



# 2019 Integrated Resource Plan (IRP) Public Input Meeting October 9, 2018



# Agenda



- Supply-Side Resource Table Levelized Costs
- Intra-Hour Flexible Resource Credits
- Updated CO<sub>2</sub> Assumption

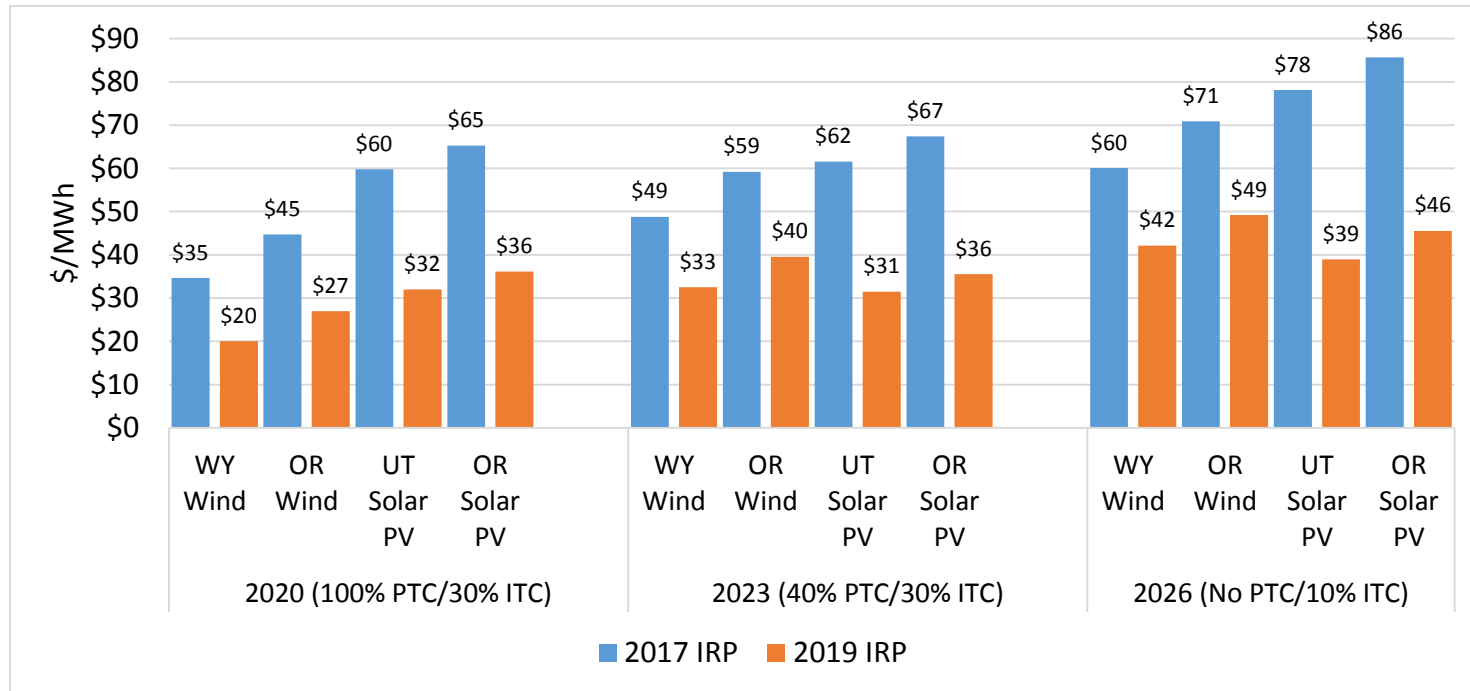


# Supply-Side Resource Table

## Levelized Costs

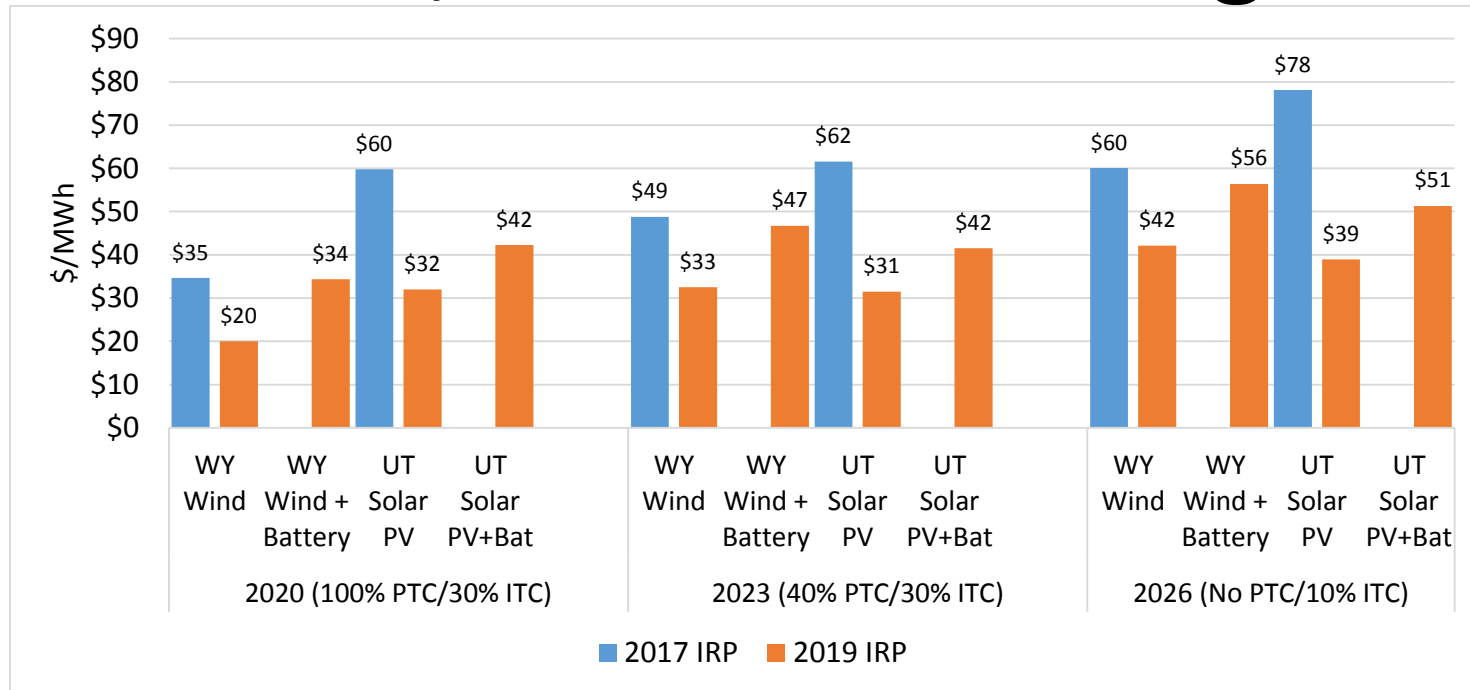


# Nominal Levelized Costs for Wind and Solar



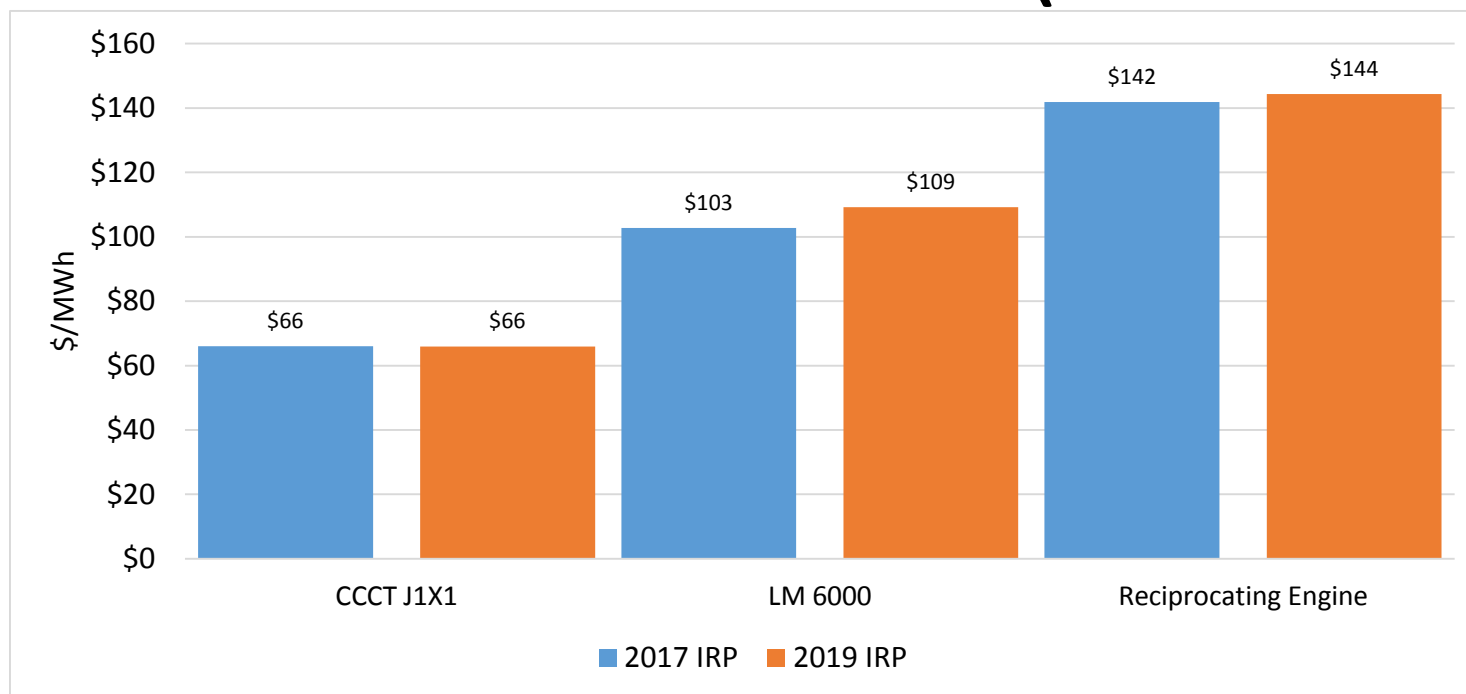
- Representative levelized cost information from the 2017 IRP and for the 2019 IRP both reflect the Tax Cut and Jobs Act.
- Wyoming wind costs from the 2017 IRP reflect updated assumptions applied in the final stages of the portfolio-development process (10.7 percent reduction in capital with a 41.3% capacity relative to the supply-side resource table from the 2017 IRP).
- Wind and solar costs reflect the proposed annual escalation/de-escalation rates summarized later in this presentation.

# Nominal Levelized Costs for Wind, Solar and Storage



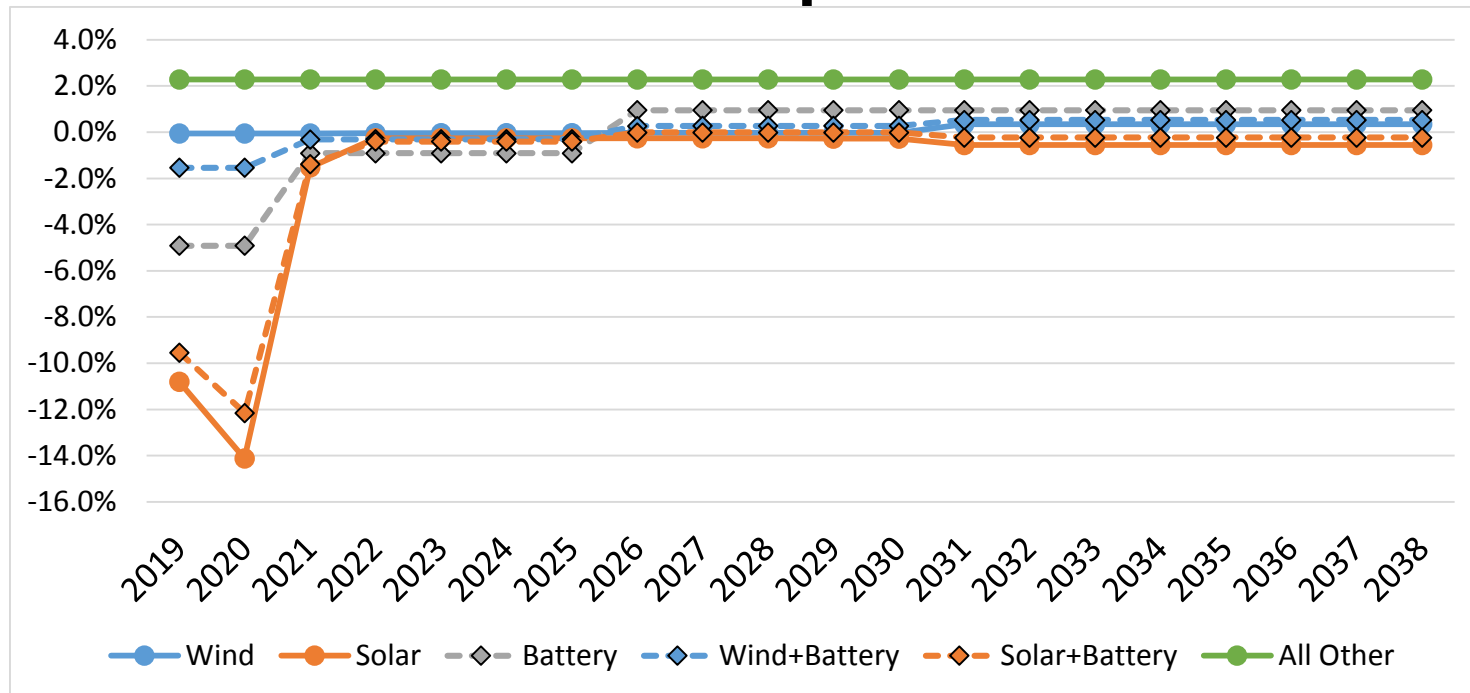
- Representative levelized cost information from the 2017 IRP and for the 2019 IRP both reflect the Tax Cut and Jobs Act.
- Wyoming wind costs from the 2017 IRP reflect updated assumptions applied in the final stages of the portfolio-development process (10.7 percent reduction in capital with a 41.3% capacity relative to the supply-side resource table from the 2017 IRP).
- Wind, solar and battery costs reflect the proposed annual escalation/de-escalation rates summarized later in this presentation.
- Note, the 2017 IRP did not include combined wind and battery or combined solar and battery alternatives.

# Nominal Levelized Costs for Natural Gas Resources (2026 COD)



- Representative levelized cost information from the 2017 IRP and for the 2019 IRP both reflect the Tax Cut and Jobs Act and the same base case natural gas prices proposed for the 2019 IRP.
- There are no PTC/ITC phase-out assumptions tied to natural gas resources—2026 is shown for illustrative purposes only.
- Natural gas resource costs reflect the proposed annual escalation/de-escalation rates summarized later in this presentation.
- For levelized cost calculation purposes, it is assumed the CCCT operates at a 78% capacity factor and that the LM6000 and Reciprocating Engine operate at a 33% capacity factor.

# Nominal Year-by-Year Escalation for Resource Capital Costs



- Annual capital cost escalation/de-escalation rates for solar are based on unweighted median scenarios from General Electric Renewable Energy, the U.S. Energy Administration, and Burns and MacDonald—note, rates for 2019 and 2020 are adjusted to calibrate levelized costs to be consistent with pricing received in the 2017R RFP.
- Annual capital cost escalation/de-escalation rates for wind are based on unweighted median scenarios from Energy+Environmental Economics, General Electric Renewable Energy, Berkley Labs, ArcTechnica, the Office of Energy Efficiency & Renewable Energy Administration, and Burns and MacDonald—note, rates for 2019 and 2020 are adjusted to calibrate levelized costs consistent with pricing received in the 2017S RFP.
- Annual capital cost escalation/de-escalation rates for batteries are based on data from Burns and MacDonald.
- All other resources are assumed to escalate at 2.28% per year.



# Intra-Hour Flexible Resource Credits

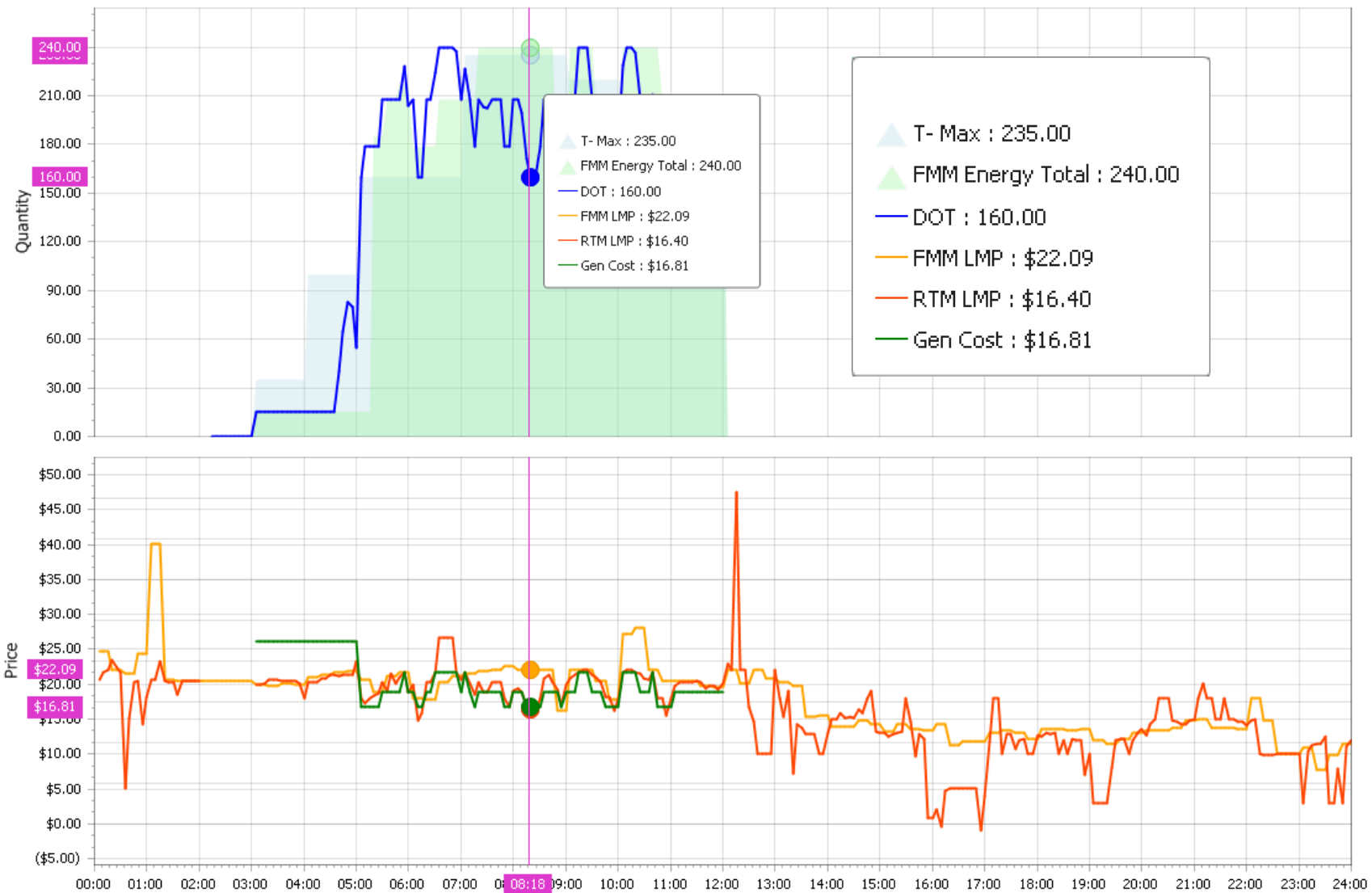


# Input Variables



- **T-Max** = PacifiCorp's Hourly Base Schedule
- **FMM Energy Total** = EIM's Fifteen Minute Advisory Schedule
- **DOT** = EIM's Five Minute Dispatch Schedule
- **FMM LMP** = EIM's Fifteen Minute Market Price
- **RTM LMP** = EIM's Five Minute Market Price
- **Gen Cost** = PacifiCorp's Cost of Generation
- **IHFRC** = Intra-hour Flexible Resource Credit
- **IHFRC** =  $(\text{FMM Energy Total} - \text{T-Max}) * \text{FMM LMP} + (\text{DOT} - \text{FMM Energy Total}) * \text{RTM LMP} - (\text{DOT} - \text{T-Max}) * \text{Gen Cost}$

# EIM Single Unit Example



# Calculation



## Variables

- **T-Max** = PacifiCorp's Hourly Base Schedule
- **FMM Energy Total** = EIM's Fifteen Minute Advisory Schedule
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- **FMM LMP** = EIM's Fifteen Minute Market Price
- **RTM LMP** = EIM's Five Minute Market Price
- **Gen Cost** = PacifiCorp's Cost of Generation

## Calculation

- $$\text{IHFRC} = ((\text{FMM Energy Total} - \text{T-Max}) * \text{FMM LMP} + (\text{DOT} - \text{FMM Energy Total}) * \text{RTM LMP} - (\text{DOT} - \text{T-Max}) * \text{Gen Cost}) / 12$$
  - $$\text{IHFRC} = ((240 \text{ MWh} - 235 \text{ MWh}) * 22.09 \text{ \$/MWh} + (160 \text{ MWh} - 240 \text{ MWh}) * 16.40 \text{ \$/MWh} - (160 \text{ MWh} - 235 \text{ MWh}) * 16.81 \text{ \$/MWh}) / 12$$
  - $$\text{IHFRC} = ((5 \text{ MWh}) * 22.09 \text{ \$/MWh} + (-80 \text{ MWh}) * 16.40 \text{ \$/MWh} - (-75 \text{ MWh}) * 16.81 \text{ \$/MWh}) / 12$$
  - $$\text{IHFRC} = (\$110.45 - \$1312.00 + \$1260.75) / 12$$
  - $$\text{IHFRC} = \$59.20 / 12$$
  - $$\text{IHFRC} = \$4.93 / 5 \text{ min}$$
1. Market price received for being available to ramp up in FMM
  2. Market price paid for ramping down in RTM
  3. Fuel costs saved from reduced dispatch versus base schedule

# Supply-Side Resource Values



Resource	Credit (\$/kw-year)	Dispatch (% of Nameplate)	Cycles/day	Source
Pumped Hydro 6-14hr	30.44	9.2% - 9.8%	0.2 - 0.4	Proxy
CAES 48hr	30.28	11%	0.05	Proxy
Flow 6hr	27.24	10%	0.38	Proxy
Li-Ion 4hr	25.60	9%	0.56	Proxy
Li-Ion 2hr	25.02	8%	0.90	Proxy
Interruptible Load (528 hrs/yr)	19.20	6%	n/a	Proxy
Interruptible Load (30 hrs/yr)	6.00	0.3%	n/a	Proxy
Resource	Minimum operating level (%)			
SCCT Intercooled	18.51	8%	15%	Proxy
SCCT Aero	16.58	10%	40%	Proxy
Baseload Steam	5.54	*	24%	Actual
Peak Steam	4.89	*	24%	Actual
CCCT	3.77	*	70%	Actual
SCCT Frame F	3.47	1%	43%	Proxy
Resource/Bid Price	% of annual output			
Solar/\$0	1.22	-1.7%	5.6%	Proxy
Wind/\$0	0.87	-1.1%	2.9%	Proxy
Wind/PTC	0.14	-0.04%	0.1%	Proxy

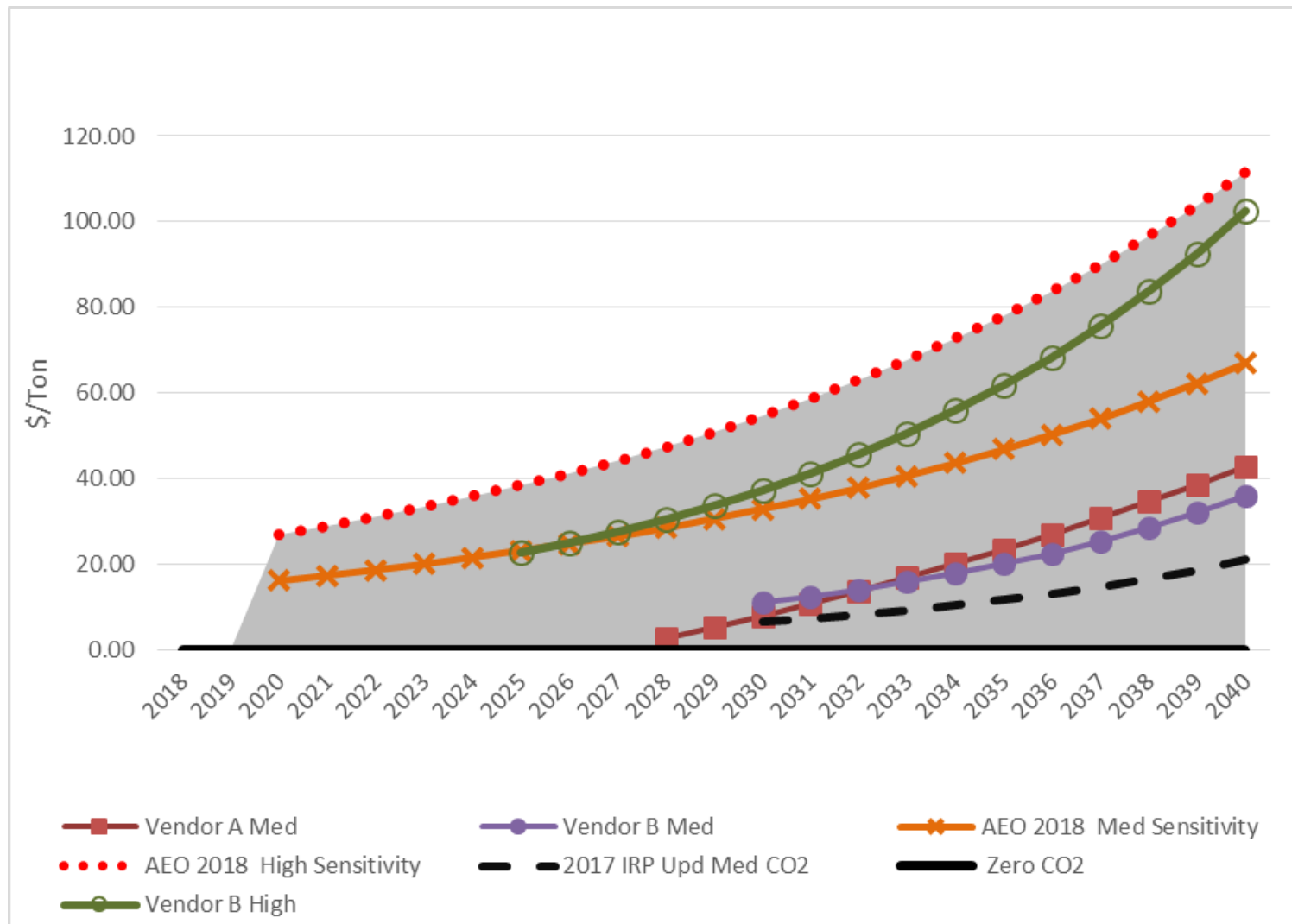
\*Resources are dispatched up and down from base schedule in EIM.



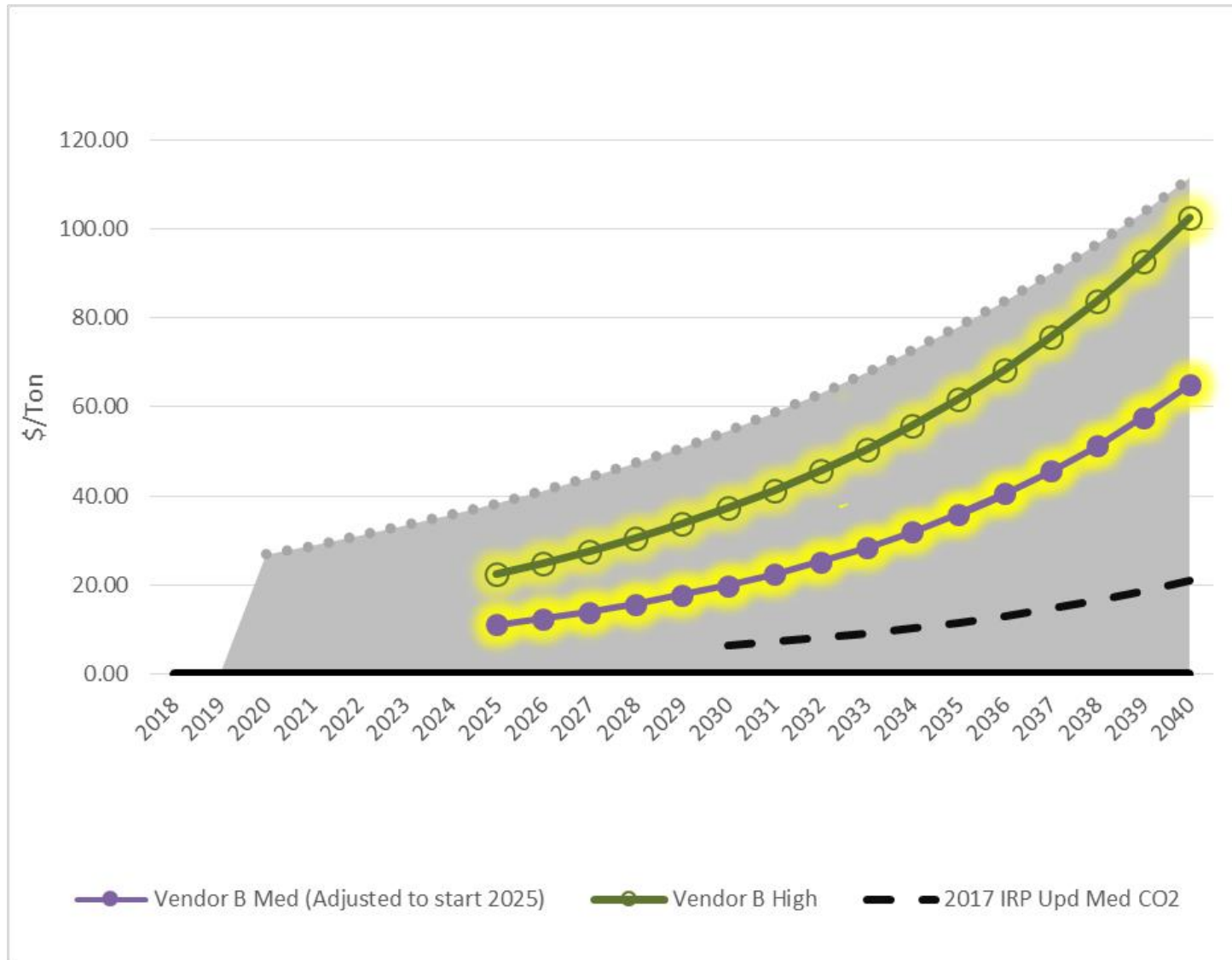
# Updated CO<sub>2</sub> Assumption



# Survey of CO<sub>2</sub> Price Forecasts



# CO<sub>2</sub> Price Forecasts





# Additional Information and Next Steps



# Draft Topics for Upcoming PIMs\*



November 1-2, 2018 PIM\*:

- Coal Studies
- Stakeholder Feedback Form Recap

December 3-4, 2018 PIM\*:

- Load & Resource Balance
- Regional Haze Portfolios
- Portfolios / Sensitivity Cases
- Stakeholder Feedback Form Recap

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

# Additional Information and Next Steps



- Public Input Meeting Presentation and Materials:
  - [pacificorp.com/es/irp.html](http://pacificorp.com/es/irp.html)
- 2019 IRP Stakeholder Feedback Forms and Summary Matrix:
  - [pacificorp.com/es/irp/irpcomments.html](http://pacificorp.com/es/irp/irpcomments.html)
- IRP Email / Distribution List Contact Information:
  - [IRP@PacifiCorp.com](mailto:IRP@PacifiCorp.com)
- Upcoming Public Input Meeting Dates:
  - 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*