2019 Integrated Resource Plan (IRP) Public Input Meeting January 24, 2019




PACIFICORP
POWERING YOUR GREATNESS

Agenda

January 24

- 9:00am-9:30am pacific – Capacity-Contribution Values for Energy-Limited Resources
- 9:30am-11:30am pacific – Coal Studies Discussion
- 11:30am-12:15pm pacific – Lunch Break
- 12:15pm-3:00pm pacific – Coal Studies Discussion (continued)
- 3:00pm-3:30pm pacific – Stakeholder Feedback
- 3:30pm-4:00pm pacific – Wrap-Up / Next Steps

Progress Update

- At the December 3-4, 2018 public-input meeting, PacifiCorp presented initial results of our coal study analysis. These findings revealed more analysis was needed to meet minimum reliability requirements.

- The coal study is a comprehensive research effort informing PacifiCorp's integrated resource planning process and supports our steadfast aim of identifying the most reliable and affordable mix of resources to meet our customers' energy needs.

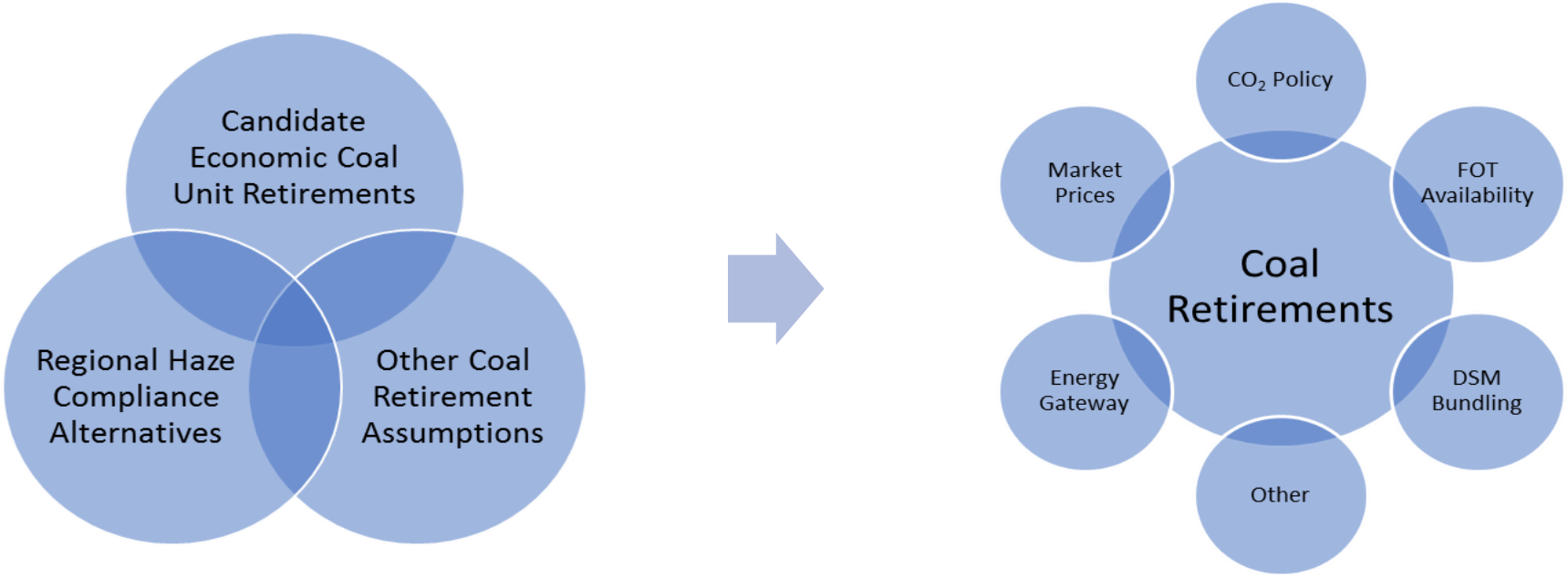
- Our initial coal study findings revealed more analysis was needed to meet minimum reliability requirements. Since the December public input meeting, we have made progress in addressing reliability requirements, but further analysis is needed to satisfy our reliability mandate.

- To continue the complex modeling and critical stakeholder review needed to complete our coal study analysis prior to initiating our portfolio-development, PacifiCorp is postponing the 2019 IRP filing from April 1, 2019 to August 1, 2019.
  - Filings requesting approval will be filed in Idaho, Utah, and Washington.
  - Filings providing notification will be filed in Oregon and Wyoming.
  - No filing required in California.

Today's Presentation

- Capacity-contribution values for energy-limited resources.
- Corrections and enhancements to initial coal-study modeling from the December 2018 public-input meeting.
- Progress in implementing modeling enhancements to address reliability.
- Other coal study follow-up items.
- Next steps.

Portfolio-Development Process



- Initial model runs for the portfolio-development process will consider the interplay of Regional Haze compliance alternatives with potential economic coal unit retirements while evaluating near-term coal unit decisions (*i.e.*, Naughton 3, Jim Bridger 1 and 2), updating analysis from the 2017 IRP (*i.e.*, Cholla 4), and incorporating commission-ordered analysis (*i.e.*, Colstrip 3 and 4).
- Additional portfolio will be developed, using coal retirement assumptions that can meet compliance obligations and that minimize system costs, using alternative assumptions for other system variables (*i.e.*, CO_2 policies, market prices, FOT availability, Energy Gateway, and DSM).
- Once initial model results are available, additional portfolios may be developed.
- Cost-and-risk analysis will be performed using PaR under three different price-policy scenarios.

Capacity Contribution of Energy Limited Resources

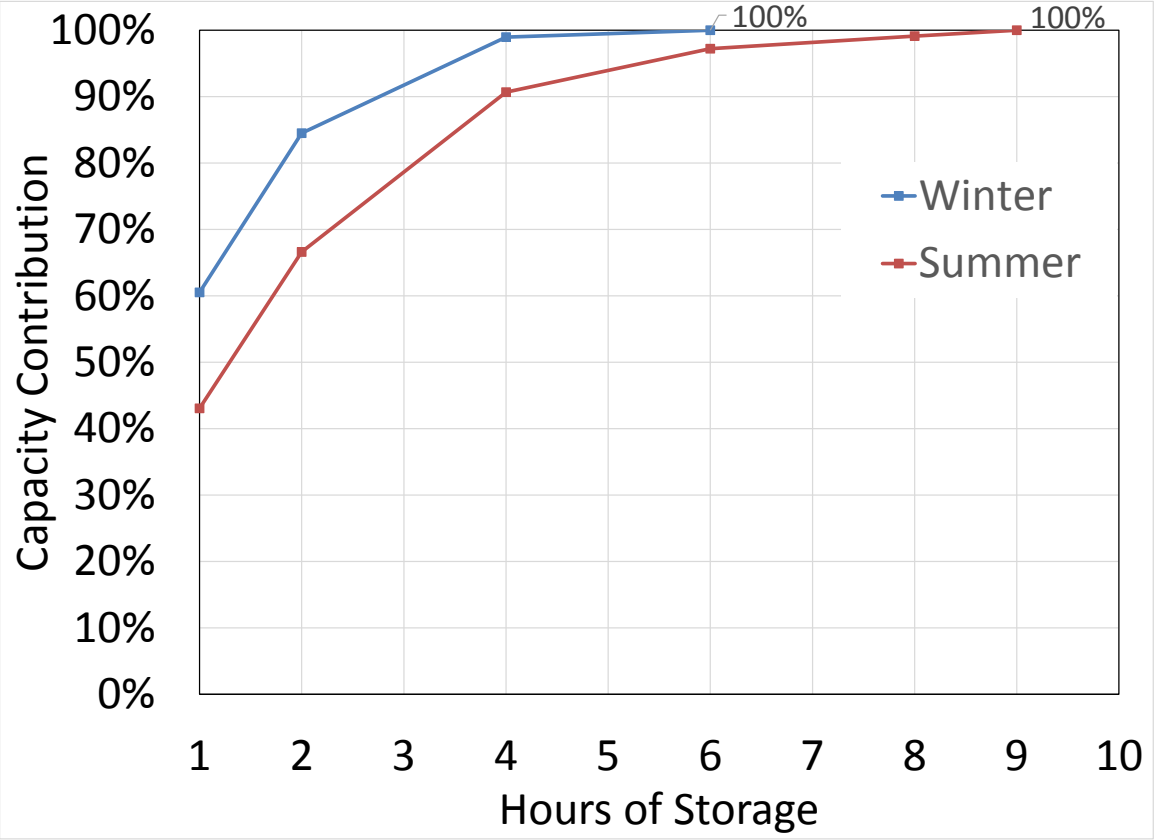



PACIFICORP
POWERING YOUR GREATNESS

Capacity Contribution of Energy Limited Resources

- The 2019 IRP capacity-contribution methodology has been discussed in public-input meetings in July, August, and September 2018.
- Capacity-contribution values for energy storage resources and load-control programs discussed herein have been incorporated in modeling.
- PacifiCorp adapted the Capacity Factor Approximation Methodology (CF Method) and system data (as discussed in previous meetings) to energy storage and load-control programs.
- The standard application of the CF Method examines the loss-of-load probability (LOLP) in every hour of a test year, based on the results of 500 stochastic iterations of PacifiCorp.
- The availability of energy storage resources depends on their storage capacity. Similarly, the availability of a load-control program is dependent on daily and annual curtailment limits.
- As a result, the duration of individual outage events and the daily and annual total outages must be assessed for each iteration, rather than as an average.
- Stochastic iteration loss-of-load results:
    - Up to 35 hours of loss of load occurred in a single year.
    - Up to 9 hours of loss of load occurred in a single day.
    - 60% of the 500 iterations had no loss-of-load events.

Energy Storage Capacity Contribution



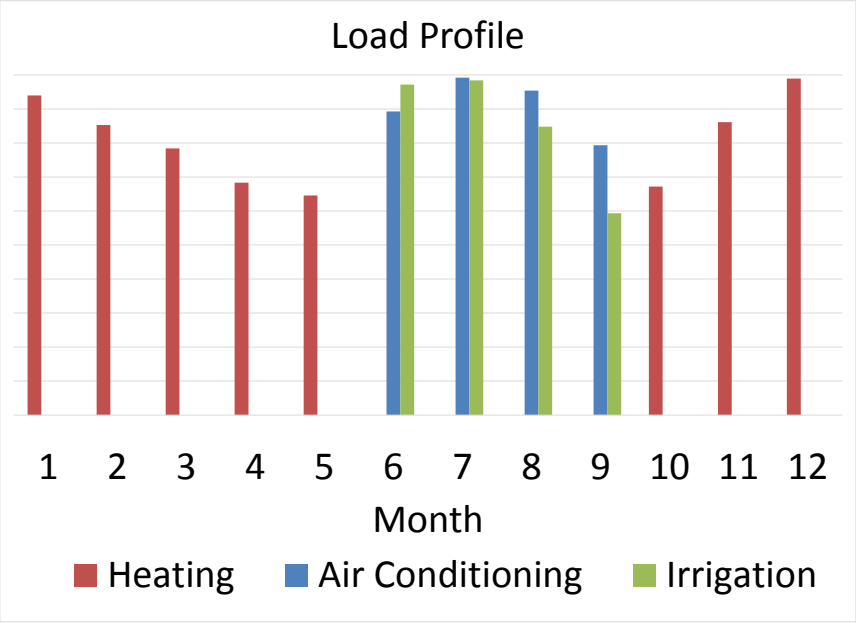
- The maximum outage duration was nine hours in the reliability studies –nine hours of storage provides a 100% contribution.
- A four-hour resource covers just over 90% of summer events, and 99% of winter events.

PACIFICORP
POWERING YOUR GREATNESS

Interruptible-Load Programs Capacity Contribution

- Interruptible-load programs modeled in the 2019 IRP:
  - Interruption allowed 4-6 hours per day.
  - Interruption allowed 30-528 hours per year.
  - 10 programs: five are year round and five are summer only.
  - Examples: cooling, water heating, space heating, smart appliances, electric vehicle charging, irrigation.

- Load must be in use to be interrupted.
  - Distinct profiles for:
    - Heating
    - Cooling
    - Irrigation
  - Flat profiles for:
    - Smart appliance
    - Electric-vehicle charging
    - Industrial contracts



PACIFICORP
POWERING YOUR GREATNESS

Interruptible-Load Programs Capacity Contribution

Load Profile	Hours per day	Hours per year	Capacity Contribution	Notes
Flat	6	528	98% (Winter)	
Space heating	4	50	75% (Winter)	2nd hour 50% availability
Flat	6	528	97% (Summer)	
Irrigation	4	52	85% (Summer)	
Cooling	4	50	69% (Summer)	2nd hour 50% availability

- Key factors for program design:
  - Curtailment window (*i.e.*, 12pm-8pm weekdays vs. anytime).
  - Allowed interruptions per day, and per year.
  - Notification requirements: day-ahead, hour-ahead, no-notice.
  - Response time: day-ahead, hour-ahead, 10 minute, five minute, <1 minute.
  - Response duration and restoration parameters.
  - Metering: both for real-time availability and settlement of response events.
- EIM participation has relatively high requirements for equipment, granularity of response, and program design, but provides incremental value if the conditions can be met.

Coal Study Corrections and Enhancements




PACIFICORP
POWERING YOUR GREATNESS

Corrections/Enhancements
Decommissioning Costs & Fixed Costs

Decommissioning Costs

- Decommissioning costs in the year 2038 were inadvertently omitted from the Benchmark Case C-01 and the unit-by-unit cases—no impact to portfolios selected by System Optimizer.
  - Minimal impact on unit-by-unit PVRR(d) results.
  - The correction increased the PVRR of system costs in the Benchmark Case C-01 by approximately $45m (retirement benefits in the stacked-retirement cases were understated, retirement costs in the stacked-retirement cases were overstated).

Fixed Costs

- In three unit-by-unit cases, fixed costs were incorrectly "pointed" to the wrong unit (Dave Johnston 2).
  - For Cases C-08 (Dave Johnston 3) and C-09 (Dave Johnston 4), the impact is negligible (within $1million on a present-value basis).
  - For Case C-18 (Jim Bridger 2), early retirement benefits increase by approximately $119m, aligning the results with Jim Bridger 1.

Corrections/Enhancements
Jim Bridger 1 and Battery Storage

Jim Bridger 1

- Stacked-retirement cases C-35 through C-39 that were presented at the December 3-4, 2018 public-input meeting, incorrectly allowed Jim Bridger 1 to dispatch in the Planning and Risk model beyond the assumed 2022 retirement date.
- System Optimizer studies were not impacted.
- When corrected, the present-value revenue requirement (PVRR) of system costs for the early retirement run increases by approximately $197m (an erosion of potential early retirement benefits on a present-value basis).

Battery Storage

- Battery resource options are now available for selection in the "parent" bubble within the new transmission topology that enables endogenous modeling of transmission upgrades.
  - Allows these resource options to be chosen without other new resource alternatives that were otherwise required to charge the battery.
  - Allows these resource options to be chosen without incremental transmission capacity.
- This results in more storage and fewer natural gas resources in the out years (2037-2038) regardless of early coal-unit retirement assumption.

Reliability Assessment Status Update




PACIFICORP
POWERING YOUR GREATNESS

Reliability Assessment Status

- PacifiCorp presented a preliminary reliability assessment at the December 3-4, 2018 public-input meeting that showed hourly operating reserve shortfalls in the Benchmark Case C-01 and all stacked-retirement cases reviewed—shortfalls increased as more units were assumed to retire early.
- PacifiCorp discussed three different ways it was considering to address the operating-reserve shortfalls observed in these preliminary results.
  - More closely aligning modeling with potential operational flexibility.
  - Alternative assumptions for front-office transaction limits.
  - Inclusion of incremental resources with associated costs and benefits.
- PacifiCorp further highlighted that it would need to assess potential frequency-response shortfalls once operating-reserve deficiencies are addressed.
- Progress has been made on model enhancements related to operational flexibility and front-office transaction limits, but these advancements continue to be assessed/reviewed and have not yet entirely resolved the reliability shortfalls discussed in December 2018.

Regulation Reserves with Wind and Solar

- Wind and solar resources with requisite contractual rights and controls can provide regulation reserves when forecasted output can be curtailed to free-up operating capacity on the system.
- Curtailment results in:
  - Replacement energy cost (typically market).
  - Lost renewable energy credit revenue, where applicable (only included where explicitly known).
  - Lost production tax credits, where applicable.
  - Avoided taxes (Wyoming wind only).
- PacifiCorp has been testing how to capture regulation reserves from curtailed wind and solar resources that have requisite contractual rights and controls by modeling these resources as dispatchable resources in the Planning and Risk model.
- PacifiCorp continues to test this modeling technique and is evaluating whether there are operational limitations that might apply.

Reserves from Hydro Resources and Increased Front-Office Transaction Limits

Hydro Resources

- The Planning and Risk model (PaR) optimizes dispatchable hydro generation to maximize energy value.
- Consequently, in practice, if operating reserves are needed, dispatchable hydro resources can provide more operating reserve capability by reducing energy in peak hours during the spring run-off by shifting water into off-peak times.
- To better account for the flexibility of dispatchable hydro resources, these resources were configured for spring months February through May to maximize reserve capability by establishing a consistent monthly dispatch rather than shaping to load.

Front-Office Transactions

- Modeling enhancements that address the modeling of dispatchable wind, solar, and hydro resources can result in less energy to serve load, so their viability in mitigating operating-reserve shortfalls may be restricted by limits on market purchases.
- Recognizing that market conditions vary by season, front-office transaction limits, which were established with a focus on summer and winter peak-load periods, are increased during the spring and fall to align with firm transmission rights—the increase is from 1,425 MW to 2,277 MW in these periods.

Incremental Resources for Reliability

- Wind, solar, hydro, and front-office transaction modeling enhancements show that operating-reserve shortfalls are reduced, but not resolved.
- Additional work is needed to refine wind, solar, and hydro modeling enhancements and remaining shortfalls still need to be addressed with adjustments to the resource portfolio to ensure the appropriate type of capacity is being added in the right location.
- Depending on the type and timing of the shortfall, additional resources may be required to achieve reliability and ongoing studies will evaluate least-cost, least-risk solutions. Some considerations:
  - Batteries: capable of providing all types of operating reserves, relatively modular build (scalable), limited energy duration.
  - Energy Efficiency: scalable, but no reserve capability.
  - Load Control: capable of potentially offering all types of operating reserves, relatively scalable, load must be "in use" (seasonal limitations), other program design limits need to be considered.
  - Gas-fired Peaking Capacity: no energy limits, capable of providing all types of operating reserves, but must be online to provide spin, not as scalable as other options, incremental CO_2 emissions relative to other alternatives.

Deterministic PaR Runs (Refresher)

- Reliability assessments are based on an hourly deterministic Planning and Risk model (PaR) run for a given test year (*i.e.*, the December 3-4, 2018 presentation showed results for 2023—the first full year after assumed coal unit retirements).
- Without stochastic shocks, thermal units are modeled using de-rated capacity to account for unplanned outages—hourly loads are weather normal (expected).
- System balances are summarized and graphed for load, net load (load net of Class 2 DSM, wind, and solar), spinning reserves, non-spinning reserves, and regulation reserves.
- Graphs show the type of resources that are providing system services across each hour of a selected day (*i.e.*, peak-load day, peak net-load ramp day, etc.).
- PacifiCorp has not yet fully assessed the potential need for incremental frequency response.
- The reliability assessments have been refreshed for some cases, updated to reflect corrections discussed earlier, and updated to reflect modeling enhancements for wind, solar, and hydro resources and for front-office transaction limits.

Benchmark (Case C-01) Capacity Shortfalls in 2023

	December 2018 Public-Input Meeting	January 2019 Public-Input Meeting (Wind, Solar, Hydro, FOT Enhancements)
# of Hours with Capacity Shortfall	29 Hours	0 Hours
Percentage of Hours with Capacity Shortfall	0.3%	0.0%
Types of Shortfall	Non-Spin and Regulation	None
Maximum Capacity Shortfall	290 MW	0 MW
Hour of Maximum Capacity Shortfall	HE 9 on 3/28/2023	n/a

- Enhancements tested thus far remedy capacity shortfalls initially observed in the Benchmark Case C-01.
- Considering that the deterministic runs assume normal weather, PacifiCorp continues to work on reporting templates that track how much "excess" capacity is available throughout the year.

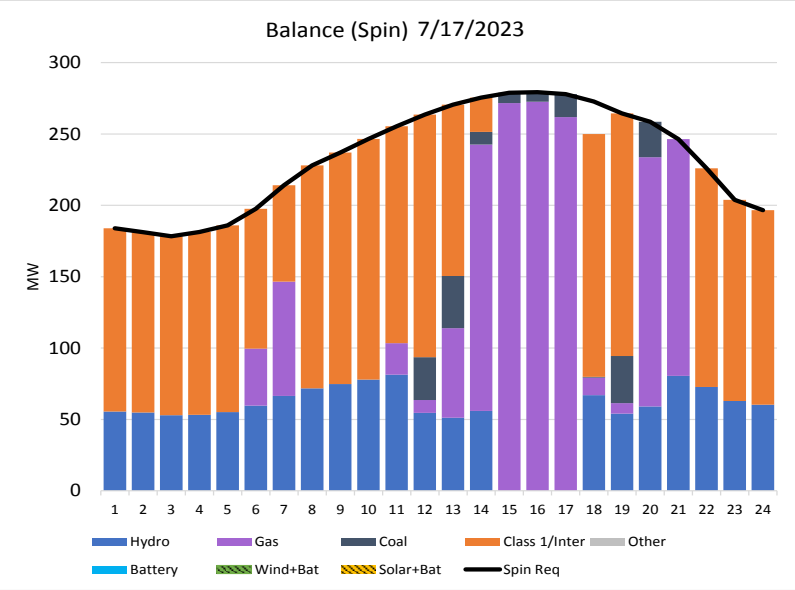
Stacked Case C-35*
Capacity Shortfalls in 2023

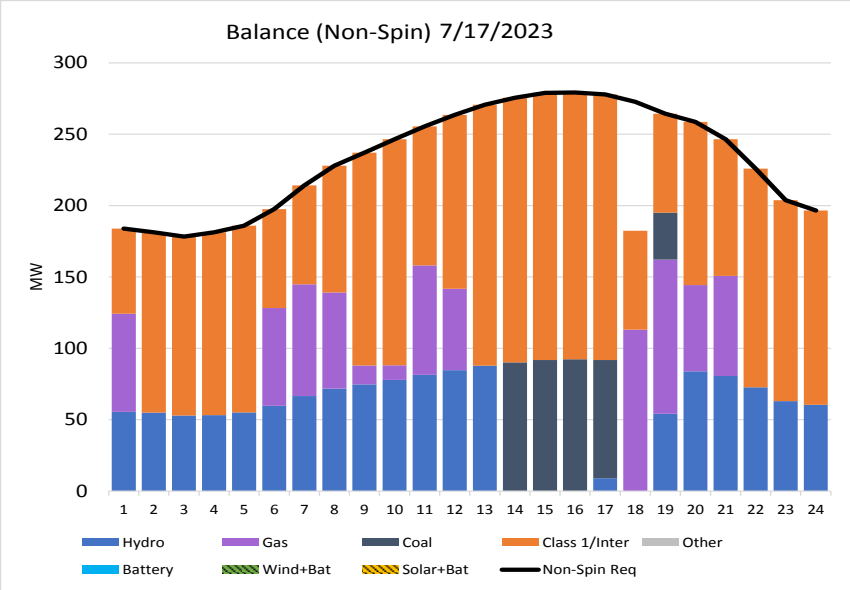
	December 2018 Public-Input Meeting	January 2019 Public-Input Meeting (Wind, Solar, Hydro, FOT Enhancements)
# of Hours with Capacity Shortfall	146 Hours	2 Hours
Percentage of Hours with Capacity Shortfall	1.7%	0.02%
Types of Shortfall	Non-Spin and Regulation	Spin, Non-Spin, and Regulation
Maximum Capacity Shortfall	318 MW	292 MW
Hour of Maximum Capacity Shortfall	HE 9 on 3/28/2023	HE 18 on 7/17/2023

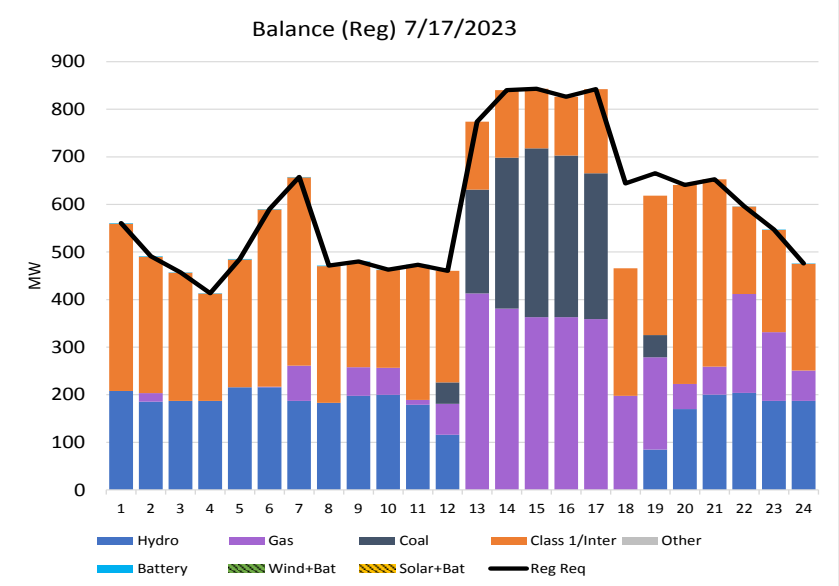
- Enhancements tested thus far reduce, but do not resolve, capacity shortfalls initially observed in the Stacked Case C-35
- Considering that the deterministic runs assume normal weather, *any* level of shortfall signals a reliability problem that must be resolved to ensure there is sufficient capacity to mitigate the effects of non-normal events.
- PacifiCorp continues to work on reporting templates that track how much "excess" capacity is available throughout the year to help determine if there is sufficient capacity to accommodate non-normal weather and other non-normal events.

*Stacked Case C-35 assumes an incremental 711 MW of early coal-unit retirements at the end of 2022 relative to the Benchmark Case—Naughton 1 and 2 and Jim Bridger 1.

Updated Case C-35 –2023 Deterministic Peak Shortfall Day (Reserves)

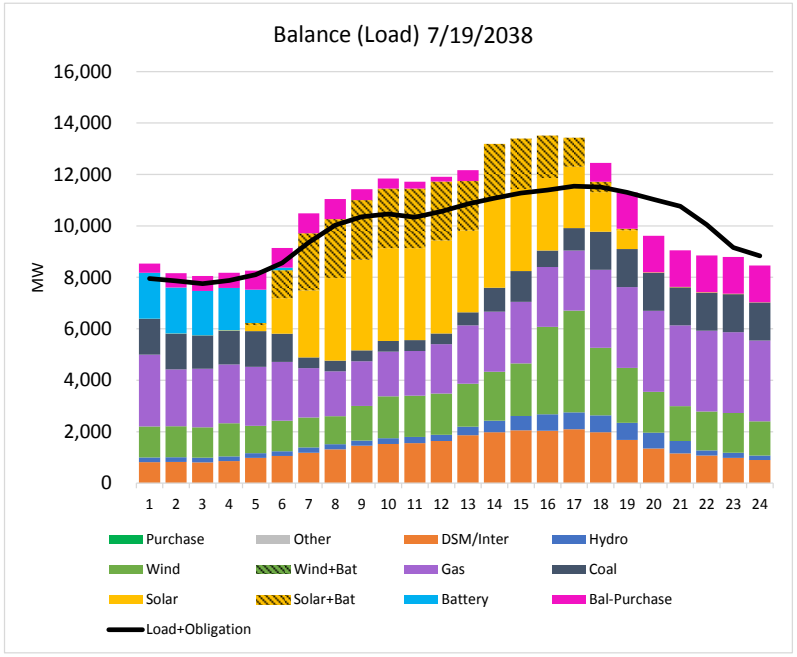


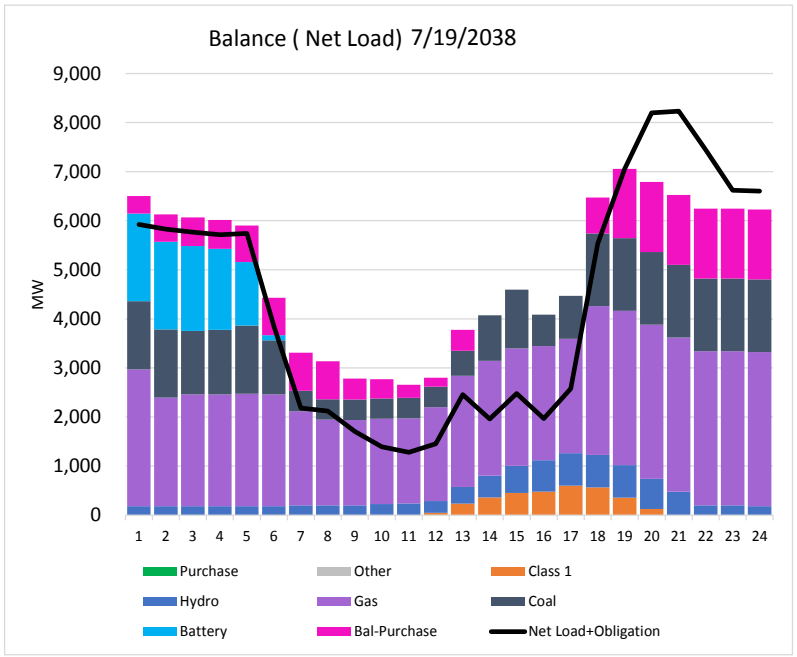




- Max aggregate shortfall = 292 MW.
- One spinning reserve shortfalls 23 MW.
- One non-spinning reserve shortfalls 90 MW.
- One hour of regulation shortfall totaling 178 MW in hour-ending nine.

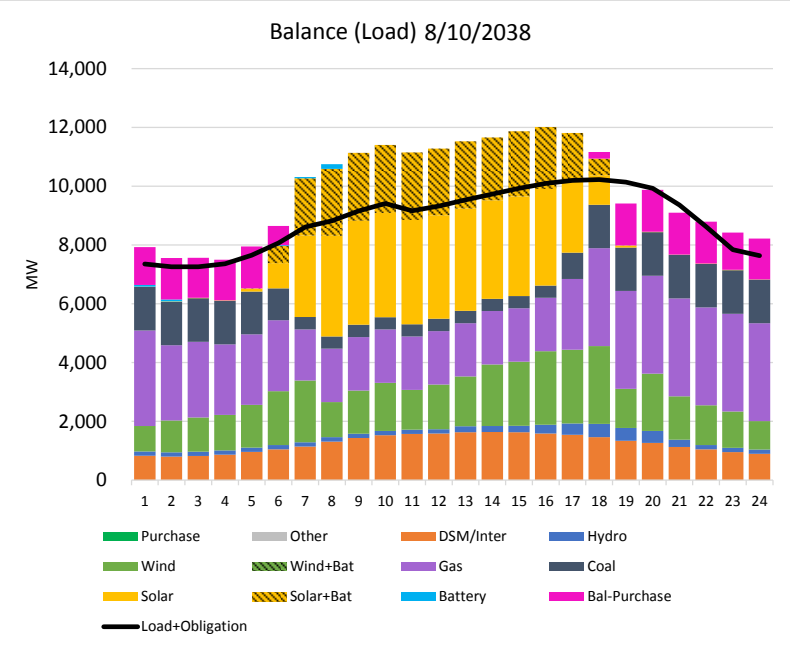
Updated Case C-35 – 2038 Deterministic Peak Load Day

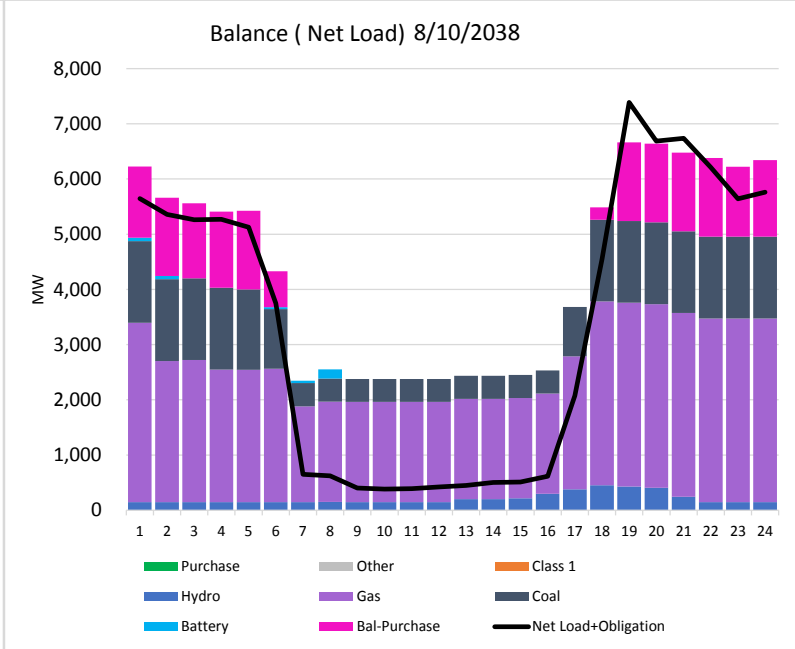




- The peak load day occurs on July 19, 2038.
- Peak load = 11,519 MW in hour-ending 17.
- Maximum three-hour net-load ramp = 5,617 MW between hour-ending 18 and hour-ending 20.
- Unserved energy is observed 5,058 MWh in hour ending 20 to hour ending 24.

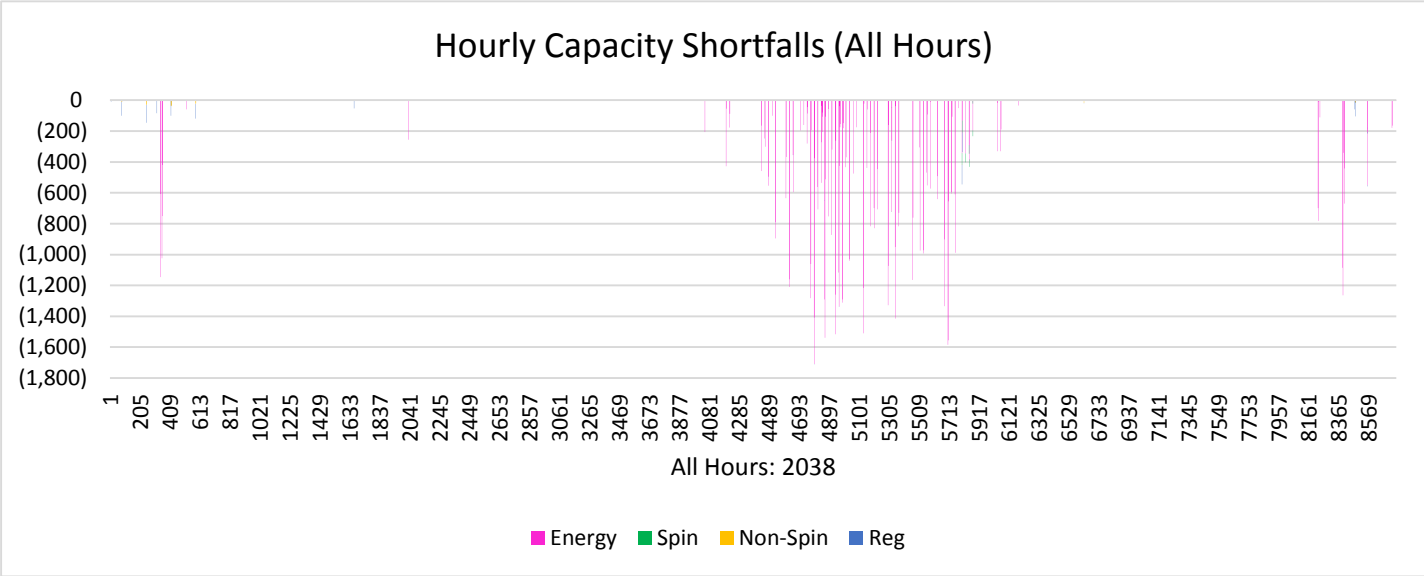
Updated Case C-35 – 2038 Deterministic Peak Net-Load Ramp Day





- The peak three-hour net-load ramp occurs on August 10, 2038.
- Maximum load = 10,105 MW in hour-ending 19.
- Peak three-hour net-load ramp = 6,770 MW between hour-ending 17 and hour-ending 19.
- Unserved energy 1,028 MWh is observed between hour-ending 19 to hour-ending 21.

Updated Case C-35 – 2038 Deterministic Capacity Shortfalls



- 215 hours (2.45%) show a capacity shortfall in energy July & August 2038.
- The maximum capacity shortfall is 1,708 MW, which occurs in hour-ending twenty-one on July 19, 2038.
- No shortfall in spinning, non-spin and regulation reserves.

Other Coal Study Follow-Up Items




PACIFICORP
POWERING YOUR GREATNESS

Transmission Timing
Gateway South

- In the preliminary coal studies presented at the December 3-4, 2018 public-input meeting, System Optimizer selected Gateway South in 2032 or 2033 in all unit-by-unit and stacked cases.
- As discussed during that public-input meeting, an additional 2033 Benchmark Case was created for comparison with cases that selected GWS in 2033 to isolate the effect of its timing and subsequent resource selections on present-value revenue requirement differential (PVRR(d)) results:
  - 2033 GWS increases System Optimizer Benchmark Case costs by roughly $15m.
  - 2033 GWS increases PaR Benchmark Case costs by roughly $81m.
- Higher costs in the PaR Benchmark Case results is driven by:
  - Reserve shortages in 2032—costs that are not “seen” by System Optimizer.
  - Transmission upgrade shifts in the west.
- These results confirm that the difference in the timing of GWS is less impactful in System Optimizer relative to PaR, and that slight changes in timing (by one year) can distort the comparative PVRR(d) results among specific units and among stacked-retirement cases (as applicable).
- Given the consistent selection of GWS in all cases in the 2032 to 2033 time frame and considering that a GWS 2032 selection better reflects PaR drivers, future updates to the coal study will restrict GWS selection to no later than 2032.

Reserve/Energy Deficiencies

- As discussed at the December 3-4, 2018 public-input meeting, there were a number of cases where the present-value benefits or costs associated with an assumed early retirement of coal units were being heavily influenced by the cost of reserve/energy deficiencies in certain years as reported by the Planning and Risk model (PaR).
- Reserve/energy deficiencies in PaR appear to be driven by relatively slight changes in resource selections being made in System Optimizer.
- In some cases, high-cost out-year deficiencies in 2038 (coincident with multiple Jim Bridger unit retirements), appear to be tied to these minor changes in the resource portfolio that are largely inconsequential to the System Optimizer PVRR but more impactful when evaluated in PaR.
- For instance, there are times when there are shifts in battery resources from the west to the east, and the swapping of renewables for thermal resources.
- PacifiCorp will be testing ways to remedy this impact by requiring minimum levels of reserve-capable capacity in specific areas of the system (*i.e.*, west vs. east) to ensure anomalous reserve/energy deficiency costs are not unduly affecting economic results.

Coal Study Next Steps

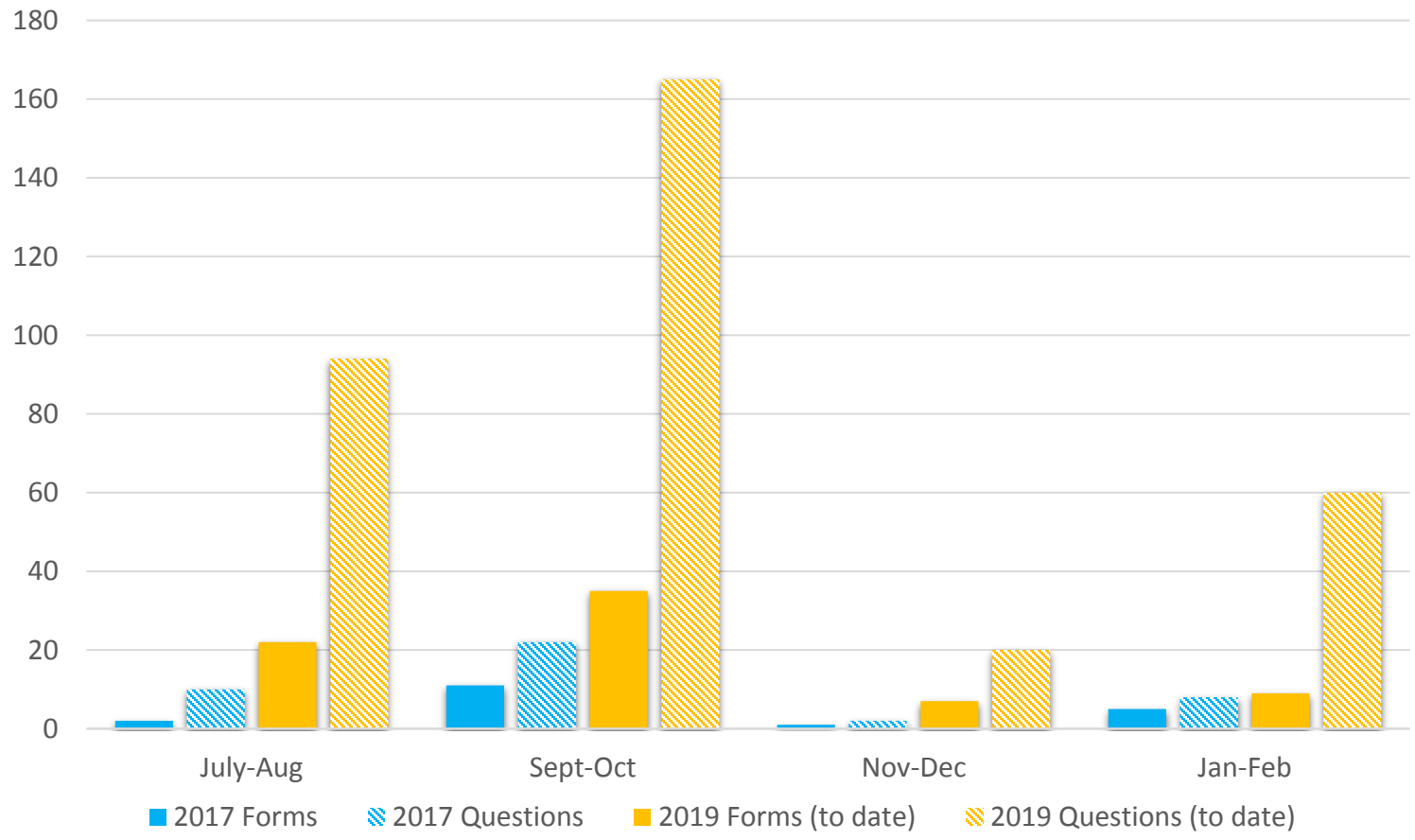
- Complete testing on reliability assessments across multiple years (not just 2023) and layer in incremental resources as needed to address capacity shortfalls—inputs to reflect guidance from operational teams and must account for non-normal events.
- Assess potential frequency-response shortfalls.
- Evaluate updated resource portfolios, with reliability-driven adjustments, in 20-year stochastic results—report updated PVRR(d) findings with two additional price-policy scenarios.
- Run a benchmark study consistent with the company's recently filed depreciation study (non-Oregon)—compare unit-by-unit and stacked cases to this alternative benchmark case.
- Evaluate sensitivities.
  - Exclude units from stacked cases where ability to control retirement decisions is limited.
  - Practical implementation considerations (*i.e.*, staggered retirement dates).
  - Restrict the selection of natural gas resources, as applicable.

Stakeholder Feedback Form Recap




PACIFICORP
POWERING YOUR GREATNESS

2019 IRP vs. 2017 IRP Stakeholder Feedback Form Activity to Date



Stakeholder Feedback Forms

- 73 stakeholder feedback forms submitted to date.
- Stakeholder feedback forms and responses can be located at: www.pacificorp.com/es/irp/irpcomments.html
- Depending on the type and complexity of the stakeholder feedback received responses may be provided in a variety of ways including, but not limited to, a written response, a follow-up conversation, or incorporation into subsequent public input meeting material.
- Stakeholder feedback following the most recent public input meeting is summarized on the following slides for reference.

Summary - Recent Stakeholder Feedback Forms

Stakeholder	Date	Topic	Brief Summary (complete form available online)	Response (posted online when available)
J. Nicolaysen Wyoming	Dec 6	Modeling Assumptions	Questions regarding demand growth, reliability assessment, stacked retirement cases, baseload capacity, and carbon sequestration.	Responded to questions.
S. Hughes Wyoming	Dec 8	Modeling Assumptions	Questions regarding renewables, carbon sequestration, CO_2 policies, and natural gas assumptions.	Responded to questions.
UCE	Dec 21	Coal Analysis	Comments and recommendations regarding coal analysis and modeling renewables for reserve requirements.	Responded and to be discussed Jan 24-25 PIM.
First Solar, Inc.	Dec 26	Modeling Assumptions	Comments and recommendations for modeling utility-scale solar for reserve requirements.	Responded and to be discussed Jan 24-25 PIM.
Sierra Club	Jan 8	Coal Analysis	Comments regarding coal analysis.	To discussed at Jan 24 PIM and response week of January 28.
City of Kemmerer	Jan 16	General	Comments and questions from Dec. PIM presentation.	Target response week of January 28
City of Kemmerer	Jan 16	Coal Analysis	Comments and questions from Dec. PIM presentation.	Target response week of January 28
City of Kemmerer	Jan 16	Coal Analysis	Comments and questions from Dec. PIM presentation.	Target response week of January 28
City of Kemmerer	Jan 16	Coal Analysis	Comments and questions from Dec. PIM presentation.	Target response week of January 28

Additional Information and Next Steps




PACIFICORP
POWERING YOUR GREATNESS

Draft Topics for Upcoming PIMs*

February 21-22, 2019 PIM*

- Coal Studies Discussion
- Stakeholder Feedback Form Recap

March 21-22, 2019 PIM*

- Coal Studies Discussion
- Initial Regional Haze Portfolios
- Stakeholder Feedback Form Recap

** Topics and timing are tentative and subject to change*

April 25-26, 2019 PIM*

- Regional Haze Portfolios
- Portfolio Development Cases
- Stakeholder Feedback Form Recap

May-July, 2019*

- Portfolio Development Cases
- Sensitivity Studies
- Portfolio Selection Process
- Preferred Portfolio
- Action Plan
- Stakeholder Feedback Form Recap

Additional Information and Next Steps

- Public Input Meeting Presentation and Materials:
  - pacificorp.com/es/irp.html
- 2019 IRP Stakeholder Feedback Forms and Summary Matrix:
  - pacificorp.com/es/irp/irpcomments.html
- IRP Email / Distribution List Contact Information:
  - IRP@PacifiCorp.com
- Upcoming Public Input Meeting Dates:
  - February 21-22, 2019
  - March 21-22, 2019
  - April 25-26, 2019
  - May 23-24, 2019
  - June 20-21, 2019
  - July 18-19, 2019 *(as needed)*
  - August 1, 2019 – 2019 IRP File Date