Integrated Resource Plan

2021 IRP Public Input Meeting

January 29, 2021




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Agenda

- 9:00am-9:15am pacific - Introductions
- 9:15am-9:30am pacific - Multi-State Process/Nodal Pricing Model/Extended Day-Ahead Market Update
- 9:30am-9:45am pacific - Private Generation and Load Forecast Update
- 9:45am-10:30am pacific - Energy Efficiency and Renewable Resource Shapes
- 10:30am-11:15am pacific - Energy Efficiency Bundling Methodology
- 11:15am-11:45am pacific - 2020 All-Source Request for Proposals Update
- 11:45am-12:00pm pacific - Stakeholder Feedback Form Update

Nodal Pricing, Multi-State Process (MSP), and Extended Day-Ahead Market (EDAM)




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Nodal Pricing, MSP, and EDAM Update

MSP

The 2020 Protocol inter-jurisdictional cost allocation methodology is effective for the period of January 1, 2020 to December 31, 2023.

The 2020 Protocol extends the 2017 Protocol with certain modifications.

The Protocol also establishes a basis for the next inter-jurisdictional cost allocation, with issues divided into two categories: Resolved Issues and Framework Issues.

It is anticipated that the Framework Issues are resolved before the expiration of the 2020 Protocol or December 31, 2023.

Nodal Pricing

The nodal pricing model provides a way for PacifiCorp to continue to operate on a least cost, system basis while tracking net power costs by state.

Nodal pricing is an important component of the next inter-jurisdictional cost allocation methodology as it is anticipated that states will have unique resource portfolios.

Nodal pricing is not a component that affects modeling in the IRP. however, the 2021 IRP will include a qualitative discussion on nodal pricing.

EDAM

PacifiCorp is a leader in establishment of the Western Energy Imbalance Market (EIM) which to date since its start in 2014 has realized over $1.112 billion in gross benefits among its participants with PacifiCorp's share of those benefits at $265.01 million.

PacifiCorp has been an active participant in stakeholder efforts to develop a voluntary day-ahead market (EDAM), at the California Independent System Operator (CAISO).

Implementation was targeted for October 2022 but has been delayed due to recent summer reliability and wildfire events.

Private Generation Study Update




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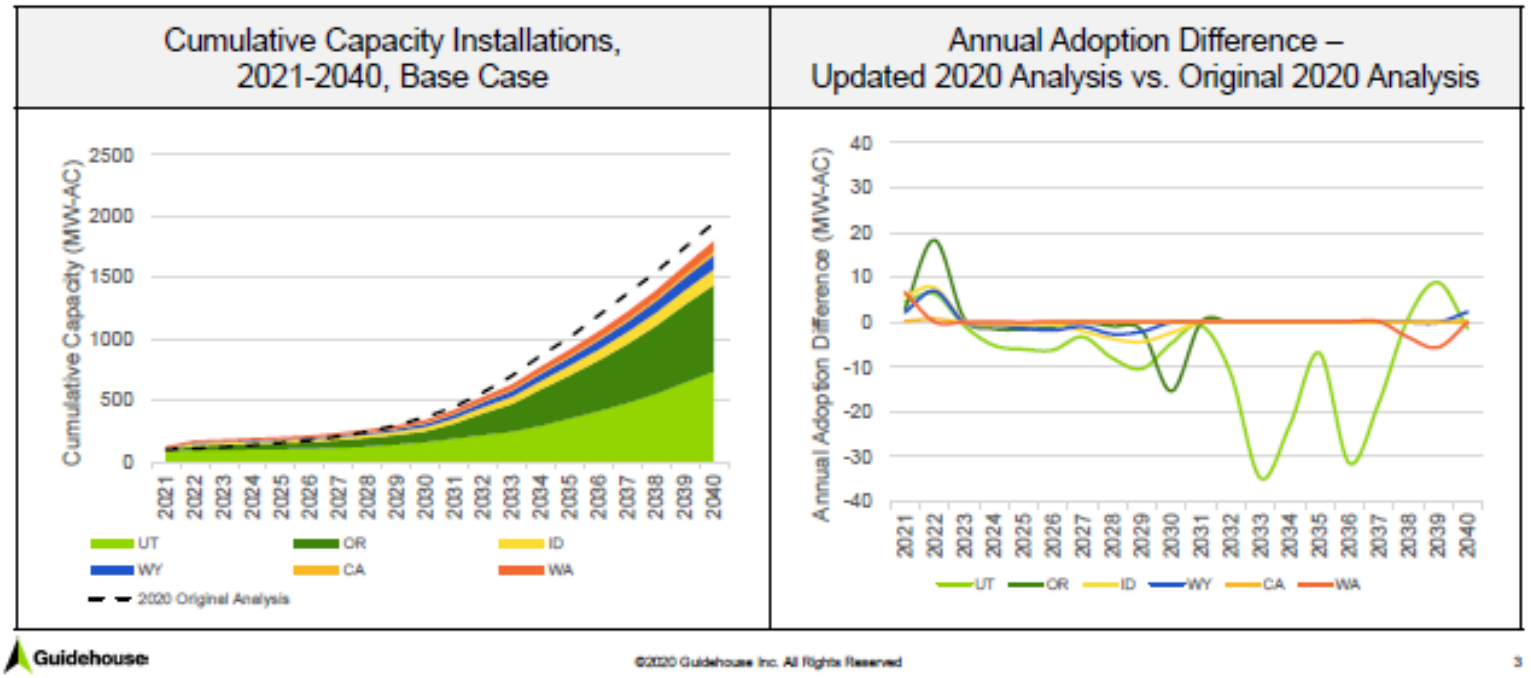
Private Generation Study – Base Case Updated ITC Schedule

- The Federal Investment Tax Credit (ITC) rules were changed in December 2020 as part of the U.S. coronavirus relief package. The analysis below includes the impacts of the new ITC rules. No other changes were made to the analysis inputs.



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- Impact on load forecast is anticipated to be minimal.

Energy Efficiency and Renewable Resource Shapes




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Overview

Weather is a major driver of PacifiCorp's load – in any given month weather results in a range of high and low load conditions.

Weather also impacts energy efficiency savings and renewable resource output.

Past IRPs did not account for the fact that weather can impact the load forecast, energy efficiency savings and renewable resource output all at once.

- In the 2019 IRP, energy efficiency savings on the peak load day may have been understated, because of the mismatch between the load forecast and the energy efficiency savings profiles.
- The 2019 IRP did not assess whether forecasted renewable resource output was consistent with forecasted load conditions.

A realistic representation of the relationship between load and weather-sensitive energy efficiency and renewable resource options is necessary to portfolio selections support reliable system operation.

For the 2021 IRP, PacifiCorp is proposing to reshape the daily volumes from energy efficiency and renewable resources to better align with the load forecast.

- Reshaping changes the pattern of days within each month, but not the total volume.

Load Shapes

- The hourly and daily patterns in the Company's load forecast are chaotic normal:
  - "Chaotic" – the days in the forecast reflect a range of actual conditions based on historical patterns.
  - "Normal" – the forecast represents a median condition – equally likely to be higher or lower
- The jurisdictional hourly models use the 20-year average normal daily weather organized in the chaotic normal weather pattern to create hourly loads with a normal amount of variability.
- The load forecast maintains the same weather on the same day of the week throughout the forecast period by rotating with the calendar for weekdays, weekends and holidays.

Energy Efficiency Shapes

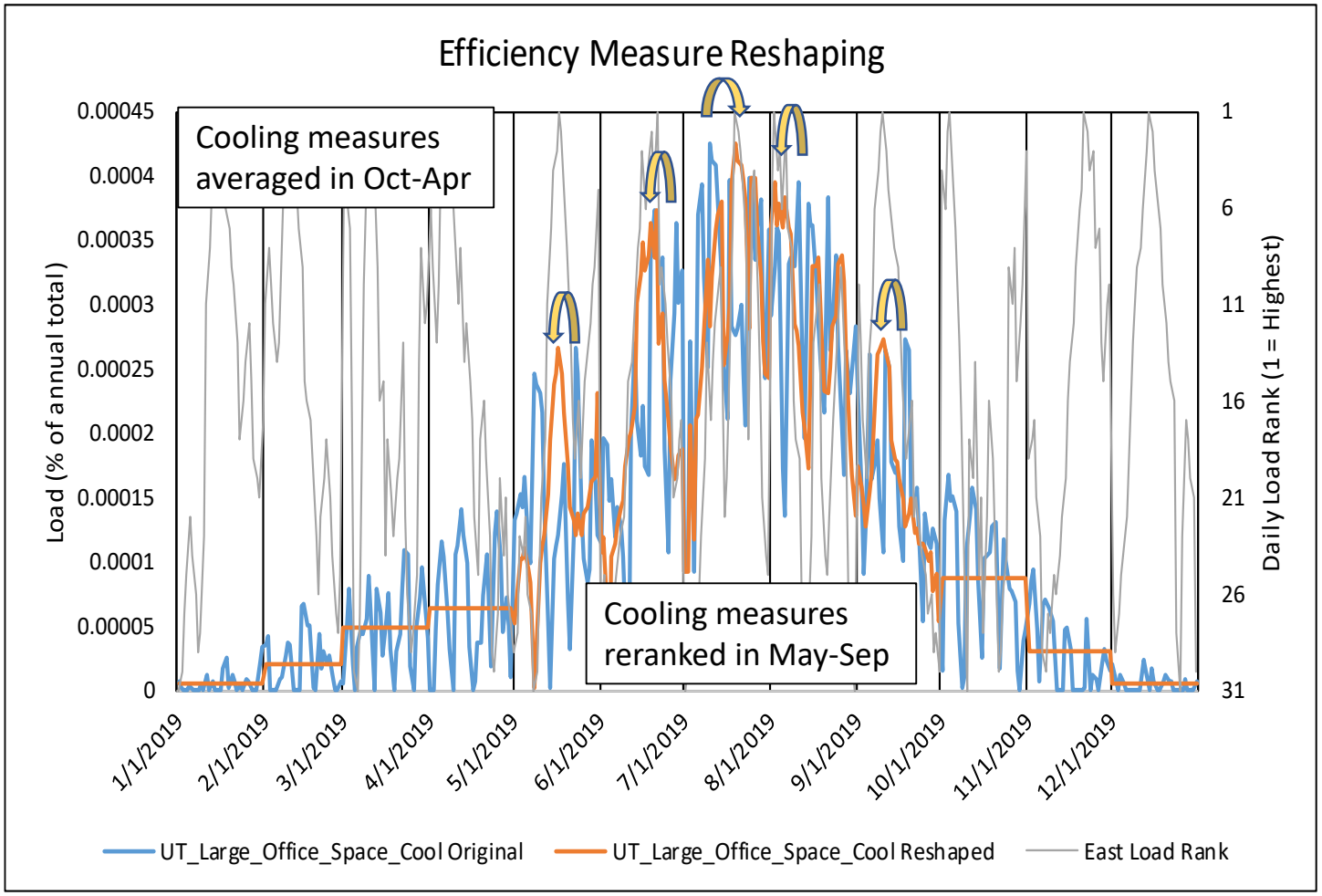
Non-weather-sensitive end uses are derived from Power Council shapes.

- While some variation in end use demand is likely, the aggregate effect over PacifiCorp's service territory will tend toward an average level. To simplify, these measures are now reflected as monthly averages – equal savings on all days in a month. Intra-day shapes are unchanged, for example residential lighting demand is highest in the evening.

Weather-sensitive end uses are simulations tied to weather stations near PacifiCorp's service territory.

- While the simulation produces a reasonable range of values it is not aligned with the weather in PacifiCorp's load forecast.
- Weather drives PacifiCorp's peaks - the highest demand for weather-sensitive end use loads is expected to occur at the time of the peak.
    - For each end use, within its relevant season, the highest simulated savings is mapped to the highest load day (by BAA), 2nd highest savings to the 2nd highest load day, etc.
    - Cooling season: May-September
    - Heating season: October-March
    - Dual season end uses: heat pumps, HVAC auxiliary systems (i.e. ventilation)
- Weather-sensitive shapes rotate with PacifiCorp's load forecast to keep the peak aligned.

Reshaping Example



Reshaping Results Summary

- Higher efficiency savings during high load periods results in higher capacity contributions for weather-related measures.
- The following table shows the estimated impact based on the 2019 IRP loss of load probability (LOLP).

	Average Capacity Contribution											
	19IRP Ranked LOLP			19IRP Average LOLP			Delta (Ranked minus Avg)			Delta (% of Avg)		
Type	**Annual**	**Summer**	**Winter**	**Annual**	**Summer**	**Winter**	**Annual**	**Summer**	**Winter**	**Annual**	**Summer**	**Winter**
Other	56%	56%	58%	56%	56%	58%	0%	0%	0%	0%	0%	0%
Dual-Season	33%	32%	47%	23%	23%	26%	10%	9%	21%	**+45%**	**+41%**	**+80%**
Cooling	51%	55%	1%	37%	40%	1%	14%	15%	0%	**+38%**	**+38%**	**+2%**
Heating	5%	0%	56%	3%	0%	33%	2%	0%	22%	**+65%**	**+0%**	**+67%**

- Energy value is also likely to increase within the production dispatch results.
- Because the MWh of weather-related measures are more targeted, they will be worth more than non-weather-related measures with equivalent levelized cost.
  - *This topic will be addressed further in the Energy Efficiency Bundling section.*

Renewable Resource Shapes

- Renewable resource shapes are derived from 2018 actuals.
- Resources generating during 2018 have profiles that reflect 2018 actuals with adjustments up or down to match expected median output for each month.
- Resources generating during 2018 that have been repowered have profiles that account for the expected change in output with larger blades and generation capacity – relatively more output at lower capacity factors.
- New resources have profiles based on a composite of the closest existing resources of the same type (wind or solar), with adjustments to match expected output.
- Using a single calendar year of data helps ensure realistic correlation between different resources of the same type, and between wind and solar.
- The single calendar year of renewable shapes repeats and does not rotate with the load forecast.
    - ***Wind and solar shapes are not aligned with the weather conditions in PacifiCorp's load forecast.***

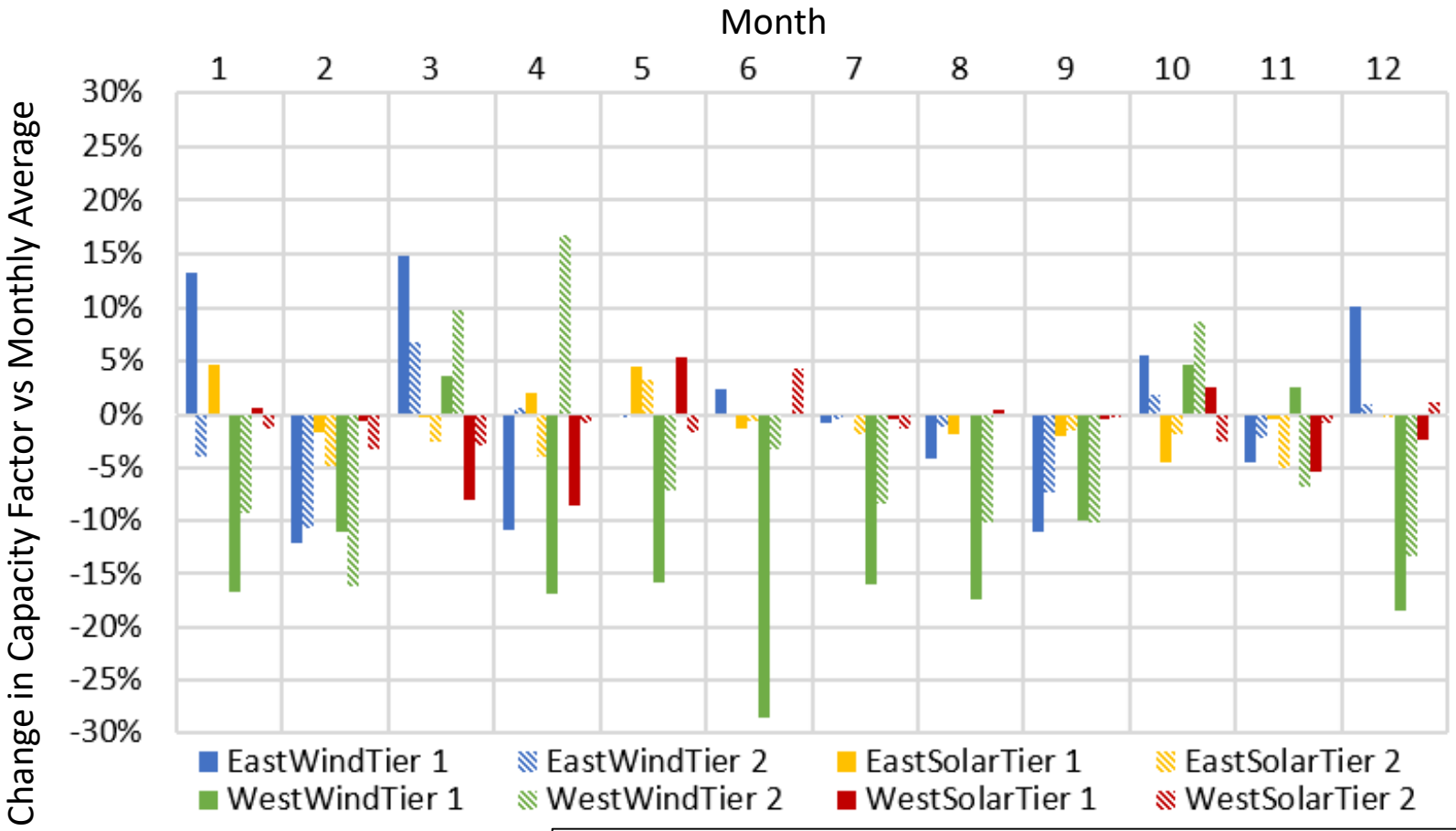
Renewable Resources vs. Actual Load

Data for stochastic analysis is drawn from 2016-2019 actuals, primarily daily averages (hydro is weekly). Standard stochastic evaluation of prices, loads, etc. is based on standard deviations and mean reversion statistics.

Wind and solar output has relationships with load, but they are poorly represented by standard deviations – a different technique is necessary. The same 2016-2019 data set is used (solar data is limited prior to this time).

- Goal is to align the intra-month variations in wind and solar with intra-month variations in load. All months will continue to have the same expected wind and solar output in total.
- Each day in a month is ranked based on its average load and placed in one of seven groups:
  - The peak load day
  - 2^{nd} – 5^{th} highest load days
  - Days 6-10
  - Days 11-15
  - Days 16-20
  - Days 21-25
  - Days 26-31
- The wind and solar generation on the days in each group is compared to the average wind and solar generation for that month.

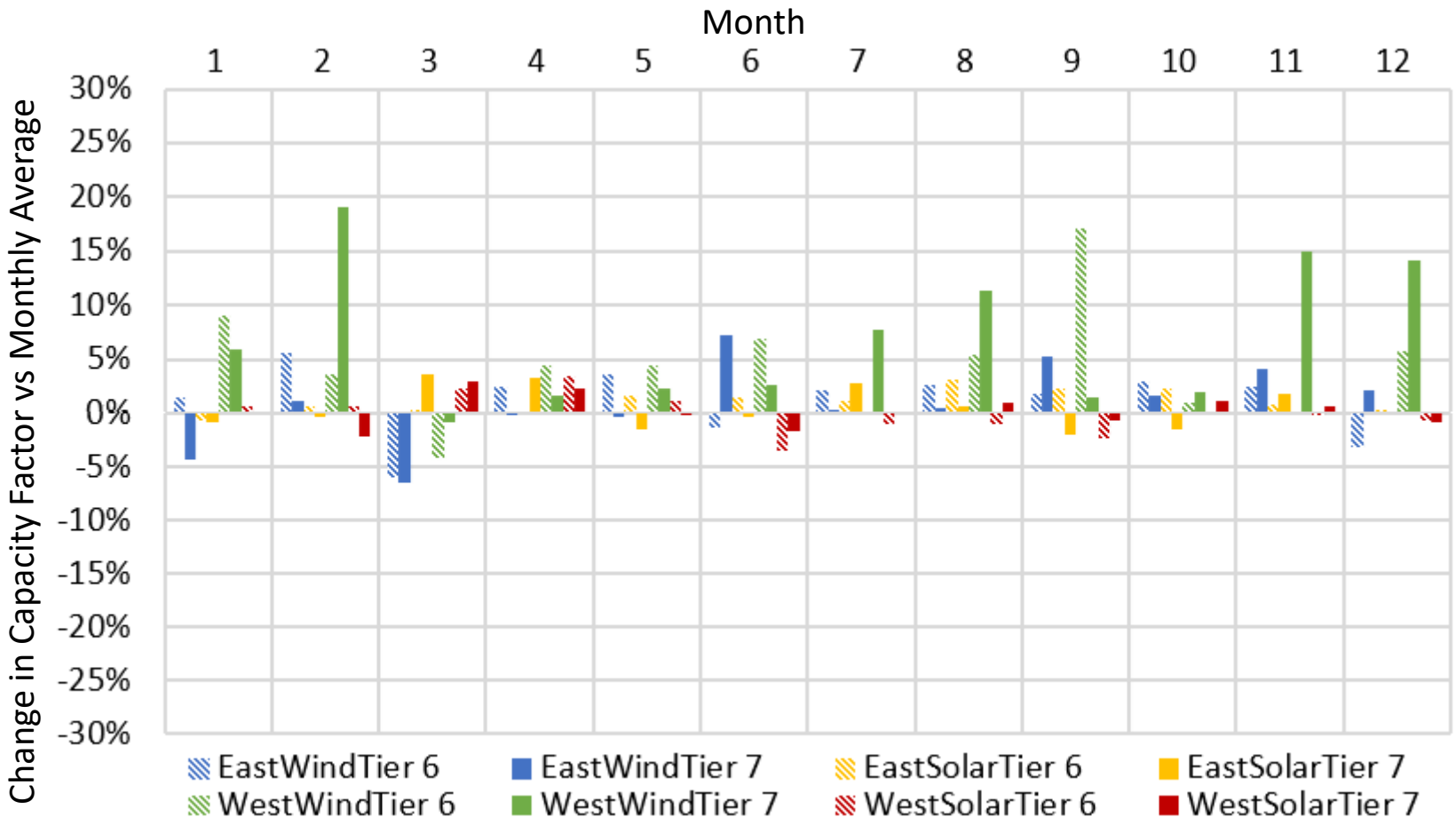
Renewable Resources vs. High Load



Tier 1: Monthly Peak Load Day
Tier 2: Top Days Ranked 2-5

- West wind is generally below average during high load days
- East wind is often above average during high load days in the winter
- Solar output is mostly near average during high load days

Renewable Resources vs. Low Load



Tier 1: Low Days Ranked 21-25
Tier 2: Lowest Days Ranked 26-31

- All renewables tend to be above average during low load days
- The impact is greatest for West wind

Renewable Resources vs. Forecasted Load

Wind and solar data is modeled as a single 8760 profile that repeats every year, while the load forecast rotates with the calendar, such that the peak load day moves around the month.

- Goal is to align the intra-month variations in the 20-year IRP study forecast period (2021-2040) with the intra-month variations in the 2016-2019 historical period.
- Each day of renewable resource output derived from the 2018 history is mapped to a specific day for modeling purposes – only the order of the days changes. To maintain correlations within wind and solar output the entire system is mapped using the same days.
- There isn't a simple way to calculate the best realignment, instead:
  - Random day combinations were tested, and the best alignment with peak load conditions (Tier 1) was selected for each month (minimizing the difference between the forecasted and historical intra-month variation among all four renewable types: East/West & Wind/Solar).
  - All of the days on which Tier 1 loads occurred were locked (roughly 7-10 days month).
  - Random day combinations were repeated on the remaining days, and the best alignment with Tier 2 conditions was selected for each month.
  - All of the days in which Tier 2 loads occurred were also locked
  - Random day combinations were repeated on the remaining days (roughly half of each month), and the best overall alignment over Tiers 3-7 was selected for each month.
- Result is a pattern of 2018 days that best aligns wind and solar output with load.
- All of the wind and solar shapes for the 2021 IRP have been rearranged to this daily pattern.

Energy Efficiency Bundling

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Energy Efficiency Bundling

Energy Efficiency Bundling was previously discussed at the July 30-31, 2020 Public Input Meeting.

- The existing levelized cost of energy (LCOE) methodology groups measures by their cost in $/MWh.
- At the July meeting, PacifiCorp described a Net Cost of Capacity Methodology, which groups measures by their cost of capacity in $/kW-yr, after adjusting for the energy value and capacity contribution of the end use load profiles associated with a measure.

Net cost of capacity per kW-yr =

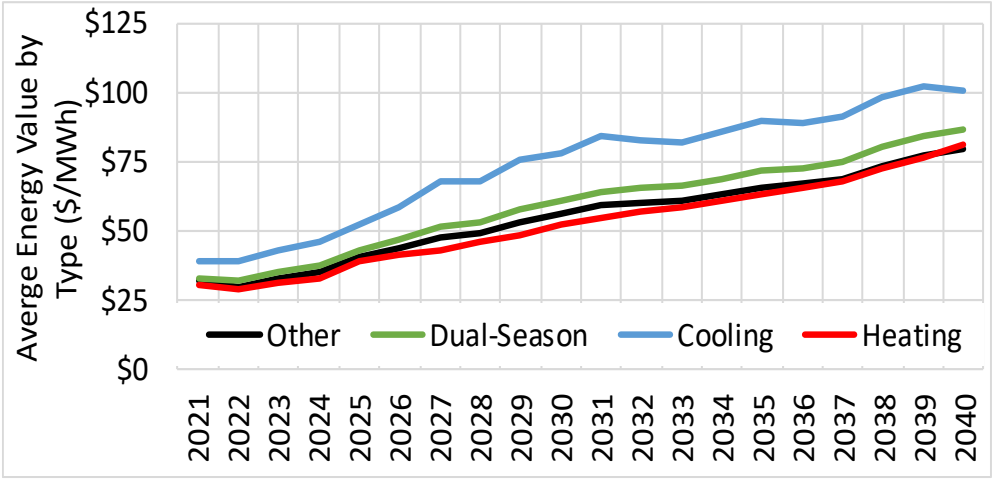
(LCOE - Energy Value) * (Load Factor * Hrs/yr) / Cap. Contrib. / (kW/MW)

  - Winter and summer were identified as key differentiating characteristics
  - As discussed earlier in this meeting, weather-sensitive and non-weather sensitive measures can also be differentiated.

Energy Efficiency: Energy Value

Energy value for each end use load profile is calculated from the hourly average of the Mid-Columbia and Palo Verde market prices, under the September 2020 medium gas/medium greenhouse gas scenario (Sept 2020 MM).

- As previously discussed, load profiles reflect either weather-sensitivity (aligned with load) or uniform daily impacts by month.
- For bundling, 75% of the market value is used, to provide better specificity for:
  - Scenarios with lower market prices or greenhouse gas costs.
  - Locations with congestion that prevents incremental volumes from reaching market.
  - This is only used for ranking and has **no bearing on the modeled costs or benefits of a measure**.
  - The intent is to differentiate measures and ensure a reasonably accurate mix is available even under low energy cost conditions. Under high energy cost conditions, selections would move to higher cost bundles.



Energy Efficiency: Capacity Contribution

As previously discussed, the capacity contribution of weather-sensitive measures has been increased by aligning savings during periods of high load conditions.

- Results are repeated here for ease of reference.

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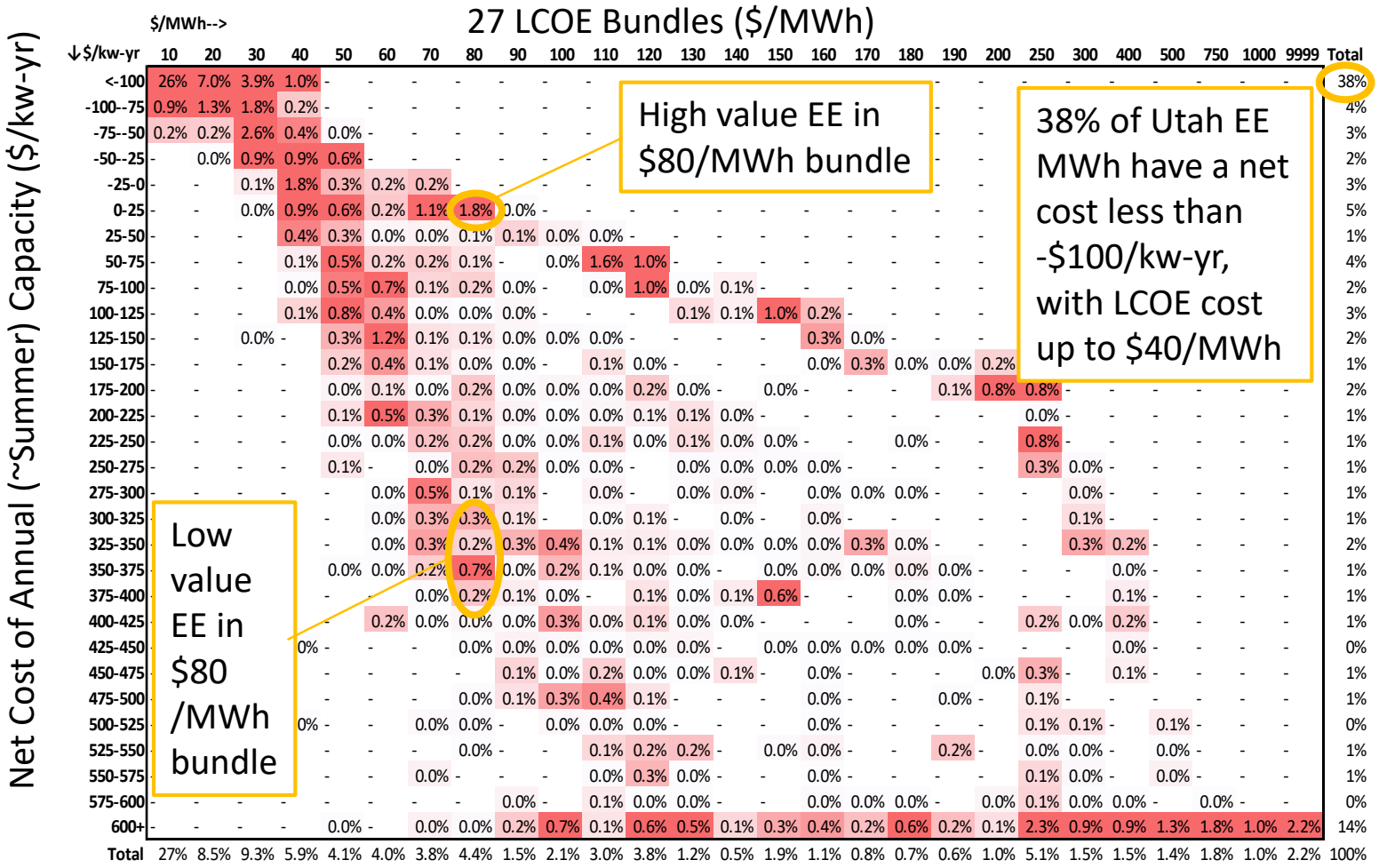
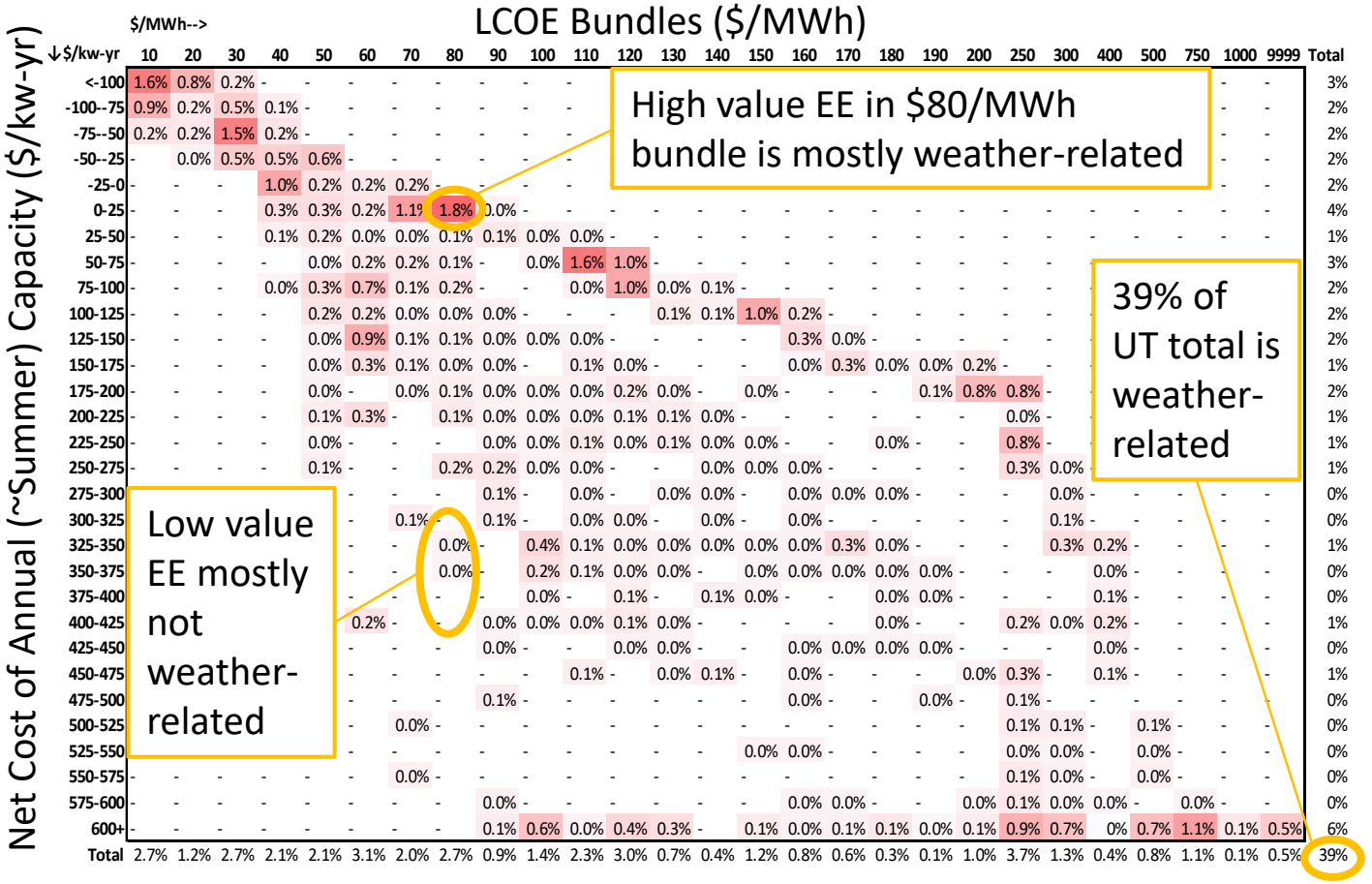
Energy Efficiency: LCOE vs Net Cost



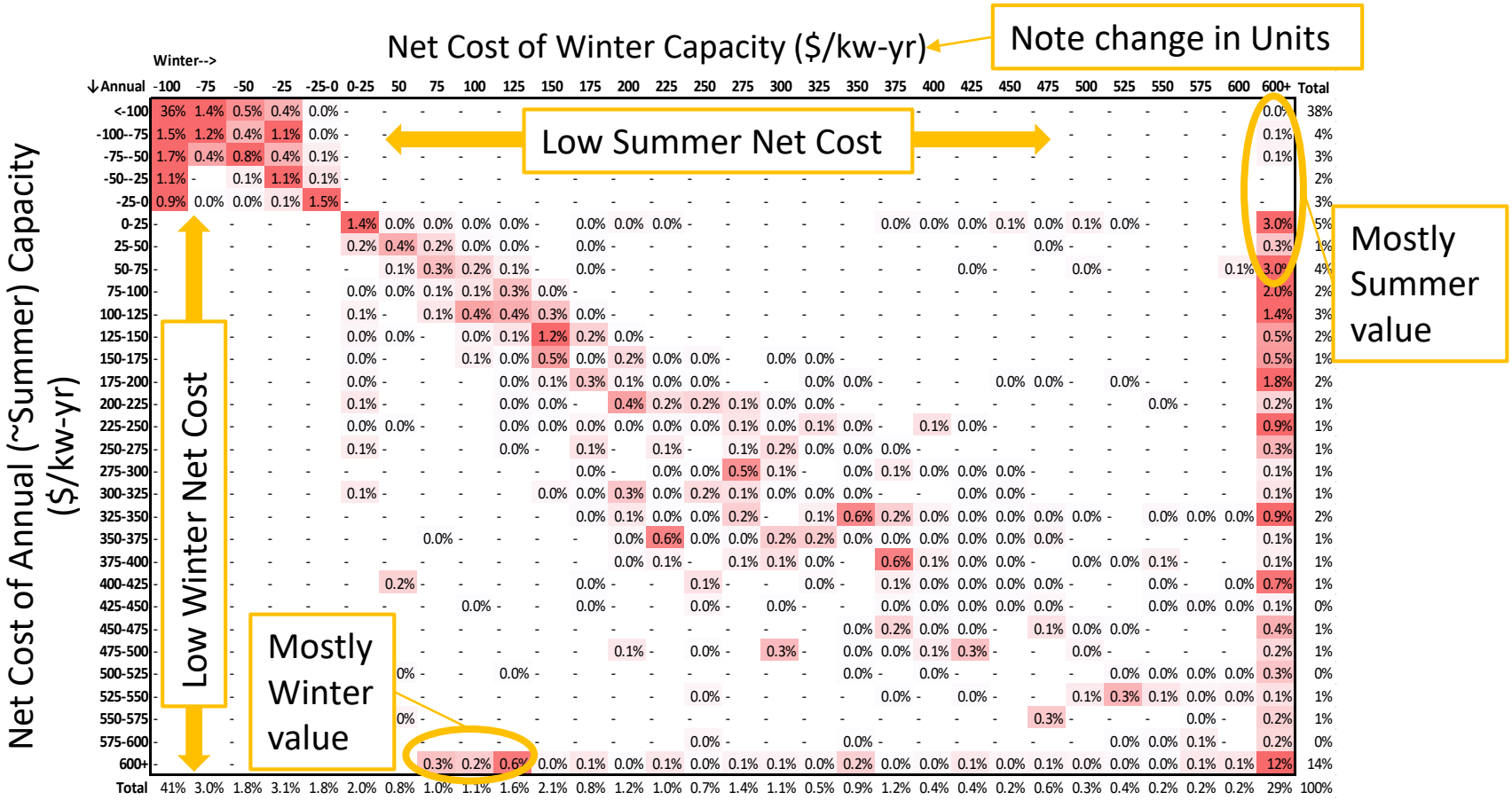
There are a range of capacity values embedded within the existing LCOE bundles – an opportunity for a more targeted approach. This is Utah measure data as an example.

Energy Efficiency: LCOE vs Net Cost Weather-Related Measures Only



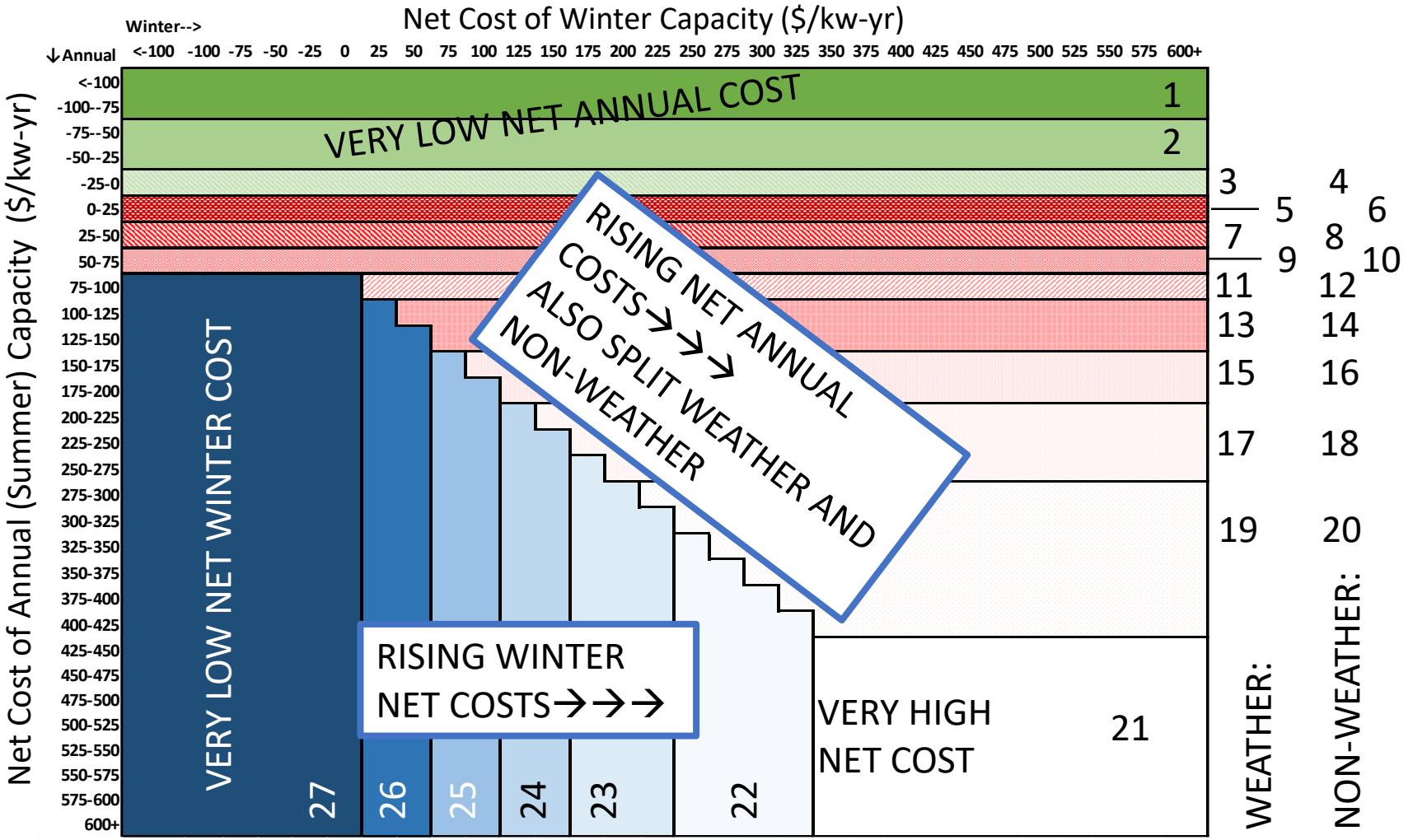
Looking at weather-related measures only – they are concentrated at the top, which reflects lower net cost of capacity. This is Utah measure data as an example.

Energy Efficiency: Summer and Winter Net Cost of Capacity



Measures along the bottom left provide relatively low-cost winter capacity, but score poorly based on the annual capacity contribution, which is mostly summer. This is Utah measure data as an example.

Energy Efficiency: 27 Proposed Bundles



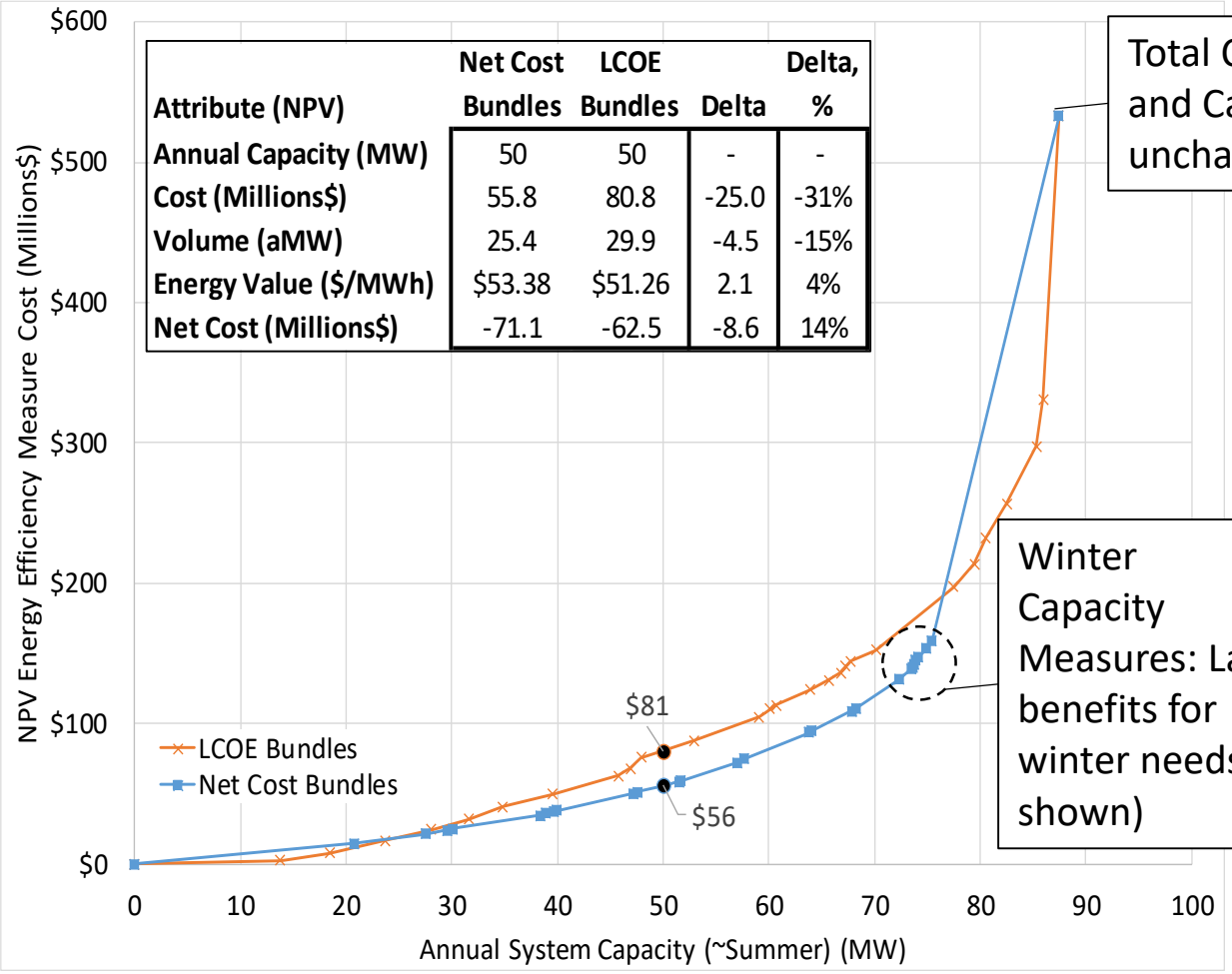
There is no significance to the specific numbering – all bundles are evaluated at the same time.

Energy Efficiency: Why Rebundle?

- Utah EE measures provide 50 MW of capacity at 31% lower cost after rebundling.
- Rebundled energy volume is lower, but estimated value per MWh is higher at medium gas / medium GHG power prices.
- Net cost of rebundled EE is $8.6M lower.
- Targeting winter or weather measures could provide additional value.

Utah Energy Efficiency Measures By Bundling Method

Attribute (NPV)	Net Cost Bundles	LCOE Bundles	Delta	Delta, %
Annual Capacity (MW)	50	50	-	-
Cost (Millions$)	55.8	80.8	-25.0	-31%
Volume (aMW)	25.4	29.9	-4.5	-15%
Energy Value ($/MWh)	$53.38	$51.26	2.1	4%
Net Cost (Millions$)	-71.1	-62.5	-8.6	14%



- 50 MW capacity is representative, model will select volumes and timing of each bundle.

2020 All-Source Request for Proposals (2020AS RFP) Update

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2020AS RFP Update

Current Status:

- The originally proposed timeline for determining the final shortlist remains on schedule.

- PacifiCorp Transmission's transitional cluster study is on-going. 2020AS RFP initial shortlist candidates are expected to receive new or revised interconnection study results no later than mid-April 2021.

Next Steps:

- Upon completion of transitional cluster study, initial shortlisted bidders will provide to PacifiCorp's RFP team these results coupled with on opportunity to "reprice" their original bid.

- To better align the in-service date of the Gateway South transmission project with the commercial operation date proposed by interconnecting generators that require Gateway South for interconnection, Gateway South is now planned to be placed in service in 2024 instead of 2023

- 2020AS RFP final shortlist selections are expected to be announced no later than June 2021.

Stakeholder Feedback Form Update




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Stakeholder Feedback Form Update

- 73 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 following the previous public input meetings is summarized on the following slides for reference.
- During November 16, public input meeting, PacifiCorp received suggestions to clarify the stakeholder feedback form, that process is underway.

Summary - Recent Stakeholder Feedback Forms

Stakeholder	Date	Topic	Brief Summary (complete form available online)	Response (posted online when available)
Wyoming Industrial Energy Consumers (067)	Dec. 4, 2020	Portfolio Modeling Recommendation	Recommend modeling resource uncertainty associated with weather events.	Responded.
Southwest Energy Efficiency Project (068)	Dec. 4, 2020	2021 CPA Final Measure Results	Request to reconcile 2021 CPA Final Measure Results with the RMP program results and goals.	Response targeted week of 1/25/2021.
Washington Utilities and Transportation Commission (069)	Dec. 11, 2020	Feedback on December PIM	Coal retirement variants, recommended sensitivity, price-policy scenario contents (i.e., SC-GHG methodology), Colstrip 3&4 early closure/divestiture economic analysis update.	Responded.
Powder River Basin Resource Council (070)	Dec 17, 2020	Regional Haze Compliance	Recommend model include range of likely pollution control requirements to comply with federal regional haze program.	Response targeted week of 1/25/2021.

Recent Stakeholder Feedback Forms (continued)

Stakeholder	Date	Topic	Brief Summary (complete form available online)	Response (posted online when available)
Sierra Club (071)	Dec. 21, 2020	Portfolio Modeling Recommendation	Questions and recommendations on RFP results, power prices, customer preference, business as usual cases, and coal plant operating variants.	Targeted response the week of 2/1/2021.
Catriona Buhayar (072)	January 19, 2021	Coal Operating Limits	Recommendation regarding coal retirements.	Response targeted week of 1/25/2021.
Oregon Public Utility Commission (073)	January 19, 2021	Feedback on December PIM	Questions and recommendations regarding supply-side resources.	Response targeted week of 2/1/2021.

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

Next Steps

Upcoming Public-Input Meeting Dates:

- February 10, 2021 – Public-Input Meeting
- February 25-26, 2021 – Public-Input Meeting
- March 12, 2021 – Public-Input Meeting (*if needed*)
- April 1, 2021 – File the 2021 IRP

**meeting dates are subject to change*