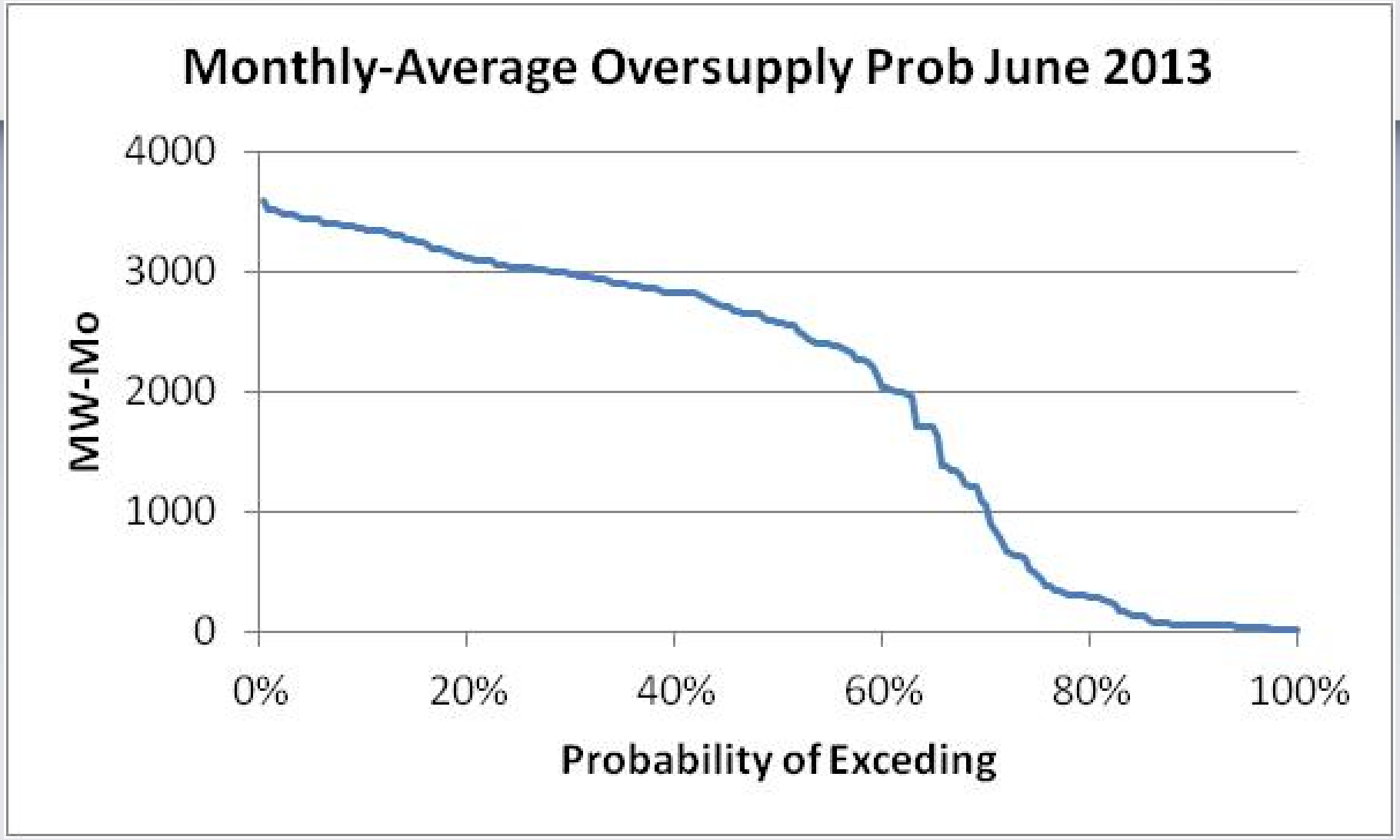

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