Integrated Resource Plan

2021 IRP Public-Input Meeting

July 30, 2021




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Agenda

- 9:00am-9:15am Pacific – Introductions
- 9:15am-11:45am Pacific – Portfolio Optimization
- 11:45pm-12:15pm Pacific – Lunch Break
- 12:15pm-2:15pm Pacific – Modeling Discussion
- 2:15pm-2:30pm Pacific – Next Steps Modeling and Analysis
- 2:30pm-3:00pm Pacific – Washington Clean Energy Implementation Plan Update
- 3:00pm-3:30pm Pacific – Oregon House Bill 2021
- 3:30pm-3:45pm Pacific – Stakeholder Feedback Form Update
- 3:45pm-4:00pm Pacific – Wrap-Up/Next Steps

Portfolio Optimization




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Portfolio Optimization (1)

- At PacifiCorp's June 25, 2021 public-input meeting, the use of granularity and reliability adjustments was described.
  - The granularity adjustment reflects the difference in economic value between an hourly 8760 cost calculation in ST modeling, and the four-block per month representation used in the LT model.
    - Resources with high variable costs that are rarely dispatched may provide a large value in a few intervals in the ST study, while not dispatching in any of the 4 LT blocks
    - Storage resources allow for arbitrage among high value and low value hours in each day; however, the four-block granularity smooths out many of the storage arbitrage opportunities.
  - The reliability adjustment addresses unmet MW needs by hour in the LT model portfolio selection.
    - Much of the peak load hour requirements in mid-afternoon in the summer are adequately met by solar resources.
    - Resource requirements are driven by portfolio-dependent net load peaks (load less renewable resource output), which are harder for the LT model to identify.
- While these techniques helped direct the LT model to more cost-effective resources and a more reliable portfolio, the LT model has difficulty selecting a reliable portfolio.
  - Marginal benefits decline as any resource type becomes a larger share of a portfolio, as it saturates the need in the hours it is available.
    - With solar resources this is illustrated by CAISO's "duck curve".
    - A similar effect occurs with storage, where each incremental MW of system storage capacity must cover a longer duration.
  - Static granularity and reliability values do not give the LT model the ability to settle on a balanced and reliable mix of resources.
- PacifiCorp has developed a more direct approach using ST model results to identify resource selections.

Portfolio Optimization (2)

- While a large number of resource options are being evaluated, new generation resources are mostly restricted to two circumstances:
  - Replacement resources at retiring generators
  - New resources at locations with interconnection or transmission upgrade options
- These interconnection and transmission upgrade options are limited and can be expensive
  - Replacing existing thermal generators with resources that provide only a portion of their interconnection capacity in "firm" capacity creates a need for additional interconnection capacity elsewhere
  - Maximizing the "firmness" of each MW of interconnection capacity can provide greater value:
    - Modeling of combined solar and storage resources now reflects storage with capacity equal to 100% of solar nameplate, and four-hour duration—up up from 50% of solar capacity identified in previous 2021 IRP meetings and from 25% of solar capacity in the 2019 IRP.
- Aggregate resource selections must maintain portfolio reliability over time.
- Driven by anticipated permitting challenges and federal policy risks, PacifiCorp is focused on alternatives to new natural gas plants.
- In light of the above constraints, a limited set of resource options have costs and performance suitable to each location.

Reliable Resource Options

- The following resource options can all generate at 100% of their nameplate in any specified hour:

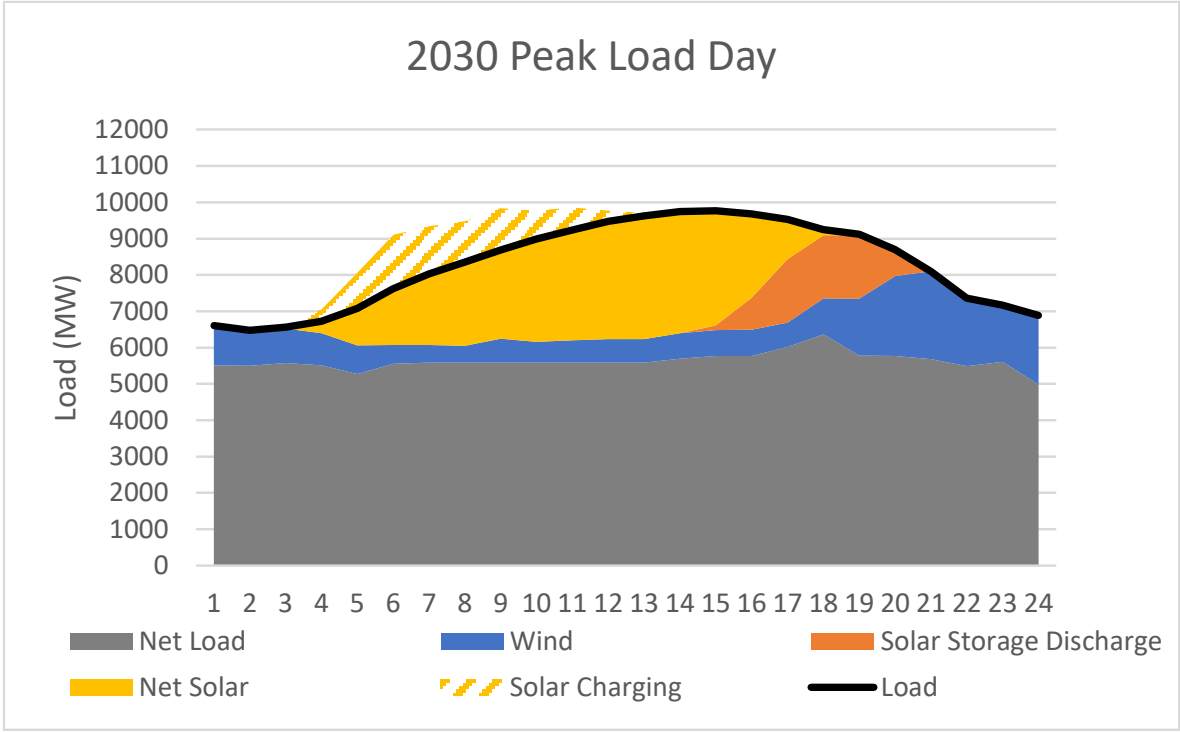
	Duration	Energy	Notes
Stand-alone Storage	4-12 hrs	System Marginal Cost	Charging requires excess system energy resources
Solar w/ 100% 4hr Storage	Solar -> 4 hrs	Solar	Total daily output limited, especially in winter
Advanced Nuclear w/ Storage	Nuclear -> 5.5 hrs	Nuclear	Future technology, longer duration, fairly high daily output
Coal-fired/Gas Conversion	No limit	High cost if emissions price	Less frequent use if high emissions price.
Non-emitting Peaking Resource	No limit	Very high cost	Future technology, very infrequent use

Note: Energy efficiency and demand response are thus not restricted by interconnection limits, so they do not have to compete for space on the system.

What resource is the best fit for PacifiCorp's system?

Resource Need - 2030 Summer

- Peak load day in July 2030
- 4,300 MW solar capacity with 1,700 MW storage
- 5,500 MW wind capacity
- Remaining energy need: 5,600 aMW



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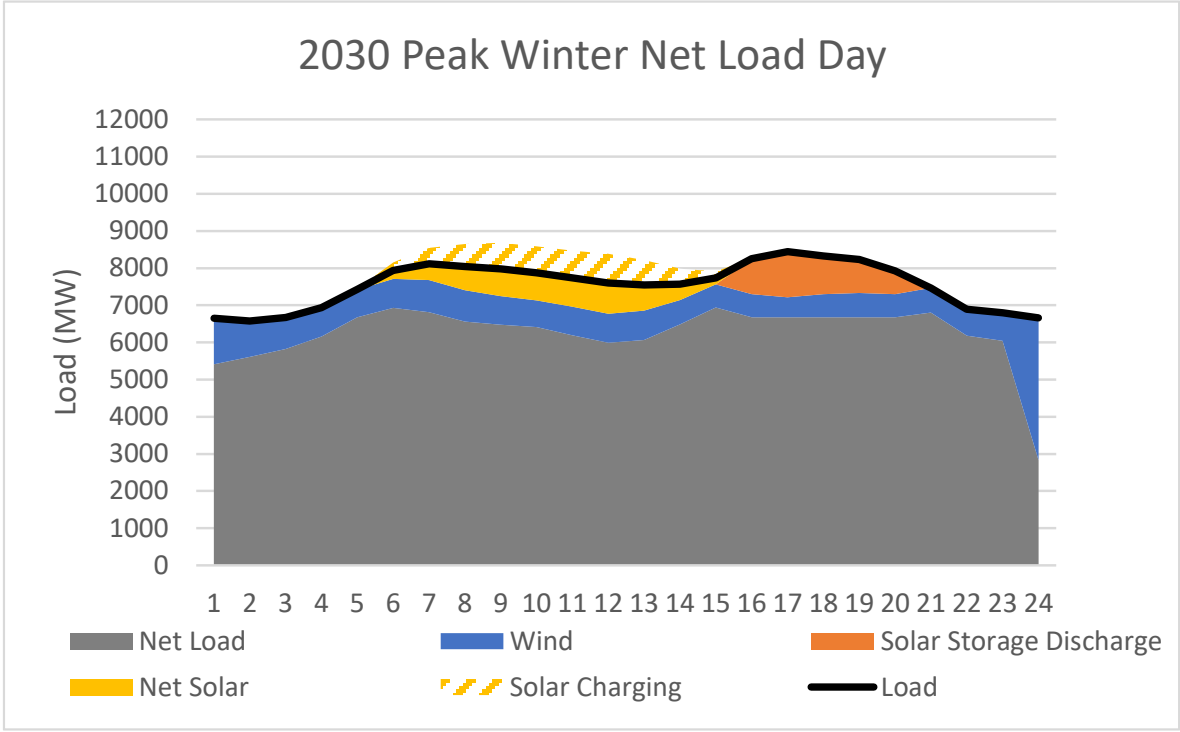
Resource Need - 2030 Winter

- Winter net load peak day in December 2030
- 4,300 MW solar capacity with 1,700 MW storage
- 5,500 MW wind capacity
- Remaining energy need: 6,200 aMW



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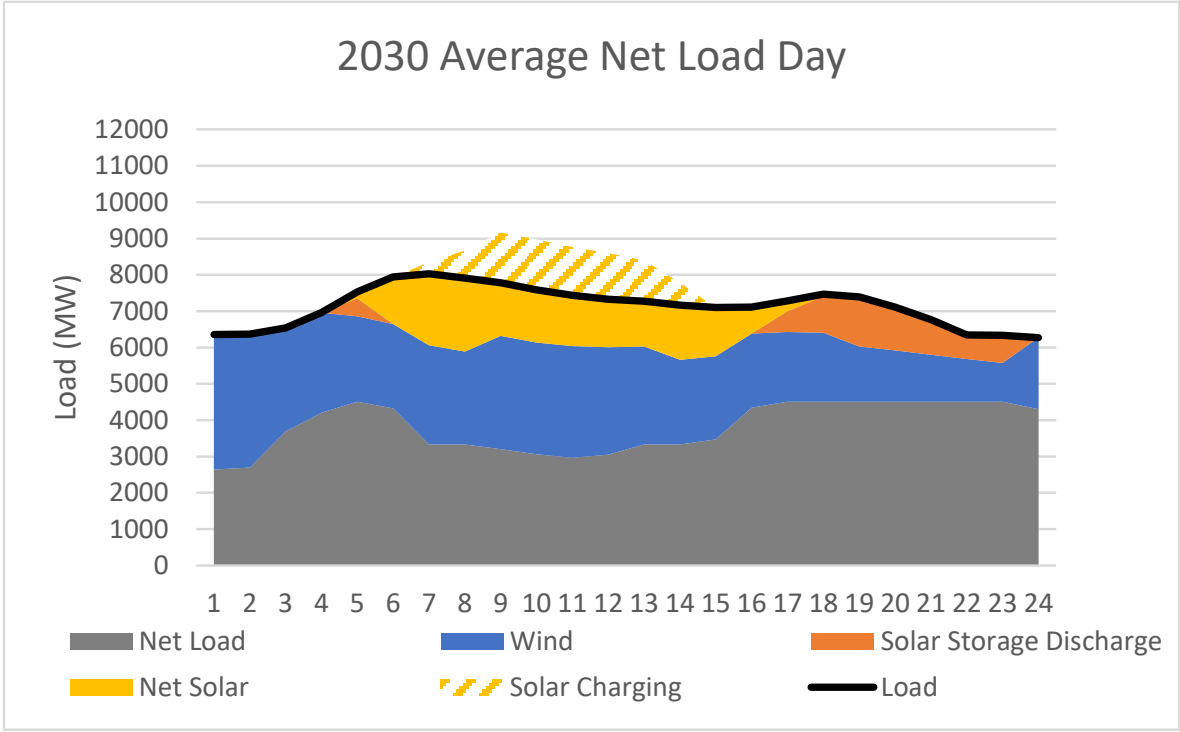
Resource Need - 2030 Average

- Average net load day in March 2030
- 4,300 MW solar capacity with 1,700 MW storage
- 5,500 MW wind capacity
- Remaining energy need: 3,800 aMW



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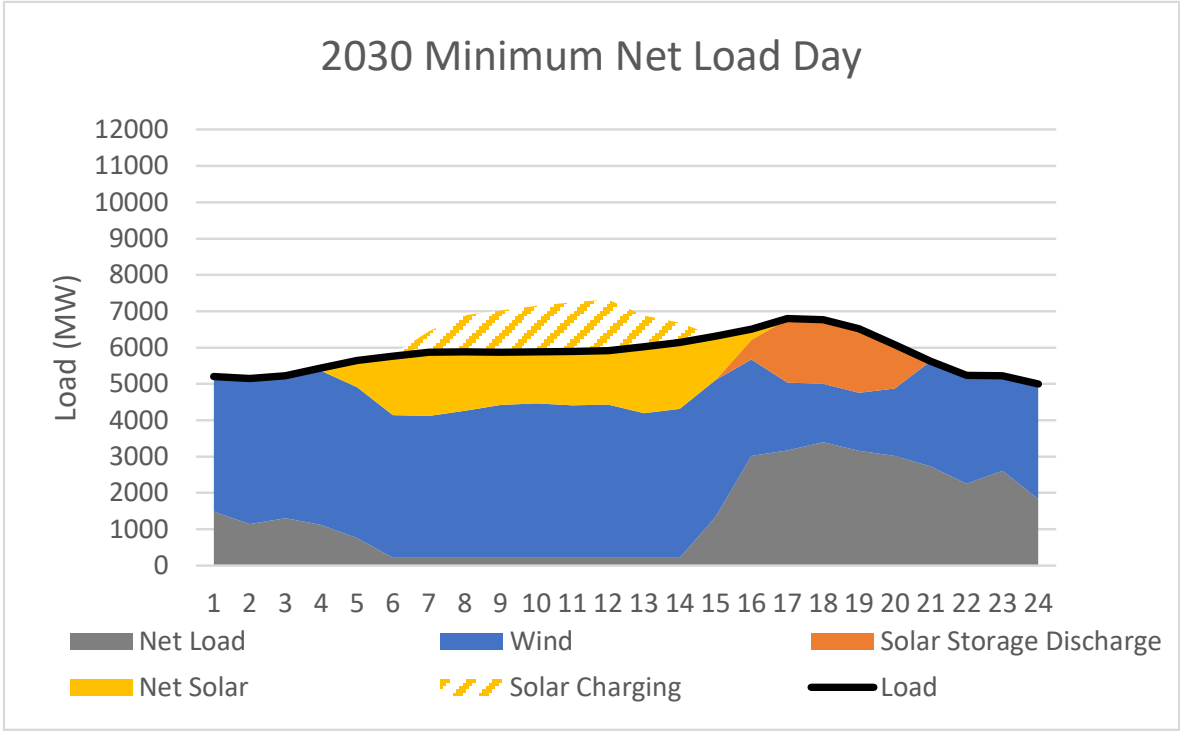
Resource Need - 2030 Minimum

- Minimum net load day in October 2030
- 4,300 MW solar capacity with 1700 MW storage
- 5,500 MW wind capacity
- Remaining energy need: 1,400 aMW – but significant variation across the day



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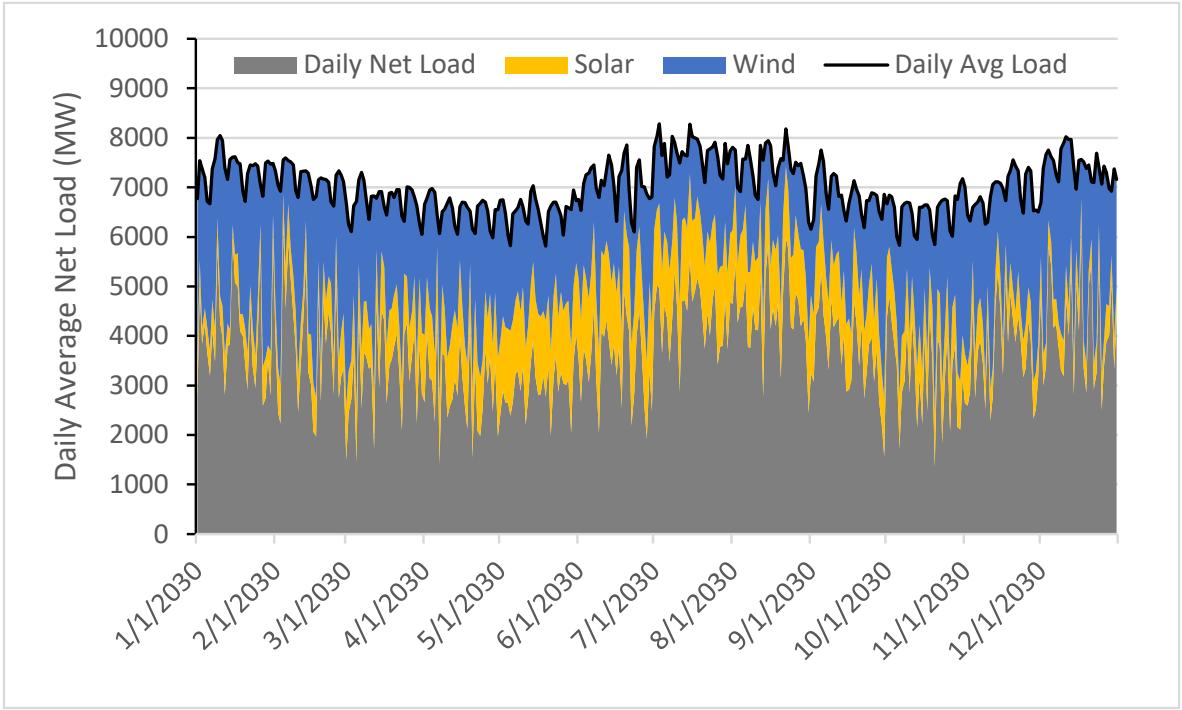
Daily Resource Need in 2030

- Load varies across each week, as well as seasonally
- 4,300 MW solar capacity with 1,700 MW storage – output is highest in spring and summer
- 5,500 MW wind capacity – output is highest in winter, but is volatile
- Remaining energy need varies throughout the year:
  - Some resources will need to run at a high capacity factor
  - Some resources will need to run at a low capacity factor
  - Some resources will operate at intermediate capacity factors.



			Conditions on that day:	
	Daily Load	Daily Net Load	Wind C.F.	Solar C.F.
Date	MW	MW	%	%
10/20/2030	5,842	1,355	62%	24%
12/17/2030	7,561	6,316	14%	11%

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Daily Resource Need in 2030 - Ranked

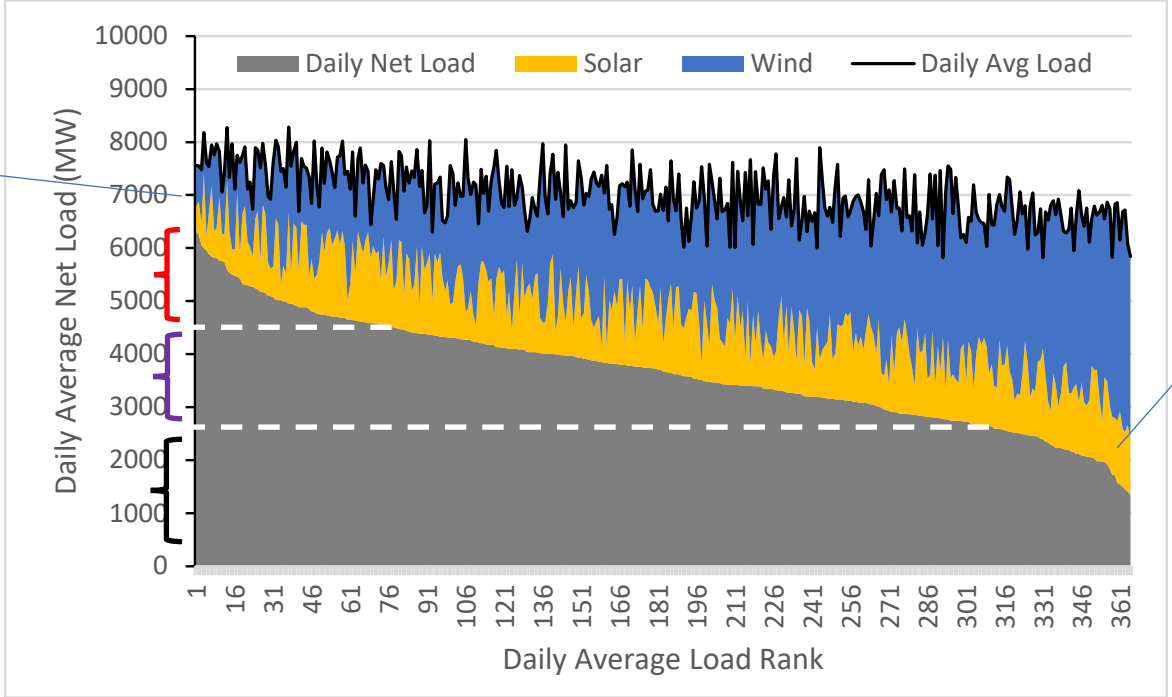
On the highest net load days, wind and solar provide limited output

A rough delineation:

Peak (low c.f.)

Intermediate

Baseload (high c.f.)



On the lowest net load days, wind and solar output is high and result in curtailment or backdown of low-cost/high c.f. baseload resources

What resource is the best fit for PacifiCorp's system?

- A mix of wind, solar, peaking, intermediate, and baseload resources work well together.
- As wind and solar (with low energy costs) get higher, the rest of the portfolio must be more flexible.

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What is the right resource mix?

It depends on marginal costs

- Each additional peaking unit will run more if it replaces other resource types -> marginal costs will go up in the extra hours it has to run.
- Each additional baseload unit will run less if it replaces other resource types -> marginal costs will go down in the hours it is backed down.

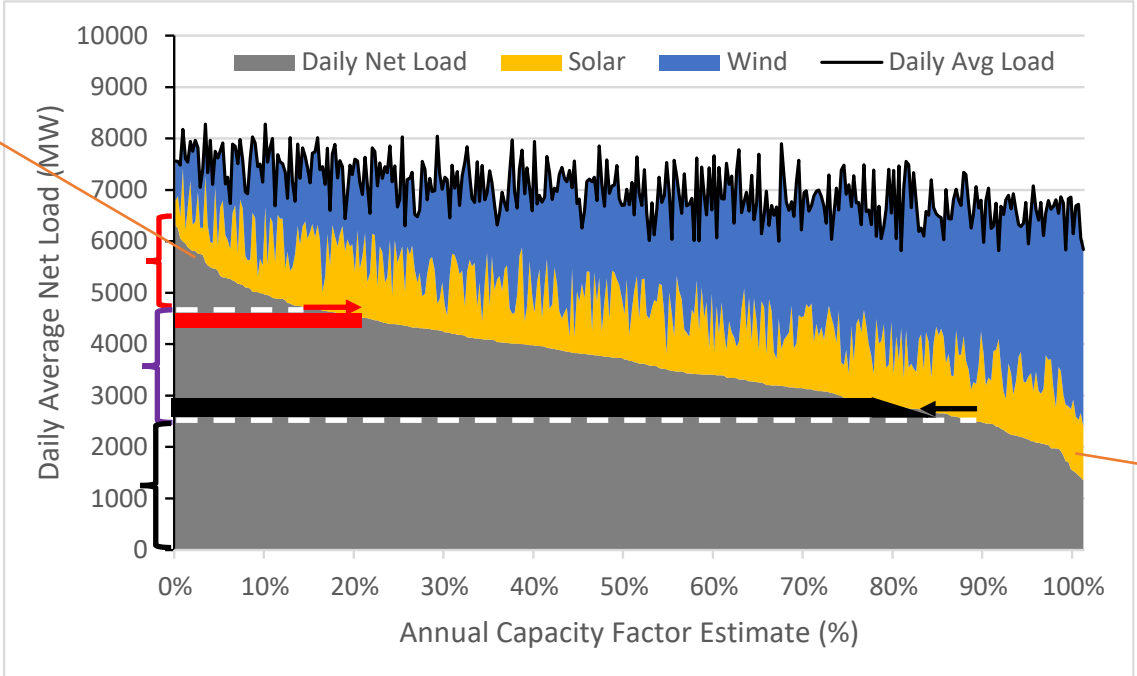
High marginal costs

A rough delineation:

Peak (low c.f.)

Intermediate

Baseload (high c.f.)



Low marginal costs

- In reality (and modeling) hourly dispatch is more complicated, but significant battery additions smooth out intra-day variation.

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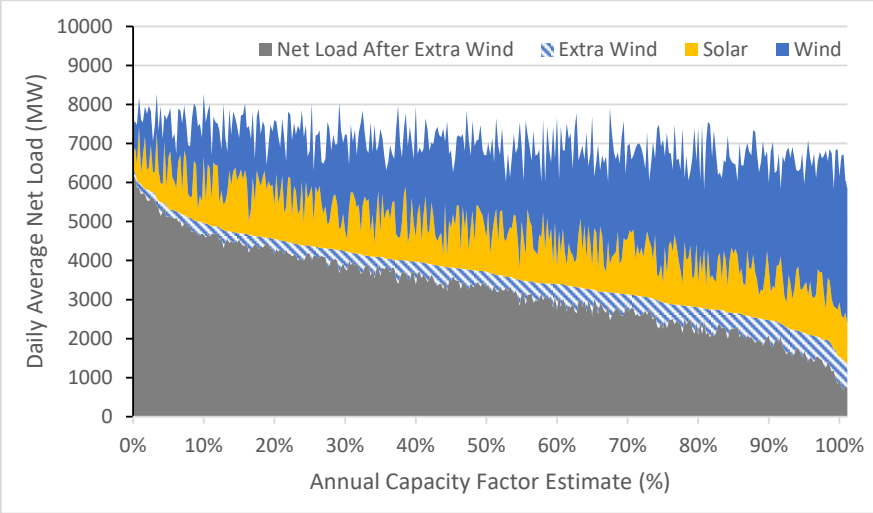
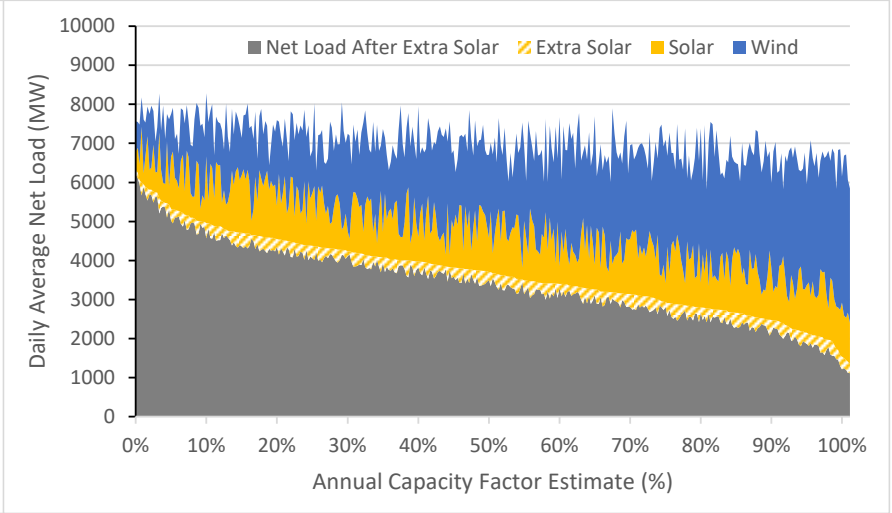
What is the right resource mix?

Marginal costs also apply to wind and solar

- Additional wind doesn't add much on the highest net load days, but adds a lot on intermediate and low net low days.
- Additional solar is also relatively low on the highest net load days, but has a more uniform distribution relative to wind.





Can we summarize the marginal costs for each resource option? Yes!

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Locational Marginal Prices and Net Revenue

- Plexos calculates a locational marginal price (LMP) specific to each area in each hour that is based on supply and demand in that area and available imports and exports on transmission links to adjacent areas. This is also known as a shadow price.
- Plexos also calculates the marginal price specific to ancillary services (i.e. operating reserves) in each hour.
- Plexos multiplies these prices by a generator's energy and operating reserve provision for each hour, and reports the total as a resource's estimated revenue. In an organized market, this would represent the expected payments based on market-clearing prices.
- When variable costs (such as fuel, emissions, and VOM) are subtracted out, the result is a resource's "net revenue".

Limitations:

- Net revenue represents the value of the last MW of capacity from a given resource – as resources get larger, the average value from the first MW of capacity to the last MW of capacity will tend to be somewhat higher than the reported marginal value. Conversely, adding more of a particular resource will result in declining values.
- While marginal prices will be very high in hours with supply shortfalls, this only indirectly contributes to reliable operation. Identifying periods of shortfalls and reliable resource alternatives to cover those periods requires additional analysis.

Net Cost of Capacity

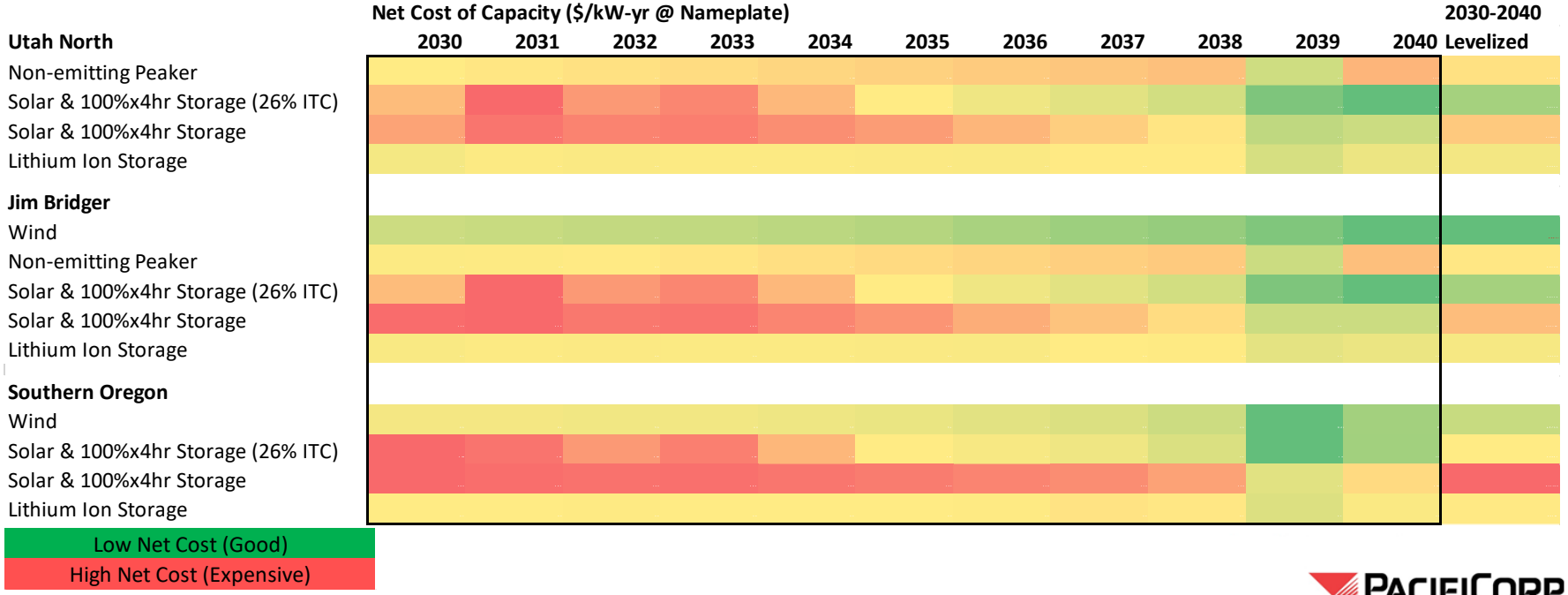
- By combining reported net revenue with fixed costs for each resource we can estimate the relative impact of a resource on revenue requirement.

$/kW-yr	Oregon Solar	Oregon Solar & 100% x 4hr Storage	Oregon Solar & 100% x 4hr Storage, 26% ITC	Utah South Solar	Utah South Solar & 100% x 4hr Storage	Utah South Solar & 100% x 4hr Storage, 26% ITC	Utah North Non-emitting Peaker
Annualized Build Cost + FOM	$144	$282	$185	$114	$249	$152	$92
Net Revenue (Resource)	$87	$87	$87	$96	$96	$96	$0
Net Revenue (Storage)	n/a	$6	$6	n/a	$21	$21	n/a
Net Cost of Capacity	$57	$189	$91	$17	$131	$34	$92

- Note that these values are per kW of nameplate, and these resources do not have equivalent capacity value or contribute equally to reliability.
- Solar with 100% x 4-hr storage has favorable reliability and cost if it qualifies for a 26% ITC, but a significant portion of the portfolio must be long duration resources as demonstrated by the net load figures on the previous slides.
- Net revenue values are specific to a portfolio AND price-policy scenario (values shown are for MM, medium gas, medium CO2 price). Under the HH scenario (high gas price, high CO2 price), marginal costs would be higher, generally leading to higher net revenue for non-emitting resources.

Net Cost of Capacity

- By comparing relative costs for resource options in each location over time, we can identify the most cost-effective options.
- While wind is low cost, it does not contribute as much to reliability, so it would need to be paired with more reliable options.
- Stand-alone storage and solar with storage also have diminishing reliability as their share of the portfolio increases.
- Low net costs for all resources in 2039 indicates a possible reliability shortfall, as a few hours of shortfalls will dramatically increase the average marginal cost.



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What is a non-emitting peaking unit?

- Net load data shows a low-capacity factor, long-duration resource option is needed – ideally with a low fixed cost per kW. Cost per MWh is less important, because it will operate infrequently.
- Traditionally, this role was filled by a Natural Gas-Fired Frame Simple Cycle Combustion Turbine (SCCT), but our core cases are not considering new natural gas-fired resources.
- A variety of suitable technology options are under development: including hydrogen, ammonia, and long-duration storage of various types.
- As a proxy for this future technology (assumed available in 2030), PacifiCorp developed costs and performance data for a 100% hydrogen-fired Frame SCCT. While this is not mature technology, major turbine manufacturers plan to deploy this in the next few years.
- Key differences from a natural-gas fired SCCT:
  - 14% higher build cost per kW
  - $27/MMBTU (nominal) burner-tip hydrogen fuel cost – estimated based on the energy cost of Utah South solar resources (without expiring tax credits), and including electrolyzer and delivery fixed costs.
  - 25% higher Variable Operations and Maintenance (VOM) Cost
  - 3.7% increase in nameplate capacity
- This works out to a variable cost of around $300/MWh. There is lots of opportunity for competing technologies or fuels to fill the peaking role at that price.

Portfolio Results




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Portfolio Development Cases

Case "Name"	Price-Policy	Existing Coal	Existing Gas	Other Existing Resources	Proxy Resources*
P02-MM	MM	Optimized	End of Life	End of Life	Optimized
BAU1-MM	MM	End of Life	End of Life	End of Life	Optimized
P03-MM	MM	Retired by 2030	End of Life	End of Life	Optimized
BAU2-MM	MM	2019 IRP	2019 IRP	2019 IRP	2019 IRP+

* Excludes new gas proxy resources not including options for gas conversion of specific existing resources that will be optimized

- P02, P03, BAU1 and BAU2 portfolios will be developed and assessed under MM, MN, LN, and HH price-policy assumptions

P02-MM Portfolio Summary

Resource	Installed Capacity, MW																			
	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040
Expansion Options																				
Gas - CCCT	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Gas - Peaking	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
NonEmitting Peaker	-	-	-	-	-	-	-	-	-	-	-	-	402	-	-	-	-	618	-	206
DSM - Energy Efficiency	157	134	139	160	181	206	233	257	273	298	295	287	267	244	216	194	188	170	159	157
DSM - Demand Response	-	123	242	184	79	63	69	80	78	77	82	50	213	70	160	125	183	159	108	302
Renewable - Wind	49	-	151	43	1,641	745	-	-	-	489	-	450	-	-	-	-	-	-	-	60
Renewable - Wind+Storage	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Renewable - Utility Solar	-	-	-	95	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Renewable - Utility Solar+Storage	-	-	-	752	455	600	-	83	-	558	820	-	1,100	-	-	-	1,009	-	-	156
Renewable - Battery, Wind+Storage	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Renewable - Battery, Solar+Storage	-	-	-	239	258	600	-	42	-	558	820	-	1,100	-	-	-	1,009	-	-	156
Renewable - Geothermal	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Battery - Stand Alone	-	-	-	200	-	-	-	-	549	1	-	-	-	-	-	-	650	-	-	-
Storage - CAES	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Storage - Pumped Hydro	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	500
Nuclear	-	-	-	-	-	-	-	345	-	-	-	-	-	-	-	-	-	690	-	-
Nuclear Storage	-	-	-	-	-	-	-	155	-	-	-	-	-	-	-	-	-	310	-	-
Front Office Transactions	386	413	428	387	500	234	291	290	366	414	408	459	539	703	589	764	885	1,046	1,082	1,187
Existing Unit Changes																				
Coal Plant End-of-life Retirements	-	-	-	-	-	(230)	-	(788)	(123)	-	-	-	-	-	-	-	(909)	(699)	-	(268)
Coal Early Retirements	-	-	-	-	-	(357)	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Coal - CCUS	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Coal - Gas Conversions	-	-	-	713	-	-	-	-	-	-	-	-	-	-	-	-	-	(713)	-	-
Coal Plant ceases running as Coal	-	-	-	(713)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Gas Plant End-of-life Retirements	-	-	-	-	-	-	-	-	-	(247)	-	-	(356)	-	-	-	(237)	-	-	-
Retire - Hydro	-	-	(163)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Retire - Wind	-	(10)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Expire - Wind PPA	-	-	-	(41)	-	(65)	-	-	(99)	(200)	-	-	-	-	-	-	-	-	-	-
Retire - Solar	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	(18)	-	-	-
Expire - Solar PPA	-	-	-	-	-	-	-	(2)	-	-	-	(8)	-	-	-	-	(73)	-	-	-
Expire - QF	-	(2)	-	(50)	-	-	(29)	-	(83)	(0)	-	(81)	(181)	(91)	(19)	(208)	(744)	(30)	(100)	(92)
Retire - Other	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	(32)	-	-
Expire - Other	-	11	-	32	(91)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

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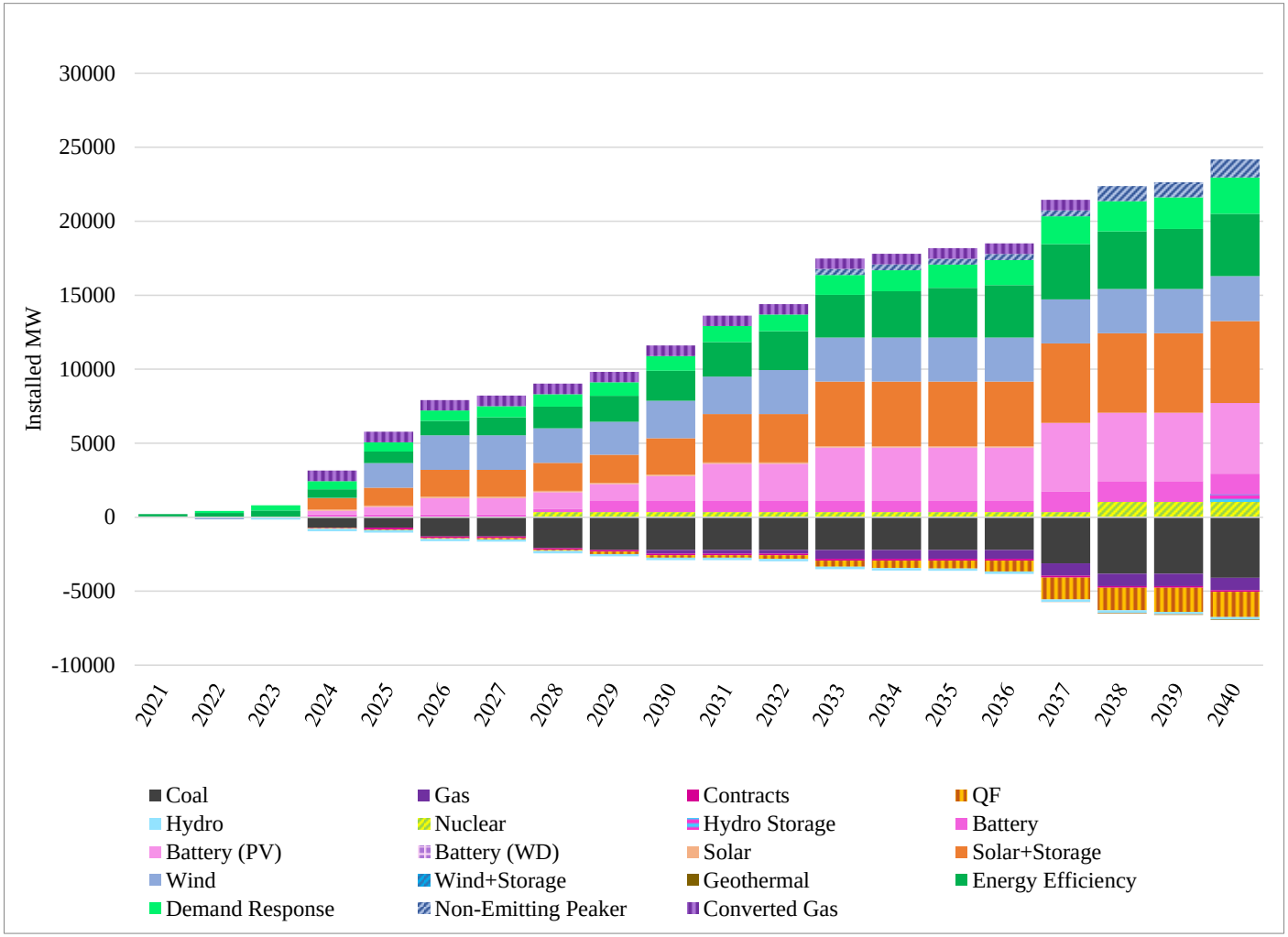
P02-MM Resource Changes



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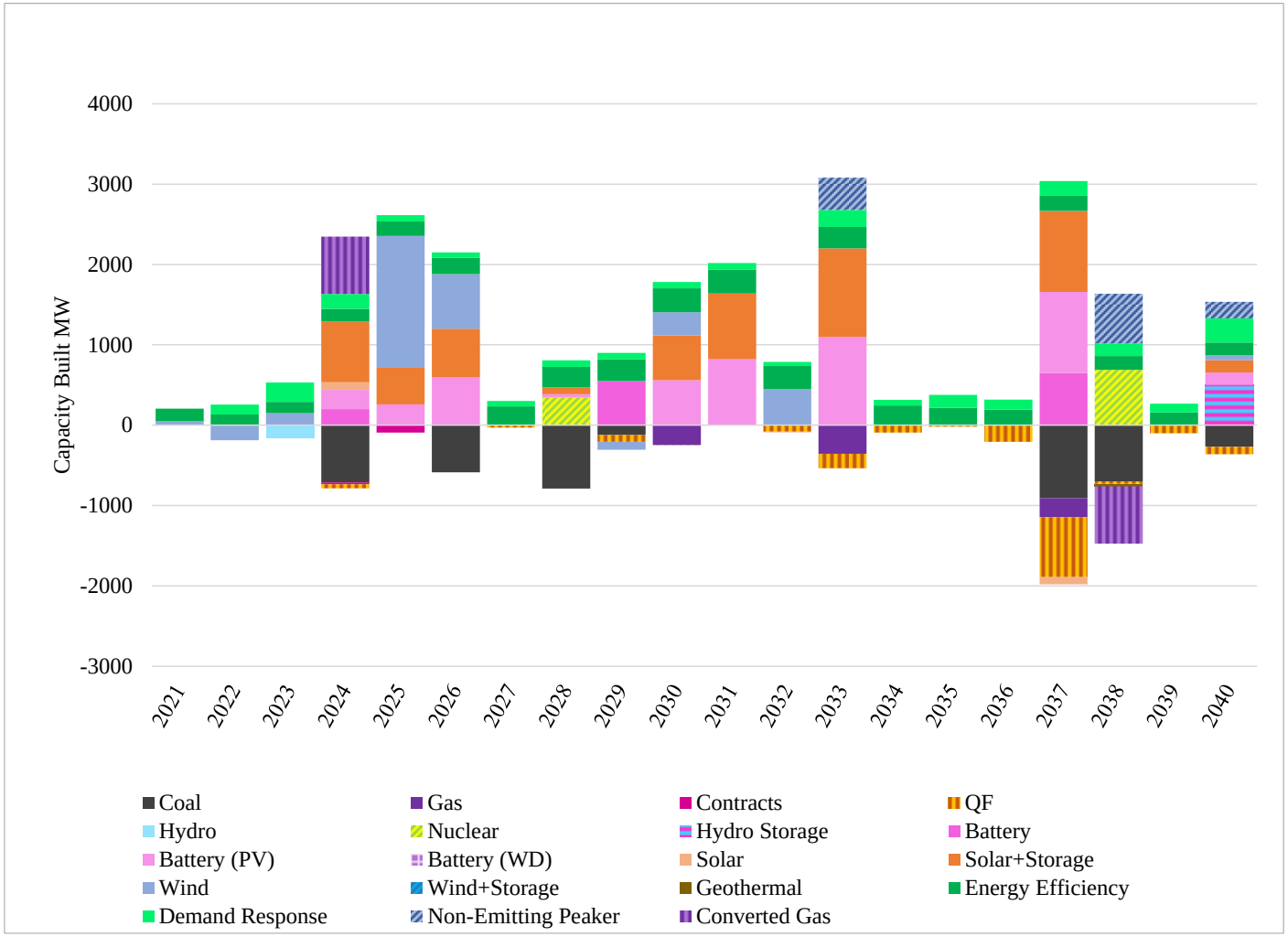
P02-MM Incremental Portfolio Changes



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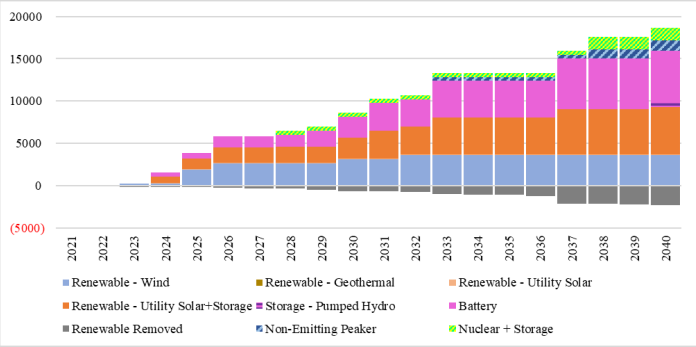
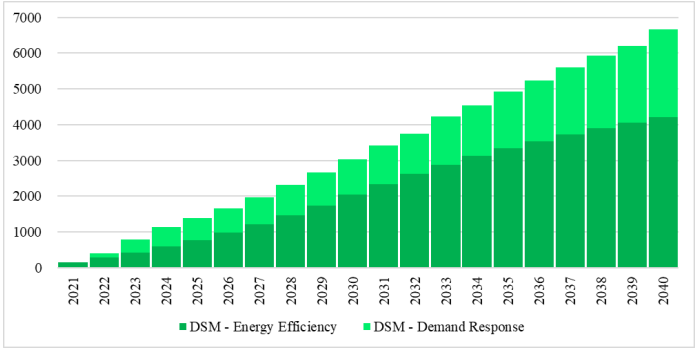
P02-MM Portfolio Resources

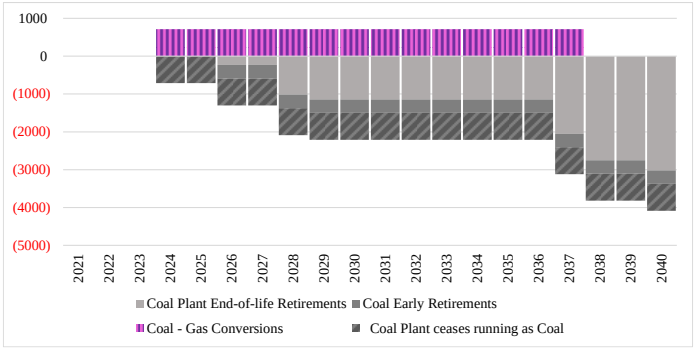
Renewables & Non-Emitting



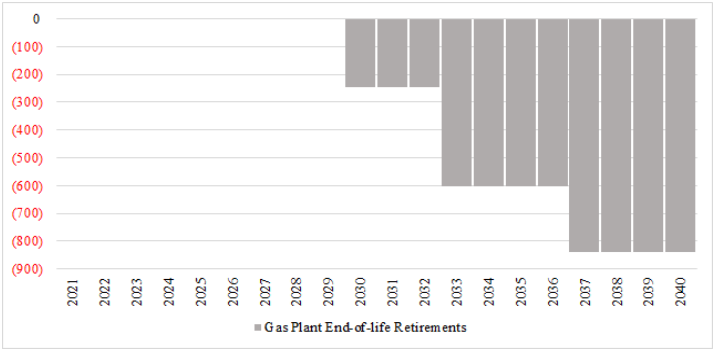
Demand-side Management



Coal



Gas



Resource Type	Resource Additions*
Wind	3174
Solar	5474
Battery	6181
Energy Efficiency	4216
Demand Response	2448
Gas	(840)
Coal	(4088)
Nuclear	1500
Non-Emitting Peaker	1226
Pumped Hydro Storage	500

* Net of retirements and expirations

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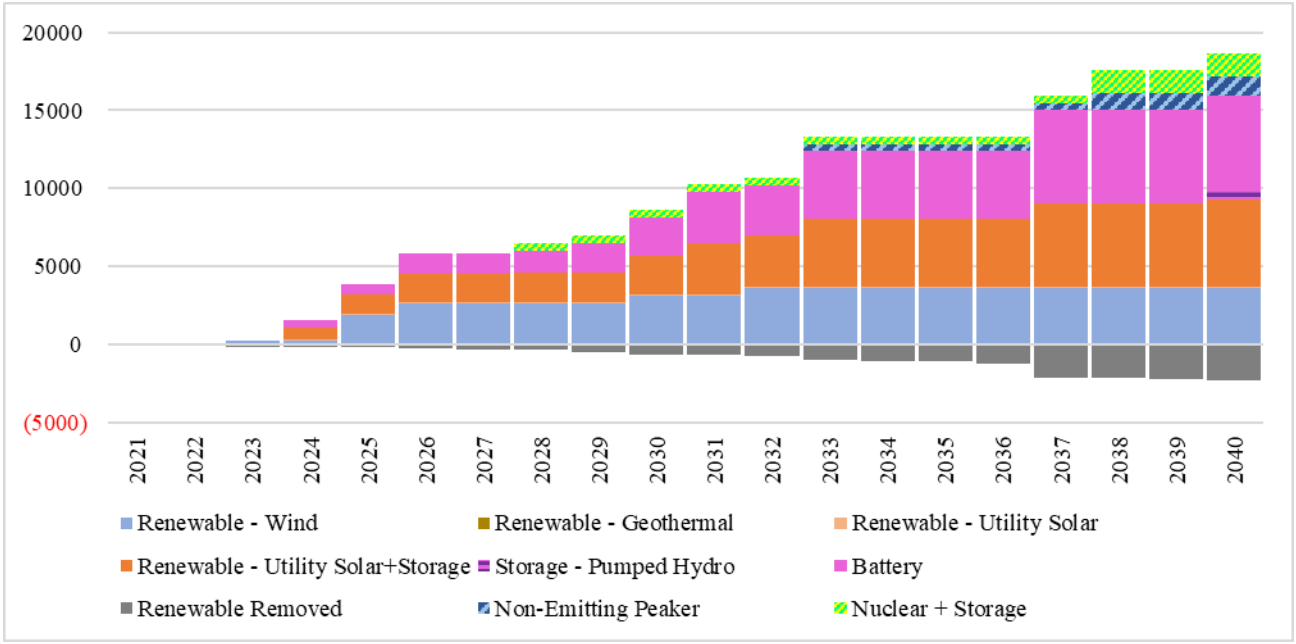
P02-MM New Transmission

- Gateway South (GWS, Expected in-service date late 2024
  - Transfer capability from Wyoming East to Clover (central UT)
  - Supports additional interconnection capability in Wyoming and Utah
- Boardman to Hemingway (B2H, Expected in-service date 2026)
  - Westbound transfer capability from Borah to Hemingway to Midpoint
  - Eastbound transfer capability from Walla Walla to Borah
  - Supports additional interconnection capability in Idaho (Borah)
- Portland North Coast (interconnection only, selected 2026)
- Willamette Valley (interconnection only, selected 2026)
- Southern Oregon (interconnection only, selected 2027)
- Yakima (interconnection only, selected 2030)
- Utah North (interconnection only, selected 2031)
- Portland North Coast to Willamette Valley (transfer capability and interconnect, selected 2032)
- Utah South to Utah North (transfer capability and interconnect, selected in 2033)
- Central Oregon (interconnection only, selected 2037)
- Portland North Coast to Southern Oregon (transfer capability and interconnect, selected 2037)
- Central Oregon to Willamette Valley (transfer capability and interconnect, selected 2040)

P02-MM Renewables & Non-Emitting



- By 2025, includes 1,884 MW of wind additions increasing to 3,628 MW by 2040
- By 2025, includes 1,302 MW of solar additions increasing to 5,628 MW by 2040
- By 2025, includes 200 MW of new standalone battery increasing to 1,400 MW by 2040
- Includes the 500 MW Natrium demonstration project in 2028
- By 2040, includes 2,726 MW of non-emitting nuclear and peaker resources

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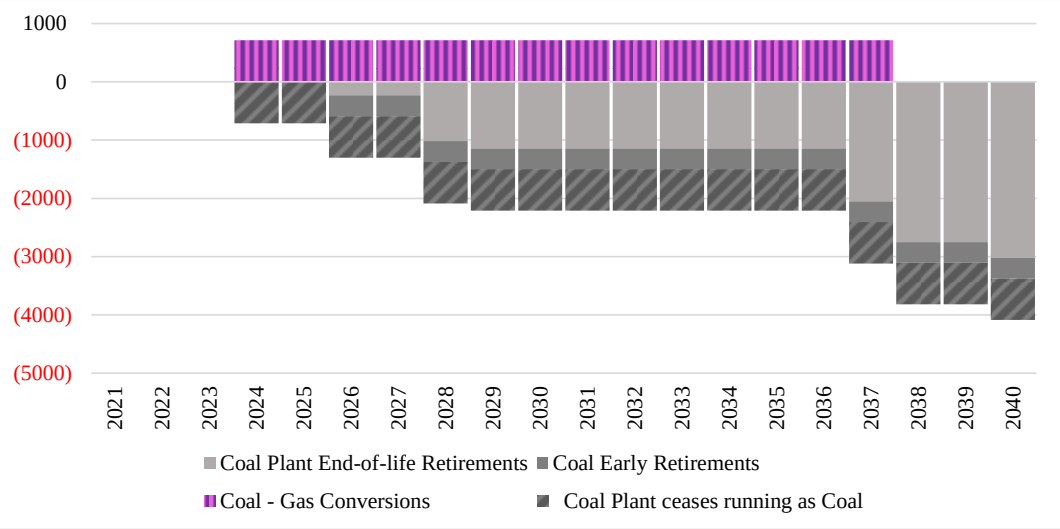
P02-MM Coal Retirements / Gas Conversions



Location	Coal Retirements/Gas Conversion (2021-2025)*	Coal Retirements/Gas Conversion (2026-2030)*	Coal Retirements/Gas Conversion (2031-2040)*
Wyoming	2023 = 713 MW (J. Bridger 1-2) / Gas Conversion 2024 2025 = 357 MW (Naughton 1-2)	2027 = 755 MW (D. Johnston 1-4)	2037 = 699 MW (J. Bridger 3-4) 2037 = 713 MW (Gas Conversion J. Bridger 1-2) 2039 = 268 MW (Wyodak)
Colorado	2025 = 82 MW (Craig 1)	2028 = 79 MW (Craig 2) 2028 = 44 MW (Hayden 1) 2027 = 33 MW (Hayden 2)	n/a
Montana	2025 = 148 MW (Colstrip 3-4)		n/a
Utah	n/a	n/a	2036 = 909 MW (Huntington 1-2)

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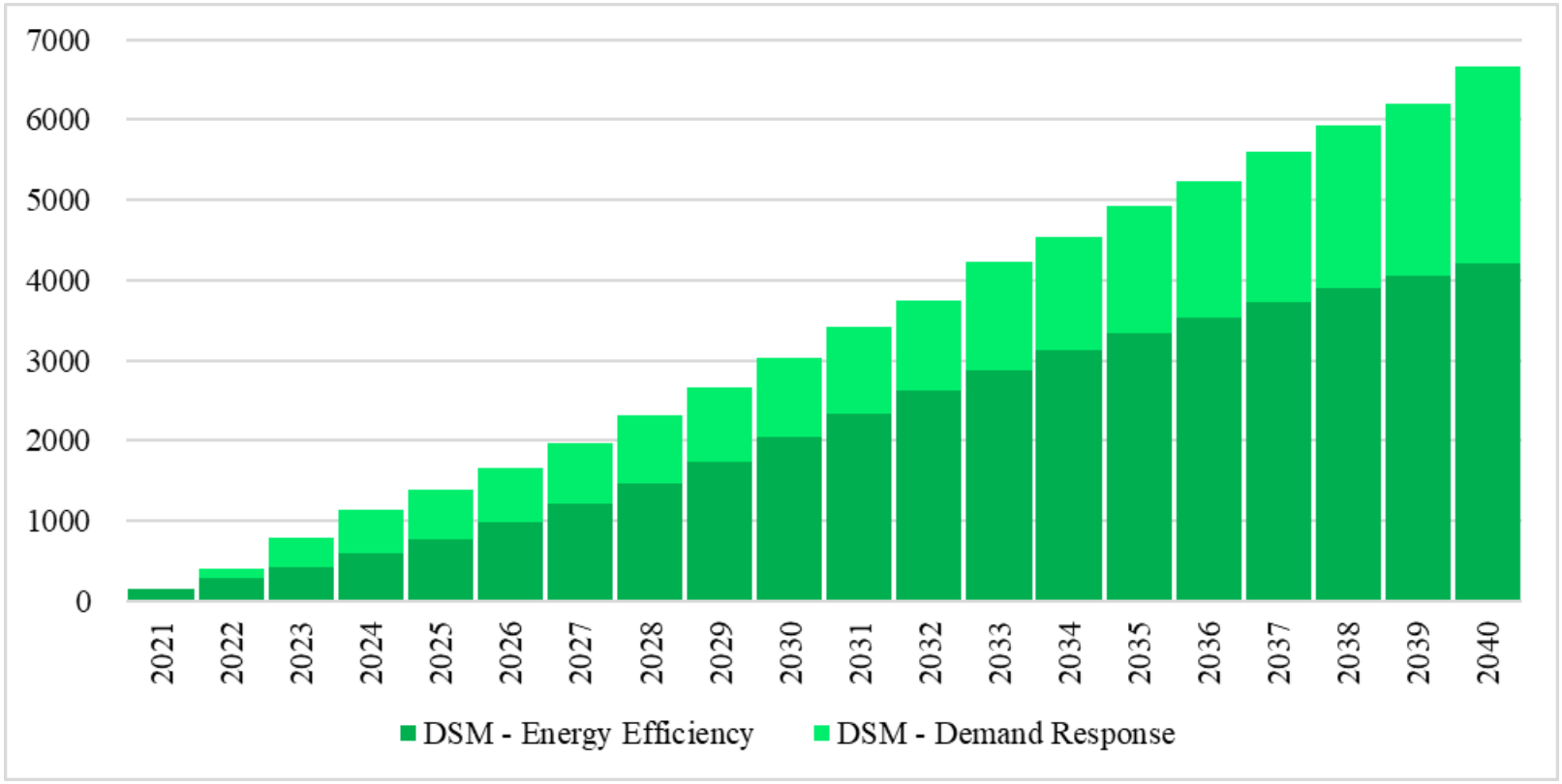
P02-MM Demand-Side Management



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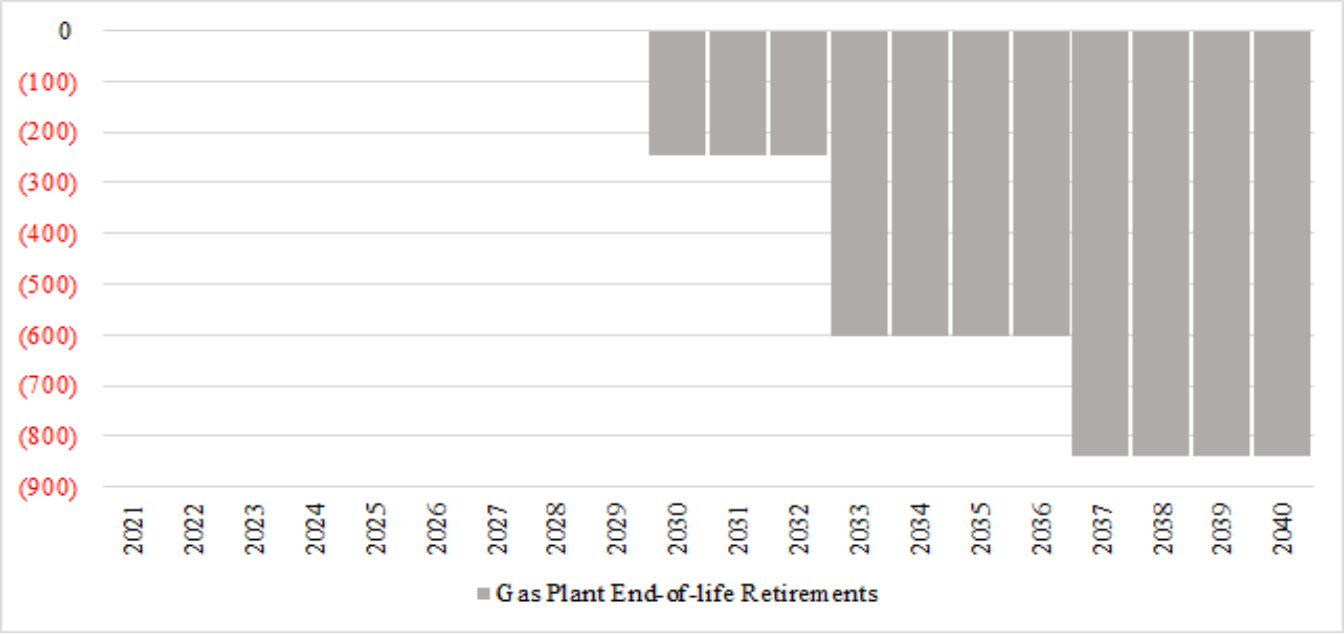
P02-MM Natural Gas Retirements



State	Gas Retirements (2021-2024)*	Gas Retirements (2025-2040)*
Wyoming	n/a	2029 = 247 MW Naughton 3
Utah	n/a	2032 = 356 MW Gadsby 1-6
Oregon	n/a	2036 = 237 MW Hermiston

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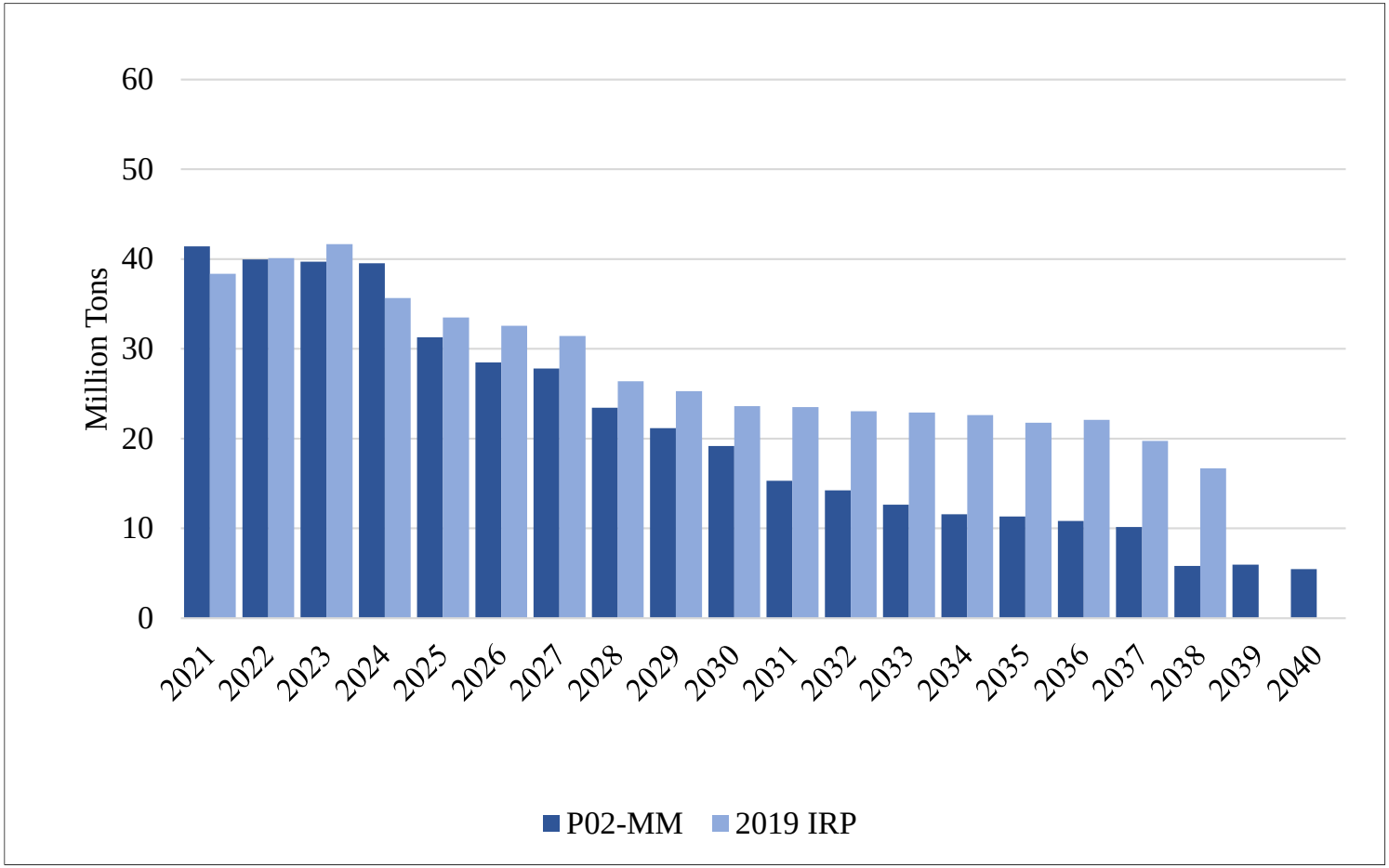
P02-MM CO_2 Emissions



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P03-MM Portfolio Summary

Resource	Installed Capacity, MW																			
	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040
Expansion Options																				
Gas - CCCT	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Gas - Peaking	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
NonEmitting Peaker	-	-	-	-	-	-	-	-	-	618	-	-	402	-	-	-	-	412	-	-
DSM - Energy Efficiency	157	137	142	159	191	219	253	277	290	298	294	286	267	244	215	185	156	133	118	106
DSM - Demand Response	-	123	402	336	114	84	100	112	92	105	112	69	85	80	102	84	119	108	106	118
Renewable - Wind	49	-	151	43	1,641	745	-	-	-	489	-	450	-	-	-	-	-	-	-	60
Renewable - Wind+Storage	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Renewable - Utility Solar	-	-	-	95	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Renewable - Utility Solar+Storage	-	-	-	1,152	705	1,090	160	543	-	557	820	-	1,100	-	-	-	100	-	-	156
Renewable - Battery, Wind+Storage	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Renewable - Battery, Solar+Storage	-	-	-	639	508	1,090	160	502	-	557	820	-	1,100	-	-	-	100	-	-	156
Renewable - Geothermal	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Battery - Stand Alone	-	-	-	200	-	-	-	-	549	1	-	-	-	-	-	-	650	-	-	-
Storage - CAES	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Storage - Pumped Hydro	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	500
Nuclear	-	-	-	-	-	-	-	345	-	-	345	-	-	-	-	-	-	690	-	-
Nuclear Storage	-	-	-	-	-	-	-	155	-	-	155	-	-	-	-	-	-	310	-	-
Front Office Transactions	386	413	419	410	553	635	585	1,010	1,179	1,153	812	929	894	919	954	1,024	1,213	1,213	1,264	1,277
Existing Unit Changes																				
Coal Plant End-of-life Retirements	-	-	-	-	-	(230)	-	(788)	(123)	-	-	-	-	-	-	-	-	-	-	-
Coal Early Retirements	-	-	-	(418)	(269)	(1,177)	-	(727)	(450)	(351)	-	-	-	-	-	-	-	-	-	-
Coal - CCUS	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Coal - Gas Conversions	-	-	-	713	-	-	-	-	-	-	-	-	-	-	-	-	-	(713)	-	-
Coal Plant ceases running as Coal	-	-	-	(713)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Gas Plant End-of-life Retirements	-	-	-	-	-	-	-	-	-	(247)	-	-	(356)	-	-	-	(237)	-	-	-
Retire - Hydro	-	-	(163)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Retire - Wind	-	(10)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Expire - Wind PPA	-	-	-	(41)	-	(65)	-	-	(99)	(200)	-	-	-	-	-	-	-	-	-	-
Retire - Solar	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	(18)	-	-	-
Expire - Solar PPA	-	-	-	-	-	-	-	(2)	-	-	-	(8)	-	-	-	-	(73)	-	-	-
Expire - QF	-	(2)	-	(50)	-	-	(29)	-	(83)	(0)	-	(81)	(181)	(91)	(19)	(208)	(744)	(30)	(100)	(92)
Retire - Other	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	(32)	-	-
Expire - Other	-	11	-	32	(91)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

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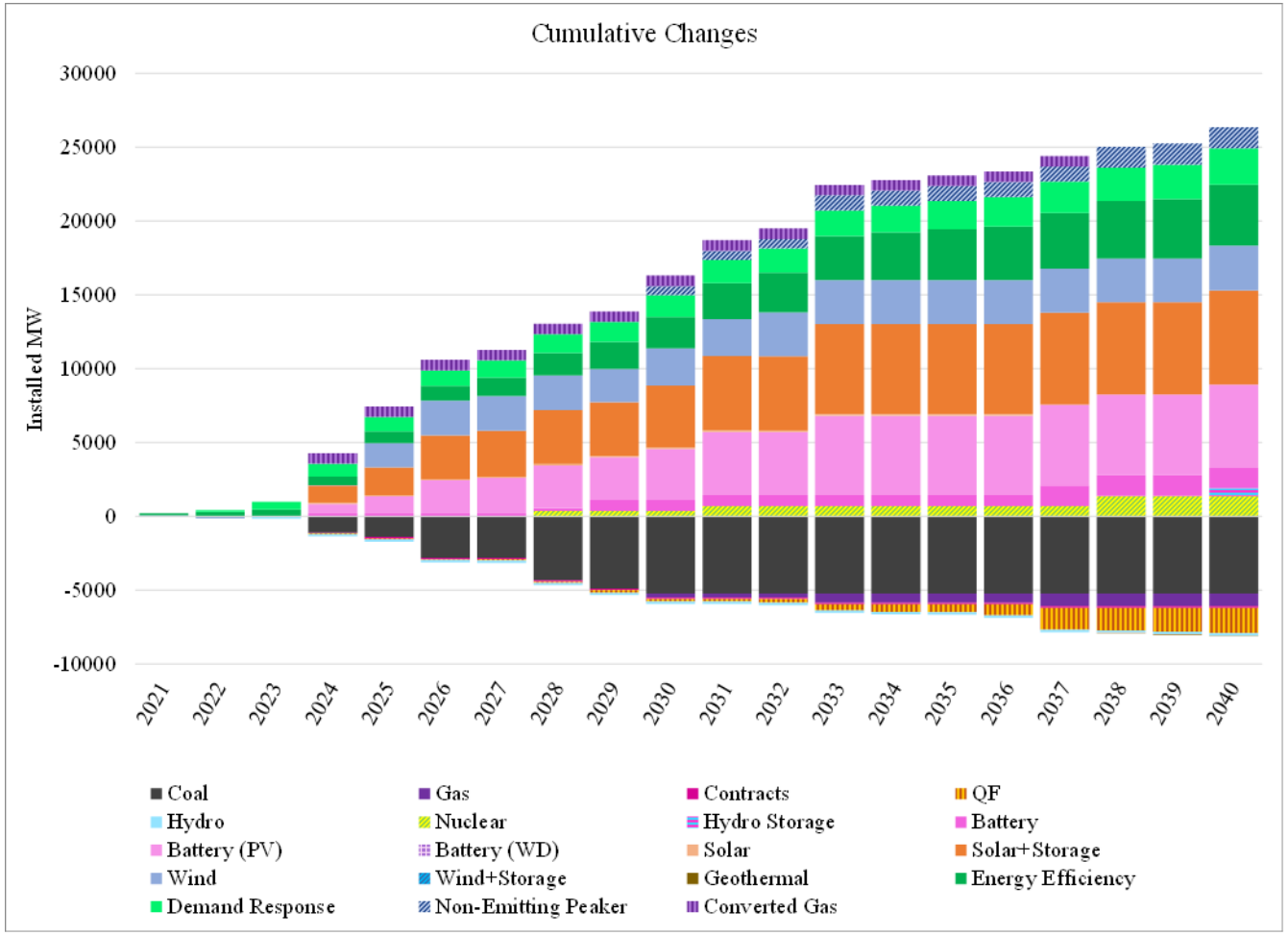
P03-MM Resource Changes



PACIFICORP
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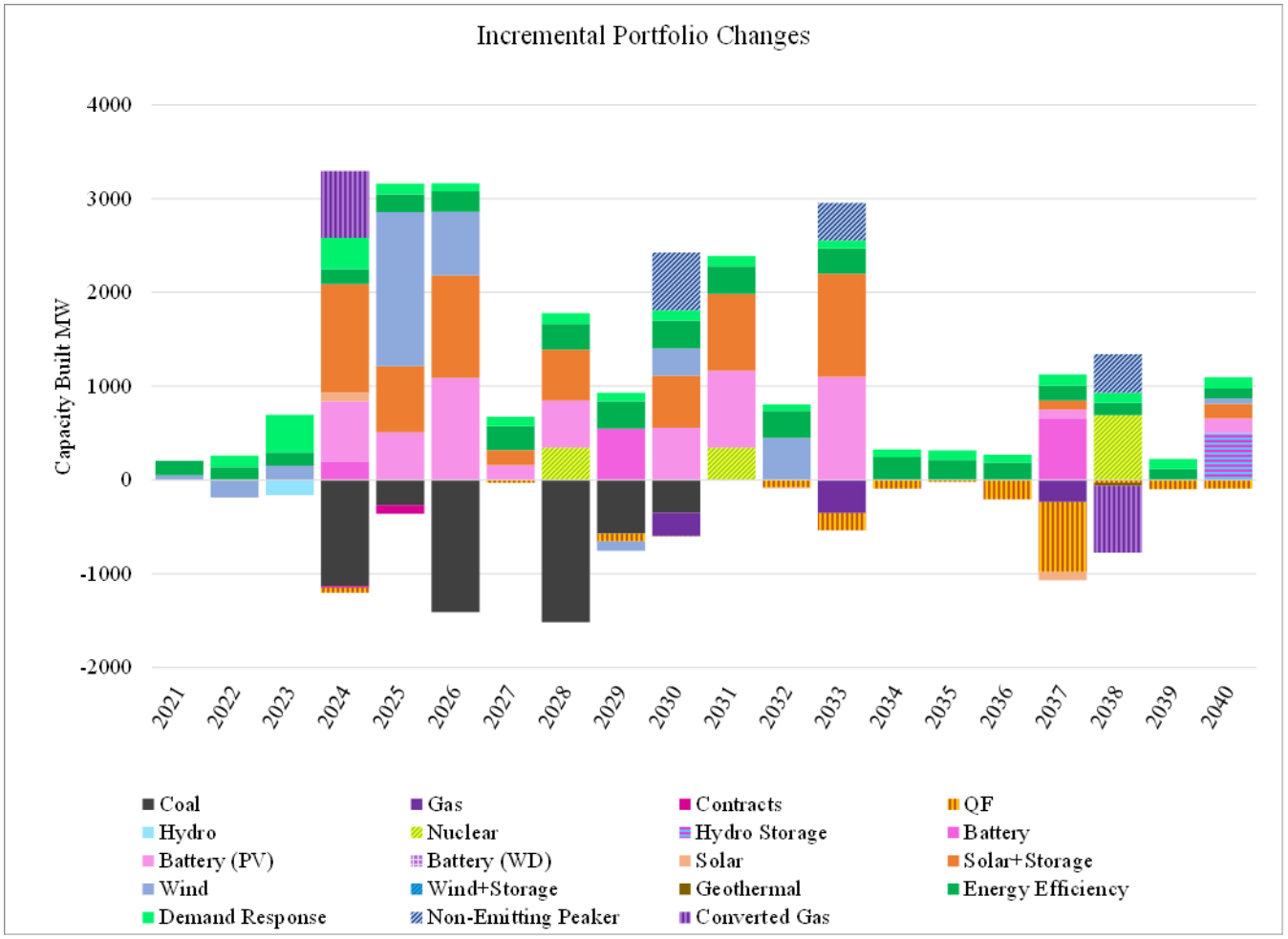
P03-MM Incremental Portfolio Changes



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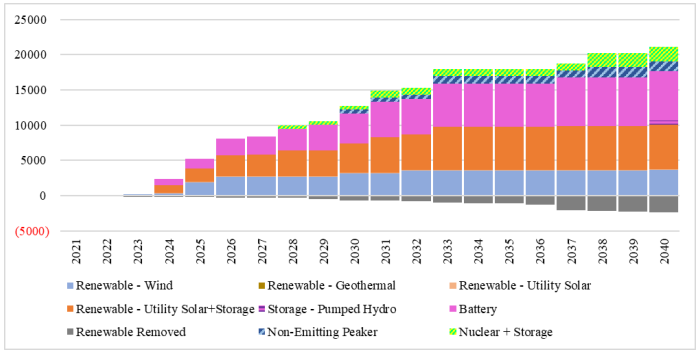
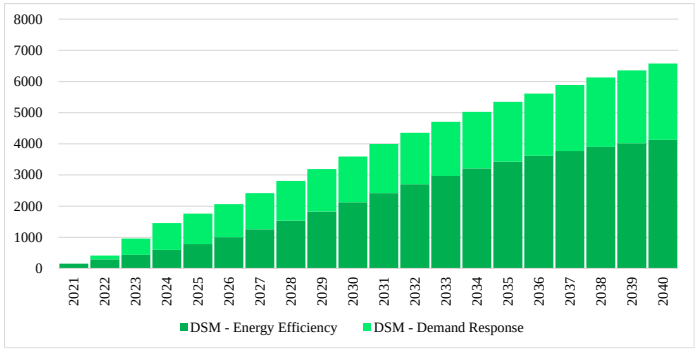
P03-MM Portfolio Resources

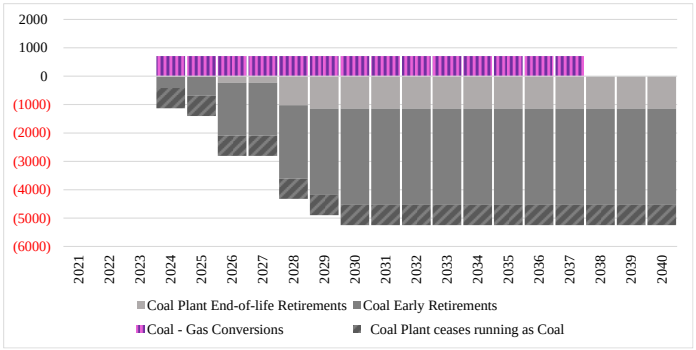
Renewables & Non-Emitting



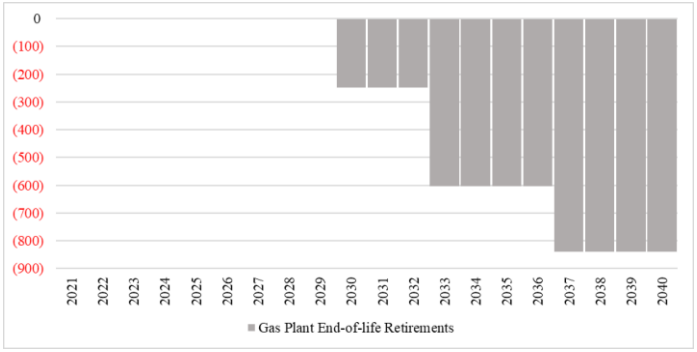
Demand-side Management



Coal



Gas



Resource Type	Resource Additions*
Wind	3174
Solar	6324
Battery	7031
Energy Efficiency	4126
Demand Response	2454
Gas	(840)
Coal	(5246)
Nuclear	2000
Non-Emitting Peaker	1432
Pumped Hydro Storage	500

* Net of retirements and expirations

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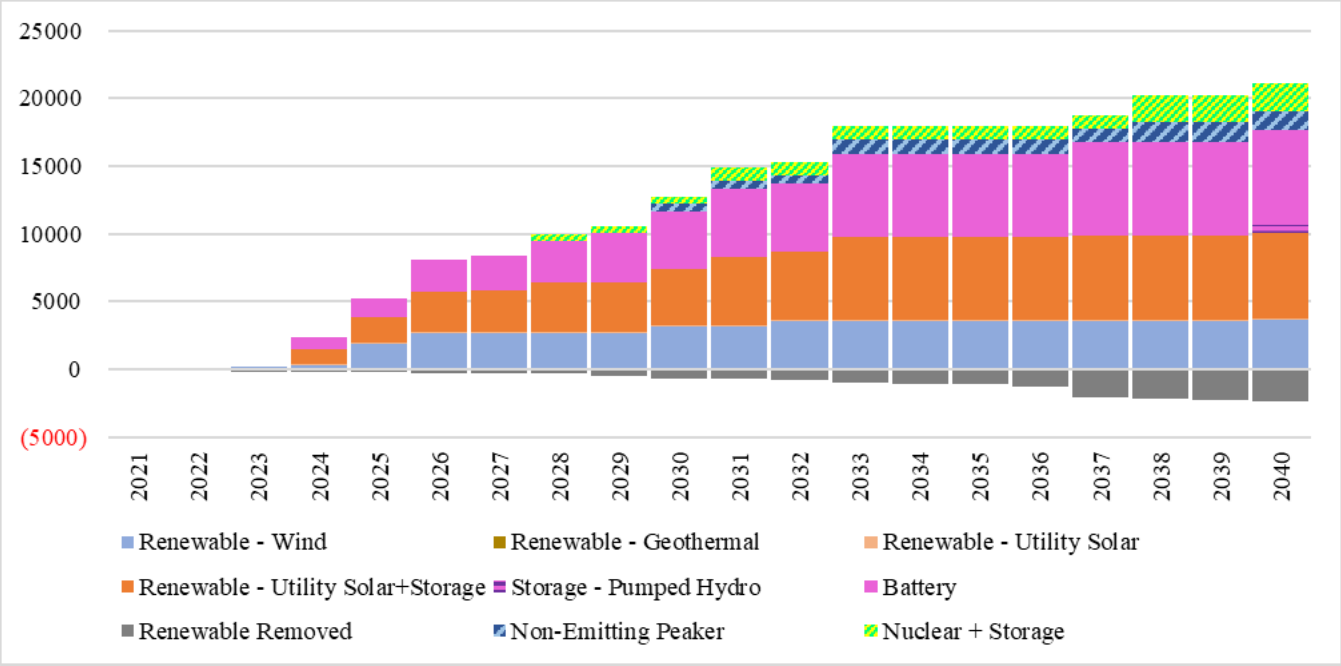
P03-MM Renewables & Non-Emitting



- By 2025, includes 1,884 MW of wind additions increasing to 3,628 MW by 2040
- By 2025, includes 1,952 MW of solar increasing to 6,478 MW by 2040
- By 2025, includes 200 MW of new standalone battery increasing to 1,400 MW by 2040
- Includes the 500 MW Natrium demonstration project in 2028
- By 2040, includes 3,432 MW of non-emitting nuclear and peaker resources

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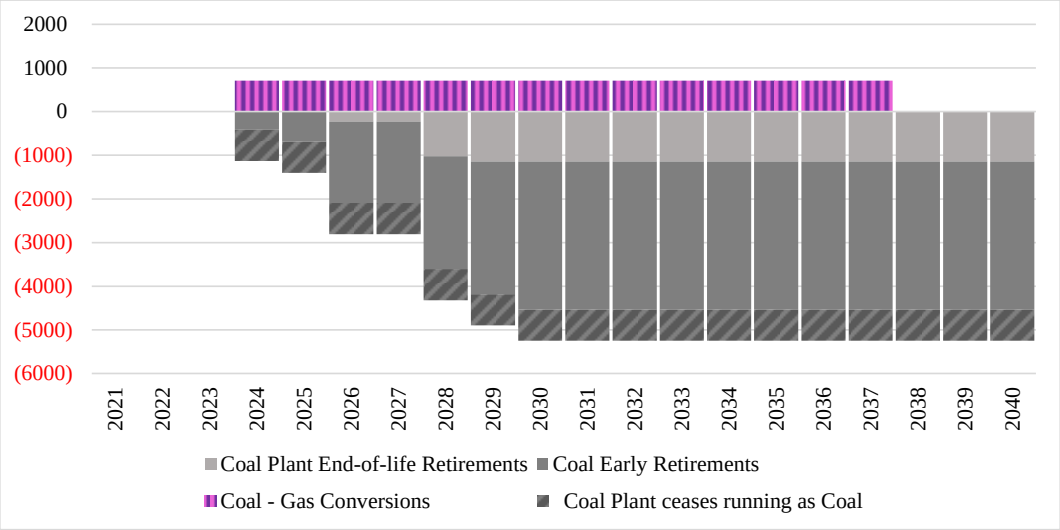
P03-MM Coal Retirements / Gas Conversions



Location	Coal Retirements/Gas Conversion (2021-2025)*	Coal Retirements/Gas Conversion (2026-2030)*	Coal Retirements/Gas Conversion (2031-2040)*
Wyoming	2023 = 713 MW (J. Bridger 1-2) / Gas Conversion 2024 2025 = 357 MW (Naughton 1-2) 2025 = 349 MW (J. Bridger 3)	2027 = 755 MW (D. Johnston 1-4) 2027 = 268 MW (Wyodak) 2029 = 351 MW (J. Bridger 4)	2037 = 713 MW (Gas Conversion J. Bridger 1-2)
Colorado	2025 = 82 MW (Craig 1)	2028 = 79 MW (Craig 2) 2028 = 44 MW (Hayden 1) 2027 = 33 MW (Hayden 2)	n/a
Montana	2025 = 148 MW (Colstrip 3-4)		n/a
Utah	2023 = 418 MW (Hunter 1) 2024 = 269 MW (Hunter 2) 2025 = 471 (Hunter 3)	2027 = 459 MW (Huntington 1) 2028 = 450 MW (Huntington 2)	n/a

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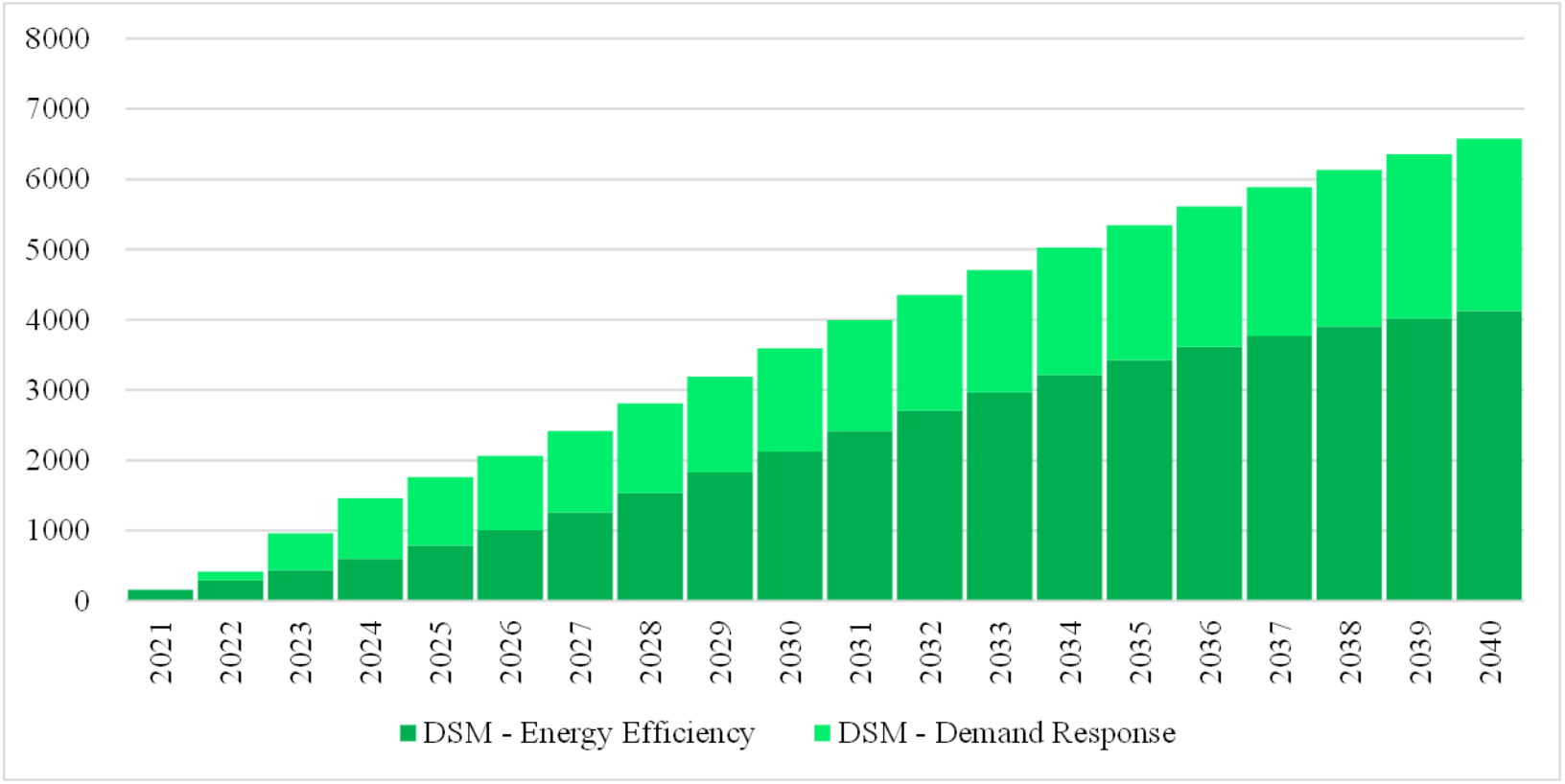
P03-MM Demand-Side Management



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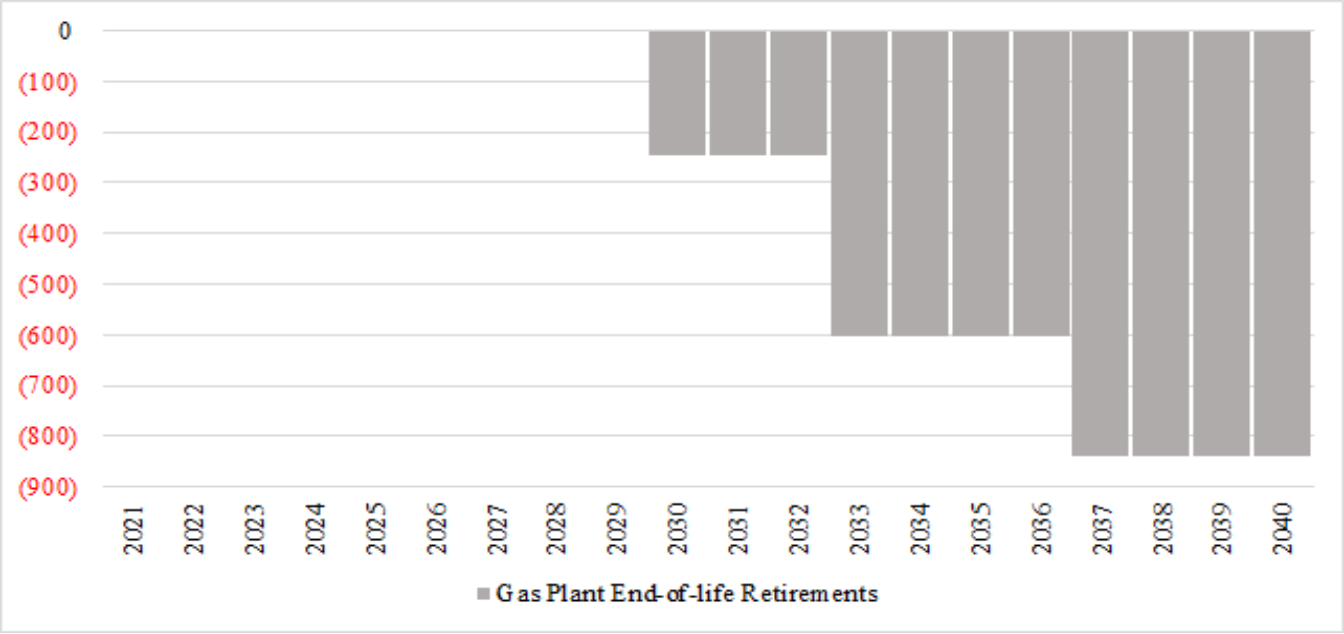
P03-MM Natural Gas Retirements



State	Gas Retirements (2021-2024)*	Gas Retirements (2025-2040)*
Wyoming	n/a	2029 = 247 MW Naughton 3
Utah	n/a	2032 = 356 MW Gadsby 1-6
Oregon	n/a	2036 = 237 MW Hermiston

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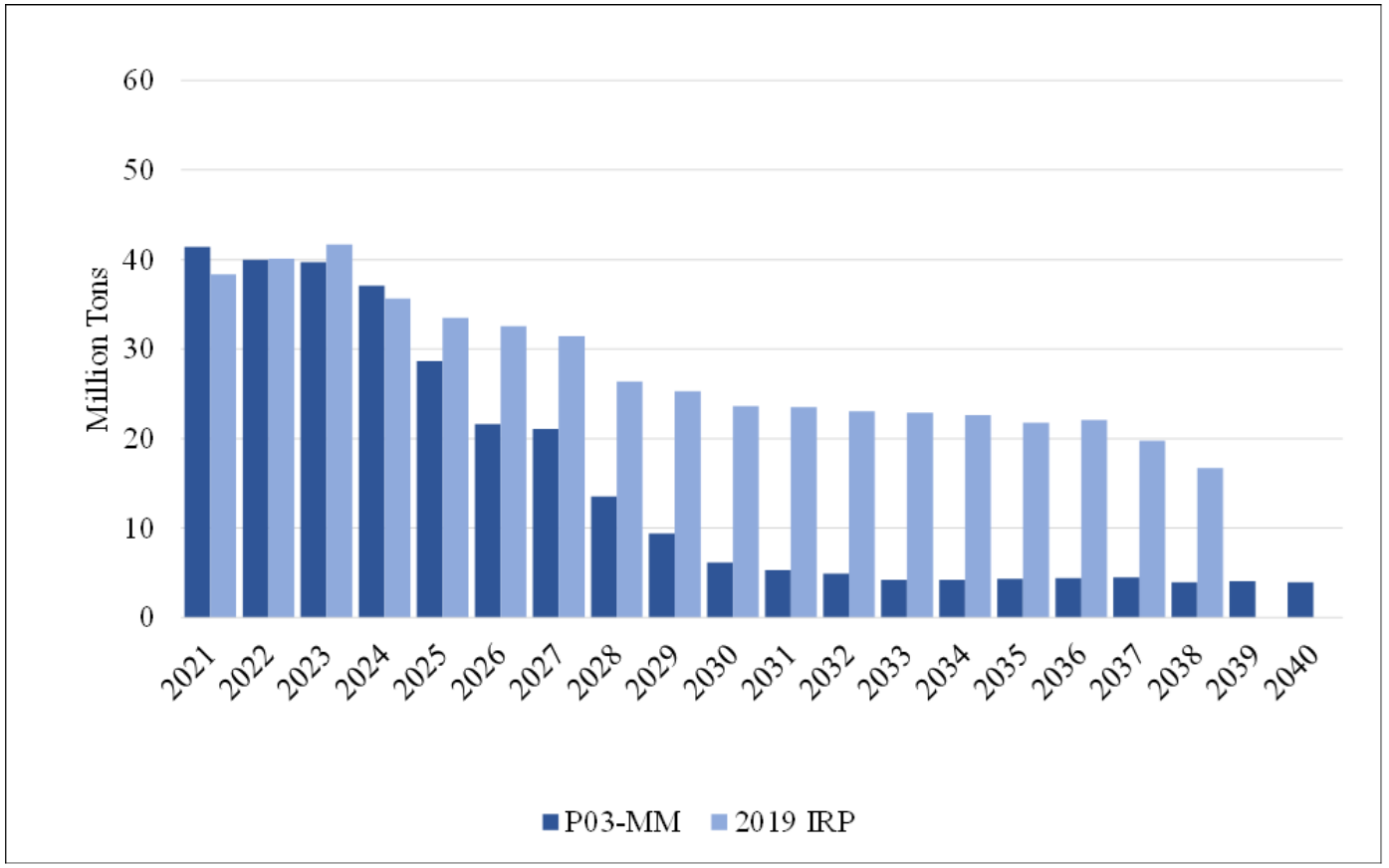
P03-MM CO_2 Emissions



PACIFICORP
POWERING YOUR GREATNESS

BAU1-MM Portfolio Summary

Resource	Installed Capacity, MW																			
	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040
Expansion Options																				
Gas - CCCT	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Gas - Peaking	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
NonEmitting Peaker	-	-	-	-	-	-	-	-	-	-	-	-	402	-	-	-	412	618	-	206
DSM - Energy Efficiency	154	124	130	157	181	206	232	254	265	294	294	286	266	243	214	184	156	137	119	107
DSM - Demand Response	-	123	402	336	114	84	100	112	92	105	112	69	84	80	99	84	92	135	108	121
Renewable - Wind	49	-	151	43	1,641	745	-	-	-	489	-	450	-	-	-	-	-	-	-	-
Renewable - Wind+Storage	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Renewable - Utility Solar	-	-	-	95	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Renewable - Utility Solar+Storage	-	-	-	752	455	600	-	83	-	1,146	820	-	1,100	-	-	-	597	-	-	156
Renewable - Battery, Wind+Storage	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Renewable - Battery, Solar+Storage	-	-	-	239	258	600	-	42	-	1,146	820	-	1,100	-	-	-	597	-	-	156
Renewable - Geothermal	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Battery - Stand Alone	-	-	-	200	-	-	-	-	-	-	-	-	-	-	-	-	650	-	-	-
Storage - CAES	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Storage - Pumped Hydro	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	500
Nuclear	-	-	-	-	-	-	-	345	-	-	-	-	-	-	-	-	-	690	-	-
Nuclear Storage	-	-	-	-	-	-	-	155	-	-	-	-	-	-	-	-	-	310	-	-
Front Office Transactions	386	413	421	337	432	274	295	302	316	403	402	460	465	703	557	589	713	1,052	1,192	1,193
Existing Unit Changes																				
Coal Plant End-of-life Retirements	-	-	-	-	-	(230)	-	(788)	(123)	(357)	-	-	-	-	-	-	(909)	(1,413)	-	(268)
Coal Early Retirements	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Coal - CCUS	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Coal - Gas Conversions	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Coal Plant ceases running as Coal	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Gas Plant End-of-life Retirements	-	-	-	-	-	-	-	-	-	(247)	-	-	(356)	-	-	-	(237)	-	-	-
Retire - Hydro	-	-	(163)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Retire - Wind	-	(10)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Expire - Wind PPA	-	-	-	(41)	-	(65)	-	-	(99)	(200)	-	-	-	-	-	-	-	-	-	-
Retire - Solar	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	(18)	-	-	-
Expire - Solar PPA	-	-	-	-	-	-	-	(2)	-	-	-	(8)	-	-	-	-	(73)	-	-	-
Expire - QF	-	(2)	-	(50)	-	-	(29)	-	(83)	(0)	-	(81)	(181)	(91)	(19)	(208)	(744)	(30)	(100)	(92)
Retire - Other	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	(32)	-	-
Expire - Other	-	11	-	32	(91)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

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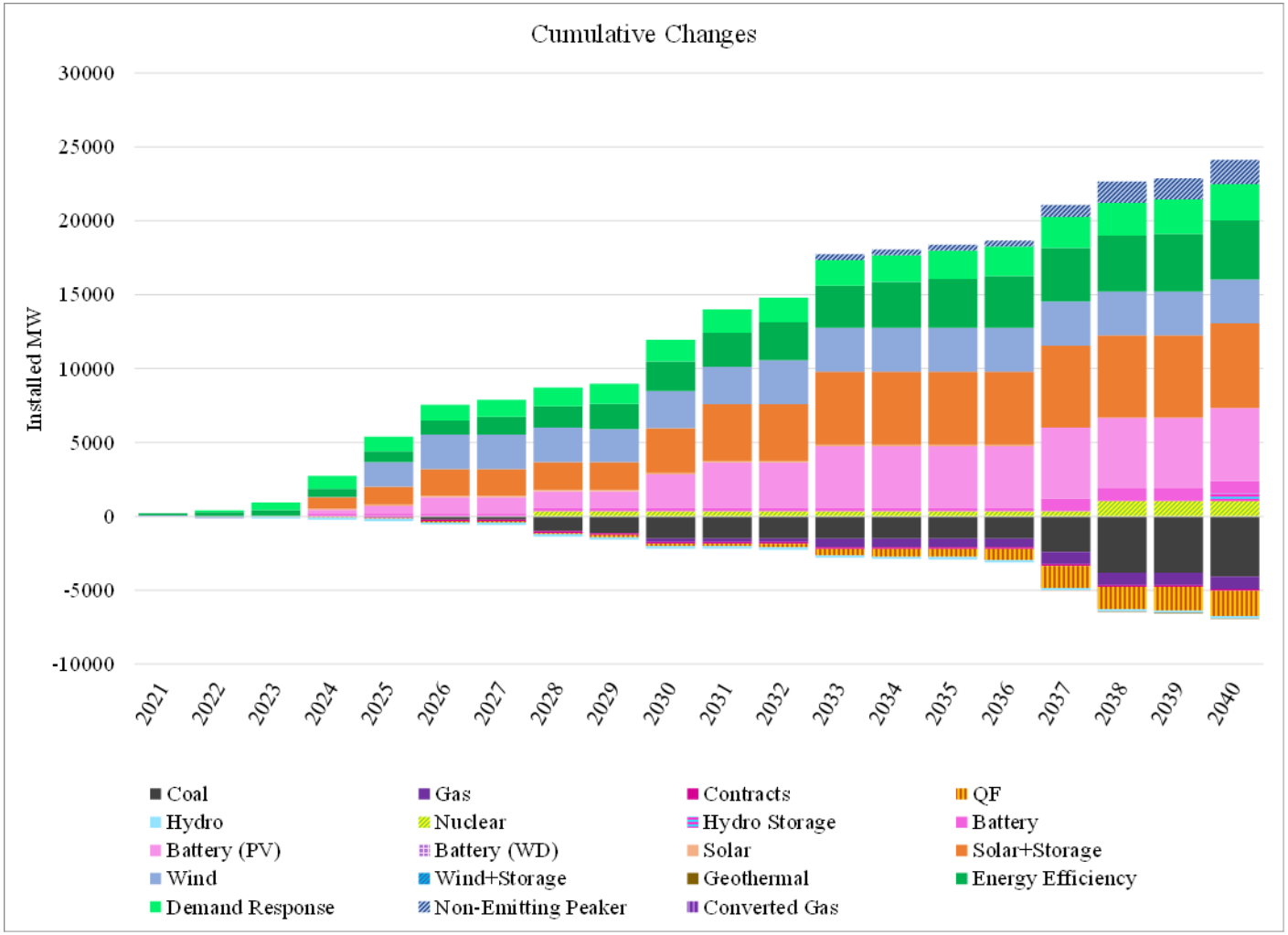
BAU1-MM Resource Changes



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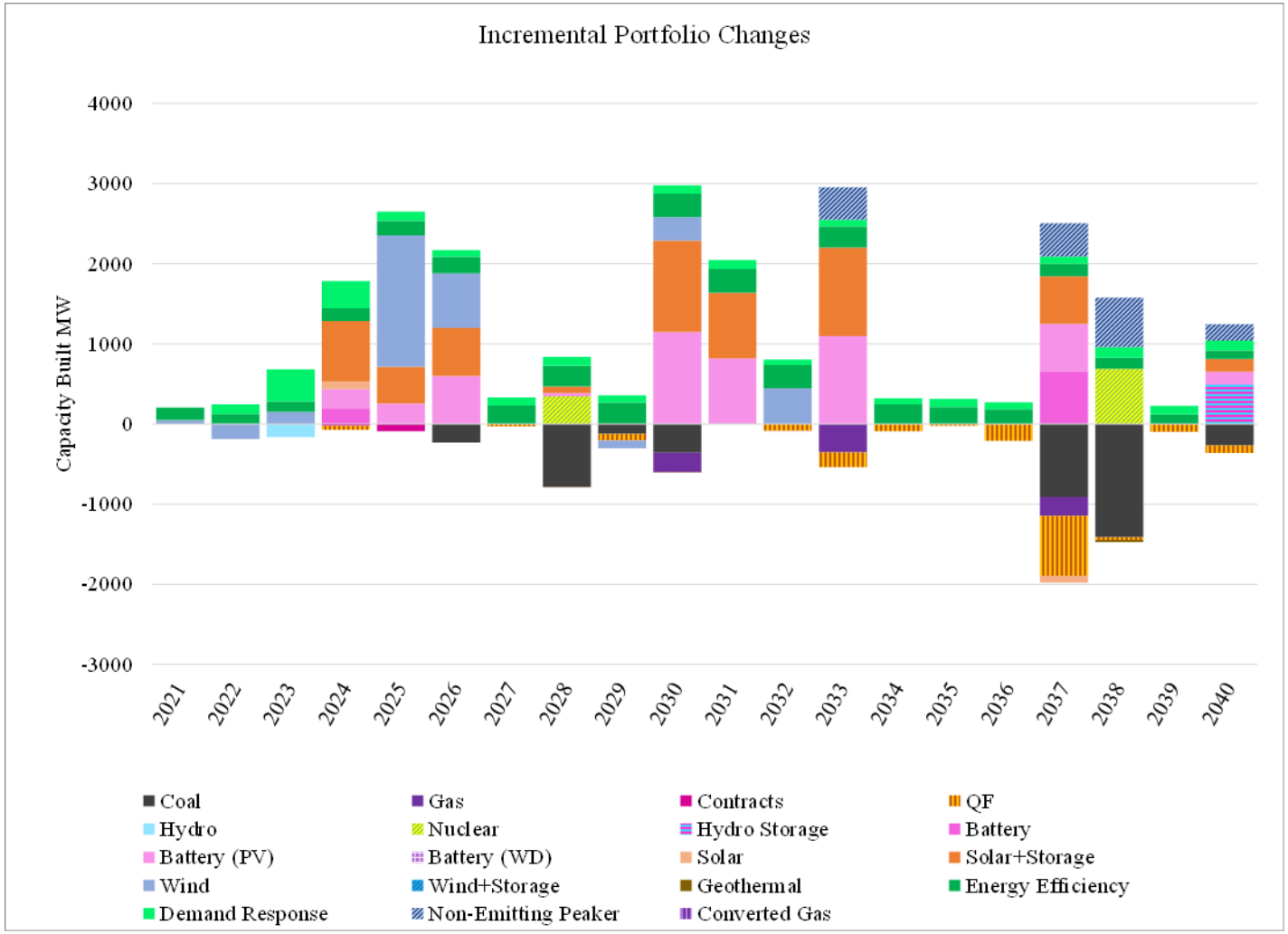
POWERING YOUR GREATNESS

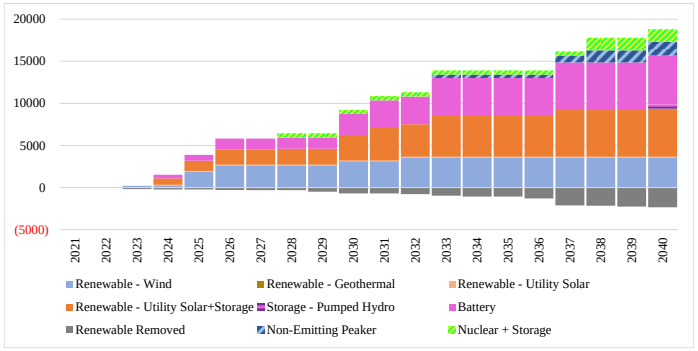
BAU1-MM Incremental Portfolio Changes



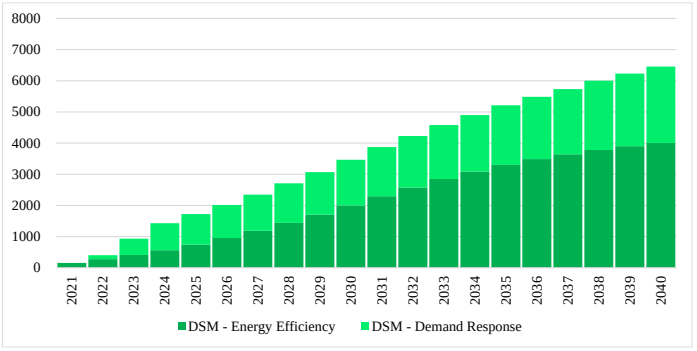
PACIFICORP
POWERING YOUR GREATNESS

BAU1-MM Portfolio Resources

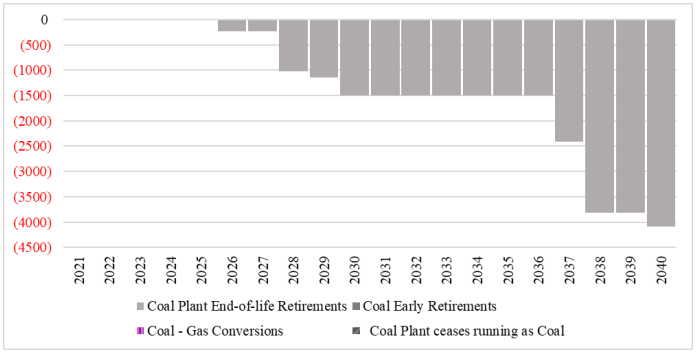
Renewables & Non-Emitting



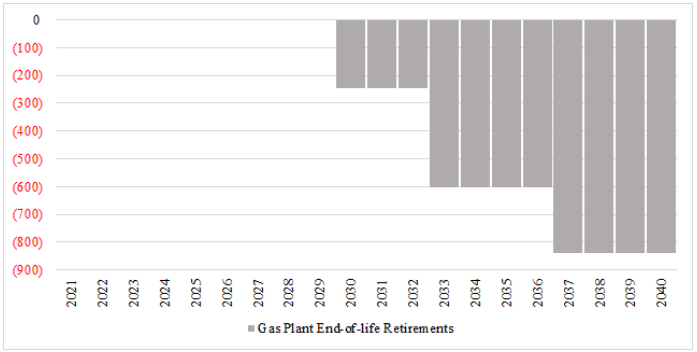
Demand-side Management



Coal



Gas



Resource Type	Resource Additions*
Wind	3114
Solar	5650
Battery	5807
Energy Efficiency	4006
Demand Response	2453
Gas	(840)
Coal	(4088)
Nuclear	1500
Non-Emitting Peaker	1638
Pumped Hydro Storage	500

* Net of retirements and expirations

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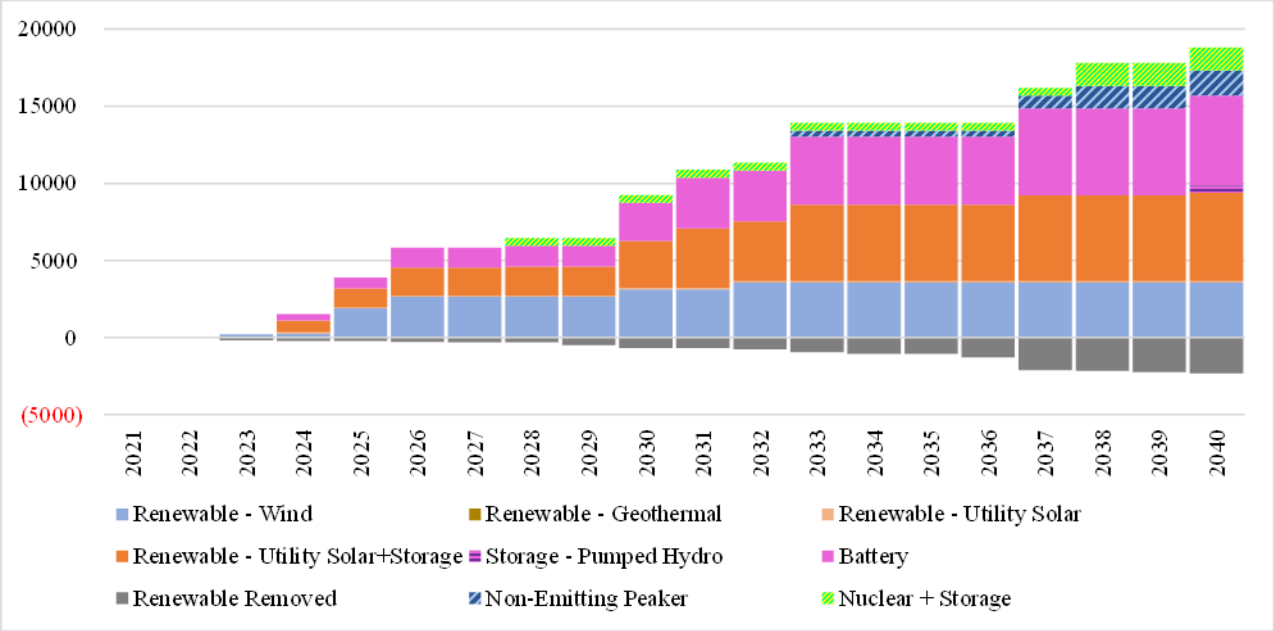
BAU1-MM Renewables & Non-Emitting



- By 2025, includes 1,884 MW of wind additions increasing to 3,628 MW by 2040
- By 2025, includes 1,302 MW of solar additions increasing to 5,804 MW by 2040
- By 2025, includes 200 MW of new standalone battery increasing to 1,400 MW by 2040
- Includes the 500 MW Natrium demonstration project in 2028
- By 2040, includes 3,138 MW of non-emitting nuclear and peaker resources

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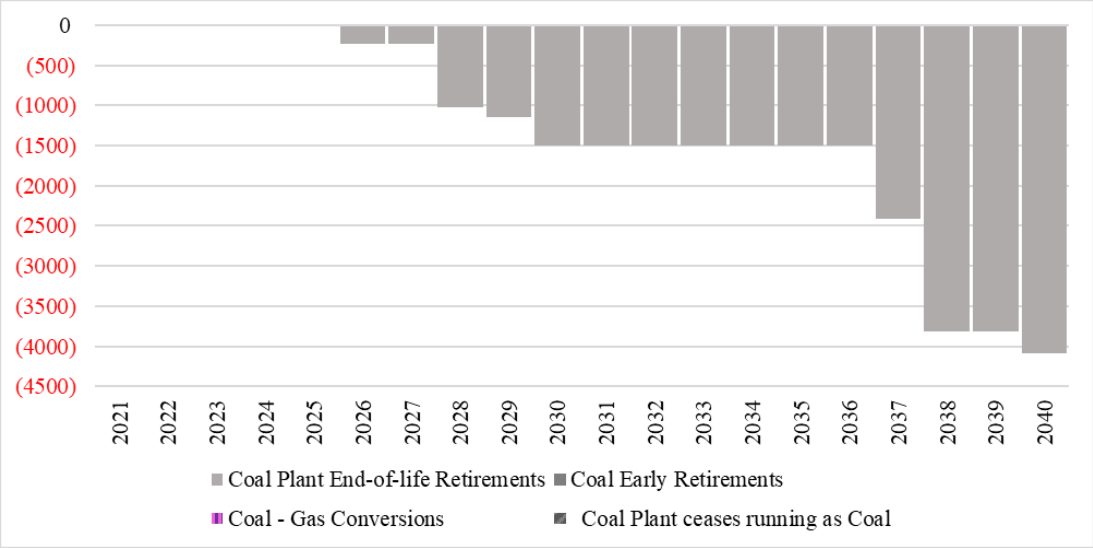
BAU1-MM Coal Retirements / Gas Conversions



Location	Coal Retirements/Gas Conversion (2021-2025)*	Coal Retirements/Gas Conversion (2026-2030)*	Coal Retirements/Gas Conversion (2031-2040)*
Wyoming	n/a	2027 = 755 MW (D. Johnston 1-4) 2029 = 357 MW (Naughton 1-2)	2037 = 1,413 MW (J. Bridger 1-4) 2039 = 268 MW (Wyodak)
Colorado	2025 = 82 MW (Craig 1)	2028 = 79 MW (Craig 2) 2028 = 44 MW (Hayden 1) 2027 = 33 MW (Hayden 2)	n/a
Montana	2025 = 148 MW (Colstrip 3-4)		n/a
Utah	n/a	n/a	2036 = 909 MW (Huntington 1-2)

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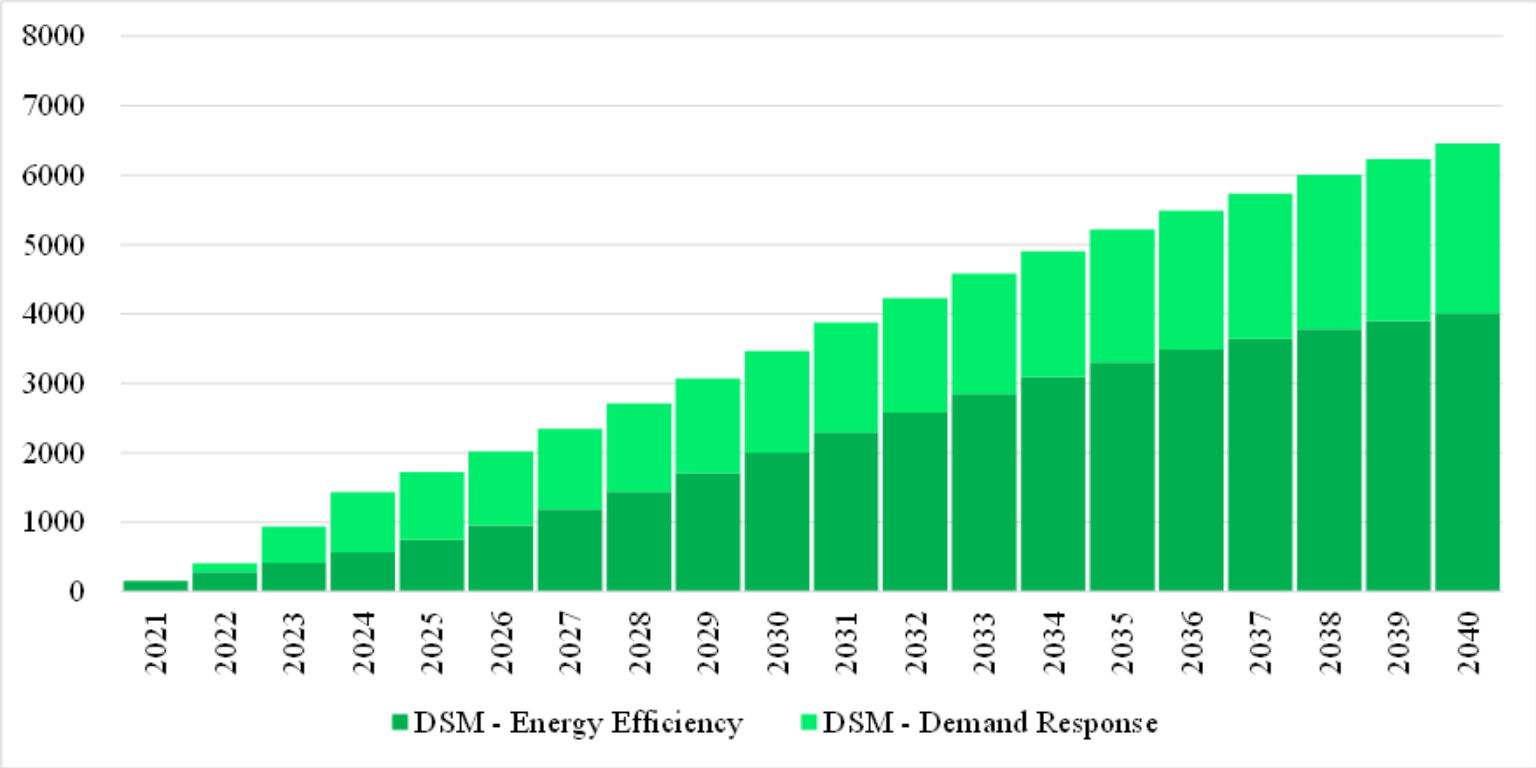
BAU1-MM Demand-Side Management



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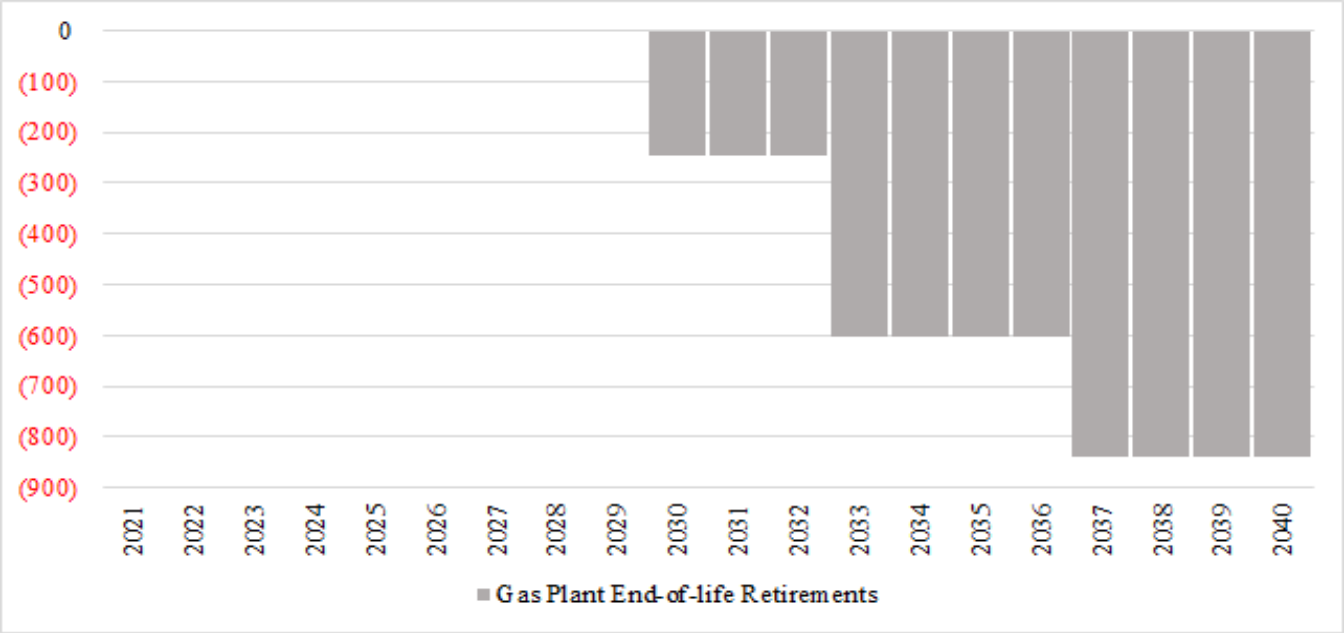
BAU1-MM Natural Gas Retirements



State	Gas Retirements (2021-2024)*	Gas Retirements (2025-2040)*
Wyoming	n/a	2029 = 247 MW Naughton 3
Utah	n/a	2032 = 356 MW Gadsby 1-6
Oregon	n/a	2036 = 237 MW Hermiston

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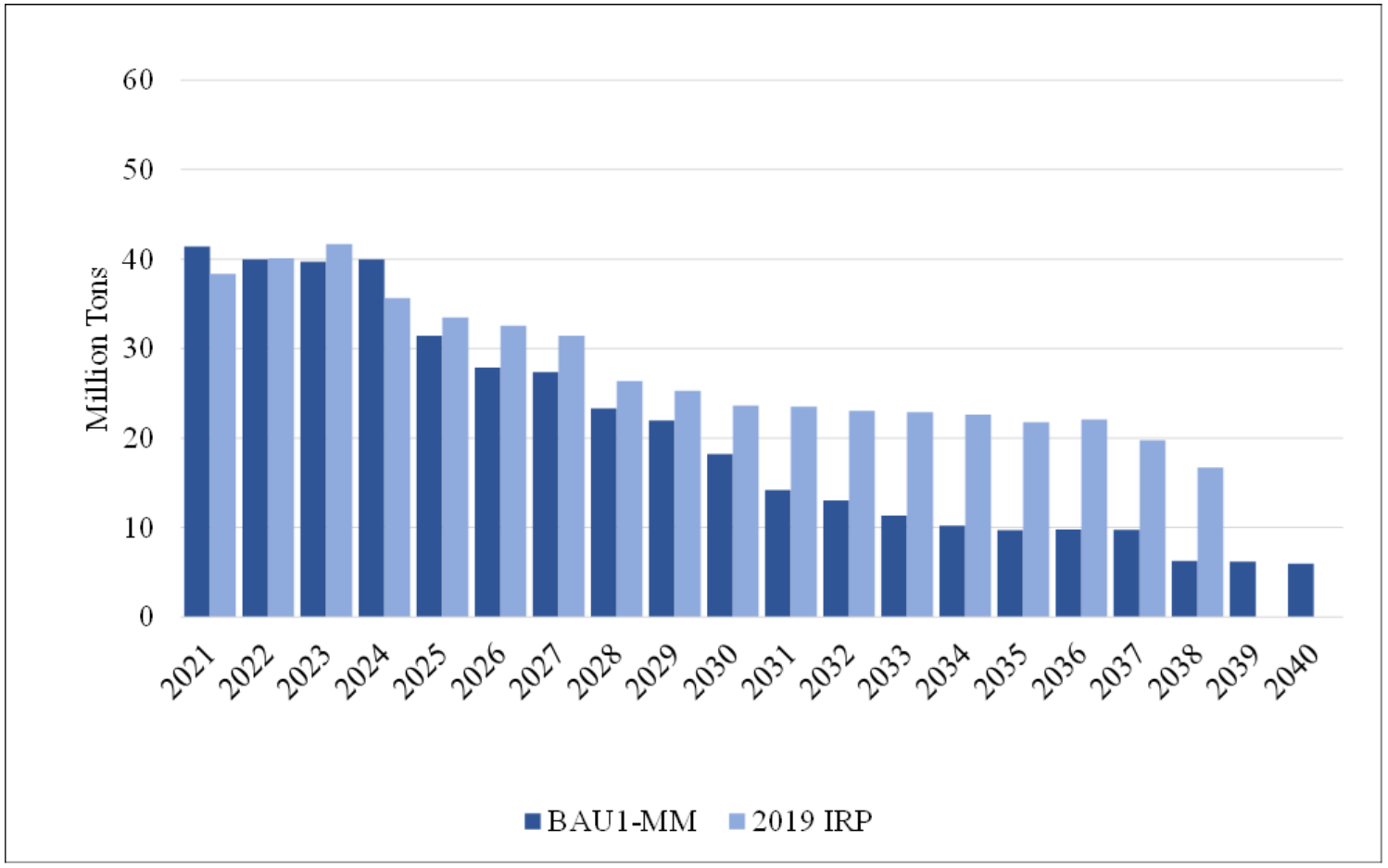
BAU1-MM CO_2 Emissions



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BAU2-MM Portfolio Summary

Resource	Installed Capacity, MW																			
	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040
Expansion Options																				
Gas - CCCT	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Gas - Peaking	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
NonEmitting Peaker	-	-	-	-	-	-	-	-	-	412	-	-	402	-	-	-	-	206	-	206
DSM - Energy Efficiency	157	134	139	160	181	206	233	257	273	298	295	287	267	244	216	194	188	170	159	157
DSM - Demand Response	-	123	242	184	79	63	69	80	78	77	82	50	213	70	160	125	183	159	108	302
Renewable - Wind	49	-	151	43	1,641	745	-	-	-	489	-	450	-	-	-	-	-	-	-	60
Renewable - Wind+Storage	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Renewable - Utility Solar	-	-	-	95	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Renewable - Utility Solar+Storage	-	-	-	1,012	455	600	-	83	-	558	820	-	1,100	-	-	-	1,009	-	-	156
Renewable - Battery, Wind+Storage	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Renewable - Battery, Solar+Storage	-	-	-	499	258	600	-	42	-	558	820	-	1,100	-	-	-	1,009	-	-	156
Renewable - Geothermal	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Battery - Stand Alone	-	-	-	200	-	-	-	-	549	1	-	-	-	-	-	-	650	-	-	-
Storage - CAES	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Storage - Pumped Hydro	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	500
Nuclear	-	-	-	-	-	-	-	345	-	-	-	-	-	-	-	-	-	690	-	-
Nuclear Storage	-	-	-	-	-	-	-	155	-	-	-	-	-	-	-	-	-	310	-	-
Front Office Transactions	386	413	428	366	427	209	286	243	369	414	424	459	562	702	627	741	859	955	1,005	1,079
Existing Unit Changes																				
Coal Plant End-of-life Retirements	-	-	-	-	-	(230)	-	(788)	(123)	-	-	-	-	-	-	-	(909)	(699)	-	(268)
Coal Early Retirements	-	-	-	(354)	-	(357)	-	-	(359)	-	-	-	-	-	-	-	-	-	-	-
Coal - CCUS	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Coal - Gas Conversions	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Coal Plant ceases running as Coal	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Gas Plant End-of-life Retirements	-	-	-	-	-	-	-	-	-	(247)	-	-	(356)	-	-	-	(237)	-	-	-
Retire - Hydro	-	-	(163)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Retire - Wind	-	(10)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Expire - Wind PPA	-	-	-	(41)	-	(65)	-	-	(99)	(200)	-	-	-	-	-	-	-	-	-	-
Retire - Solar	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	(18)	-	-	-
Expire - Solar PPA	-	-	-	-	-	-	-	(2)	-	-	-	(8)	-	-	-	-	(73)	-	-	-
Expire - QF	-	(2)	-	(50)	-	-	(29)	-	(83)	(0)	-	(81)	(181)	(91)	(19)	(208)	(744)	(30)	(100)	(92)
Retire - Other	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	(32)	-	-
Expire - Other	-	11	-	32	(91)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

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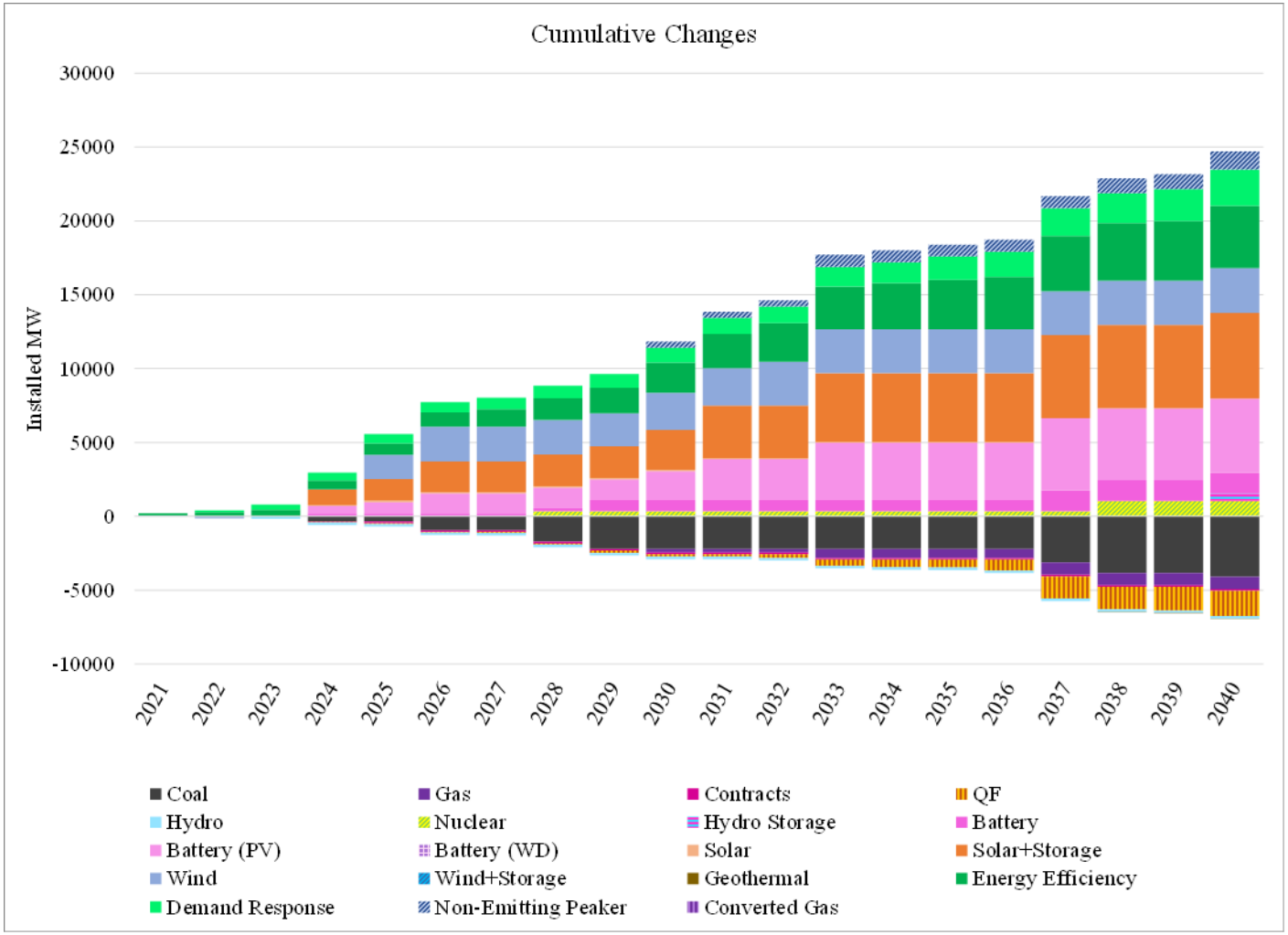
BAU2-MM Resource Changes



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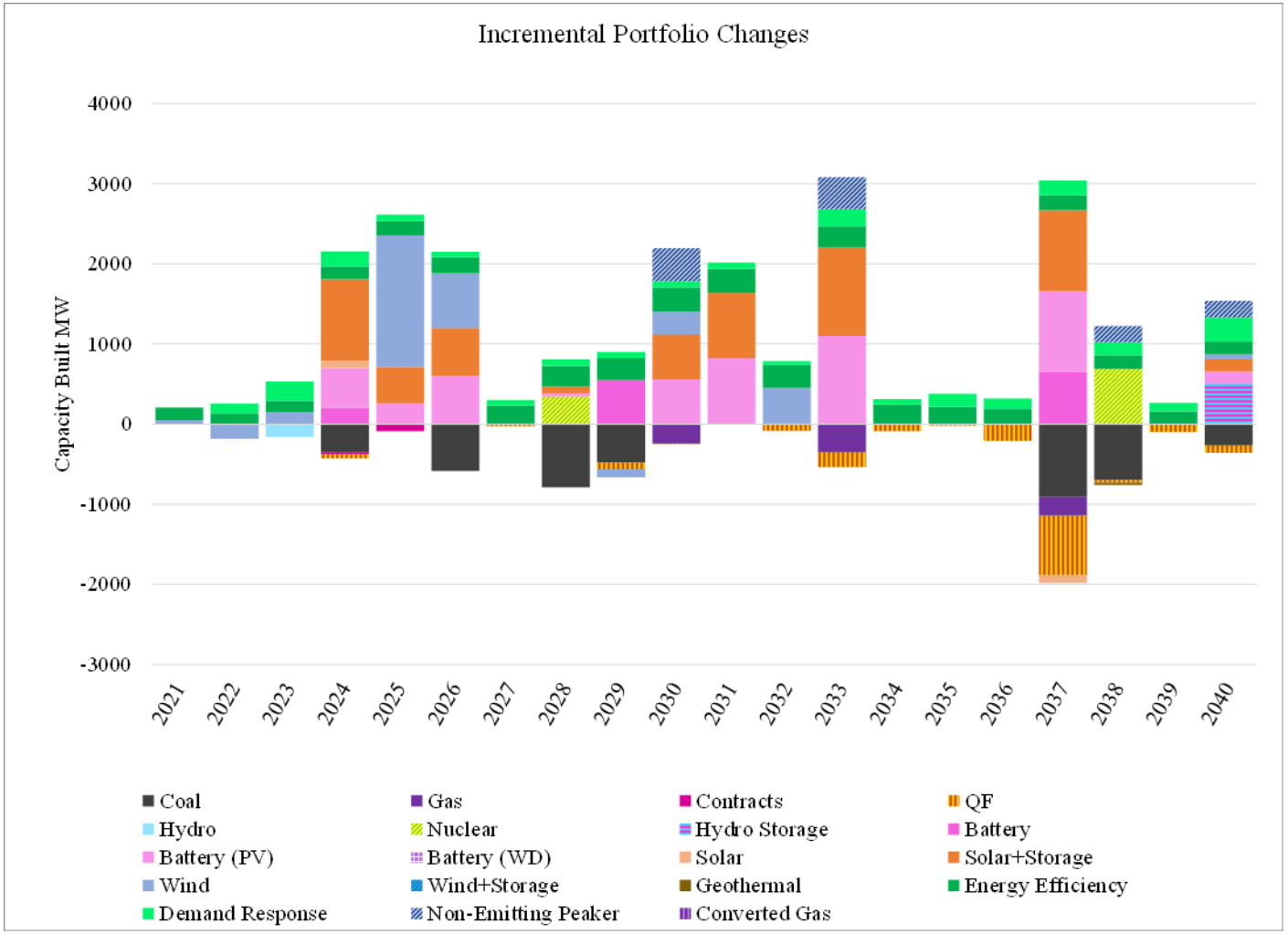
BAU2-MM Incremental Portfolio Changes



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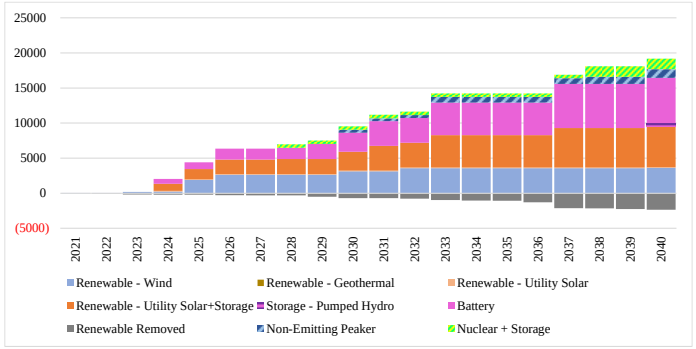
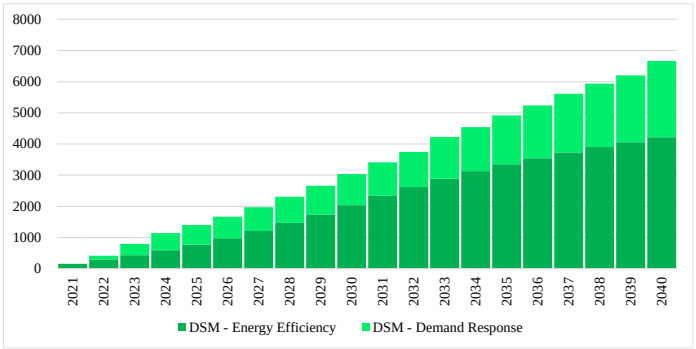
BAU2-MM Portfolio Resources

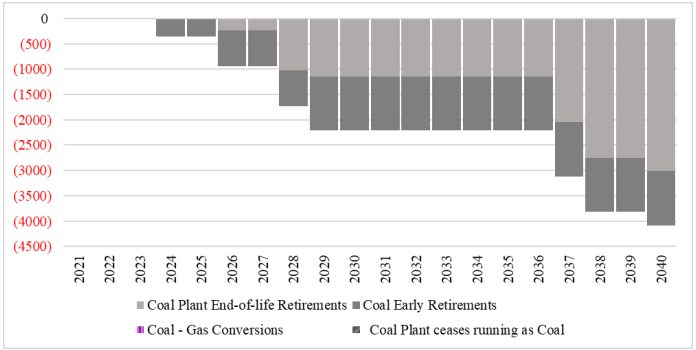
Renewables & Non-Emitting



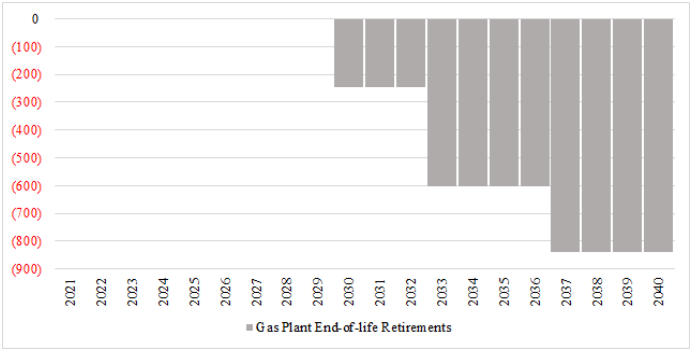
Demand-side Management



Coal



Gas



Resource Type	Resource Additions*
Wind	3174
Solar	5734
Battery	6441
Energy Efficiency	4216
Demand Response	2448
Gas	(840)
Coal	(4088)
Nuclear	1500
Non-Carbon Emitting	1226
Pumped Hydro Storage	500

* Net of retirements and expirations

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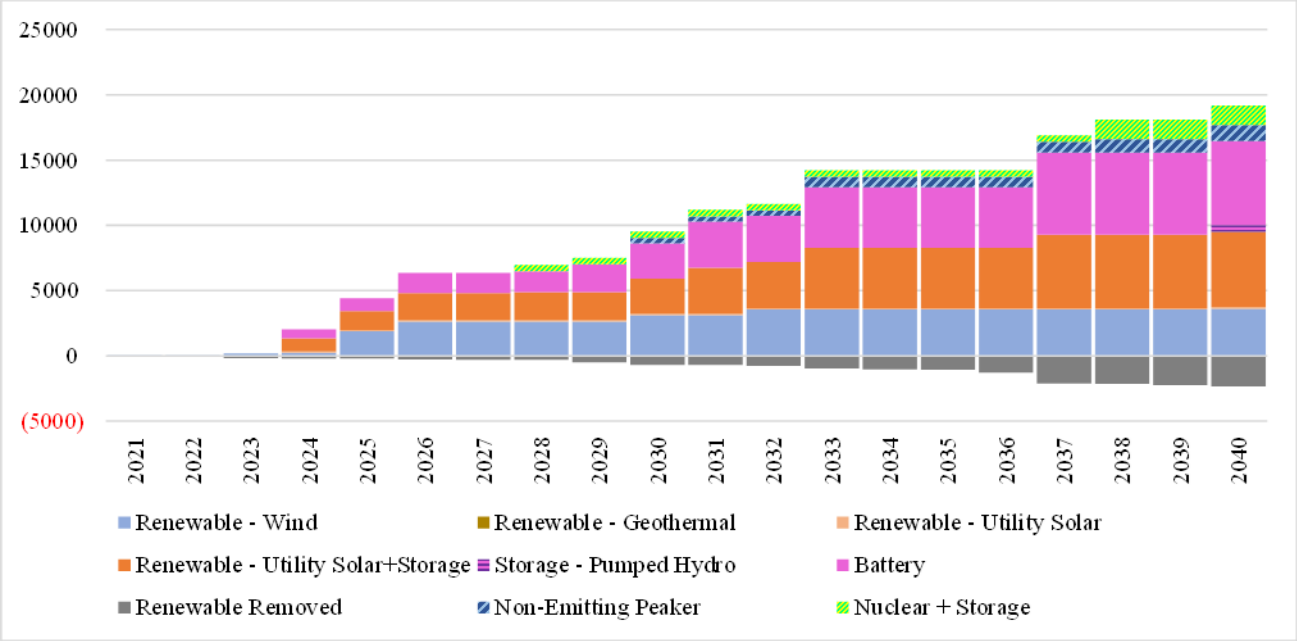
BAU2-MM Renewables & Non-Emitting



- By 2025, includes 1,884 MW of wind additions increasing to 3,628 MW by 2040
- By 2025, includes 1,592 MW of solar additions increasing to 5,888 MW by 2040
- By 2025, includes 200 MW of new standalone battery increasing to 1,400 MW by 2040
- Includes the 500 MW Natrium demonstration project in 2028
- By 2040, includes 2,726 MW of non-emitting nuclear and peaker resources

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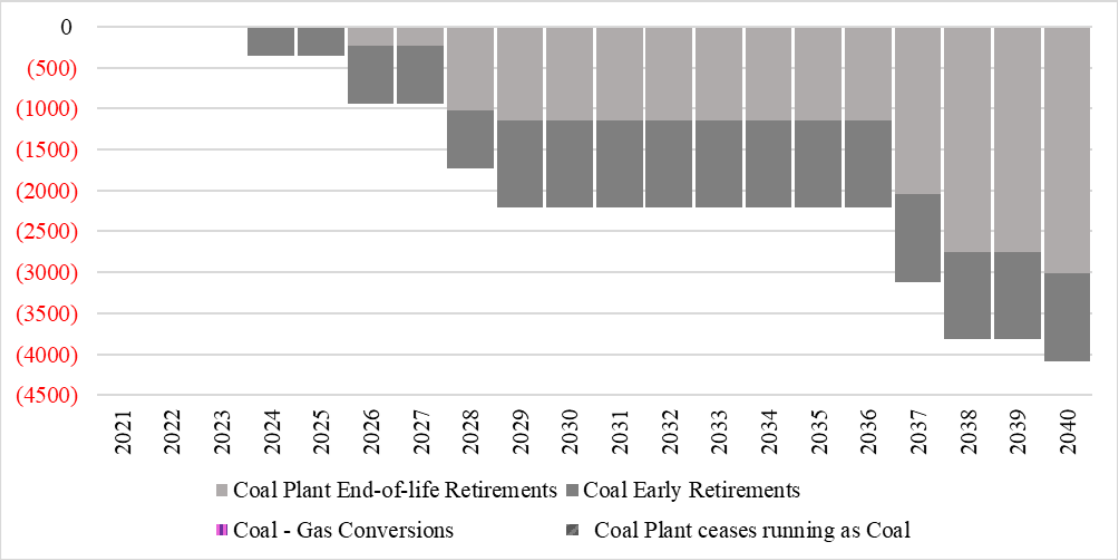
BAU2-MM Coal Retirements / Gas Conversions



Location	Coal Retirements/Gas Conversion (2021-2025)*	Coal Retirements/Gas Conversion (2026-2030)*	Coal Retirements/Gas Conversion (2031-2040)*
Wyoming	2023 = 354 MW (J. Bridger 1) 2025 = 357 MW (Naughton 1-2)	2027 = 755 MW (D. Johnston 1-4) 2028 = 359 MW (J. Bridger 2)	2037 = 699 MW (J. Bridger 3-4) 2039 = 268 MW (Wyodak)
Colorado	2025 = 82 MW (Craig 1)	2028 = 79 MW (Craig 2) 2028 = 44 MW (Hayden 1) 2027 = 33 MW (Hayden 2)	n/a
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Utah	n/a	n/a	2036 = 909 MW (Huntington 1-2)

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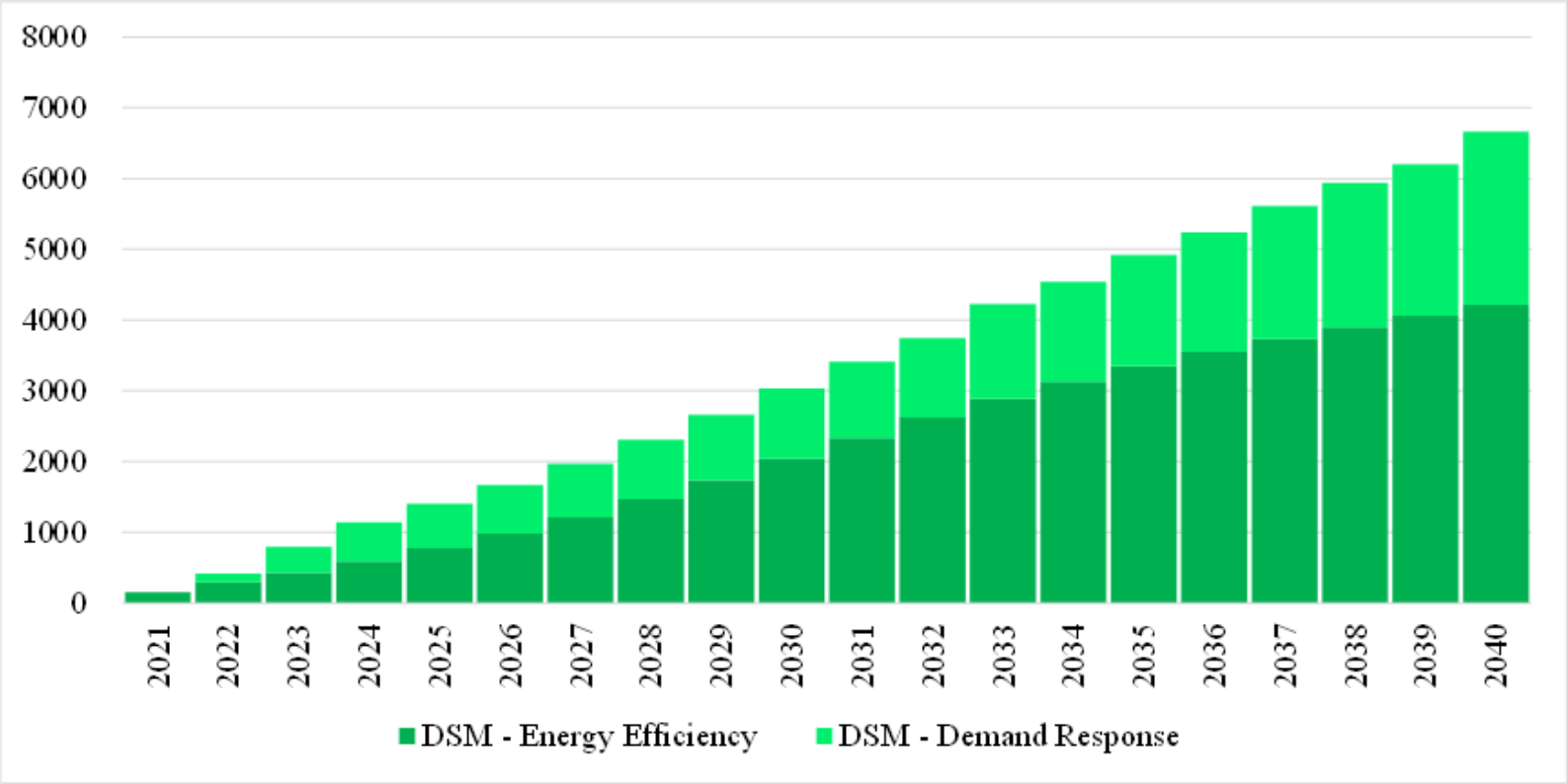
BAU2-MM Demand-Side Management



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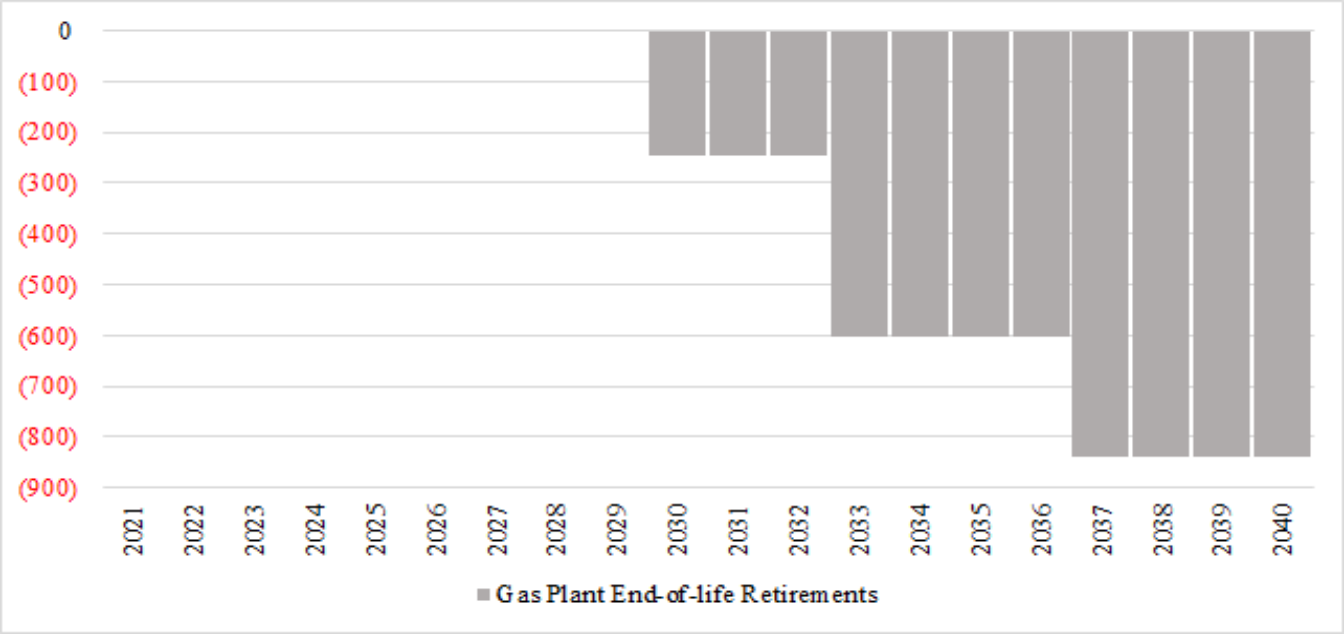
BAU2-MM Natural Gas Retirements



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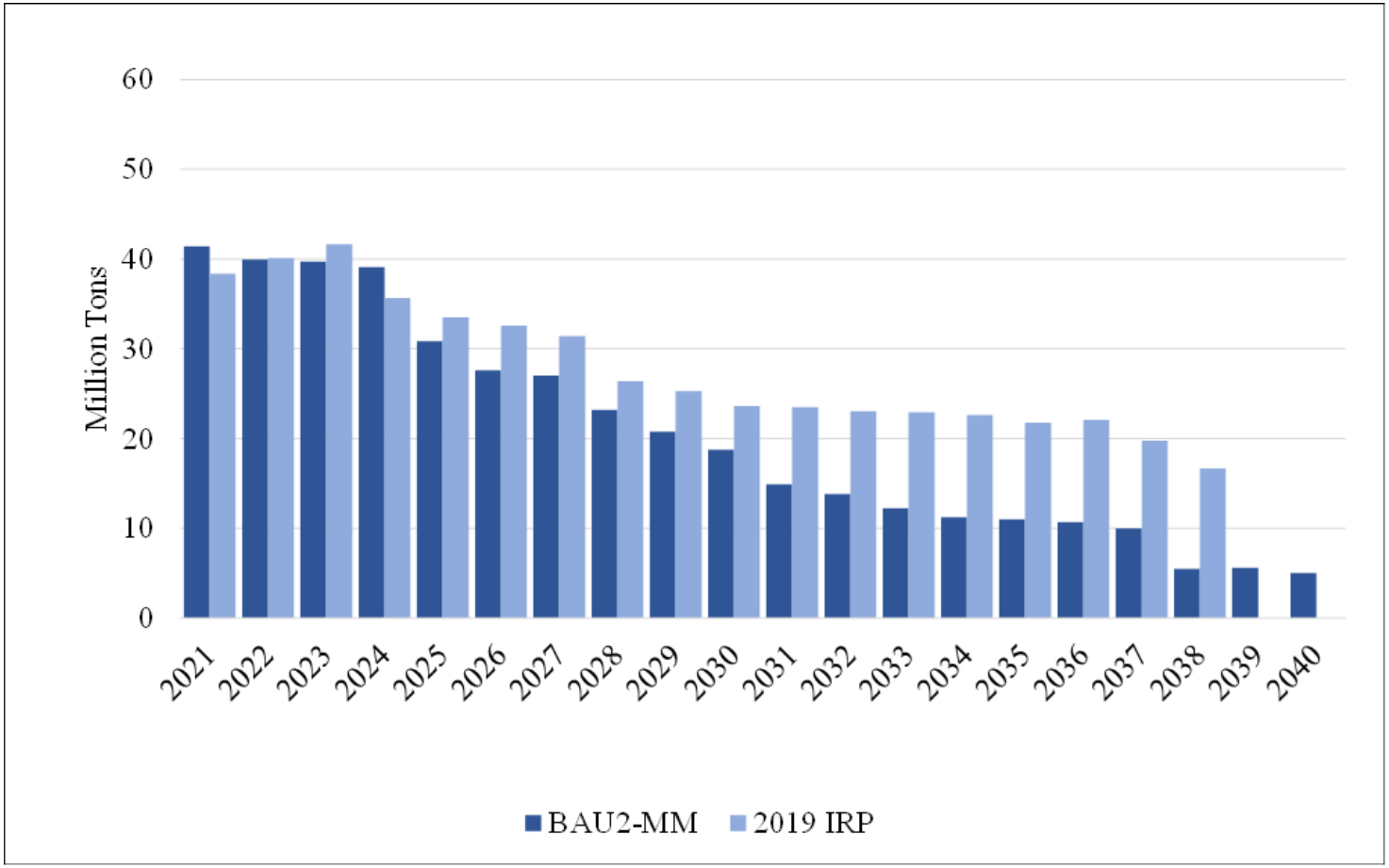
BAU2-MM CO_2 Emissions



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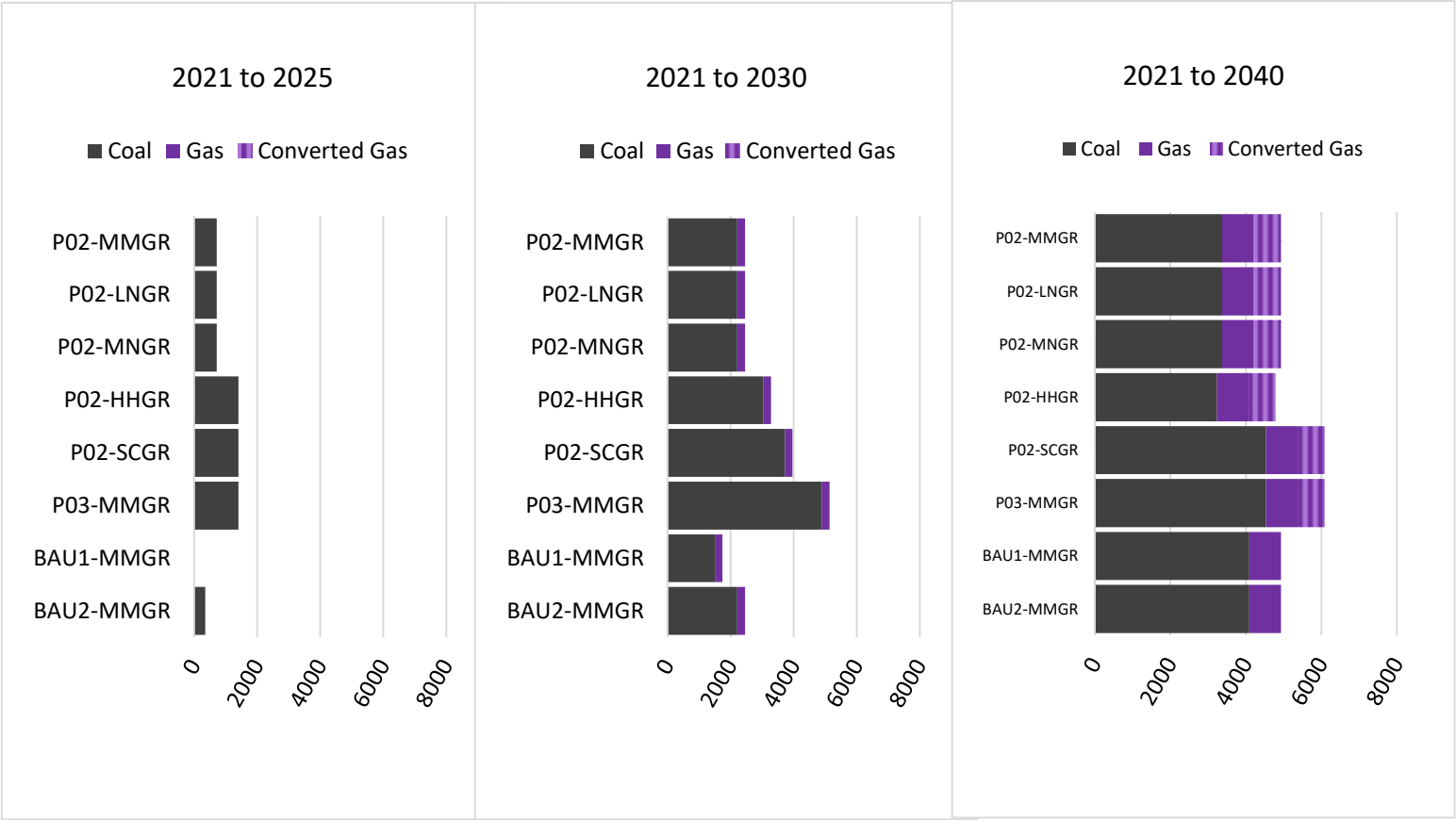
Thermal Retirements (MW)



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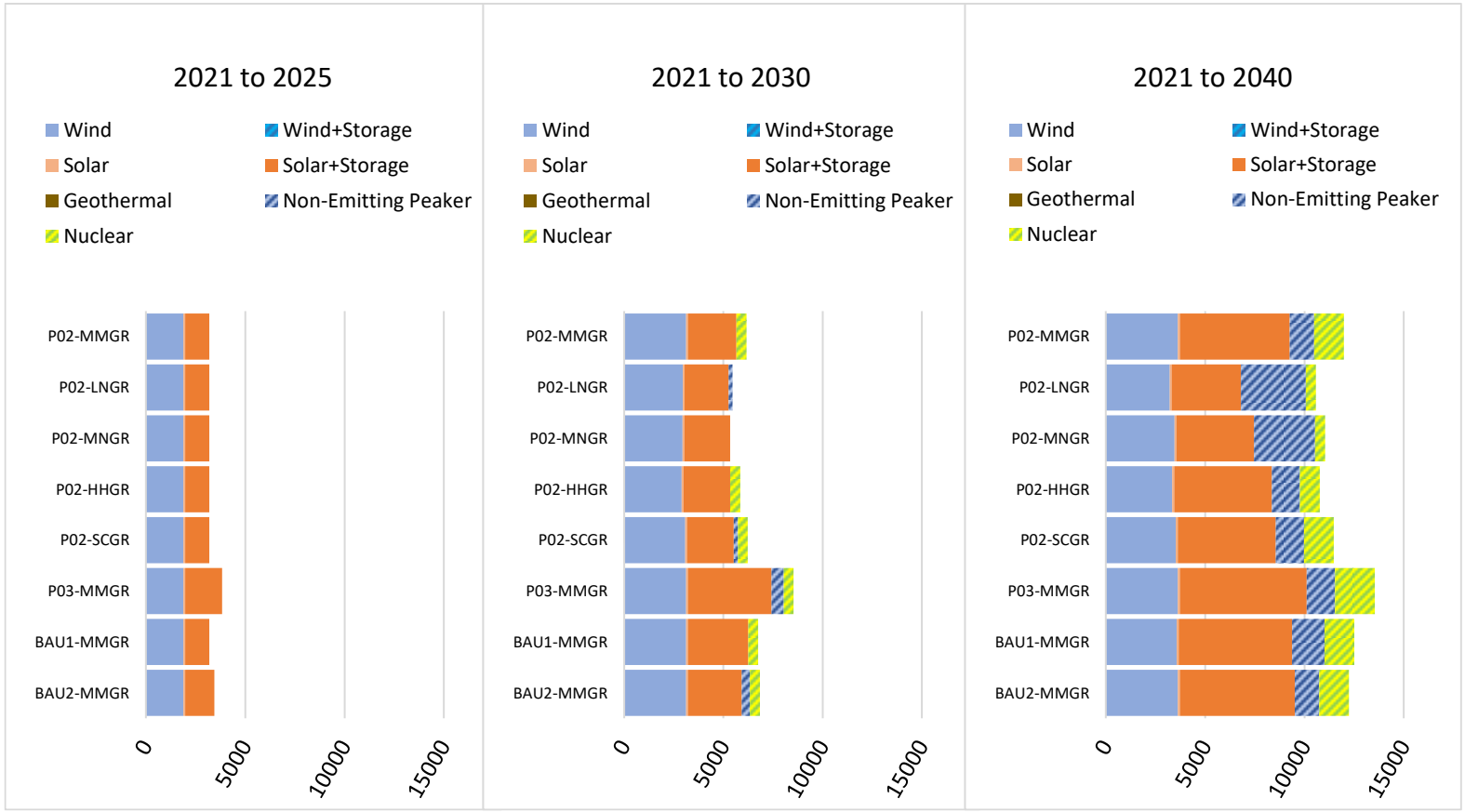
Renewables and Non-Emitting Resources (MW)



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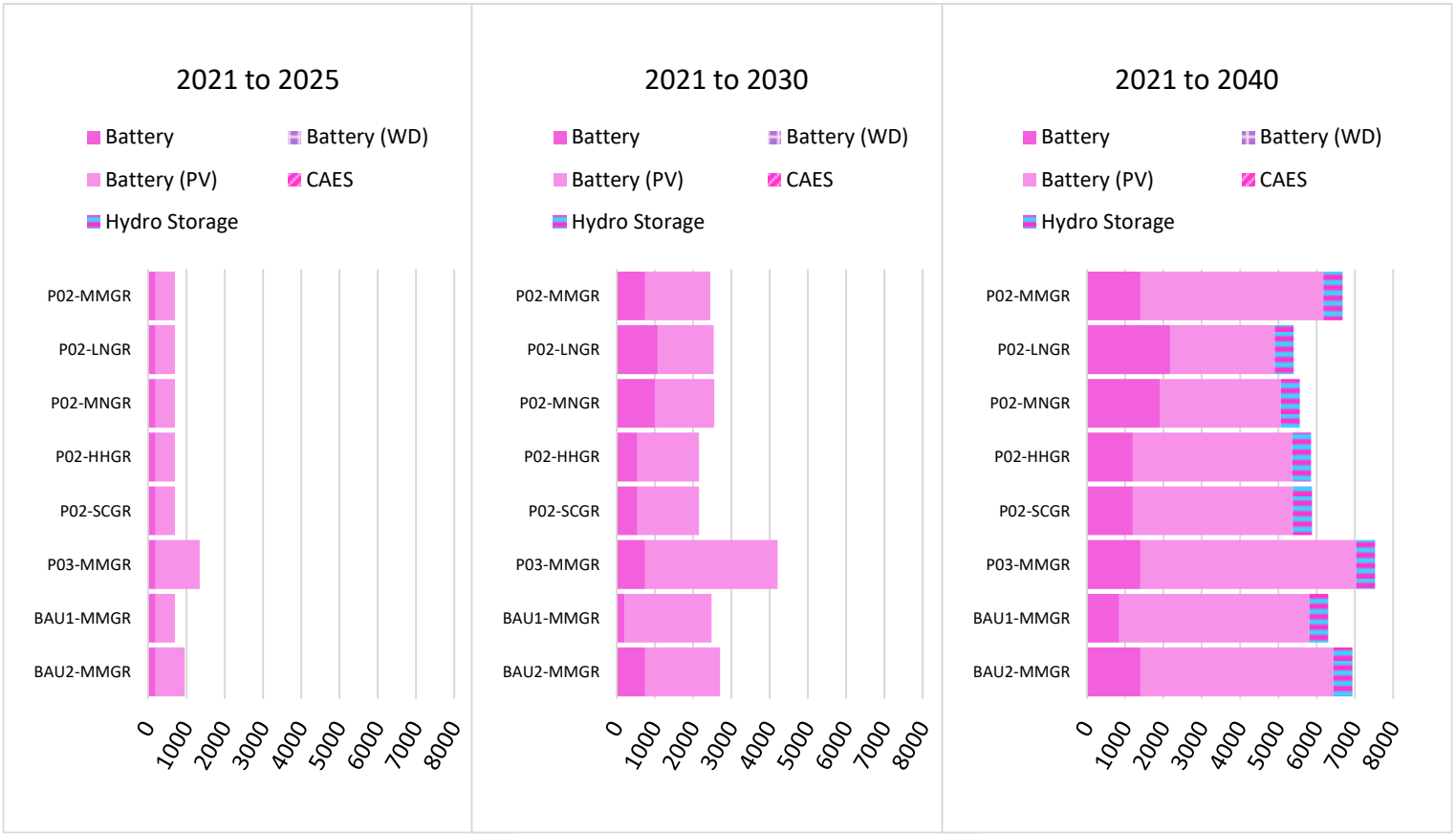
Storage (MW)



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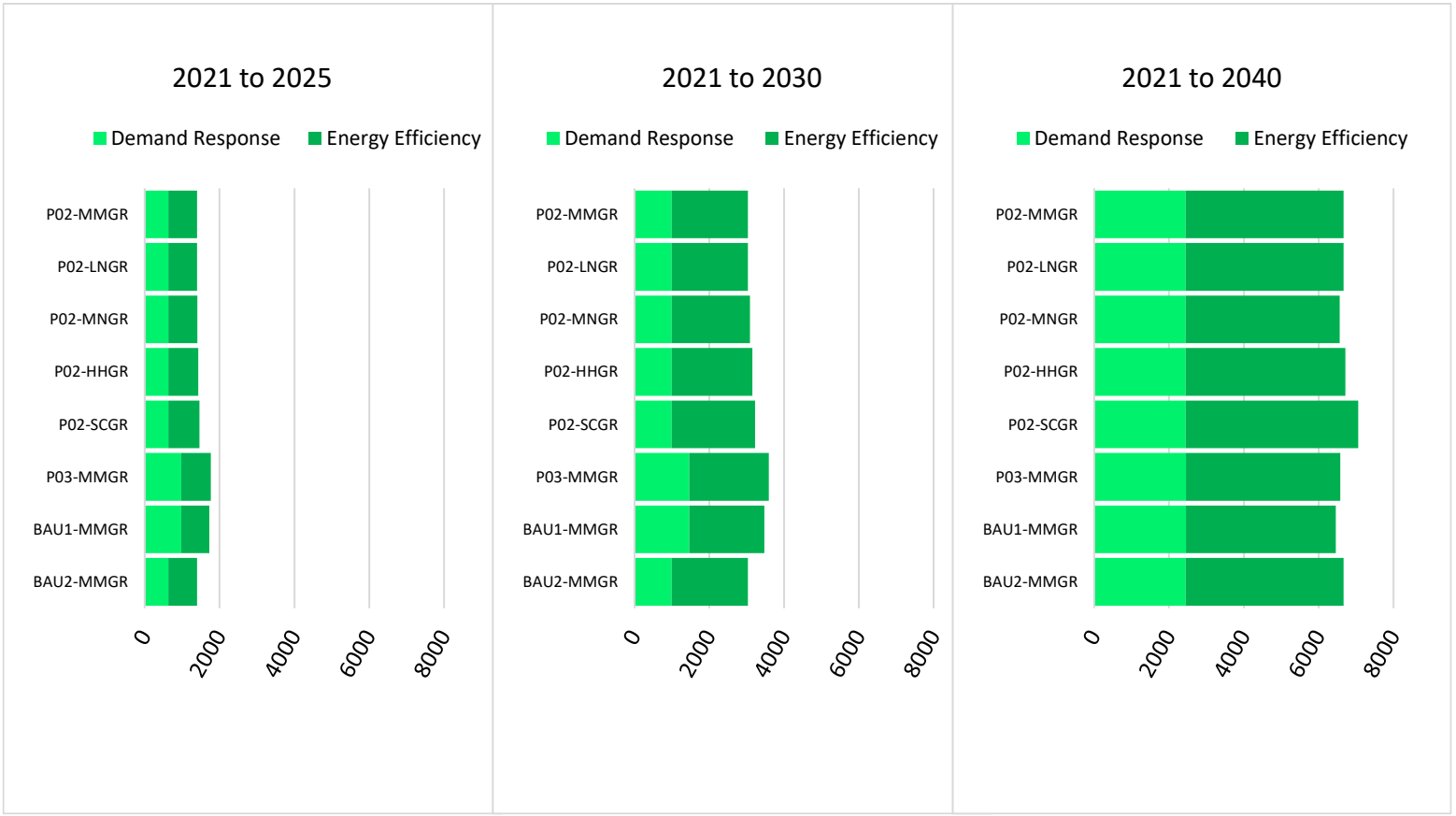
Demand Side Management (MW)



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Portfolio Initial Cost Summary

Portfolio	Present Value Revenue Requirement (PVRR)($m)	Change from Lowest Cost Portfolio	Rank
P02-MM	27,263	0	1
BAU2-MM	27,732	471	2
BAU1-MM	27,801	538	3
P03-MM	29,261	1,999	4

Portfolio	Present Value Revenue Requirement (PVRR)($m)
P02-LN	22,901
P02-MN	23,201
P02-MM	27,263
P02-HH	28,416
P02-SCGHG	36,855

- Portfolio cost information is based on ST deterministic runs.
- Stochastic runs and results to follow.

Next Steps Modeling and Analysis




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Next Steps Modeling and Analysis

- Completion of alternative price-policy portfolio operational scenarios including Business as Usual portfolios (BAU1 and BAU2), P02 (no new gas) and P03 (no new gas and coal retire 2030)
- Complete portfolio modeling and analysis necessary to determine the preferred portfolio including, but may not be limited to:
  - Additional P02 resource portfolios and analysis, eligible for preferred portfolio selection:
    - P02a – without gas conversion of Jim Bridger 1-2
    - P02b – without Boardman to Hemingway transmission project
    - P02c – without Gateway South transmission project
    - P02d – without 2020 All-Source Request for Proposals Final Shortlist / Gateway South
    - P02e – without Natrium demonstration project
    - P02f – without 2025 early retirement of Naughton 1-2
- Washington required scenarios under the Clean Energy Transformation Act: future climate change, maximum customer benefit, and alternative lowest reasonable cost
- Sensitivities:
  - High/low load, 1-in-20 load
  - High/low private generation
  - High/no customer preference
  - Market reliance
  - Business plan sensitivity
  - SC-GHG applied as a dispatch adder in operations

Washington Clean Energy Implementation Plan (CEIP) Update




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Washington CEIP Update

- At its July 8, 2021, open meeting, the Washington Utilities and Transportation Commission approved PacifiCorp's Motion to Amend General Order 601 to allow filing of the draft 4-year Washington-specific CEIP by November 1, 2021, and its Petition for Exemption of WAC 480-100-6410(1) to file the final CEIP by January 1, 2022
- As part of approval for the revised file dates, PacifiCorp is required to file an IRP to CEIP modeling workplan August 15, 2021
- On July 30, 2021, PacifiCorp will also file an update to its CEIP public participation plan (filed previously on May 1, 2021) to incorporate expanded opportunities for input and participation from the public and our customers in Washington
- As a near-term next step, PacifiCorp has made available an online survey (available through August 2021) to seek input on what matters to our customers and public to ensure that the health, safety, and well-being of our communities is considered in the CEIP development process – exploring options for a paper survey
- Further opportunities for public participation in the 2022 CEIP process and subsequent CEIP development efforts are also being discussed

Washington Equity Advisory Group (EAG)

- PacifiCorp held its third meeting of its Washington EAG on July 21, 2021
- The meeting discussed PacifiCorp's vulnerable populations within its Washington service territory and focused on discussion and development of Customer Benefit Indicators (CBIs) including PacifiCorp's existing customer programs and the role of CBIs in tracking progress on equity and their alignment with challenges of highly impacted communities and vulnerable populations
- The fourth meeting of the EAG is scheduled August 18, 2021 from 1:00pm-4:00pm pacific
- The upcoming meeting will focus on methods and data to support CBI metrics and explore the constraints and challenges of CBI metrics
- Meeting materials, upcoming meeting schedule, and public participation information are posted in advance of PacifiCorp's Washington CEIP webpage: pacificorp.com/energy/washington-clean-energy-transformation-act-equity.html

Oregon House Bill 2021




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Oregon HB 2021

Clean Energy Standards

80% below baseline emissions level by 2030
90% below baseline emissions level by 2035
100% below baseline emissions level by 2040

*Baseline is average of emissions from 2010-2012, based on emissions reported to DEQ

Community and Environmental Justice Focus

- Utilities will convene a "Community Benefits and Impacts Advisory Group"
- In consultation with the Advisory group, will prepare a biennial report to assess community benefits and impacts

Requirements and Deliverables

IRP

IRP will show pathway to clean energy standards. IRPs must consider HB 2021 beginning January 1, 2022.

Clean Energy Plan

Must be filed no later than 180 days after IRP (beginning after Jan. 1, 2022). Will outline Oregon actions and investments based on IRP.

Community Reporting

Filed biennially and in collaboration with Advisory Group. Will focus on community benefits and impacts, and actions to reduce impacts.

Stakeholder Feedback Form Update




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Stakeholder Feedback Form Update

- 84 stakeholder feedback forms submitted to date
- Stakeholder feedback forms and responses can be located at pacificorp.com/energy/integrated-resource-plan/comments
- 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 forms received following the previous public-input meeting is summarized on the following slide(s) for reference

Recent Stakeholder Feedback Forms

Stakeholder	Date	Topic	Brief Summary (complete form available online)	Response (posted online when available)
Utah Association of Energy Users (082)	June 29, 2021	Oregon House Bill 2021	Questions regarding how Oregon HB 2021 may impact the IRP and associate planning processes.	Responded and posted to the webpage July 9, 2021.
Western Resource Advocates (083)	July 9, 2021	Natrium Demonstration Project	Questions regarding the technology and potential fuel sources for the natrium demonstration project.	Anticipated response week of August 2, 2021
Green Energy Institute (084)	July 15, 2021	Natrium Demonstration Project and Oregon HB 2021	Recommended discussion of Oregon HB 2021 during the July IRP public meeting; questions on potential fuel sources and storage for natrium demonstration project.	Anticipated response week of August 2, 2021

Additional Information/Next Steps




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Additional Information

- Public Input Meeting and Workshop Presentation and Materials:
  - pacificorp.com/energy/integrated-resource-plan/public-input-process
- 2021 IRP Stakeholder Feedback Forms:
  - pacificorp.com/energy/integrated-resource-plan/comments
- IRP Email / Distribution List Contact Information:
  - IRP@PacifiCorp.com
- IRP Support and Studies:
  - pacificorp.com/energy/integrated-resource-plan/support
- Information on PacifiCorp's Washington-specific Clean Energy Implementation Plan:
  - pacificorp.com/energy/washington-clean-energy-transformation-act-equity.html

Next Steps

Upcoming Public-Input Meeting Dates:

- August 6, 2021 – Public-Input Meeting
- August 12, 2021 – Public-Input Meeting
- September 1, 2021 – File 2021 IRP

**meeting dates are subject to change*