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PNW Coal Closure Study

Resource Adequacy Technical Committee Meeting

October 9th, 2014



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Prior Closure Assessment

- Centralia 1 (730 MW) and Boardman (601 MW) retiring by end of 2020
- Closure Assessment presented at January 16th, 2013 Council Meeting
- Based on the 2017 Resource Adequacy Assessment (published December 2012)
- LOLP assessment for 2021 was 15.3 percent without the plants
- 2,000 MW of new dispatchable resource capability required to bring the LOLP down to the 5 percent standard
- Council staff identified over 3,000 MW of planned resources that were not counted in the analysis, but could be added by 2021

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Update to the Assessment

- Based on the 2019 Resource Adequacy Assessment (published May 2014)
 - Includes all cost effective conservation of 6th Power Plan (loads grow 0.6% annually after conservation)
 - The 2019 LOLP assessment is 6 percent
- 2021 LOLP is 10.9 percent without the plants
 - Compared to 15.3 percent of the 2013 Assessment for 2021
- It would take approximately 1,700 MW of dispatchable units reduce the LOLP to the 5 percent standard
 - Compared to the 2,000 MW of the 2013 Assessment for 2021
 - 1,700 MW is divided into four units at 400 MW each and one unit at 100 MW (for forced outage calculations)

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Coal Replacement Plans

- Boardman – 601 MW
 - The 2016 PGE IRP process will include the Boardman coal plant replacement (and any additional RPS resources required post 2020)
- Centralia – 730 MW
 - IPP plant and replacement is uncertain (can't recover costs in a rate process)
 - Expedited permitting available for a new gas-fired plant at site

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Non-Natural Gas Resources Available (6th Power Plan)

6th Power Plan Renewable Potential	
	<u>MW</u>
Animal Manure	57
Landfill Gas	69
Waste Water	12
Biomass	665
Geothermal	374
Solar ¹	Substantial
Wind ²	11535
Acheivable Conservation ³	535
1. High cost - estimate not required (\$9000 per kW)	
2. Excludes Alberta	
3. Achievable by 2021 but not cost-effective	

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Bookend Studies

- Could solar PV or wind reduce the LOLP to 5 percent in 2021?
 - These studies are not power plans and only focus on meeting the LOLP reliability criteria
 - No assumptions are made about costs of these resources (including integration)
 - Energy storage not considered
 - Positive and negative environmental attributes not considered
 - Siting and permitting not considered

Solar PV

- 2021 LOLP assessment of 5 percent if the region adds 15 GW of solar PV
 - (current U.S. installed base is 15.9 GW of which 17.4 MW is PNW utility scale solar)
- Only a limited amount of solar data was available for the study
 - Based on 2 years of actual data (monthly hourly averages)
 - Small set of solar projects in southern Oregon (15 percent west side and 85 percent east side)

Solar Capacity Factors

	Hour Ending:																							
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
Oct	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.03	0.25	0.45	0.51	0.52	0.49	0.49	0.51	0.50	0.41	0.15	0.00	0.00	0.00	0.00	0.00	0.00
Nov	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.03	0.15	0.24	0.29	0.32	0.34	0.29	0.26	0.13	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Dec	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.10	0.22	0.25	0.24	0.26	0.27	0.24	0.09	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Jan	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.13	0.28	0.30	0.30	0.31	0.32	0.33	0.22	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Feb	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.05	0.25	0.35	0.37	0.39	0.38	0.36	0.36	0.28	0.12	0.01	0.00	0.00	0.00	0.00	0.00	0.00
Mar	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.07	0.30	0.46	0.51	0.54	0.55	0.53	0.49	0.48	0.40	0.24	0.06	0.00	0.00	0.00	0.00	0.00
Apr	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.23	0.48	0.55	0.61	0.64	0.65	0.66	0.62	0.58	0.54	0.42	0.20	0.02	0.00	0.00	0.00	0.00
May	0.00	0.00	0.00	0.00	0.00	0.00	0.11	0.40	0.54	0.59	0.63	0.64	0.65	0.63	0.60	0.58	0.53	0.46	0.30	0.09	0.00	0.00	0.00	0.00
June	0.00	0.00	0.00	0.00	0.00	0.01	0.19	0.45	0.58	0.62	0.66	0.68	0.67	0.68	0.66	0.64	0.61	0.54	0.42	0.19	0.01	0.00	0.00	0.00
July	0.00	0.00	0.00	0.00	0.00	0.00	0.13	0.44	0.61	0.67	0.70	0.72	0.71	0.67	0.65	0.63	0.61	0.53	0.37	0.14	0.01	0.00	0.00	0.00
August	0.00	0.00	0.00	0.00	0.00	0.00	0.03	0.26	0.50	0.59	0.63	0.65	0.64	0.62	0.59	0.57	0.52	0.45	0.26	0.04	0.00	0.00	0.00	0.00
Sept	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.13	0.39	0.49	0.51	0.52	0.51	0.53	0.51	0.50	0.44	0.33	0.10	0.00	0.00	0.00	0.00	0.00

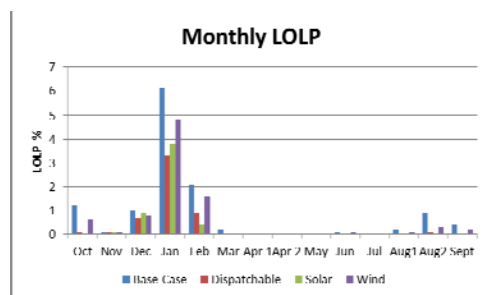
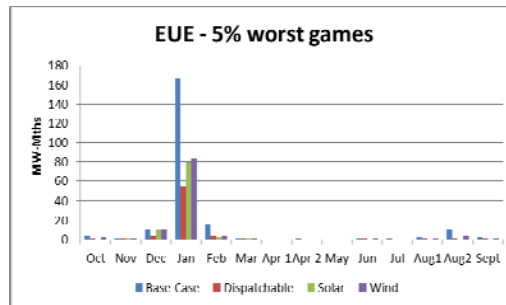
Wind

- A 2021 LOLP assessment of 5 percent could not be achieved with wind
 - 15 GW of wind lowered the LOLP to 7.6 percent
 - Larger amounts of wind destabilized the model
 - Study used existing capacity factors developed for RAAC based on relationship between load center temperature and BPA wind fleet generation
 - Because they are based on the existing BPA wind fleet, they do not reflect the capability of wind in other areas (Coastal, Idaho, Montana, and Wyoming)

LOLP Results

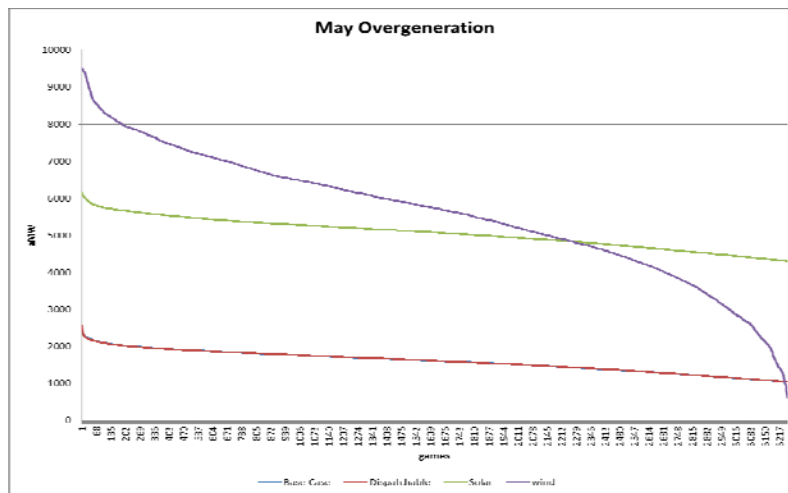
LOLP events occur primarily in the winter

Planning metrics – should be built around winter energy and capacity solutions



May Over-Generation in 2021

(includes modeled must-run hydro, wind and solar generation) in excess of PNW load



Appendix – 2017 & 2019 Assumptions

Item	2017	2019
Operating Year	Oct 2016 to Sep 2017	Oct 2018 to Sep 2019
Number of Games	6160 (all comb hydro and wind)	6160
Random Thermal Outage	On	On
Water year selection	Sequential	Sequential
Water year range	80 years historic 1929-2008	80 years historic 1929-2008
Temperature year selection	Exhaustive pairing w/water	Exhaustive pairing w/water
Temperature year range	77 years 29-05 (to match wind)	77 years 29-05 (to match wind)
Wind year selection	Correlated to temp year	Correlated to temp year
Wind year range	77 years synthetic 1929-2005	77 years synthetic 1929-2005
Wind/temp uncertainty	1 wind set per temp year	Random, 20 sets per temp year
Thermal	Sited and licensed	Sited and licensed
Installed Wind Capacity	4,579 MW (sited and licensed)	4,846 MW (sited and licensed)
Demand response	In standby resources	In standby resources
Load call back provisions	In standby resources	In standby resources
Standby energy	83,000 MW-hours	40,800 MW-hours
Standby capacity (Oct-Apr)	660 MW	623 MW
Standby capacity (May-Sep)	720 MW	833 MW
Energy Efficiency magnitude	Council's 6 th plan targets	Council's 6 th plan targets
Energy Efficiency shape	Same as load	Same as load
NW market (Oct-Apr)	3,451 MW (full IPP)	3,467 MW (full IPP)
NW market (May-Sep)	1,000 MW	1,000 MW
BC market	0 MW	0 MW
Southern Idaho market	Not in model	Not in model
SW market winter on-peak	1,700 MW	2,500 MW
SW market winter off-peak	3,000 MW (purchase ahead)	3,000 MW (purchase ahead)
SW market summer on-peak	0 MW	0 MW
SW market summer off-peak	3,000 MW (purchase ahead)	3,000 MW (purchase ahead)
Maximum SW import limit	3,200 MW	3,200 MW
Fed Hydro balancing reserves	900 INC and 1100 DEC	900 INC and 1100 DEC
Additional balancing reserves	Not modeled	Not modeled
Energy Imbalance Market	Not modeled	Not modeled
Borrowed hydro	1000 MW-periods	1000 MW-periods
Hydro constraints	Draft 2017 regulation	Final 2019 regulation

PNW Utility Scale Solar > 0.5 MW

PNW Utility Solar	
Greater than 0.5 MW	
	<u>MW</u>
Baldock	1.8
Bellevue	1.7
Black Cap	2.0
King Estate	1.0
Outback	5.7
Prologis	3.5
Wildhorse	0.5
Yamhill	1.2
	17.4