2019 Integrated Resource Plan (IRP) Public Input Meeting August 30-31, 2018

PACIFICORP
POWERING YOUR GREATNESS

Agenda

August 30 – Day One

- 9:00am-10:30am pacific – Private Generation Study (with Navigant)
- 10:30am-12:00pm pacific - Conservation Potential Assessment and Energy Efficiency Credits
- 12:00am-1:00pm pacific – Lunch Break
- 1:00pm-2:00pm pacific – Portfolio Development Process / Initial Sensitivity Studies
- 2:00pm-3:30pm pacific – Flexible Reserve Study
- 3:30pm-4:00pm pacific – Process Improvement / Next Steps

August 31 – Day Two

- 9:00am-10:00am pacific – Market Reliance Assessment
- 10:00am-12:00pm pacific – Planning Reserve Margin Study / Capacity Contribution Study

Private Generation Study

Please refer to stakeholder presentation Navigant Private Resource Assessment, August 30, 2018.

2019 Conservation Potential Assessment (CPA)

PACIFICORP
POWERING YOUR GREATNESS

Class 2

Key Drivers of Change WA, UT, WY, ID, CA

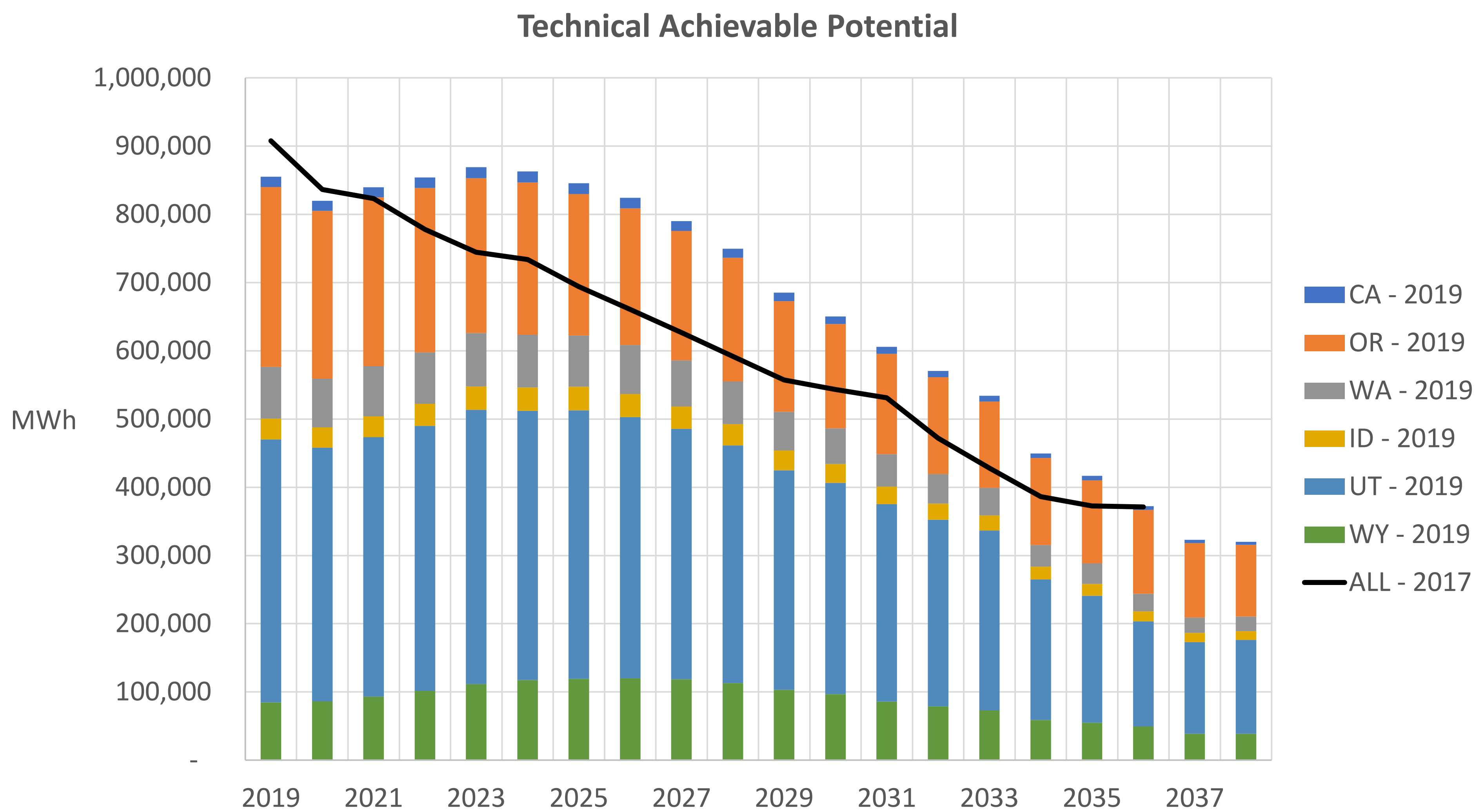
- Baseline forecast updates
- LED lighting updates
  - Early years more efficient, lower cost
- Heat pump water heaters
  - More efficient, cheaper, customers interested in Tier 2 & 3
- New measures/permutations
  - Emerging technology, advanced versions of existing measures
  - CO_2 heat pump, zero net energy NC, connected homes
- Waste Heat to Power and Regenerative Technologies
  - Potential integrated with CPA (previously separate)
- Admin cost update
  - Potential more expensive in CA, WA, ID, and WY

Key Drivers of Change - OR

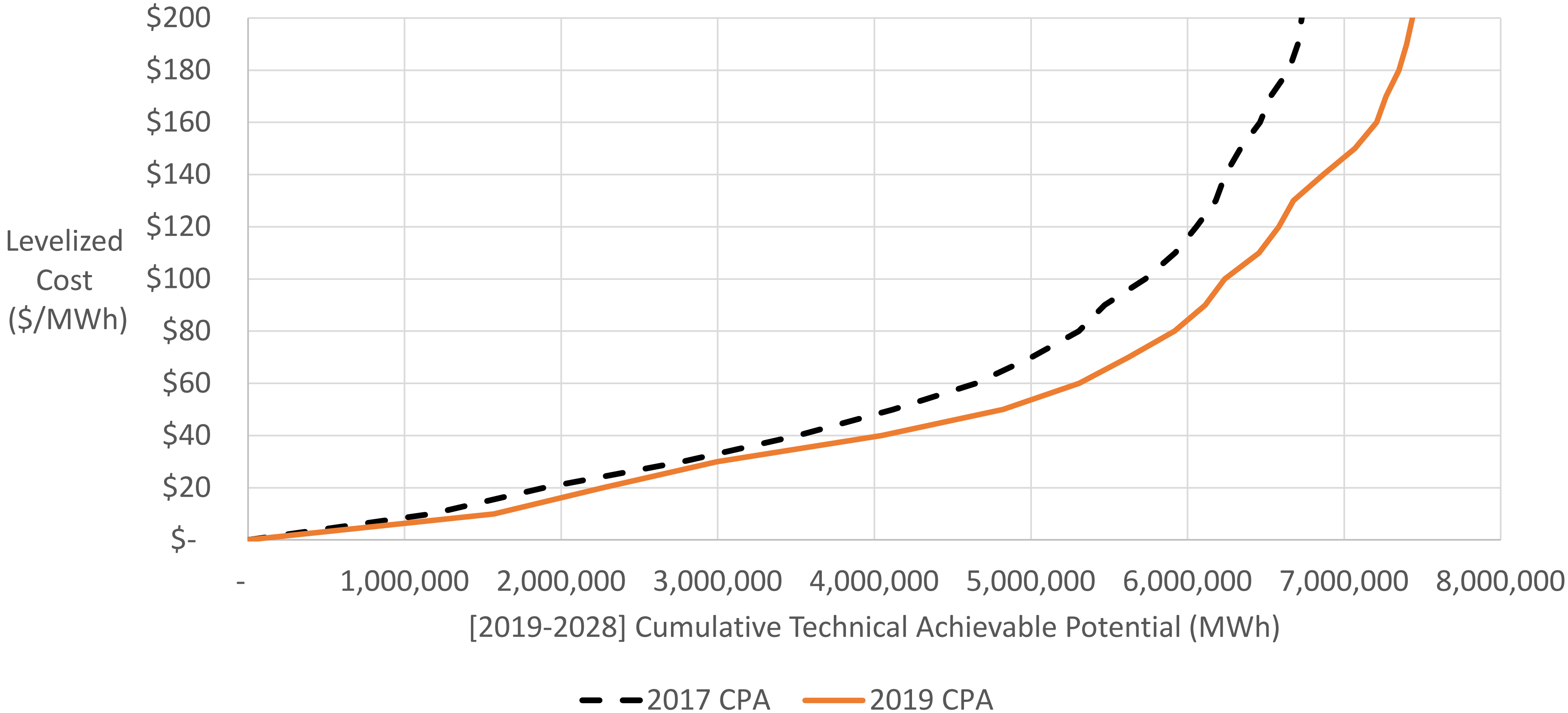
- Updated measure assumptions
  - A significant number of measures were updated with the most up-to-date savings, cost and market assumptions (RBSA refresh)
- Measure additions
  - Several emerging technologies were added to the supply curve and assumptions were updated for existing emerging technologies
  - Residential cooling measures to better align with other states
- Efforts to align IRP forecasting with Energy Trust's policy directive to "pursue all available energy efficiency resources that are cost effective, reliable and feasible"[1] and Energy Trust program goals
  - Load Shape alignment
    - Reviewed both organizations load shapes and determined differences were minimal
  - Deployment and Ramp Rate Calibration
    - Deployment ramp rates are calibrated to program achievements and budgeted goals → accelerating potential in beginning years
  - Large Project Adder
    - Added a project adder to account for unknown large projects

[1] OPUC docket UM-551, ORS 757.054 and OR SB1547

Technical Achievable Potential Comparison



Technical Achievable Potential Supply Curve Comparison (All States)

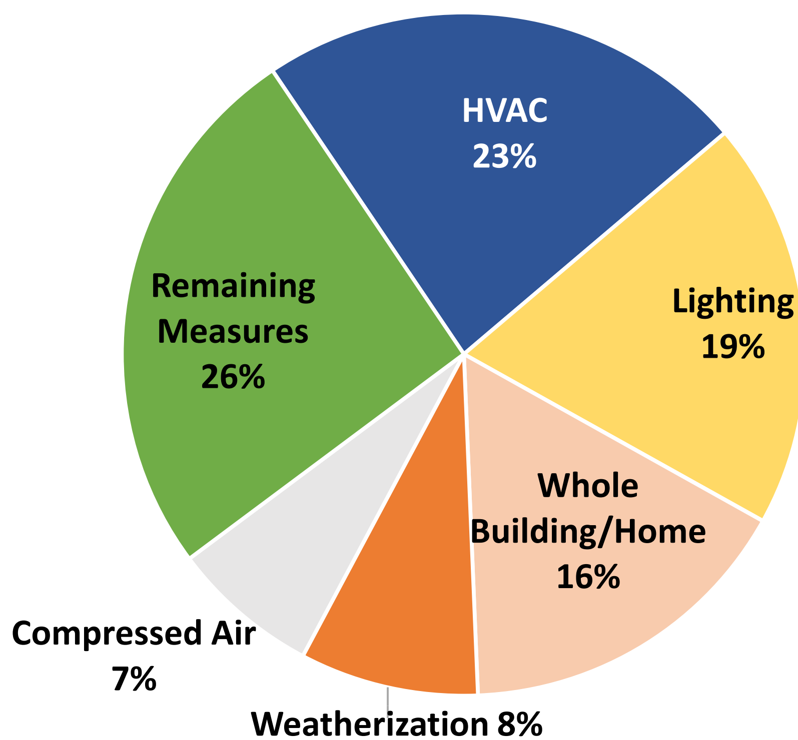


- Cost bundles represent the technical achievable potential, not economic potential.
- Each cost bundle represents a different shape based on the measures within it.
- Cost bundles are selected based on economics and their ability to contribute to the system in competition with all other supply-side resources.

Oregon Results by Measure

Rank	Measure Category	MWh in 2038	% of Total
1	HVAC	823,842	23.2%
2	Lighting	684,512	19.3%
3	Whole Building/Home	575,256	16.2%
4	Weatherization	299,495	8.4%
5	Compressed Air	248,007	7.0%
6	Ind (Motor/Pump/Other)	246,802	7.0%
7	Water Heating	243,458	6.9%
8	Appliance/Plug Load	183,412	5.2%
9	Behavioral/EM	110,903	3.1%
10	Refrigeration	59,378	1.7%
11	Agriculture/Irrigation	46,774	1.3%
12	Cooking	22,489	0.6%
	Total	**3,544,327**	**100.0%**

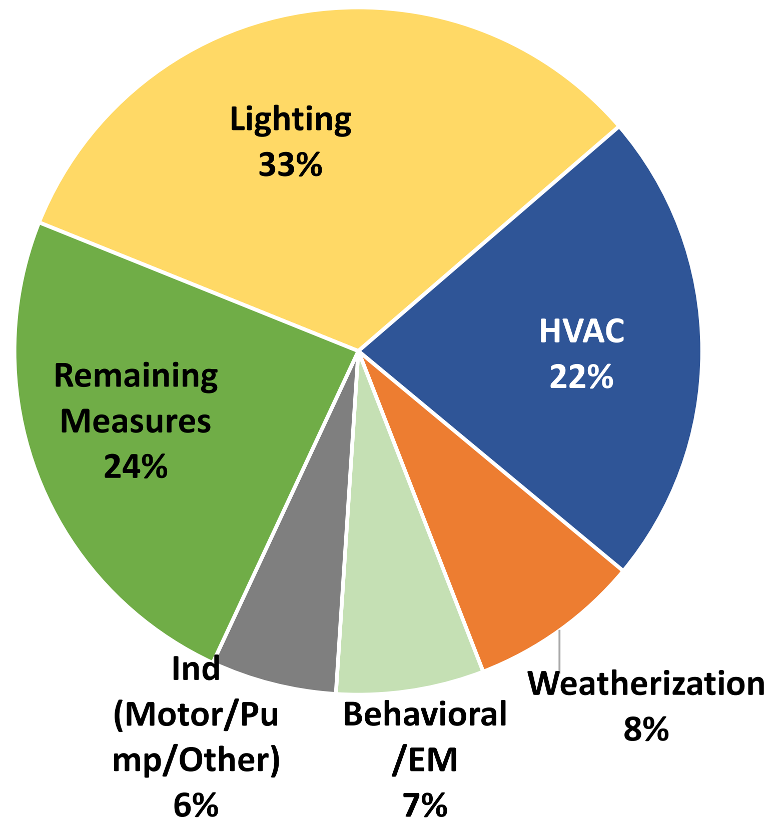
Oregon, Technical Achievable Potential, Cumulative in 2038 (Values Rounded)



Utah Results by Measure

Rank	Measure Category	MWh in 2038	% of Total
1	Lighting	1,983,061	32.6%
2	HVAC	1,359,746	22.3%
3	Weatherization	490,669	8.1%
4	Behavioral/EM	423,217	7.0%
5	Ind (Motor/Pump/Other)	359,787	5.9%
6	Water Heating	325,894	5.4%
7	Appliance/Plug Load	269,197	4.4%
8	Whole Building/Home	268,937	4.4%
9	Compressed Air	159,331	2.6%
10	Waste Heat to Power	149,320	2.5%
11	Refrigeration	144,603	2.4%
12	Cooking	98,130	1.6%
13	Agriculture/Irrigation	31,846	0.5%
14	Data Center	23,478	0.4%
	Total	**6,087,217**	**100.0%**

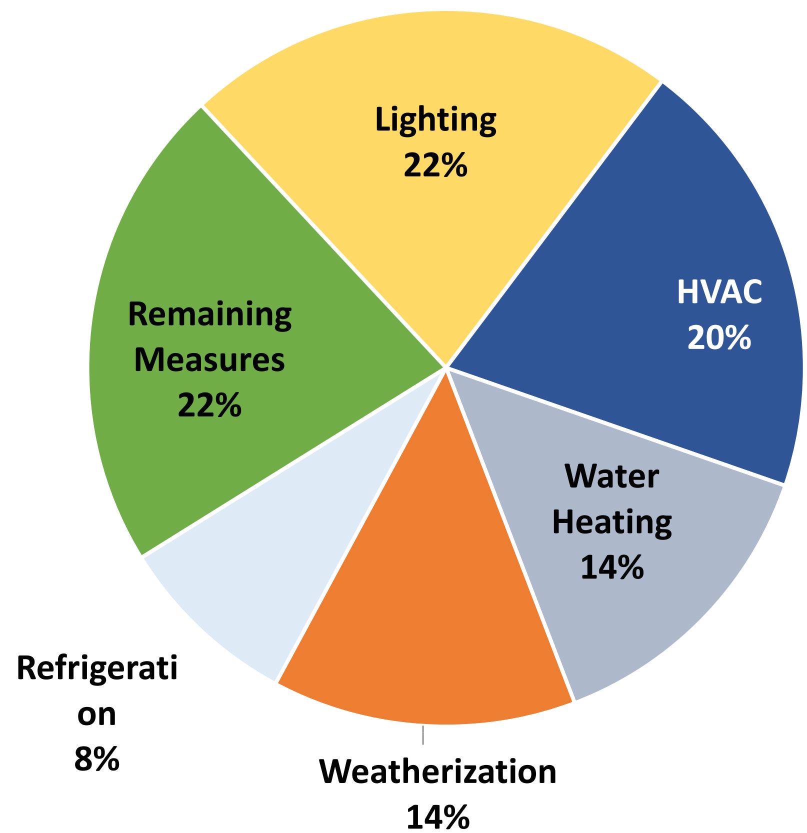
Utah, Technical Achievable Potential, Cumulative in 2038 (Values Rounded)



Washington Results by Measure

Rank	Measure Category	MWh in 2038	% of Total
1	Lighting	244,121	22.2%
2	HVAC	220,410	20.1%
3	Water Heating	152,169	13.8%
4	Weatherization	150,801	13.7%
5	Refrigeration	90,640	8.2%
6	Ind (Motor/Pump/Other)	59,098	5.4%
7	Appliance/Plug Load	41,233	3.8%
8	Behavioral/EM	39,176	3.6%
9	Whole Building/Home	23,707	2.2%
10	Agriculture/Irrigation	23,099	2.1%
11	Compressed Air	21,472	2.0%
12	Cooking	18,291	1.7%
13	Waste Heat to Power	14,554	1.3%
14	Data Center	367	0.0%
	Total	**1,099,137**	**100.0%**

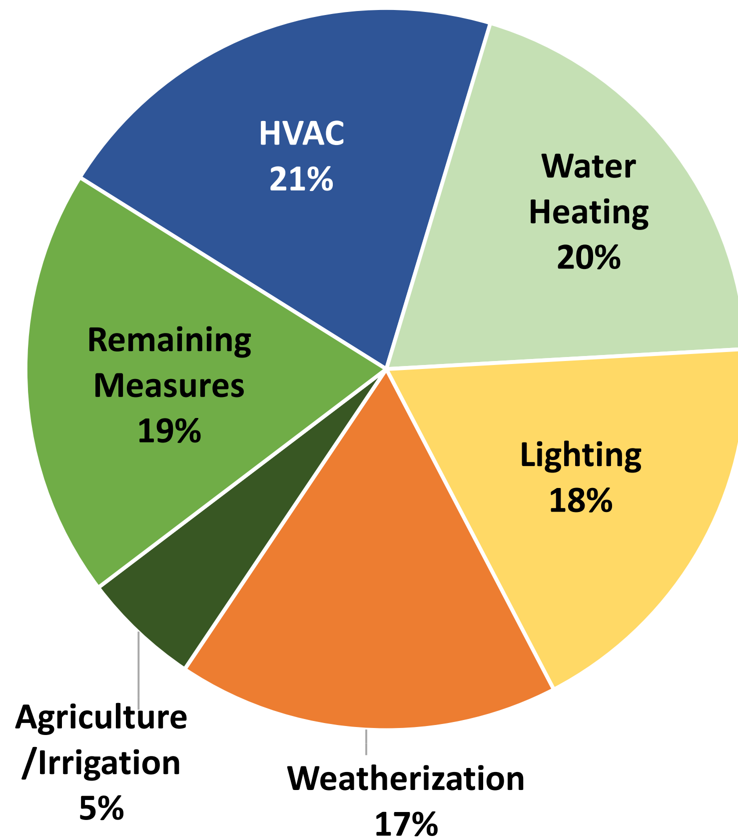
Washington, Technical Achievable Potential, Cumulative in 2038 (Values Rounded)



California Results by Measure

Rank	Measure Category	MWh in 2038	% of Total
1	HVAC	47,943	20.8%
2	Water Heating	44,936	19.5%
3	Lighting	42,104	18.2%
4	Weatherization	39,458	17.1%
5	Agriculture/Irrigation	12,113	5.2%
6	Appliance/Plug Load	11,298	4.9%
7	Behavioral/EM	9,813	4.2%
8	Refrigeration	6,415	2.8%
9	Whole Building/Home	5,030	2.2%
10	Ind (Motor/Pump/Other)	5,011	2.2%
11	Cooking	3,385	1.5%
12	Waste Heat to Power	1,973	0.9%
13	Compressed Air	1,397	0.6%
14	Data Center	51	0.0%
	Total	**230,928**	**100.0%**

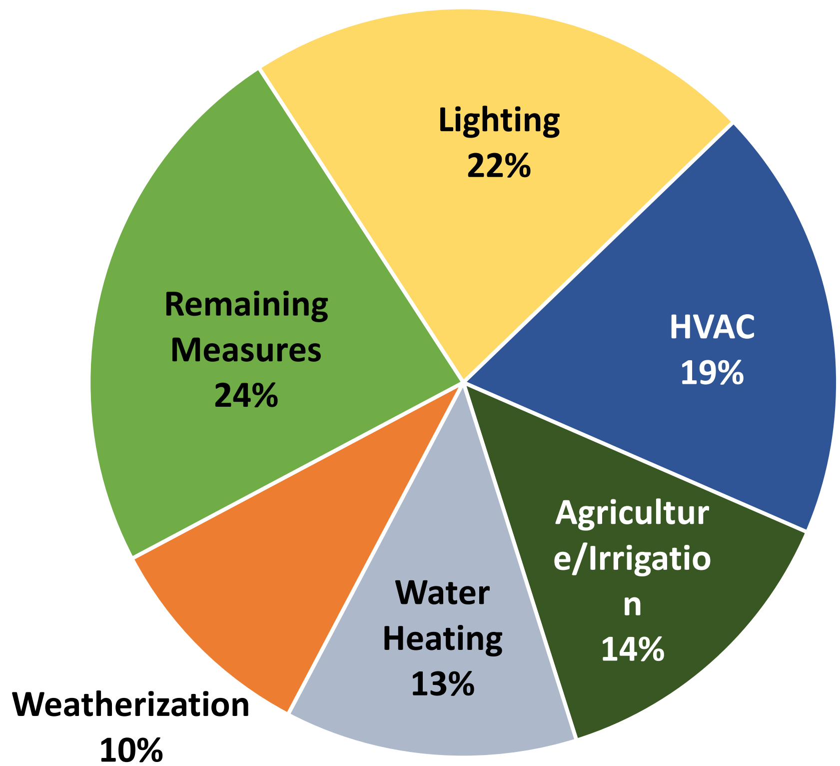
California, Technical Achievable Potential, Cumulative in 2038 (Values Rounded)



Idaho Results by Measure

Rank	Measure Category	MWh in 2038	% of Total
1	Lighting	116,525	22.0%
2	HVAC	99,308	18.7%
3	Agriculture/Irrigation	72,106	13.6%
4	Water Heating	66,871	12.6%
5	Weatherization	50,405	9.5%
6	Behavioral/EM	28,518	5.4%
7	Appliance/Plug Load	23,921	4.5%
8	Whole Building/Home	21,555	4.1%
9	Ind (Motor/Pump/Other)	17,385	3.3%
10	Refrigeration	12,846	2.4%
11	Cooking	9,072	1.7%
12	Compressed Air	8,637	1.6%
13	Waste Heat to Power	3,030	0.6%
14	Data Center	153	0.0%
	Total	**530,330**	**100.0%**

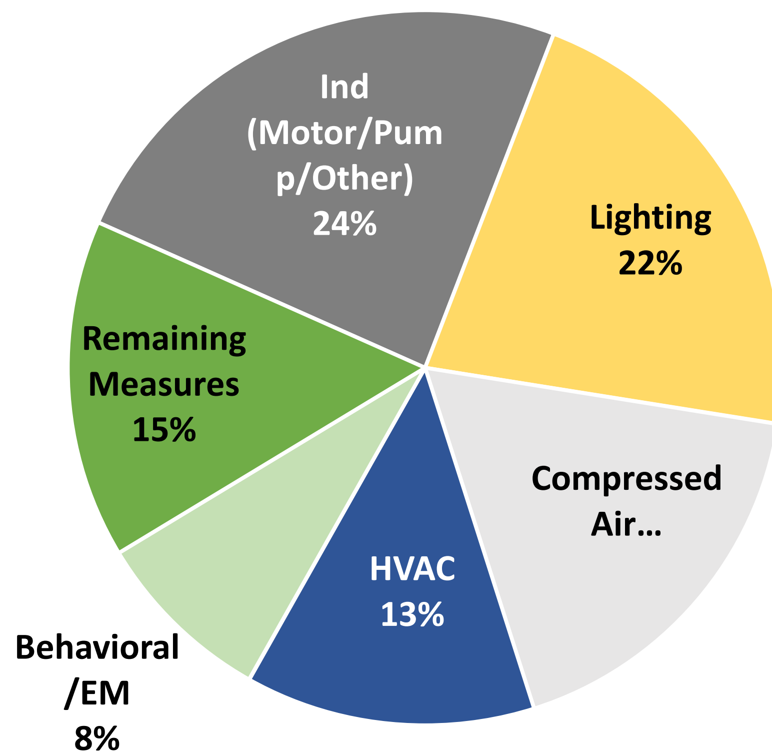
Idaho, Technical Achievable Potential, Cumulative in 2038 (Values Rounded)



Wyoming Results by Measure

Rank	Measure Category	MWh in 2038	% of Total
1	Ind (Motor/Pump/Other)	421,997	24.2%
2	Lighting	378,127	21.7%
3	Compressed Air	306,188	17.5%
4	HVAC	228,928	13.1%
5	Behavioral/EM	142,356	8.2%
6	Water Heating	69,517	4.0%
7	Weatherization	63,718	3.7%
8	Appliance/Plug Load	32,644	1.9%
9	Refrigeration	28,286	1.6%
10	Waste Heat to Power	27,603	1.6%
11	Whole Building/Home	26,144	1.5%
12	Cooking	14,281	0.8%
13	Agriculture/Irrigation	4,968	0.3%
14	Data Center	305	0.0%
	Total	**1,745,063**	**100.0%**

Wyoming, Technical Achievable Potential, Cumulative in 2038 (Values Rounded)



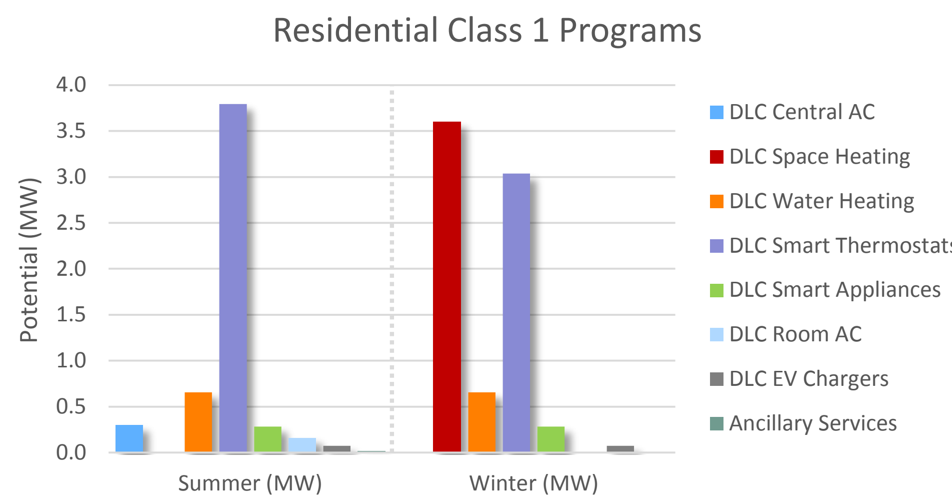
Class 1

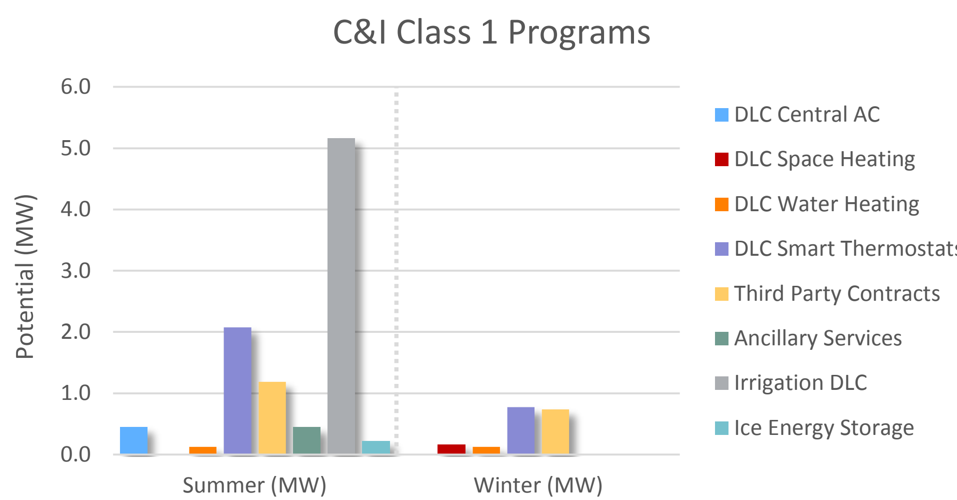
What Changed Since the Last Study?

- Updated Saturations base on new primary research
  - Very small effect on potential
- Programs
  - Added Ancillary Services program
    - Subset of other DLC programs – outside our hierarchy since AS events are not usually coincident with peak events
  - Added Smart Thermostat program of C&I
  - Weighted impacts toward Smart thermostats and away from traditional DLC
  - Relabeled Curtailment as 3rd Party Contracts
  - Reduced per customer impacts for EV chargers and Ice Storage in light of new research
- New way of looking at costs
  - Applying the CA CPUC C/B Protocols in California, Oregon, Washington, and Wyoming. Utah and Idaho use traditional methods
    - Discount the incentive cost by 75%
    - Also addresses discounting the value of capacity, but this only affects the Benefit side of the equation

MW by Option Class 1 – CA

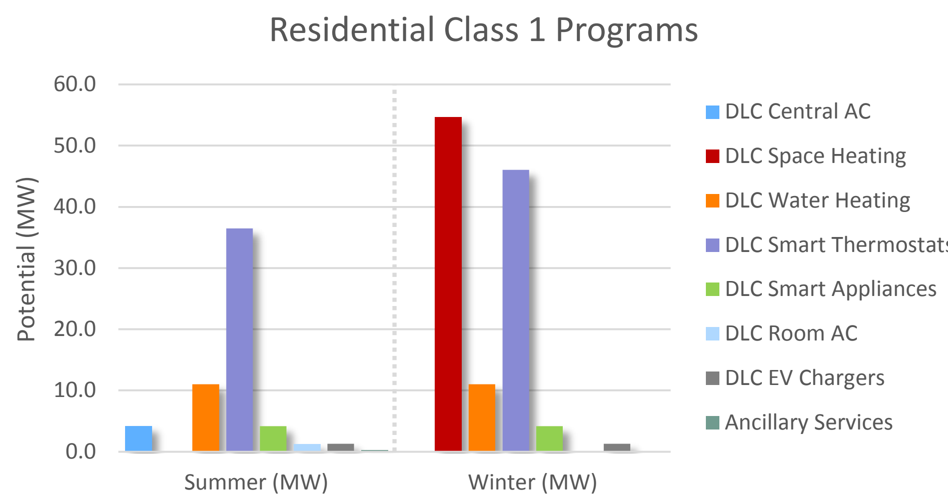
State	Option	2038 Summer (MW)	2038 Winter (MW)
Residential	DLC Central AC	0.30	-
	DLC Space Heating	-	3.60
	DLC Water Heating	0.66	0.66
	DLC Smart Thermostats	3.79	3.04
	DLC Smart Appliances	0.28	0.28
	DLC Room AC	0.16	-
	DLC EV Chargers	0.07	0.07
	Ancillary Services	0.02	-
	Res Total	**5.27**	**7.65**
C&I	DLC Central AC	0.45	-
	DLC Space Heating	-	0.16
	DLC Water Heating	0.12	0.12
	DLC Smart Thermostats	2.08	0.77
	Third Party Contracts	1.18	0.74
	Ancillary Services	0.45	-
	Irrigation DLC	5.16	-
	Ice Energy Storage	0.22	-
	C&I Total	**9.67**	**1.80**

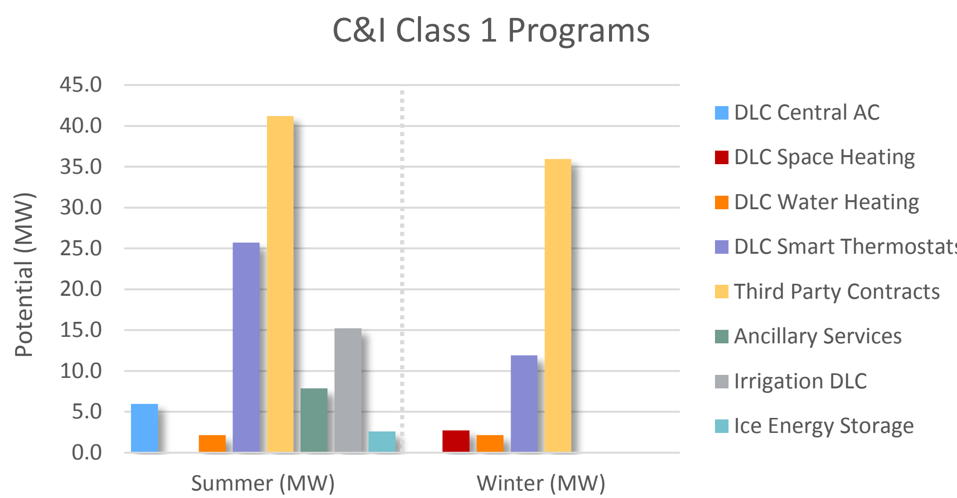




MW by Option Class 1 – OR

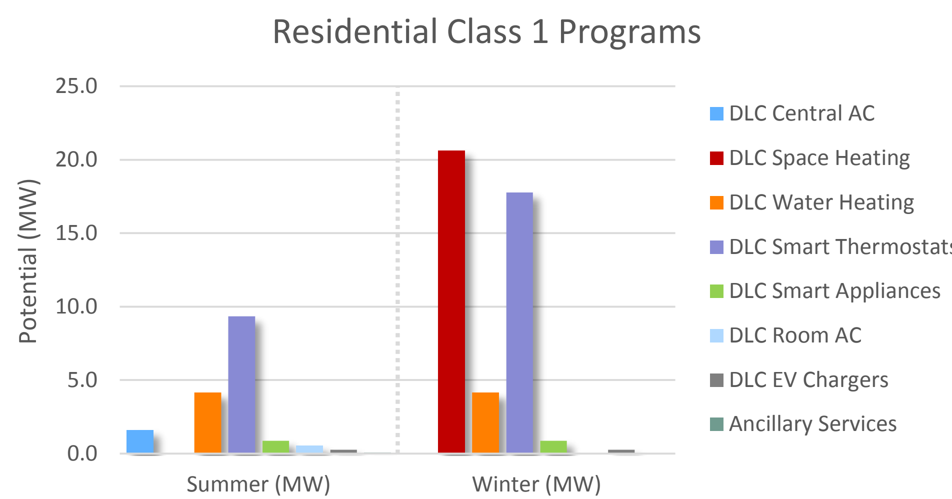
State	Option	2038 Summer (MW)	2038 Winter (MW)
Residential	DLC Central AC	4.24	-
	DLC Space Heating	-	54.67
	DLC Water Heating	11.03	11.03
	DLC Smart Thermostats	36.46	46.04
	DLC Smart Appliances	4.18	4.18
	DLC Room AC	1.23	-
	DLC EV Chargers	1.29	1.29
	Ancillary Services	0.30	-
	Res Total	**58.74**	**117.21**
C&I	DLC Central AC	5.98	-
	DLC Space Heating	-	2.68
	DLC Water Heating	2.14	2.14
	DLC Smart Thermostats	25.69	11.89
	Third Party Contracts	41.21	35.94
	Ancillary Services	7.87	-
	Irrigation DLC	15.21	-
	Ice Energy Storage	2.60	-
	C&I Total	**100.71**	**52.65**

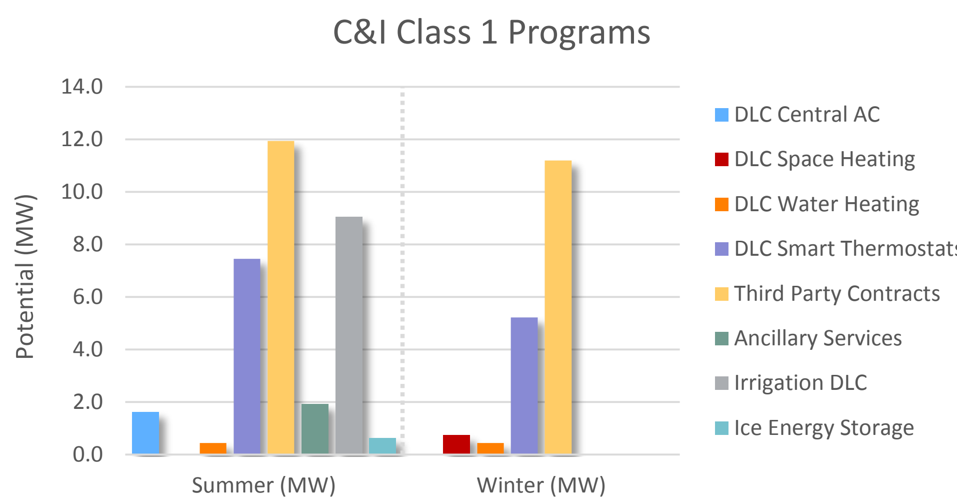




MW by Option Class 1 – WA

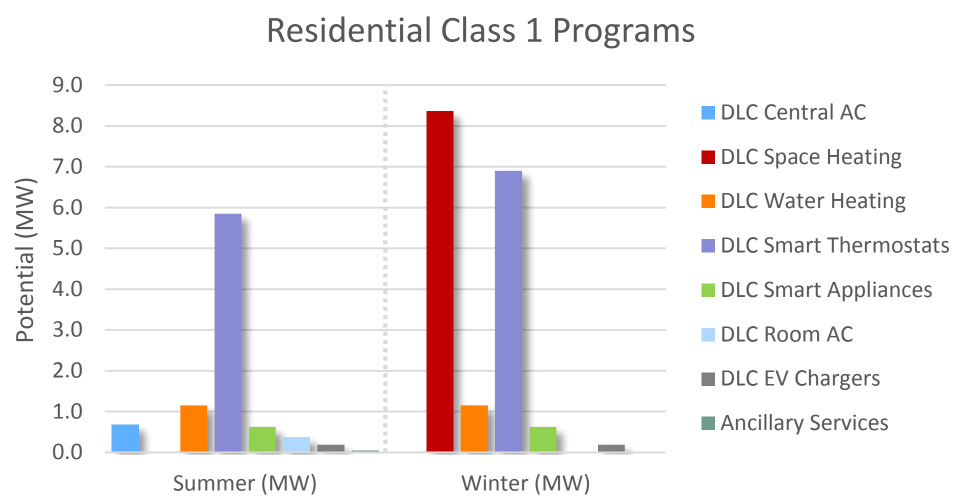
State	Option	2038 Summer (MW)	2038 Winter (MW)
Residential	DLC Central AC	1.62	-
	DLC Space Heating	-	20.63
	DLC Water Heating	4.16	4.16
	DLC Smart Thermostats	9.34	17.77
	DLC Smart Appliances	0.87	0.87
	DLC Room AC	0.55	-
	DLC EV Chargers	0.27	0.27
	Ancillary Services	0.06	-
	Res Total	**16.88**	**43.69**
C&I	DLC Central AC	1.62	-
	DLC Space Heating	-	0.73
	DLC Water Heating	0.45	0.45
	DLC Smart Thermostats	7.45	5.22
	Third Party Contracts	11.94	11.20
	Ancillary Services	1.93	-
	Irrigation DLC	9.05	-
	Ice Energy Storage	0.62	-
	C&I Total	**33.06**	**17.60**

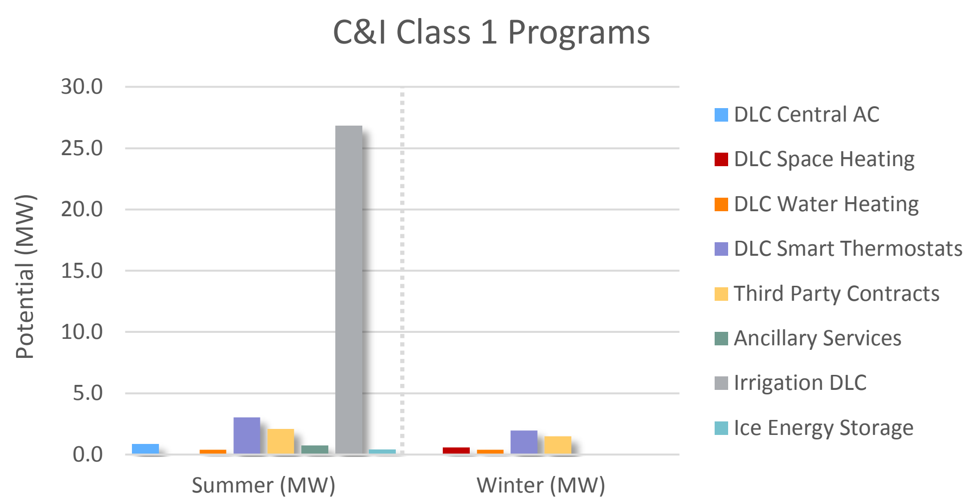




MW by Option Class 1 – ID

State	Option	2038 Summer (MW)	2038 Winter (MW)
Residential	DLC Central AC	0.67	-
	DLC Space Heating	-	8.36
	DLC Water Heating	1.15	1.15
	DLC Smart Thermostats	5.85	6.90
	DLC Smart Appliances	0.63	0.63
	DLC Room AC	0.38	-
	DLC EV Chargers	0.19	0.19
	Ancillary Services	0.04	-
	Res Total	**8.91**	**17.23**
C&I	DLC Central AC	0.83	-
	DLC Space Heating	-	0.55
	DLC Water Heating	0.39	0.39
	DLC Smart Thermostats	3.03	1.97
	Third Party Contracts	2.08	1.48
	Ancillary Services	0.74	-
	Irrigation DLC	26.85	-
	Ice Energy Storage	0.42	-
	C&I Total	**34.33**	**4.39**

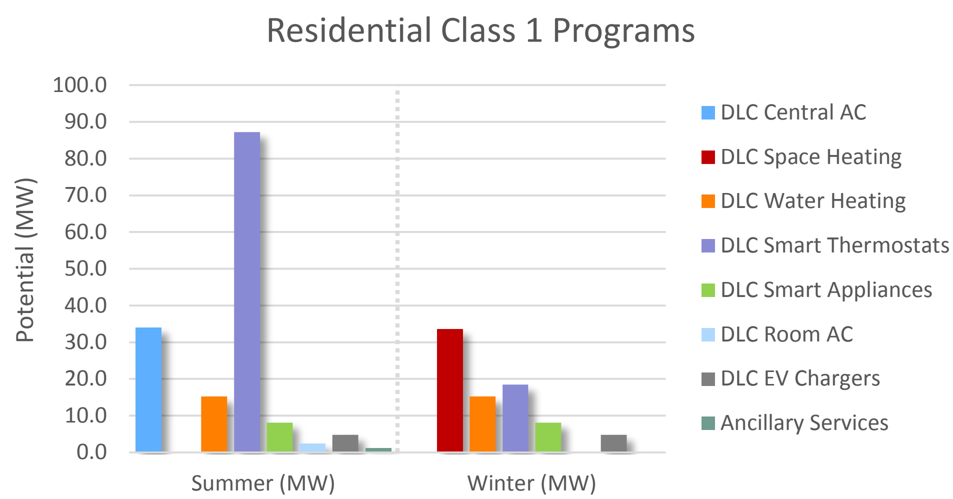


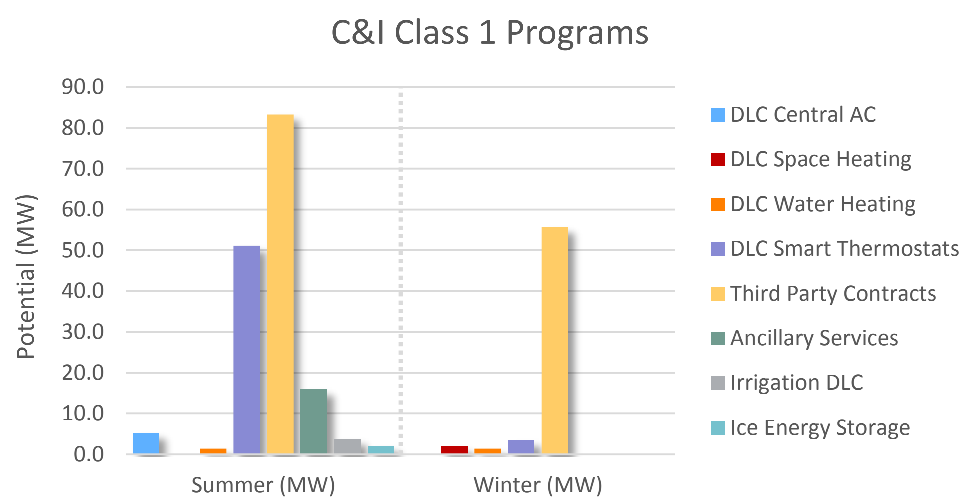


POWERING YOUR GREATNESS

MW by Option Class 1 – UT

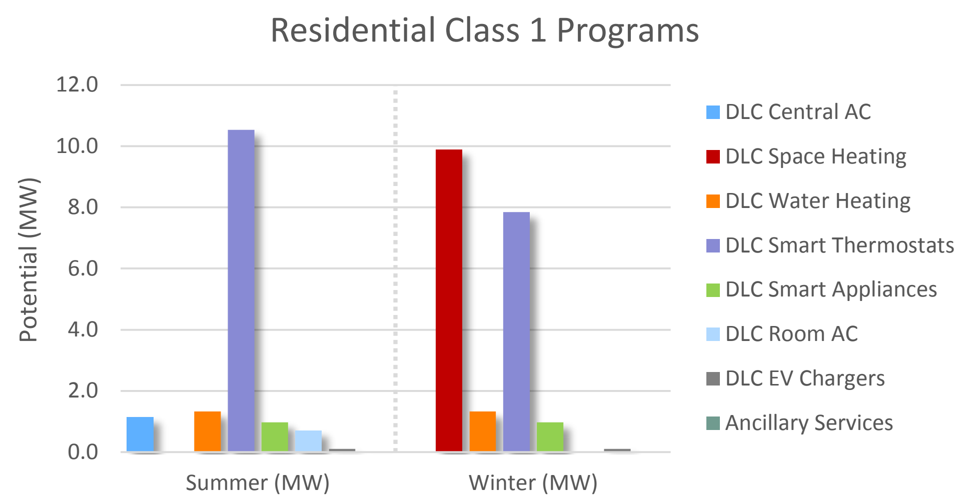
State	Option	2038 Summer (MW)	2038 Winter (MW)
Residential	DLC Central AC	33.93	-
	DLC Space Heating	-	33.50
	DLC Water Heating	15.25	15.25
	DLC Smart Thermostats	87.19	18.47
	DLC Smart Appliances	8.09	8.09
	DLC Room AC	2.38	-
	DLC EV Chargers	4.79	4.79
	Ancillary Services	1.13	-
	Res Total	**152.76**	**80.09**
C&I	DLC Central AC	5.26	-
	DLC Space Heating	-	1.98
	DLC Water Heating	1.43	1.43
	DLC Smart Thermostats	51.13	3.52
	Third Party Contracts	83.28	55.67
	Ancillary Services	15.90	-
	Irrigation DLC	3.74	-
	Ice Energy Storage	2.09	-
	C&I Total	**162.82**	**62.60**

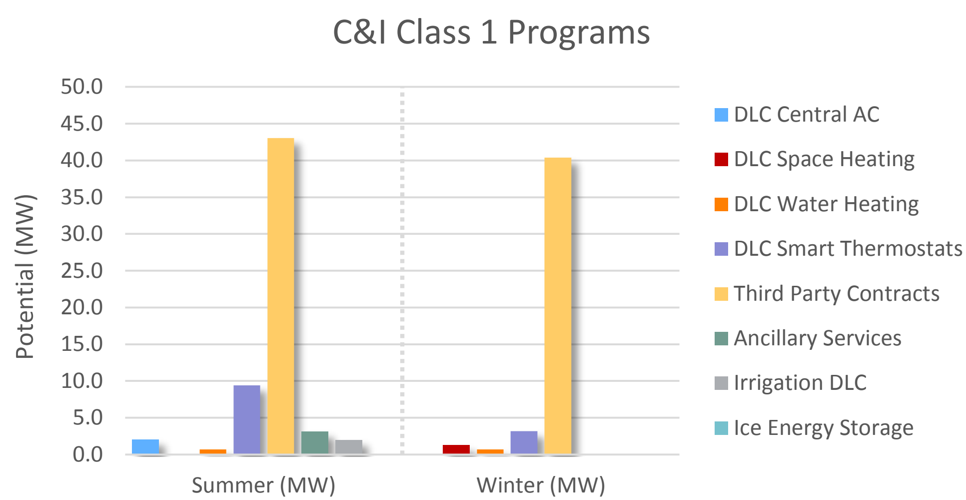




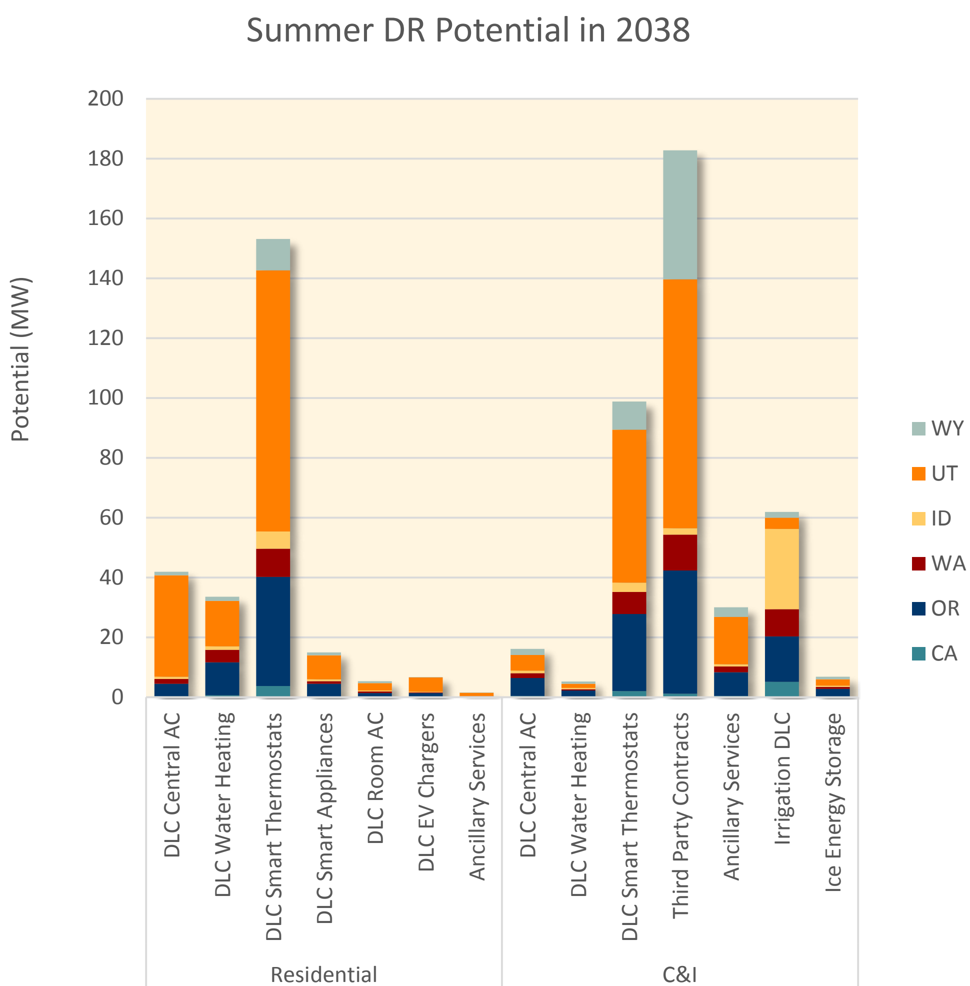
MW by Option Class 1 – WY

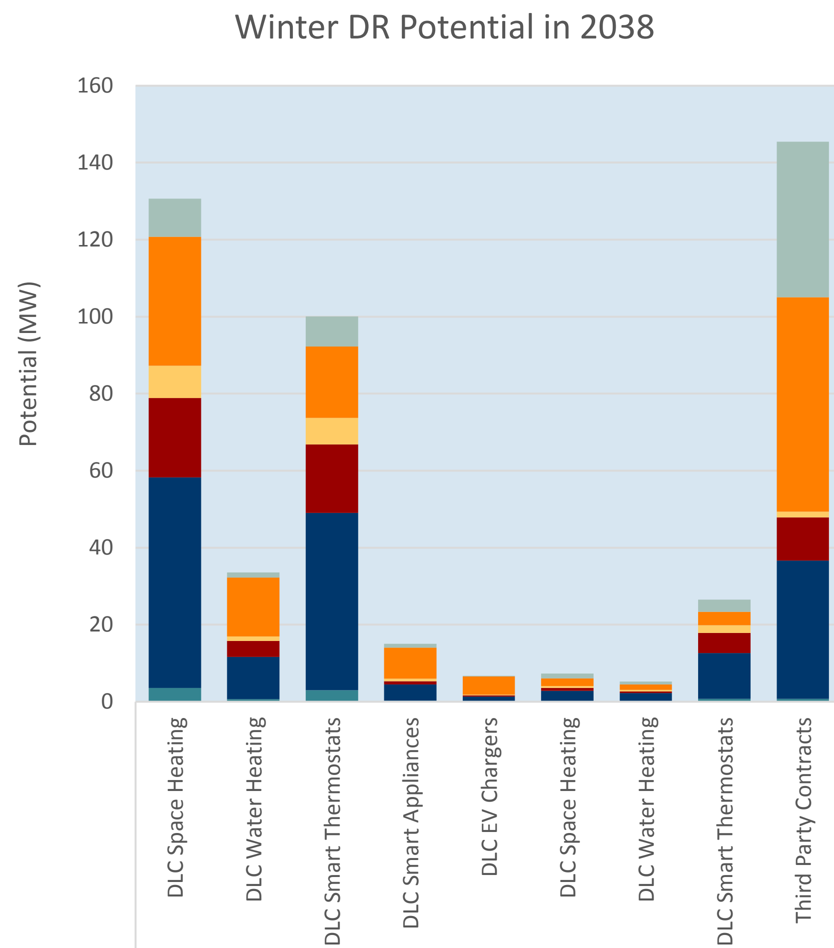
State	Option	2038 Summer (MW)	2038 Winter (MW)
Residential	DLC Central AC	1.15	-
	DLC Space Heating	-	9.88
	DLC Water Heating	1.34	1.34
	DLC Smart Thermostats	10.53	7.84
	DLC Smart Appliances	0.98	0.98
	DLC Room AC	0.71	-
	DLC EV Chargers	0.10	0.10
	Ancillary Services	0.02	-
	Res Total	**14.83**	**20.14**
C&I	DLC Central AC	2.05	-
	DLC Space Heating	-	1.26
	DLC Water Heating	0.69	0.69
	DLC Smart Thermostats	9.39	3.17
	Third Party Contracts	43.05	40.39
	Ancillary Services	3.15	-
	Irrigation DLC	1.96	-
	Ice Energy Storage	-	-
	C&I Total	**60.30**	**45.51**





State Contribution to potential – Summer and Winter





IRP Energy Efficiency Credits

Energy Efficiency (EE) Credits

- The IRP incorporates three credits that reduce the modeled cost of energy efficiency bundles competing with supply-side resources in IRP modeling:
  - Stochastic Risk Reduction Credit
  - Northwest Power Act 10-percent credit (Oregon & Washington only)
  - Transmission and Distribution Deferral Credit

- These credits are intended to capture benefits of energy efficiency that would otherwise not be reflected in IRP modeling.
- These credits are consistent with industry standards and with the Northwest Power and Conservation Council.

Stochastic Risk Reduction Credit

- The stochastic risk reduction credit is intended to reflect the value energy efficiency provides in terms of reducing portfolio risk.
- This credit is calculated by:
    - Determining the difference in present-value revenue requirement (PVRRd) between stochastic studies and deterministic studies with and without energy efficiency.
    - Dividing the delta of the two PVRR(d) results by the net present value of the energy efficiency savings (MWh) yields the $/MWh assumed value of stochastic risk reduction.
- The 2019 IRP credit value is $4.74/MWh.

NW Power Act 10% Credit - T&D Credit

Northwest Power Act 10-percent Credit (Oregon & Washington only)

- The formula for calculating this $/MWh credit is:

$$\frac{Bundle\ price\ - (1st\ year\ MWh\ savings \times Market\ Value \times 10\% + 1st\ year\ MWh\ Savings \times T\&D\ Deferral \times 10\%)}{1st\ year\ MWh\ savings}$$

Transmission & Distribution (T&D) Credit

- The T&D value is applied to each EE cost bundle to convert it to a $/MWh credit.

$$\frac{T\&D\ Value \times Summer\ PCF \times 1000}{\text{EE 1 year bundle shape [between 1 and 8760]}}$$

- Example:

$$\frac{\$12.96 \text{ x } .57 \text{ x } 1000}{5750} = \$1.29/\text{MWh reduction in the EE cost bundle}$$

T&D Deferral Value Key Inputs

- Transmission and Distribution Capacity Capital Investment
  - 5 year forward looking
  - Estimated costs
- Capacity Installed
  - Net
- Power Factor
  - Standard Power factor
- Real Levelized Carrying Charge
  - Transmission and Distribution
- Locational Proxy
  - Distribution Substation Transformer Utilization

T&D Deferral Value Calculation

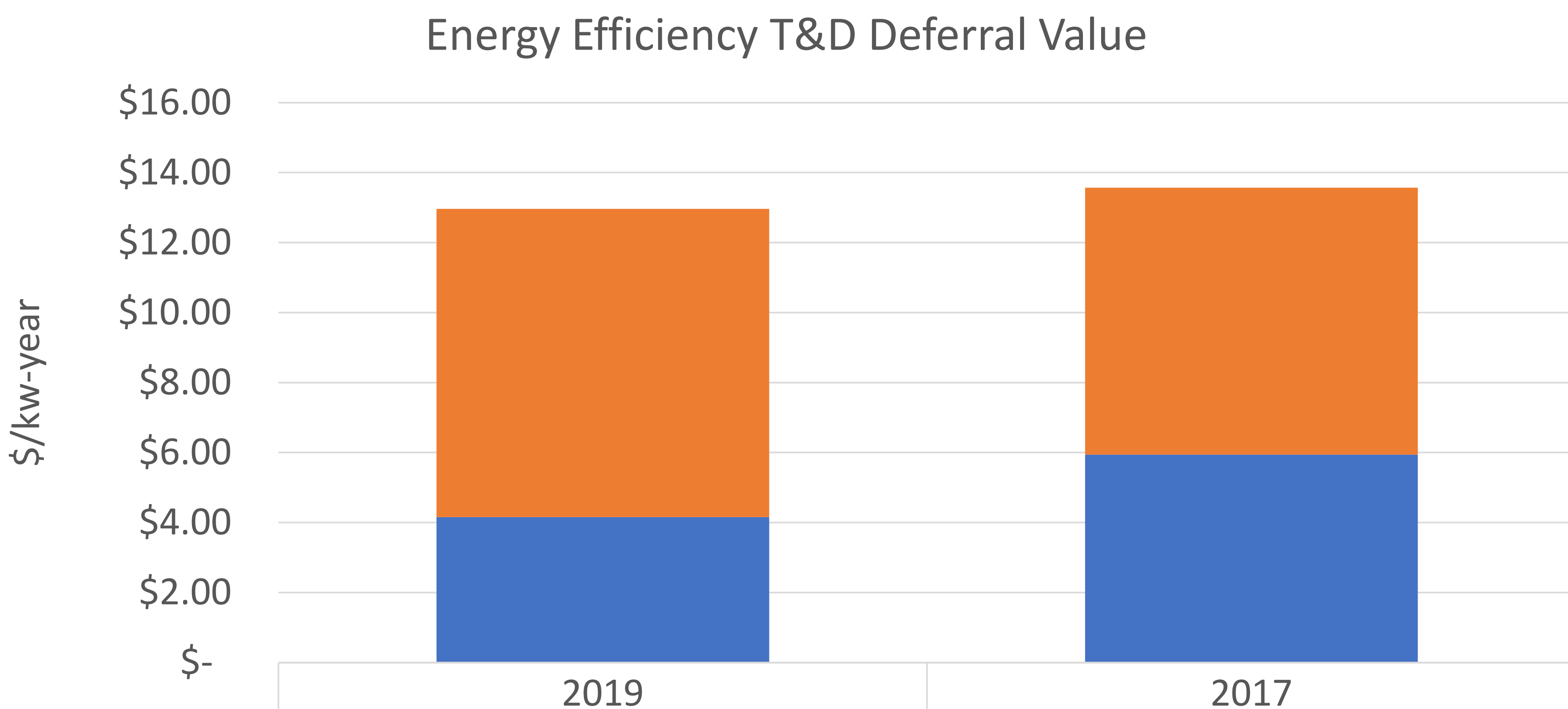
- Transmission

$$\left(\left(\frac{Transmission\ Capacity\ Investment}{Capacity\ Installed}\right) \div Power\ Factor\right) \times Real\ Levelized\ Transmission\ Carrying\ Charge$$

- Distribution

$$\left(\left(\frac{Distribution\ Capacity\ Investment}{Capacity\ Installed}\right) \div Power\ Factor\right) \times Real\ Levelized\ Distribution\ Carrying\ Charge\ \times Distribution\ Substation\ Transformer\ Utilization$$

Energy Efficiency T&D Deferral Value



	2019	2017
Distribution	$8.80	$7.63
Transmission	$4.16	$5.94
Total	$12.96	$13.57

Flexible Reserve Study

PACIFICORP
POWERING YOUR GREATNESS

Flexible Capacity Requirements

- Loads and resources must balance over each and every interval.
- Requirements are forecasted in advance but uncertain until delivery occurs.
- Variable generating resources (wind and solar) contribute to uncertainty.
- Resource flexibility is increasingly constrained as delivery approaches.
- Maintaining flexibility may require out of merit order resource dispatch, resulting in higher costs.

Regulation Reserve

- Compliance with reliability standard BAL-001-2.

Definitions & Acronyms

- **Regulation reserve:** capacity that PacifiCorp holds available to ensure compliance with the NERC regional reliability standard BAL-001-2.
- **BAAL:** Balancing Authority Area Control Error Limit: the dynamic bandwidth of acceptable deviation under BAL-001-2.
- **VER:** Variable Energy Resources
- **Non-VER:** Non-Variable Energy Resources
- **EIM:** Energy Imbalance Market
- **LOLP:** Loss of Load Probability

Regulation Reserve – Outline

- Enhancements since the 2017 Flexible Reserve Study
- Operational Data: Five-minute granularity
- Regulation Reserve Need: Forecast error
- Planning Reliability: Probability of failure
- BAAL: Allowed deviations
- Regulation Reserve Forecast: Amount held
    - Wind
    - Solar
    - Load
    - Non-VER
- Incremental Regulation Reserve
- EIM Diversity Benefit
- 2017 PacifiCorp System-Wide Portfolio with EIM Benefit
- 2018 PacifiCorp System-Wide Portfolio with EIM Benefit

Enhancements since the 2017 Study

Methodology

- Reserve need calculated through quantile regression methodology.
- Portfolio requirement co-optimized across load, solar, wind and non-variable energy resources.
- Incremental wind extrapolated through cumulative stacking.

Changes

- Actual solar data employed due to proliferation of large scale solar facilities.
- True market hour ahead schedules employed for load.
- Adjusted timescale of EIM diversity benefit to account for CAISO's corrected calculations.

Application of the Results

- Reserve requirements have been calculated for the existing portfolio of wind and solar as of 1/1/2018.
- Reserve requirements vary over time with changes in wind and solar capacity.

Operational Data: Five-minute granularity

- As part of EIM operations, base schedules must be submitted for all resources at 40 minutes before the delivery hour (T-40). Base schedules must balance forecasted loads.
- The imbalance between resource base schedules and actual meter data for each five minute interval is supplied by PacifiCorp resources or EIM transfers.
- The regulation reserve analysis was conducted on a five minute granularity to take advantage of the data available through EIM.
- The study term is January 2017 through December 2017

Load data: Load imbalance is settled on an hourly basis in EIM, so actual load data was used to develop five-minute deviations.

- o Five-minute interval actual load
- o Hourly base schedules

VER data: Resources that (1) are renewable; (2) cannot be stored by the facility; and (3) have variability that is beyond the control of the facility. 2017 study period includes wind and solar.

- o Five-minute interval actual output
- o Hourly base schedules

Non-VER data: All resources which are not VERs (primarily thermal and hydroelectric), and which are not dispatchable by PacifiCorp or the EIM.

- o Five-minute interval actual output
- o Hourly base schedules

Up-Dispatchable resources: Compensate for deviations by other transmission users.

Regulation Reserve Need - Wind

For each 5 minute interval, before input into regression model:

a. Forecast error: Hourly Base Schedule - Actual Meter Value

Trading Date	Trading Hour	Trading Interval	Base Schedules w Ramp	Actuals	Error
1/1/2017	3	5	957	936	-21
1/1/2017	3	10	956	940	-16
1/1/2017	3	15	955	941	-14
1/1/2017	3	20	955	900	-55
1/1/2017	3	25	955	908	-48
1/1/2017	3	30	955	929	-26
1/1/2017	3	35	955	914	-41
1/1/2017	3	40	955	916	-39
1/1/2017	3	45	955	916	-39
1/1/2017	3	50	955	918	-37
1/1/2017	3	55	954	917	-37
1/1/2017	3	60	951	919	-32

This calculation applies to Load, Wind, Solar and Non-VER classes.

Regulation Reserve Need – Combined

For each 5 minute interval, before input into regression model

a. Forecast error: Load Error – Wind Error – Solar Error – Non VER Error

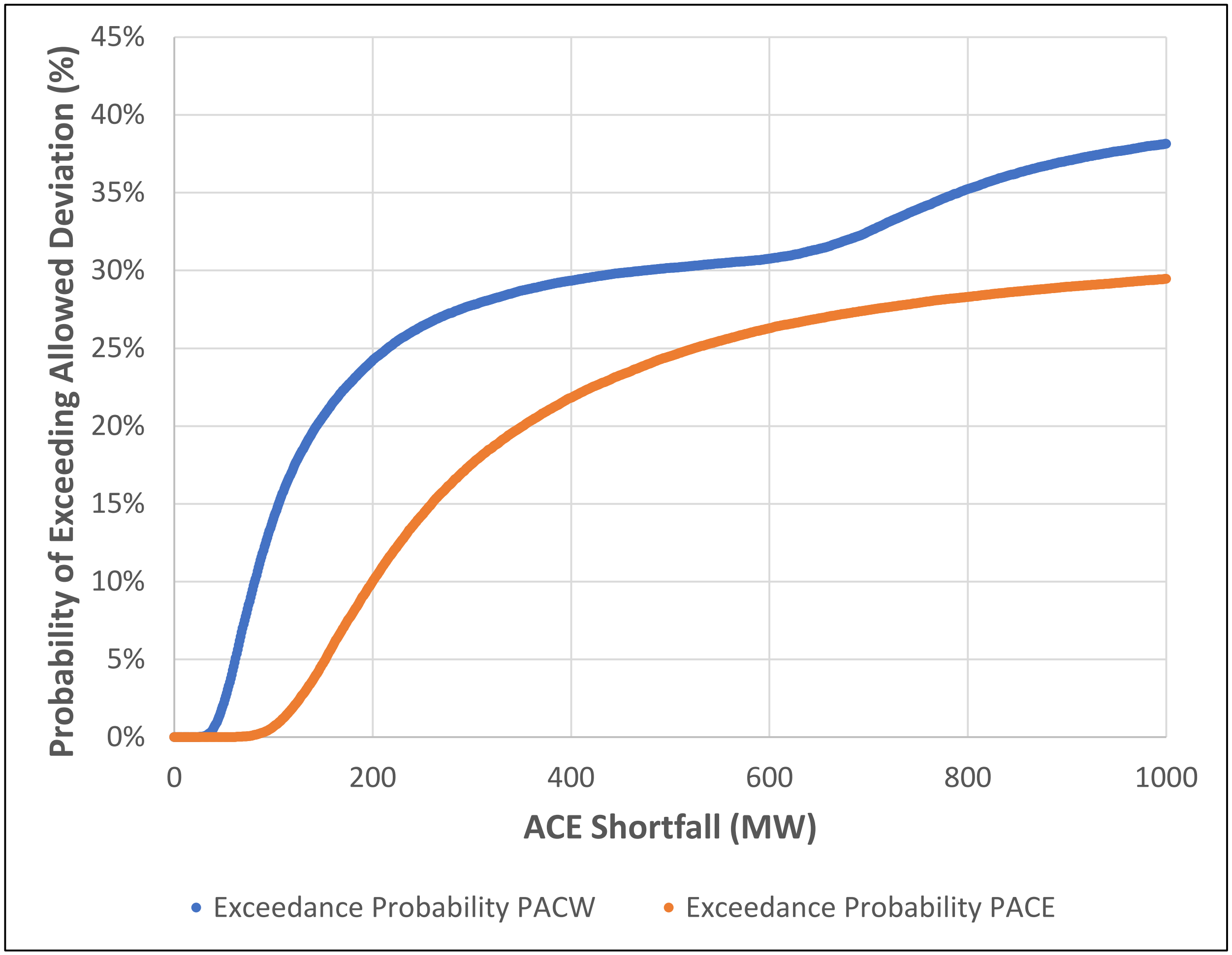
Trading Date	Trading Hour	Trading Interval	Load Error	Non VER Error	Wind Error	Solar Error	Combined Diversity Error
1/1/2017	3	5	49	-5	-21	0	75
1/1/2017	3	10	40	-6	-16	0	61
1/1/2017	3	15	36	-3	-14	0	53
1/1/2017	3	20	35	-6	-55	0	97
1/1/2017	3	25	34	-6	-48	0	87
1/1/2017	3	30	36	-4	-26	0	67
1/1/2017	3	35	36	-7	-41	0	84
1/1/2017	3	40	32	-8	-39	0	80
1/1/2017	3	45	30	-5	-39	0	74
1/1/2017	3	50	31	2	-37	0	66
1/1/2017	3	55	37	1	-37	0	73
1/1/2017	3	60	45	2	-32	0	75

Planning Reliability: Probability of Failure

- Resource planning commonly uses a reliability target such as loss of load probability (LOLP), i.e. a plan to curtail firm load in rare circumstances, rather than acquiring resources for extremely unlikely events.
- If available reserve is insufficient, and the ACE shortfall exceeds the BAAL, 100% compliance with the BAL-001-2 standard can be maintained by curtailing firm load.
- Curtailing firm load balances the cost of holding additional regulation reserve against the likelihood of regulation reserve shortage events.
- This study optimizes towards 0.5 hours of lost load hours per year as appropriate for planning and ratemaking purposes.
- If the regulation reserve available is greater than the regulation reserve need for an hour, the LOLP is zero for that hour.
- If the regulation reserve held is less than the amount needed, the LOLP is derived from the BAAL probability distribution. As the magnitude of the shortfall increases, the probability of exceeding the BAAL increases.
- For instance, a 43 MW ACE shortfall in PACW has a one percent chance of exceeding the BAAL. A one percent probability of failing to meet the BAAL in one hour is 0.01 loss of load hours per year. Fifty such hours would correspond to the targeted level of reliability.

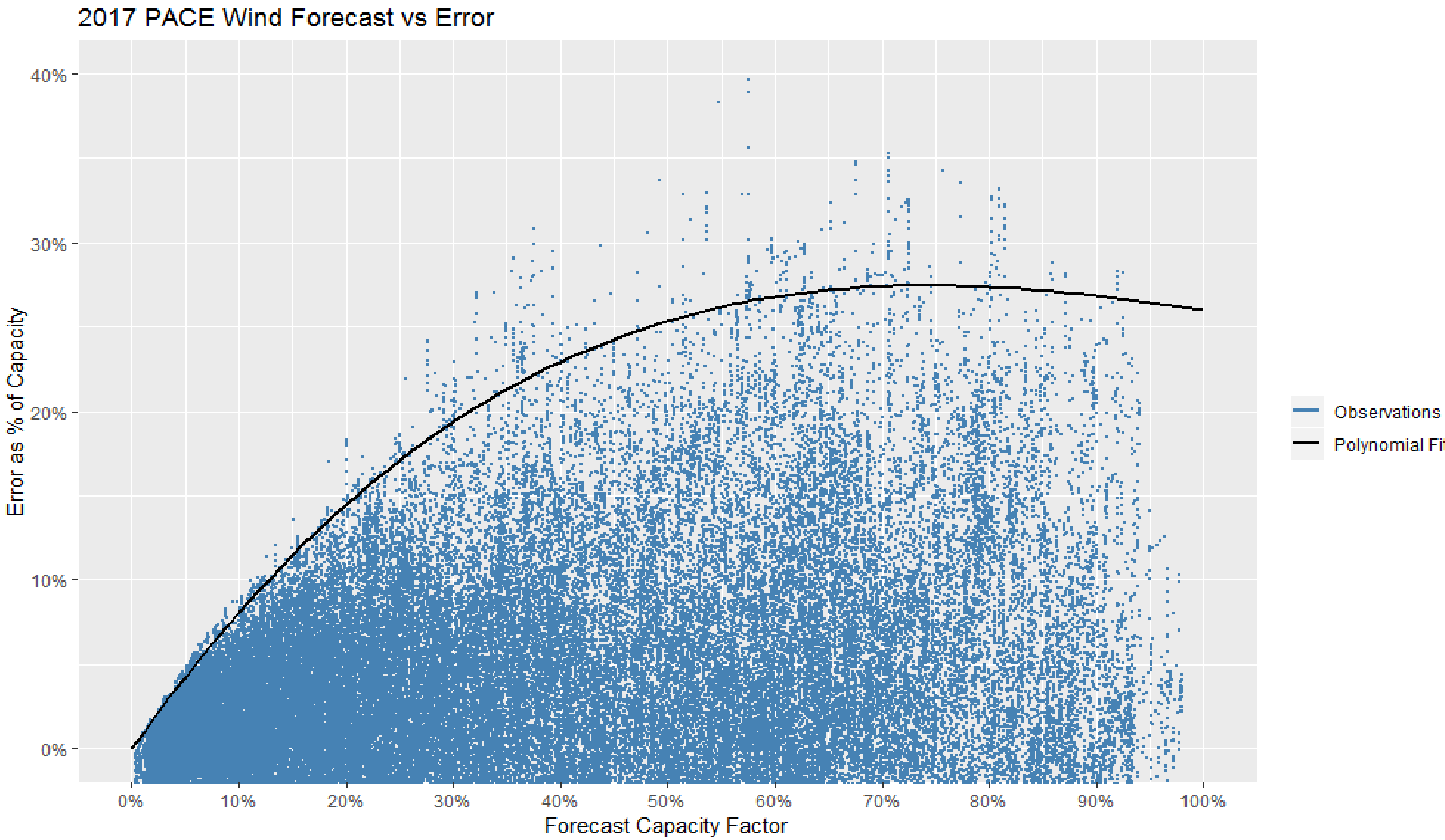
BAAL: Allowed Deviations

- The BAAL is specific to each BAA and varies dynamically as a function of WECC frequency.
- As WECC frequency drops below 60 Hz, ACE is increasingly restricted for BAAs with higher loads than resources.
- As the ACE shortfall increases, the BAAL is more likely to be exceeded.



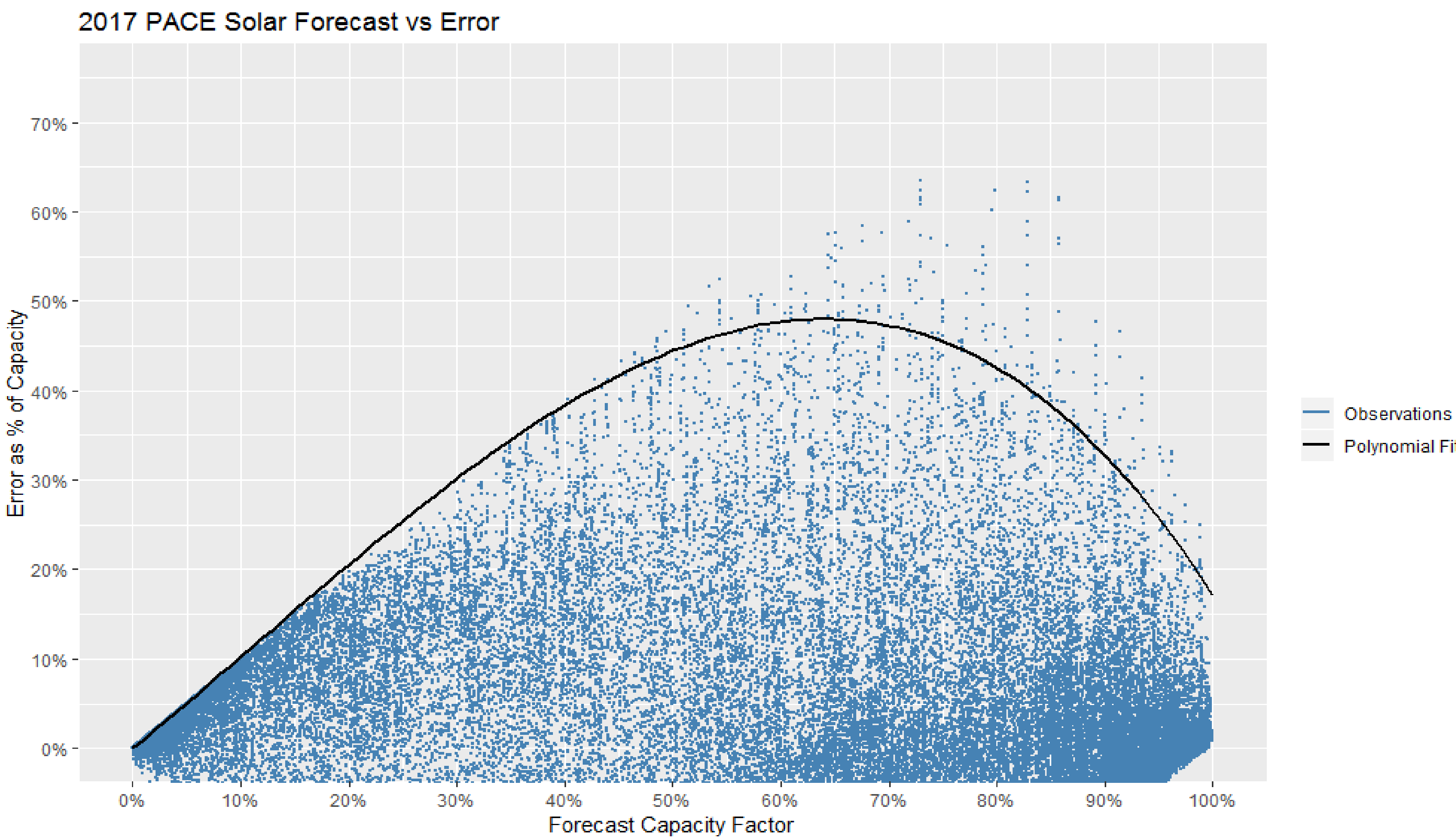
- A 43MW ACE shortfall has a 1% chance of exceeding the PACW BAAL.
- A 106MW ACE shortfall has a 1% chance of exceeding the PACE BAAL.

Wind Regulation Reserve Forecast



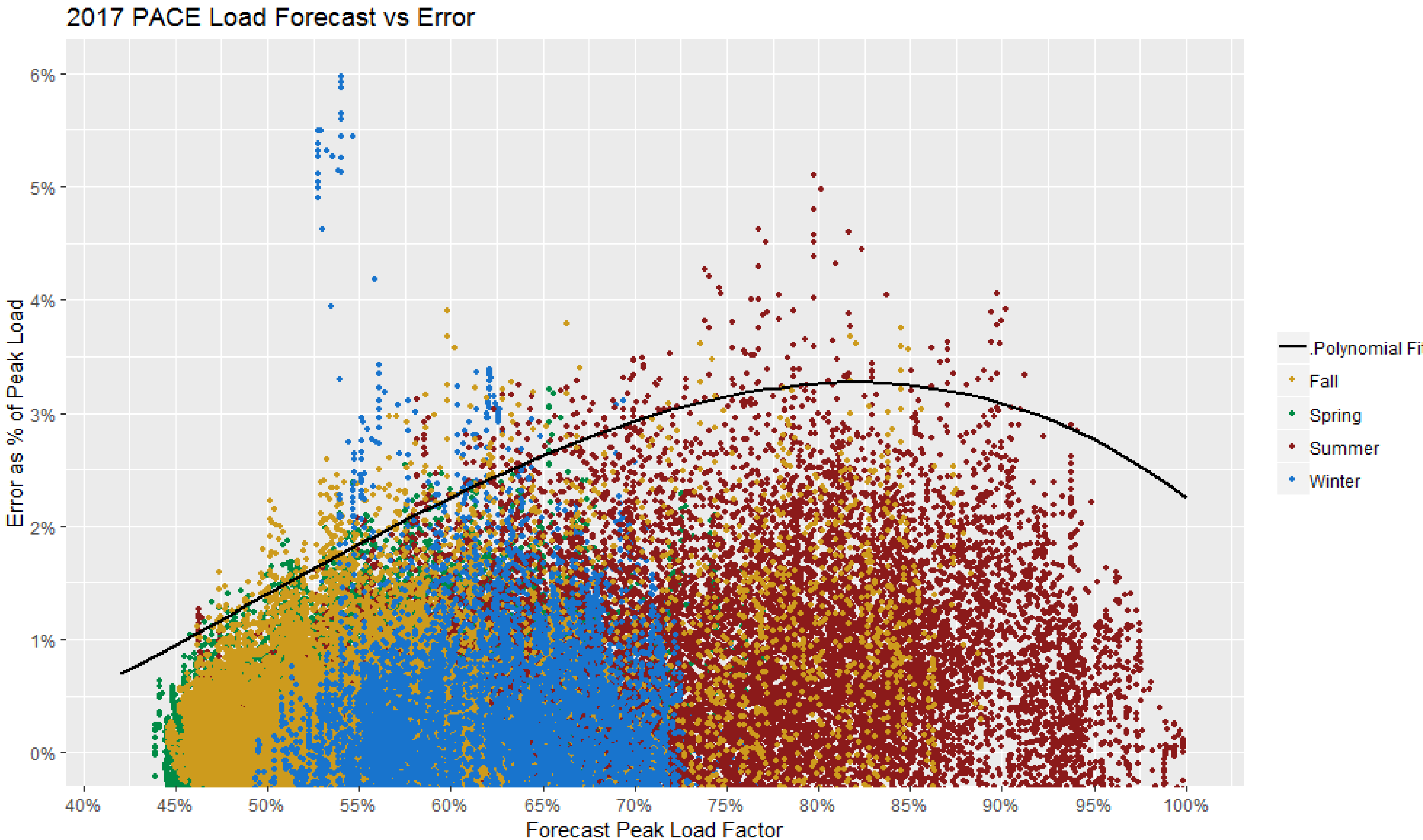
- Polynomial quantile regression such that exceedance events contribute to an LOLP of 0.5 hours on a combined portfolio basis.

Solar Regulation Reserve Forecast



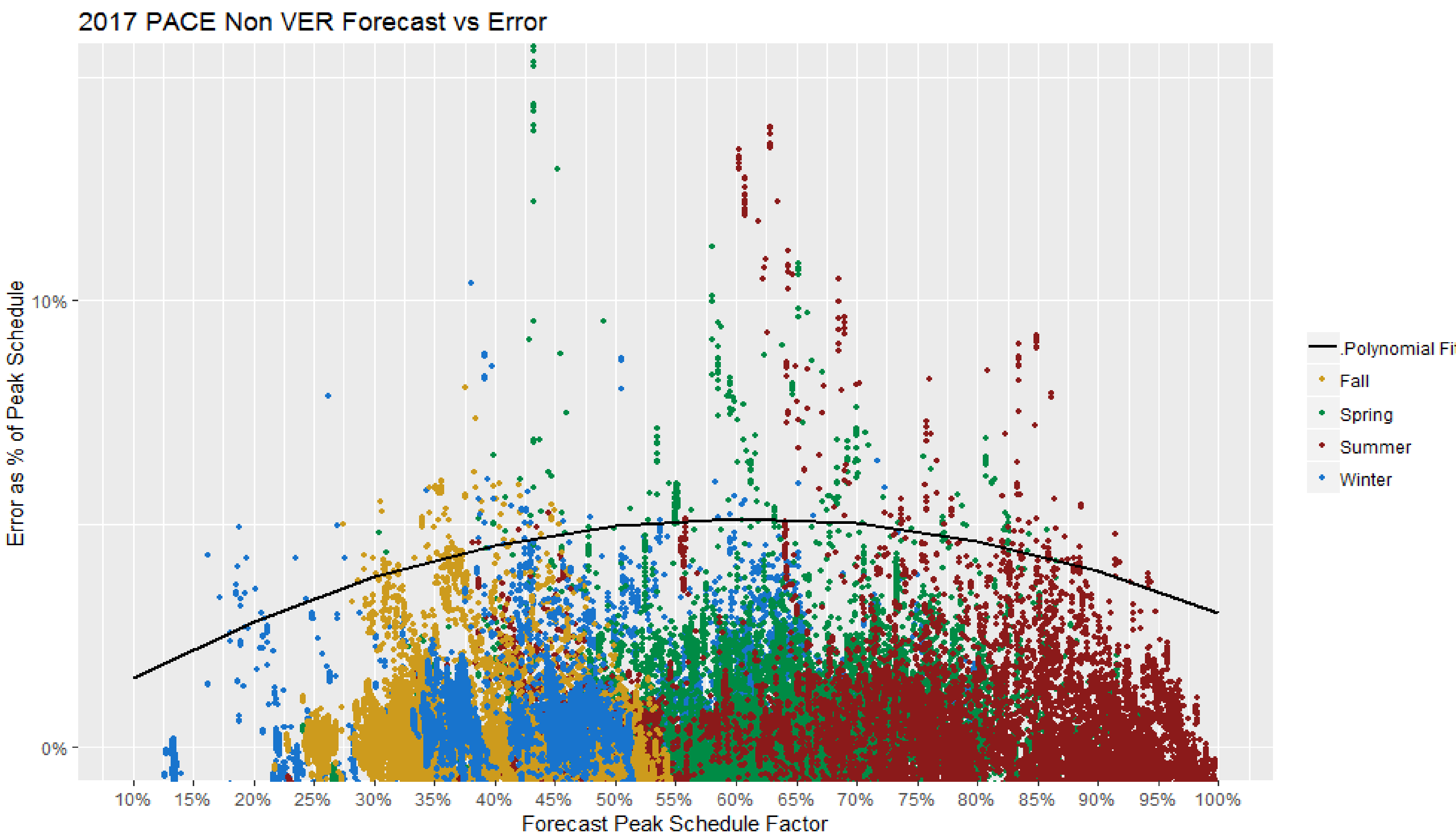
- Polynomial quantile regression such that exceedance events contribute to a LOLP of 0.5 hours on a combined portfolio basis.

Load Regulation Reserve Forecast



- Polynomial quantile regression such that exceedance events contribute to a LOLP of 0.5 hours on a combined portfolio basis.

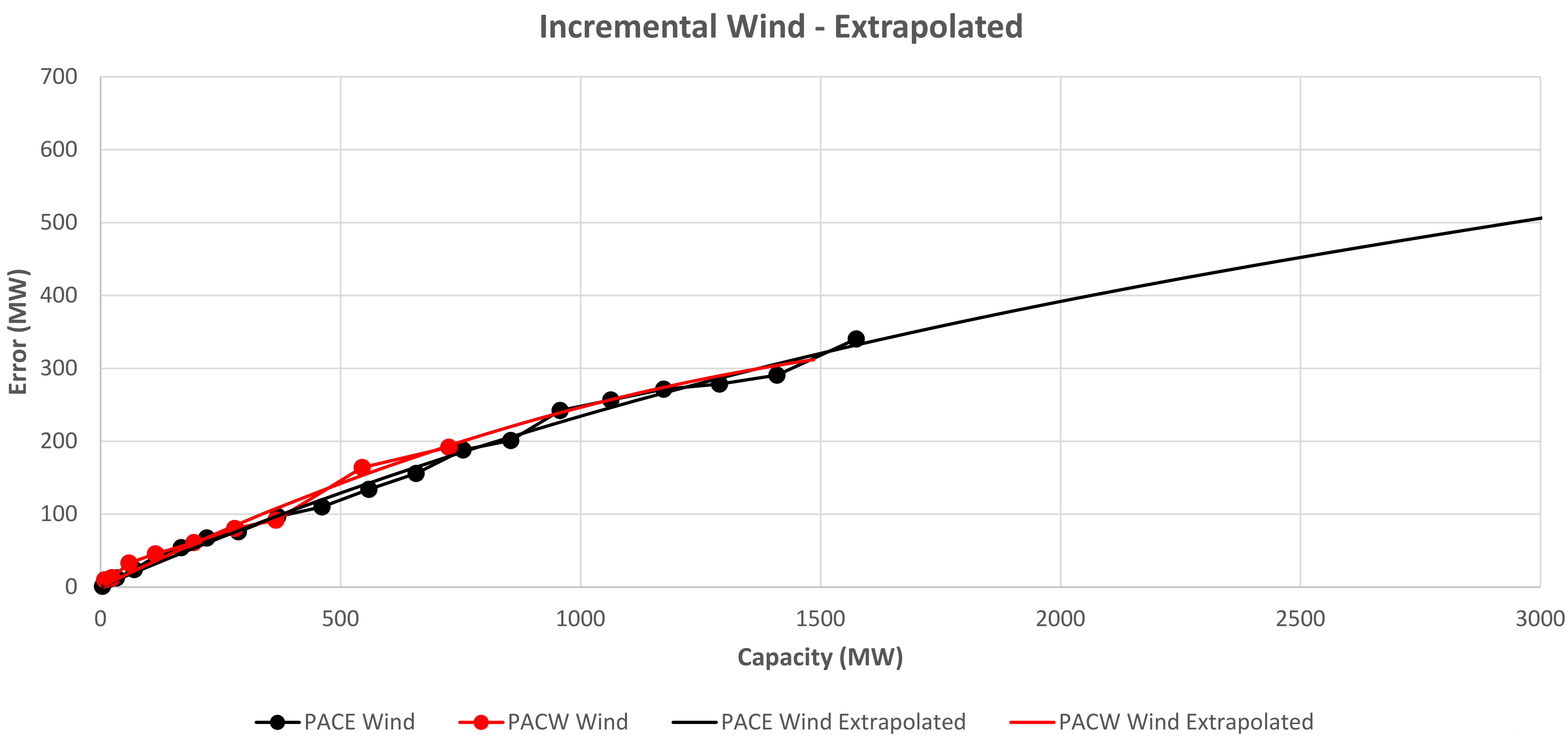
Non-VER Regulation Reserve Forecast



- Polynomial quantile regression such that exceedance events contribute to a LOLP of 0.5 hours on a combined portfolio basis.

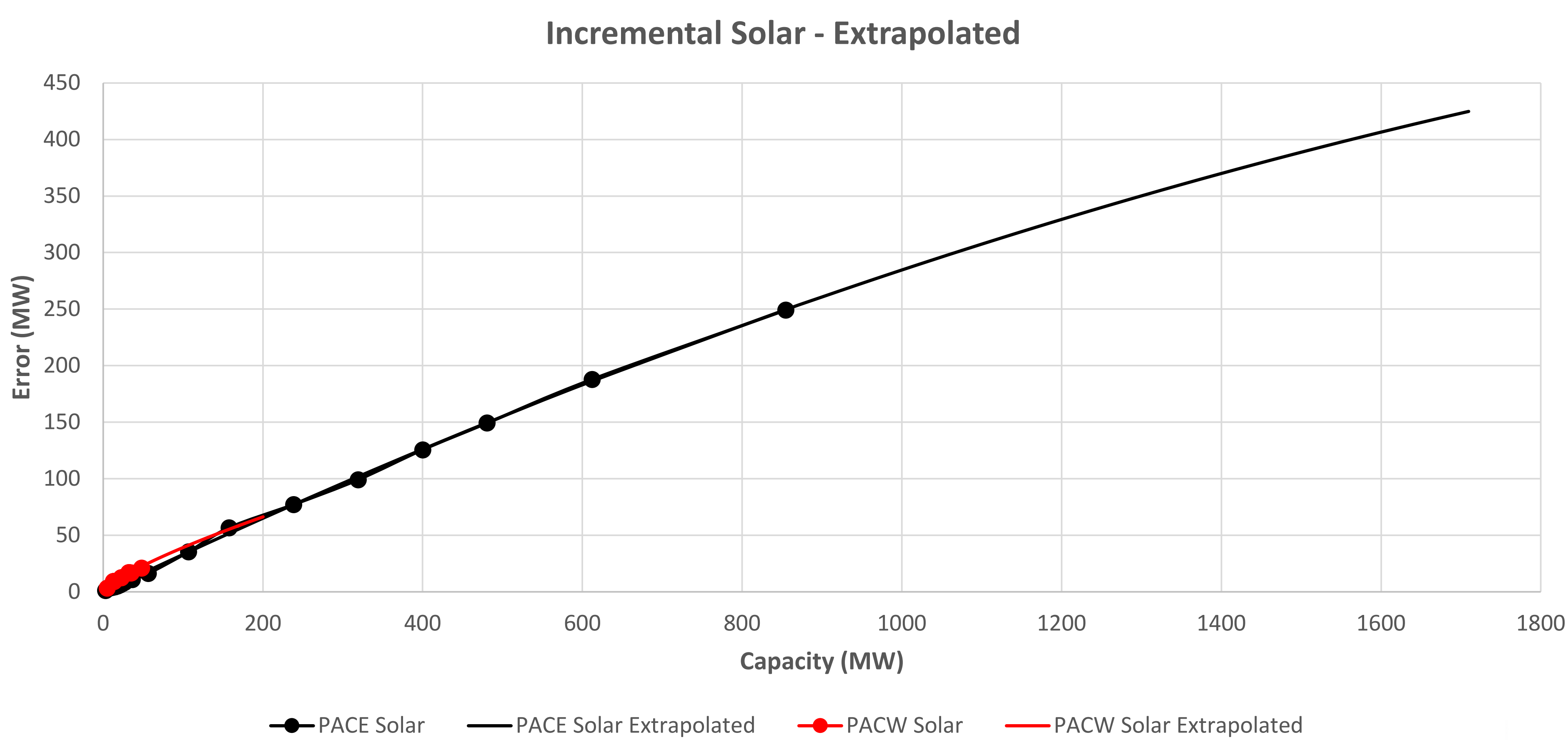
Incremental Wind Regulation Reserve

- Wind resources were stacked incrementally and cumulatively, then the trend in the increase of errors, at the relevant percentile, was extrapolated.
- Regulation reserve requirements increases in a declining non-linear fashion.
- This reflects geographical diversity benefits and general forecast stability associated with a larger scale.



Incremental Solar Regulation Reserve

- Solar resources were stacked incrementally and cumulatively, then the trend in the increase of errors, at the relevant percentile, was extrapolated.
- Regulation reserve requirements increases in a declining non-linear fashion.
- This reflects general forecast stability associated with a larger scale.



EIM Diversity Benefit

- Each EIM participating BAA (entity) must pass certain hourly tests to ensure they are not “leaning” on other participants.
- If certain tests are passed, the entity is allowed to participate in the EIM for that hour.
- As part of its market, the CAISO calculates a diversity benefit which allocates the diversity of the combined EIM footprint to each entity.
- PacifiCorp included this diversity benefit as a credit to the flexible capacity requirements.

2018 Flexible Reserve Study Results

Scenario	Stand-alone Regulation Forecast (aMW)	Stand-alone Rate (%)	Portfolio Regulation Forecast (aMW)	Portfolio Rate (%)	2017 Capacity (MW)	Rate Determinant
Non-VER	110	5.7%	70	3.7%	1,912	12 CP
Load	305	3.0%	195	1.9%	10,044	12 CP
VER - Wind	434	15.8%	277	10.1%	2,750	Nameplate
VER - Solar	145	14.8%	93	9.5%	983	Nameplate
Total	**994**		**635**			
Total with EIM			**531**			
Portfolio Confidence Interval			99.35%			
Portfolio LOLP (hours/year)			0.53			
Diversity Savings (%)			36%			

- A total portfolio requirement of 531 MW approximates the reliability target of 0.5 hours per year.

2019 IRP – Technical Review Committee

- PacifiCorp established a technical review committee (TRC) of industry experts in the 2013 IRP to provide formal review and feedback on its wind integration study.
- The TRC has continued to provide valuable feedback as the wind integration study has evolved in recent IRPs with the inclusion of solar integration costs in what has been referred to as the Flexible Reserve Study (FRS) starting in the 2017 IRP.
- PacifiCorp has engaged the TRC for the 2019 IRP FRS.
- The TRC in response has expressed its belief that PacifiCorp's study is well-established and that the same need for a formal TRC review no longer exists.
- Two of the four members however, have indicated they will provide feedback, if any, in early September 2018.
- PacifiCorp held a conference call with TRC members in August 2018 and will hold a final conference call in September 2018.

Market Reliance Assessment



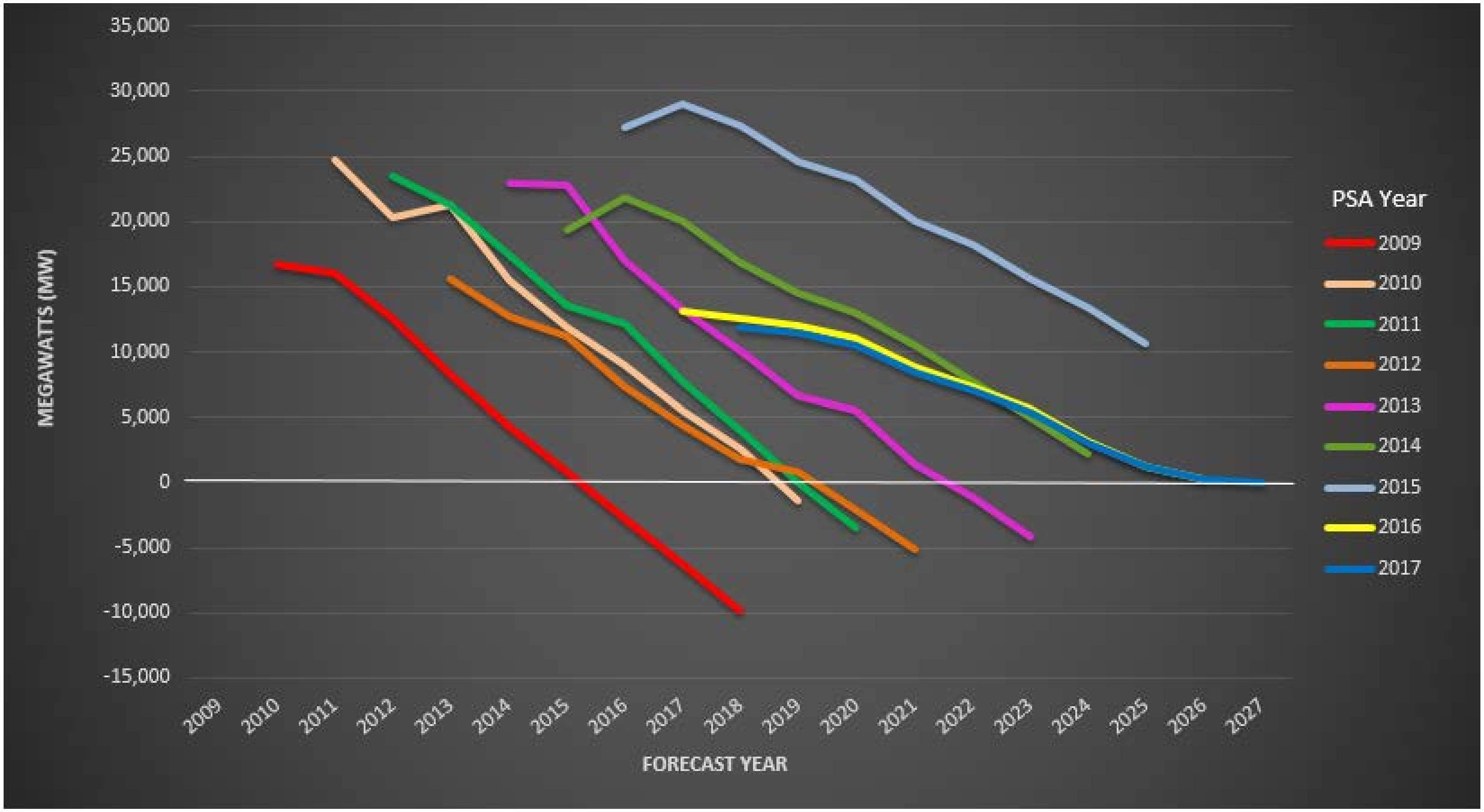

PACIFICORP
POWERING YOUR GREATNESS

Front Office Transaction Limits

Market Hub/Proxy FOT Product Type	Availability Limit (MW)			
	2019		2017	
	Summer (July)	Winter (December)	Summer (July)	Winter (December)
Mid-Columbia (Mid-C)				
Flat Annual or Heavy Load Hour	400	400	No Change	
Heavy Load Hour	375	375	No Change	
California Oregon Border (COB)				
Flat Annual or Heavy Load Hour	250	250	Reduced to 250 from 400	
Nevada Oregon Border (NOB)				
Heavy Load Hour	100	100	No Change	
Mona				
Heavy Load Hour	300	300	No Change	
Total	**1,425**	**1,425**	**1,575**	**1,575**

- Limits represent maximum ***available*** front office transaction (FOT) capacity resource by market hub
- The total 2019 IRP FOT limit is 1,425 MW, reduced from 1,575 MW in the 2017 IRP
- COB decrease of 150MW reflecting expired reservation and review of historical derates
- Annual flat products are “7x24”; heavy load hour (HLH) products are “6x16”
- PacifiCorp develops its FOT limits based on active participation in wholesale power markets, its view of physical delivery constraints, market liquidity/depth, and with consideration of regional resource supply.

WECC Power Supply Margin (PSM)



- The first PSM deficit year of each study has shifted to a later year with each update
- After 2013, no deficit years appear within the 10-year study period
- WECC 2017 data estimated based on a 5% reduction from 2016 PSA values; summer margins in the upcoming (Dec 2018) WECC PSA are expected to remain positive
- 2016 and 2017 trends are consistent with flattening loads
- This data assumes existing resources, net transfers and resources under construction

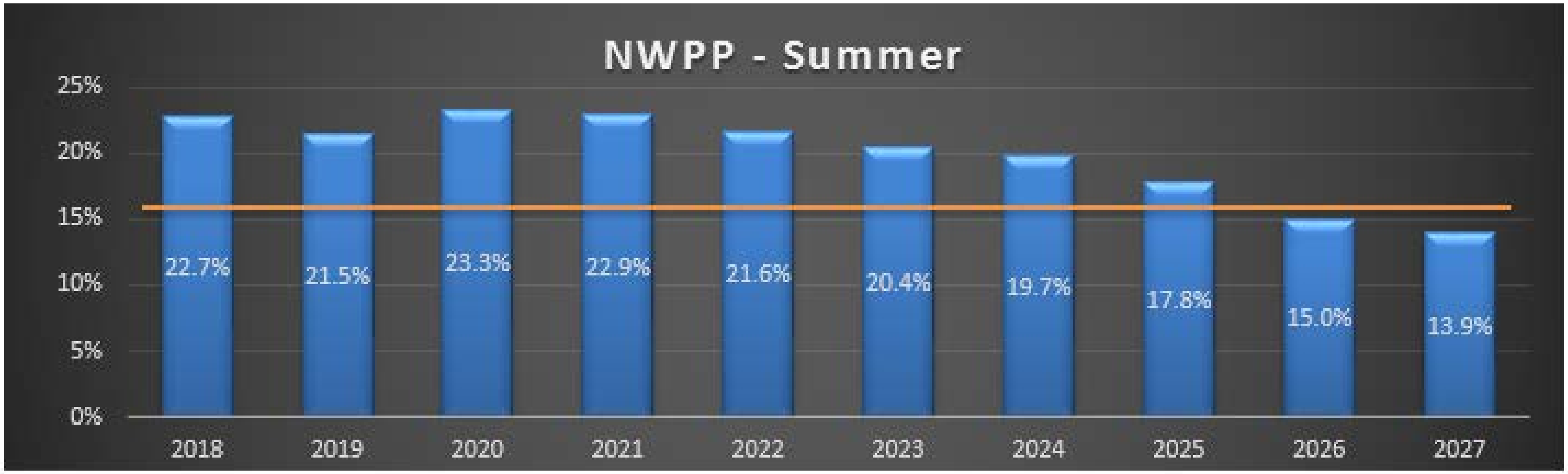
WECC Planning Reserve Margin by Region

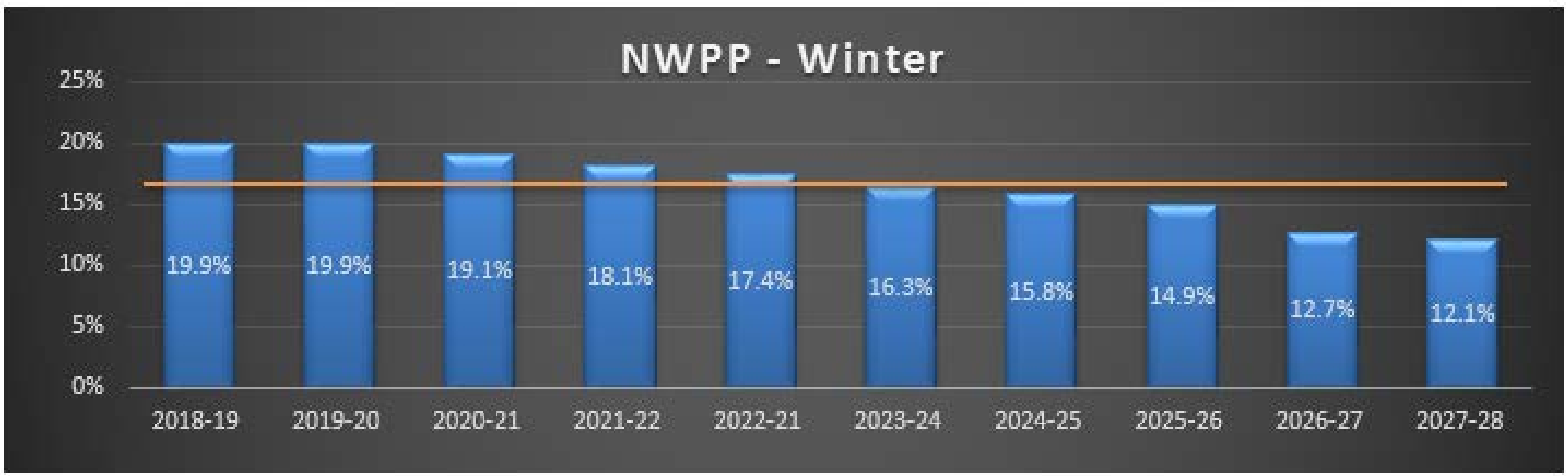
Summer		PRM by Year (subject to new developments)									
Subregion	**Target PRM**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**	**2027**
NWPP	**15.20%**	22.7%	21.5%	23.3%	22.9%	21.6%	20.4%	19.7%	17.8%	15.0%	13.9%
RMRG	**14.14%**	22.0%	19.3%	17.1%	15.1%	14.7%	14.7%	14.6%	11.7%	11.5%	11.5%
SRSG	**15.82%**	18.4%	16.2%	16.1%	12.6%	12.5%	12.5%	12.4%	12.4%	12.4%	12.3%
CA/MX	**16.16%**	14.1%	15.3%	15.1%	16.3%	14.7%	13.8%	12.4%	11.0%	11.0%	10.6%
WECC Total	**15.37%**	19.1%	18.6%	18.2%	17.5%	16.0%	15.0%	13.9%	12.3%	11.1%	10.5%

Winter		PRM by Year (subject to new developments)									
Subregion	**Target PRM**	**2018-19**	**2019-20**	**2020-21**	**2021-22**	**2022-21**	**2023-24**	**2024-25**	**2025-26**	**2026-27**	**2027-28**
NWPP	**16.70%**	19.9%	19.9%	19.1%	18.1%	17.4%	16.3%	15.8%	14.9%	12.7%	12.1%
RMRG	**11.65%**	54.5%	46.8%	43.4%	39.6%	36.6%	34.5%	32.4%	30.1%	28.3%	26.2%
SRSG	**12.11%**	96.6%	96.0%	91.5%	89.2%	84.8%	80.0%	75.9%	72.1%	68.3%	64.7%
CA/MX	**13.50%**	14.3%	14.9%	15.8%	17.2%	13.8%	15.3%	14.6%	12.9%	13.2%	13.6%
WECC Total	**14.27%**	30.3%	29.9%	29.2%	28.5%	26.7%	24.9%	23.8%	22.5%	21.2%	20.3%

- WECC in total meets its overall PRM target in winter and falls short in summer 2023
- Northwest Power Pool (NWPP), the region in which PacifiCorp operates, barely falls below target in 2026 in the summer and in 2023-24 in the winter.
- WECC data includes existing resources, net transfers plus resources under construction; recent PacifiCorp projects such as EV2020 are not included
- WECC 2017 data estimated based on a 5% reduction from 2016 PSA values.

WECC – NWPP Region





- WECC - Northwest Power Pool (NWPP) Planning Reserve Margin forecast year 2018 -2027 for both winter and summer

External Studies

- Updated forecasts indicate Pacific Northwest energy and capacity surplus will become deficit between 2021 and 2026.
- Similar to the trend in the WECC forecasts on slide 4, the identified deficit years shift to a later year in updated studies:
    1. NPCC: “Pacific Northwest Power Supply Adequacy Assessment for 2022” - deficit year 2021 → 2022
    2. PNUCC: “2017 Northwest Regional Forecast” - Winter peak deficit year 2020 → 2021
    3. BPA: “2017 Pacific Northwest Loads and Resources Study” deficit year 2020 → 2021
- Similar to WECC, these external studies conservatively restrict resources according to planning and construction status, would not yet include EV2020, and additionally assume extreme hydro conditions
- External studies do not consider PacifiCorp’s unique circumstances:
    - Access to multiple market hubs
    - Diverse geographic location of resources and transmission (e.g., California / EIM)

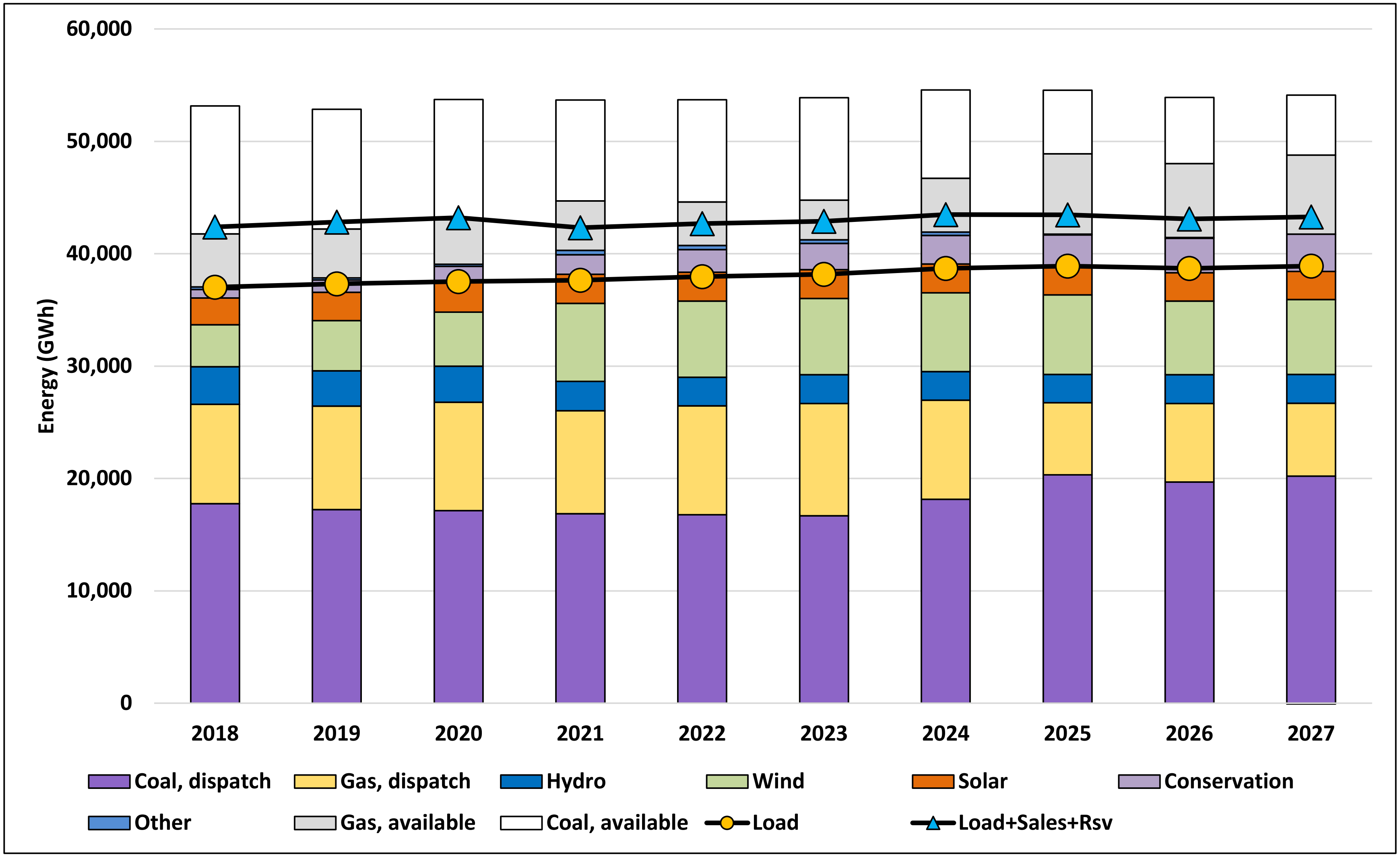
PacifiCorp Position Overview

The next three slides, developed from PacifiCorp's 2017 IRP update, progress from annual to hourly views of system position.

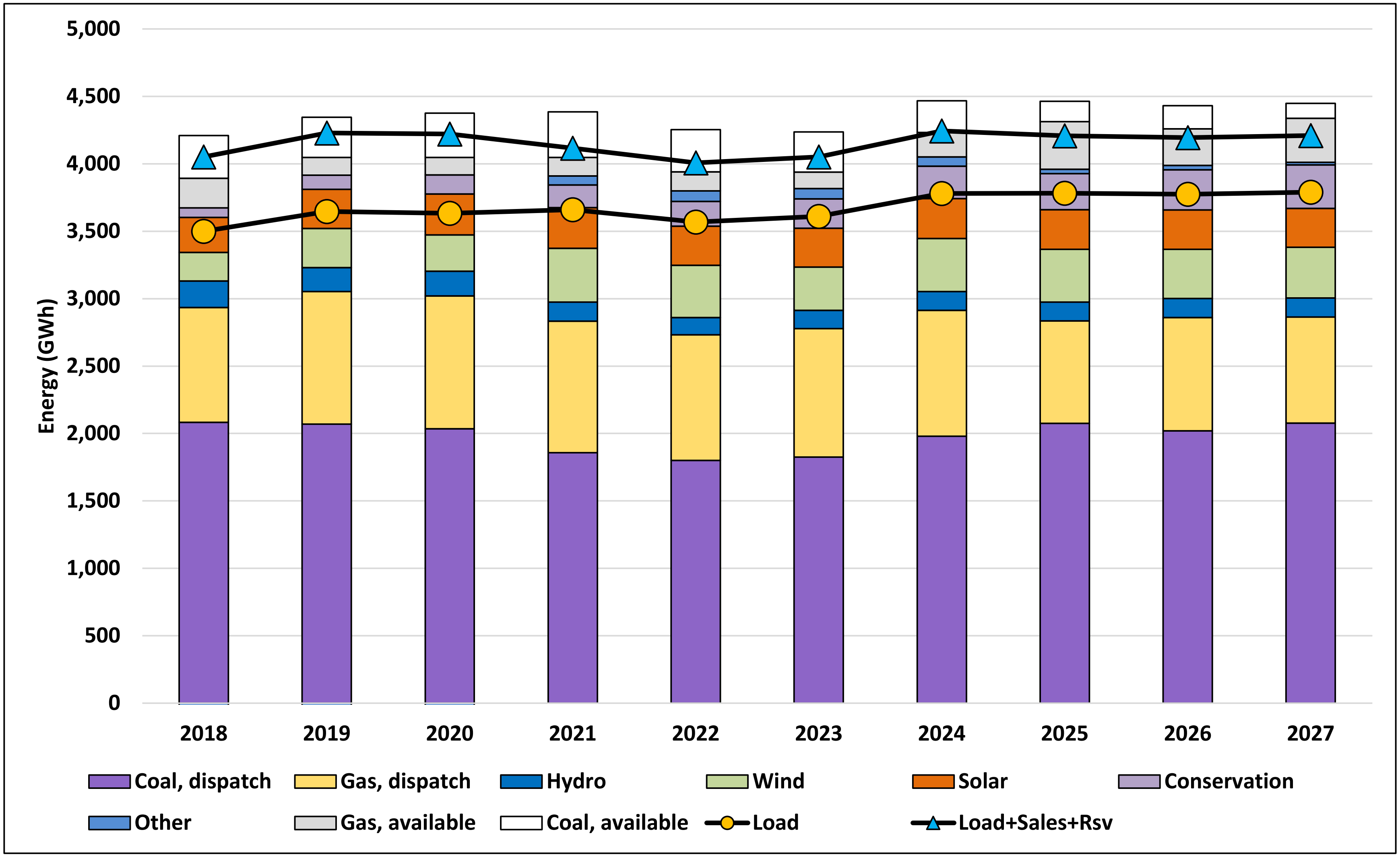
- Annual Heavy Load Hour(HLH) position
- Peak Heavy Load Hour month position
- Peak day position

In each slide, energy position is compared to a load target, where load includes projected sales and reserve requirement. The gap between energy and load are met by market purchases, but in many cases could have been met by other system resources.

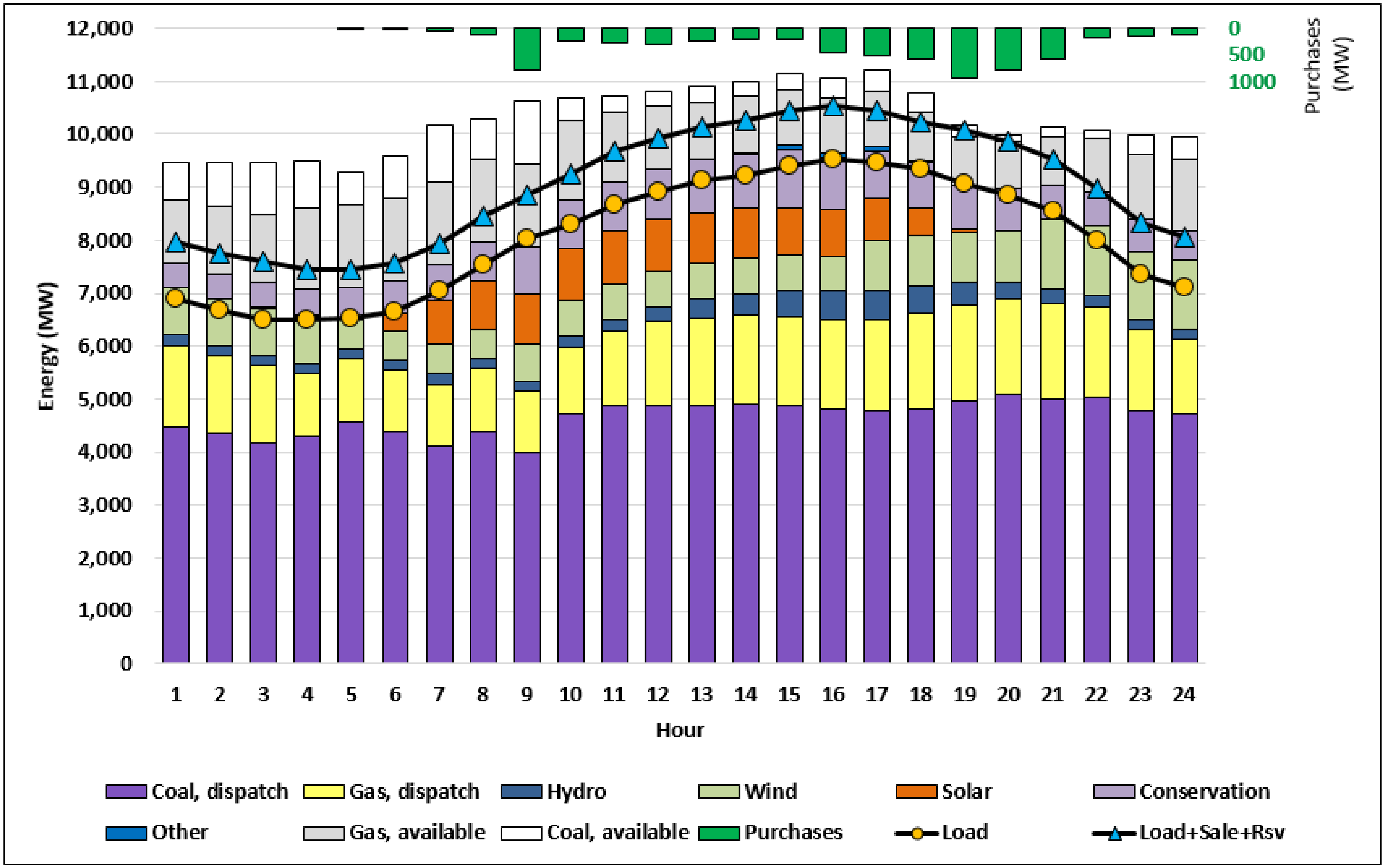
System Annual HLH Position



July Monthly HLH Position

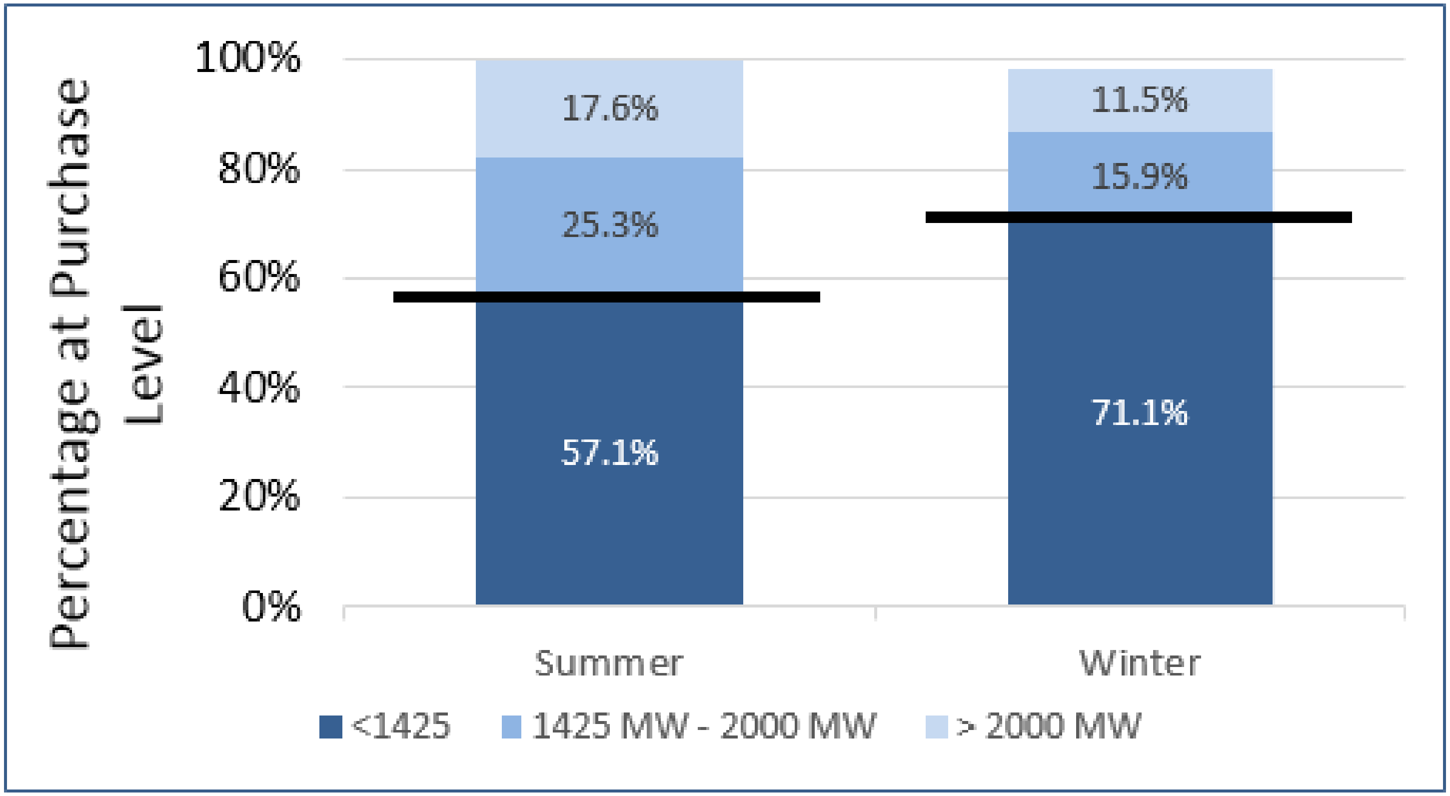


Sample July Peak Day Position



- Sample forecast day from mid-July, 2027

PacifiCorp Market Purchases



- PacifiCorp reviewed its hourly purchases in December and January from 2009 through 2017
- December and January reflect peak load months when market purchases may be constrained
- From 2009 to 2017, 27% of winter peak load hour purchases were more than 1,425 MW
- From 2009 to 2017, 43% of summer peak load hour purchases were more than 1,425 MW
- PacifiCorp's lower purchases in winter reflect lower load requirements relative to the summer peak time period.

Conclusion

Front office transactions will be limited to 1,425 MW as a capacity resource, down from 1,575 MW in the 2017 IRP.

- The FOT limit reduction is due to the COB decrease 400 MW to 250 MW in the 2019 IRP.
- NWPP margins have been robust, and are expected to be similar in the December update.
- Updated external studies continue to shift shortfalls to later years.
- PacifiCorp continues to find sufficient market depth for transactions in actual operations.
- Outside of COB, no additional changes to the FOT limits are assumed for the 2019 IRP.

Planning Reserve Margin Study

Planning Reserve Margin Study Updates

- Planning reserve margin (PRM) studies are currently underway. The following slides build on the methodology discussion from the July 26-27, 2018 public input meeting.

- Planning reserve margin (PRM) is expressed as a percentage of coincident system peak load.

- The purpose of the PRM is to ensure that IRP portfolios a) meet customer load b) while maintaining operating reserves, c) meeting a one day in 10 year reliability target, d) at a low reasonable cost.

- The 2019 IRP PRM selection is made by analyzing:
  - Relationships between reliability modeling and production cost modeling results
  - PRM cases range from 11% to 18% in the target year (2030)
  - Bookend cases will be run for years 2022 and 2036

PRM Update Overview

- 2017 IRP Update assumptions with updated load forecast and June 2018 OFPC.
- Front office transaction reserve credit of 6% has been lowered to 3%, reflecting the 3% of generation requirement.
- Market purchases above FOT limits in PaR are eliminated.
- Planning capacity factors (PCF) have been adjusted based on updated analysis:
  - Solar
  - Demand-side management
  - Natural gas

Market Purchases

- The System Optimizer (SO) planning limit for FOT selection as a capacity resource in the 2019 IRP is 1,425 MW in both summer and winter.

- In past IRPs, Planning and Risk (PaR) has allowed for market balancing purchases up to transmission limits for the purpose of valuing portfolios in all months of the year.

- In the 2017 IRP, all PRM levels met PaR loss of load hour (LOLH) requirements, relying on market purchases.

- In the 2019 IRP, PaR market purchases will be restricted to FOT limits in all months of the PRM models.

- This change will make PaR reliability measures consistent with market reliance assumptions, and allow the impact of market purchase reliance to be assessed in reliability analysis.

Planning Capacity Factor Updates

- Interruptible Load (Class 1 DSM)
  - Limits on hours per day and hours per year reduce capacity contribution.
  - Applied CF approximation method to each interruptible program.
  - PCF reduced by a weighted average of 11%, ranging from -2% to -22% by program.
  - Summer availability expanded to June through September

- Energy Conservation/Efficiency (Class 2 DSM)
  - Limits on hours per day and hours per year limit capacity contribution
  - PCF reduced by a weighted average of 15%, ranging from -24% to +13% by bundle.

- Solar
  - 2030 solar resource PCF was measured relative to a case with no solar.
  - East solar has an overall effective capacity contribution of 29.3%, down from 37.9% for fixed and 59.7% for tracking.
  - West solar has an overall effective capacity contribution of 35.6%, down from 53.9% for fixed and 64.8% for tracking.

- Natural Gas
  - Past IRPs have relied on monthly average temperature impacts.
  - The 2019 IRP will use a summer peak temperature to improve consistency with peak capacity needs.
  - PCF values are currently being determined.

Capacity Contribution Study




Capacity Contribution Studies

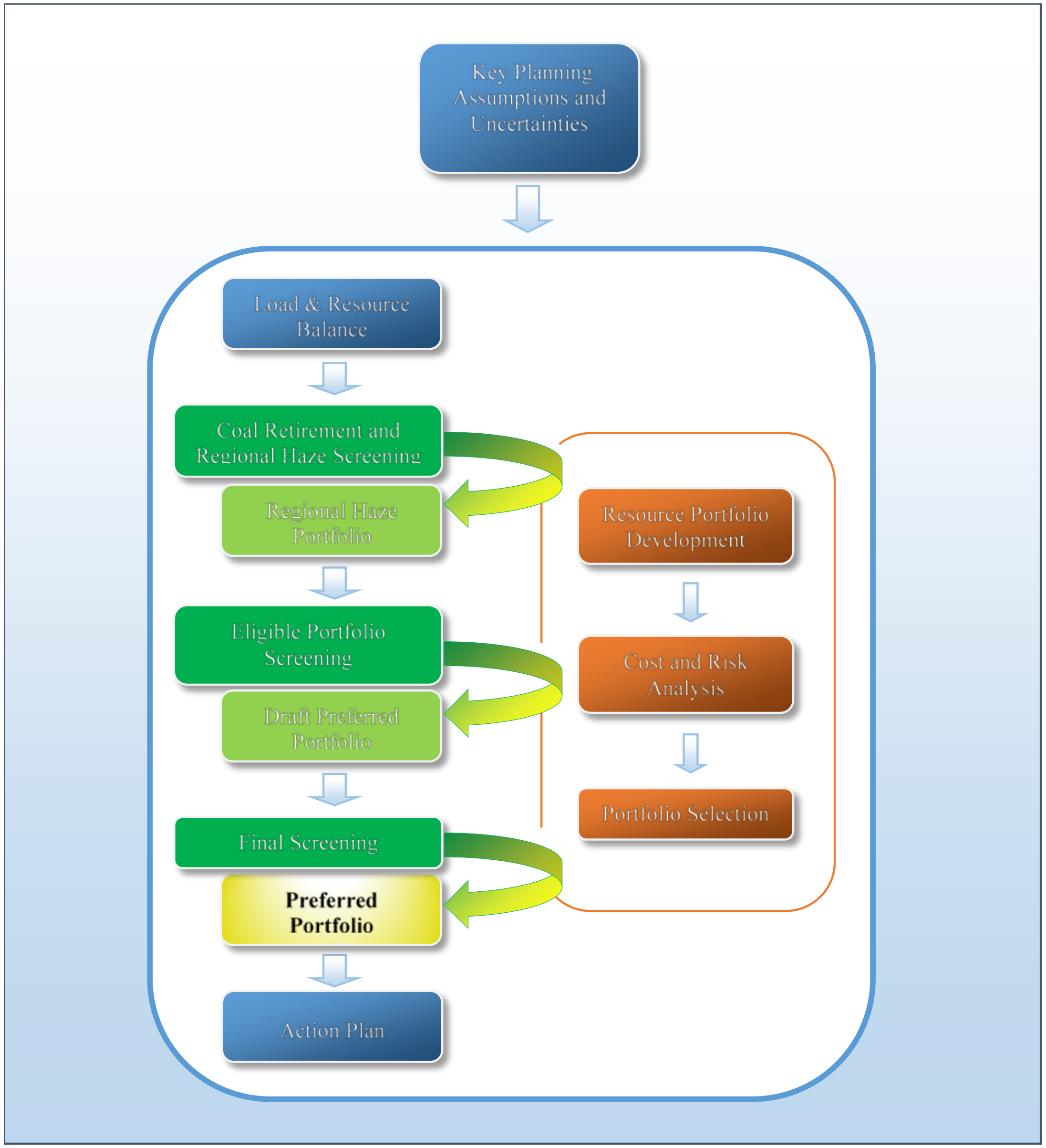
- No changes to the methodology are anticipated from the capacity contribution methodology presented at the July 26-27, 2018 public input meeting.
    - The target reliability measure from the PRM study will inform the capacity contribution study.
    - Wind and solar capacity contribution calculations (east and west):
        - Existing wind
        - Existing solar (fixed tilt and tracking)
        - New wind
        - New solar (fixed tilt and tracking)
- Studies to determine final solar and wind capacity contributions will be conducted once the final planning reserve margin studies are complete, and the final PRM available.
- Updated wind and solar capacity contribution figures will be used to develop the load and resource balance and will be used when developing resource portfolios.

Portfolio Development Process / Initial Sensitivity Studies




PACIFICORP
POWERING YOUR GREATNESS

Portfolio Development



- Objective: Identify the best mix of resources to serve customers in the future (20-year planning period).
- The best mix of resources is identified through analysis that measures costs and risks.
- The least-cost, least-risk portfolio, designated as the preferred portfolio, drives specific action items (*i.e.*, issuance of an RFP) with a focus on the first two to four years of planning period.

Portfolio Development

- Resource Portfolio Development (System Optimizer Model)
  - Identify resource portfolios that meet projected resource needs with a target Planning Reserve Margin.
  - Each portfolio is unique; characterized by type, timing and location of new resources.
  - Diversity in resource portfolios is a key element of the process achieved by defining a range of “case definitions”, which reflect assumptions that drive different resource outcomes (i.e., environmental and tax policies, wholesale power and natural gas prices, etc.).
  - Ultimately one portfolio is selected as the “preferred portfolio”.
- Cost and Risk Analysis (Planning and Risk Model)
  - Perform additional modeling to produce metrics to support comparative cost and risk analysis among the portfolio alternatives – all portfolios are assessed using the same planning assumptions.
  - Stochastic risk modeling using Monte Carlo random sampling of stochastic variables.

Portfolio Evaluation and Selection

- Preliminary and initial screening based primarily of review of cost and risk trade-offs (scatter plots – stochastic mean PVRR vs. upper tail mean PVRR).
- Remaining portfolios are ranked:
  - Primary metric is a risk-adjusted PVRR metric
  - Additional selection criteria are considered for relative portfolio differences in areas such as supply reliability, CO_2 emissions and customer rate impacts
- Final selection may also consider results of deterministic risk analysis modeling, resource diversity and other supplemental modeling results.

Study Development Process

Coal Retirement and Regional Haze Analysis → Core Resource Portfolios → Sensitivity Cases → Preferred Portfolio Selection

- PacifiCorp will conduct robust analysis of potential coal retirement and Regional Haze cases, including an endogenous retirement case, among a range of market price and future greenhouse gas policy assumptions to inform assumptions used in core resource portfolios for existing coal units.
- Core resource portfolios include an optimized portfolio and supplemental portfolios targeting specific types of resources.
  - Promotes portfolio diversity and resources having operating characteristics not valued in System Optimizer to be analyzed in Planning and Risk during the cost and risk analysis phase of the portfolio development process.
- Cost and risk analysis performed using the Planning and Risk model will include market price and future greenhouse gas policy assumptions.
- Sensitivity cases will be informed by modeling results from core cases.
  - PacifiCorp has identified initial sensitivity cases but will consider additional sensitivities.
  - As appropriate, sensitivity cases can be used to select a preferred portfolio, inform the action plan, and inform acquisition path analysis.

Examples Only – Core Cases

Resource Class	Case 1 (OP-1)	Case 2 (FR-1)	Case 3 (FR-2)	Case 4 (RE-1)	Case 5 (RE-2)	Case 6 (DLC-1)
Flexible Resources	Optimized	10% of Incremental L&R Balance	20% of Incremental L&R Balance	10% -20% of Incremental L&R Balance	10%-20% of Incremental L&R Balance	Optimized
Renewable Resources	Optimized	Optimized	Optimized	Just-in-Time Physical RPS Compliance	Early Physical RPS Compliance	Just-in-Time Physical RPS Compliance
Class 1 DSM Resources	Optimized	Optimized	Optimized	Optimized	Optimized	5% of Incremental L&R Balance
All Other Resources	Optimized	Optimized	Optimized	Optimized	Optimized	Optimized

- Core Cases for the 2019 IRP have not yet been developed. The table above are examples considered in the 2017 IRP process.
- In the 2017 IRP, core cases included an optimized portfolio and supplemental portfolios targeting specific types of resources.
- This approach was implemented to promote portfolio diversity and to ensure resources having operating characteristics not valued in System Optimizer could be analyzed in Planning and Risk during the cost and risk analysis phase of the portfolio development process.

Initial List of Sensitivity Studies

- The following set of sensitivities is not exhaustive. The list of sensitivities can be expanded and/or modified based on observations from model results or stakeholder feedback:
  - Load Growth (Low/High and 1 in 20)
  - Private Generation (Low/High)
  - Energy Gateway Transmission
  - Energy Storage (if not selected in core case portfolios)
  - Business Plan (in accordance with Utah requirements)
  - CO_2 Price Sensitivities (social cost of carbon)
  - Other/TBD

Additional Information and Next Steps




Process Improvement Items

- Discussion of recommendation to start meetings a half hour early
- Discussion of recommendation to shorten lunch to 45 minutes and at times, hold working lunches
- Discussion to recap stakeholder feedback form activity

Draft Topics for Upcoming PIMs*

September 27-28, 2018 PIM* / November 1-2, 2018 PIM*:

- Initial Load & Resource Balance
- Coal Studies
- MSP update
- OFPC / price-policy scenarios
- Transmission

December 3-4, 2018 PIM*:

- Core Cases / Sensitivity Cases for Modeling

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

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:
  - September 27-28, 2018
  - November 1-2, 2018
  - December 3-4, 2018
  - January 24-25, 2019
  - February 21-22, 2019
  - March 2019 – *TBD /as needed*
  - *April 1, 2019 – 2019 IRP File Date*