Integrated Resource Plan
2023 IRP Public Input Meeting
April 7, 2022

PACIFICORP
POWERING YOUR GREATNESS

Agenda

April 7, 2022

- 9:00 am - 9:15 am pacific – Introductions
- 9:15 am - 11:00 am pacific – 2023 Conservation Potential Assessment (CPA)
- 11:00 am - 12:00 pm pacific – Planning Environment Update
- 12:30 pm - 1:00 pm pacific – Lunch Break (30 min)
- 1:00 pm – 2:45 pm pacific – Optimization Modeling Overview
- 2:45 pm - 3:00 pm pacific – Wrap-Up / Next Steps

Conservation Potential Assessment

Schedule and Milestones

Throughout the 2023 CPA development process, we will continue to request feedback from interested parties.

For this meeting, PacifiCorp posted energy efficiency and demand response measure lists to solicit feedback from stakeholders.

Timeframe	Milestone	Public Input Request
February 22, 2022	Share Work Plan	Provide input on scope (**2 emails**)
February 25, 2022	Present on Scope of Work	Additional input on scope
April 1, 2022	Share Draft EE & DR Measure List	Provide feedback on included measures
April 7, 2022	Present on Measure List	Ask questions and provide feedback by **April 13.**
April 18, 2022	Finalize Measure List	n/a – feedback incorporated
May 12, 2022	Share Key Drivers of Potential and Assumptions	Participate in meeting, provide input on key drivers
September 1/2, 2022	Present Draft Results and Share Measure Data	Review materials and provide feedback
October 13/14, 2022	Present Final Supply Curves	Review changes made due to feedback
November 2022	Draft CPA for Review	Provide input on draft report
January 2023	Publish Final Report	n/a – feedback incorporated

Energy Efficiency Measures

EE Measure List Changes

PacifiCorp and AEG have identified over 200 changes relative to the 2021 CPA EE measure lists. There are four general categories:

Measure Added: new measure for the 2023 CPA from AEG's review of priority sources and emerging technologies

- *NEEA Tier 5 Heat Pump Water Heater (CCE/UEF 3.5)*

New Measure Encompassed by Other Measure: newly-included measures with very similar analog or considered part of a measure in the existing list

- *Connected Hot Water Controller → Home Energy Management System (HEMS)*

Measure Reclassified: Measure label or efficiency in alignment with industry trends

- *ENERGY STAR Dishwasher (**2.0**) → Water Heater - ENERGY STAR Dishwasher (**3.0**)*

Measure Removed/Excluded: Measure that had been determined to be obsolete or superseded by a more efficient option, or modeled under another measure

- *Water Heater Tank Blankets*

Measure List Changes, Cont.

- Reclassifications mainly due to:
  - Various measure nomenclature changes for consistency & standardization
  - ENERGY STAR version updates (all Final or Final Draft levels included)
  - Efficiency level adjustments to match code, priority sources, and available data
- Changes to HVAC/lighting measures similar across Commercial and Industrial sectors
- Many removed measures were consolidated with or covered by other measures

Action Taken	Residential	Commercial	Industrial	Irrigation	Total
Measure Added	20	20	15	0	**55**
New Measure Encompassed by Other Measure	7	5	4	0	**16**
Measures Reclassified	38	47	29	8	**122**
Measures Removed	4	14	11	11	**40**
Measures Excluded	5	6	2	0	**13**

Measure List Changes, Cont.

Residential Measure Change Examples

Added	Added, Encompassed by Other Measure	Reclassified	Removed/Excluded
Dehumidifier Recycling	Windows - External Shading	Evaporative Cooler - Whole Home	Water Heater Tank Blanket
HVAC - Air Conditioner Fan Controller	Connected Hot Water Controller	Evaporative Cooler - Zonal	Geothermal HP: EER 42 / COP 5.2
Windows - High Efficiency (U-0.17)	Building Shell - High Reflectivity Shingles	Stove - Smart Heating Elements	Pool Pump: Two-Speed ENERGY STAR (2.0)
Windows - Dynamic Glazing		Room AC: CEER 15.0	Windows - High Efficiency (U-0.30)
Int. and Ext. Lighting: LED 2035		Building Shell - High Reflectivity Roof	Thermostat - Programmable
Ducting - Retrofit/Replacement (MH Only)		HVAC - Maintenance and Tune-Up	Ductless Mini Split AC
HPWH: NEEA Tier 5 Heat Pump (UEF 3.5)		Windows - High Efficiency (U-0.22)	Low-Flow Toilets
		Windows - Manual Shading	

Commercial and Industrial Measure Change Examples

Added	Added, Encompassed by Other Measure	Reclassified	Removed/Excluded
Air-Cooled Chiller: COP 4.88 (IPLV 16.7)	Chilled Beam/Ceiling Panels	Ventilation - High Efficiency Motors	Interior Lighting - Bi-Level Stairwell Fixture
Int. and Ext. Lighting: LED 2035	RTU - Enhanced Ventilation	HVAC - Maintenance	Interior Fluorescent - Delamp and Install Reflectors
Building Shell - Vegetated Roof	Ventilation - Switch Reluctance Motor	Refrigeration - High Efficiency Compressor	Exterior Lighting - Bi-Level Parking Garage Fixture
Windows - Dynamic Glazing	HVAC - Occupancy Sensor	Refrigeration - High Efficiency Evaporator Fan Motors	Office Equipment - Power Management
Ventilation - Adsorbent Air Cleaning		Desktop Computer: ENERGY STAR (8.0)	Streetlighting - Dimming and Tuning Controls
HVAC - Economizer Addition		Laptop: ENERGY STAR (8.0)	Chiller - Thermal Energy Storage
HVAC - Economizer Controls		Monitor: ENERGY STAR (8.0)	Ductless Mini Split AC
Grocery - Display Case - Closed Case Replacement		Interior Lighting - LED/LEC Exit Lighting	Thermostat - Programmable
Efficient Refrigerated Chef Base		High Frequency Battery Chargers	Water Heater - Tank Blanket/Insulation
Kitchen Ventilation - Heat Recovery		Building Shell - High Reflectivity Roof	Low-Flow Toilets
Infiltration Control - Loading Dock Sealing			Motion-Control Faucets
Ventilation - Parking Garages, Demand Controlled			
Water Cooler - Timer			
Efficient Hand Dryers			
Water-Energy Nexus Measures			

Major Measures

Given expansive measure list, we recognize it may not be possible for stakeholders to review every measure and data input.

To help focus the review of measures that are likely to receive either high potential or a high level of interest (or both) in this study, AEG identifies "major measures." Major measures are defined as:

- *Large current or expected contributions to PacifiCorp's program portfolio (nonresidential linear lighting)*
- *Stakeholder comments and interest (heat pumps)*
- *High potential in PacifiCorp's 2021 CPA (windows)*
- *High potential in comparable utility DSM programs and plans throughout the country*

AEG created a "major measure" flag in the measure list to help PacifiCorp staff and stakeholders efficiently review draft inputs.

- ***This will be defined in the final measure list and measure database***

Emerging Technologies

For the 2023 CPA, AEG completed a thorough review of emerging technologies, which included:

- Updating the emerging technology review conducted as part of the 2021 CPA
  - Conducted a thorough review of emerging technologies, using data from NEEA, BPA, NREL, U.S. DOE, and pilot/R&D programs throughout the nation
- Screening measures for:
  - Technical maturity (e.g., R&D, pilot, or regional implementation)
  - Applicability (e.g., small niche, one segment, one sector)
  - Data availability (e.g., manufacturer claims, independent publications, pilot data)
- Revisiting measures put on the "watch" list during the last study

PacifiCorp welcomes additional sources and/or measures not already captured on the emerging technologies measure list.

- Stakeholders can submit measures ideas and sources through the feedback form

Resource Hierarchy: Energy Efficiency

Similar to the 2021 CPA, a "Resource Hierarchy" for energy efficiency source data **specific to each state** has been developed.

Expanded/clarified for the 2023 CPA

Focus on state-specific needs and regulatory requirements, regionally applicable sources → Prioritize TRMs from neighboring states and utilities → Leverage national sources, consider reliable TRMs from Midwest/Northeast

Priority	Washington	Idaho	Utah/Wyoming	California
Primary	RTF	RTF	RMP Ex-Ante Measure Characterizations RTF with Adjustments	California Technical Forum Electronic TRM (eTRM)
Secondary	2021 Power Plan Program-Specific Evaluations	RMP Ex-Ante Measure Characterizations Idaho Power TRM Program-Specific Evaluations	Idaho Power TRM Xcel Energy Colorado DSM Plan Program-Specific Evaluations	RTF with Adjustments 2021 CPUC P&G Study DEER and Non-DEER Workpapers Program-Specific Evaluations
Other	California eTRM RMP | National Sources Other Regularly Updated TRMs	2021PP | California eTRM | National Sources | Other Regularly Updated TRMs	2021PP | California eTRM | National Sources | Other Regularly Updated TRMs	CMUA TRM | 2021PP National Sources | Other Regularly Updated TRMs

Baselines & Considerations

AEG will develop baselines unique to how DSM planning is conducted in each state. Examples include:

- State Building Codes
  - ASHRAE 90.1, IECC or State-Specific (see table below)
- Federal equipment efficiency standards with applicable state-specific adjustments
- Baseline market data for equipment and measure saturation
  - PacifiCorp surveys, project data
  - Regional Technical Forum and California CPUC/eTRM
  - National and census region-specific saturation data

State	Residential Energy Code Used	Non-Residential Energy Code Used
California	2019 Building Energy Efficiency Standards, Title 24	2019 Building Energy Efficiency Standards, Title 24
Washington	Washington State Energy Code (WSEC) 2018 with HB1444 adjustments.	Washington State Energy Code (WSEC) 2018 with HB1444 adjustments.
Idaho	2018 IECC with amendments	2018 IECC
Utah	2015 IECC with amendments	2018 IECC
Wyoming	2009 IECC with adjustments based on survey data for new buildings	2009 IECC with adjustments based on survey data for new buildings

Baselines & Considerations, Cont.
General Service Lighting

As of December 2021, the U.S. Department of Energy determined that the 45 lm/W general service lighting backstop should have been triggered in 2020.

- Once the final rule is published, the backstop is likely to be effective within 120 days

The 2023 CPA will treat this differently in each state:

- **California**: Already implemented through state building codes and rulemakings
- **Washington**: Already implemented per HB 1444
- **Idaho, Utah, and Wyoming:** Implemented in 2023 (first year of potential)

AEG will work with PacifiCorp's Load Forecasting department to ensure baseline assumptions in the load forecast are not duplicated or double-counted in the CPA.

Measure Example

AEG curates data from multiple sources to account for variations in baselines, weather conditions, etc.

Care must be taken to ensure source data is applied consistently and appropriately.

Triangulate across standards and priority sources to ensure representation of key efficiency levels

Example Measure: Central Split-System Air Conditioner (Res)

Proposed Efficiency Levels	RTF	California eTRM	RMP Measure Characterization	Federal Guidelines	Consortium for Energy Efficiency (CEE) Tiers	Annual Energy Outlook 2022
SEER 14.0	--	--	--	SEER 14 (2023 Standard North)	--	SEER 14.0
SEER 15.0	SEER 15	SEER 15	SEER 15	SEER 15 (2023 Standard CA)	--	SEER 15.1
SEER 16.0 ENERGY STAR	SEER 16	SEER 16	--	SEER 16 (ENERGY STAR 6.1)	SEER 16	SEER 16.0
SEER 17.0	SEER 17	SEER 17	SEER 17	--	--	SEER 16.5
SEER 18.0	SEER 18	SEER 18 / 19 / 20	--	--	SEER 18	--
SEER 21.0	--	SEER 21	SEER 20	--	--	--
SEER 24.0 VRF	Measure is included as part of the emerging technology screen and is characterized using other sources, including DOE projections.					

Note: still using equivalent SEER ratings instead of SEER2 ratings active in 2023; the new ratings are taken into account using federal conversions.

Levelized Costs

Similar to savings, measure costs may vary by jurisdiction.

Assumptions presented from Table 2-2 in 2021 CPA report:

Table 2-2 Economic Components of Levelized Cost by State

Parameter	WA	CA	WY	UT	ID
Cost Test	Total Resource Cost (TRC)		Utility Cost Test (UCT)		
Initial Capital Cost	Included (100% of incremental cost, full measure cost for retrofit measures)		Utility Incentive		
Annual Incremental O&M	Included	Not Included			
Secondary Fuel Impacts	Included	Not Included			
Non-Energy Impacts	Included	Not Included			
Administrative Costs (% of IMC)	38%	54%	37%	20%	46%
Incentive Costs (% of IMC)	n/a[17]		40%	38%	43%

The table below walks through the adjustments that AEG makes prior to levelizing measure costs for supply curves, which are based on the state-specific cost-effectiveness test

Field	Washington	California	Oregon	Wyoming	Utah	Idaho
Cost-Effectiveness Test	TRC, plus 10% adder	TRC	TRC	UCT	UCT	UCT
Measure Cost	$1,000	$1,000	$1,000	n/a	n/a	n/a
Incentive Paid	n/a	n/a	n/a	$400 (40%)	$380 (38%)	$430 (43%)
Utility Admin %	38%	54%	40%	37%	20%	46%
Admin Spend	$380	$540	$400	$370	$200	$460
Cost for Bundling	$1,380	$1,540	$1,400	$770	$580	$890

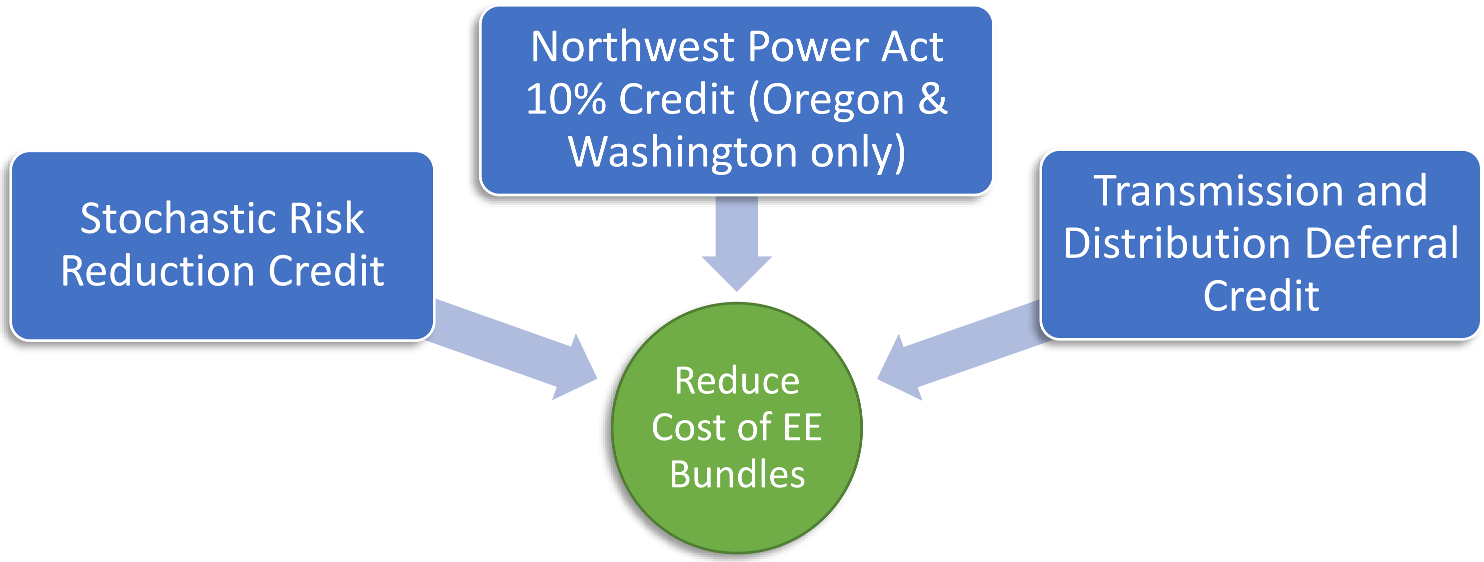
** Administrative costs will be updated during the 2023 study

Levelized Cost Inputs by State

Perspective	Total Resource Cost			Utility Cost			Included In:
	WA	CA	OR	ID	UT	WY	
State/Sector-Specific Line Losses	✓	✓	✓	✓	✓	✓	Potential Study
Customer Cost	✓	✓	✓				Potential Study
Utility Investment	✓	✓	✓	✓	✓	✓	Potential Study
Annual Incremental O&M	✓	✓	✓				Potential Study
Secondary Fuel Impacts	✓		✓				Potential Study
Non-Energy Impacts	✓		✓				Potential Study
10% Conservation Credit	✓		✓				IRP Modeling
T&D Deferral Benefits	✓	✓	✓	✓	✓	✓	IRP Modeling
Risk Mitigation Benefits	✓	✓	✓	✓	✓	✓	IRP Modeling

IRP Credits

The IRP incorporates three credits that reduce the modeled cost of energy efficiency bundles competing with supply-side resources in IRP modeling:



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.

IRP Credits, Cont.
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 (PVRR(d)) 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 2021 IRP credit value was $3.59/MWh, and this will be updated for the 2023 IRP.

IRP Credits, Cont.
T&D Deferral Credit

Table 7.10 from Volume I of the 2021 IRP shows the T&D credits used

Table 7.10 – State-specific Transmission and Distribution Credits

State	Transmission Deferral Value ($/KW-year)	Distribution Deferral Value ($/KW-year)	Total
California	$6.34	$11.06	$17.40
Oregon	$6.34	$13.38	$19.72
Washington	$6.34	$16.86	$23.20
Idaho	$6.34	$16.72	$23.06
Utah	$6.34	$13.20	$19.54
Wyoming	$6.34	$7.48	$13.82

Transmission & Distribution (T&D) Credit

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

$$\frac{T\&D\ Value \times Seasonal\ PCF \times 1000}{\text{EE 1–Year Bundle Hours [between 1 and 8760]}}$$

- Example:

$$\frac{\$17.40 \text{ x } 0.57 \text{ x } 1000}{5750} = \$1.72\text{/MWh reduction in the EE cost bundle}$$

IRP Credits, Cont.
NW Power Act 10% Credit

Northwest Power Act 10-Percent Credit

- Oregon & Washington only
- The formula for calculating this $/MWh credit is:

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

Northwest Power and Conservation Council

Demand Response Resources

Defining Demand Response

Demand Response (DR): *Resources from fully dispatchable or scheduled firm capacity product offerings/programs such as a load control*

- Previously Class 1 DSM

Demand Response Program: one or more DR technologies which can be called to perform one or more grid services during a utility DR event.
This approach will be used in the 2023 CPA.

- Grid Service Provided: Peak Shaving, Fast DR, etc.
- Control Mechanism: Smart Thermostat, DLC Switch, etc.
- Technology Controlled: Central AC, Irrigation Pumps, HPWH
- **Example: HVAC Direct Load Control (Cool Keeper).** A central AC with a direct load control switch cycling during a peak event. Program specific to one control mechanism and one technology.

Evolving Considerations for DR

Regulations for Bulk Electric System:

- Regulations (CAISO) for resource modeling continue to evolve and recognize non-traditional resources
- Metering requirements for resource aggregation continue to evolve and allow more widespread use

Evolving Deployment Technology:

- Innovation continues to develop for capacity measurement and deployment in Real Time
  - Accuracy in measurement increases value by reducing forecast error
  - Real Time flexible deployment increases the possible uses of resources

Grid Services View of DR

- Demand response can provide a variety of grid services for PacifiCorp. These are primarily defined by characteristics like time required for:

Advance Notice | Full Deployment | Event Duration

- The 2023 CPA will assess DR's ability to provide value through events beyond peak shaving to align DR's capabilities with PacifiCorp's potential use cases.

Market Participation	Grid Services	DR Products	Advance Notice (mins)	Full Deployment (mins)	Duration (mins)
PAC BAA	Capacity & Energy	Capacity & Energy	55+	55+	60
PAC BAA	Regulation	Regulation	<1-30	<30	<1-60
EIM	Flexibility & Regulation	EIM Capacity & Energy	52.5	60	60+
EIM	Flexibility & Regulation	EIM Capacity & Energy FMM	22.5	15	15+
EIM	Flexibility & Regulation	EIM Capacity & Energy RTD	2.5	5	5+
PAC BAA	Non-Spinning Reserves	Non-Spinning Reserves	10	10	60
PAC BAA	Spinning Reserves	Spinning Reserves	<1	10	60
PAC BAA	Frequency Response	Frequency Response	<1	<1	1

BAA = Balancing Authority Area
EIM = Energy Imbalance Market
RTD = Real time dispatch
FMM = Fifteen-minute market

Resource Options

- In 2021 CPA, looked at individual technologies' ability to provide different grid services, defined by time to full deployment and event duration.
- Ultimately, we found negligible value and/or could not identify reliable impacts at the technology granularity (particularly for non-residential third-party curtailment)
- Instead, presented impacts for two types of events that help to capture the differences in impacts and eligibility. In 2023, PacifiCorp is proposing these event definitions:

Fast Events: represents the impacts that could be achieved over a shorter event period (≤ 1 hour). Notification times are typically 15 minutes or less with a near-instantaneous response.

Sustained Events: represents the impacts that could be realized over a longer event period (> 1 hour). Notification could be day-ahead or day-of.

- Will continue to model third-party program potential with these two categories.

Resource Options, Cont.

Program Category	Program Bundle	Mechanism / Description	Eligible for Fast Event Potential?*	Current Offering
Direct Load Control (Conventional)	Electric Vehicle Connected Charger Direct Load Control (DLC)	Automated, level 2 EV chargers that postpone or curtail charging during peak hours. Can potentially be used for energy storage.	✓	
	HVAC DLC	DLC switch installed on customer's heating and/or cooling equipment.	✓	UT
	Irrigation Load Control	Automated pump controllers or DLC switch installed on customer's equipment.	✓	UT, ID, Pilot in OR
	Pool Pump DLC	DLC switch installed on customer's equipment.	✓	
	Domestic Hot Water Heater (DHW) DLC	DLC switch installed on customer's equipment.	✓	
Direct Load Control (Smart / Interactive)	DLC of Smart Home	Internet-enabled control of operational cycles of white goods appliances, electronics, and lighting. Controlled by a central smart hub or smart speaker.		
	Grid Interactive Water Heater	CTA-2045 or other integrated communication port. Can also be used for energy storage.	✓	
	Connected Thermostats DLC	Internet-enabled control of thermostat set points.		
Energy Storage	Battery Energy Storage DLC	Internet-enabled control of battery charging and discharging.	✓	UT, Pilot in ID
Curtailment	Third-Party (Fast Event)	Customers enact their customized, mandatory curtailment plan. May use stand-by generation. Penalties apply for non-performance. Customers must have EMS for automated compliance.	✓	Underway in UT
	Third-Party (Sustained Event)	Customers volunteer a specified amount of capacity during a predefined "economic event" called by the utility in return for a financial incentive.		Underway in UT

*All program bundles eligible for sustained events, some are eligible for fast events

Resource Assumptions

AEG conducts research to develop a comprehensive list of DR measure/program assumptions. We utilize PacifiCorp-specific program data where available.

Event Assumptions

- Capacity Reductions
- Seasonal Availability
- Climate Zone & Curtailable Load
- Event Ramp Up (Time until Full Response)
- Event Duration
- Maximum Events per Year

DR Program Data Assumptions

- Comparable Program Assumptions (Key Sources)
- Measure Dependencies (AMI)
- Participation (including state-specific assumptions, WA CTA-2045)
- Regulatory Lead Time (years)
- Levelized Cost Methodology

Resource Costs

The following components are typically included within demand response program costs:

- Measure Costs
  - Energy-using technology cost (e.g. ENERGY STAR Connected EV Charger)
  - Enabling technology cost (e.g. DLC Switch, Smart Thermostat, HEMS)
  - “Bring-Your-Own” program designs can lower measure costs substantially and will be considered where possible
- Incentives (annual, per-event, or both)
  - In states utilizing the California DR Cost-Effectiveness Protocol, only a portion of the incentive is counted to estimate the customer’s cost to participate (see next slide)
- Utility administrative costs*
  - Utility staff to manage program (X FTEs at $Y/yr. allocated across multiple programs)
  - Program development costs (up-front $ for each new program)
  - Marketing costs ($/yr.)

**Can be transitioned to a third-party aggregator in some circumstances*

Participant Costs

- In Pacific Power states, participant costs are estimated to satisfy requirements of Total Resource Cost test.
  - Not applicable to Rocky Mountain Power: participant cost assumptions have no impact on levelized cost from Utility Cost Test perspective
- PacifiCorp uses the California DR Cost-Effectiveness Protocol methodology to estimate participant costs as a percentage of incentives.
  - Lower percentages used to reflect programs that are less intrusive to customers
  - See assumptions from 2021 CPA below:

Program	Participant Cost (% of Incentive)
HVAC Direct Load Control (DLC)	35%
Domestic Hot Water Heater (DHW) DLC	25%
Grid-Interactive Water Heaters	25%
Connected Thermostat DLC	35%
Smart Appliances DLC	75%
DLC of Pool Pumps	75%
Electric Vehicle DLC Smart Chargers	75%
Battery Energy Storage DLC	75%
Third Party Contracts	75%
Irrigation Load Control	75%

Resource Examples

The examples of DR program assumptions to the right highlight some of the unique considerations between jurisdictions.

Connected Thermostats DLC	Washington	Utah
Summer kW Reduction	0.53 kW	0.97 kW
Winter kW Reduction[1]	1.01 kW	0.21 kW
Eligible Market	Connected Thermostats	Connected Thermostats not enrolled in Cool Keeper
Equipment Costs[2]	$0	$0

[1] Savings weighted by electric heating and cooling saturations

[2] Assuming bring-your-own program designs; DR model linked to connected thermostat saturations in EE model.

Water Heater DLC	Washington	Utah
Summer kW Reduction	0.58 kW	0.58 kW
Winter kW Reduction	0.58 kW	0.58 kW
Eligible Market	**All** electric water heaters at turnover[3]	Electric water heaters, limited by customer choice
Equipment Costs	$0	$315 switch + installation

[3] Washington House Bill 1444 set an appliance standard mandating CTA-2045 communication ports on all new water heaters in the state

Demand Response (DR) Credits

The 2021 IRP incorporated two credits that reduced the modeled cost of DR bundles competing with supply-side resources in IRP modeling. These credits are intended to capture benefits that would otherwise not be reflected in IRP modeling.

Transmission and Distribution Deferral Credit

- Applied same credit to DR as described in the EE measure section of this presentation.

Granularity Adjustment

- The granularity adjustment reflects the difference in economic value between an hourly 8760 cost calculation, and the four-block per month representation used in the long-term model. This adjustment is needed because 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 model blocks.

Non-Modeled Resources

Demand-Side Rates

- Voluntary rate options that reduce demand during peak periods.
- Objective similar to demand response = reduce or shift peak
- Significant difference in resource firmness
  - Utility can rely on DR program impacts through direct control or contractual agreement
  - Customers' response to varying rate design is dependent on their desire to response to economic signals
  - **IRP does not model incremental demand-side rate potential as a resource**
- Resource assumption development process similar to DR, but delivery cost is not assessed in CPA
- Rate designs modeled in CPA: only those that are incremental to the baseline forecast (e.g., existing block rates are omitted)

Demand-Side Rate Options

Critical Peak Pricing (CPP)

- Much higher rate for a particular block of hours that occurs only on event days. Requires AMI technology.

Peak Time Rebates (PTR)

- Rebates for reduced consumption for a particular block of hours that occurs only on event days. Requires AMI technology.

Time-of-Use (TOU)

- Higher rate for a particular block of hours that occurs every day. Requires either on/off peak meters or AMI technology.

Real Time Pricing (RTP)

- Variable hourly rates based on real-time utility production costs. Requires AMI technology.

*Behavioral DR/Conservation Messaging moved to Education & Information (E&I) program investigation.

Education and Information

- Non-incented behavioral-based impacts achieved through broad energy education and communication efforts
- Not modeled in IRP; conducting research to estimate expected ranges of impacts

Residential

- Behavioral Demand Response
- Conservation Messaging
- Direct Community Engagement
- Energy Audit/Commissioning
- Energy Challenges and Competitions
- Energy Monitoring/Real-Time Feedback
- School Energy Education

Non-Residential

- Benchmarking
- Building Operator Certification
- Business Reports
- Conservation Messaging
- Energy Audit/Commissioning

Feedback on 2023 CPA

Stakeholder Feedback Forms

- Draft measure lists have been posted to the PacifiCorp website on April 1 at https://www.pacificorp.com/energy/integrated-resource-plan/public-input-process.html
  - Please provide feedback **no later than April 13**.
- Stakeholder feedback forms and responses can be located at www.pacificorp.com/energy/integrated-resource-plan/comments.html
- Depending on the type and complexity of the stakeholder feedback received, responses may be provided in a variety of ways including, but not limited to, a written response, a follow-up conversation, or incorporation into subsequent public input meeting or state specific advisory group meeting materials.

Planning Environment Update

PACIFICORP
POWERING YOUR GREATNESS

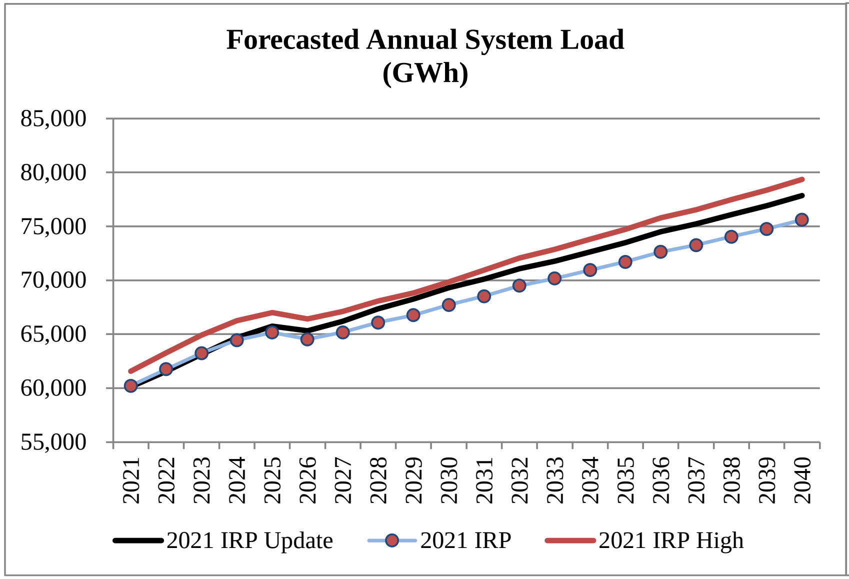
EPA Ozone Transport Rule

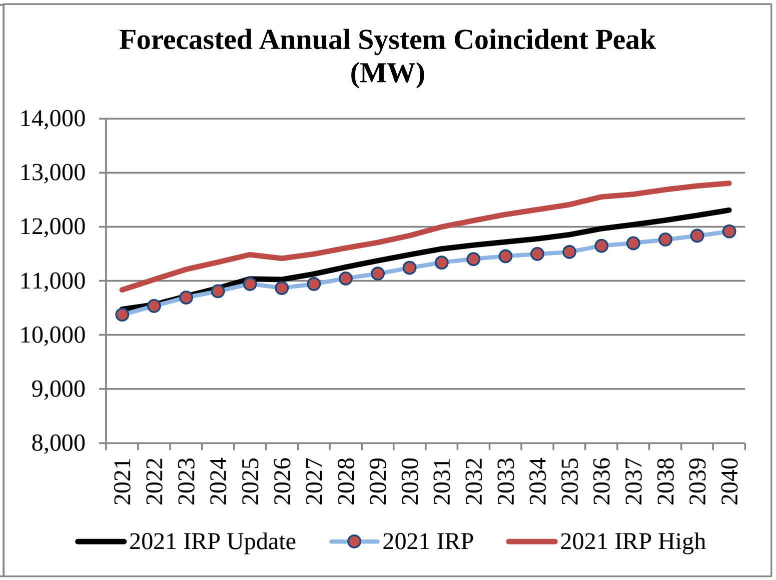
- On March 11, 2022, the Environmental Protection Agency (EPA) released a pre-publication version of its "Ozone Transport Rule" (OTR). On April 6, 2022, the EPA formally proposed the rule.
  - OTR is also referred to as the Good Neighbor Rule or Cross-State Air Pollution Rule
  - OTR is focused on reductions of nitrogen oxides, precursors to ozone formation
  - OTR will now cover 26 states - four states are included for the first time – Wyoming, Utah, Nevada and California
  - Beginning in 2023, trading allowances and emissions budgets are expected to be set to achieve reductions through immediately available measures
  - Starting in May of 2026, emissions budgets are expected to be set for coal-fired units at levels achievable through the installation of selective catalytic reduction (SCR) controls
  - Daily emission limits for units with SCR will become effective in 2027
  - The agency will hold a virtual hearing and accept public comments on the proposal for 60 days following publication in the Federal Register; PacifiCorp anticipates submitting comments

Ozone Transport Rule
State Map

2021 IRP Update

- On March 31, 2022, PacifiCorp filed its 2021 IRP Update, required in the off-years of a full IRP development cycle
- Key updates driving preferred portfolio outcomes include higher load, DSM alignment with achievable objectives and improved alignment to load, and resource changes due to 2020 All-source RFP activity and long-term contracts





- Portfolio changes include accelerated transmission, increased wind, non-emitting resources and energy efficiency, offset by decreases in solar, storage, and demand response.
- The 2021 IRP Update is located on PacifiCorp's IRP webpage: pacificorp.com/energy/integrated-resource-plan

Optimization Modeling Overview

PACIFICORP
POWERING YOUR GREATNESS

Optimization Modeling

- Optimization modeling (OM) is a form of mathematics used to determine the optimal minimum or maximum of a complex equation
- OM is used to determine the optimal minimum or maximum of a complex equation, such as the lowest present value revenue requirement (PVRR) of PacifiCorp's system
- OM math obey constraints and meets requirements (e.g., reserves requirements, unit capabilities, transmission constraints, market prices, and other parameters and relationships)
- OM math avoids the need to examine every possible combination of options to determine the optimal solution
- To understand how OM works, it is meaningful to compare it to the alternative of "stepwise" problem solving

Stepwise Approach

- Solves a problem by executing a series of intuitive steps
- Example: If you know that you must hold reserves on your energy system, some of your steps might be:
  - Rank your generators by reserve carrying cost, low to high
  - Hold reserves on each unit, in order, until reserve requirements are met
  - Determine how much generating capacity is left after reserves
  - Rank order your units by energy production cost, low to high
  - Generate from each unit, in order, until all loads are met
  - Calculate remaining generating capability (“excess energy”)
  - Sell excess energy at market:
    - …when economic; compare production cost to market prices
    - …when deliverable; keep a running total of transmission usage
- Repeat your steps for every hour (or other period) of every year, accounting for what you did in the prior hour (e.g., unit commitment)

OM Approach

- OM mathematically determines the best (optimal) solution:
  - By eliminating solutions that cannot meet requirements (infeasible)
  - By eliminating feasible solutions that cannot be the optimal solution
  - By assessing linear relationships to get as close to the theoretically optimal solution (“relaxed solution”) as possible and;
  - Provides available output about the best solution. Possible output includes:
    - Discrete decisions (e.g., add capacity at a particular site, acquire a particular DSM package)
    - Energy production of modeled resources, usage of transmission, purchases of capacity or energy from markets

- Not all information is needed to provide a solution
  - No need for a reserve stack
  - No need to assign reserves to specific units

Simple OM Example

Problem: How much gas energy and how much coal energy should we generate?

Objective: Minimize system costs assuming two generating units (one gas, one coal), one transmission line, and one load area, operating for a period of one hour.

Relationships: A transmission line conveys energy to the load area.

Parameters and Constraints (in a single hour):

- Generate up to 120 MW from our gas unit
- Generate up to 150 MW from our coal unit
- Transmission capacity and load requirement are both 200 MW

Run cost:

- 1 MWh of gas-power costs $2 to generate
- 1 MWh of coal-power costs $3 to generate
- Failure to meet load costs $100/MW

OM Simple Example, continued

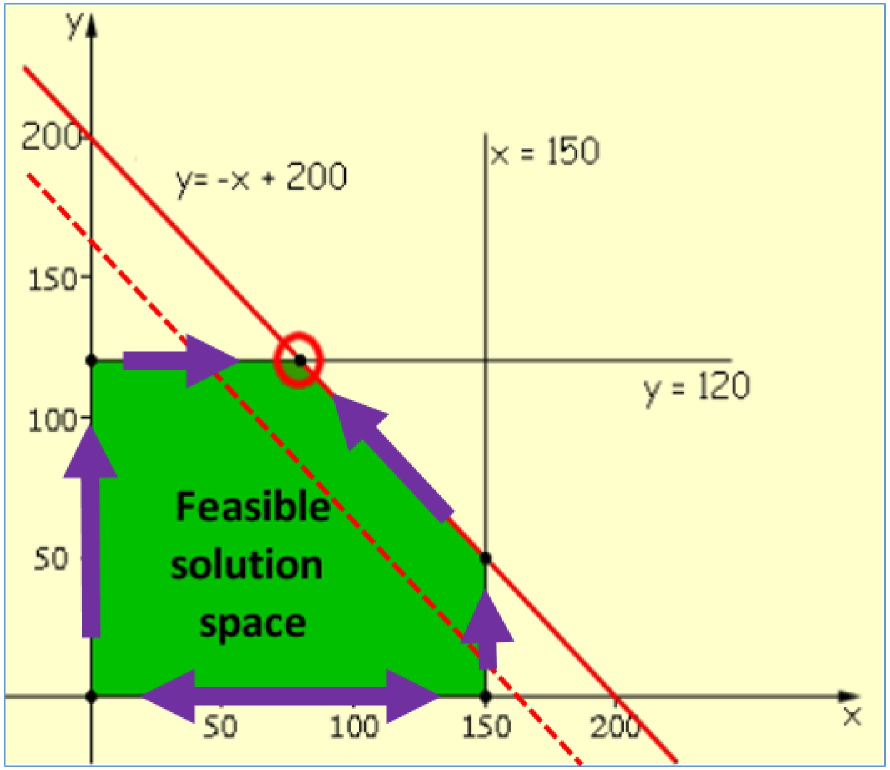
- When the model runs, modeled constraints and objectives become mathematical constraints and objectives, expressed as inequalities:

Linear Inequalities	Purpose
$x \leq 150$	Coal can generate up to 150 MW
$y \leq 120$	Gas can generate up to 120 MW
$x + y \leq 200$	Total generation cannot exceed transmission
$x \geq 0$	Coal generation cannot be negative
$y \geq 0$	Gas generation cannot be negative

- The model uses these inequalities to explore a "feasible solution space" – a range of possible solutions that *might* be the right answer

OM Simple Example, continued

- The graph at right illustrates how the math defines the "feasible solution space"
- The load requirement dictates that only solutions along the red line could be the best answer. (At each point on the red line, the generation total is 200 MW, avoiding the $100/MW penalty for not meeting load)
- The model "searches" for the edge of the feasible solution space, then examines other solutions along that edge to see if moving in one direction or another improves the solution (by lowering PVRR)
- The model quickly arrives at the optimal solution, found at one end (vertex) of the 200 MW load requirement
- This vertex meets all requirements and constraints and produces the lowest PVRR. No other solution does this



- The dotted red line would apply to a scenario where the two generators could not supply the 200 MW needed for load. The model would find an optimal solution in the same manner, minimizing the amount of penalty it must pay

OM Advantages and Complexities

- You get the best (i.e., optimal) answer
  - Complexity: The best answer may not be immediately intuitive
  - However, if it isn't intuitive, it must be investigated for errors

- Multi-dimensional problem solving; detailed precision and accuracy that non-optimization approaches cannot match
  - Complexity: Determining an acceptable amount of complexity
  - Complexity: Tremendous amounts of data are required
  - Complexity: Time required to produce and analyze results
  - Complexity: Highly technical software, equipment
  - Complexity: 1-2 year training ramp-up, starting with a skilled analyst

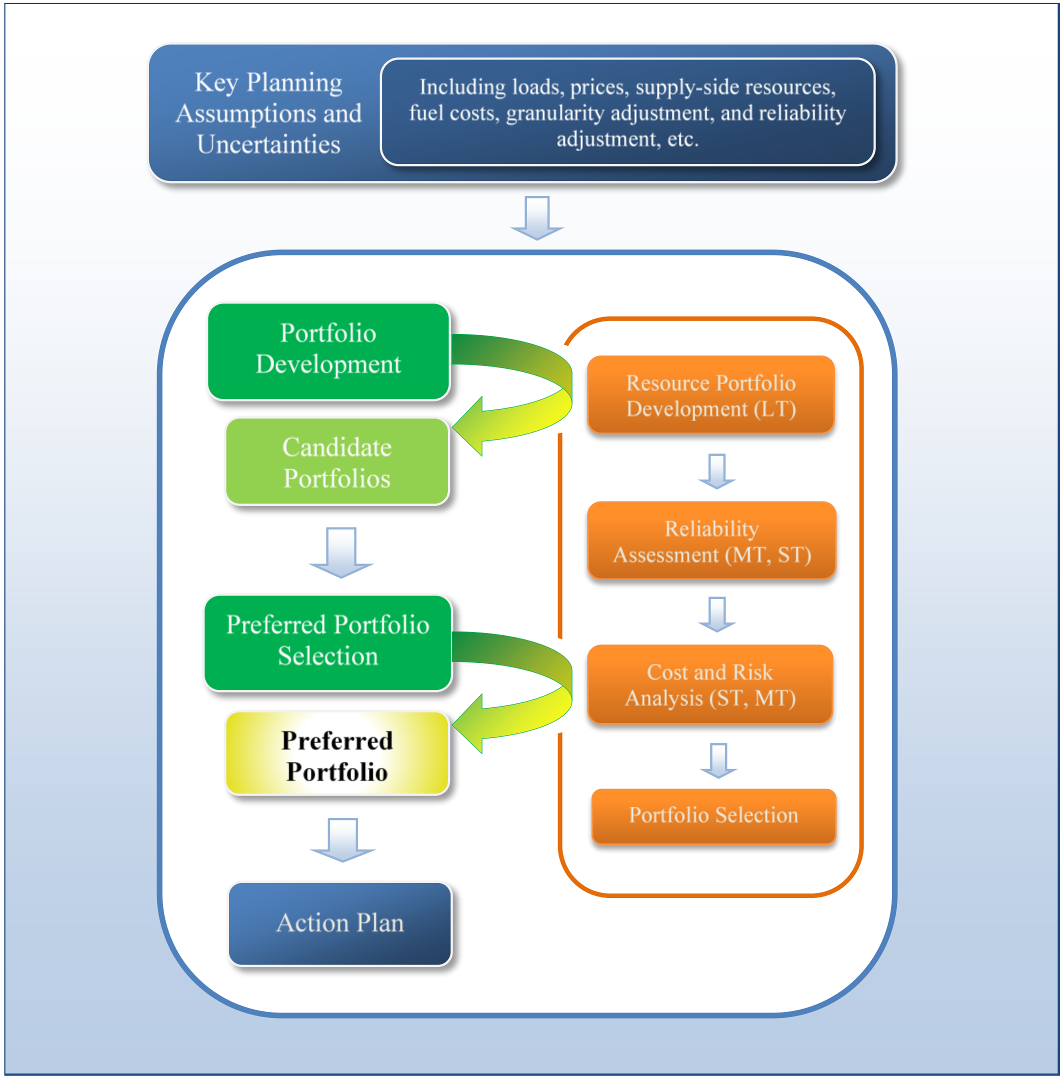
- OM math is incredibly fast for what it does; has the *effect* of examining every modeled possibility
  - Complexity: All desired outputs may not be readily available

Plexos Modeling

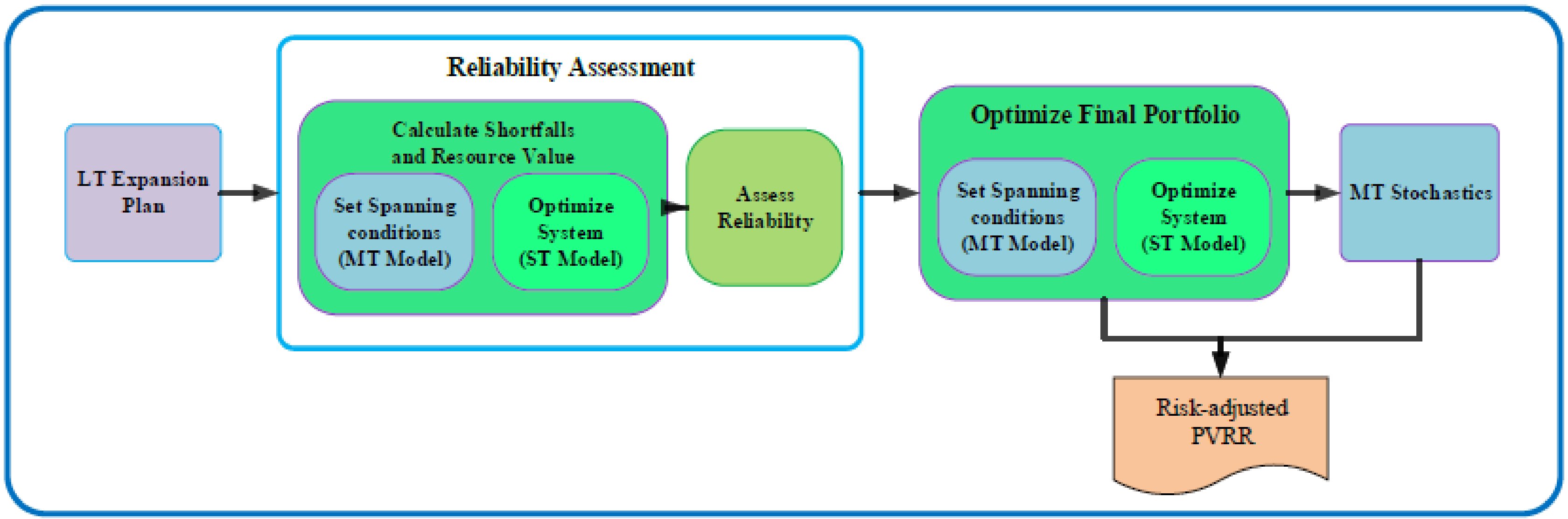
Plexos Advantages

- The optimization math remains the same
- The interface, organization and available modeling objects are much more aligned with our needs
- Challenges addressed:
  - Granularity – significantly more control over model alignment and aggregation sampling
  - Reliability – operating reserves and resource availability to meet requirements replace the planning reserve margin (PRM)
    - 3 models contribute to portfolio optimization
    - Reliability measures (such as net revenue) and tools are built in
  - Endogenous transmission
    - No complex topology additions or analytics, just math constraints
    - No need to create multiple copies of every resource
    - Multiple paths can be modeled as one option
  - Retirements – multiple retirement options can be modeled with reasonable performance, evaluating hundreds of thousands times as many options.
    - The 2019 IRP evaluated 70-80 retirement portfolios vs. over 260,000 combinations considered in a single Plexos run, conservatively assuming just 2 variants for 18 of 22 coal units.

Portfolio Selection



Portfolio Development Process



Wrap-Up/Additional Information

PACIFICORP
POWERING YOUR GREATNESS

Additional Information

- 2021 IRP Upcoming Public Input Meetings:
  - May 12, 2022 (Thursday)
  - June 9-10, 2022 (Thursday-Friday)
- Public Input Meeting and Workshop Presentation and Materials:
  - pacificorp.com/energy/integrated-resource-plan/public-input-process
- 2023 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