Integrated Resource Plan

2023 IRP Public Input Meeting

May 12, 2022

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Agenda

May 12, 2022

- 9:00 am - 9:15 am pacific – Introductions
- 9:15 am - 10:45 am pacific – Conservation Potential Assessment
- 10:45 am - 11:00 pm pacific – Request For Proposals Update
- 11:00 am - 11:15 pm pacific – Price Curve Development Update
- 11:15 pm - 11:45 pm pacific – Lunch Break (30 min)
- 11:45 pm – 12:30 pm pacific – Transmission Modeling
- 12:30 pm – 1:45 pm pacific – Climate Modeling
- 1:45 pm - 2:00 pm pacific – Wrap-Up / Next Steps

2023 Integrated Resource Plan (IRP) Conservation Potential Assessment




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Schedule and Milestones

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

- As of May 6th, 2022, we have not received any feedback forms only emails .

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 (0 forms)
April 1 and April 7, 2022	Share Draft Lists, Present on Resource List	Provide feedback by April 11. **(2 emails)**
April 18, 2022	Finalize Resource Lists	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

Stakeholder Feedback

Measure List Feedback

Received three questions from stakeholder regarding the measure list

The measure list have been finalized

Comment	Response
What is the difference between the exclusion and removal of a measure?	Removals are measures that were included in the 2021 CPA but removed for this study. Exclusions are measures that were not included in the 2021 CPA, that were re-evaluated for the current CPA and after consideration were not included in the 2023 CPA.
It's great to see a cool/green roof measure – referring to the Commercial Building Shell, vegetated roof – I am curious to know if this was considered as an option for industrial and/or irrigation customers?	The savings associated with Cool / Green Roof measures are associated with HVAC end uses. Given the limited applicability and data on adoption of this measure for the industrial sector, AEG did not recommend assessing it in the industrial sector. Irrigation sector consumption is entirely associated with pumps, so the cool roof measure is not applicable to that sector.
Does the Residential HEMS measure include retrofitting water heaters with DR switches/controls? Something like this is mentioned in the emerging technologies tab but I wasn't sure if it was the same technology.	Yes, the HEMS measure does include retrofitting water heaters to enable control for demand response.

Recap of Key Discussion Topics from April 7, 2022 CPA Workshop #2

Recap of Key Discussion Topics from April 7, 2022 CPA Workshop #2

Measure Lists

- Resource Hierarchy – described prioritization of savings and costs sources
- Emerging Technologies – provided updates on inclusion of emerging tech
- Baseline Characterization – described how we propose to set baselines for measures in the CPA.

Energy Efficiency Levelized Cost Characterization by State

- Cost-effectiveness tests used for each state.
- Administrative costs assumptions
- IRP Credits

Demand Response Modeling Considerations

- Overview of grid services and resource assumptions
- Differentiation between fast and sustained DR events
- Draft program list
- IRP credits

Drivers of Difference in Forecasted Potential by State

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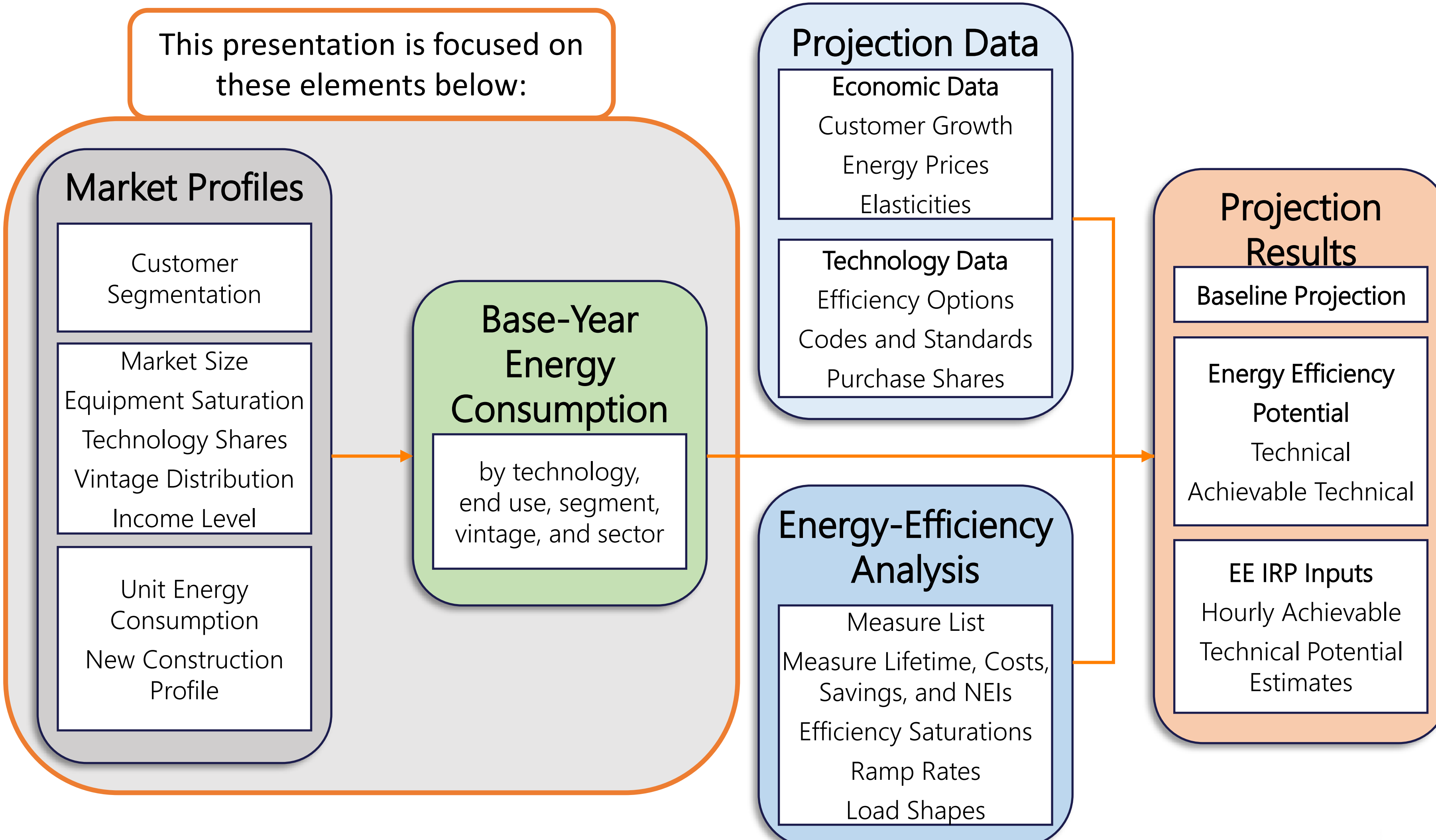
CPA Methodology (except Oregon)



Key Drivers of Differences between States

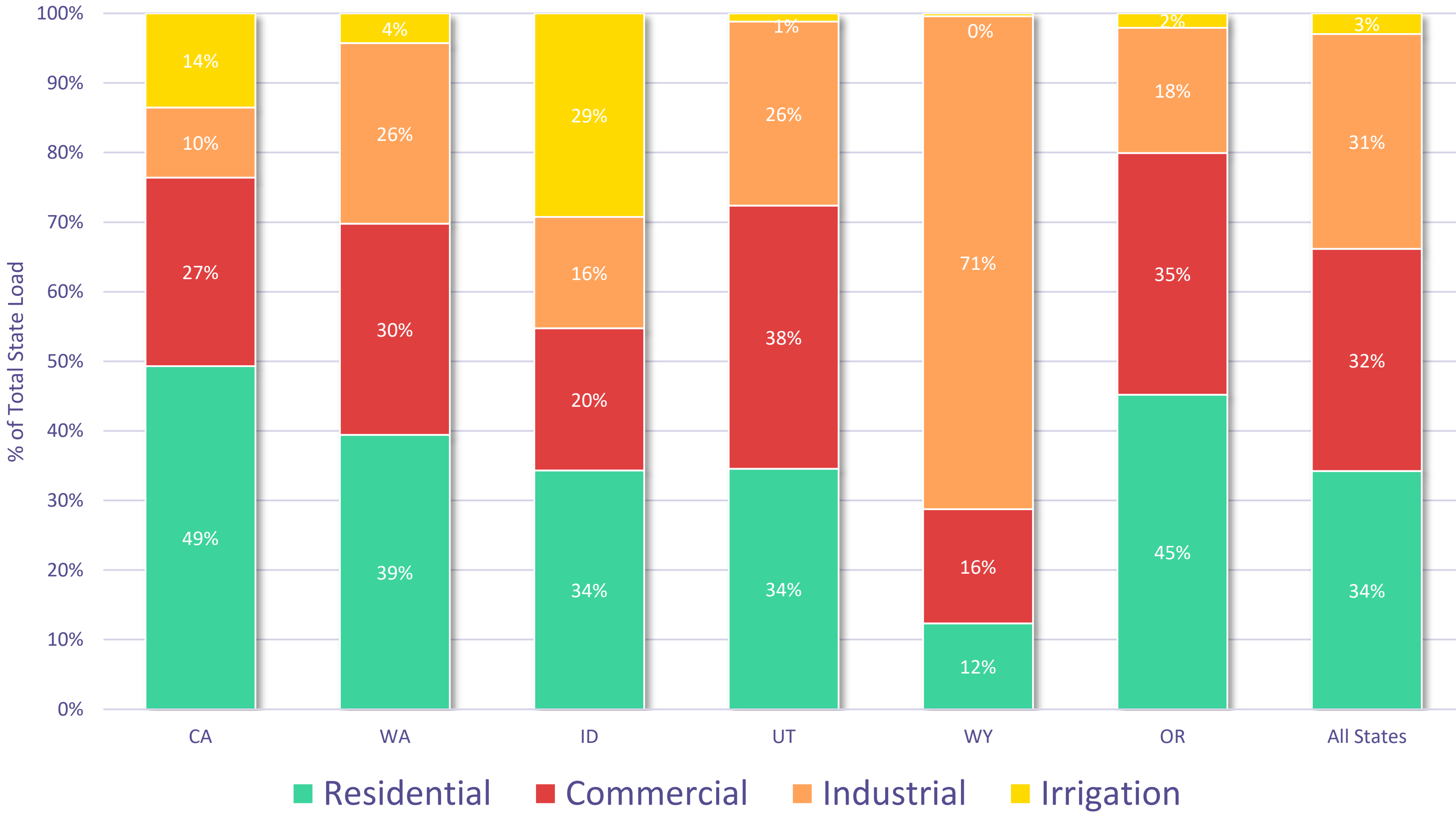
- Technical Drivers:
  - Distribution of Customers and Sales by Sector Forecasts by Sector
  - Sub-Sector Share of Load
  - Sector-Specific Measures
  - Climate
  - Equipment Saturations
  - Ramp Rates

This CPA workshop is focused on these technical drivers

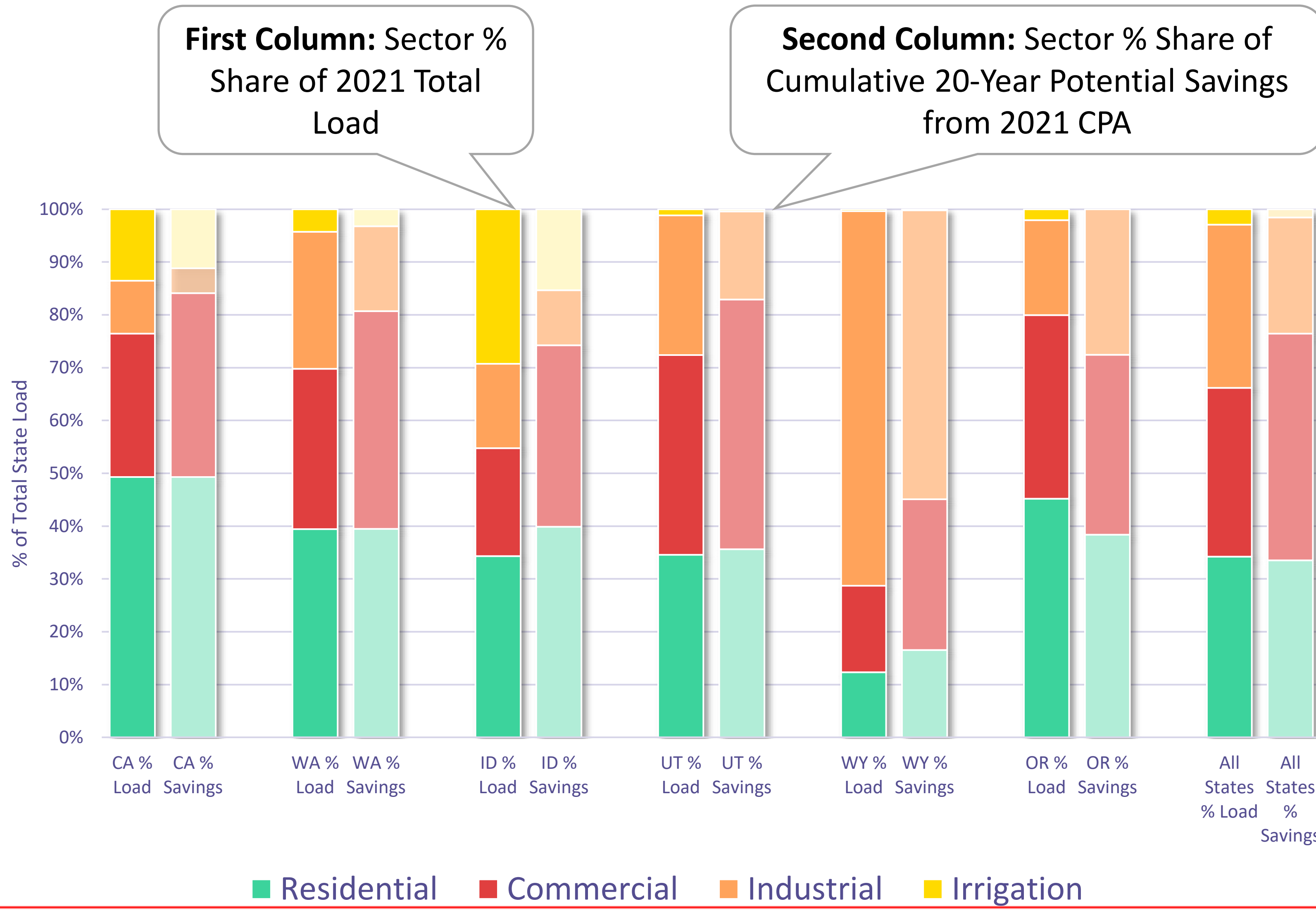
- Other Drivers *(discussed in prior workshops)*:
  - Cost-Effectiveness Requirements by State
  - Measure Sourcing Requirements
  - Stringency of Local Building Codes and Standards

Baseline Load Considerations and Effects on Potential

2021 Load by State & Sector



Share of Load vs. Share of Potential



Note, industrial and irrigation potential is combined in Oregon

Differences in Consumption by Sector

- State-level consumption by sector drives overall savings opportunities
  - States with higher industrial and irrigation loads tend to have lower savings potential compared to overall load due to fewer opportunities for measures.
  - Different measure-level opportunities by sector and sub-sector.
- Residential and commercial sectors generally have higher savings potential
  - More measure options.
  - Often, more mature programs have more potential in early years due to more advanced ramp rates

Market Segmentation

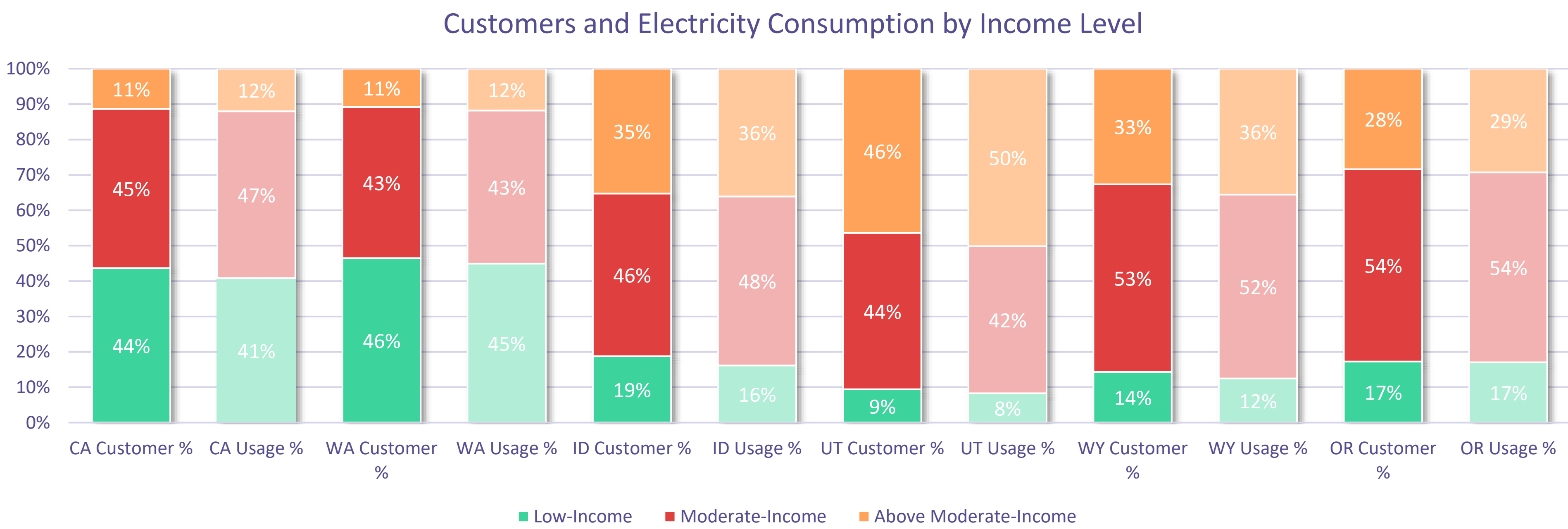
Residential Low-Income Segmentation

- In 2021 CPA, segmented residential low-income customers for Washington
- In 2023 CPA, segmenting residential low-income customers in all states*
- Threshold definitions for 2021 (same as Residential Survey year)
  - Three income categories: low, moderate, and above-moderate
  - Combination of federal poverty guidelines (FPG) and state median income (SMI), depending on LIHEAP annual income and household size levels

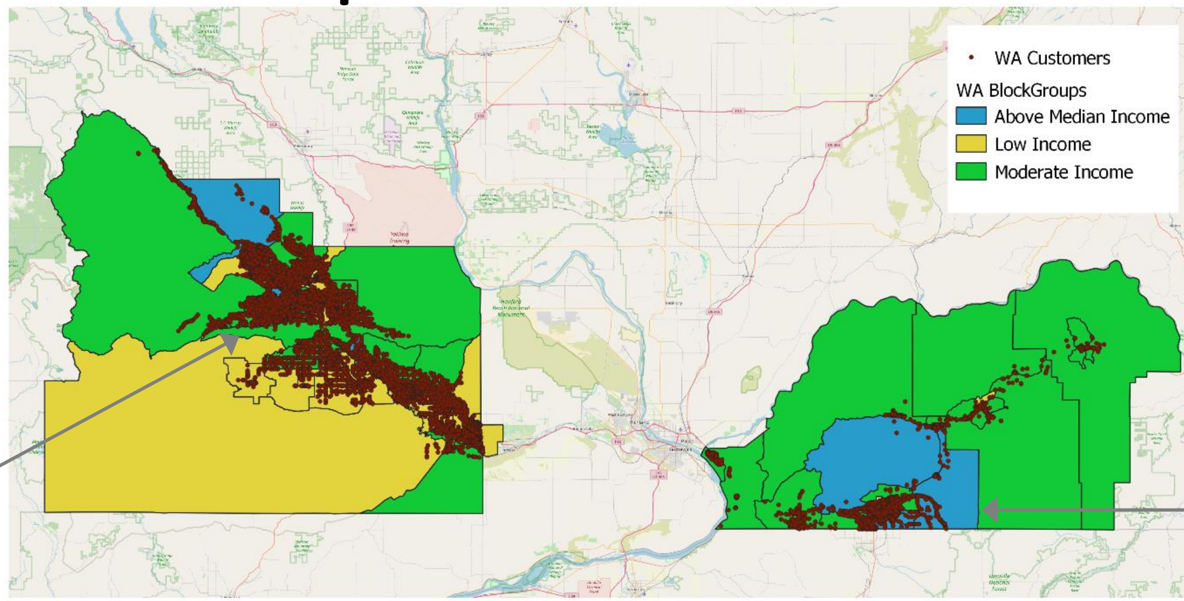
Jurisdiction	Threshold Definitions		
	Low-Income:	**Moderate-Income:** Above LI and Below:	**Above-Moderate Income:**
CA	≤ 60% SMI	≤ 100% SMI	> 100% SMI
ID	≤ 200% FPG		
OR*	≤ 200% FPG		
UT	≤ 200% FPG		
WA	≤ minimum of (60% SMI, 200% FPG)		
WY	≤ 60% SMI		

**Oregon potential is only differentiated by low-income threshold*

Income-Based Residential Customer Segmentation

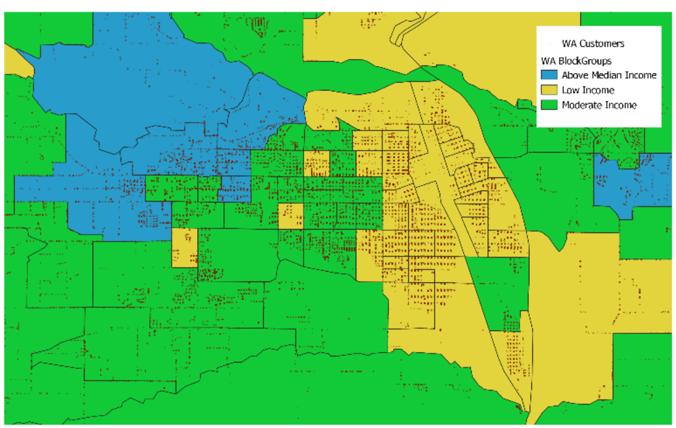


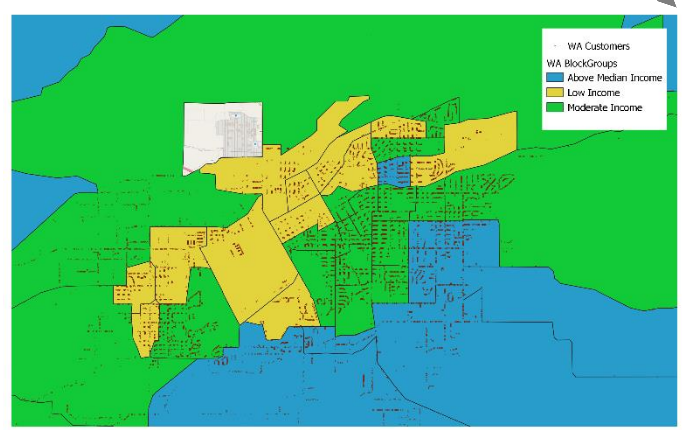
Washington Customers by Census Block Group and Income Level



Yakima Area

Walla Walla Area





Market Profiles: Sector-Level Drivers
Residential

Drivers of Residential Differences Across States

Location and Climate	Overall Household Energy Use	Saturation of Equipment
• Differences in climate and location drive the saturation of cooling equipment and the run time of heating equipment • More rural communities have higher saturations of electric heating equipment due to lack of natural gas access	• Differences in household usage drives difference in certain end uses • Example: types of existing heating equipment varies by home type, which drives the amount of heating potential	• Higher saturations of electric heating and water heating equipment increase overall household baseline energy use and present more savings opportunities

Residential Market Profile Example: Utah Single Family – Above Median Income

Segment:	Single Family - Reg. Income
Households:	323,246
Total 2021 MWh:	3,406,713
Intensity (kWh/HH):	10,539

- Residential profile represents consumption for average home in 2021
- Saturation - % of homes the electrically-powered technology is present
- UEC – unit energy consumption - annual energy consumed per unit when installed
- Intensity – Saturation*UEC
  - Model is calibrated to total household intensity
- Usage – Intensity*Households
  - Total MWh at meter

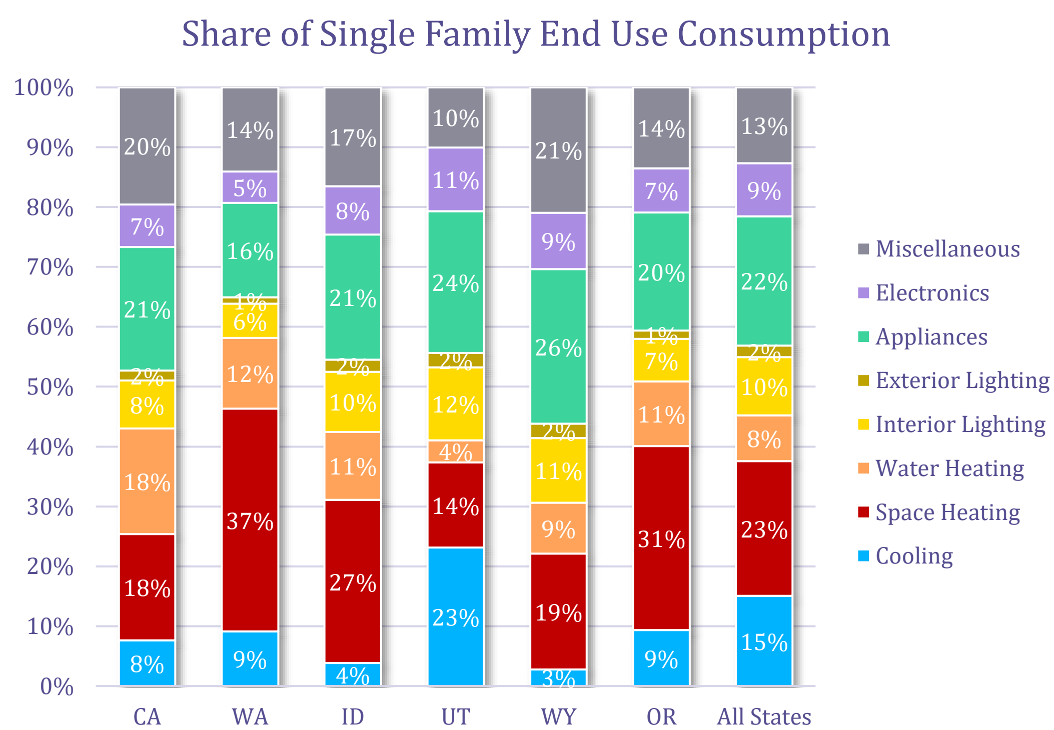
Average Single Family - Reg. Income Market Profile

End Use	Technology	Saturation	UEC (kWh)	Intensity (kWh/HH)	Usage (MWh)
Cooling	Central AC	88%	2,379	2,086	674,175
Cooling	Room AC	3%	442	12	3,922
Cooling	Air-Source Heat Pump	1%	2,188	26	8,395
Cooling	Geothermal Heat Pump	1%	1,887	16	5,022
Cooling	Evaporative Cooler	6%	285	16	5,099
Cooling	Ductless Mini Split Heat Pump	0%	859	4	1,185
Space Heating	Electric Room Heat	1%	12,867	138	44,679
Space Heating	Electric Furnace	6%	12,756	763	246,644
Space Heating	Air-Source Heat Pump	1%	7,813	93	29,971
Space Heating	Geothermal Heat Pump	1%	3,951	33	10,516
Space Heating	Ductless Mini Split Heat Pump	0%	3,907	17	5,389
Water Heating	Water Heater (<= 55 Gal)	8%	3,217	256	82,602
Water Heating	Water Heater (> 55 Gal)	1%	2,918	17	5,349
Interior Lighting	General Service Lighting	100%	797	797	257,571
Interior Lighting	Linear Lighting	100%	135	135	43,754
Interior Lighting	Exempted Lighting	100%	418	418	135,026
Exterior Lighting	General Service Lighting	100%	269	269	86,966
Appliances	Clothes Washer	99%	108	108	34,808
Appliances	Clothes Dryer	75%	762	575	185,904
Appliances	Dishwasher	81%	85	69	22,282
Appliances	Refrigerator	100%	553	552	178,319
Appliances	Freezer	69%	466	321	103,805
Appliances	Second Refrigerator	60%	829	500	161,655
Appliances	Stove/Oven	48%	157	76	24,474
Appliances	Microwave	110%	113	124	40,148
Appliances	Dehumidifier	5%	613	28	9,076
Appliances	Air Purifier	12%	349	42	13,640
Electronics	Personal Computers	79%	126	99	31,997
Electronics	Monitor	124%	54	67	21,791
Electronics	Laptops	233%	32	75	24,160
Electronics	TVs	229%	81	185	59,820
Electronics	Printer/Fax/Copier	60%	38	23	7,362
Electronics	Set-top Boxes/DVRs	44%	89	39	12,737
Electronics	Devices and Gadgets	100%	582	582	188,126
Miscellaneous	Electric Vehicle Chargers	4%	2,538	99	32,022
Miscellaneous	Pool Pump	4%	1,313	47	15,166
Miscellaneous	Pool Heater	2%	3,517	70	22,732
Miscellaneous	Hot Tub/Spa	11%	1,960	212	68,666
Miscellaneous	Furnace Fan	96%	385	368	118,934
Miscellaneous	Well Pump	4%	561	20	6,387
Miscellaneous	Bathroom Exhaust Fan	36%	46	16	5,308
Miscellaneous	Miscellaneous	100%	2,066	2,066	667,904
Generation	Solar PV	8%	(12,113)	(918)	(296,773)
Total				**10,539**	**3,406,713**

Residential Market Comparison

Key differences:

- Cooling Consumption
  - 23% in UT vs. less than 10% all other states
- Electric Space Heating
  - 37% in WA vs. 14% in UT
- Electric Water Heating
  - 18% in CA vs. 4% in UT)
- Household Usage:

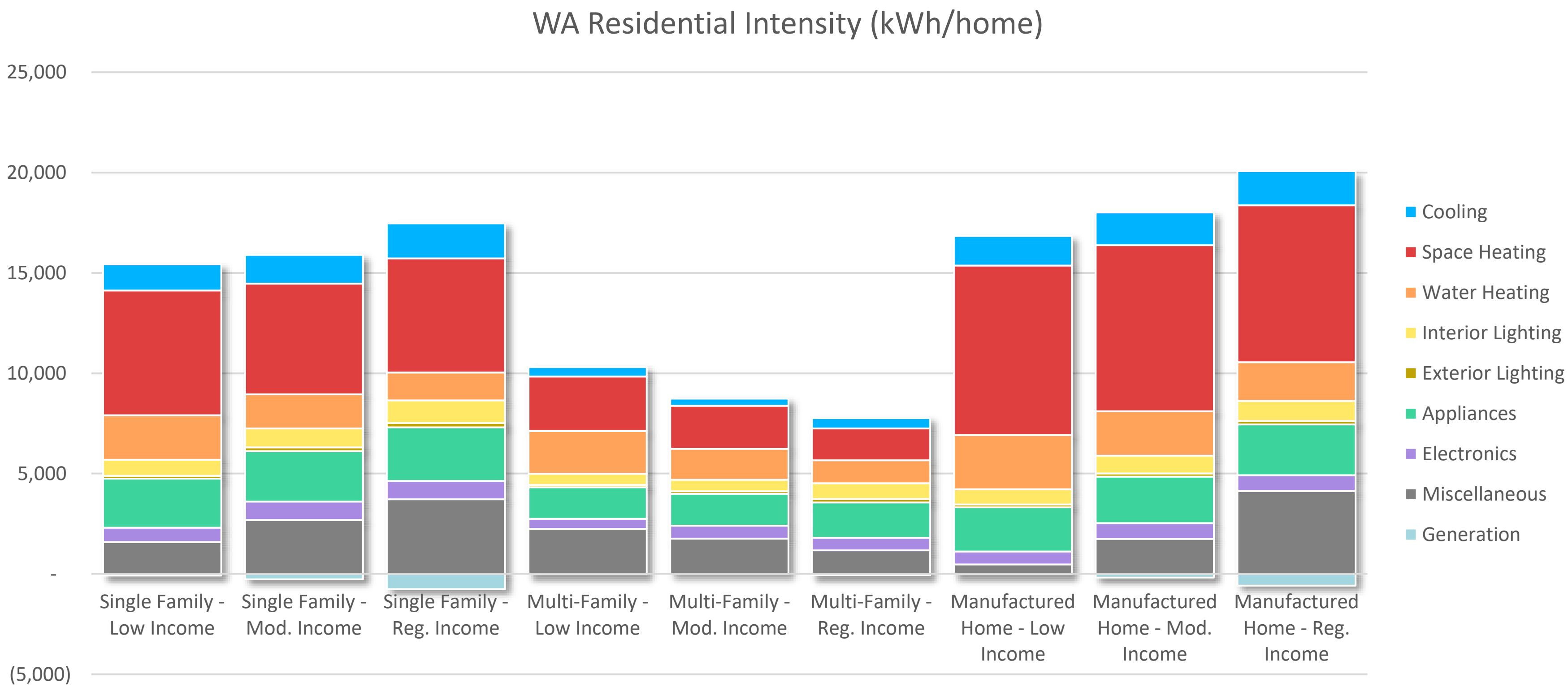


Average Annual Household Consumption by State (kWh)

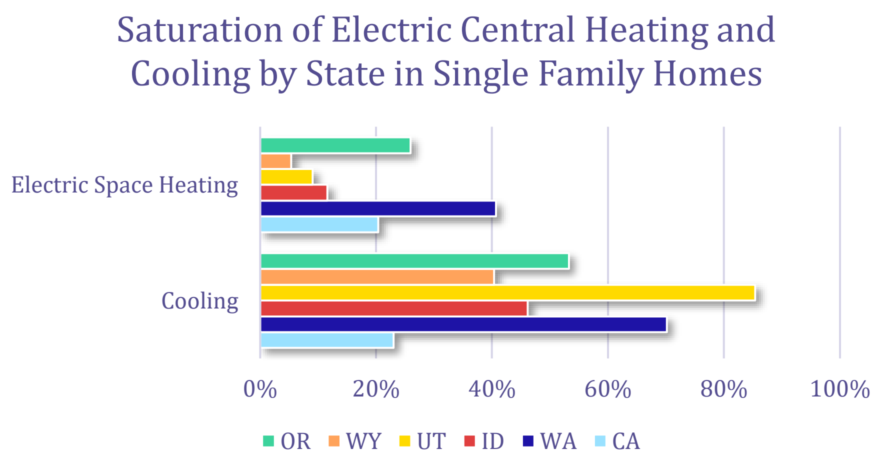
State:	CA	WA	ID	UT	WY	OR	All States
Single Family Usage:	11,256	15,644	12,360	10,046	10,006	11,873	11,054
Variant from Average:	2%	42%	12%	-9%	-9%	7%	0%

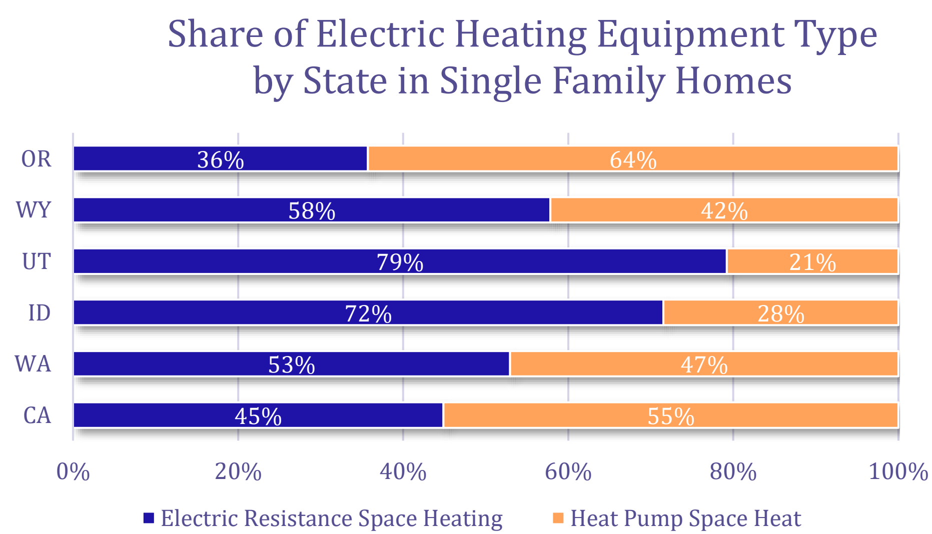
Comparison Across Segment and Income

- Washington stacked bar graph of consumption by end use for each segment



Residential Central Cooling and Heating Saturation Comparison





- Much higher saturation of central cooling in WA and UT
- WA, CA, and OR have highest central electric space heat saturations
  - However, that doesn't necessarily translate to the same opportunities
  - 64% of all Electric Heated Homes in OR use heat pumps compared to 21% in UT
  - Higher savings are available from shell improvements in homes with resistance heat

Market Profiles: Sector-Level Drivers Commercial

Drivers of Commercial Differences Across States

Building Type

- Certain equipment is more applicable to certain building types
- Example: Compared to offices, grocery has more refrigeration consumption, lodging has more water heating consumption

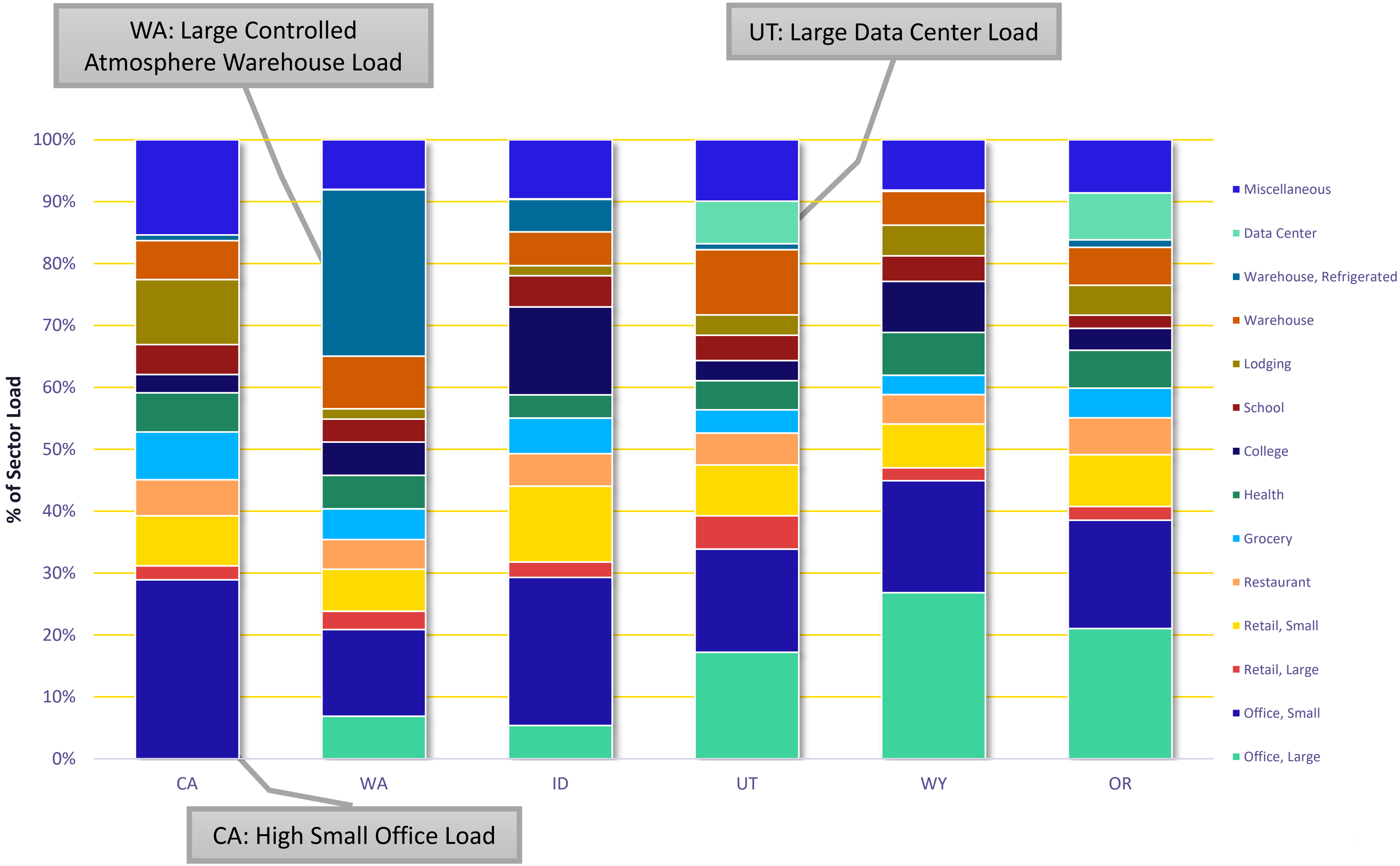
Climate and Location

- Much like residential, climate can have a large impact due to varying runtimes
- Access to natural gas service affects saturation of electric space and water heating

Data Sourcing

- Differences in building characteristics drive differences in energy use intensity (kWh/sq ft) EUI and saturation.
- Example: Different sources for RMP and Pacific Power states – CBECS and CBSA

Commercial Market Comparison



Commercial Market Profile Example – ID Large Office

Segment	Large Office
Floor Space (Thousands SqFt)	6,869.03
Total Load (GWh)	105.1
Intensity (kWh/SqFt)	15.95

- Commercial profile represents consumption for typical building square footage.
- EUI – energy utilization index
  - Different from UEC, kWh consumed per square foot when technology is present (not consumption per technology unit)
- Overall building intensities (kWh/SqFt) sourcing varies by state and adjusted due to weather and other characteristics. Typically, Pacific Power states utilize CBSA, RMP states utilize CBECs

Electric Market Profiles

End Use	Technology	Saturation	EUI (kWh)	Intensity (kWh/Sqft)	Usage (GWh)
Cooling	Air-Cooled Chiller	7.3%	2.87	0.21	1.4
Cooling	Water-Cooled Chiller	47.4%	3.00	1.42	9.4
Cooling	RTU	13.4%	2.56	0.34	2.3
Cooling	PTAC	1.1%	2.11	0.02	0.2
Cooling	PTHP	0.7%	2.56	0.02	0.1
Cooling	Evaporative AC	6.1%	1.02	0.06	0.4
Cooling	Air-Source Heat Pump	9.6%	2.56	0.25	1.6
Cooling	Geothermal Heat Pump	6.0%	2.38	0.14	0.9
Heating	Electric Furnace	10.4%	1.44	0.15	1.0
Heating	Electric Room Heat	0.0%	1.37	0.00	0.0
Heating	PTHP	0.7%	1.16	0.01	0.1
Heating	Air-Source Heat Pump	9.6%	1.28	0.12	0.8
Heating	Geothermal Heat Pump	6.0%	1.22	0.07	0.5
Ventilation	Ventilation	100.0%	3.33	3.33	21.9
Water Heating	Water Heater	47.6%	0.98	0.47	3.1
Interior Lighting	General Service Lighting	100.0%	0.28	0.28	1.9
Interior Lighting	Exempted Lighting	100.0%	0.08	0.08	0.5
Interior Lighting	High-Bay Lighting	100.0%	0.04	0.04	0.2
Interior Lighting	Linear Lighting	100.0%	2.58	2.58	17.0
Exterior Lighting	General Service Lighting	100.0%	0.08	0.08	0.5
Exterior Lighting	Area Lighting	100.0%	0.65	0.65	4.3
Exterior Lighting	Linear Lighting	100.0%	0.27	0.27	1.8
Refrigeration	Walk-in Refrigerator/Freezer	2.0%	0.09	0.00	0.0
Refrigeration	Reach-in Refrigerator/Freezer	14.0%	1.57	0.22	1.5
Refrigeration	Glass Door Display	4.0%	0.54	0.02	0.1
Refrigeration	Open Display Case	1.3%	0.43	0.01	0.0
Refrigeration	Icemaker	44.9%	0.22	0.10	0.7
Refrigeration	Vending Machine	44.9%	0.06	0.03	0.2
Food Preparation	Oven	66.0%	0.04	0.03	0.2
Food Preparation	Fryer	76.4%	0.06	0.05	0.3
Food Preparation	Dishwasher	20.0%	0.04	0.01	0.0
Food Preparation	Hot Food Container	20.0%	0.01	0.00	0.0
Food Preparation	Steamer	20.0%	0.06	0.01	0.1
Office Equipment	Desktop Computer	100.0%	0.84	0.84	5.6
Office Equipment	Laptop	100.0%	0.26	0.26	1.7
Office Equipment	Server	100.0%	1.76	1.76	11.6
Office Equipment	Monitor	100.0%	0.15	0.15	1.0
Office Equipment	Printer/Copier/Fax	100.0%	0.04	0.04	0.3
Office Equipment	POS Terminal	40.0%	0.01	0.00	0.0
Miscellaneous	Non-HVAC Motors	89.6%	0.17	0.16	1.0
Miscellaneous	Pool Pump	0.0%	0.03	0.00	0.0
Miscellaneous	Pool Heater	0.0%	0.03	0.00	0.0
Miscellaneous	Clothes Washer	0.0%	0.01	0.00	0.0
Miscellaneous	Clothes Dryer	0.0%	0.03	0.00	0.0
Miscellaneous	Other Miscellaneous	100.0%	1.67	1.67	11.0
Total				**15.95**	**105.1**

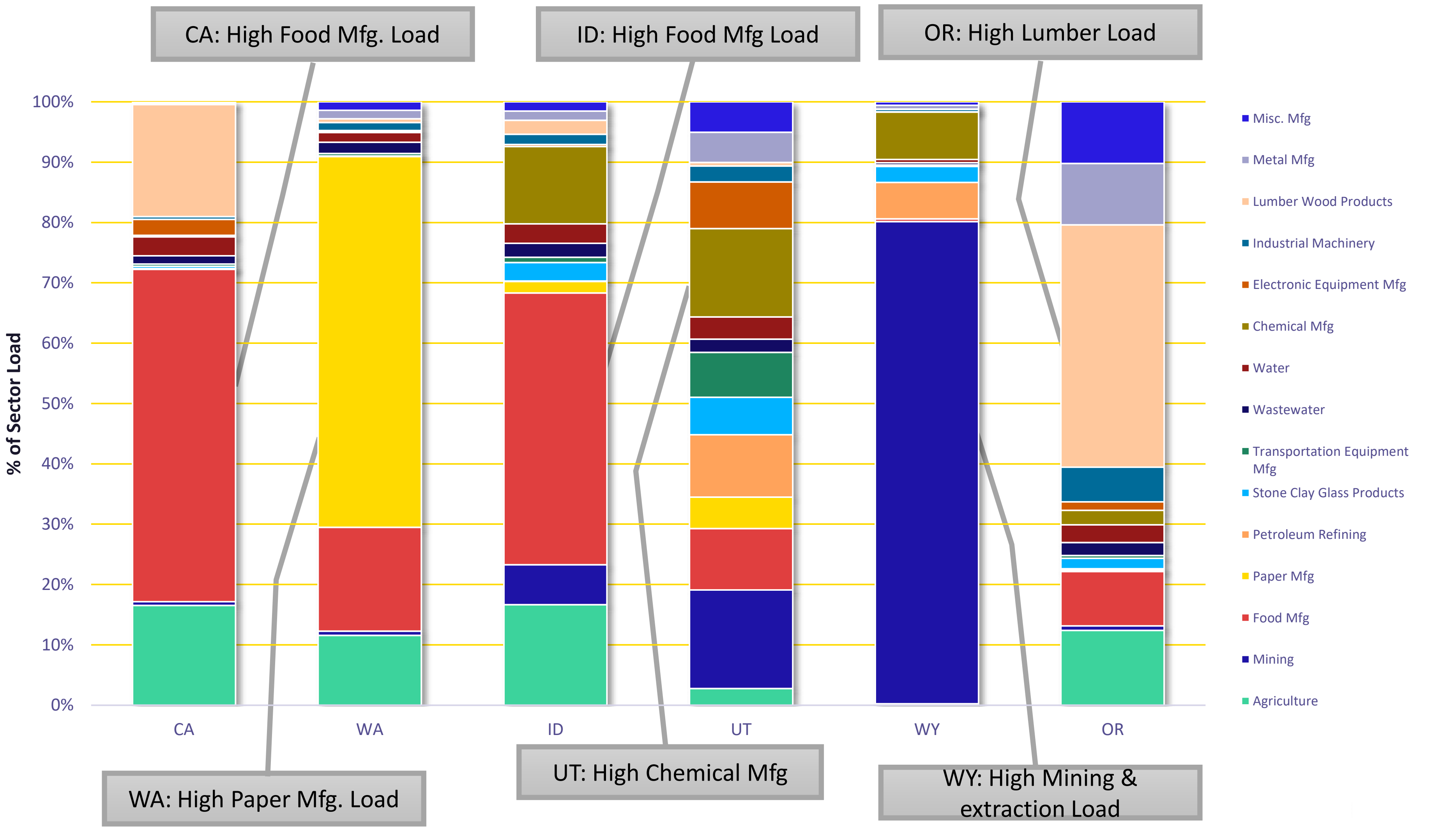
Market Profiles: Sector-Level Drivers
Industrial

Drivers of Industrial Differences Across States

Industry Type	Applicable Measures	Data Sourcing
• The industry type drives the savings potential • Example: Some industrial facilities may look more like a warehouse while others are heavy processing, presenting different savings opportunities due to equipment types and operation schedules	• Opportunities differ by what equipment types are present in the facility. Some industries have high compressed air loads, others may be driven more by motors or lighting loads. • Projects tend to be highly customized, capital-intensive, and may require interruptions to operations, affecting their technical feasibility.	• Differences in building characteristics drive differences in energy use intensity (kWh/sq ft) EUI and saturation. • Example: Different sources for RMP and PAC states – MECS for RMP and NWPCC for Pacific Power

Climate is a much lower driver of difference in industrial than in other sectors

Industrial Market Comparison



Industrial Market Profiles/Saturation

Segment:	Mining
Employees:	47,859
Total Load (GWh):	5,771.3
Intensity (MWh/employee):	120.6

- Industrial profile represents consumption for typical industry per employee.
  - Employment is used as a proxy for energy consumption since floor area is less reliable
  - E.g. 10% of space may use 90% of energy, rest of space could be warehouse
- Began with commercial warehouse market profile by state, added industrial end uses
- Intensity from Bureau of Labor Statistics, cross-referenced with 2014 IFSA and MECs

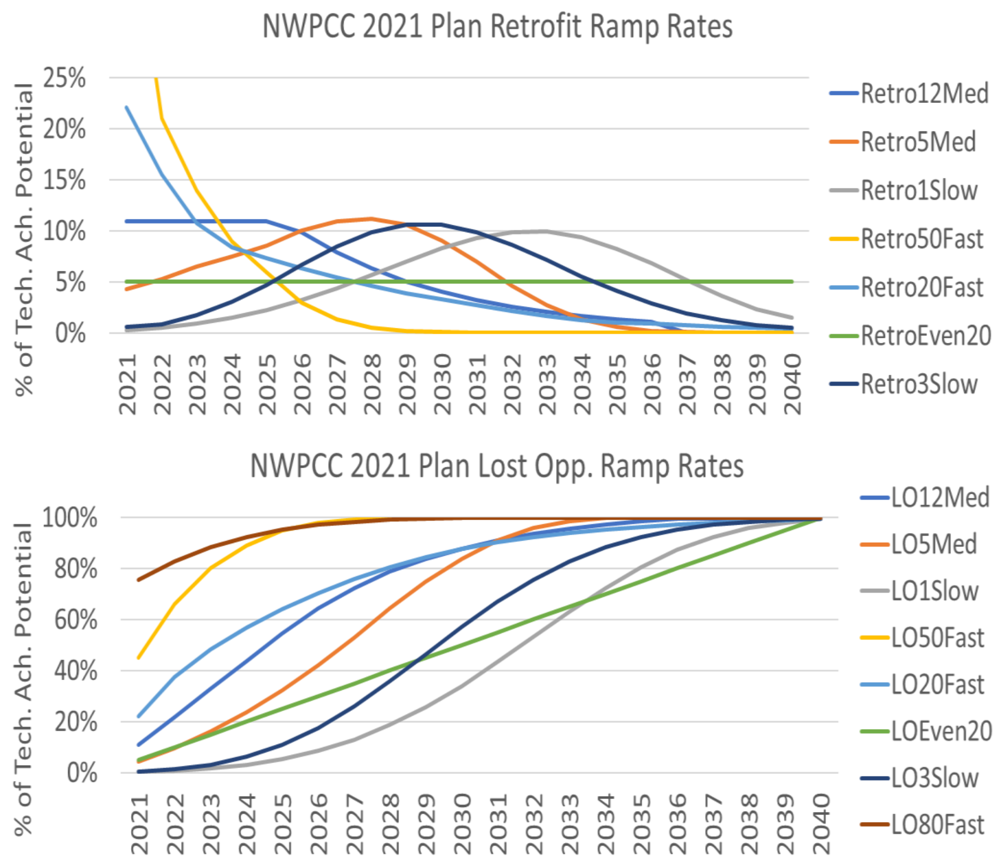
Mining & Extraction Market Profile - Wyoming

End Use	Technology	Saturation	EUI (kWh)	Intensity (kWh/ Employee)	Usage (GWh)
Cooling	Air-Cooled Chiller	2.6%	75.5	1.9	0.1
Cooling	Water-Cooled Chiller	2.5%	-	-	-
Cooling	RTU	50.3%	3,557.5	1,790.3	85.7
Cooling	Air-Source Heat Pump	2.7%	3,218.0	87.6	4.2
Cooling	Geothermal Heat Pump	0.0%	1.0	-	-
Heating	Electric Furnace	0.0%	1.0	-	-
Heating	Electric Room Heat	9.1%	18,974.1	1,721.2	82.4
Heating	Air-Source Heat Pump	2.7%	18,102.0	492.7	23.6
Heating	Geothermal Heat Pump	0.0%	1.0	-	-
Ventilation	Ventilation	100.0%	3,309.0	3,309.0	158.4
Interior Lighting	General Service Lighting	100.0%	382.6	382.6	18.3
Interior Lighting	High-Bay Lighting	100.0%	950.5	950.5	45.5
Interior Lighting	Linear Lighting	100.0%	2,701.0	2,701.0	129.3
Exterior Lighting	General Service Lighting	100.0%	582.2	582.2	27.9
Exterior Lighting	Area Lighting	100.0%	314.3	314.3	15.0
Exterior Lighting	Linear Lighting	100.0%	725.8	725.8	34.7
Motors	Pumps	100.0%	32,276.4	32,276.4	1,544.7
Motors	Fans & Blowers	100.0%	6,004.9	6,004.9	287.4
Motors	Compressed Air	100.0%	9,758.0	9,758.0	467.0
Motors	Material Handling	100.0%	9,007.4	9,007.4	431.1
Motors	Other Motors	100.0%	3,753.1	3,753.1	179.6
Process	Process Heating	100.0%	28,887.8	28,887.8	1,382.5
Process	Process Cooling	100.0%	2,222.7	2,222.7	106.4
Process	Process Refrigeration	100.0%	2,222.7	2,222.7	106.4
Process	Process Electrochemical	100.0%	2,026.8	2,026.8	97.0
Process	Process Other	100.0%	2,466.5	2,466.5	118.0
Miscellaneous	Miscellaneous	100.0%	8,903.7	8,903.7	426.1
Total				**120,589.3**	**5,771.3**

Other Drivers

Ramp Rates

- Ramp rates dictate the pace at which the potential is assumed to be achievable, separately for lost opportunity and retrofit measures
  - Lost Opportunity rates indicate the percent of equipment up for replacement in a given year that is assumed to be upgraded
  - Retrofit rates indicate the share of the 20-year potential assumed to be acquired in a given year
- The study uses a set of S-shaped diffusion curves developed by the Northwest Power and Conservation Council
- AEG analyzes PacifiCorp's recent state-specific program history to determine which ramp rate is most appropriate to apply



Next Steps

Presentations

- Provide updates on progress during summer meetings.
- Draft CPA Technical Potential Results at September IRP Stakeholder Meeting
- Discuss feedback received and planned updates in September 2023 IRP Stakeholder Meeting
- Final CPA Technical Achievable Potential results in October 2023 IRP Stakeholder Meeting

CPA/IRP Analysis

- Finish Measure Characterization and Develop Supply Curves

Stakeholder Feedback

- 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.

2020 AS RFP Update

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2020AS RFP Update

- PacifiCorp issued the 2020AS RFP to the market on July 7, 2020; bidder responses were returned to PacifiCorp for evaluation on August 10, 2020 representing over 28,000 MW of conforming bids
- In October 2020, the initial shortlist was identified, which included 5,453 MW of renewable resource capacity—2,974 MW of solar or solar with storage (1,130 MW of battery storage), 2,479 MW of wind, and 200 MW of standalone battery capacity
- Consistent with the bid evaluation and selection methodology set forth in the 2020AS RFP, PacifiCorp has evaluated a range of potential bid portfolios, reflecting results from the transitional interconnection cluster study process, to select the final shortlist, which includes:
    - 1,792 MW of new wind resources (590 MW as build-transfer agreements and 1,202 MW as power-purchase agreements)
    - 1,453 MW of solar capacity (all power-purchase agreements)
    - 735 MW of battery energy storage system capacity—535 MW paired with solar bids and 200 MW as standalone battery storage (power-purchase agreement)
- Final contracting efforts continue as part of this process. Most 2020AS RFP agreements are expected to be executed prior to the close of Q2 2022.

Price Curve Development Update

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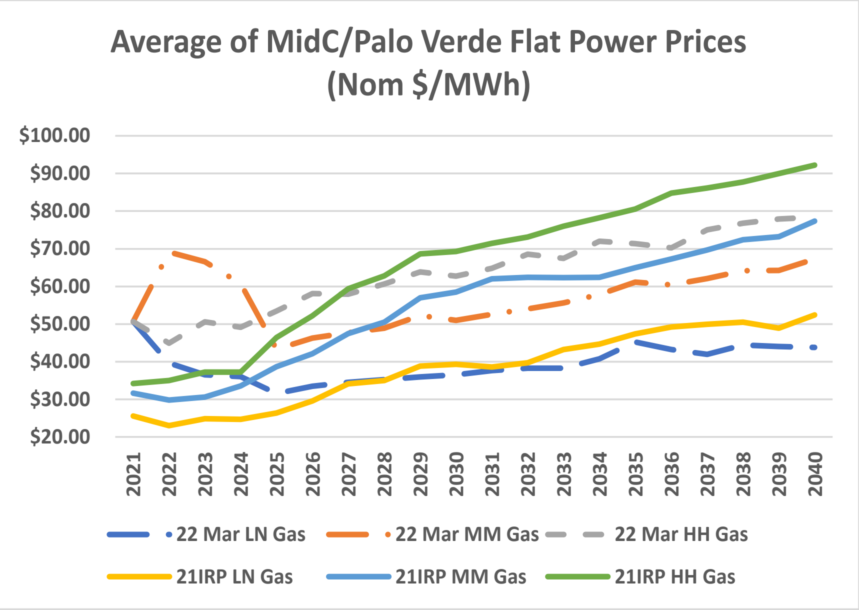
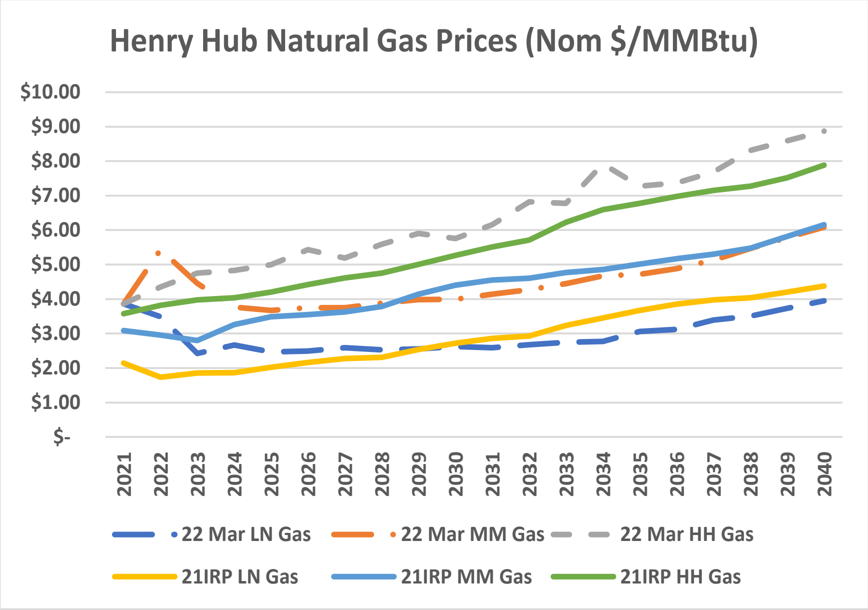
Price Curve Development Update

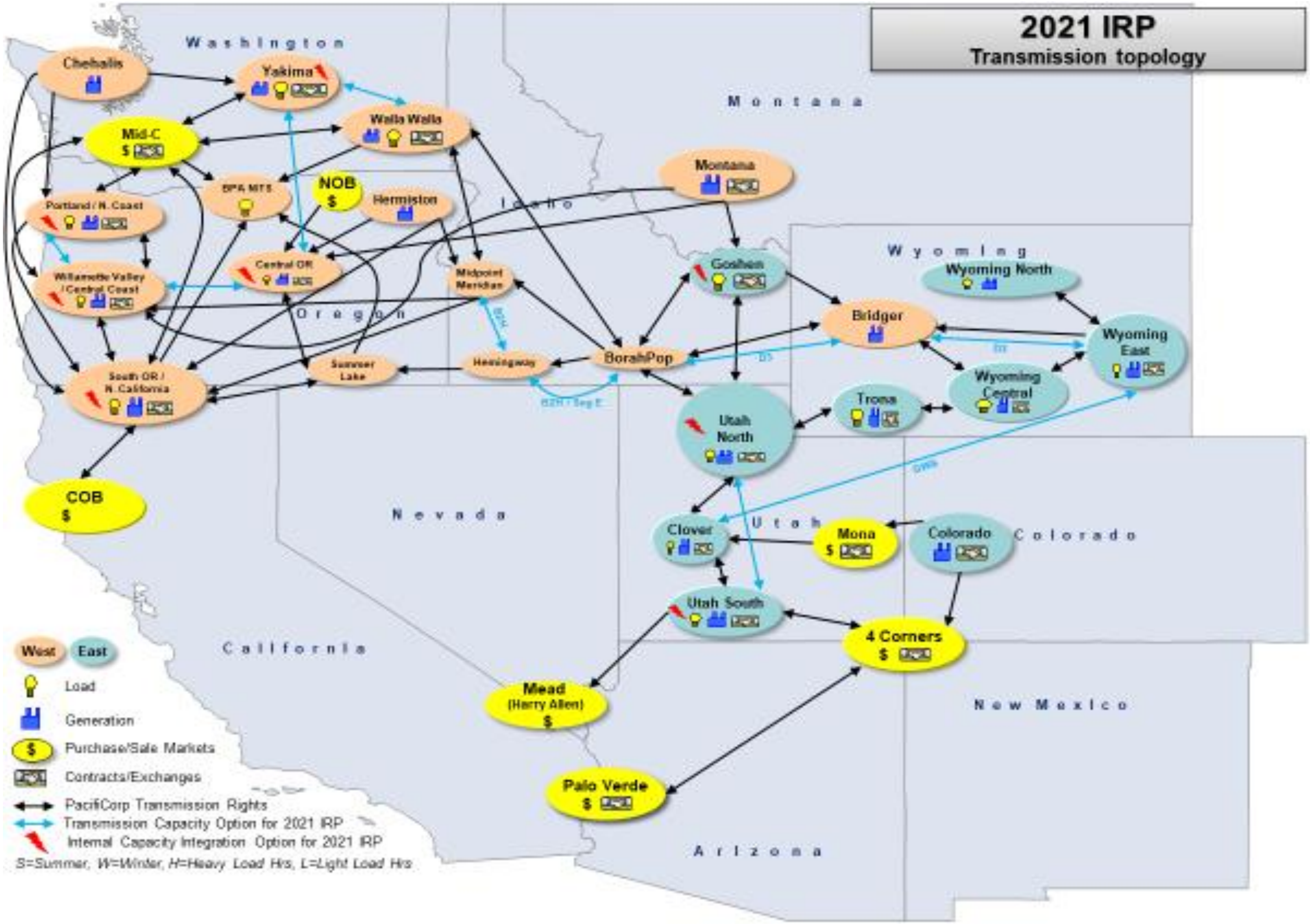
- The Company's 2021 IRP reflected market prices for electricity and gas from March 2021, based on a range of assumptions for natural gas prices and greenhouse gas costs.
- The figures below provide a comparison to more recent pricing from March 2022, with the same range of no/medium/high greenhouse gas assumptions used in the 2021 IRP.
- Current power and gas prices are very high and are expected to decline in the next few years.
- Higher renewable resource penetration from state mandates is expected to lead to lower average power prices relative to the prior forecast.
- After updating greenhouse gas assumptions (discussed on a later slide) updated market prices will be developed for use in the 2023 IRP, likely in September 2022.





Transmission Modeling





2021 IRP
Transmission topology
Washington
Montana
Idaho
Wyoming
Oregon
Nevada
Utah
Colorado
California
New Mexico
Arizona
Chehalis
Yakima
Walla Walla
Mid-C
BPA NTS
NOB
Hermiston
Montana
Portland / N. Coast
Willamette Valley / Central Coast
Central OR
Midpoint Meridian
Goshen
Wyoming North
Bridger
Wyoming East
Wyoming Central
Trona
South OR / N. California
Summer Lake
Hemingway
BorahPop
Utah North
COB
Clover
Mona
Colorado
Utah South
4 Corners
Mead (Harry Allen)
Palo Verde
West
East
Load
Generation
Purchase/Sale Markets
Contracts/Exchanges
PacifiCorp Transmission Rights
Transmission Capacity Option for 2021 IRP
Internal Capacity Integration Option for 2021 IRP
S=Summer, W=Winter, H=Heavy Load Hrs, L=Light Load Hrs

Transmission Overview

- There are two types of transmission options:
  - **Incremental** options include transmission capability between topology bubbles, and usually also allows new resources to be added
  - **Interconnection** options do not add transmission capability but rather add resource build capacity
- Incremental options use transmission *properties* to determine transfer capability
- Both types of options use *constraints* to limit the nameplate capacity of resource additions enabled by each option

Transmission Properties and Constraints

- Properties
  - “Max Flow” - sets the maximum allowable flow (in megawatts) on the line between two transmission bubbles, i.e., from A to B
  - “Min Flow” - sets the limit on flow in the opposite direction, i.e., from B to A. It can also be zero, if flow is uni-directional.
- Constraints
  - “Export Capacity Coefficient” defines the relationship between the Max Flow and the amount of allowed resource capacity
  - For example, if the coefficient is 0.5 (read as 50%) on a line with 100 MW available transfer capability (ATC), then up to 50 MW of nameplate resource additions are allowed

Transmission Options

Object	Property	Value	Data File	Units	Date From	Date To	Scenario	Memo
CON Central OR > TxCON 2027	Units	0		-				
CON Central OR > TxCON 2027	Project Start Date	1/1/2027		-				
CON Central OR > TxCON 2027	Max Flow	400		MW				
CON Central OR > TxCON 2027	Min Flow	0		MW				
CON Central OR > TxCON 2027	Export Capacity Coefficient	-1		MW				

- Units = 0
  - This flag tells Plexos that it is a selectable option and not planned or existing
- Project Start Date = 1/1/2027
  - This is the earliest year for the model to choose this option
- Max Flow = 400, Export Capacity Coefficient = -1
  - As an Interconnection option, the flow runs between Central Oregon and a "faux" topology bubble called "TxCON"
  - Combines with the Export Capacity Coefficient to limit new builds to 400 MW
- Min Flow
  - This is the capacity in the opposite direction, from TxCON to Central Oregon, but is irrelevant as this is not an Incremental transmission option

Transmission Constraints

Object	Property	Value	Data File	Units
TxCON Central OR Max Resource Build	Sense	<=		-
TxCON Central OR Max Resource Build	Balance Value	0		-
HYS.PX.COR._._PS.OW	Installed Capacity Coefficient	1		MW
PVS.PX.COR._.___.PV	Installed Capacity Coefficient	1		MW
WD_.PX.COR._.___.WD	Installed Capacity Coefficient	1		MW
BAT.PX.COR._.___.Lithium-ion	Capacity Built Coefficient	1		MW
CON Central OR > TxCON 2025	Export Capacity Coefficient	-1		MW
CON Central OR > TxCON 2026	Export Capacity Coefficient	-1		MW
CON Central OR > TxCON 2027	Export Capacity Coefficient	-1		MW

- The Export Capacity coefficient and the Installed Capacity Coefficient are balanced in a constraint
- Sense = “<=“
  - The nameplate of resource additions must be less than or equal to the transmission capacity
- Installed Capacity or Capacity Built coefficients
  - Percentage of new resource capacity that must be balanced against the transmission capacity

Brownfield Resource and Transmission Reclamation

Object	Property	Value	Data File	Units
ExpBF Naughton Max Resource Build	Sense	<=		-
ExpBF Naughton Max Resource Build	Balance Value	960.3		-
CL_.Ex.UTN._._25.Naughton 1	Installed Capacity Coefficient	1		MW
CL_.Ex.UTN._._25.Naughton 2	Installed Capacity Coefficient	1		MW
GCV.PL.UTN._.___.Naughton 3	Installed Capacity Coefficient	1		MW
GSC.EX.UTN._.___.Gadsby 1	Installed Capacity Coefficient	1		MW
GSC.EX.UTN._.___.Gadsby 2	Installed Capacity Coefficient	1		MW
GSC.EX.UTN._.___.Gadsby 3	Installed Capacity Coefficient	1		MW
XSC.PX.UWY._.___.Naughton - Non-E	Installed Capacity Coefficient	1		MW
NUC.PX.UTN._.___.Sm Adv Naughton	Installed Capacity Coefficient	1		MW
PVS.PX.UWY._.___.Naughton.PV	Installed Capacity Coefficient	1		MW
BAT.PX.UTN._.___.Naughton	Capacity Built Coefficient	1		MW

- Upon retirement, the model cannot access transmission capability that was assigned to those resources unless the retiring resources are replaced
- Similar to transmission option modeling, the model has the option to replace or not the resources
- In this example, the total resources at this site cannot exceed 960.3 MW
  - Initially this 960.3 is occupied by existing resources
  - As retirements occur, some of this 960.3 can be taken up by new resources

2023 IRP Transmission Options

- Near-term transmission options to be modeled in the 2023 IRP will generally reflect cost and timing from studies prepared for project-specific requests. Options will also be added for locations without specific requests and to address long-term needs.
- PacifiCorp Transmission posts studies on OASIS: https://www.oasis.oati.com/ppw (select Generation Interconnection in the sidebar)
- Key study categories:
  - Serial Queue (closed to new requests): primarily resources with signed contracts from PacifiCorp's old process, where requests were evaluated one at a time. Some requests are not yet in service and could potentially move forward.
  - Cluster Queue: A single study covers all requests in a specific location.
    - Transition Cluster: Studies initiated in 2020
    - Cluster 1: Studies initiated in 2021
    - Cluster 2: Studies requested through May 15, 2022, to be completed by November 2022.
- Each Cluster Study builds on requirements for pending prior requests, restudies can occur if prior requests withdraw.
- PacifiCorp will provide details on interconnection and transmission options for the 2023 IRP in a future public input meeting.

Climate Modeling

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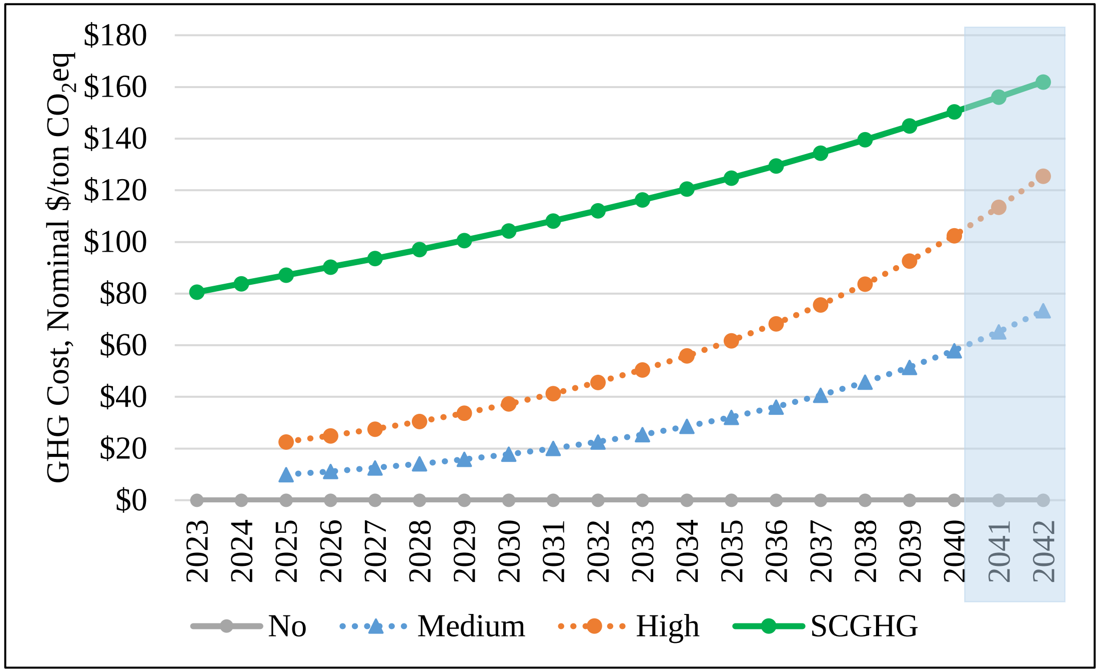
Climate Modeling

- Climate Modeling falls into two primary categories, one old and one new:
  - **Policies:** Greenhouse gas (GHG) cost assumptions are intended to represent the impact of potential future regulation of emitting resources, which may take the form of a tax, cap & trade, or other policies. For ease of modeling given the wide range of forms regulation may take, GHG costs have been applied to emitting resources, as a specified cost per ton of emissions.
    - Compliance with state policies, such as Oregon's HB2021 and Washington's Clean Energy Transformation Act (CETA), are assessed separately.
  - **Forecasting:** Weather conditions impact many aspects of system dispatch, including load, hydro generation, wind and solar output, thermal derates, and transmission and distribution system operations.
    - Changing climate may impact both expected conditions ("new normal") and the range of outcomes (i.e. what is 1 in 20-year event going forward?)
    - A key focus will be ensuring the various weather-dependent inputs reflect expected correlation, i.e. load, hydro, and thermal output reflect appropriate weather at a given point in time.
- Some overlap is expected, for example, climate-related policies may impact forecasted load.

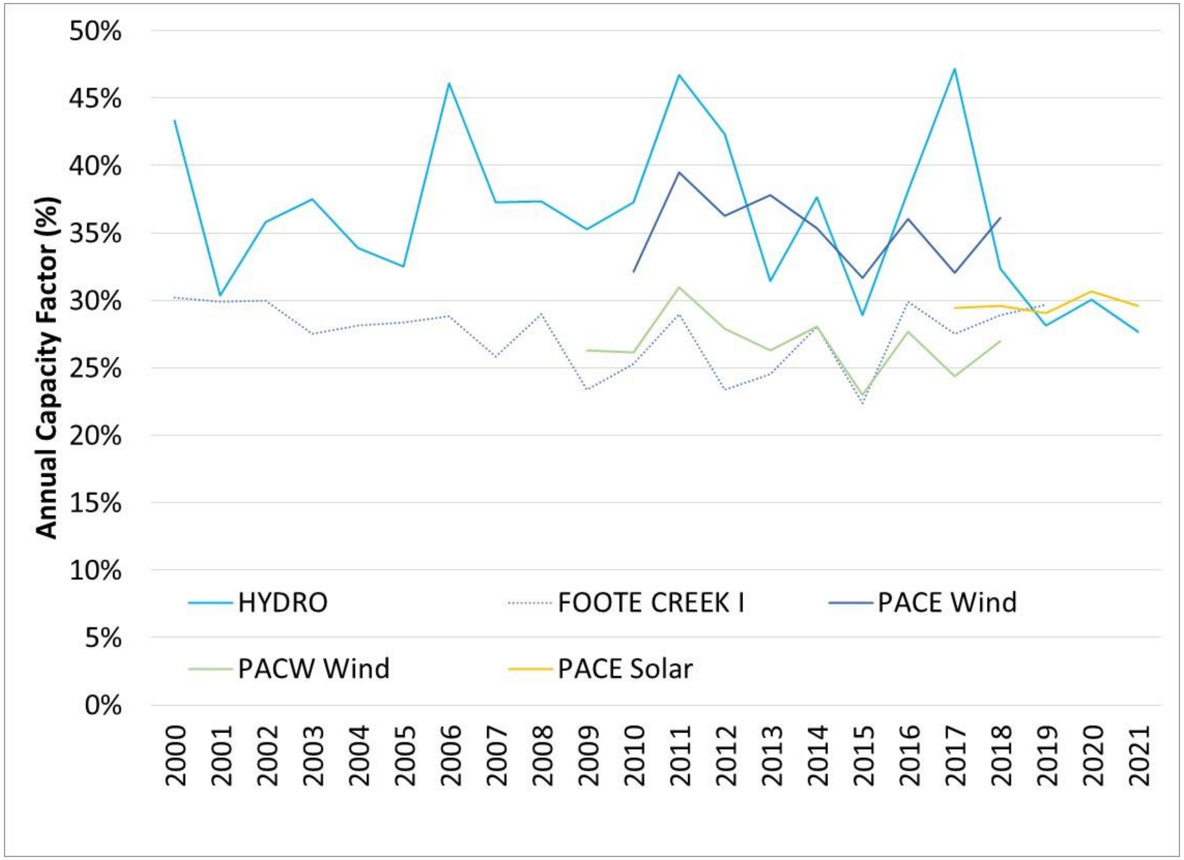
2021 IRP Greenhouse Gas Cost Scenarios

- Four GHG scenarios were modeled in the 2021 IRP
- Two bookends are fixed:
  - **Social cost of greenhouse gases (SCGHG):** Required under Washington's Clean Energy Transformation Act (CETA, RCW 19.280.030) with a 2.5% discount rate.
  - **No Cost:** Existing policies, including resource-specific obligations, if applicable.
- Medium and High GHG scenarios had costs starting in 2025.
- PacifiCorp would like stakeholder feedback on this topic and plans to discuss it in its July public input meeting before making a determination for the 2023 IRP.



Annual Weather Variation

- Climate is a pattern of weather conditions, and is represented in historical variation.
- Historical annual variation:
    - Hydro – high
    - Wind – medium
    - Solar – low (but limited data)



- Wind and solar data shown reflect a subset of the Company's portfolio, to maintain comparability across time.

Monthly Weather Variation: Hydro

- Monthly hydro variation is higher than annual
- The last several years have been below average in most months.
- Further adjustments are needed to account for operational changes (e.g. license requirements) that have evolved over time.

		Month					Variance (% of Average)							
	Year	1	2	3	4	5	6	7	8	9	10	11	12	Annual
Hydro	2000	29%	45%	24%	7%	27%	30%	26%	50%	53%	35%	-15%	-39%	20%
Hydro	2001	-47%	-53%	-48%	-37%	1%	-10%	-1%	9%	8%	0%	-1%	35%	-16%
Hydro	2002	22%	7%	4%	8%	10%	13%	9%	-1%	-23%	-14%	-43%	-30%	-1%
Hydro	2003	6%	28%	28%	10%	-17%	-19%	-10%	-2%	12%	-1%	-15%	11%	3%
Hydro	2004	-21%	22%	1%	-24%	-26%	-4%	-11%	-8%	45%	6%	-8%	-11%	-6%
Hydro	2005	-20%	-37%	-40%	-5%	9%	-14%	-10%	9%	-9%	-3%	4%	8%	-10%
Hydro	2006	63%	54%	14%	4%	13%	25%	0%	-2%	0%	1%	56%	43%	27%
Hydro	2007	4%	-11%	40%	8%	-23%	-18%	-3%	9%	-1%	2%	-15%	33%	3%
Hydro	2008	-5%	-18%	-7%	2%	1%	60%	45%	20%	17%	-5%	-2%	-32%	3%
Hydro	2009	4%	-25%	-9%	1%	38%	12%	-4%	-12%	-14%	-19%	-11%	-16%	-3%
Hydro	2010	15%	-29%	-14%	-8%	-11%	30%	3%	-7%	11%	12%	11%	30%	3%
Hydro	2011	18%	2%	37%	53%	51%	42%	55%	30%	41%	11%	20%	-11%	29%
Hydro	2012	20%	28%	25%	0%	16%	13%	14%	24%	1%	-11%	36%	22%	17%
Hydro	2013	-19%	-5%	-29%	-8%	-5%	-13%	-8%	0%	-5%	12%	-23%	-33%	-13%
Hydro	2014	-27%	7%	40%	3%	8%	-27%	-11%	0%	-18%	10%	16%	27%	4%
Hydro	2015	3%	-2%	-34%	-36%	-47%	-33%	-17%	-28%	-36%	-43%	-9%	21%	-20%
Hydro	2016	-11%	21%	44%	-5%	-22%	-29%	-12%	-7%	-17%	66%	31%	8%	5%
Hydro	2017	-35%	33%	69%	54%	54%	27%	10%	-5%	45%	35%	40%	19%	30%
Hydro	2018	20%	1%	-26%	19%	-9%	-23%	-13%	-14%	-23%	-33%	-33%	-22%	-11%
Hydro	2019	-23%	-51%	-40%	10%	-17%	-11%	-20%	-14%	-6%	2%	-38%	-36%	-22%
Hydro	2020	1%	10%	-38%	-18%	-14%	-18%	-18%	-20%	-42%	-27%	-27%	-11%	-17%
Hydro	2021	2%	-25%	-40%	-40%	-37%	-33%	-25%	-32%	-41%	-36%	25%	-16%	-23%

Monthly Weather Variation: Wind & Solar

- Monthly variation for wind and solar is higher than annual
- Solar has monthly variation not evident in the annual results.

		Month					Variance (% of Average)							
	Year	1	2	3	4	5	6	7	8	9	10	11	12	Annual
PACE Wind	2010	-17%	-24%	-22%	15%	26%	5%	28%	16%	2%	-8%	-14%	-20%	**-6%**
PACE Wind	2011	7%	9%	27%	32%	45%	23%	18%	9%	-6%	13%	21%	-4%	**15%**
PACE Wind	2012	30%	-14%	22%	-5%	9%	18%	-8%	2%	-26%	9%	15%	1%	**6%**
PACE Wind	2013	18%	5%	-3%	13%	19%	6%	-12%	-1%	28%	12%	9%	21%	**11%**
PACE Wind	2014	19%	3%	14%	19%	-11%	8%	-8%	-2%	-9%	-1%	5%	-11%	**3%**
PACE Wind	2015	-8%	-8%	-12%	-27%	-5%	-35%	14%	1%	12%	-15%	0%	3%	**-7%**
PACE Wind	2016	5%	34%	2%	-16%	-3%	-11%	28%	18%	29%	27%	-21%	-1%	**6%**
PACE Wind	2017	-13%	12%	10%	6%	-24%	4%	-30%	-23%	-18%	-33%	-11%	11%	**-6%**
PACE Wind	2018	24%	16%	-6%	17%	-28%	5%	6%	16%	9%	-2%	2%	5%	**6%**
PACW Wind	2010	-22%	-57%	-11%	28%	27%	10%	11%	8%	-5%	-7%	-5%	1%	**-1%**
PACW Wind	2011	50%	29%	9%	32%	15%	22%	0%	25%	-10%	19%	24%	-18%	**17%**
PACW Wind	2012	47%	9%	28%	-15%	28%	19%	-14%	-19%	-35%	14%	-28%	24%	**6%**
PACW Wind	2013	4%	28%	-5%	18%	-2%	-25%	-8%	-25%	33%	-37%	-10%	25%	**0%**
PACW Wind	2014	3%	16%	16%	12%	19%	14%	-4%	-8%	11%	-1%	10%	-22%	**6%**
PACW Wind	2015	-42%	-21%	-36%	-22%	-33%	-31%	18%	13%	-1%	-3%	-10%	29%	**-13%**
PACW Wind	2016	-8%	13%	7%	-15%	11%	-5%	12%	-13%	27%	20%	4%	14%	**5%**
PACW Wind	2017	-59%	2%	8%	16%	-25%	-2%	-4%	-35%	-16%	22%	11%	-29%	**-8%**
PACW Wind	2018	36%	70%	-3%	5%	-16%	-3%	-13%	3%	-5%	-38%	-7%	-4%	**2%**
PACE Solar	2017	-17%	-14%	8%	1%	6%	6%	-5%	-7%	-10%	11%	0%	23%	**0%**
PACE Solar	2018	8%	6%	-3%	-3%	-2%	11%	-4%	-3%	6%	-11%	3%	-5%	**0%**
PACE Solar	2019	-2%	-6%	-7%	-9%	-12%	-3%	9%	6%	0%	9%	-2%	-17%	**-2%**
PACE Solar	2020	7%	16%	-3%	3%	-2%	-3%	11%	6%	1%	5%	-3%	3%	**3%**
PACE Solar	2021	5%	-2%	5%	7%	10%	-11%	-12%	-1%	2%	-14%	2%	-4%	**-1%**

Weather Forecasting

- Historical data reflects correlation between weather-dependent inputs. Before contemplating climate impacts, PacifiCorp intends to assess historical relationships:
  - Weather adjustments to historical load
  - Actual generation: hydro, wind, solar
  - Thermal resource weather-related derates
  - Temperature may be used to link various adjustments
  - Market prices under various temperature conditions
- Historical generation data for wind and solar is limited, many resources are new or added recently. PacifiCorp is reviewing available data, including:
  - MERRA-2: https://gmao.gsfc.nasa.gov/reanalysis/MERRA-2/
  - National Solar Radiation Database: https://nsrdb.nrel.gov/
  - Western Wind Integration Data Set: https://www.nrel.gov/grid/eastern-western-wind-data.html
  - WIND Toolkit: https://www.nrel.gov/grid/wind-toolkit.html
- PacifiCorp expects historical weather modeling to help identify a range of potential future conditions that will enhance the 2023 IRP analysis.

Climate Forecasting

- Climate change refers to changes in the distribution of weather conditions over time, modeling inputs could reflect a different range of weather conditions versus history.
  - Modeling a range of conditions remains important.
  - Recent historical weather might be better aligned with future conditions – sampling might be able to represent shifts over time.
  - Modifying historical weather to represent more a wider range of conditions is also possible.
  - The range of weather conditions could evolve over the 20-year study horizon.
  - Market prices and supply may need to reflect regional supply limitations, particularly under adverse conditions.
- Parameters for these climate impacts need to be defined.
  - PacifiCorp would like stakeholder feedback on this topic and plans to discuss it further in a future public input meeting.
  - Citations to analysis that is recent or targeted near PacifiCorp's locations would be appreciated.

Wrap-Up/Additional Information

Additional Information

- 2023 IRP Upcoming Public Input Meetings:
  - June 9-10, 2022 (Thursday-Friday)
  - July 14-15, 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