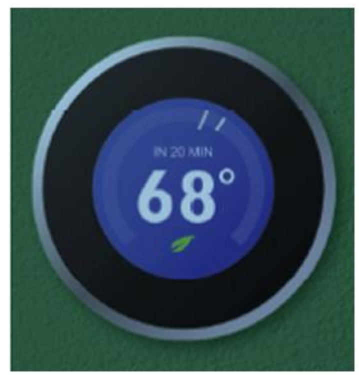
2019 Integrated Resource Plan (IRP)
Public Input Meeting
July 26-27, 2018



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Agenda

July 26 – Day One

- Energy Storage Workshop
- Lunch Break (1 hour) - 11:00-12:00 pacific
- Renewable Resource Schedules and Load Forecast
- Distribution System Planning
- Supply-Side Resource Study Efforts

July 27 – Day Two

- Environmental Policy
- Renewable Portfolio Standards
- Lunch Break (1 hour) – 11:30-12:30 pacific
- 2019 IRP Modeling Assumptions and Study Updates:
    - Intra-Hour Dispatch Credit
    - Stochastic Parameters Update
    - Overview of Planning Reserve Margin and Capacity Contribution Studies
- Wrap-Up / Next Steps

Distributed Energy Resources

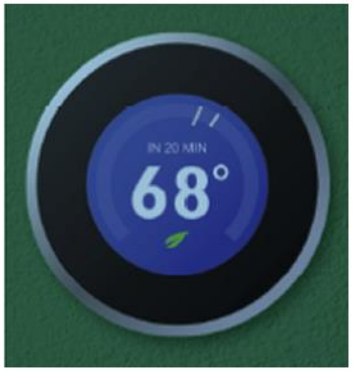
- What are Distributed Energy Resources (DER) generally?

  Resources sited close to customer loads that contribute to meeting system requirements.

- For IRP planning purposes:

DER Type	Treatment in IRP	Public Input Meeting (PIM) Discussion
Private Generation	Accounted for in load forecast	Load Forecast – July Private Generation – August
Demand Response (Class 1 DSM) and Energy Efficiency (Class 2 DSM)	Competes as supply-side resources for model selection	DSM Draft Potential – June DSM Potential and Credits – August Portfolio Selection – Early 2019
Energy Storage	Competes as supply-side resources for model selection	Energy Storage Workshop & Supply-Side Resource Table Technologies – July Supply-Side Resource Table – September

Energy Storage Workshop



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Topics

- Energy storage overview
- Planned energy storage projects
- Energy storage valuation methodologies
  - List of use cases
  - Valuation methodology and models
  - Storage technology inputs
  - Co-optimization of use cases
  - Types of energy storage
  - Customer-sited storage
- IRP Modeling

Energy Storage Overview

- What are energy storage resources?
  - Act as resources when discharging and as loads when charging
  - Typically very flexible when controlled by system operator

- Key benefits of energy storage
  - Energy: moves from low-value periods to high-value periods
  - Capacity: can be an alternative to generation, transmission, and/or distribution additions.

- Planned energy storage projects in Oregon and Utah will help further refine cost, performance and benefit information

Planned Energy Storage Projects

Utility-scale projects:

- Utah SB 115–The Sustainable Transportation and Energy Plan (STEP)
  - 1 MW/5MWh, 2019 COD
    - Process to select engineering, procurement, and construction (EPC) contractor is underway

- Oregon HB 2193
  - If authorized by Commission, procure energy storage by 1/1/2020 with at least 5 MWh and no more than 1% of 2014 Oregon system peak load.
  - Development of Storage Potential Evaluation methodology was required to accompany the project proposals
  - Project 1: At least 2MW/6MWh, 2021 COD
    - An all-party stipulation supporting the project proposal was filed July 18, 2018. Commission approval is still required.

Energy Storage Valuation

- Framework developed in Oregon Docket UM-1857 (Filed April 2018)
  - https://apps.puc.state.or.us/edockets/docket.asp?DocketID=20915
- Key elements:
  - List of use cases
  - Valuation methodology and models
  - Storage technology inputs
  - Co-optimization of use cases
- Accompanied by detailed project proposals:
  - Project #1 – Utility Owned Distributed Storage Pilot
    - Primarily utility benefits (system-wide)
  - Project #2 – Community Resiliency Pilot
    - Primarily benefits specific customers, but stacking other use cases can provide system-wide benefits and improve cost-effectiveness

List of Use Cases

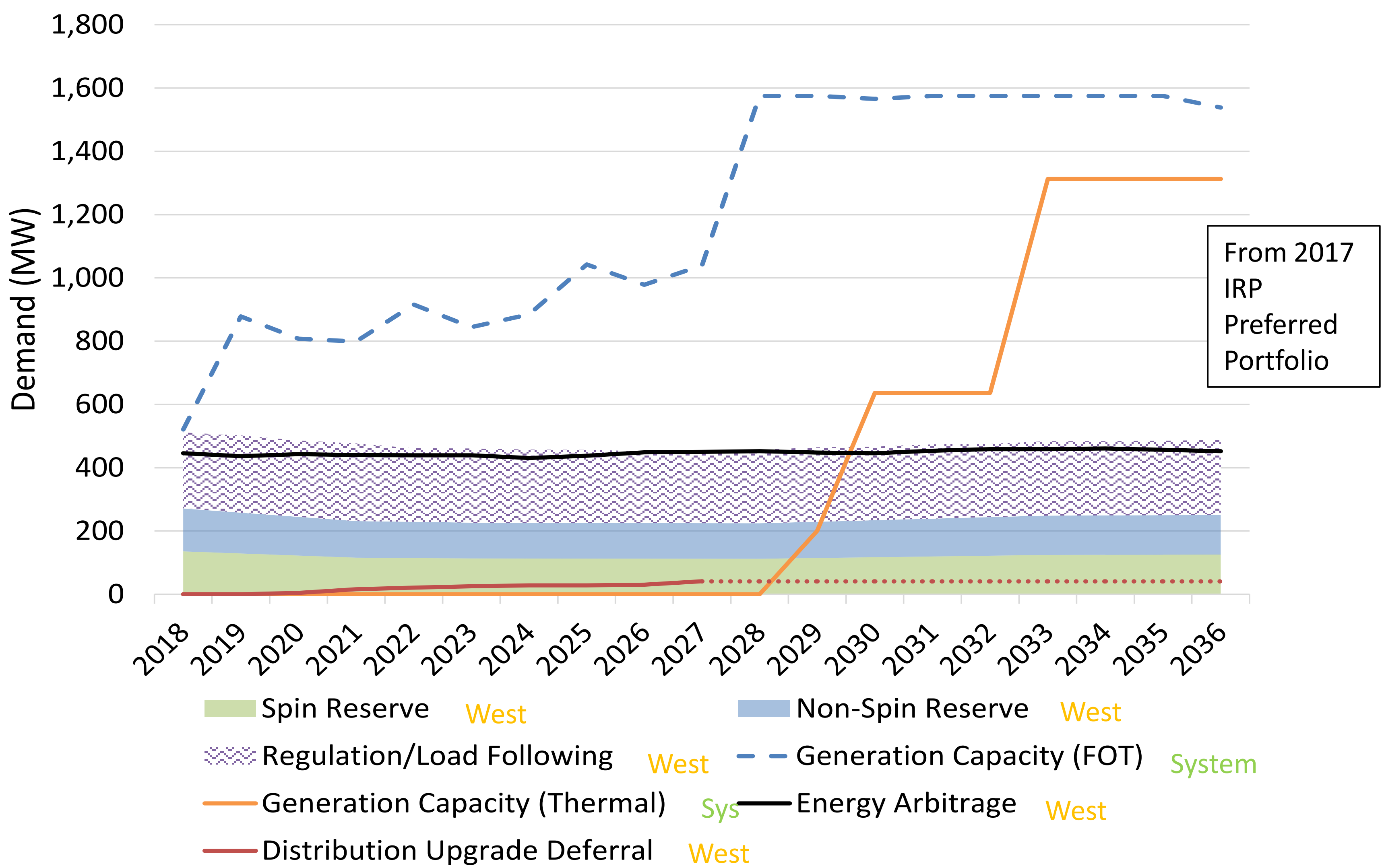
Use Case	Service	Evaluation Approach/Tools Leveraged
Bulk Energy	Capacity or Resource Adequacy	IRP preferred portfolio, GRID, RVOS
	Energy Arbitrage	RVOS
Ancillary Services	Regulation	GRID, EIM
	Load Following	GRID, EIM
	Spin/Non-spin Reserve	GRID
	Voltage Support	Included in T&D Deferral
	Black Start Services	Not evaluated - No need currently identified.
	Frequency Response	Not evaluated - No need currently identified.

Use Case	Service	Evaluation Approach/Tools Leveraged
Transmission Services	Transmission Congestion Relief	Included in Energy Arbitrage
	Transmission Upgrade Deferral	IRP preferred portfolio, Alternative Evaluation Tool
Distribution Services	Distribution Upgrade Deferral	IRP preferred portfolio, Alternative Evaluation Tool
	Volt-VAR Control	Included in T&D Deferral
	Outage Mitigation	Not evaluated - not a utility benefit
	Distribution Congestion Relief	Included in Distribution Deferral
Customer Energy Management Services	Power Reliability	Included in Outage Mitigation
	Time-of-Use Charge Reduction	Not evaluated - not a utility benefit
	Demand Charge Reduction	Not evaluated - not a utility benefit

Evaluation Tools

Model/Tool	Input	Output
Integrated Resource Plan (IRP)	Load data, market prices and system constraints, characteristics of existing and potential resources including costs	Preferred Portfolio of low cost least risk solutions, cost and characteristics of resources selected. (Resource-specific capacity contribution values)
Generation and Regulation Initiative Decision Tools (GRID) Model	Same as IRP but leverages the preferred portfolio as a starting point for evaluation	Marginal system impacts of operating reserves and deferred IRP resources
EIM Dispatch Model	Twelve months of EIM pricing results, characteristics of resources under consideration	Expected EIM benefits for specific resources
Resource Value of Solar (RVOS) Model	Charge/Discharge profiles, efficiency, interconnection voltage, & export condition	Value of generation capacity deferral, net energy and losses, levelized values for T&D deferral and ancillary services
Transmission and Distribution (T&D) Planning Studies	Current load data, predicted load growth, capacity of existing infrastructure	Needs for T&D Projects, low cost solutions to meet needs
Alternative Evaluation Tool	T&D projects identified by planning study, typical cost of traditional solutions, typical cost of alternate solutions	High level cost estimates for alternative solutions - closer look is performed if costs are within 20% of traditional solutions

Forecasted Demand By Use Case



Broad Applications

- The use cases in the Storage Potential Evaluation methodology are resource and technology agnostic.
- Individualized valuations can be produced for a wide range of resource options:
  - Energy arbitrage reflects timing differences in fixed (expected) resource schedules.
    - Applicable to: solar PV, wind, energy efficiency.
  - Dispatchable resources can provide regulation, load following, or spin/non-spin reserve, depending on their flexibility and response time.
    - Applicable to: energy storage, demand response, thermal or hydro resources.

Sample Energy Storage Technology Inputs

Parameter		Value	Unit	Notes
Sizing & Use	Discharge Capacity	2	MW	
	Storage Capacity	6	MWh	
	Hours Discharging	3	hours	Storage capacity divided by discharge capacity
	Availability Outage Rate	3	%	Up-time of 97% per Table 8 of the "Battery Energy Storage Study for the 2017 IRP."
	Planned Outages	3	days/yr	Per Table 8 of the "Battery Energy Storage Study for the 2017 IRP."
Technology Dependent	Efficiency	81	%	Average efficiency for lithium ion battery technology per Table 8 on page 15 of the "Battery Energy Storage Study for the 2017 IRP."
	Hours Charging	3.7	hours	Storage capacity divided by charge capacity and efficiency
	Expected Lifetime Cycles	3500	cycles	Typically, the number of cycles until 80% of storage capacity due to degradation is reached. Per Section 3.6, page 12 and Table 8, page 15 of the "Battery Energy Storage Study for the 2017 IRP."
	Energy Storage Equipment Cost	37.13	$/kWh	End of cycle life storage replacement costs based on the low end of forward projections for lithium ion technology per Figure 3 in Section 4.9 of the "Battery Energy Storage Study for the 2017 IRP."
	Storage Capacity Degradation Cost	10.61	$/MWh	Energy storage equipment replacement cost divided by assumed lifetime cycles
	Storage Capacity Degradation Rate	3.5	%/1000 cycles	Decline in maximum storage capability (MWh)

Benefits and Co-optimization

Energy Storage Stand-alone Use Case Benefits
- from Oregon docket UM-1857

Use Case	Service	Benefit ($/kw-yr)
Bulk Energy	Capacity or Resource Adequacy	**$55.07**
	Energy Arbitrage	**$16.52**
Ancillary Services	Regulation	**$63.27**
	Load Following	**$35.55**
	Spin/Non-spin Reserve	**$28.60**
Transmission Services	Transmission Upgrade Deferral	**$8.09**
Distribution Services	Distribution Upgrade Deferral	**$17.89**

- Generally only one service can be provided in a given interval.
- Generation capacity is additive: serving peak load requires energy, ancillary services, and T&D capacity.
- Generation capacity contribution varies depending on whether storage has a fixed schedule or is dispatchable.
- Distribution deferral can provide high value with relatively low usage - other services can be provided in the remainder of the year. But it is feasible in limited locations.

Use Case Benefit Stacking

Service	Use Case Benefit $/kw-year	Annual Usage %	Avg. Use Case Benefit $/MWh	Capacity Benefit $/MWh
Distribution Upgrade Deferral	$17.89	2%	$102.09	varies
Transmission Upgrade Deferral	$8.09	2%	$46.19	varies
Ancillary Services - Regulation	$63.27	100%	$7.22	$6.29
Ancillary Services - Load Following	$35.55	100%	$4.06	$6.29
Ancillary Services - Spin/Non-spin	$28.60	100%	$3.26	$6.29
Energy Arbitrage - Fixed Schedules	$30.01	100%	$3.66	$2.99

Technology Sensitivities

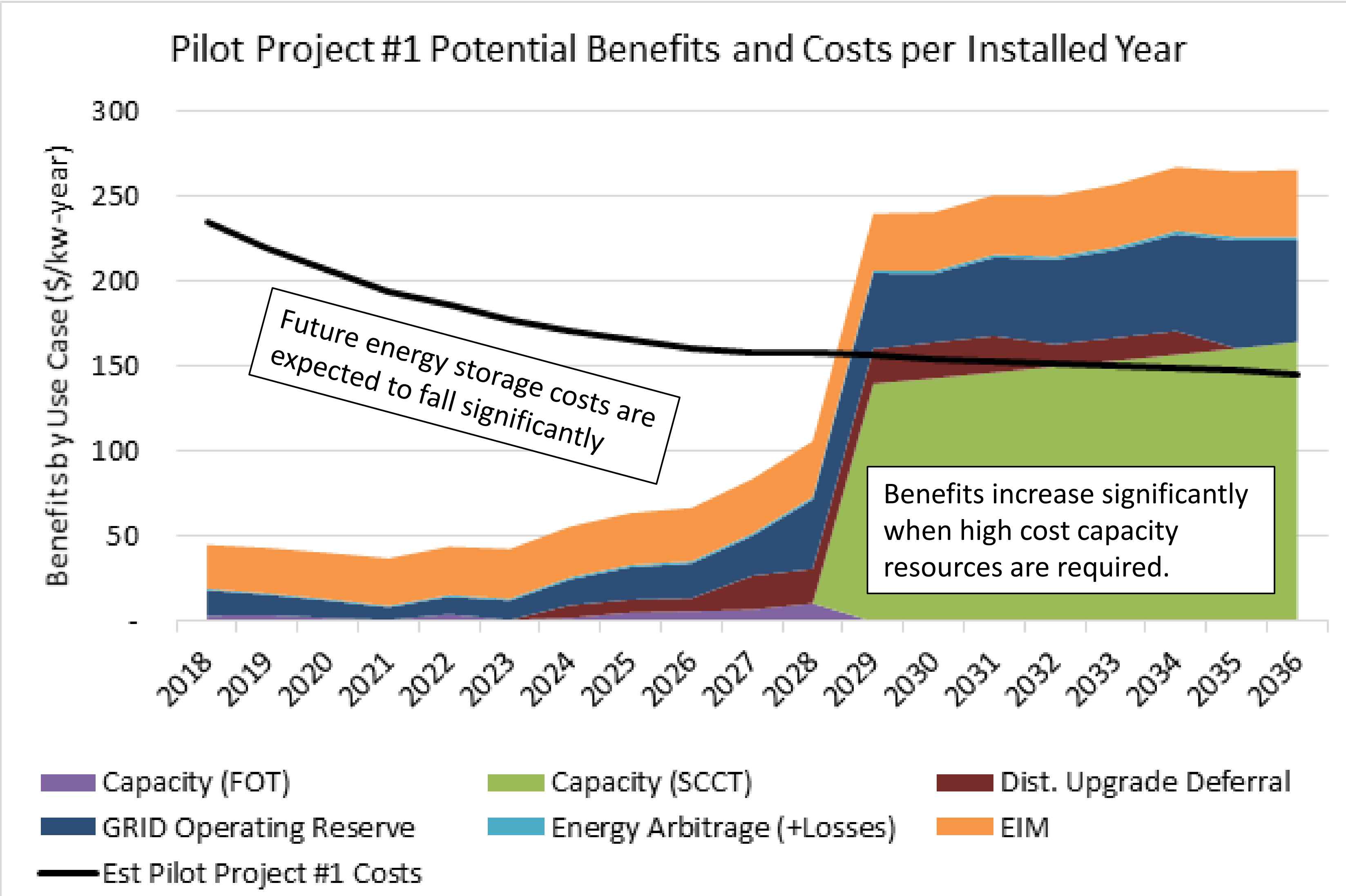
Energy storage operating parameters impact costs and benefits.

- Hours of Storage
  - Assuming four hours of storage for a 100% capacity contribution is typical.
  - More hours of storage are required as use-limited resources increase.
  - Additional power output (fewer hours of storage) has significant value in EIM. It may be cost-effective if the cost is low.
- Efficiency
  - For applications with frequent cycling, efficiency losses are significant.
  - In operating reserve applications, much of the value is from being available, rather than cycling, so efficiency is less important.
- Energy Storage Equipment Replacement Cost
  - Many energy storage systems have components that degrade with use.
  - Each cycle brings replacement of degraded components closer.
  - As with efficiency, this is more important for applications with frequent cycling.

Combined Solar and Storage

- Combining solar and storage can provide enhanced benefits:
  - Investment Tax Credits (ITC) for solar can be applied to on-site energy storage, subject to certain operating limitations
  - Improved charging efficiency (DC-DC vs AC-DC)
  - Reduce lost solar output due to inverter capacity limits
  - Shared construction costs and transmission system interconnection
- There are some operating limitations from combined solar and storage:
  - Charging from grid, rather than on-site solar, impacts ITC for a certain period
  - Storage resource may be “trapped” behind solar output due to inverter and transmission interconnection limits
- The costs of combined solar and storage, and other combinations, will be part of the supply-side resource table.

Future Cost Effectiveness



Customer-Sited Storage

- Customer-sited energy storage benefits:
  - Reliability – customer benefit
  - Outage mitigation – customer benefit
  - Time of use or demand charge reductions – customer benefit
    - Ideally, reductions in customer electricity costs are consistent with achieved utility cost savings
- Evolution of time of use and demand charge periods may be appropriate with changing system composition, for instance increasing solar resources reduce costs during daytime.
- Additional system benefits can be achieved through flexible dispatch, but operational requirements and program costs can be significant, particularly for small resources.

Time Varying Rates and Pilots

- Vast majority of customers greater than 1 MW in size are subject to mandatory time varying prices
- Several time of use options are available for smaller customers:

State	Schedule	# of Customers	On-Peak Period (M-F, excluding holidays)
UT	Sch 2 - Residential	447	1pm-8pm, Summer Only
UT	Sch 6A/6B – Non-Residential	2,600	7am-11pm
UT	Sch 10, TOD Option – Irrigation	249	9am-8pm
OR	Sch 210 – Residential Sch 210 – Small Non-Residential	1,108 308	Winter – 6-10am & 5-8pm; Summer – 4pm-8pm
ID	Sch 36 – Residential	11,798	Winter - 8am-11pm; Summer – 7am-10pm

- Pilots testing other time of use rate designs:

State	Schedule	# of Customers	On-Peak Period (M-F, excluding holidays)
UT	Sch 2E – Residential EV	150	3-8pm All Year + 8-10am in Winter
OR	Sch 215 – Irrigation	97	2pm-6pm, Summer Only
CA	Sch PA-115 – Irrigation	22	2pm-6pm, Summer Only

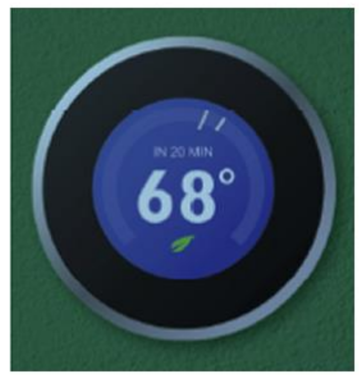
IRP Modeling

- The IRP preferred portfolio and cost assumptions inform evaluation of energy storage and the results of that evaluation can inform the IRP.
- IRP modeling captures:
  - Generation capacity
  - Operating reserve opportunity costs (i.e. spin/non-spin)
  - Energy arbitrage
- Developing technology credits that account for:
  - EIM dispatch benefits (i.e. regulation)
  - T&D upgrade deferral

Energy Storage Next Steps

- Refine assumptions for 2019 IRP modeling:
    - Supply-side resource costs and technology characteristics
    - Capacity contribution
    - EIM Intra-hour dispatch benefits
    - T&D deferral opportunities

Renewable Resource Schedules and Load Forecast



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Solar Power-Purchase Agreements

Developer	Project	State	MW	Term
Invenergy	Prineville Solar Energy	OR	55	12/20 (20 Yrs)
Invenergy	Millican Solar Energy	OR	45	12/20 (20 Yrs)
Community Energy Solar	Hunter Solar	UT	100	12/20 (25 Yrs)
Community Energy Solar	Sigurd Solar	UT	80	12/20 (25 Yrs)
First Solar	Cove Mountain	UT	58	12/20 (25 Yrs)
Longroad Energy	Milford Solar	UT	99	11/20 (25 Yrs)
	Total Portfolio	OR/UT	437	20/25 Years

- Contracts executed June 2018 (projects were offered into 2017S Request for Proposals).
  - Six power-purchase agreements (PPAs) between developers and PacifiCorp.
  - Six renewable energy certificate purchase and sale agreements between developers and PacifiCorp.
  - One Oregon Schedule 272 renewable energy certificate (REC) purchase agreement between PacifiCorp and Facebook.
- On average, levelized prices for the energy and capacity from the portfolio of solar projects is less than $26/MWh (lower than bids evaluated in the 2017S Request for Proposals).
- The PPAs are system resources and will provide net-power cost savings for customers.
- In accordance with Oregon Schedule 272, renewable energy credits will be retired on behalf of the Facebook.

Utah Schedule 32
Renewable Energy Contracts

- 2012 law allows the utility to enter into a renewable energy contract with a customer to supply some or all of the customer's electricity service (Utah Code § 54-17-801 thru -805):
  - Customer must pay for all incremental costs associated with metering, communications facilities, administration, and the use of transmission and distribution facilities to deliver the electricity to customer at utility applicable rates, in addition to costs of renewable energy
  - Amount of electricity may not be less than 2 MW on an annual load basis; a customer may aggregate multiple metered delivery points to meet minimum
  - Overall program cap of 300 MW for Renewable Energy Contracts, unless commission approves a higher amount
  - Amount of electricity in any hour under a renewable energy contract may not exceed the customer's metered load in that hour; excess generation may be credited at avoided cost rates
  - Renewable energy facility may be owned by the utility, the customer, any other entity, or by a combination of the above
- Schedule 32
  - Sets rates for monthly administration and for delivery and daily back-up charges, which are in addition to the renewable energy contract
    - Charges mirror partial requirements service but for an offsite facility

Utah Schedule 34
Renewable Energy Tariff

- 2016 law allows for new renewable energy tariff (Utah Code § 54-17-806):
  - Qualifying customers must be at least 5,000 kW in annual peak load
  - Qualifying customers must pay:
    - Normal tariff rate plus an incremental charge equal to the difference between the cost of the renewable generation and avoided costs, or
    - A different methodology recommended by the utility
    - An administrative fee
- Schedule 34 governs contract guidelines for the company to provide service to qualifying customers from a renewable resource
  - The renewable resource may be owned by the utility, the customer, or any other entity
  - Eligible renewable resources must not already be included in rates
  - PacifiCorp will take physical delivery of output from renewable facility
  - RECs will be retired on behalf of the customer
  - Maximum amount of renewable energy will be based upon reasonably projected energy consumed by the customer. Excess output that exceeds customer usage on an annual basis will be compensated at avoided cost rates.
- Contract approval will be based on a finding that the contract is just and reasonable and in the public interest. Public interest will include consideration of contribution to system fixed costs
- Non-refundable application fee of $5,000
- Penalty for early termination, but may be transferred to another customer

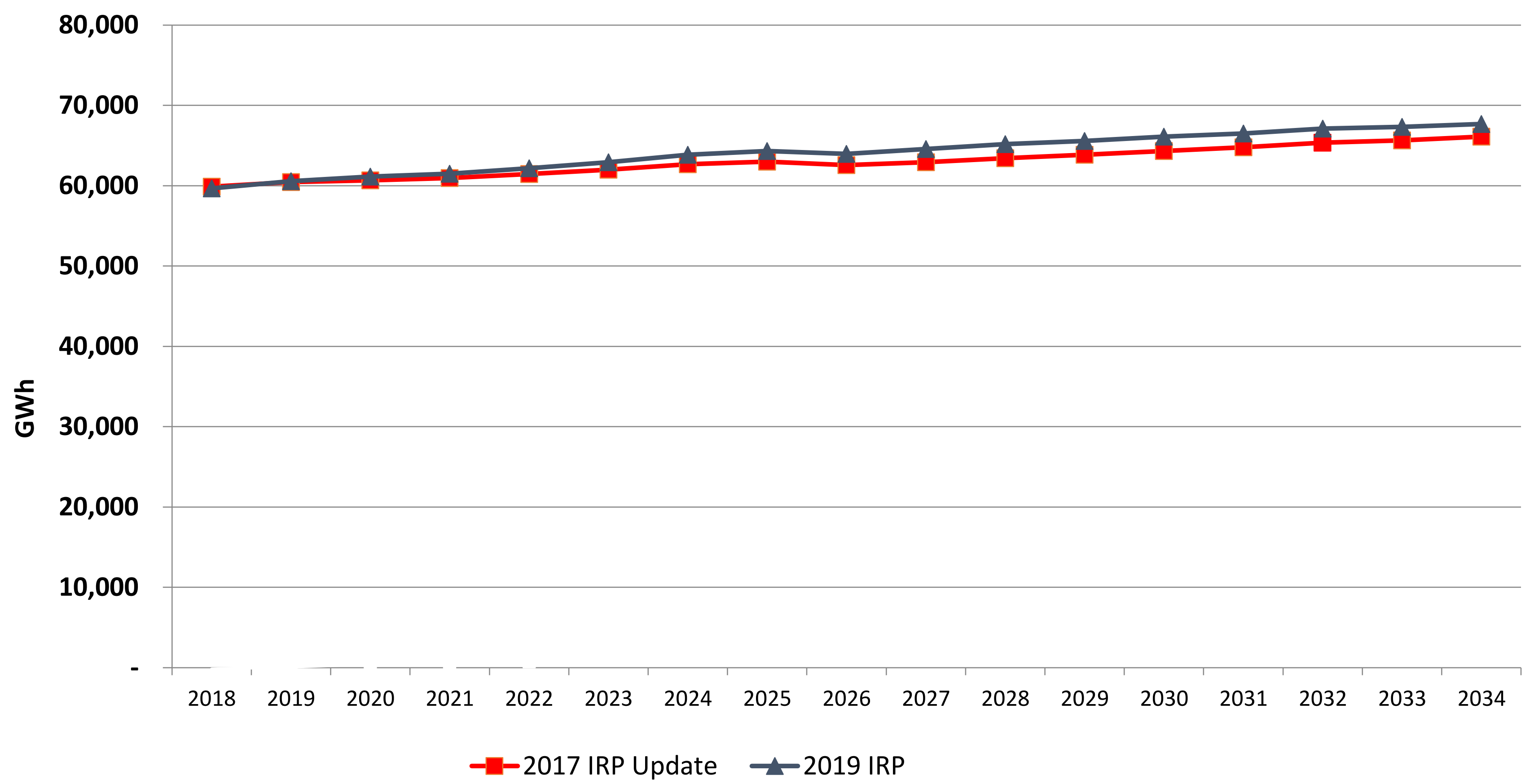
Utah Schedule 73
Subscriber Solar Program Rider

- Subscriber Solar is a voluntary program for Rocky Mountain Power's Utah customers to purchase electricity from solar resources
  - Customers on Rates 1, 2, 3, 6, 6A, 6B, 8, 9, 9A, and 23 can participate in Schedule 73
  - Customers not on interval meters are assigned 1 kW blocks of capacity and 200 kWh per month of energy for each block of capacity
  - Customers on interval meters are assigned the actual output associated with their 1 kW of capacity
  - Residential and Small Customers can purchase blocks up to 100% of their annual usage
  - Commercial and Industrial Customers can purchase the lower of 2000 kW or 100% of their annual usage
- Customers are charged a Solar Block Delivery Charge and Solar Block Generation Charge that varies depending on the customer's applicable tariff schedule, and includes program and administrative costs
  - Customers pay their tariff rate for all additional kWh's purchased above the Subscriber Solar blocks
  - There is a $50 per block cancellation fee in the first 3 years then no cancellation fee thereafter
  - Blocks are 'portable' if a customer moves w/in the Company's territory, so long as they stay on the same rate schedule
  - RECs are retained by the Company and retired on behalf of the customers
- Pavant 3, a 20 MW solar facility owned by juwi, Inc. in Millard County UT, started producing the energy for Subscriber Solar on January 1, 2017
  - The program has essentially been fully subscribed since it began, and has had a waitlist for a number of months

Load Forecast Summary

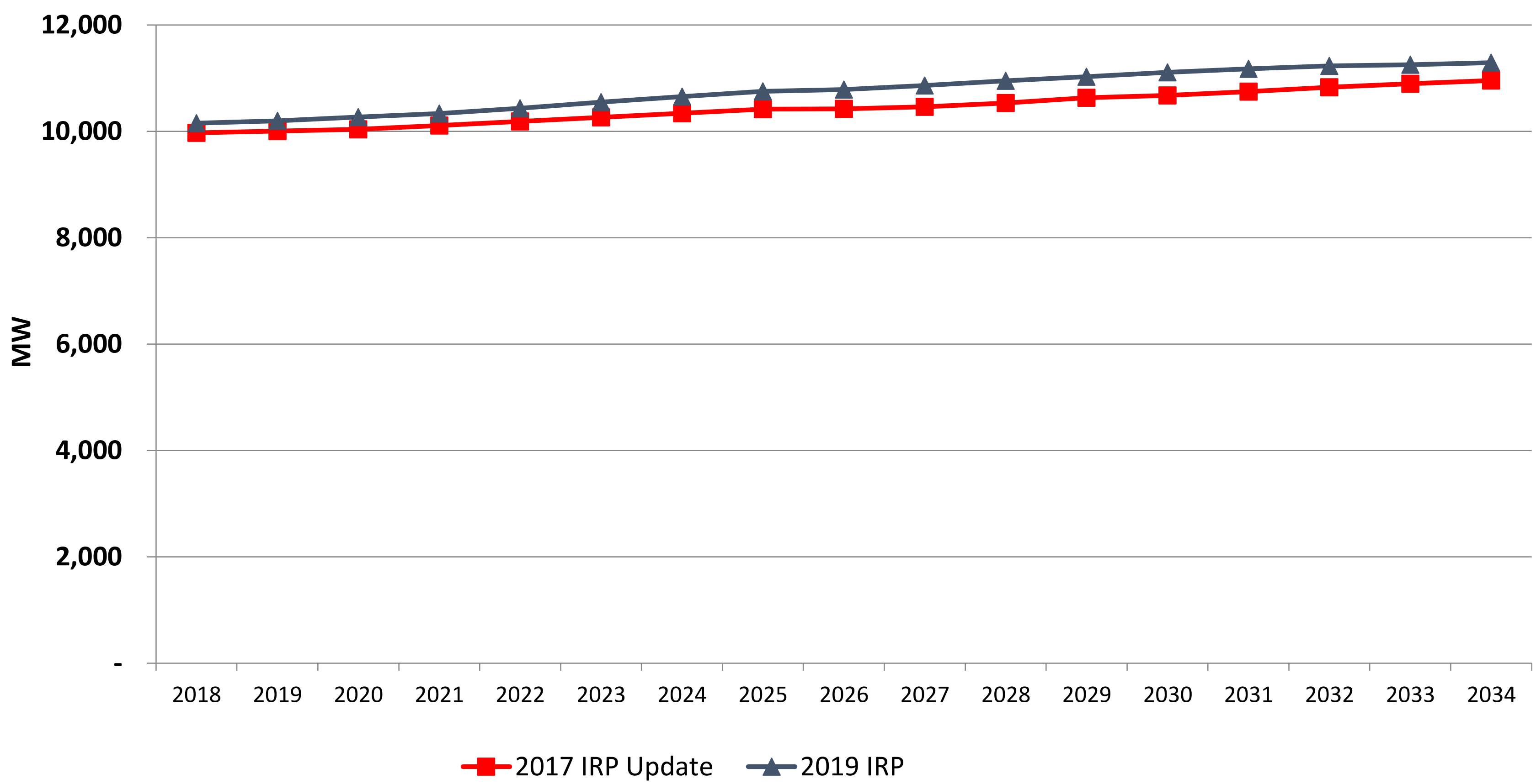
- The 2019 IRP load forecast for peak and energy is higher in all years compared to 2017 IRP Update driven by:
  - Increase in energy use driven by commercial and residential sectors
    - Commercial – higher data center forecast and strong sales in the class for 2017
    - Residential – stronger than anticipated sales in 2017 as well as increased residential customer growth
  - Peak increase due to overall increase in energy
    - Peaks continue to be driven by summer cooling load
  - Improved economic conditions
    - Increase in industrial usage in Washington, Oregon, Idaho and California
    - Increase in commercial usage in Utah, Oregon, Washington and California

System Energy Load Forecast Change



Source: PacifiCorp, Load Forecasting Group work product

System Peak Load Forecast Change



Source: PacifiCorp, Load Forecasting Group work product

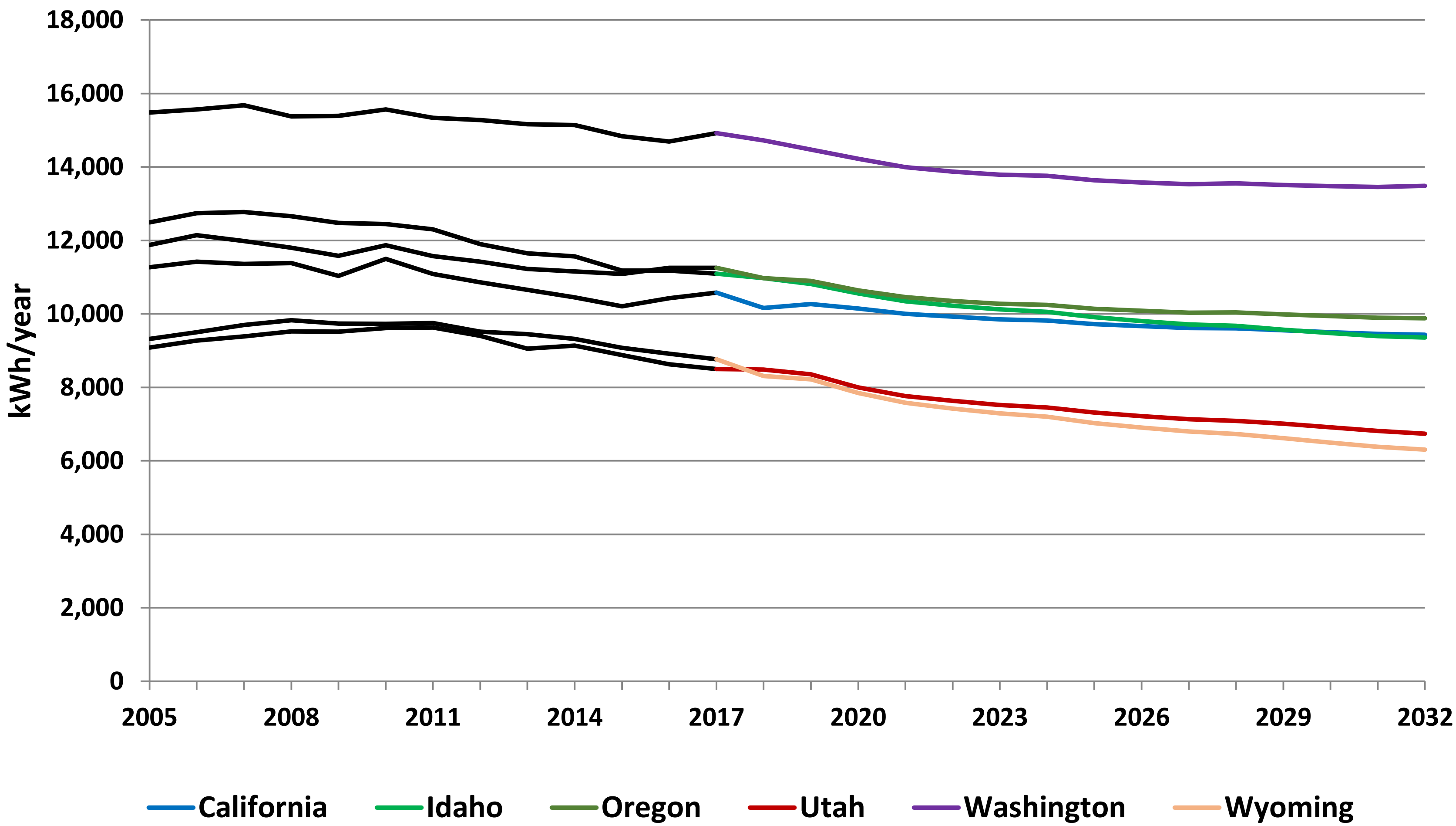
Current Trends

- An increase in sales for Wyoming oil and gas customers (3 percent year-over-year) due to recent stabilization / increase in oil prices
- Recent publications put the estimate of the number of cryptominers in the U.S., in the tens of thousands
- Results from the 2017 Residential Survey annual usage is 3,912 kWh higher for customers with indoor agricultural equipment as compared to all other residential customers. Also, loads for PacifiCorp's commercial cannabis customers have increased 142 percent over the 2016 to 2017 timeframe

2017 Residential Survey

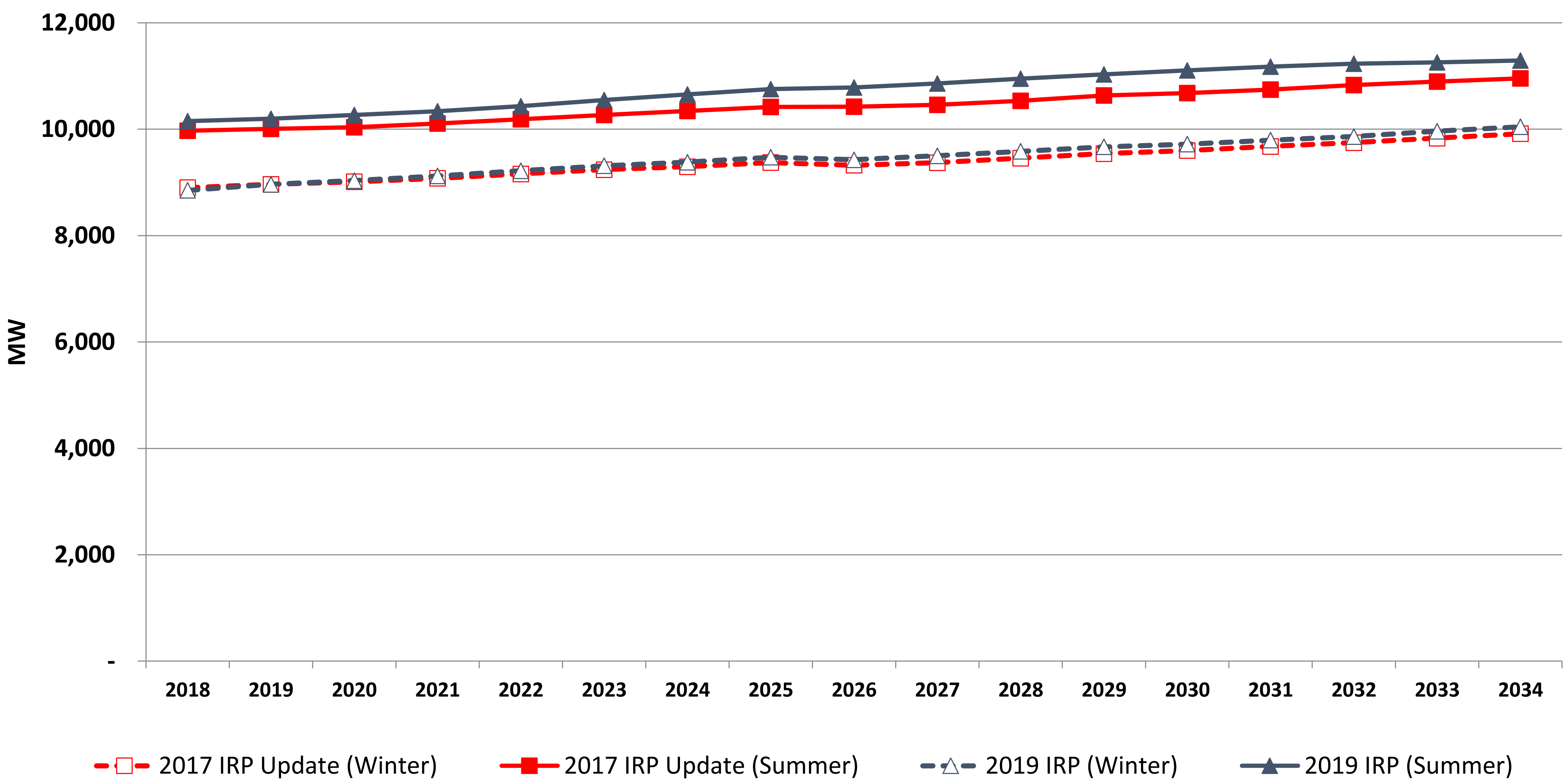
- PacifiCorp conducted a 2017 residential survey with the following findings relative to the prior 2015 residential survey:
  - Adoption of LEDs increased by 12 percent
  - Central AC increased in all states except California and Washington
  - Use per customer decreased partially due to decreasing household size. However, a corresponding increase in the number of customers outweighs the decrease in use per customer
  - 1.6 percent of customers report having electric vehicles, which are associated with an additional 579 kWh per customer in annual usage, or 15 GWh per year system-wide
  - 0.6 percent of customers report having indoor agriculture equipment

Weather Normalized Average Use per Residential Customer



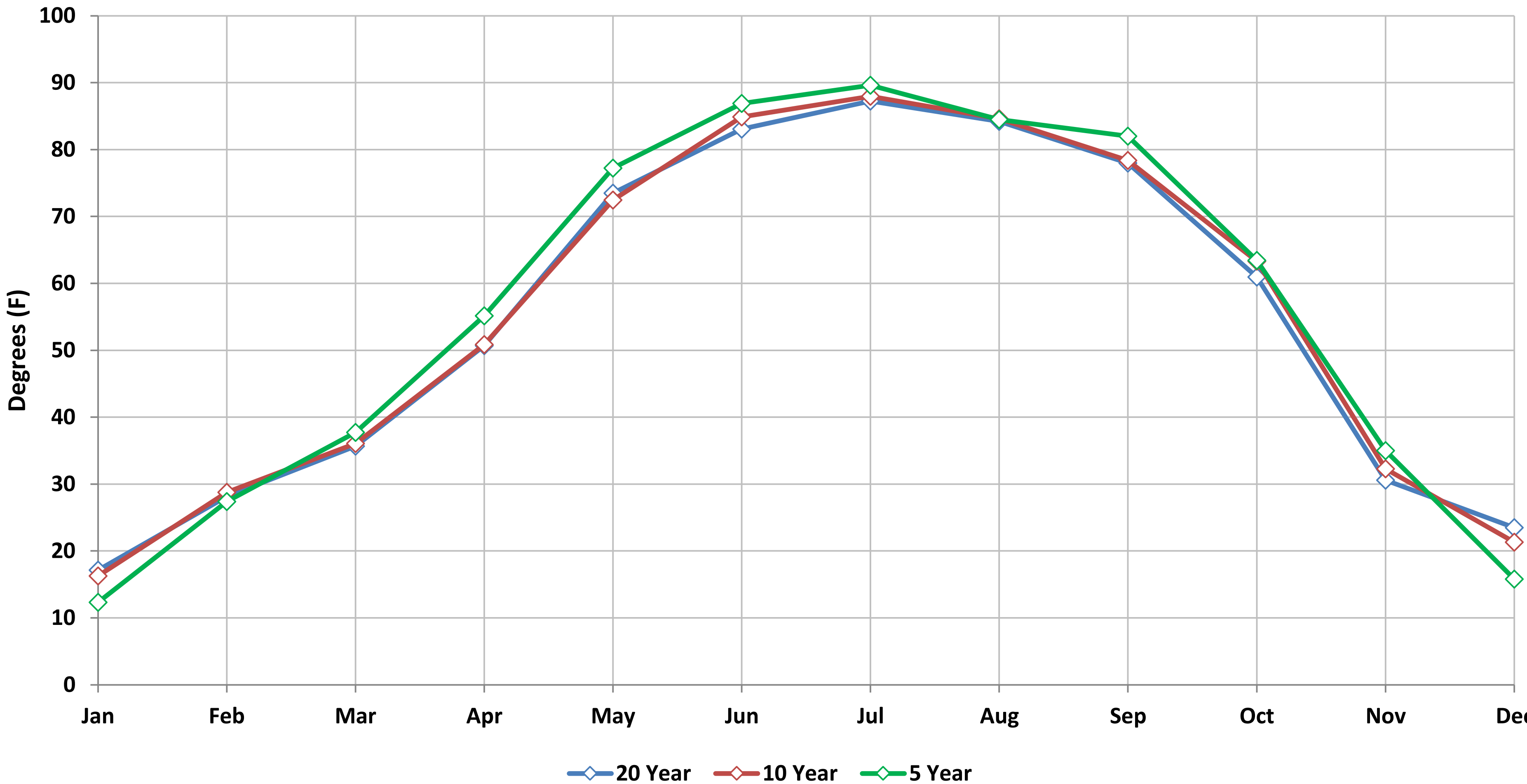
Source: PacifiCorp, Load Forecasting Group work product

Winter and Summer System Peak Load Forecast



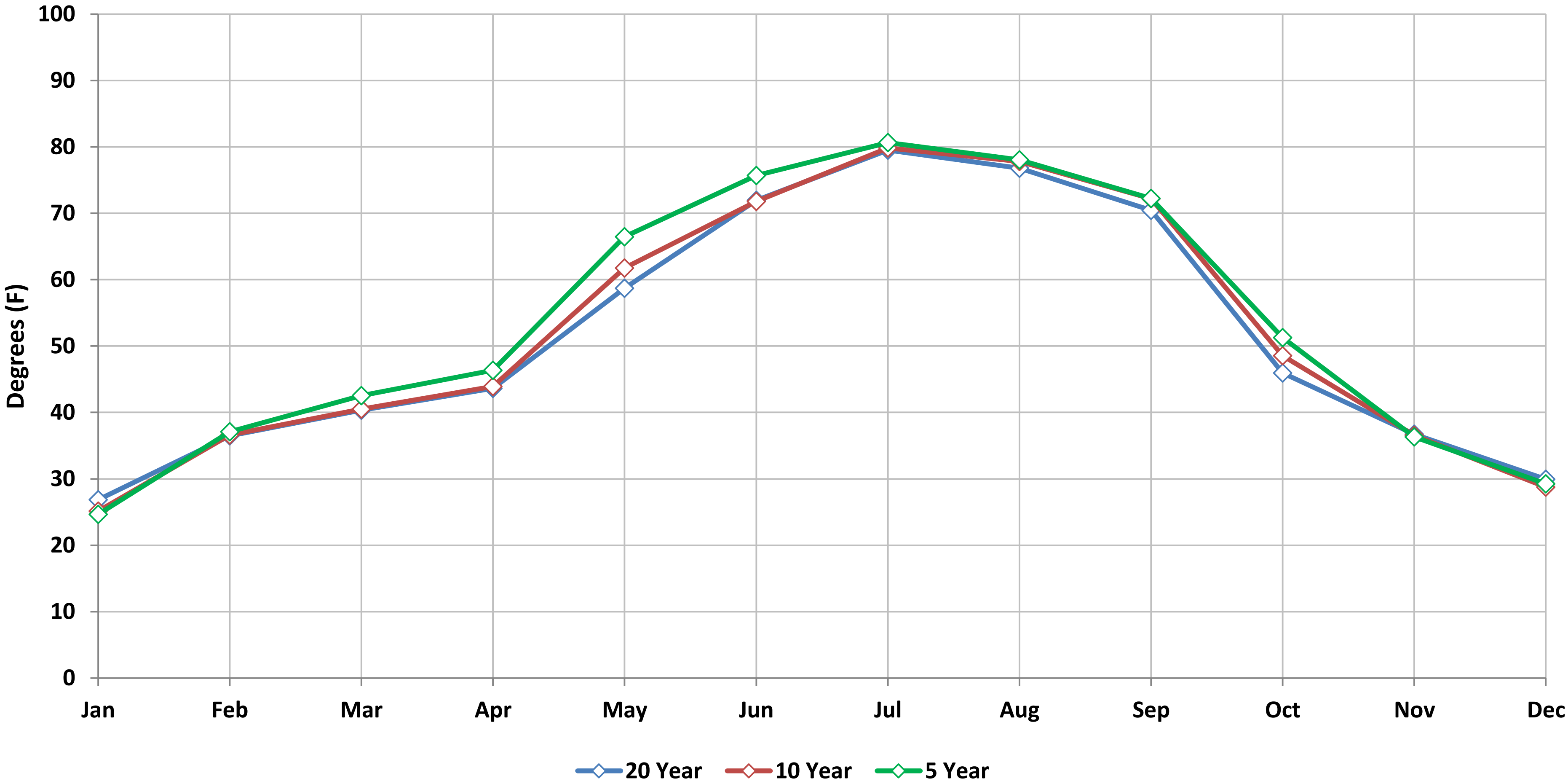
Source: PacifiCorp, Load Forecasting Group work product

Utah Peak Producing Weather



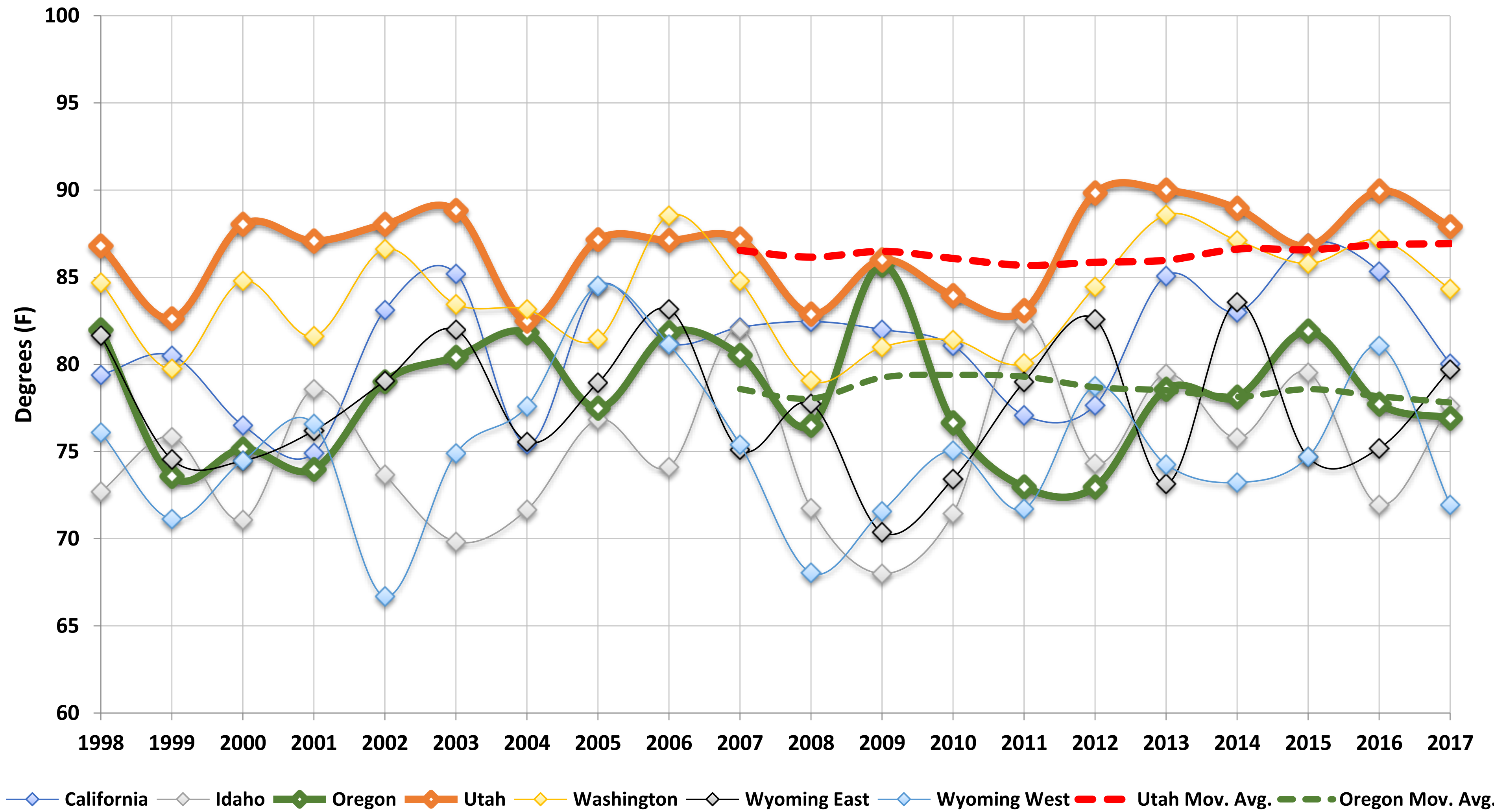
Source: MDA Federal, Salt Lake City Airport Weather Station

Oregon Peak Producing Weather



Source: MDA Federal, weighted average for Medford Airport, Portland Airport, Salem Airport, Klamath Falls Airport, Redmond Airport , North Bend Airport, and Astoria Airport Weather Stations

July Peak Producing Weather Average Dry Bulb Temperature on Peak Day

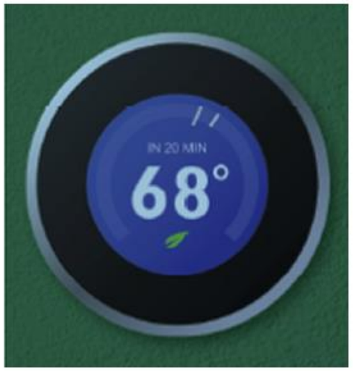


Source: MDA Federal, California – Medford Airport Weather Station, Idaho – Pocatello Airport Weather Station, Oregon - weighted average for Medford Airport, Portland Airport, Salem Airport, Klamath Falls Airport, Redmond Airport , North Bend Airport, and Astoria Airport Weather Stations , Utah – Salt Lake City Airport Weather Station, Washington – Yakima Airport Weather Station, Wyoming – weighted average for Salt Lake City Airport and Casper Airport Weather Stations

Load Forecast 2019 IRP Sensitivities

- 2019 IRP load forecast sensitivities:
  - 1-in-20 year (5 percent probability) extreme peak producing weather scenario
  - High and low economic growth

Distribution System Planning



Distribution System Planning (DSP) Studies

- DSP Study:
  - 5-year planning horizon
  - Less than 35kV
  - Distribution Substation Getaway to End of Feeder
- Area Planning Study:
  - 10-year horizon
  - Distribution Substations
  - Sub-Transmission
  - Transmission
- Transmission Studies

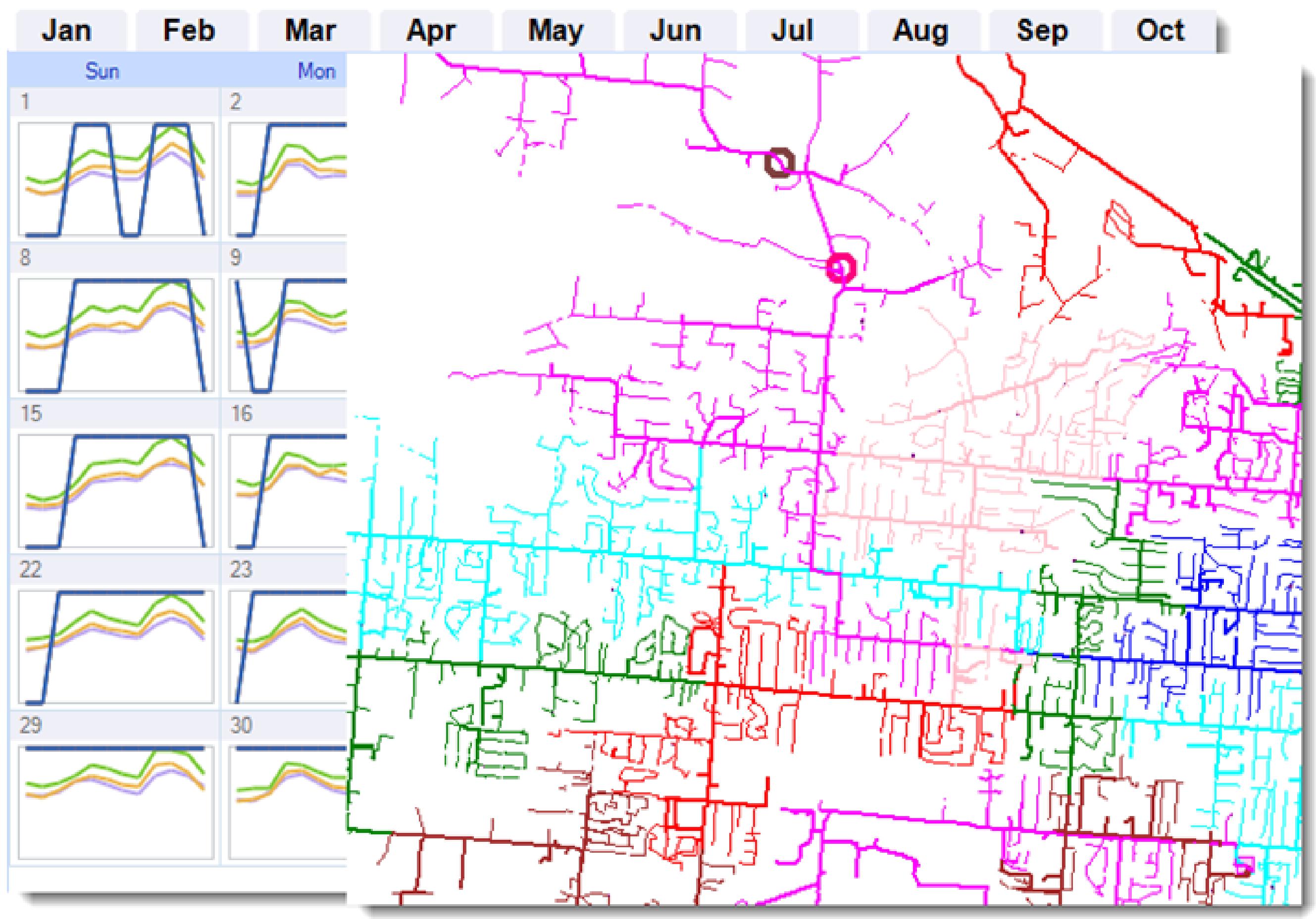
DSP Drivers

What drives the need?

- New Customer Uses
- Enhance system capacity
- Improve system reliability
- Perform work required by mandates
- Replace equipment/modernize grid

DSP Tools

- Distribution:
    - Power flow model (CYME)
    - CYME Gateway (Data)
    - Reliability model (GREATER, FIRE)
    - SCADA
    - PI Historian
    - DER Screening tool
- Customer:
    - Production/load resource meters
    - AMI meters (in development)



DSP Load Forecast

- Load and DER Projections:
  - Primary purpose is to identify equipment and conductor thermal loading and voltage constraints
  - Regressive Analysis
  - Block Additions/Subtractions
  - Netting Generation
  - Non-coincidental peak, 1-in-5, summer and winter

DSP Solutions

- Solutions to identified issues in planning:
  - Improve Planning Information
  - Improve System Operation
  - Modernize the Energy Grid
  - Enhance System Capacity
  - Incorporate Customer Solutions
  - Utilize Advanced Technology

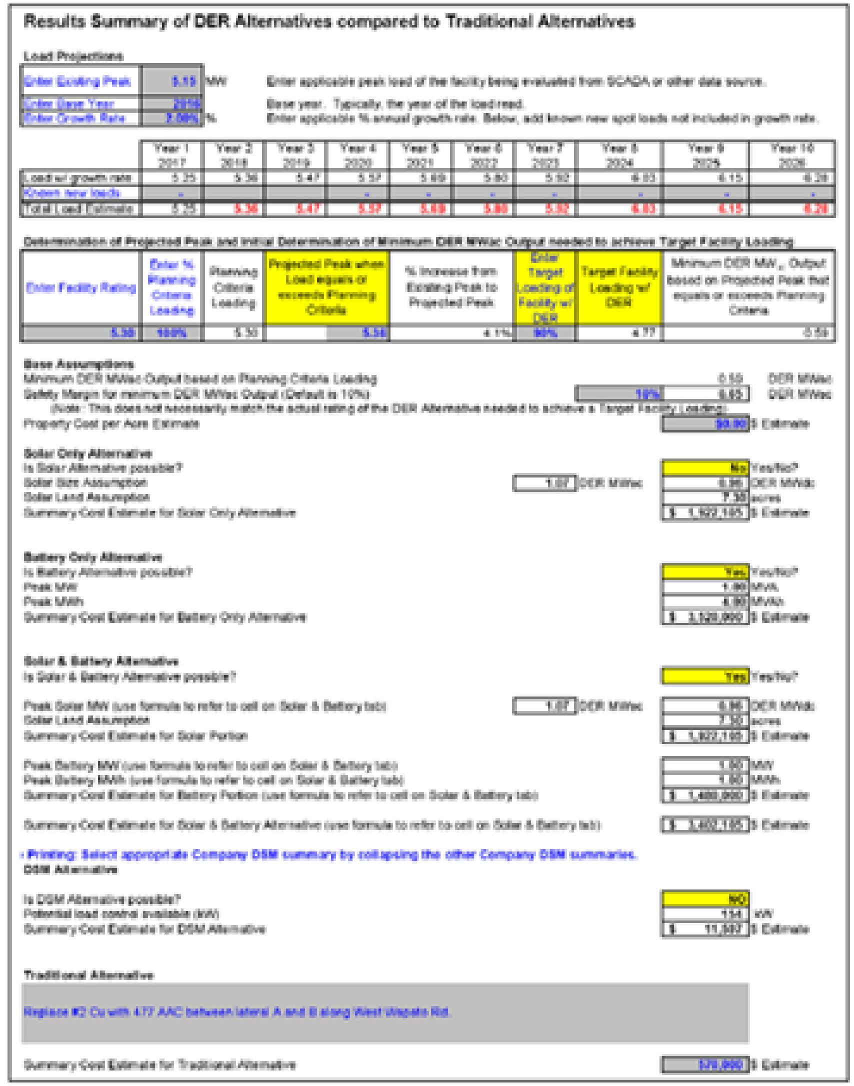
Non-Wires Screening Tool

- Solar
- Solar and Energy Storage
- Energy Storage
- Demand Side Management

For more information:

2017 Pacific Power Oregon Smart Grid Report

- Screening Tool Discussion (pages 21,22)
- Appendix F Non-Wires Screening Tool



DSP Prioritization

- Dependent on Investment:
  - New Customer
  - Mandated
  - Replace
  - Reliability
  - Capacity

DSP and IRP

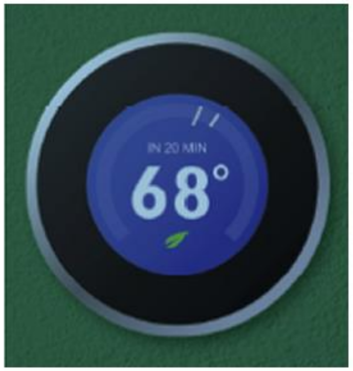
- Distinct and separate planning requirements:
  - T&D subject to different regulatory requirements
  - Different timeframes and study periods
  - Example of interaction:
    - Non-Wires Screening Template
    - Energy Trust of Oregon Targeted Energy Efficiency Pilot

DSP Moving Forward

- Develop margins for distribution planning
- Identification of relevant costs, risks, benefits
- Maintain focus on industry developments
  - Modeling tool developments in power flow software
  - Greater data needs now and in the future
  - Integration and interfaces between data sources and data uses is critical to ensure proper answers are developed
- Distribution models and application become more critical
- Leverage smart grid technologies that optimize the electrical grid when and where it is economically feasible, operationally beneficial and in the best interest of customers
- T&D Planning and the IRP
  - Maintain distinct and separate requirements that inform each other
  - Improvements in methods to value projects at distribution level may be applied to methods in the IRP

Environmental Policy



Environmental Policy Overview

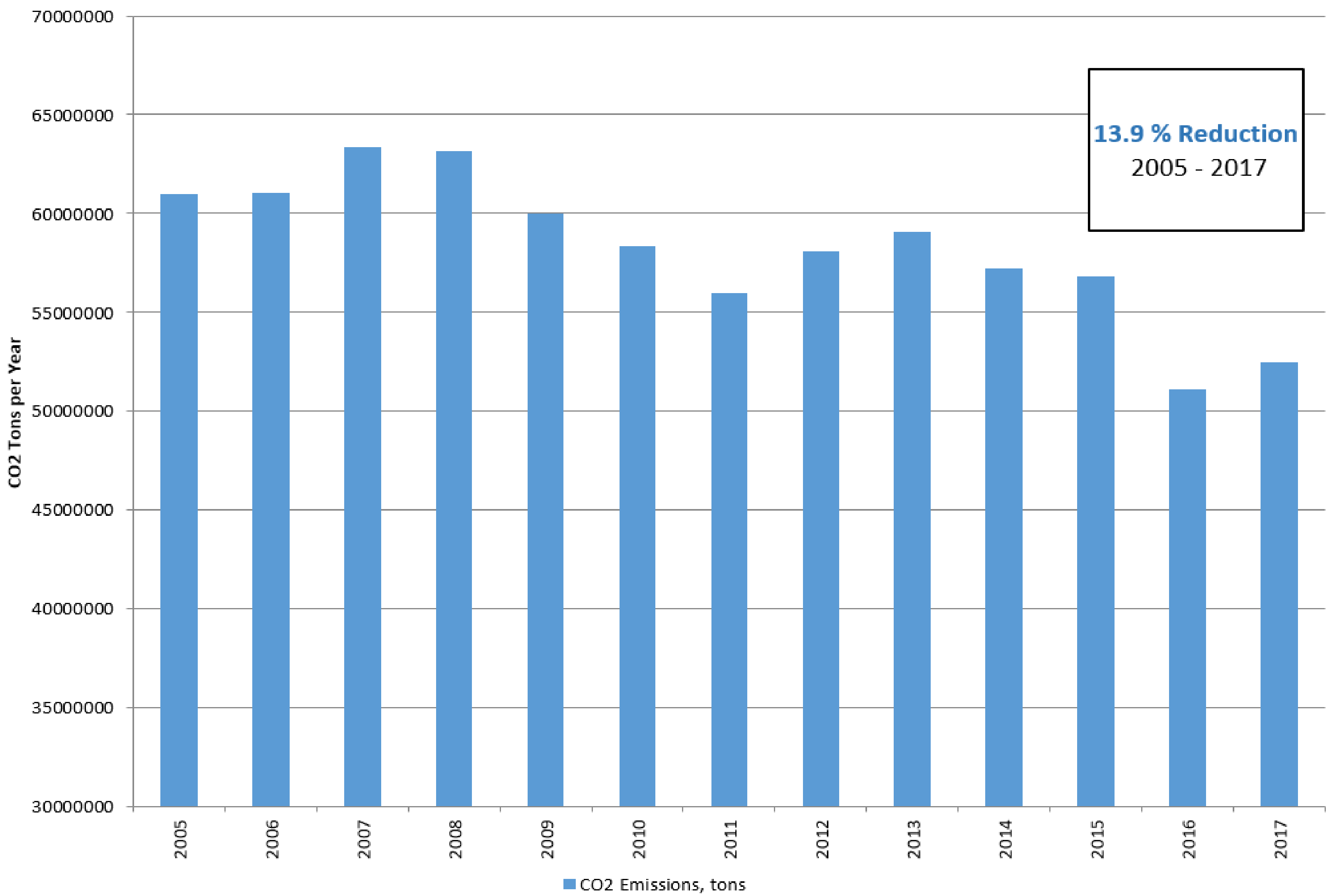
- Clean Power Plan (“CPP”)
- Regional Haze
- National Ambient Air Quality Standards (“NAAQS”)
- Coal Combustion Residuals Regulation (“CCR”)
- Clean Water Act (“CWA”)
  - Effluent Limitation Guidelines (“ELG”)
- GHG Emissions Policy Update

Clean Power Plan

Clean Power Plan

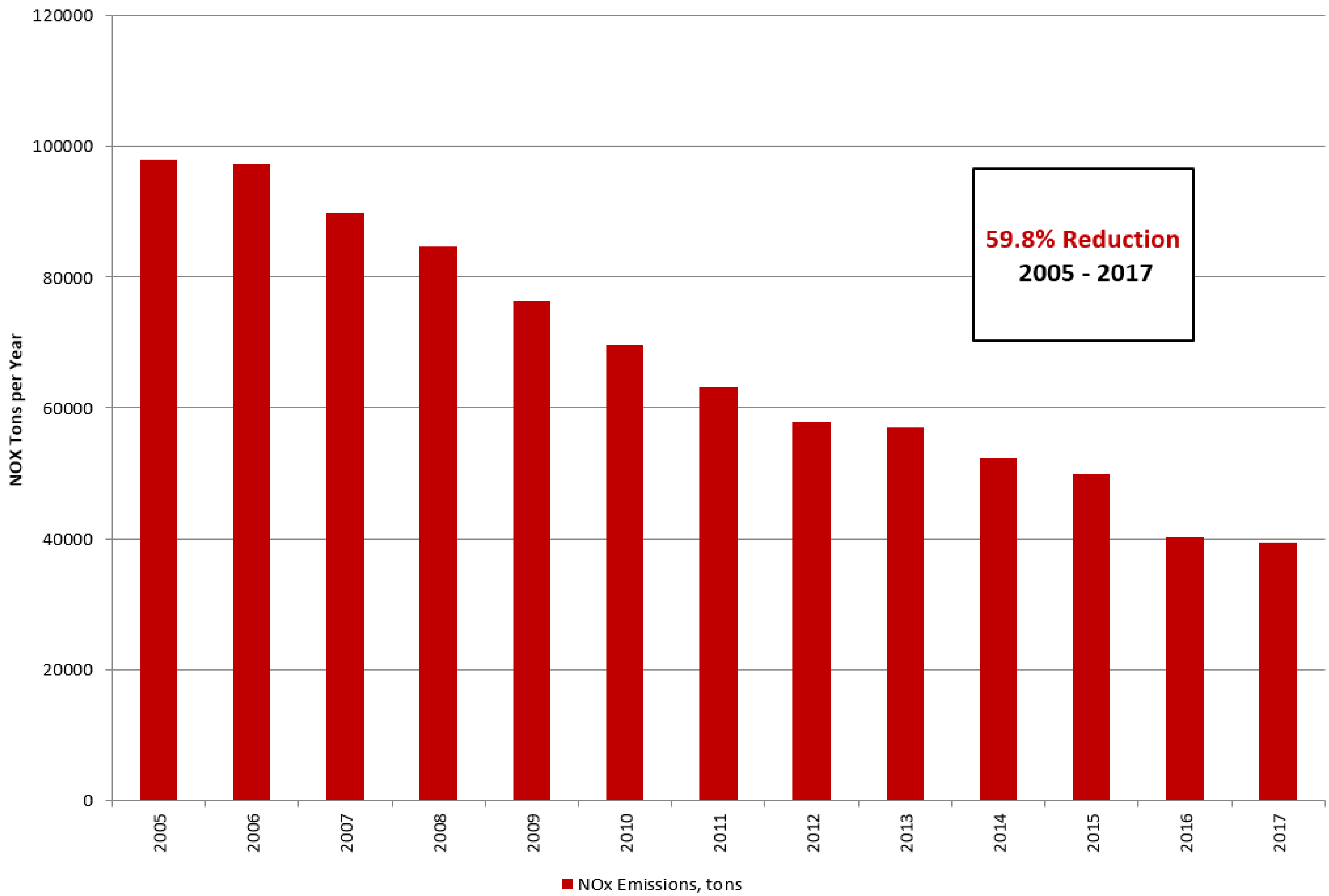
- The final CPP rule was published in the *Federal Register* on October 23, 2015
- February 2016, the U.S. Supreme Court issued a stay of the CPP until legal challenges were resolved
- March 2017, President Trump issued an Executive Order directing the EPA to review the CPP
- April 2017, the Circuit Court of Appeals abates the lawsuits on the CPP for 60 days; lawsuit continues to be on hold
- October 2017, EPA published the repeal of the CPP and issued an Advanced Notice of Proposed Rulemaking to solicit information on the best system for emission reduction; EPA also requested the case remain in abeyance until completion of rulemaking
- PacifiCorp submitted comments on the ANPR on February 26, 2018 and the CPP Repeal on April 28, 2018
- June 27, 2018, Court granted 60-day extension, noting it would be the last extension it grants
- July 9, 2018, the EPA sent a proposed replacement rule to the White House Office of Management and Budget for review

PacifiCorp System CO_2 Emissions

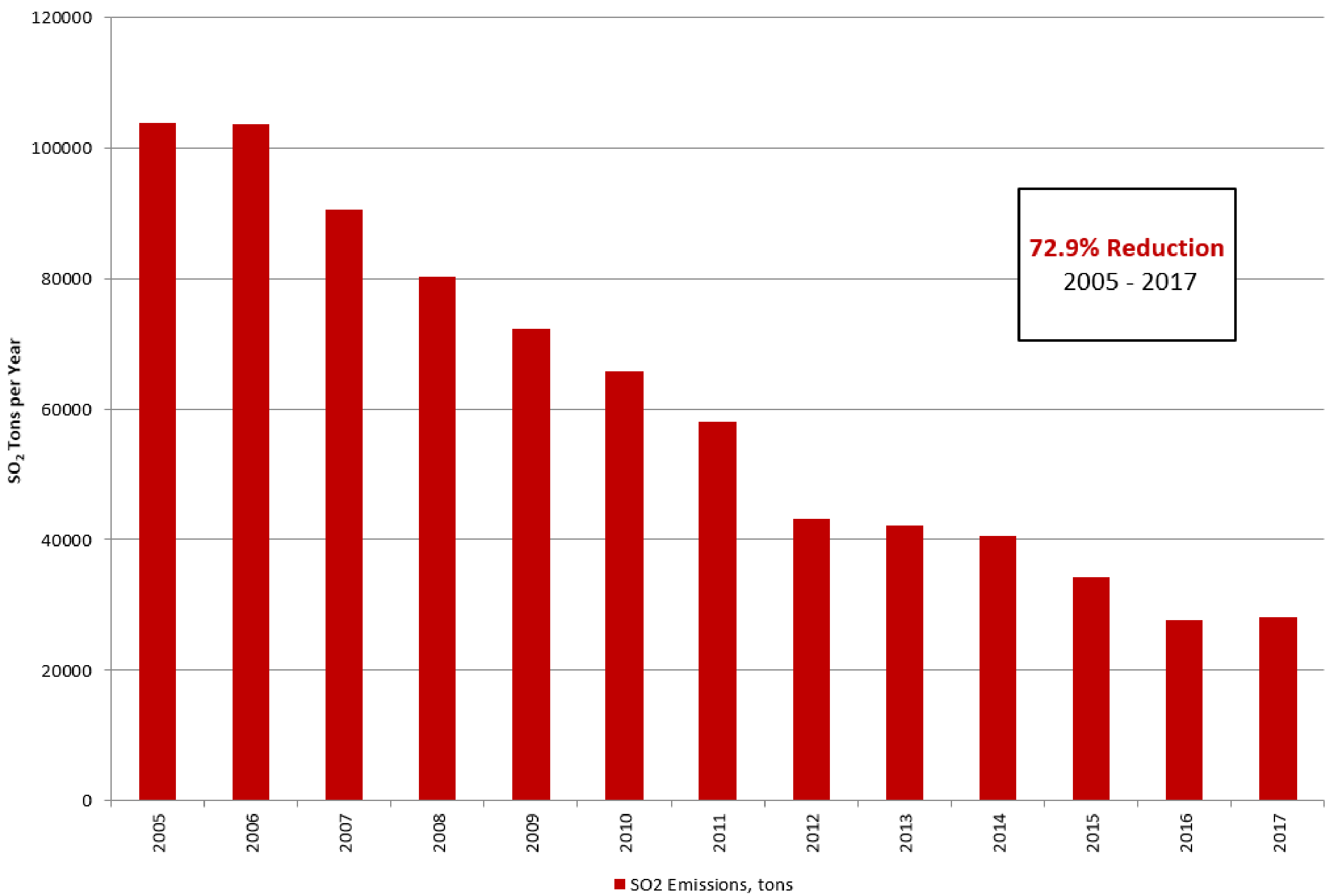


Regional Haze

PacifiCorp NO_x Emissions



PacifiCorp SO_2 Emissions



Utah Regional Haze Compliance

- July 2016, EPA published its final action on UT Regional Haze SIP. requiring SCR on Hunter Units 1 and 2 and Huntington Units 1 and 2 within 5-years
- September 2016, PacifiCorp and other parties filed a request for reconsideration and an administrative stay with EPA
- July 2017, EPA sent letters to PacifiCorp and the state of Utah indicating its intent to reconsider its FIP; the agency also filed a motion with the 10th Circuit Court of Appeals to hold the litigation in abeyance pending the rule's reconsideration
- September 2017, the 10th Circuit granted the petition for stay and the request for abatement; the compliance deadline of the FIP and the litigation was stayed indefinitely pending EPA's reconsideration
- EPA is working with petitioners on development & analysis of technical information related to its reconsideration, including CAMx air quality modeling
- Litigation remains on hold

Wyoming Regional Haze Compliance

- Jan 2014, EPA issued a regional haze FIP partially approving certain parts of the state of Wyoming's SIP
- EPA approved the following SIP requirements:
  - Jim Bridger Units 3&4 Installed SCR in 2015, 2016
  - Jim Bridger Units 1&2 Install SCR by 2021 and 2022
  - Naughton Unit 3: Install SCR to reach .07 lb/MMBtu NO_X rate, or convert to gas
  - Naughton Units 1&2: Install LNB and OFA (.26 lb/MMBtu NO_X rate)
  - Dave Johnston Unit 4: install LNB and OFA (.15 lb/MMBtu NO_X rate)
  - Dave Johnston Unit 1&2: no new controls
  - Dave Johnston Unit 3: EPA offered two alternative compliance paths in the FIP: (1) install LNBs and OFA and shut-down by 2027 or (2) install LNB/OFA and SCR.
  - Wyodak Unit 1: Install SCR within five years of the final rule (challenged by PacifiCorp)
- April, 2017, after appeals, EPA and Basin Electric negotiated settlement agreement and filed a joint motion in the 10th Circuit to hold the Basin-specific issues in abeyance

Wyoming Regional Haze Compliance

- PacifiCorp, Wyoming and Basin Electric submitted motions requesting the court hold all of the consolidated appeals of challenged portions of the Wyoming Regional Haze FIP in abeyance while the Basin Electric settlement is processed and promulgated by EPA

- The 10th Circuit Court of Appeals granted the motion to hold entire case in abeyance pending Basin's settlement; finalizing the settlement requires notice and comment rulemaking and is anticipated to take up to two years to complete

- The court denied Environmental groups motion asking the court to bifurcate certain claims and to reconsider its decision to abate the case pending settlement

- PacifiCorp is in compliance with all requirements relating to the SIP

Non-Operated Plants
Regional Haze Compliance

Colorado

- Tri-State's environmental compliance staff and counsel negotiated an agreement in principle with EPA, CDPHE, WildEarth Guardians, and the National Parks Conservation Association on an alternate Regional Haze compliance strategy incorporating accelerated retirement for Unit 1. The agreement will result in a year-end 2025 shutdown with certain interim NO_X emission reduction commitments from the partner owners

- The state of Colorado's Air Quality Board approved the agreement during a hearing held on December 15, 2016

- CDPHE submitted SIP amendment documentation to EPA Region VIII on May 27, 2017

- EPA approval process expected to last to year-end of 2018

National Ambient Air Quality Standards

National Ambient Air Quality Standards

One-hour NO2 & SO2 Standards

- NO2: All areas of the country designated as unclassifiable/attainment
- SO2: In January 2018 EPA published the Air Quality Designations for the 2010 SO2 NAAQS Round 3
- Counties of Emery, Campbell, Lincoln and eastern Sweetwater were classified as attainment/unclassifiable
- Converse County will not be designated until December 2020

Fine Particulate (PM2.5) Standard

- In May 2017 EPA reclassified Salt Lake City and Provo to Serious Nonattainment
- Utah has until December 31, 2019 to demonstrate attainment through modeling or monitoring

Ozone Standard

- EPA finalized new ozone standard in October 2015
- In May 2018 the Wasatch Front was designated as Marginal Compliance for Ozone and has three years to develop a plan to meet the standard

Coal Combustion Residuals

Coal Combustion Residuals

- PacifiCorp operates six impoundments and four landfills (with three additional impoundments currently in the process of being closed) that are subject to the CCR rule
- First annual groundwater monitoring and corrective action reports were posted online, as required by rule, prior to March 2, 2018
- Utah adopted the federal final rule in September 2016, PacifiCorp is in compliance with all requirements
- August 2017, EPA proposed permitting guidance on how states' CCR programs should comply with the requirements of the final rule.
- It is anticipated that Utah and Wyoming will submit applications for approval of their respective CCR programs prior to the end on 2019
- July 2018, EPA posted Final CCR Rule, Phase 1 Part 1; rule extends certain deadlines and incorporates some risk-based analysis

Clean Water Act

Clean Water Act

Effluent Limit Guidelines (ELG)

- EPA published the final ELG for steam electric generating units in the *Federal Register* on November 3, 2015
- The revisions will impact PacifiCorp's Dave Johnston, Naughton, and Wyodak facilities
- Sep. 2017, EPA postponed compliance dates and announced its intent to conduct new rulemaking for FGD and bottom ash transport water
- The postponement places the earliest compliance date for both waste streams as soon as possible beginning November 1, 2020

State Greenhouse Gas Emissions Policy Update

Greenhouse Gas - California

- Emissions Performance Standard applies to new financial commitments – limited to 1,100 lbs CO_2/MWh
- California Cap-and-Trade and Mandatory Reporting Regulation (MRR) enabled by Assembly Bill 32 (AB 32) Global Warming Solutions Act of 2006
  - Achieve 1990 greenhouse gas emission level by 2020 with long-term goal of 80% reduction from 1990 levels by 2050
  - Regulates greenhouse gas sources in California as well as “first jurisdictional deliverer” of electricity
- PacifiCorp subject to MRR and the Cap-and-Trade program for wholesale sales to California, retail service, and transfers made via the energy imbalance market
- In July 2017, Governor Brown signed AB 398, which extended California’s Cap-and-Trade program through 2030
  - Accordingly, the California Air Resources Board has proposed allowance allocations through 2030

Greenhouse Gas - Oregon

- Emissions Performance Standard applies to new financial commitments – limited to 1,100 lbs CO_2/MWh
- Clean Electricity and Coal Transition Plan (SB 1547) passed March 8, 2016
  - Reduces Oregon greenhouse gas emissions from the electric sector
  - Requires the elimination of coal from Oregon's allocation of electricity, as reflected in retail rates, by 2030
  - Designed to ensure that Oregon's greenhouse gas emission reductions goals are met, as they apply to the electric sector

Greenhouse Gas - Washington

- Emissions Performance Standard applies to new financial commitments – limited to 970 lbs CO_2/MWh
- Washington Department of Ecology proposed Clean Air Rule (CAR) issued June 1, 2016
- After the CAR was challenged by stakeholder groups, in December 2017, Washington's Superior Court concluded that the Department of Ecology did not have the authority to impose the Clean Air Rule without legislative approval
- The Department of Ecology has since suspended the CAR compliance requirements

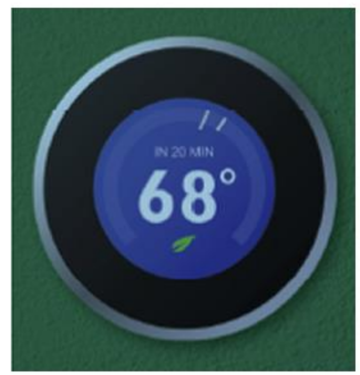
Greenhouse Gas - Washington

- In Docket UE-160353 (PacifiCorp's 2017 IRP), the Commission ordered additional requirements to be incorporated in the utility's future IRPs.
  - Consideration of known and future greenhouse gas regulation(s) including continuation of modeling other higher and lower cost estimates to understand how they may impact the resource portfolio.
  - Development of a supply curve of emissions abatement, identifying all programs and technologies reasonably available in the company's service area, then using the best available information to estimate the amount of emissions reductions each option might achieve, and at what cost.

2019 IRP Scenarios

Plant	Ref Case	RH-1	NAU3 Ret (OR 5e)	CHOL4 Ret 2025 (OR 5g)	JB1 & 2 SCR (ID,WA & OR 5d)	Cols 3 & 4 (WA)
Hunter 1	SCR 2023 Ret. 2042	No SCR Ret. 2042	No SCR Ret. 2042	No SCR Ret. 2042	No SCR Ret. 2042	No SCR Ret. 2042
Hunter 2	SCR 2023 Ret. 2042	No SCR Ret. 2042	No SCR Ret. 2042	No SCR Ret. 2042	No SCR Ret. 2042	No SCR Ret. 2042
Huntington 1	SCR 2023 Ret. 2036	No SCR Ret. 2036	No SCR Ret. 2036	No SCR Ret. 2036	No SCR Ret. 2036	No SCR Ret. 2036
Huntington 2	SCR 2023 Ret. 2036	No SCR Ret. 2036	No SCR Ret. 2036	No SCR Ret. 2036	No SCR Ret. 2036	No SCR Ret. 2036
Jim Bridger 1	SCR 2022 Ret. 2037	No SCR Ret. 2028	No SCR Ret. 2028	No SCR Ret. 2028	SCR 2022 Ret. 2037	No SCR Ret. 2028
Jim Bridger 2	SCR 2021 Ret. 2037	No SCR Ret. 2032	No SCR Ret. 2032	No SCR Ret. 2032	SCR 2021 Ret. 2037	No SCR Ret. 2032
Naughton 3	Gas Conv. 1/30/2019 - 6/30/2019 Ret. 2029	Gas Conv. 1/30/2019 - 6/30/2019 Ret. 2029	No Gas Conv. Ret. 1/30/2019	Gas Conv. 1/30/2019 - 6/30/2019 Ret. 2029	Gas Conv. 1/30/2019 - 6/30/2019 Ret. 2029	Gas Conv. 1/30/2019 - 6/30/2019 Ret. 2029
Cholla 4	No Gas Conv. Ret. 4/2025	No Gas Conv. Ret. 2020	No Gas Conv. Ret. 2020	No Gas Conv. Ret. 4/2025	No Gas Conv. Ret. 2020	No Gas Conv. Ret. 2020
Craig 1	No SCR Ret. 2025	No SCR Ret. 2025	No SCR Ret. 2025	No SCR Ret. 2025	No SCR Ret. 2025	No SCR Ret. 2025
Wyodak	SCR 2024 Ret. 2039	No SCR Ret. 2039	No SCR Ret. 2039	No SCR Ret. 2039	No SCR Ret. 2039	No SCR Ret. 2039
Colstrip 3	No SCR Ret. 2046	No SCR Ret. 2046	No SCR Ret. 2046	No SCR Ret. 2046	No SCR Ret. 2046	No SCR Ret. 2027
Colstrip 4	No SCR Ret. 2046	No SCR Ret. 2046	No SCR Ret. 2046	No SCR Ret. 2046	No SCR Ret. 2046	No SCR Ret. 2027

Renewable Portfolio Standards



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Renewable Portfolio Standard - Oregon

- Enacted by Senate Bill 838 (SB 838) in 2007, requiring Oregon utilities to deliver at least 25 percent of electricity from eligible renewable resources by 2025
- Expanded by the Clean Electricity and Coal Transition Plan (Senate Bill 1547) which passed March 8, 2016. Key provisions include:
  - Elimination of coal from Oregon rates by 2030
  - Increased RPS targets

2015 - 2019	2020 - 2024	2025 - 2029	2030 - 2034	2035 - 2039	2040 Onward
15%	**20%**	**27%**	**35%**	**45%**	**50%**

  - Elimination of solar capacity standard (previously mandated by House Bill 3039)
    - Required that by January 1, 2020, the total solar photovoltaic generating nameplate capacity of all Oregon utilities be at least 20 MW_{AC}. PacifiCorp's share of that was 8.7 MW_{AC}, of which 7 MW_{AC} have been developed.

Renewable Portfolio Standard - Oregon

- **Community Solar Program**
  - For residential and commercial customer to own off-site solar
  - At least 10% of program capacity set aside for low-income customers

- **Small-scale Renewables**
  - Requirement rather than goal
  - By 2025, at least 8% of state's aggregate electrical capacity to come from renewables 20 MW or less

- **Transportation Electrification**
  - Investor-owned utilities required to propose programs to accelerate transportation electrification

Renewable Portfolio Standard - Oregon

- **Eligible Resources**
  - Operational after January 1, 1995
    - Pre-1995 Hydro – eligible if certified by the Low Impact Hydro Institute, and only up to 50 average megawatts of utility-owned and 40 average megawatts not owned by the utility annually (total 90 aMW per year)
    - Pre-1995 Biomass and Solid Waste – eligible for use immediately, with the passing of SB 1547; previously not recognized as eligible until 2026
  - RPS-certified by Oregon Department of Energy
  - Located within the Western Electricity Coordinating Council (WECC)
  - Technologies – Wind, Solar, Solar Thermal, Geothermal, Wave, Tidal, Ocean Thermal, Hydro located outside protected water areas, Incremental Hydro (efficiency upgrades), Biomass, Municipal Solid Waste, Thermal RECs from Biomass (SB 1547 addition)

Renewable Portfolio Standard - Oregon

- **Renewable Energy Certificates (RECs)**
  - Must be issued in Western Renewable Energy Generation Information System (WREGIS)
  - Can be a combination of Bundled and Unbundled RECs (unbundled limited to 20% of annual RPS target
    - Qualifying Facilities (QFs) located in Oregon do not contribute to unbundled REC limit)
  - Retirement of RECs no longer required to follow first-in-first-out rule (SB 1547)

- **Banking Provisions (SB 1547)**
  - REC life limited to five years (previously unlimited)
  - Exceptions (Unlimited REC life):
    - Long-term resources coming online between bill passage and the end of 2022 generate RECs with unlimited REC life for the first five years of the resource's life
    - Existing REC bank (anything generated prior to bill passage)

Renewable Portfolio Standard - Oregon

- **Cost Controls**
  - Alternative compliance payments can be used in lieu of meeting the RPS requirement with renewables ($90 per megawatt-hour for 2018 and 2019)
  - Cost Cap – a utility is not required to comply with the RPS if the incremental cost of the RPS exceeds 4 percent of annual revenue requirement in a compliance year

- **Penalties**
  - Oregon Public Utilities Commission (OPUC) can impose penalties for failing to comply with the RPS in an amount determined by the OPUC

Renewable Portfolio Standard - California

- Established in 2002; expanded in 2011 under Senate Bill 2 (SB2-1X) requiring at least 33% renewable resources by 2020
- Senate Bill 350, the Clean Energy and Pollution Reduction Act was signed into law on October 7, 2015. Key provisions:
- Expanded RPS targets:

By Dec. 2016	By Dec. 2020	By Dec. 2024	By Dec. 2027	By Dec. 2030
25%	33%	40%	45%	50%

- Starting 2021, at least 65% of procurement must be from long-term resources (10 or more years)
- Increased flexibility in banking bundled RECs
- Exploration of regional energy market
- Higher energy efficiency goals
- Transportation electrification

Renewable Portfolio Standard - California

- **Eligible Resources**
  - RPS-certified by California Energy Commission
  - Located within the Western Electricity Coordinating Council (WECC)
  - Technologies – Wind, Solar, Solar Thermal, Geothermal, Wave, Tidal, Ocean Thermal, Biomass, Landfill Gas, Municipal Solid Waste, Digester Gas, Fuel Cells, Hydro*

    * Hydro – eligible if capacity of 30 megawatts or less and procured or owned as of effective date of act

- **Renewable Energy Certificates (RECs)**
  - Must be issued in Western Renewable Energy Generation Information System (WREGIS).
  - California procurement is defined by Portfolio Content Categories (buckets) which increasingly limit the use of unbundled RECs over time. The policy is intended to encourage the procurement of in-state renewables.
  - As a multijurisdictional utility serving California load, PacifiCorp is exempt from the bucket limitations.

Renewable Portfolio Standard - California

- **Cost Controls**
  - No cost controls in place however, the California Public Utilities Commission (CPUC) is tasked with developing a Procurement Expenditure Limitation as part of SB 350

- **Penalties**
  - CPUC has the authority to impose penalties for not meeting RPS targets
  - SB 350 tasked CPUC with developing those penalties

Renewable Portfolio Standard - Washington

- Enacted by Initiative 937 (I-937) in 2006, requiring the use of at least 15% eligible renewables by 2020
- **RPS Targets**

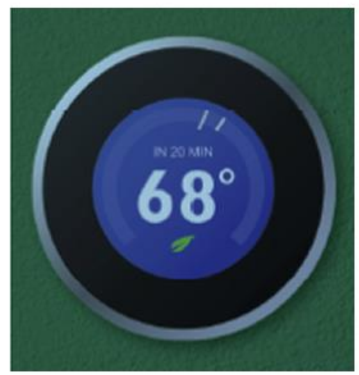
2012-2015	2016-2019	2020 Onward
3%	9%	15%

- **Eligible Resources**
  - Operational after March 31, 1999
  - Located within the Pacific Northwest as defined by Bonneville Power Administration; for multijurisdictional utilities, resource can be located in any state served by the utility
  - Technologies – Wind, Solar, Solar Thermal, Geothermal, Wave, Tidal, Ocean Thermal, Incremental Hydro (only upgrades after March 1999), Biomass, Anaerobic Digestion

Renewable Portfolio Standard - Washington

- **Renewable Energy Certificates (RECs)**
  - Must be issued in Western Renewable Energy Generation Information System (WREGIS)
  - Can be a combination of Bundled and Unbundled RECs
    - No limit on unbundled RECs
  - Resources outside of 'Pacific Northwest' must be utility-owned or long-term contract (more than 12 months)
- **Banking Provisions**
  - RECs can be produced during the compliance year, the preceding year or the subsequent year
- **Cost Controls**
  - Utility is not required to comply with the RPS if the incremental cost of the RPS exceeds 4 percent of annual revenue requirement in a given year
- **Penalties**
  - $50 per megawatt-hour of shortfall

Supply-Side Resource Studies



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Supply Side Resource Table

- Selection/catalog of commercially available generating resources
- Includes performance, costs, operating characteristics and emissions
- Common resource characteristics:
  - Costs expressed in mid-2018 dollars
  - Construction cost based on turn-key, EPC contract
  - Capital includes Owner's direct costs
  - Equipment costs and performance by equipment vendors
  - Facility construction costs and performance by third party consultant
  - Includes property and sales taxes
  - Owner's costs and capitalization by PacifiCorp

Natural Gas

- Resources
  - Combined Cycle Combustion Turbine
    - G/H, 1X1 w/ duct firing – approx. 390 MW at 5,050 feet elev.
    - G/H, 2X1 w/ duct firing – approx. 780 MW at 5,050 feet elev.
    - J/HA, 1X1 w/ duct firing – approx. 480 MW at 5,050 feet elev.
    - J/HA, 2X1 w/ duct firing – approx. 950 MW at 5,050 feet elev.
  - Simple Cycle
    - Aeroderivative SCCT 3X0 – approx. 110 MW at 5,050 feet elev.
    - Intercooled Aero. SCCT 2X0 – approx. 170 MW at 5,050 feet elev.
    - F Frame SCCT 1X0 – approx. 190 MW at 5,050 feet elev.
    - Reciprocating 6X0 – approx. 110 MW
  - Elevations studied
    - Sea level, 1,500 ft, 3,000 ft, 5,050 ft, 6,500 ft

Renewables

- A single RFP has been released to study the following renewable resources:
  - Solar
  - Wind
  - Energy Storage
  - Solar + Energy Storage
  - Wind + Energy Storage
- The report will include
  - Current capital and O&M costs
  - (10) year forecast trend of expected capital costs
  - Performance data

Renewables - Solar

- Project sizes:
  - 5 MW AC
  - 50 MW AC
  - 200 MW AC
- Proxy locations:
  - Milford, UT
  - Lakeview, OR

Renewables - Wind

- Project size:
  - 200 MW
- Proxy locations:
  - Arlington, OR - (Class 2 A wind regime)
  - Goldendale, WA - (Class 2 A wind regime)
  - Pocatello, ID - (Class 2 A wind regime)
  - Monticello, UT - (Class 2 A wind regime)
  - Medicine Bow, WY - (Class 1 B wind regime)

Renewables - Energy Storage

- Project sizes:
  - 1 MW AC
  - 15 minutes
  - 2 hours
  - 4 hours
  - 8 hours
- Use cases:
  - Each service (use-case) listed in the DOE/EPRI Electricity Storage Handbook will be analyzed for additional costs.
- Customer sited energy storage pricing evaluation.

Renewables - Solar + Energy Storage

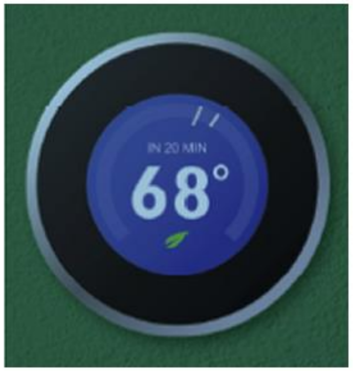
- Project sizes:
  - Solar:
    - 5 MW AC
    - 50 MW AC
    - 200 MW AC
  - Energy storage:
    - 2 hours at 25% and 50% nominal power of the solar plant
    - 4 hours at 25% and 50% nominal power of the solar plant
    - 8 hours at 25% and 50% nominal power of the solar plant
- Appropriate energy storage technology will be considered for each plant size.

Renewables - Wind + Energy Storage

- Project sizes:
  - 200 MW wind plant
  - Energy storage: 2, 4, and 8 hours at 25% and 50% power
- Appropriate energy storage technology will be considered for each plant size.

Intra-Hour Dispatch Credit



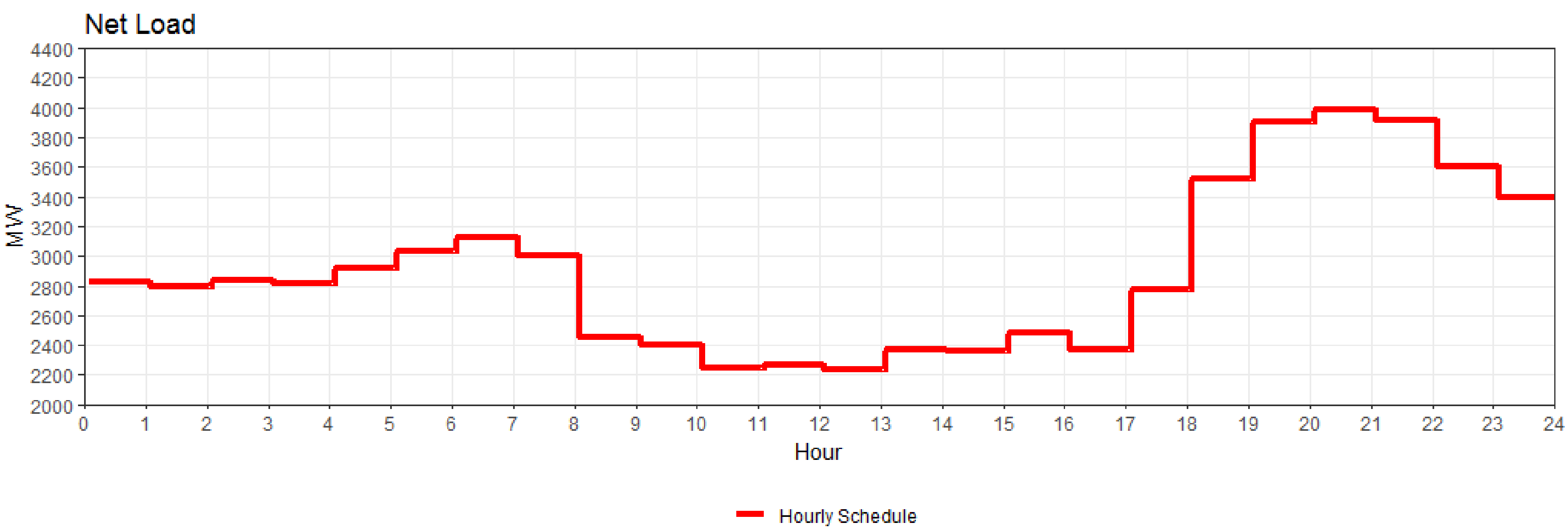



Intra-Hour Dispatch Credit

- To operate the system reliably, PacifiCorp must have the capability to move its resources within the hour to manage variations in load, solar and wind resources.
- The intra-hour dispatch credit was developed to account for the need to utilize dispatchable resources within the hour to maintain system reliability.
- PacifiCorp is exploring developing intra-hour dispatch credits for natural gas and energy storage in the 2019 IRP.

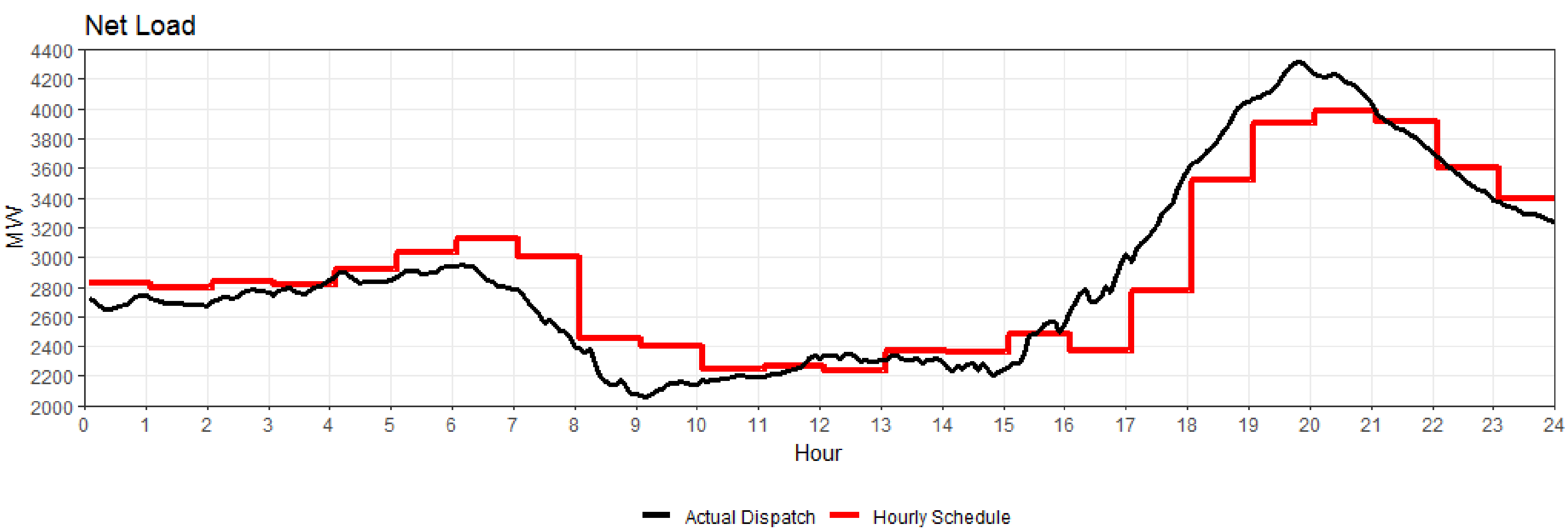
Hourly Models

- The IRP's planning model balances load and resources at an hourly granularity
- Hourly planning models rely on market purchases to achieve balance
- The below chart illustrates the observed hourly net load profile of a specific day
- At this granularity, the value of dispatchable resources are dampened due to market options to fulfill hourly requirements



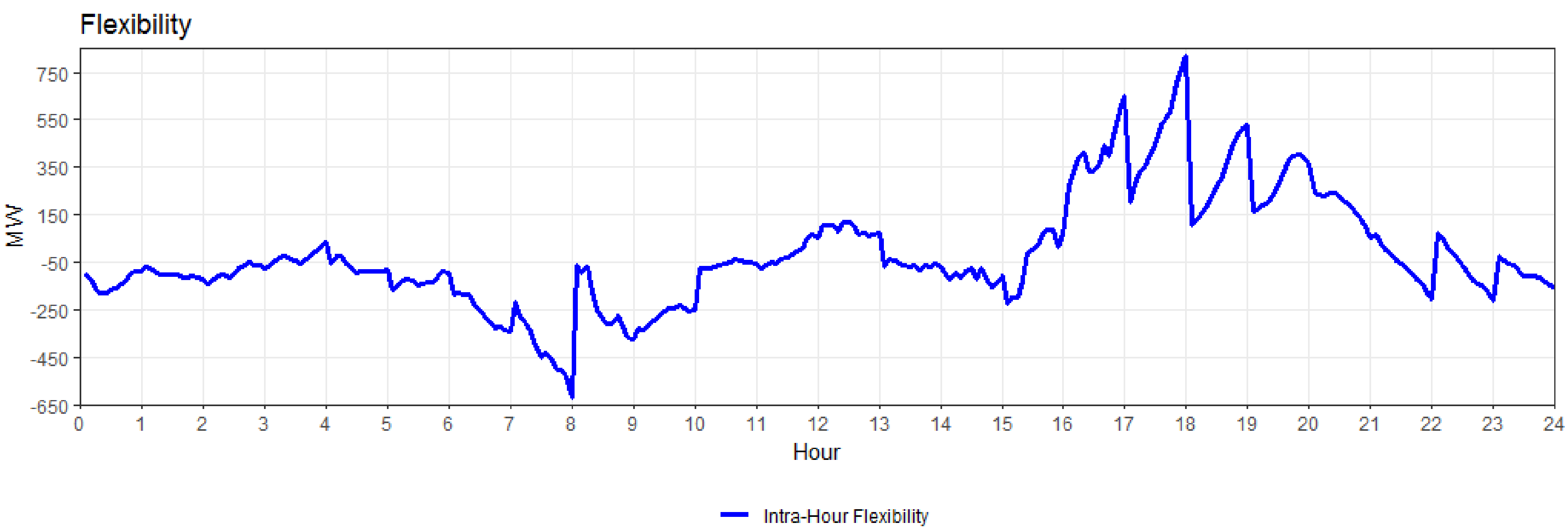
Actual Operations

- The following chart illustrates the actual net load profile for the same day
- In actual operations hourly market purchases are insufficient to maintain the load-resource balance
- Intra-hour variations in load, wind and solar create challenging ramp requirements
- These requirements amplify the value of dispatchable resources relative to the hourly scenario



Intra-Hour Dispatch Credit

- The intra-hour dispatch credit is the means by which the value of intra-hour flexibility, provided by dispatchable resources, is introduced into the hourly model
- The below chart demonstrates the relative flexibility of dispatchable resources relative to the hourly scenario (Actual Dispatch – Hourly Schedule of the prior chart)
- Using the costs of generation, combined with the intra-hour prices prevalent in the energy imbalance market, the intra-hour dispatch credit is calculated as the value provided by this flexibility relative to the hourly scenario.



Intra-Hour Dispatch Credit

- Determination of Intra-Hour Dispatch Credit Components:
  - $Base = PacifiCorp's\ Hourly\ Base\ Schedule$
  - $D_{15} = EIM's\ Fifteen\ Minute\ Advisory\ Schedule$
  - $D_5 = EIM's\ Five\ Minute\ Dispatch\ Schedule$
  - $P_{15} = EIM's\ Fifteen\ Minute\ Market\ Price$
  - $P_5 = EIM's\ Five\ Minute\ Market\ Price$
  - $Bid = PacifiCorp's\ Cost\ of\ Generation$

$$Intra - Hour\ Dispatch\ Credit \\ = (D_{15} - Base) * P_{15} + (D_5 - D_{15}) * P_5 - (D_5 - Base) * Bid$$

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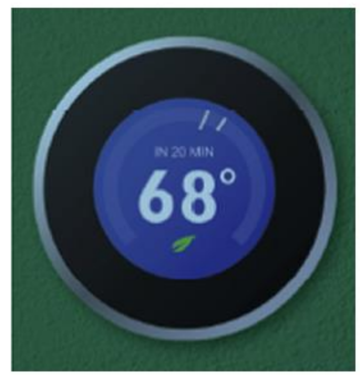
Stochastic Parameters Update



Overview of Stochastic Parameters

- Stochastic parameters are used to generate stochastic processes on key long term planning variables such as load, fuels, etc., which evolve over time to create a spread of possible outcomes over a statistical distribution.

- PaR modeling simulates mean reverting stochastic processes. It uses mean reversion, volatilities, and correlations across the key decision variables as input parameters. Under a mean reversion process, the distribution of possible outcomes would reach a steady state as time to delivery increases.

- Short term (S.T) parameters updated using historical PacifiCorp data:
  - Load: 1/1/2014 thru 12/31/2017 (4 years)
  - Hydro: 1/1/2013 thru 12/31/2017 (5 years)
  - Gas Prices: 1/1/2014 thru 12/31/2017 (4 years)
  - Power Prices: 1/1/2014 thru 12/31/2017 (4 years)

Short-Term Volatility Comparison (2019 IRP vs 2017 IRP)

2019 IRP S.T Volatility estimates

	CA	ID	Portland	OR Other	UT	WA	WY
Winter	4.65%	3.47%	3.85%	4.24%	2.12%	5.33%	1.63%
Spring	4.20%	6.49%	3.29%	3.43%	2.79%	3.68%	1.77%
Summer	3.82%	5.12%	4.99%	4.19%	4.47%	5.05%	1.61%
Fall	4.94%	4.24%	3.85%	4.20%	3.55%	4.31%	1.68%

	4C	COB	Mid-C	PV
Winter	9.84%	13.44%	16.55%	9.22%
Spring	10.41%	26.13%	47.46%	7.46%
Summer	15.47%	29.97%	21.28%	14.08%
Fall	10.13%	10.19%	10.34%	9.83%

	East Gas	West Gas
Winter	11.14%	12.00%
Spring	3.90%	6.07%
Summer	2.46%	4.87%
Fall	3.62%	4.38%

	Hydro
Winter	21.15%
Spring	16.17%
Summer	16.78%
Fall	30.08%

Change in S.T Volatility estimates from 2017 IRP to 2019 IRP

	CA	ID	Portland	OR Other	UT	WA	WY
Winter	0.16%	0.35%	0.53%	-0.13%	-0.06%	0.46%	-0.06%
Spring	0.06%	1.25%	0.35%	0.00%	-0.09%	-0.11%	0.16%
Summer	0.19%	0.29%	1.05%	0.37%	0.02%	0.29%	0.03%
Fall	0.12%	-0.67%	0.44%	0.05%	0.22%	-0.06%	0.00%

	4C	COB	Mid-C	PV
Winter	-0.74%	-0.18%	0.37%	-1.37%
Spring	1.73%	3.24%	5.47%	1.63%
Summer	4.97%	6.46%	-17.06%	5.31%
Fall	3.58%	2.84%	2.41%	4.82%

	East Gas	West Gas
Winter	-2.04%	-1.99%
Spring	-6.51%	-3.90%
Summer	-0.25%	0.70%
Fall	0.79%	-1.67%

	Hydro
Winter	0.32%
Spring	2.80%
Summer	1.89%
Fall	2.10%

Short-Term Mean Reversion Comparison (2019 IRP vs 2017 IRP)

2019 IRP S.T Mean Reversion estimates

	CA	ID	Portland	OR Other	UT	WA	WY
Winter	0.2680	0.1527	0.1769	0.1819	0.3632	0.1808	0.2726
Spring	0.2178	0.2043	0.2407	0.3790	0.5950	0.3407	0.2536
Summer	0.1853	0.0947	0.2805	0.1948	0.2132	0.1566	0.2350
Fall	0.3111	0.2185	0.2416	0.2526	0.2487	0.2031	0.2667

	4C	COB	Mid-C	PV
Winter	0.1253	0.1195	0.1398	0.1096
Spring	0.4338	0.5511	0.5508	0.2109
Summer	0.3378	0.4632	0.2709	0.2200
Fall	0.3704	0.2565	0.2787	0.4153

	East Gas	West Gas
Winter	0.1102	0.0924
Spring	0.1518	0.2652
Summer	0.1020	0.1046
Fall	0.0708	0.1072

	Hydro
Winter	0.6318
Spring	0.5015
Summer	1.5117
Fall	0.8626

Change in S.T Mean Reversion estimates from 2017 IRP to 2019 IRP

	CA	ID	Portland	OR Other	UT	WA	WY
Winter	0.0004	-0.0226	-0.0601	-0.0240	-0.0370	-0.0216	0.0101
Spring	-0.0450	0.1072	0.0371	0.1003	0.1974	0.0905	-0.0171
Summer	0.0290	-0.0064	-0.0130	-0.0052	0.0024	-0.0273	-0.0814
Fall	0.0147	0.0083	-0.0259	0.0410	-0.0387	0.0193	0.0742

	4C	COB	Mid-C	PV
Winter	-0.0039	-0.0151	0.0019	-0.0504
Spring	-0.0319	0.1166	0.0404	-0.0969
Summer	0.0676	0.0734	-0.6396	-0.0321
Fall	-0.0018	0.0294	0.0905	0.1687

	East Gas	West Gas
Winter	-0.1092	-0.1041
Spring	-0.5000	-0.2716
Summer	0.0343	-0.0204
Fall	0.0112	-0.0495

	Hydro
Winter	-0.1737
Spring	0.1280
Summer	0.0760
Fall	-0.1937

2019 IRP Short-Term Correlations

- Correlation represents a meaningful measure of strength and direction of a linear relationship between two variables.
- PaR shocks (index mechanisms) are purely dedicated to deviations from the expected, i.e. the random portion of the key variables. Correlations are calculated from residual errors on the random portion (or deviations) of the key variables.
- Typically, variables may exhibit high correlations on deterministic or expected shapes of the variables. For example, hydro dispatch being shaped to load net renewables, or price formation being shaped by demand.
- However, the uncertainty portion of the key variables are low correlated. For example, deviations on hydro generation being dependent weather pattern (La Nina-El Nino), or deviations in renewable generation vs deviations in load being driven by different temperature abnormalities.

Short-Term Correlations – Winter

	K-O	SUMAS	4C	COB	Mid-C	PV	CA	ID	Portland	OR Other	UT	WA	WY	Hydro
K-O	100.00%	89.10%	62.87%	35.34%	38.25%	66.21%	2.90%	13.83%	20.10%	13.23%	9.85%	23.97%	10.00%	5.26%
SUMAS	89.10%	100.00%	56.69%	39.51%	42.09%	60.88%	4.95%	16.94%	16.90%	13.68%	8.22%	21.53%	11.53%	6.21%
4C	62.87%	56.69%	100.00%	57.56%	57.32%	83.48%	10.11%	14.98%	26.74%	26.76%	19.76%	28.77%	11.67%	2.90%
COB	35.34%	39.51%	57.56%	100.00%	94.15%	61.02%	13.77%	18.52%	30.39%	37.21%	20.51%	43.23%	19.00%	5.77%
Mid-C	38.25%	42.09%	57.32%	94.15%	100.00%	59.35%	14.39%	20.93%	35.85%	39.67%	24.88%	45.53%	23.53%	2.30%
PV	66.21%	60.88%	83.48%	61.02%	59.35%	100.00%	10.20%	10.47%	23.93%	23.19%	16.90%	28.72%	11.85%	3.28%
CA	2.90%	4.95%	10.11%	13.77%	14.39%	10.20%	100.00%	24.14%	27.33%	66.23%	34.79%	31.62%	20.54%	-3.77%
ID	13.83%	16.94%	14.98%	18.52%	20.93%	10.47%	24.14%	100.00%	22.58%	30.39%	32.22%	31.45%	34.03%	-10.79%
Portland	20.10%	16.90%	26.74%	30.39%	35.85%	23.93%	27.33%	22.58%	100.00%	67.05%	48.31%	65.25%	29.61%	-3.85%
OR Other	13.23%	13.68%	26.76%	37.21%	39.67%	23.19%	66.23%	30.39%	67.05%	100.00%	49.47%	64.99%	28.80%	2.86%
UT	9.85%	8.22%	19.76%	20.51%	24.88%	16.90%	34.79%	32.22%	48.31%	49.47%	100.00%	48.85%	38.48%	-7.75%
WA	23.97%	21.53%	28.77%	43.23%	45.53%	28.72%	31.62%	31.45%	65.25%	64.99%	48.85%	100.00%	33.74%	14.84%
WY	10.00%	11.53%	11.67%	19.00%	23.53%	11.85%	20.54%	34.03%	29.61%	28.80%	38.48%	33.74%	100.00%	-2.19%
Hydro	5.26%	6.21%	2.90%	5.77%	2.30%	3.28%	-3.77%	-10.79%	-3.85%	2.86%	-7.75%	14.84%	-2.19%	100.00%

Gas to Gas	Gas to Electric	Electric to Load
Electric to Electric	Gas to Load	Electric to Hydro
Load to Load	Gas to Hydro	Load to Hydro
Hydro to Hydro		

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- The correlation between these different deviations can be low if the deviations are caused by different drivers.

Short-Term Correlations – Spring

	K-O	SUMAS	4C	COB	Mid-C	PV	CA	ID	Portland	OR Other	UT	WA	WY	Hydro
K-O	100.00%	55.25%	20.45%	9.90%	6.90%	32.66%	7.06%	6.73%	1.73%	0.00%	7.17%	5.21%	0.53%	2.56%
SUMAS	55.25%	100.00%	5.77%	7.97%	6.97%	13.18%	9.75%	2.33%	3.58%	3.23%	-4.99%	7.54%	2.64%	1.83%
4C	20.45%	5.77%	100.00%	33.80%	35.76%	62.11%	0.43%	7.19%	6.81%	6.40%	15.43%	11.91%	11.44%	-8.85%
COB	9.90%	7.97%	33.80%	100.00%	86.43%	39.23%	13.44%	-3.28%	23.77%	20.53%	7.73%	30.87%	13.47%	0.01%
Mid-C	6.90%	6.97%	35.76%	86.43%	100.00%	30.70%	13.30%	0.86%	25.53%	20.53%	11.46%	29.30%	14.64%	-0.16%
PV	32.66%	13.18%	62.11%	39.23%	30.70%	100.00%	3.08%	15.68%	16.63%	14.01%	24.47%	23.55%	15.42%	-2.95%
CA	7.06%	9.75%	0.43%	13.44%	13.30%	3.08%	100.00%	17.64%	19.91%	55.41%	16.56%	32.57%	8.66%	-0.99%
ID	6.73%	2.33%	7.19%	-3.28%	0.86%	15.68%	17.64%	100.00%	5.80%	19.71%	43.42%	20.05%	17.35%	-17.12%
Portland	1.73%	3.58%	6.81%	23.77%	25.53%	16.63%	19.91%	5.80%	100.00%	62.91%	22.42%	56.79%	27.21%	10.59%
OR Other	0.00%	3.23%	6.40%	20.53%	20.53%	14.01%	55.41%	19.71%	62.91%	100.00%	30.99%	65.28%	23.26%	9.81%
UT	7.17%	-4.99%	15.43%	7.73%	11.46%	24.47%	16.56%	43.42%	22.42%	30.99%	100.00%	25.31%	30.04%	-11.27%
WA	5.21%	7.54%	11.91%	30.87%	29.30%	23.55%	32.57%	20.05%	56.79%	65.28%	25.31%	100.00%	24.23%	17.92%
WY	0.53%	2.64%	11.44%	13.47%	14.64%	15.42%	8.66%	17.35%	27.21%	23.26%	30.04%	24.23%	100.00%	-1.22%
Hydro	2.56%	1.83%	-8.85%	0.01%	-0.16%	-2.95%	-0.99%	-17.12%	10.59%	9.81%	-11.27%	17.92%	-1.22%	100.00%

Gas to Gas
Electric to Electric
Load to Load
Hydro to Hydro

Gas to Electric
Gas to Load
Gas to Hydro

Electric to Load
Electric to Hydro
Load to Hydro

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Short-Term Correlations – Summer

	K-O	SUMAS	4C	COB	Mid-C	PV	CA	ID	Portland	OR Other	UT	WA	WY	Hydro
K-O	100.00%	45.28%	5.17%	-0.36%	2.37%	-0.13%	-0.27%	5.07%	-2.90%	-2.84%	7.94%	4.48%	-4.04%	-0.61%
SUMAS	45.28%	100.00%	5.44%	4.98%	9.55%	0.89%	-1.05%	-5.15%	3.38%	0.46%	-4.00%	5.47%	-6.93%	0.24%
4C	5.17%	5.44%	100.00%	27.18%	28.98%	52.08%	21.45%	11.24%	16.59%	17.09%	21.04%	18.25%	13.21%	-3.82%
COB	-0.36%	4.98%	27.18%	100.00%	84.77%	44.42%	14.80%	16.06%	32.44%	28.42%	9.18%	28.43%	7.89%	7.48%
Mid-C	2.37%	9.55%	28.98%	84.77%	100.00%	50.61%	21.56%	16.11%	48.33%	44.80%	15.15%	37.72%	3.97%	3.75%
PV	-0.13%	0.89%	52.08%	44.42%	50.61%	100.00%	22.20%	15.55%	27.83%	25.47%	24.78%	19.63%	16.44%	4.61%
CA	-0.27%	-1.05%	21.45%	14.80%	21.56%	22.20%	100.00%	38.78%	32.54%	54.86%	29.81%	46.85%	13.52%	-2.97%
ID	5.07%	-5.15%	11.24%	16.06%	16.11%	15.55%	38.78%	100.00%	17.54%	27.45%	46.75%	25.97%	22.37%	4.59%
Portland	-2.90%	3.38%	16.59%	32.44%	48.33%	27.83%	32.54%	17.54%	100.00%	80.22%	11.24%	68.17%	-5.08%	15.52%
OR Other	-2.84%	0.46%	17.09%	28.42%	44.80%	25.47%	54.86%	27.45%	80.22%	100.00%	19.96%	78.12%	0.92%	9.22%
UT	7.94%	-4.00%	21.04%	9.18%	15.15%	24.78%	29.81%	46.75%	11.24%	19.96%	100.00%	23.82%	48.38%	-6.68%
WA	4.48%	5.47%	18.25%	28.43%	37.72%	19.63%	46.85%	25.97%	68.17%	78.12%	23.82%	100.00%	3.65%	8.74%
WY	-4.04%	-6.93%	13.21%	7.89%	3.97%	16.44%	13.52%	22.37%	-5.08%	0.92%	48.38%	3.65%	100.00%	-11.11%
Hydro	-0.61%	0.24%	-3.82%	7.48%	3.75%	4.61%	-2.97%	4.59%	15.52%	9.22%	-6.68%	8.74%	-11.11%	100.00%

Gas to Gas	Gas to Electric	Electric to Load
Electric to Electric	Gas to Load	Electric to Hydro
Load to Load	Gas to Hydro	Load to Hydro
Hydro to Hydro		

- Deviation events which impact one part of PacifiCorp's system do not necessarily affect other parts of the system, due to its geographic diversity and transmission constraints.
- The correlation between these different deviations can be low if the deviations are caused by different drivers.

Short-Term Correlations – Fall

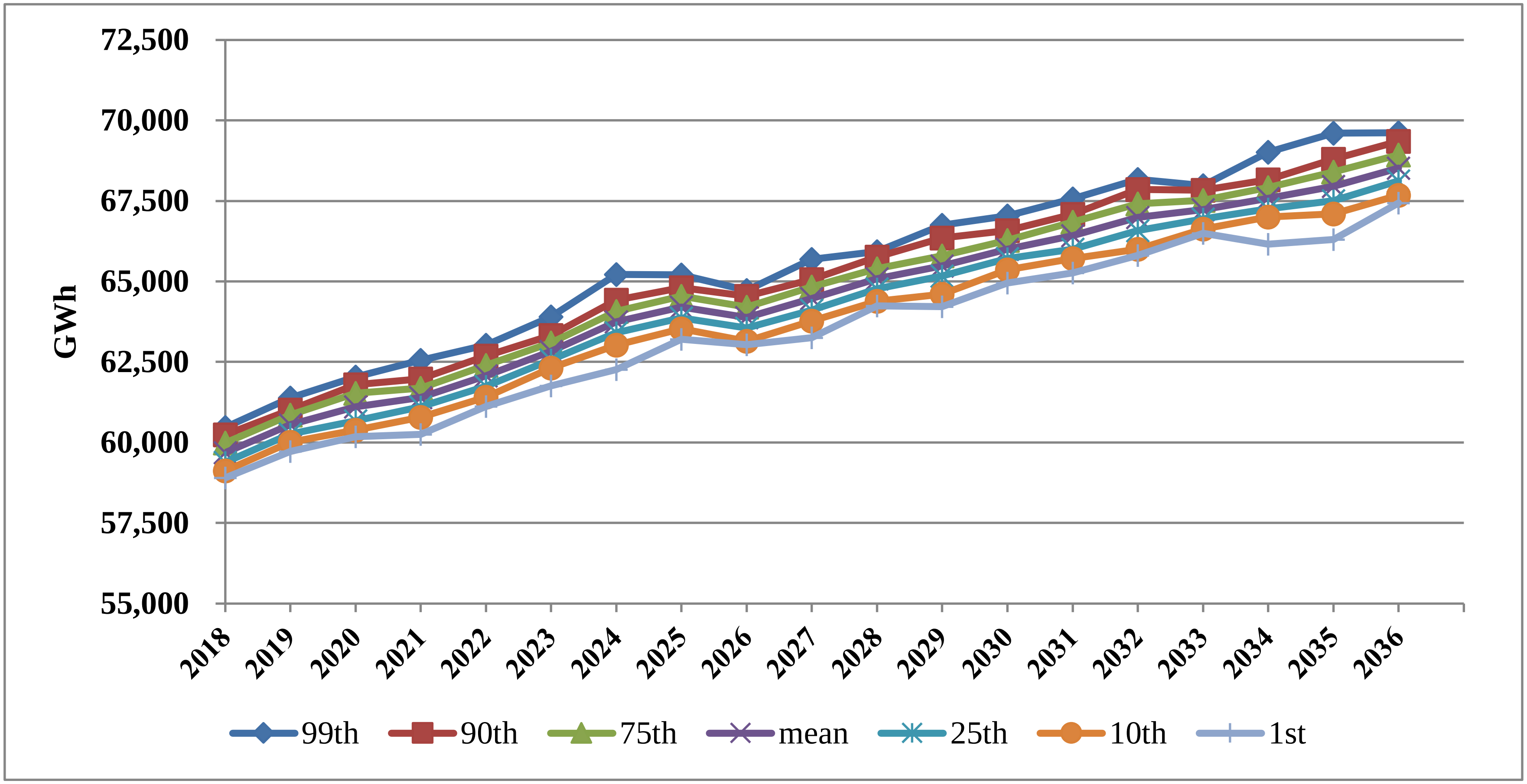
	K-O	SUMAS	4C	COB	Mid-C	PV	CA	ID	Portland	OR Other	UT	WA	WY	Hydro
K-O	100.00%	73.11%	13.52%	14.90%	12.38%	12.90%	15.47%	5.84%	11.04%	19.09%	11.37%	16.75%	7.29%	1.99%
SUMAS	73.11%	100.00%	10.00%	12.80%	13.32%	6.58%	28.29%	10.16%	25.01%	33.49%	23.53%	31.83%	22.30%	3.67%
4C	13.52%	10.00%	100.00%	36.18%	22.28%	52.75%	18.98%	9.60%	22.97%	19.73%	21.42%	21.22%	4.19%	-4.30%
COB	14.90%	12.80%	36.18%	100.00%	78.00%	62.65%	9.45%	2.04%	23.77%	16.41%	23.65%	19.07%	2.86%	-1.77%
Mid-C	12.38%	13.32%	22.28%	78.00%	100.00%	44.35%	10.50%	7.83%	22.32%	18.24%	18.87%	21.79%	2.59%	-3.76%
PV	12.90%	6.58%	52.75%	62.65%	44.35%	100.00%	8.79%	8.87%	16.36%	6.81%	20.04%	9.01%	-4.71%	1.36%
CA	15.47%	28.29%	18.98%	9.45%	10.50%	8.79%	100.00%	28.74%	46.55%	70.40%	34.42%	54.14%	37.61%	-4.58%
ID	5.84%	10.16%	9.60%	2.04%	7.83%	8.87%	28.74%	100.00%	19.16%	24.91%	40.81%	25.38%	23.85%	-11.56%
Portland	11.04%	25.01%	22.97%	23.77%	22.32%	16.36%	46.55%	19.16%	100.00%	77.86%	44.82%	72.95%	38.60%	11.96%
OR Other	19.09%	33.49%	19.73%	16.41%	18.24%	6.81%	70.40%	24.91%	77.86%	100.00%	45.36%	82.91%	47.39%	7.13%
UT	11.37%	23.53%	21.42%	23.65%	18.87%	20.04%	34.42%	40.81%	44.82%	45.36%	100.00%	43.54%	43.99%	-1.37%
WA	16.75%	31.83%	21.22%	19.07%	21.79%	9.01%	54.14%	25.38%	72.95%	82.91%	43.54%	100.00%	42.45%	9.14%
WY	7.29%	22.30%	4.19%	2.86%	2.59%	-4.71%	37.61%	23.85%	38.60%	47.39%	43.99%	42.45%	100.00%	3.95%
Hydro	1.99%	3.67%	-4.30%	-1.77%	-3.76%	1.36%	-4.58%	-11.56%	11.96%	7.13%	-1.37%	9.14%	3.95%	100.00%

Gas to Gas	Gas to Electric	Electric to Load
Electric to Electric	Gas to Load	Electric to Hydro
Load to Load	Gas to Hydro	Load to Hydro
Hydro to Hydro		

- Deviation events which impact one part of PacifiCorp's system do not necessarily affect other parts of the system, due to its geographic diversity and transmission constraints.
- The correlation between these different deviations can be low if the deviations are caused by different drivers.

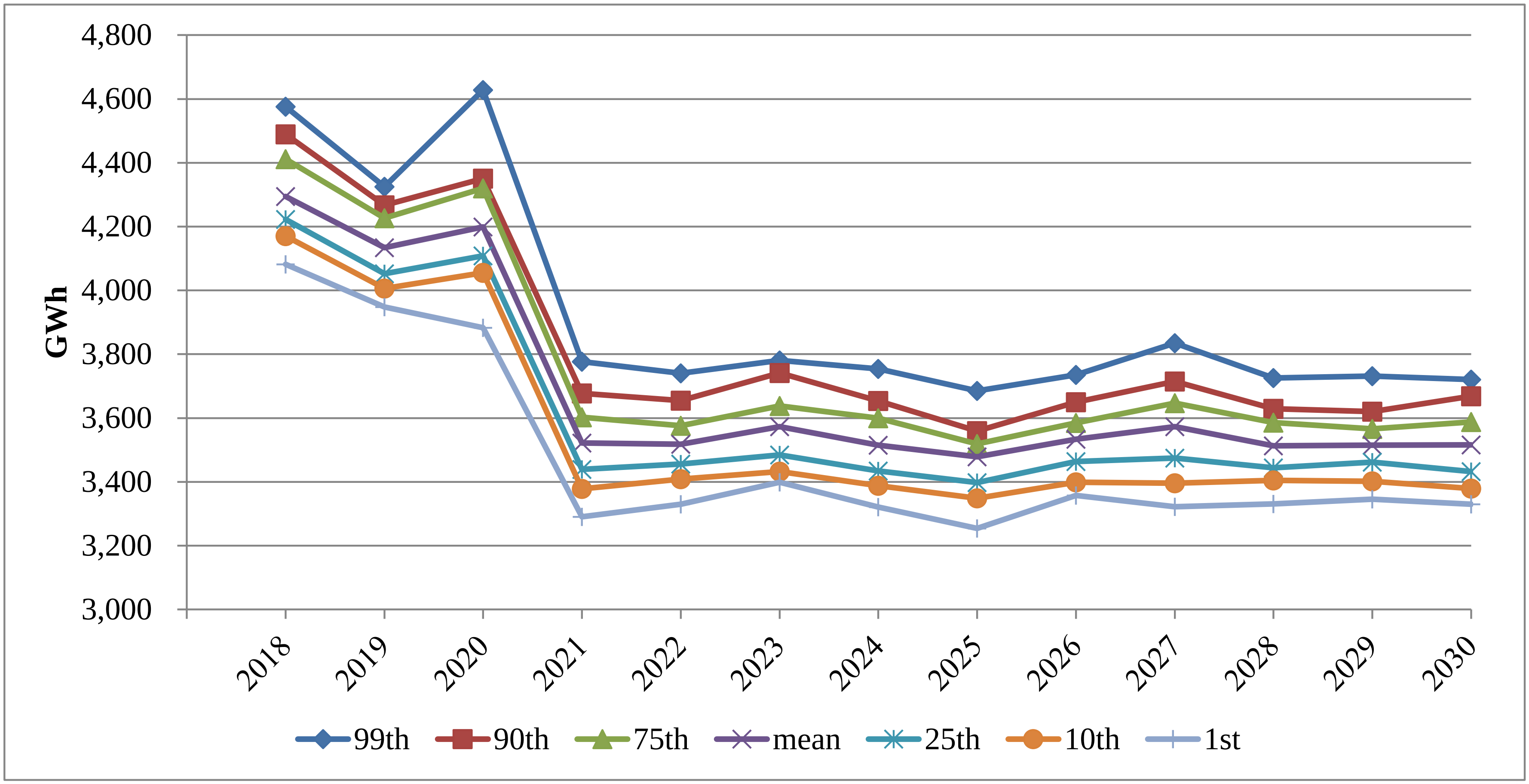
Simulated Annual System Load

- System annual loads reported at selected percentiles are based on Monte Carlo simulations using short-term volatility and mean reversion.



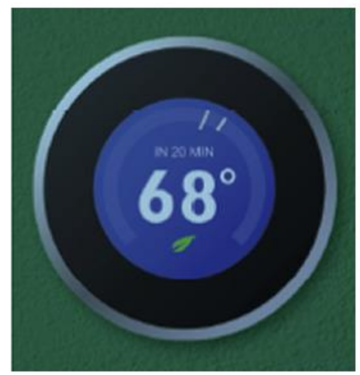
Simulated Annual System Hydro

- System annual hydro generation reported at selected percentiles are based on Monte Carlo simulations. The sharp drop in 2021 is due to the assumed decommission of the Klamath River Projects.



POWERING YOUR GREATNESS

Planning Reserve Margin (PRM) Study Overview



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Planning Reserve Margin

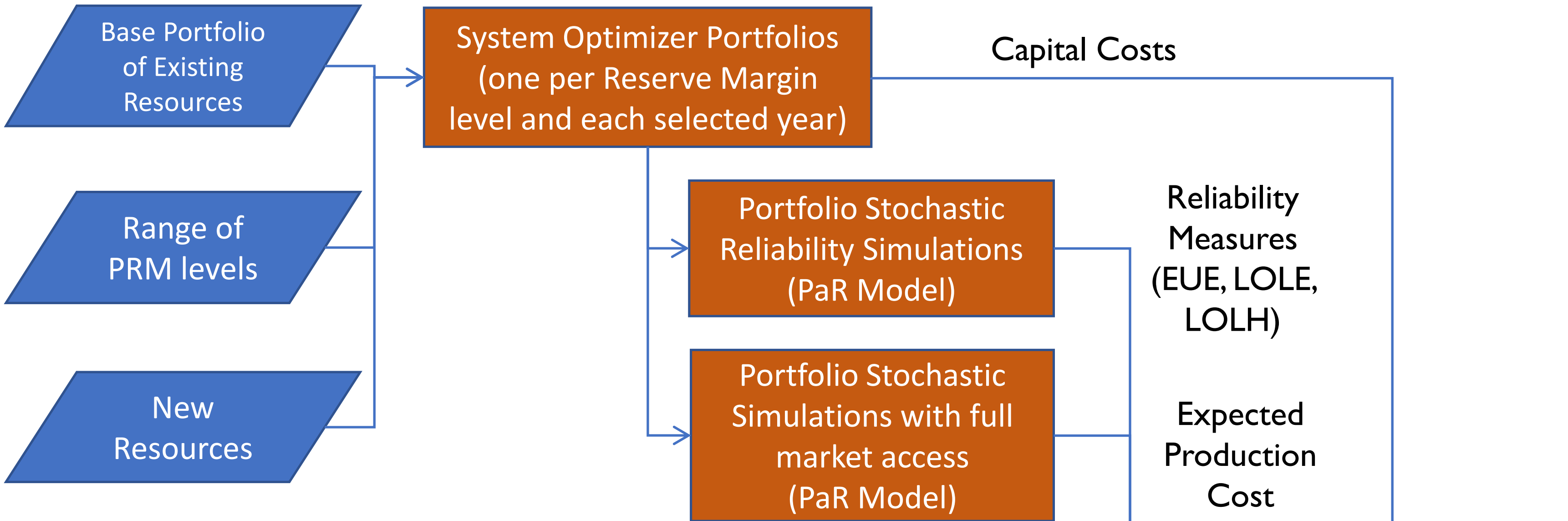
- The planning reserve margin (PRM) is a percentage of coincident system peak load used in resource planning to ensure adequate resources to reliably meet load.

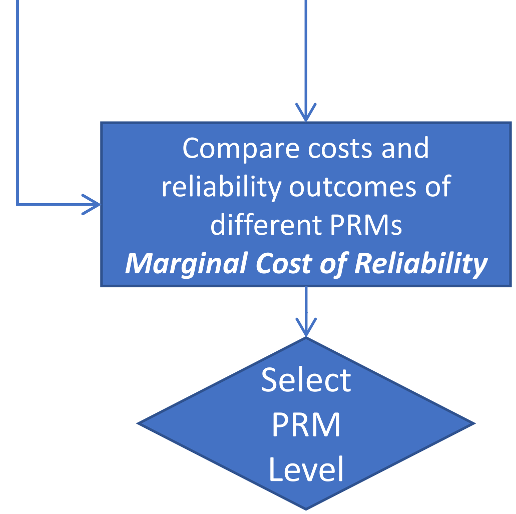
- PRM ensures sufficient capacity is available to meet both near-term and long-term uncertainties:
  - Contingency reserves (near-term)
  - Regulating margin reserves (near-term)
  - Changes in and availability of resources (near-term and long-term)
  - Changes in customer load (near-term and long-term)

- PRM studies assess reliability measures at varying PRM levels and are studied using System Optimizer model (SO) and Planning and Risk model (PaR).

- One PRM is ultimately selected for IRP planning purposes.

PRM Components and Workflow





SO model:

- Optimized resource portfolios at varying PRM levels
- Application of PRM to both summer and winter peaks

PaR model:

- Resource portfolios specific to each PRM level
- Updated stochastic parameters (load, resource availability, prices)
- 50-iteration stochastic production cost modeling
- 500-iteration stochastic reliability modeling
- Market transactions available to meet load

2019 IRP PRM Modeling Approach

- System Optimizer (SO) Modeling
  - 2017 IRP Update preferred portfolio (excluding expansion solar and wind resources)
  - Updated load forecast and price curve (June 2018 OFPC)
  - Thermal, DSM and FOTs eligible for portfolio selection
  - 2030 (target year), 8 studies at 11% to 18% PRM levels
  - 2022 (bookend), 2 studies, one at 13% and one at target PRM (unless target PRM is 13%)
  - 2036 (bookend), 1 study at target PRM
- Planning and Risk (PaR) Modeling
  - 2030 (target year), 8 studies at 11% to 18% PRM levels
  - 2022 and 2036 (bookend) studies
  - Production cost studies
  - Reliability studies (study outputs used to calculate reliability measures)

Reliability Measures

- Expected Unserved Energy (EUE)
  - Gross (prior to accounting for Northwest Power Pool (NWPP) reserve sharing)
  - Net (after accounting for NWPP reserve sharing)
  - NWPP reserve sharing method assumes PacifiCorp receives energy from other participants for the first hour after a loss of load event

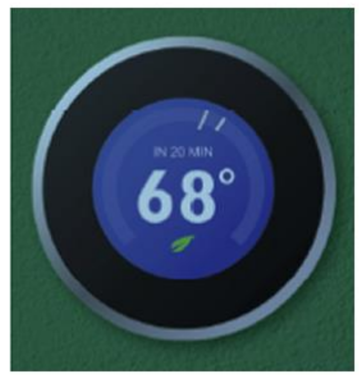
- Loss of Load Events (LOLE)
  - One event in 10 years translates into 0.1 LOLE per year
  - Does not measure duration or magnitude

- Loss of Load Hours (LOLH)
  - One day in 10 years translates into 2.4 LOLH per year
  - Does not measure the number or magnitude of occurrences

- Loss of Load Probability (LOLP)
  - An LOLP target is established from the selected PRM results for use in the wind and solar capacity contribution study

Capacity Contribution Study Overview



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Capacity Contribution

- Capacity contribution is the percentage of solar and wind resource capacity that can reliably meet peak demand.

- The methodology is based on a 2012 National Renewable Energy Laboratory (NREL) technical report produced that discusses several broad approaches:

  - Capacity Factor (CF) Approximation Method:
    - Evaluates the relationship of reliability across all hours in a given year, accounting for:
      - variability and uncertainty in load and generation resources
      - planning costs at varying levels of planning reserve margin
    - Transform hourly reliability metrics into a resource adequacy target at the time of system coincident peak

  - Effective Load Carrying Capability (ELCC) Method:
    - Compares changes in loss of load expectation in a system with and without each renewable resource
    - Iteratively tests the capacity contribution of every renewable resource given increasing flat blocks of load to match base case reliability

Wind and Solar Capacity Contribution Updates

- The 2019 IRP capacity contribution study will be informed by:
    - Updated wind and solar resource performance
    - The 2017R wind renewables request for proposals (RFP)
    - The 2017S solar renewables request for proposals (RFP)
- The target LOLP reliability measure from the PRM study will inform the capacity contribution study.
- 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.

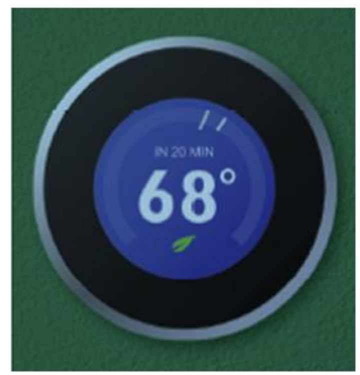
2019 IRP Approach

- Base cases:
  - 2017 IRP Update preferred portfolio
  - Updated load forecast and price curve (June 2018 OFPC)
  - Three study years (2022, 2030, 2036)
  - Establishes a base LOLP for each of the three study years

- 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)

Additional Information and Next Steps



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:
  - August 30-31, 2018
  - 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*

Draft Topics for Upcoming PIMs*

August 30-31, 2018 PIM*:

- Flexible Reserve Study
- Private Generation study results (with Navigant)
- Planning Reserve Margin / reliability study results
- Capacity Contribution study results
- Western Market Reliance study and FOT limits
- DSM potential and updated modeling credits (with AEG)

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

- Coal Studies
- MSP update
- OFPC / price-policy scenarios

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