



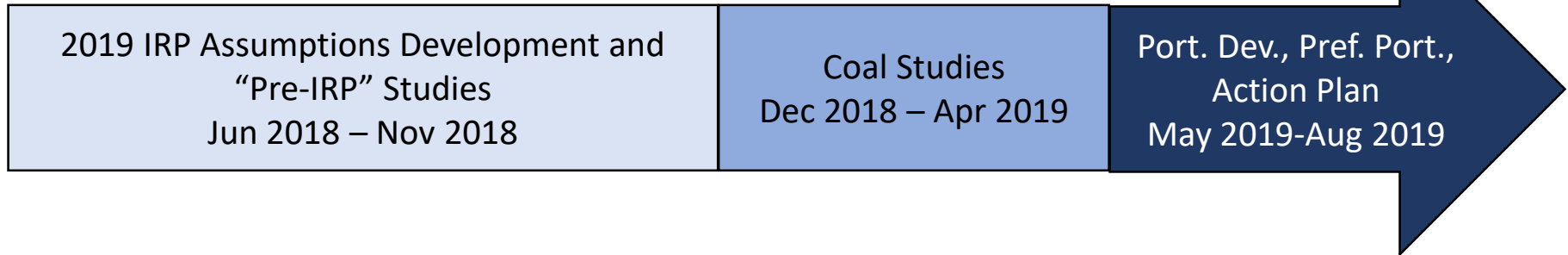
2019 Integrated Resource Plan

OPUC Special Public Meeting

May 30, 2019



Summary



Updated Coal Study (April 2019 Public-Input Meeting)

- Stacked coal-retirement cases were updated to account for incremental resource costs to address reliability issues identified and discussed at the December 2018 public-input meeting.
- These stacked cases showed that there are potential customer benefits from accelerating the retirement of certain coal units—the greatest customer benefits are associated with an accelerated retirement of certain units at the Naughton and Jim Bridger power plants.

Portfolio Development Process (May 2019 Public-Input Meeting)

- Results from the coal studies have been used to begin the portfolio-development phase of the 2019 IRP, which will be used to evaluate cost and risk metrics before selecting a preferred portfolio in advance of filing August 1, 2019.
- Additional resource portfolio analysis will be completed in the coming months before PacifiCorp finalizes the 2019 IRP, which it plans to file with state commissions by August 1, 2019.



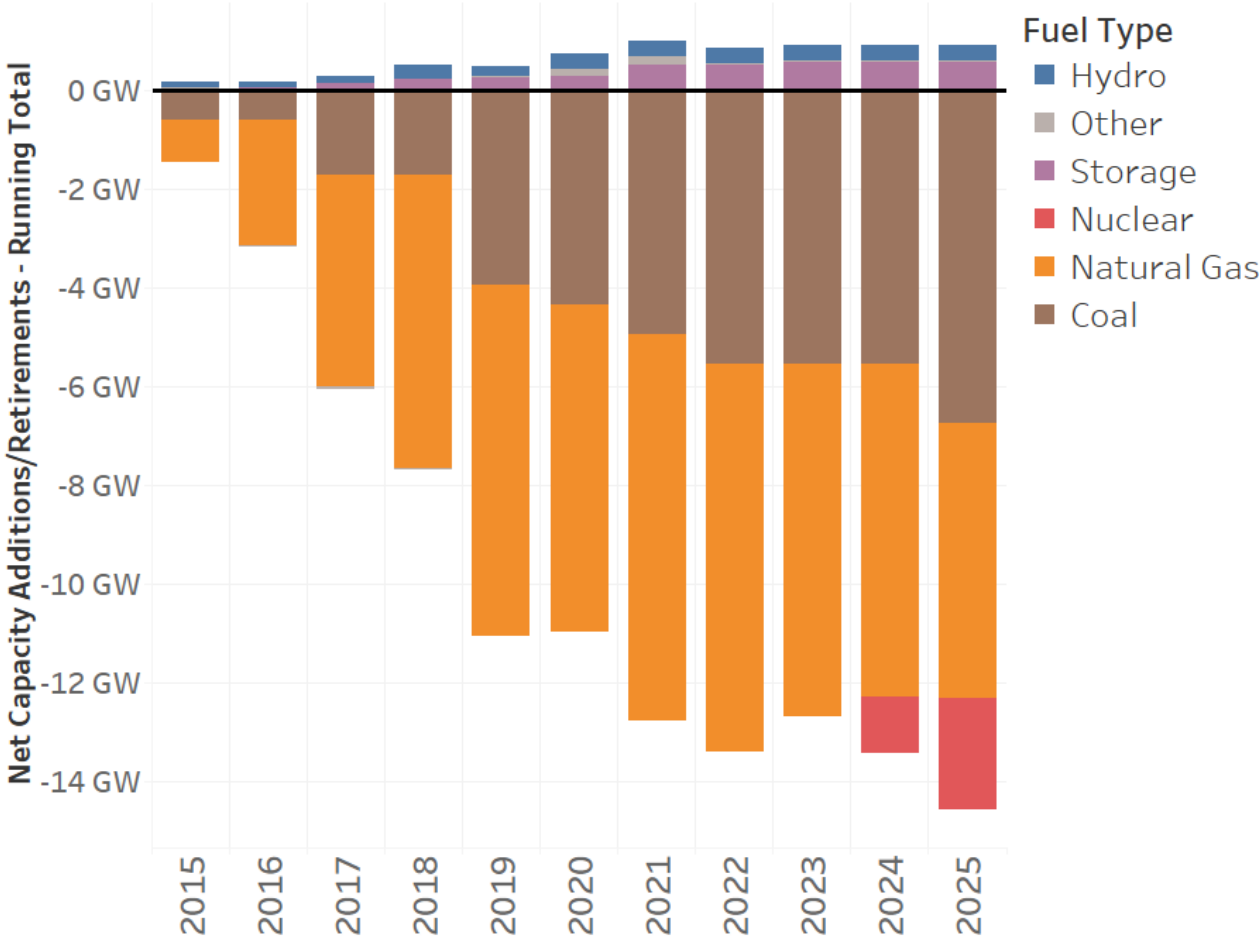
Stacked-Retirement Coal Study Results





Market Supply Uncertainty

WECC Capacity Additions and Retirements
(Dispatchable Resources) - Cumulative



- Potential PacifiCorp retirements are not included.
- Recent events have highlighted natural gas pipeline delivery risk.
- Additional flexible capacity is required to address this market supply uncertainty.

Source: Energy Information Administration Form 860.

Incremental Capacity from Deterministic Analyses



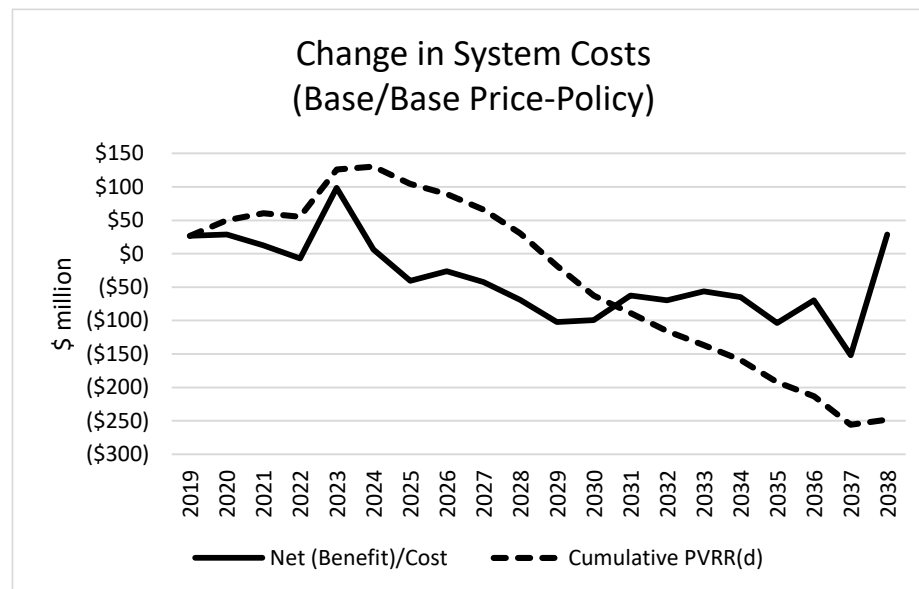
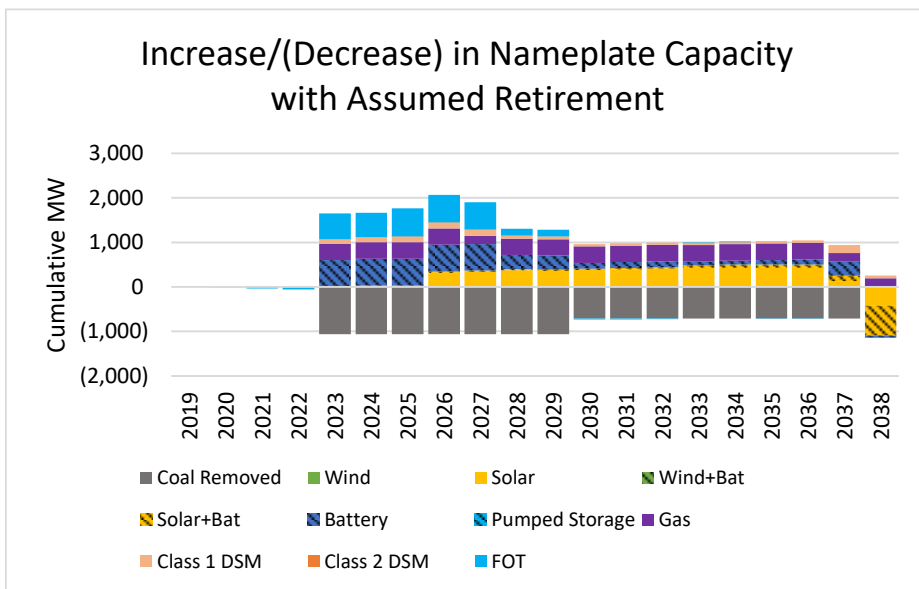
- Hourly deterministic studies (2023, 2030, 2038) for all cases are used to assess hourly maximum capacity shortfalls by season (summer and winter).
- Considering that these deterministic studies reflect “perfect foresight” for load, average outages, average hydro, and generation profiles for wind and solar, and average market prices without fuel-supply disruptions, an incremental capacity requirement is necessary to maintain reliable operation of the system when conditions deviate from normal.
- The estimated total day-ahead reserve requirement, including day-ahead uncertainty for load, wind, and solar, as a percentage of load was 18% in 2018—about 5% higher (approximately 500 MW for a peak load of 10,000 MW) than the 13% planning reserve margin traditionally used in the IRP.
- Given aforementioned risk factors, recent operational experience, and growing regional resource adequacy concerns, 500 MW of capacity in excess of hourly shortfalls identified in the deterministic studies has been added to projected hourly shortfalls to establish the incremental flexible resource capacity need (energy efficiency, storage, gas peakers).
- Incremental requirements applied: 2023-2027 based on the 2023 deterministic study, 2028-2036 based on the 2030 deterministic study, and 2037-2038 based on the 2038 deterministic study.

Stacked-Retirement Cases PVRR(d) Results



Case	Inc. Retired Capacity in 2023 (MW)	PVRR(d) (Benefit)/Cost of Early Retirement (\$m)	Naughton 1	Naughton 2	Bridger 1	Bridger 2	Hayden 1	Hayden 2	Craig 1	Craig 2	Dave Johnston 3
C-34	357	(\$123)	✓	✓							
C-35	711	(\$211)	✓	✓	✓						
C-36	510	(\$158)	✓		✓						
C-37	554	(\$143)	✓		✓		✓				
C-38	755	(\$120)	✓	✓	✓		✓				
C-39	834	(\$52)	✓	✓	✓		✓			✓	
C-40	1,193	(\$191)	✓	✓	✓	✓	✓			✓	
C-41	1,529	(\$12)	✓	✓	✓	✓	✓	✓	✓	✓	✓
C-42	1,063	(\$248)	✓	✓	✓	✓					
C-43	928	(\$31)	✓	✓	✓						✓

Stacked Case C-42 Overview (NT1-2, JB1-2)



Change in Transmission Upgrades

Change in Year	Resource Location	From	To	ATC	Max Interconnection	Change in Nominal Capital (\$m)
Accelerated from 2037 to 2028	SW WY	SW WY	SW WY	0	500	(\$7.2)
Total						(\$7.2)

Stacked Case C-42 Detail (NT1-2, JB1-2)



Study	PVRR(d) (Benefit)/Cost of 2022 Retirement (\$m)	Nom. Lev. (Benefit)/Cost of 2022 Retirement per MWh of Retired Generation (\$/MWh)
Cost Savings from Retired Unit		
Fuel	(\$535)	(\$30.65)
Inc. Capital Rev. Req. and Fixed O&M	(\$944)	(\$54.07)
Variable O&M	(\$6)	(\$0.37)
Emissions	(\$254)	(\$14.55)
Decommissioning	\$18	\$1.04
Total Net Cost Savings from Retired Unit	(\$1,722)	(\$98.59)
Net Replacement Costs		
Fuel	\$452	\$25.88
Inc. Capital Rev. Req. and Fixed O&M	\$705	\$40.34
Variable O&M	\$52	\$2.96
Emissions	\$63	\$3.60
Demand-Side Management	(\$26)	(\$1.48)
Long-Term Contracts	\$49	\$2.78
Market Purchases	\$89	\$5.09
Market Sales	\$80	\$4.60
Reserve/Energy Deficiencies	\$4	\$0.20
Transmission Upgrades	\$7	\$0.40
Transmission Reinforcements	\$0	\$0.00
Total Net Replacement Cost	\$1,474	\$84.38
Net (Benefit)/Cost of Assumed Early Retirement	(\$248)	(\$14.21)



Preliminary Portfolio Development Modeling



Portfolio Development Cases (To Date)



Coal Unit (PAC Share MW)	P-01 (Coal Study Benchmark)	P-02 (Reg. Haze Ref.)	P-03 (Reg. Haze. Intertemp.)	P-04 (Stacked Case C-42)	P-05 (Econ. Ret. Alt. 1)
Cholla 4 (387)	2020	2025	2025	No Change	No Change
Colstrip 3 (74)	2046	2027	2027	No Change	No Change
Colstrip 4 (74)	2046	2027	2027	No Change	No Change
Craig 1 (82)	2025	No Change	No Change	No Change	No Change
Craig 2 (82)	2034	2026	2026	No Change	No Change
Dave Johnston 1 (106)	2027	No Change	No Change	No Change	No Change
Dave Johnston 2 (106)	2027	No Change	No Change	No Change	No Change
Dave Johnston 3 (220)	2027	No Change	No Change	No Change	No Change
Dave Johnston 4 (330)	2027	No Change	No Change	No Change	No Change
Hayden 1 (44)	2030	No Change	No Change	No Change	No Change
Hayden 2 (33)	2030	No Change	No Change	No Change	No Change
Hunter 1 (418)	2042	SCR 2022 RET 2042	No Change	No Change	No Change
Hunter 2 (269)	2042	SCR 2023 RET 2042	No Change	No Change	No Change
Hunter 3 (471)	2042	No Change	No Change	No Change	No Change
Huntington 1 (459)	2036	SCR 2022 RET 2036	No Change	No Change	No Change
Huntington 2 (450)	2036	SCR 2023 RET 2036	No Change	No Change	No Change
Jim Bridger 1 (354)	SCR 2022 RET 2037	No Change	No SCR RET 2028	No SCR RET 2022	No SCR RET 2022
Jim Bridger 2 (359)	SCR 2021 RET 2037	No Change	No SCR RET 2028	No SCR RET 2022	No SCR RET 2022
Jim Bridger 3 (349)	2037	No Change	No Change	No Change	No Change
Jim Bridger 4 (353)	2037	No Change	No Change	No Change	No Change
Naughton 1 (156)	2029	No Change	No Change	2022	2022
Naughton 2 (201)	2029	No Change	No Change	2022	2022
Naughton 3 (280)	2019	No Change	No Change	No Change	No Change
Wyodak (268)	2039	SCR 2024 RET 2039	No Change	No Change	No Change
Gadsby 1-3 Gas (238)	2032	No Change	No Change	No Change	2020

Portfolio Development Cases (To Date)



Coal Unit (PAC Share MW)	P-06 (Econ. Ret. Alt. 2)	P-07 (Econ. Ret. Alt. 3)	P-08 (NT3 35 MW GC)	P-09 (NT3 247 MW GC)	P-10 (Econ. Ret. Alt. 4)
Cholla 4 (387)	No Change	No Change	2025	2025	No Change
Colstrip 3 (74)	2027	2027	2027	2027	No Change
Colstrip 4 (74)	2027	2027	2027	2027	No Change
Craig 1 (82)	No Change	No Change	No Change	No Change	No Change
Craig 2 (82)	2025	2025	2026	2026	No Change
Dave Johnston 1 (106)	No Change	No Change	No Change	No Change	No Change
Dave Johnston 2 (106)	No Change	No Change	No Change	No Change	No Change
Dave Johnston 3 (220)	No Change	No Change	No Change	No Change	No Change
Dave Johnston 4 (330)	No Change	No Change	No Change	No Change	No Change
Hayden 1 (44)	No Change	No Change	No Change	No Change	No Change
Hayden 2 (33)	No Change	No Change	No Change	No Change	No Change
Hunter 1 (418)	No Change	No Change	No Change	No Change	No Change
Hunter 2 (269)	No Change	No Change	No Change	No Change	No Change
Hunter 3 (471)	No Change	No Change	No Change	No Change	No Change
Huntington 1 (459)	No Change	No Change	No Change	No Change	No Change
Huntington 2 (450)	No Change	No Change	No Change	No Change	No Change
Jim Bridger 1 (354)	No SCR RET 2022	No SCR RET 2022	No SCR RET 2028	No SCR RET 2028	No SCR RET 2022
Jim Bridger 2 (359)	No SCR RET 2032	No SCR RET 2028	No SCR RET 2032	No SCR RET 2032	No SCR RET 2022
Jim Bridger 3 (349)	No Change	No Change	No Change	No Change	No Change
Jim Bridger 4 (353)	No Change	No Change	No Change	No Change	No Change
Naughton 1 (156)	No Change	No Change	No Change	No Change	2022
Naughton 2 (201)	No Change	No Change	No Change	No Change	2022
Naughton 3 (280)	Lg. GC 2020 RET 2029	Lg. GC 2020 RET 2029	Sm. GC RET 2029	Lg. GC RET 2029	Lg. GC RET 2029
Wyodak (268)	No Change	No Change	No Change	No Change	No Change
Gadsby 1-3 Gas (238)	2020	2020	No Change	No Change	No Change

Portfolio Development Cases (To Date)



Coal Unit (PAC Share MW)	P-11 (CH Early Ret.)	P-12 (Econ. Ret. Alt. 5)	P-13 (Bridger 1-2 SCRs)
Cholla 4 (387)	No Change	RET 2025	RET 2025
Colstrip 3 (74)	2027	2027	2027
Colstrip 4 (74)	2027	2027	2027
Craig 1 (82)	No Change	No Change	No Change
Craig 2 (82)	2026	2025	2026
Dave Johnston 1 (106)	No Change	No Change	No Change
Dave Johnston 2 (106)	No Change	No Change	No Change
Dave Johnston 3 (220)	No Change	No Change	No Change
Dave Johnston 4 (330)	No Change	No Change	No Change
Hayden 1 (44)	No Change	No Change	No Change
Hayden 2 (33)	No Change	No Change	No Change
Hunter 1 (418)	No Change	No Change	No Change
Hunter 2 (269)	No Change	No Change	No Change
Hunter 3 (471)	No Change	No Change	No Change
Huntington 1 (459)	No Change	No Change	No Change
Huntington 2 (450)	No Change	No Change	No Change
Jim Bridger 1 (354)	No SCR RET 2028	No SCR RET 2022	No Change
Jim Bridger 2 (359)	No SCR RET 2032	No SCR RET 2028	No Change
Jim Bridger 3 (349)	No Change	No Change	No Change
Jim Bridger 4 (353)	No Change	No Change	No Change
Naughton 1 (156)	No Change	No Change	No Change
Naughton 2 (201)	No Change	No Change	No Change
Naughton 3 (280)	Lg. GC RET 2029	Lg. GC 2020 RET 2029	Lg. GC RET 2029
Wyodak (268)	No Change	No Change	No Change
Gadsby 1-3 Gas (238)	No Change	2020	No Change

- Additional retirement cases are being developed:
 - Variations of P-07 and P-11 that include Naughton 1-2 early retirements without Gadsby 1-3 early retirements.
 - Variations of P-11 that include Naughton 1-2 and Jim Bridger 3-4 early retirements.
 - Colstrip 3-4 accelerated to 2025.
 - No coal by the end of 2029.
- Other portfolio-development cases are being developed to assess:
 - CO₂ price assumptions
 - Natural gas price assumptions
 - Market reliance
 - Energy Gateway transmission
 - Alternative bundling of energy efficiency
 - No new gas resources
- Sensitivity cases are being developed to assess:
 - Load growth
 - Private generation
 - Business plan (UT requirement)
 - West control area (WA requirement)
 - Customer preference resources

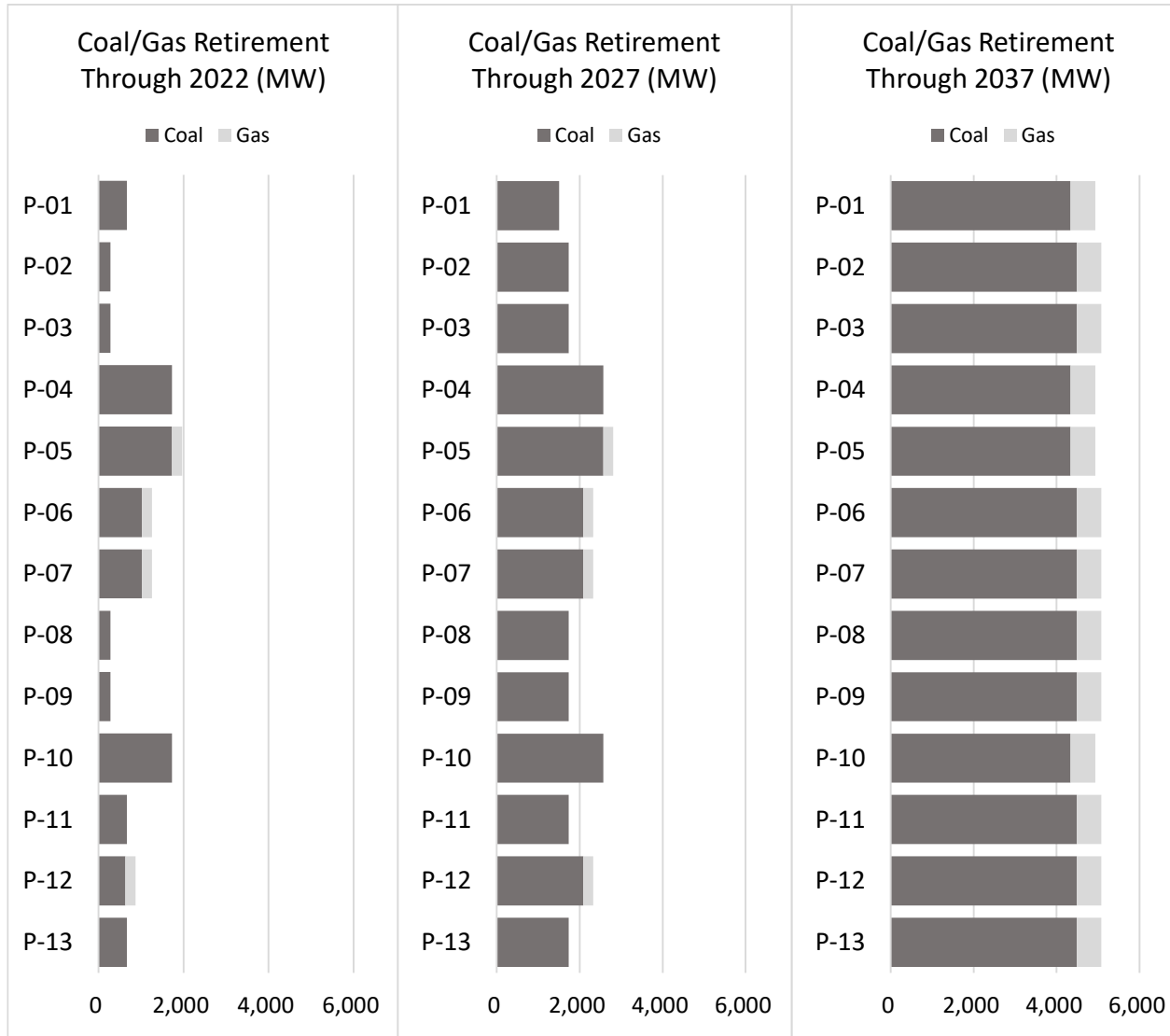
Portfolio Cost and Risk Summary



Case	Stochastic Mean			Risk Adjusted			ENS Scenario Average			CO ₂ Emissions		
	PVRR (\$m)	Change from Lowest Cost Portfolio (\$m)	Rank	PVRR (\$m)	Change from Lowest Cost Portfolio (\$m)	Rank	Average Annual ENS, 2019-2038 (GWh)	Change from Lowest ENS Portfolio	Rank	Total CO ₂ Emissions, 2019-2038 (Thousand Tons)	Change from Lowest Emission Portfolio	Rank
P01	23,973	435	12	25,180	455	12	4.0	0.2	3	655,382	38,287	13
P02	24,888	1,349	13	26,141	1,416	13	5.1	1.2	10	639,894	22,799	12
P03	23,806	268	7	25,006	281	7	4.5	0.7	8	631,667	14,572	10
P04	23,841	303	9	25,046	321	9	5.8	2.0	11	625,179	8,084	6
P05	23,926	388	10	25,136	411	10	6.3	2.5	13	621,454	4,360	4
P06	23,657	118	4	24,852	128	4	4.1	0.2	4	623,133	6,038	5
P07	23,644	105	2	24,838	114	2	3.8	0.0	1	617,095	0	1
P08	23,809	271	8	25,012	288	8	5.0	1.1	9	631,146	14,051	9
P09	23,671	133	5	24,867	143	5	4.3	0.5	7	628,283	11,188	8
P10	23,799	260	6	25,001	276	6	3.8	0.0	2	618,743	1,648	3
P11	23,539	0	1	24,725	0	1	5.8	2.0	12	626,540	9,446	7
P12	23,655	117	3	24,851	126	3	4.3	0.5	6	618,641	1,547	2
P13	23,936	397	11	25,141	417	11	4.1	0.3	5	639,245	22,150	11

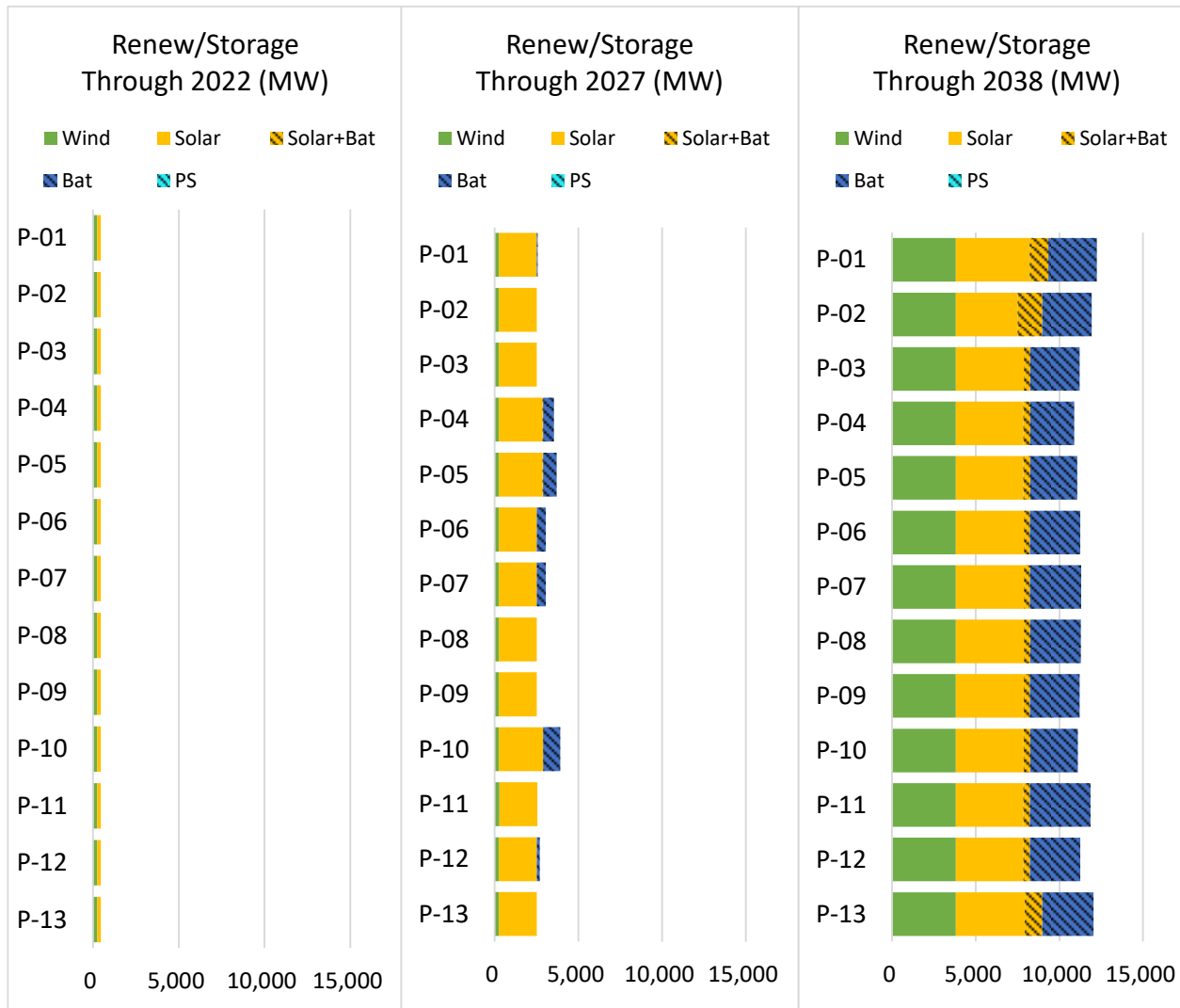


Coal/Gas Resource Retirements



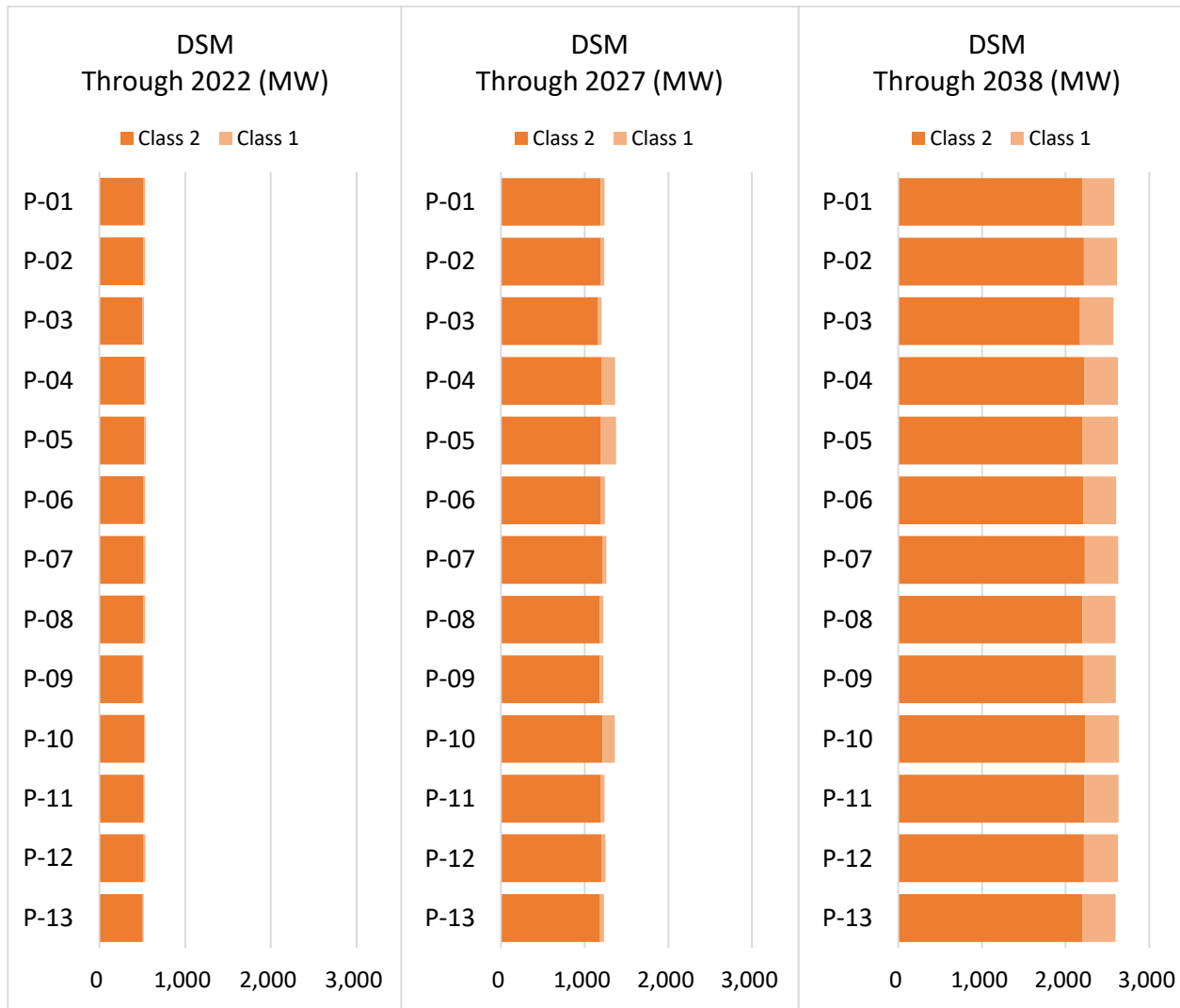
- Cases P-05, P-06, P-07, and P-12 assume Gadsby 1-3 (238 MW) are retired in 2020.
- By the end of 2037, 593 MW of gas-fired capacity is assumed to retire in all cases (Gadsby 1-3 in either 2020 or 2032, Gadsby 4-6 in 2032, and Hermiston in 2036).
- Over the near-term, Cases P-04, P-05, and P-10 assume the highest volume of accelerated coal retirements (1,730 MW), followed by Cases P-06 and P-07 (1,018 MW), Cases P-01, P-11, P-12, and P-13 (631-667 MW), and Cases P-02, P-03, P-08, and P-09 (280 MW).
- Through 2027, coal retirements range between 1,504 MW (Case P-01) and 2,568 MW (Cases P-04, P-05, and P-10).
- By the end of 2037, coal retirements range between 4,337 MW and 4,485 MW--cases at the higher range reflect an accelerated retirement of Colstrip 3 and 4, which is otherwise assumed to retire beyond the 20-year planning horizon.

New Renewable and Storage Resources



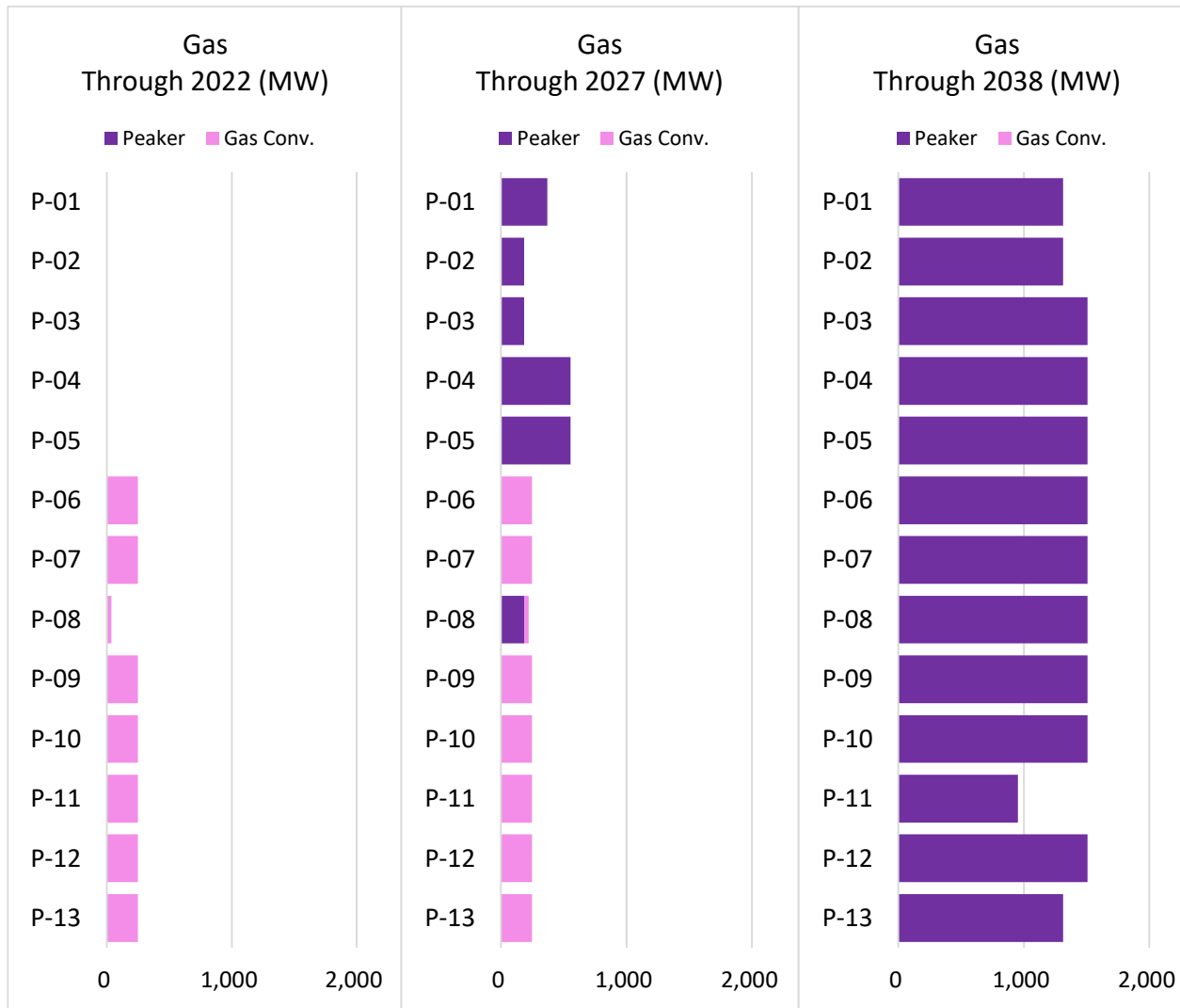
- In the near term, all cases include 240 MW of new Wyoming wind and 205 MW of new Utah solar.
- Over the mid term, solar capacity increases consistently among the cases, ranging between 2,280 MW and 2,6145 MW—cases with higher levels of earlier coal and gas retirements show a need for battery resources (up to 1,035 MW in Case P-10).
- Over the long term, all cases include 3,810 MW of new wind—solar ranges between 4,430 MW and 5,534 MW; battery storage ranges between 2,732 MW and 3,712 MW.

Incremental Demand-Side Management



- Demand-side management selections are similar among each case and timeframe.
- Through 2022, Class 2 DSM selections range between 501 MW (Case P-03) and 524 MW (Cases P-10); Class 1 DSM ranges between 11 MW and 19 MW.
- Through 2027, Class 2 DSM selections range between 1,155 MW (Case P-03) and 1,214 MW (Case P-07); Class 1 DSM ranges between 45 MW and 181 MW—more Class 1 DSM is accelerated into the mid term in cases that assume the highest level of accelerated retirements (Cases P-04, P-05, and P-10).
- Through 2038, Class 2 DSM selections range between 2,173 MW (Case P-03) and 2,231 MW (Case P-10); Class 1 DSM ranges between 384 MW and 421 MW.

New/Incremental Natural Gas Resources



- Naughton 3 is assumed to convert to natural gas in eight cases (Cases P-06 through P-13)—the converted unit is assumed to retire at the end of 2029, so it does not show up in the results through 2038.
- The two cases with the highest amount of accelerated retirements without a Naughton 3 gas conversion (Cases C-04 and C-05) show the highest volume of new peaking gas over the mid term (by 2023)—it is likely not possible to procure new natural gas resources in this timeframe.
- Note, that cases assuming a larger conversion of Naughton 3 (247 MW) defer new natural gas resources to years beyond 2027.
- Through 2038, new peaking gas capacity ranges between 953 MW (Case P-11) and 1,508 MW (multiple cases).



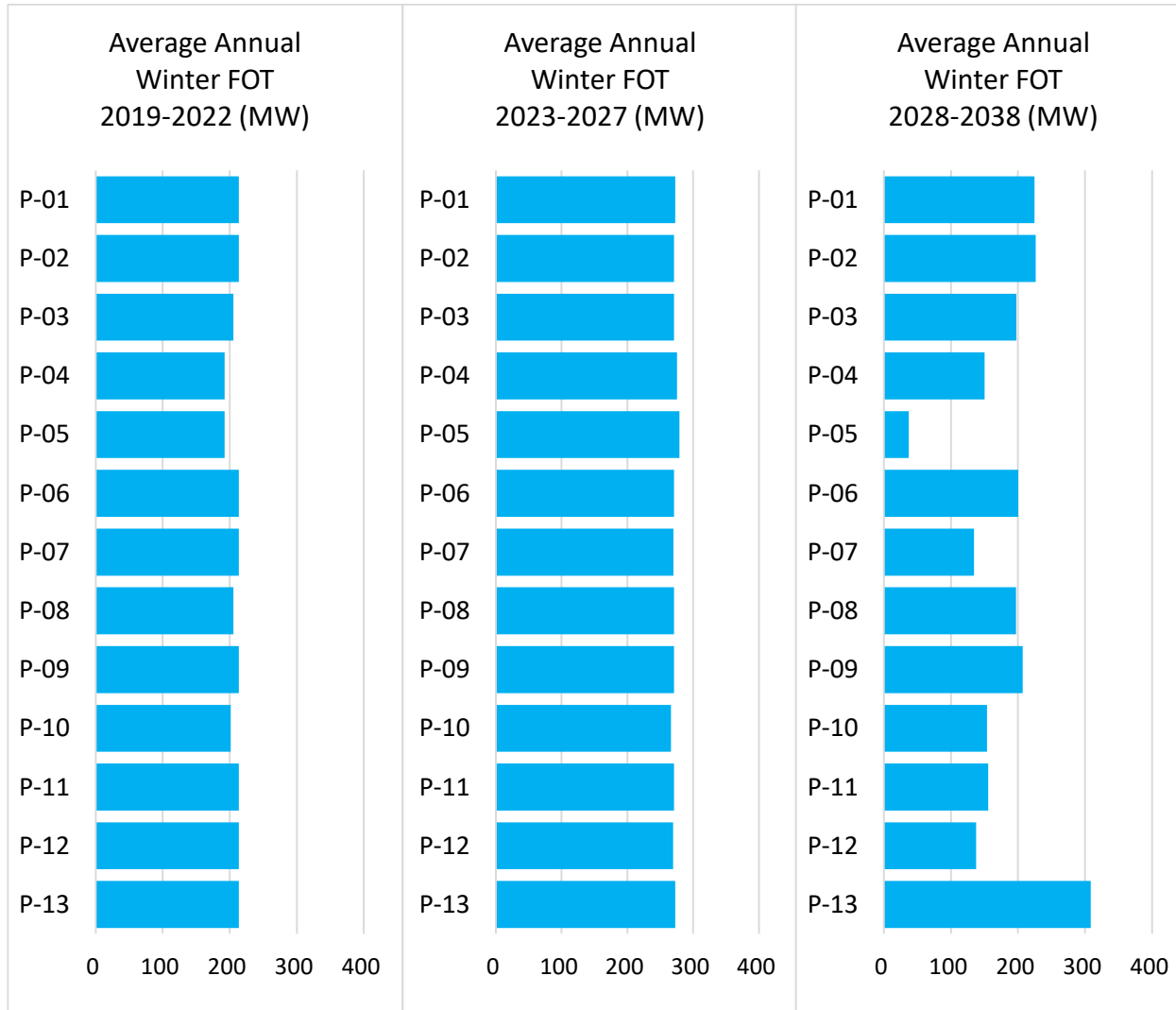
Summer Front Office Transactions



- Cases with the highest volume of coal and gas unit retirements over the near to mid term, results in portfolios with a higher reliance on the market.
- In the 2023-2027 timeframe, a period where there are growing resource-adequacy concerns in the region, summer FOTs in Cases P-04, P-05, and P-10 are approximately 1.6 times higher than in Cases P-06, P-07, and P-12 and significantly higher than in Cases P-09, P-11, and P-13.
- Over the long term, the level of summer FOTs is relatively consistent among the cases—averaging 1,336 MW.



Winter Front Office Transactions

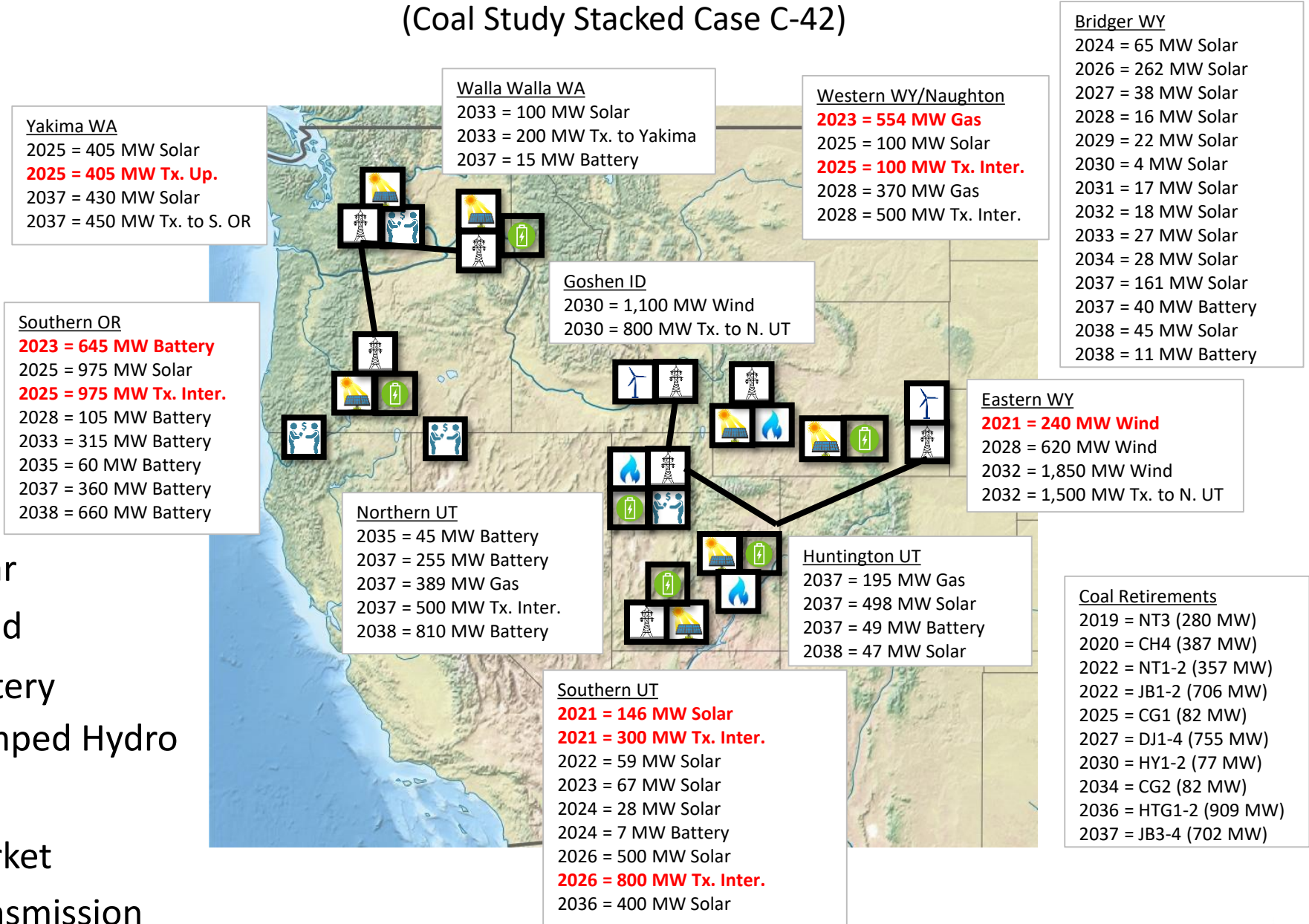


- Relative to the summer period, winter FOTs are much smaller among all cases and timeframes.
- Over the long term, winter FOTs are generally reduced as more flexible capacity is added to the system—the reduction in winter FOTs shown in Case P-05 coincides with the acceleration of battery storage capacity into 2028 in this portfolio.



Case P-04

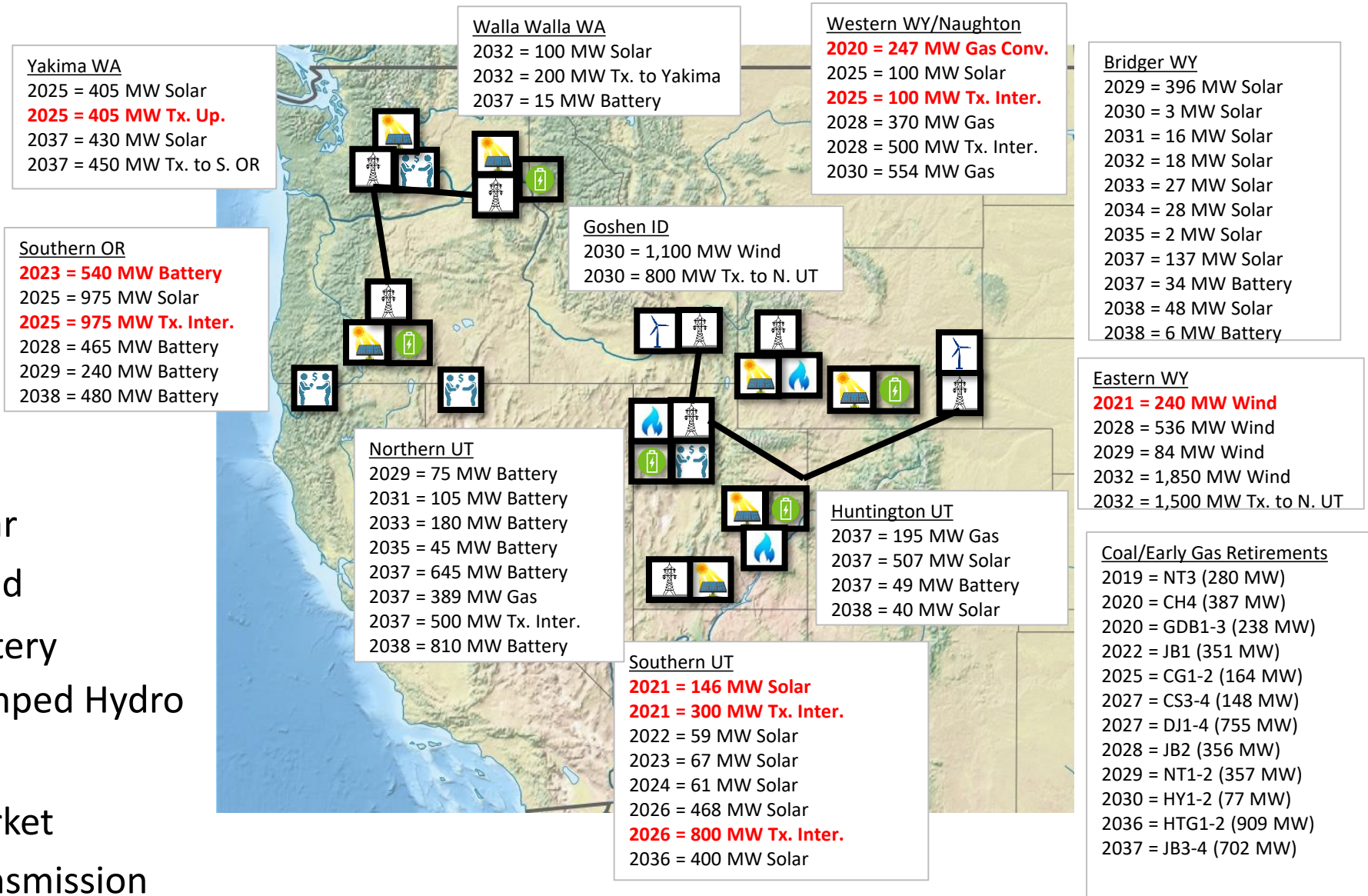
(Coal Study Stacked Case C-42)





Case P-07

(Economic Alternative Retirement 3)





Case P-11

(Cholla 4 Early Retirement)

