Regional Economic Benefit Analysis
2010 NOS

March 23, 2010

Scope

- Identify relative changes related to 2010 NOS TSRs into the existing Northwest generation and transmission system
  - Annual hourly dispatch production cost savings
  - Increase or decrease in economic transmission congestion costs
  - Increase and decrease of NW transmission loading
- Identify economic transmission congestion cost savings from the addition of proposed new transmission additions (from the 2010 Cluster Study) to the existing grid required in association with the TSR's
- Identify additional system stress conditions based on economic dispatch

Cluster Study vs. REBA

- The intent of the Cluster Study is to identify transmission requirements in order for BPA to provide firm service to the TSRs associated with the 2010 NOS
- The REBA considers the reinforcements already identified in the Cluster Study and addresses system congestion
- At the same time, REBA provides strategic input to Cluster Studies on potential congestion areas for future consideration

Observations

- Some of the 2010 NOS TSRs can be accommodated with the transmission improvements identified in the 2008 NOS Cluster Studies. Additional transmission improvements identified in the 2010 NOS Cluster Studies is required
  - Added generation increased transmission loadings and substantially reduced production costs
  - $29M of production costs savings were seen across WECC, a significant portion realized in the Northwest
- While the 2010 NOS Cluster Study identified additional transmission expansion (Northern Intertie, West of Garrison and Central Oregon), the REBA first examined congestion on the system without including these projects
  - A marked reduction in flows on the Montana – Northwest path was due to the addition of substantial wind near Garrison, Montana. That generation did cause a significant increase in congestion hours West of Garrison

Observations (Continued)

- Wind with zero variable cost crowds out other resources
  - 1,000 MW added at Garrison prevents low-cost coal-fired generation from getting out of Montana on many hours
    - This confirms the cluster study conclusion that a new transmission line will be required to deliver all of the proposed wind and existing resources from Montana
  - At peak wind output, most Northwest fossil generation is already displaced by earlier wind generators; the new additions displace out-of-region generators
  - The model indicates that wind energy will account for more than one-eighth of Northwest energy output in 2019
- Significant utilization increases on BPA's network flowgates
  - The West of Slatt loadings above 75% increased by 145 hrs and West of John Day increased by 65 hours
- This confirms Cluster Study conclusion that another new West of Slatt line is not required to meet 2010 NOS requests

Observations (Contd.)

- As coincident peak wind pushes to get to California markets, California interties show significant increases in congestion
  - No new additional NW-SW transmission capacity added in the model
- Consideration, by the simulation model, of generator and transmission forced outages would result in greater price volatility and periods of increased congestion
- High variability of wind generation results in significant cycling of low-cost combined cycle, coal and even nuclear generation
- There was no unserved load in the cases, and negligible wind ‘spill’

Observations (Continued)

- With 2010 NOS Transmission Assessment of CUPW and NI Improvements:

  [Note: all cost savings are WECC-wide reductions in variable O&M and thermal fuel costs.]

  - The Colstrip Upgrade Project (West) reduces overall 2019 WECC-wide variable cost by about $27 million assuming all the new wind generation has been added in Montana
  - The CUP (West) project reduces West of Garrison congestion at or above 75% of path limit by 1,857 hours
  - Northern Intertie improvements reduce WECC-wide production costs in 2019 by about $4 million based on assumed generation addition in BC Hydro system
  - The Northern Intertie fixes reduce Northern Intertie (West) congestion by 559 hours, Raver-Paul by 48 hours, and increase Northern Intertie (East) by 129 hours, Montana-Northwest by 57

Conclusions

- This REBA analysis supports the Cluster Study project recommendations as the total amount of congestion hours and variable operating costs are reduced dramatically
- The energy produced by the new wind generators will displace highest-cost generation, much of which is located outside the Northwest
- The new wind generation is co-located with substantial existing, 2008 and 2009 NOS wind generation, resulting in amplification of issues (they all peak at the same time)
- 2008 NOS line projects (McNary - John Day, Big Eddy - Knight, Central Ferry - Lower Monumental, and I-5 Reinforcement) are still sufficient for relieving congestion on the paths that they reinforce (such as West of McNary and South of Allston), even with the NOS 2010 TSRs added

Conclusions (Continued)

- Additional projects identified in the 2010 NOS Cluster Studies (Northern Intertie Upgrades and Colstrip Upgrade Project West) are required to support the additional 2010 NOS PTSA's
  - Colstrip Upgrade West relieves over 70% of congestion hours above 99% of limit on West of Garrison. Garrison - Ashe would relieve all of this congestion, but with a much higher cost
  - The Northern Intertie upgrades dramatically reduce congestion on the Northern Intertie for north to south transfers. There was significant congestion with 2010 NOS generation, but addition of the proposed 2010 NOS reinforcements relieved 97% of this congestion

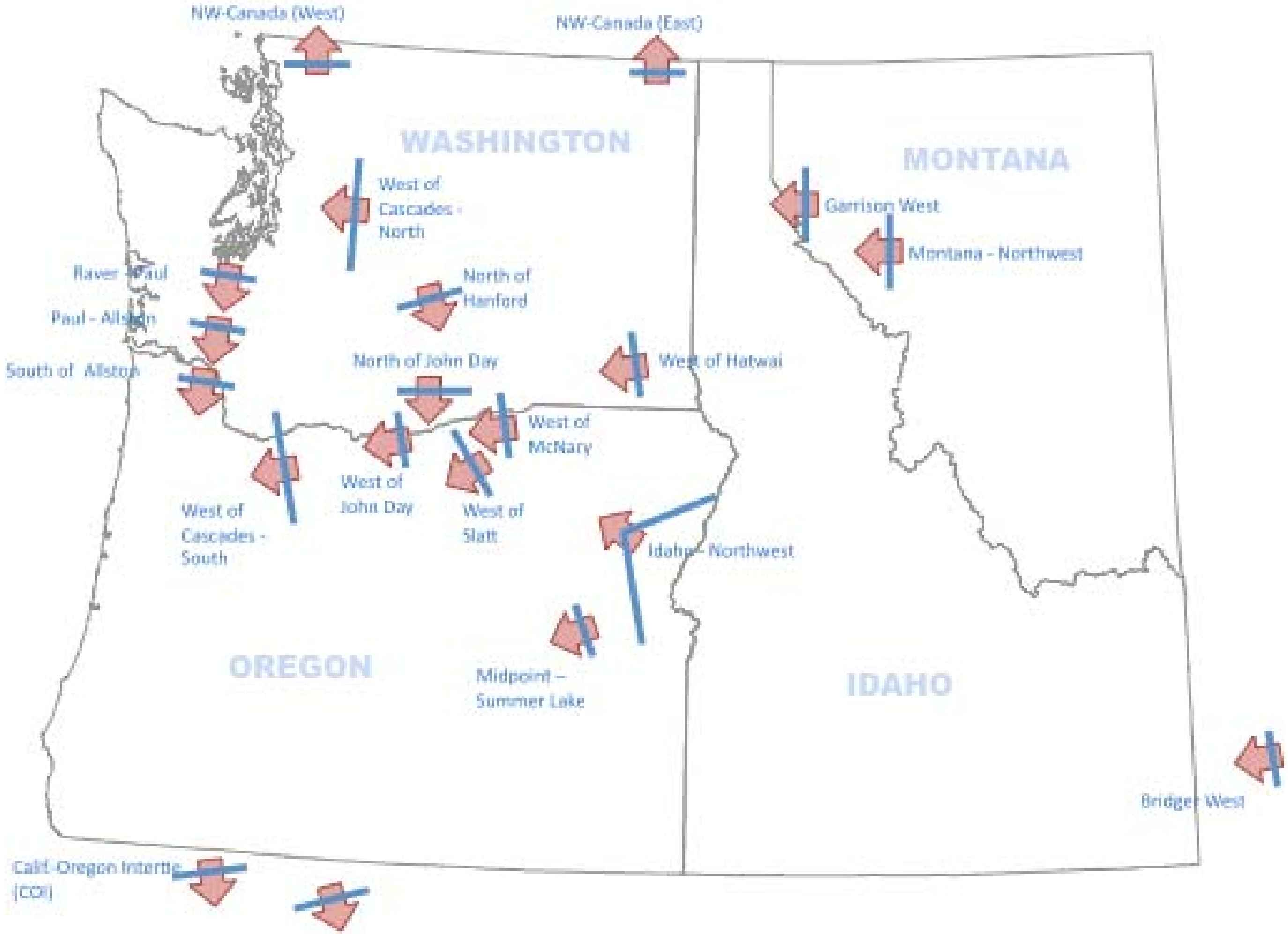
Appendix

What is REBA?

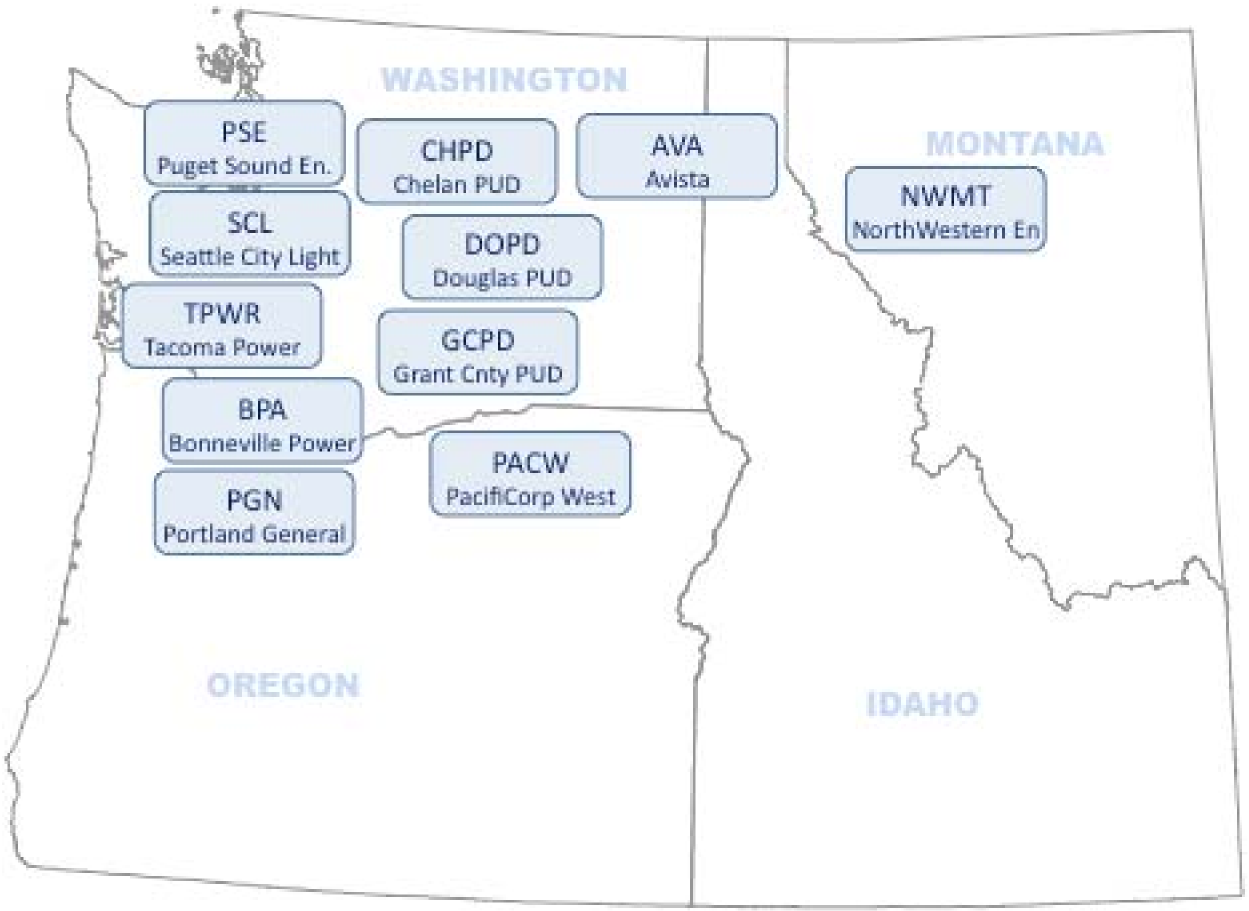
Congestion and Production Cost Analysis

- Provides high level assessment for builds identified in the Network Open Season Cluster Study
- Measure several aspects of system stress resulting from the modeling of Network Open Season (NOS) identified Transmission Service Requests (TSRs) into the Northwest and Western interconnected transmission system
- Production Cost Model helps:
  - Perform an optimal power flow using security constrained generating unit commitment and dispatch to:
    - Identify and estimate production cost benefits
    - Determine congestion impacts

Monitored Transmission Paths



NW Load Areas (GridView)



Assumptions

- TSRs associated with the 2010 NOS were separated into those associated with new generation and those deemed to be used for existing generation
- The simulator modeled the Western Interconnection as a 'single-owner' system, seeking an overall optimal operation (minimizing cost)
  - Simulations based on Year 2019 WECC transmission topology
  - Projects under construction or part of 2008 NOS were modeled in service
  - Proposed projects with a terminal in the NW were modeled out of service
- Variable costs for wind-powered electricity were assumed to be negligible
- Path loadings were considered high if there were hours at or above 75% of the path's limit

Assumptions

- Generation units are dispatched hourly to meet load requirements in a system in such a way to most economically meet the amount of energy and capacity required while maintaining reliability and other operating concerns
  - In a combined hydro and thermal system this economic dispatch is accomplished by shaping hydro production (within environmental and other constraints) and committing and dispatching thermal generators to reduce variable production costs (fuel and O&M) over a foreseeable operating future, and to provide for reliable capacity reserves to withstand unforeseen events
- Recovery of the capital costs of generation and transmission additions and allocation of costs or savings are not part of this analysis

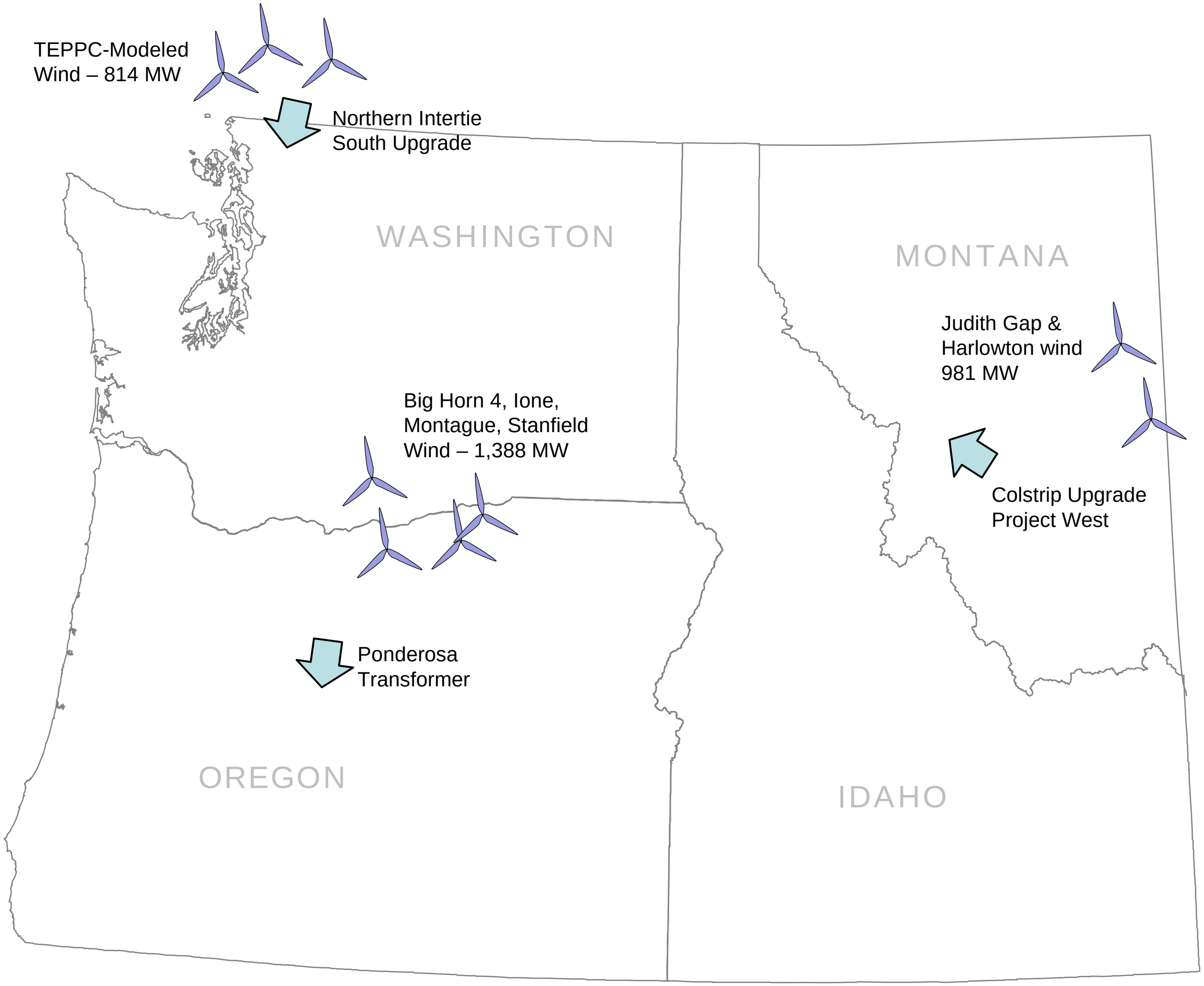
Assumptions (Costs and Dispatch)

- Zero incremental production costs for wind and hydroelectric resources
- Wind generation will occur when the wind blows unless constrained by flowgate limits
- Hydro generation shaped to follow adjusted loads
- Production costs indicated by the model equates to thermal fuel and variable operations and maintenance savings

Assumptions (Wind Resources)

- Wind resources, once installed, have very low incremental operating costs and will be fully dispatched each hour unless constrained by transmission bottlenecks, lack of demand, or other system operating issues including:
  - River operations
  - Reliability, including reserve requirements
  - Generation unit minimum requirements

2010 NOS – Generation & Transmission



Methodology

- ABB's GridView model used to perform the required analyses
- Production cost impacts estimated using an hourly chronological dispatch model with sufficient transmission resolution and load and resource definition to reasonably value the incremental transmission improvements
- The model calculates theoretical production cost savings the combined system could realize if dispatched on the assumed production costs
- Does not calculate how such savings might change or be allocated if generating units were bid or dispatched on market-based prices or other policies instead of incremental fuel costs
- The model also assumes transmission and generation capital costs are sunk and dispatch is not influenced by wheeling rates
- Calculates transmission flows resulting from the dispatch and as limited by flowgate and transmission limits. It observes flowgate limits based on actual flows computed and not scheduled flow limits. Losses are calculated in the optimization

Methodology

- The model assumes that if an optimal dispatch can be attained with resulting flows within flowgate actual flow limits, a representative set of schedules would be theoretically possible
- This study does not fully capture within-hour balancing requirements for wind
- The model does not reflect long term transmission reservation rights that might go unused because a beneficial transaction could not be negotiated
- Flow results are shown as number of hours with paths loaded to 75% or more, 90% or more, and 99% or more of their maximum limits

Methodology: Congestion

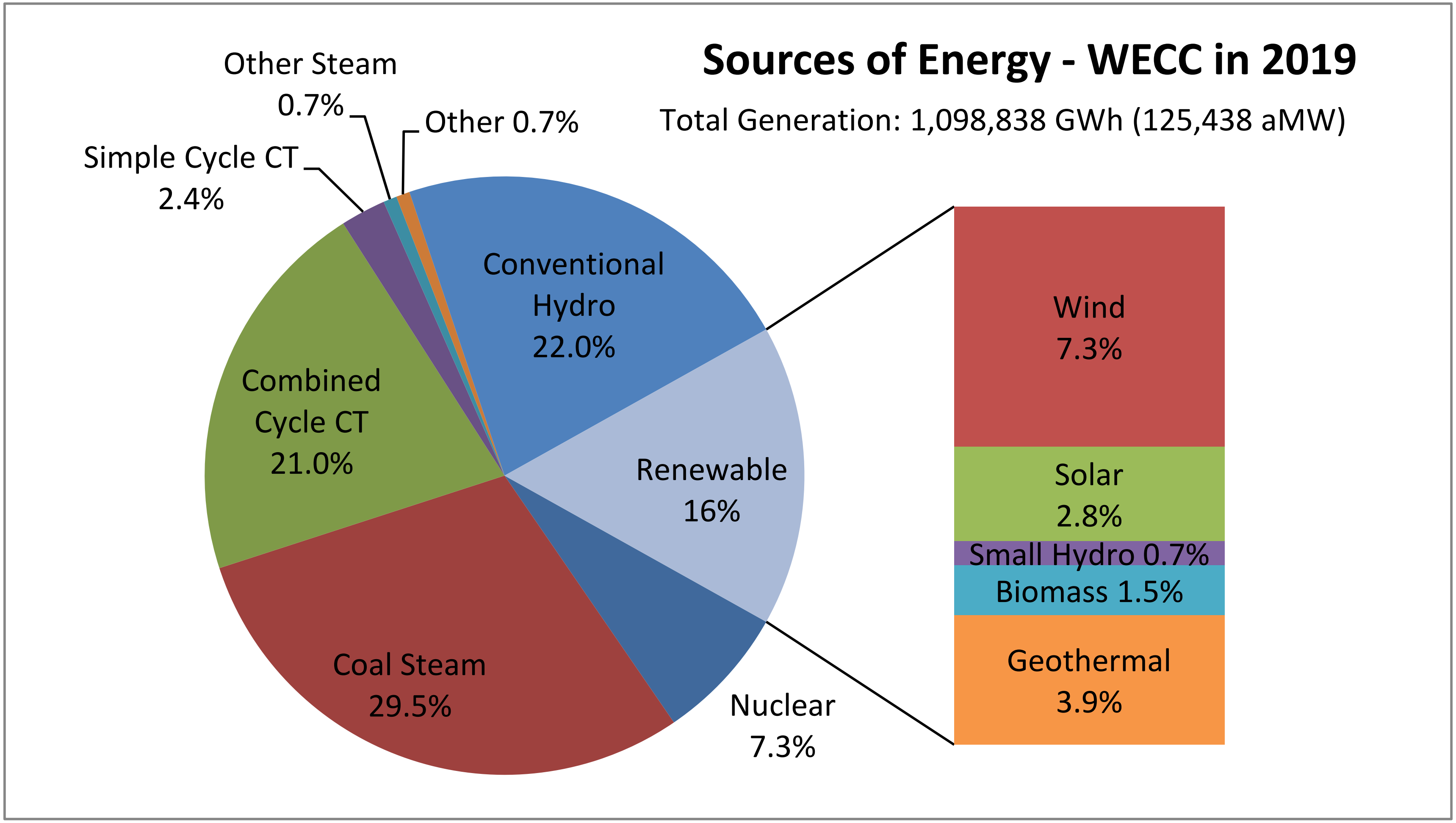
- Transmission congestion on the grid occurs when transmission flows or schedules resulting from a generation and load pattern reach transmission path limits
- When path limits are reached (or predicted to be reached or exceeded), generation must be changed to keep flows within reliability limits
  - Generation is re-dispatched from an otherwise optimal economic fuel and operational mix to keep transmission limits from being exceeded
  - Congestion therefore usually requires and shows up as an increase in the production cost of the system to serve load
  - Congestion can be reduced by the addition of new transmission or by prudent location of new generation (and/or DSM). For NOS, it is assumed the location of the new generation is known (as existing or as reflected through the GI queue)
- This analysis is a relative comparison study

Analysis

Scenarios Considered

- The BaseCase – From 2009 NOS Study
- NOS Cases *(Basecase includes 2008 NOS projects, including new path limits)*
  - With the generation associated with 2010 NOS TSRs ("2010 NOS Generation")
  - With generation associated with 2010 NOS TSRs, and the transmission infrastructure identified by the 2010 Cluster Study as necessary to provide service to those TSRs
- Garrison – Ashe project was not considered part of this study

Sources of Energy to Serve Load



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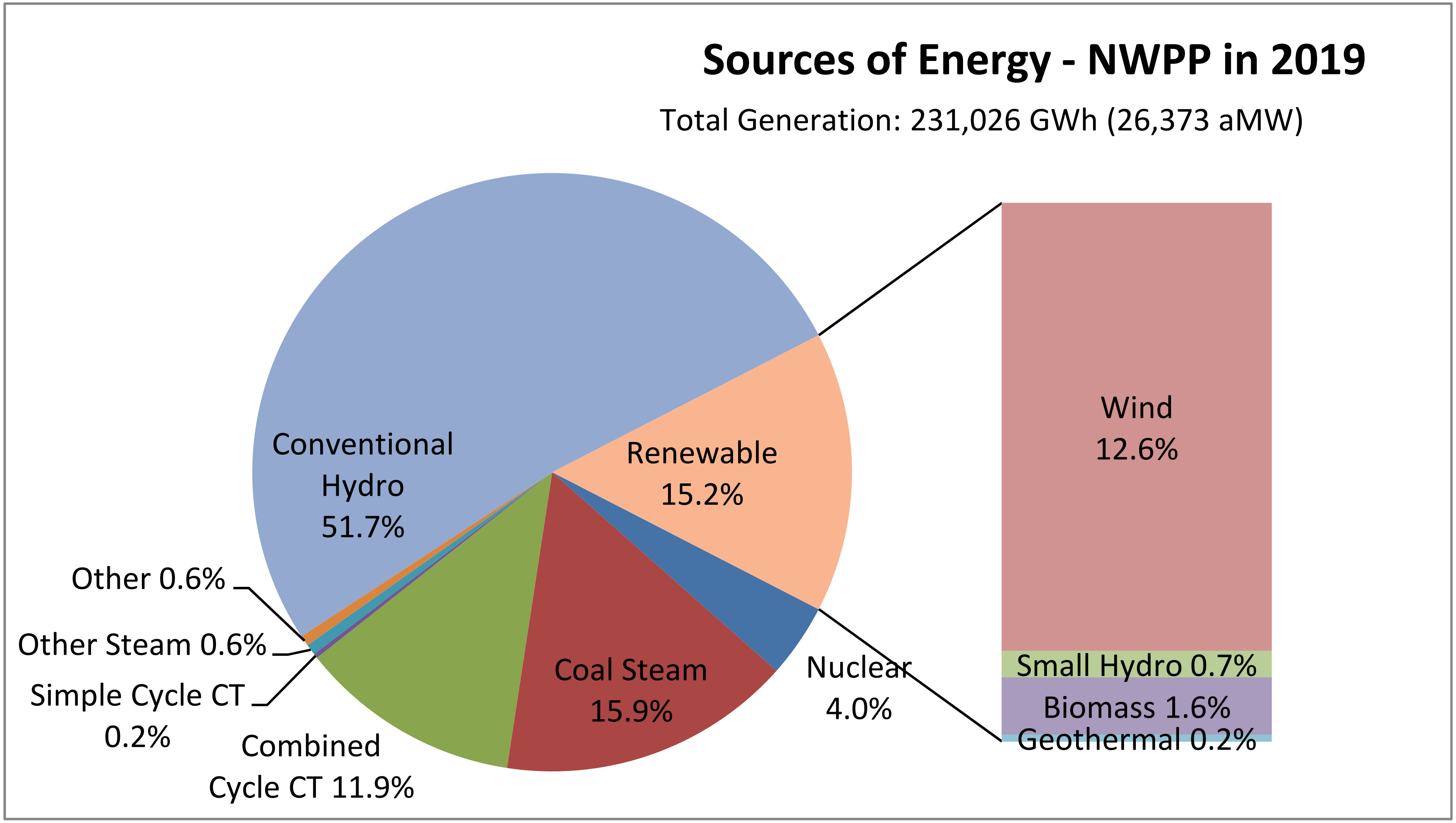

Path & Flowgate Congestion (U75)

Annual Hours At or Above 75% of Path or Flowgate Rating	Congestion Hours			Difference	
	Base Case	with 2010 NOS Gen	with 2010 NOS Gen, Trans	with 2010 NOS Gen	with 2010 NOS Gen, Trans
Internal					
Raver - Paul	14	63	5	49	(9)
Paul - Allston	278	279	292	1	14
South of Allston	41	45	42	4	1
North of Hanford	273	245	168	(28)	(105)
North of John Day	195	252	265	57	70
West of Cascades - North	184	175	198	(9)	14
West of Cascades - South	14	18	16	4	2
West of McNary	0	0	1	0	1
West of Slatt	35	168	180	133	145
West of John Day	43	123	108	80	65
External					
NW to Canada East BC	2,712	2,557	2,643	(155)	(69)
NW to Canada West BC	1,592	1,156	574	(436)	(1,018)
Montana - Northwest	3,603	1,256	3,507	(2,347)	(96)
West of Garrison	4,347	5,427	3,588	1,080	(759)
Bridger West	7,780	7,770	7,737	(10)	(43)
Idaho - Northwest	4	4	9	0	5
Midpoint - Summer Lake	34	25	18	(9)	(16)
California-Oregon Intertie (COI)	2,375	3,185	3,123	810	748
Pacific DC Intertie (PDCI)	195	376	421	181	226

Base case includes 2008 NOS projects and associated new path limits

Path & Flowgate Congestion (U90)

Annual Hours At or Above 90% of Path or Flowgate Rating	Congestion Hours			Difference	
	Base Case	with 2010 NOS Gen	with 2010 NOS Gen, Trans	with 2010 NOS Gen	with 2010 NOS Gen, Trans
Internal					
Raver - Paul	0	2	0	2	0
Paul - Allston	42	52	49	10	7
South of Allston	0	0	0	0	0
North of Hanford	48	56	16	8	(32)
North of John Day	0	8	3	8	3
West of Cascades - North	0	0	0	0	0
West of Cascades - South	0	0	0	0	0
West of McNary	0	0	0	0	0
West of Slatt	0	0	0	0	0
West of John Day	0	3	1	3	1
External					
NW to Canada East BC	1,476	1,328	1,329	(148)	(147)
NW to Canada West BC	672	596	94	(76)	(578)
Montana - Northwest	990	36	701	(954)	(289)
West of Garrison	1,343	3,610	1,600	2,267	257
Bridger West	4,818	4,731	4,587	(87)	(231)
Idaho - Northwest	1	2	2	1	1
Midpoint - Summer Lake	0	0	0	0	0
California-Oregon Intertie (COI)	1,052	1,669	1,656	617	604
Pacific DC Intertie (PDCI)	86	219	218	133	132

Base case includes 2008 NOS projects and associated new path limits

Path & Flowgate Congestion (U99)

Annual Hours At or Above 99% of Path or Flowgate Rating	Congestion Hours			Difference	
	Base Case	with 2010 NOS Gen	with 2010 NOS Gen, Trans	with 2010 NOS Gen	with 2010 NOS Gen, Trans
Internal					
Raver - Paul	0	0	0	0	0
Paul - Allston	0	0	0	0	0
South of Allston	0	0	0	0	0
North of Hanford	7	3	0	(4)	(7)
North of John Day	0	0	0	0	0
West of Cascades - North	0	0	0	0	0
West of Cascades - South	0	0	0	0	0
West of McNary	0	0	0	0	0
West of Slatt	0	0	0	0	0
West of John Day	0	0	0	0	0
External					
NW to Canada East BC	846	760	734	(86)	(112)
NW to Canada West BC	321	378	10	57	(311)
Montana - Northwest	107	0	90	(107)	(17)
West of Garrison	359	2,586	739	2,227	380
Bridger West	832	577	615	(255)	(217)
Idaho - Northwest	0	1	1	1	1
Midpoint - Summer Lake	0	0	0	0	0
California-Oregon Intertie (COI)	515	914	928	399	413
Pacific DC Intertie (PDCI)	57	143	149	86	92

Base case includes 2008 NOS projects and associated new path limits

Variable Costs

Total Annual Generation Cost ($Millions)

(Thermal Generation Only)

	Base Case	with 2010 NOS Gen	with 2010 NOS Gen, Trans	Change from Base Case: with 2010 NOS Gen	Change from Base Case: with 2010 NOS Gen, Trans	Delta: Effect of 2010 NOS Trans
Total WECC	$24,854	$24,448	$24,419	($406)	($435)	($29)
AZ-NM-NV	$6,749	$6,671	$6,685	($78)	($64)	$14
Basin	$1,627	$1,593	$1,607	($33)	($20)	$14
California	$7,927	$7,803	$7,771	($123)	($156)	($33)
Canada	$4,067	$4,059	$4,055	($8)	($12)	($5)
NWPP	$2,838	$2,699	$2,666	($139)	($172)	($33)
RMPP	$1,647	$1,623	$1,636	($24)	($11)	$13

Includes only fuel and variable operations and maintenance costs

Base case includes 2008 NOS projects. Adding the 2010 NOS Projects Results in additional $29M in WECC production cost savings. The Colstrip West upgrade project was included as part of 2010 NOS projects.


B O N N E V I L L E P O W E R A D M I N I S T R A T I O N
Questions?