



2017
Integrated Resource Plan

Public Input Meeting 5

November 17, 2016

PHONE CONFERENCE ONLY

PACIFICORP
A BERKSHIRE HATHAWAY ENERGY COMPANY

Agenda

- Introductions
- Updated Capacity Contribution Study
- Official Forward Price Curve / Price Curve Scenarios
- Next Steps





2017 Integrated Resource Plan

Updated Capacity Contribution Study

Wind and Solar Capacity Contribution

- PacifiCorp has updated its wind and solar capacity contribution study for the 2017 IRP.

- The methodology is based on a National Renewable Energy Laboratory ("NREL") report on Effective Load Carrying Capability (ELCC) approximation methods.

- The methodology (the "CF Approximation Method") relies upon weighted hourly loss of load probability (LOLP) statistics based on the reliability model used in PacifiCorp's planning reserve margin study at the 13% planning reserve margin level.

- PacifiCorp has used the updated figures to develop its load and resource balance for the 2017 IRP and will adopt these assumptions when developing resource portfolios for the 2017 IRP.

CF Approximation Method

- 500-iteration hourly PaR run (based on the same reliability model used in the planning reserve margin study) is used as the basis for this analysis.

- Each hour's LOLP is calculated, with weighting factors calculated by dividing each hour's LOLP by the total LOLP in a 2020 study year.

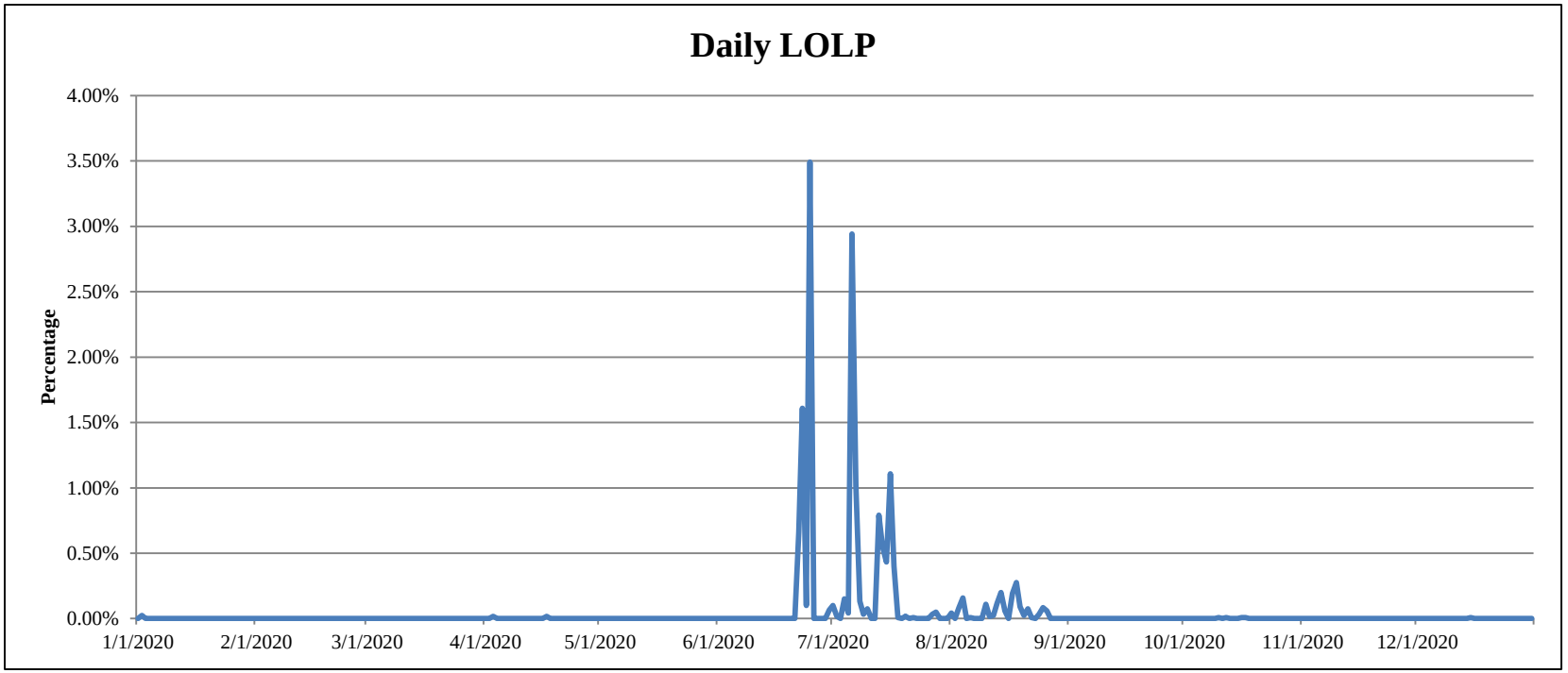
- The capacity contribution is calculated as the sum of hourly weighted capacity factors for each resource type:
  - East and West Wind (expected generation profiles)
  - Solar shapes align with updated project data
    - Solar shape strategy is now consistent with wind shape data source
    - Data used to model new wind and solar are based on existing wind and solar data provided by project developers

Capacity Contribution Results

	Wind			Solar PV					
	West	East	Average Wind	West, OR Fixed Tilt	East, UT Fixed Tilt	Average Fixed Tilt	West, OR Single Axis Tracking	East, UT Single Axis Tracking	Average Single Axis Tracking
2015 IRP (CF Approximation)	25.4%	14.5%	18.1%	32.2%	34.1%	33.1%	36.7%	39.1%	37.9%
2017 IRP Updated (CF Approximation)	12.9%	15.8%	14.6%	52.3%	36.6%	46.2%	63.6%	57.2%	58.5%

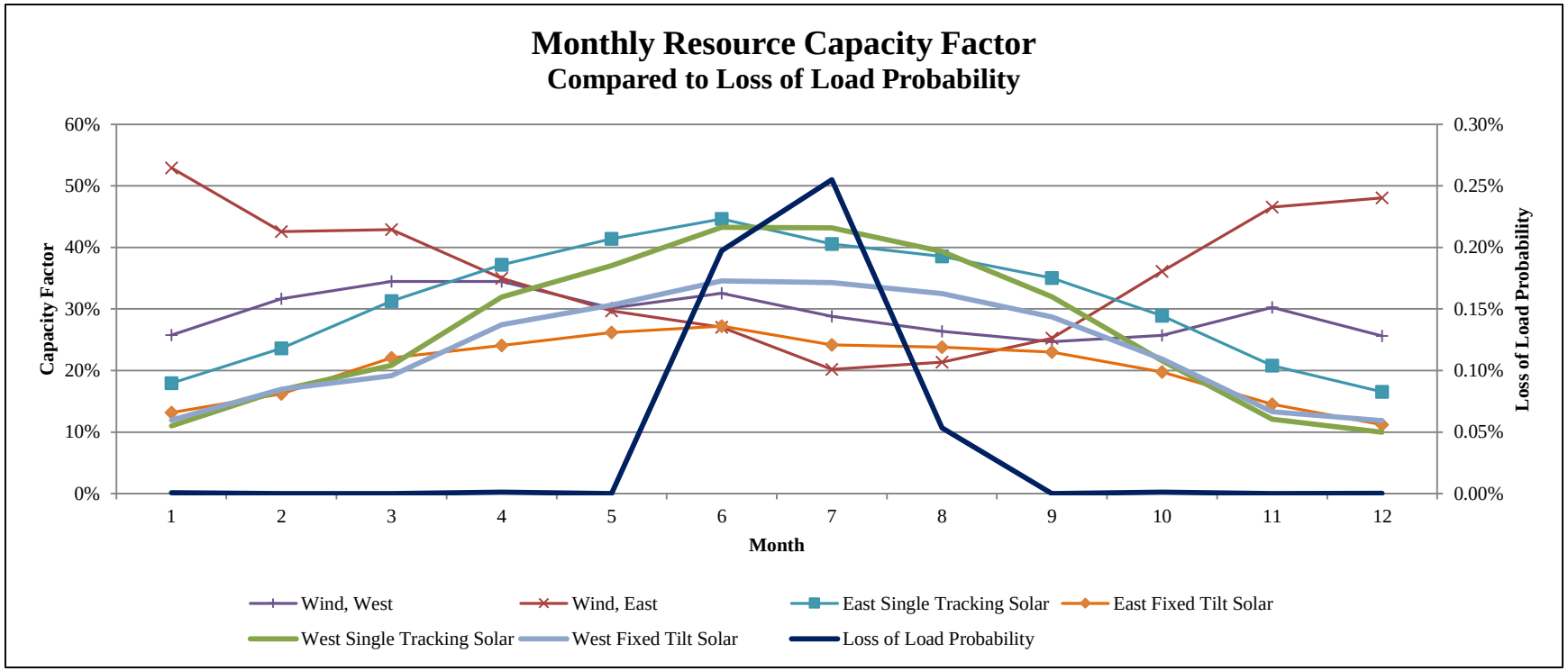
- The results of the capacity contribution study are driven by the coincidence of LOLP and resource shapes/capacity factors and location.
- The updated hourly LOLP distribution is focused in the summer period, which is the primary driver to changes in wind and solar capacity contribution values.
  - Solar capacity contribution values increase vs. 2015 due to seasonally higher coincidence of shape with LOLP distribution.
  - West wind capacity contribution values decrease vs. 2015 due to seasonally lower coincidence of shape with LOLP distribution.

2017 IRP LOLP



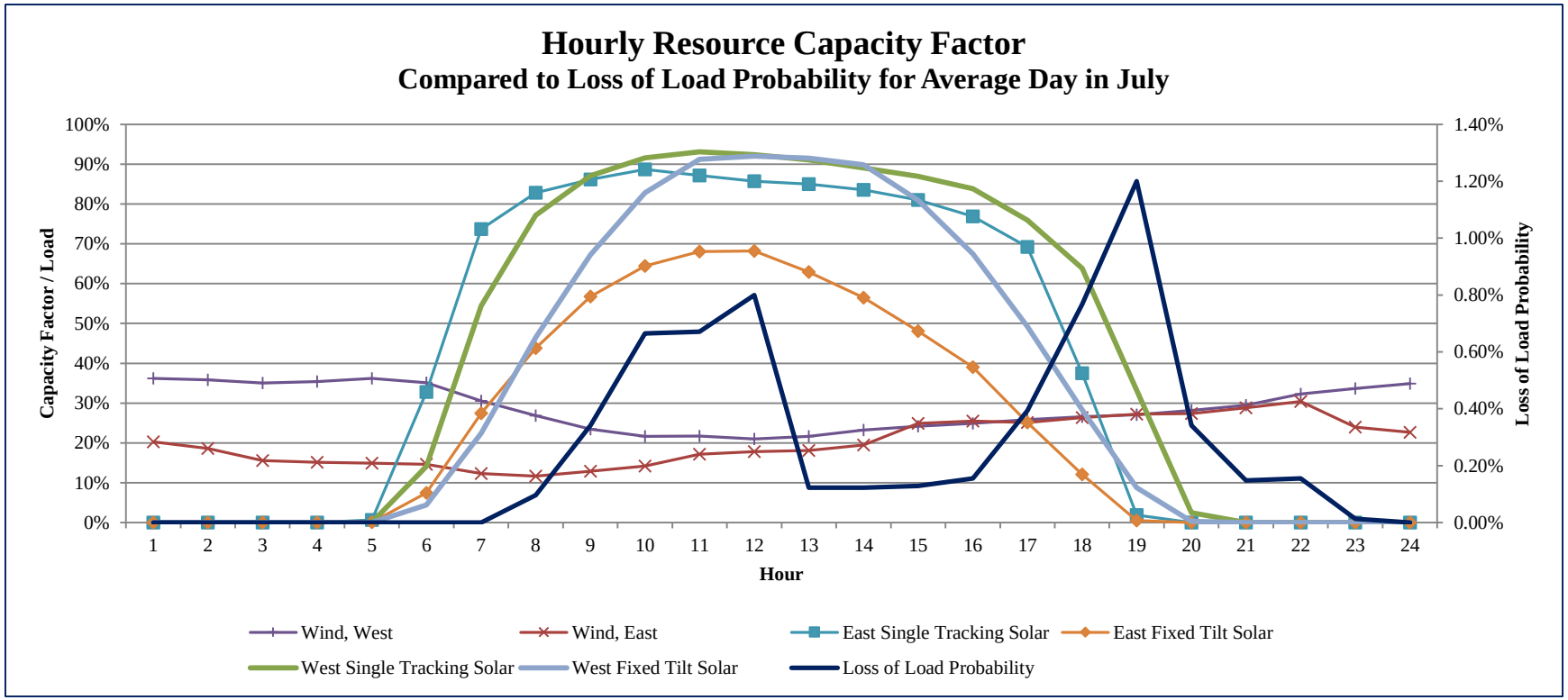
- The seasonal distribution of the 2017 IRP LOLP shows the highest loss of load probability in summer when load peaks in July.
- The difference in LOLP distribution is the main driver of the capacity contribution results.

2017 IRP LOLP & Capacity Factors



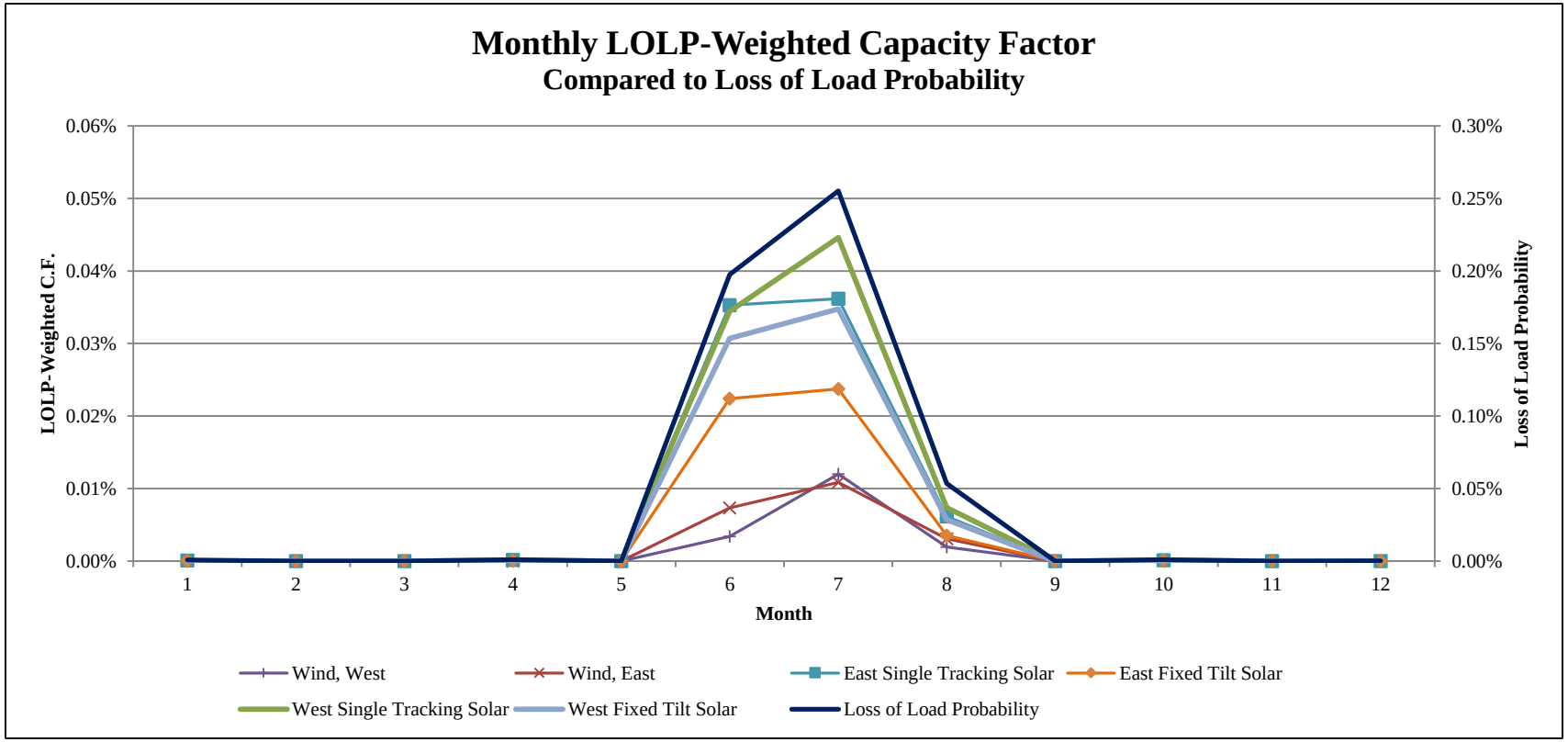
- The coincidence of the seasonal distribution of LOLP (highest in summer) and solar capacity factors increasing in summer drives the increase in solar capacity contribution.
- The coincidence of the seasonal distribution of LOLP (highest in summer) and wind capacity factors decreasing in summer drives the decrease in wind capacity contribution.

2017 IRP LOLP & Capacity Factors



- The hourly distribution of LOLP displays a high coincidence with solar capacity factors and low coincidence with wind capacity factors, contributing to higher solar capacity contribution and lower wind capacity contribution.
- Among July hours in the 2020 study year, LOLP events peak during morning and evening ramp periods.

2017 IRP LOLP & Capacity Factors



- Key metric – weighted capacity factors. The weighted capacity factors display the dominance of single tracking solar over fixed tilt solar, and of east wind over west wind.





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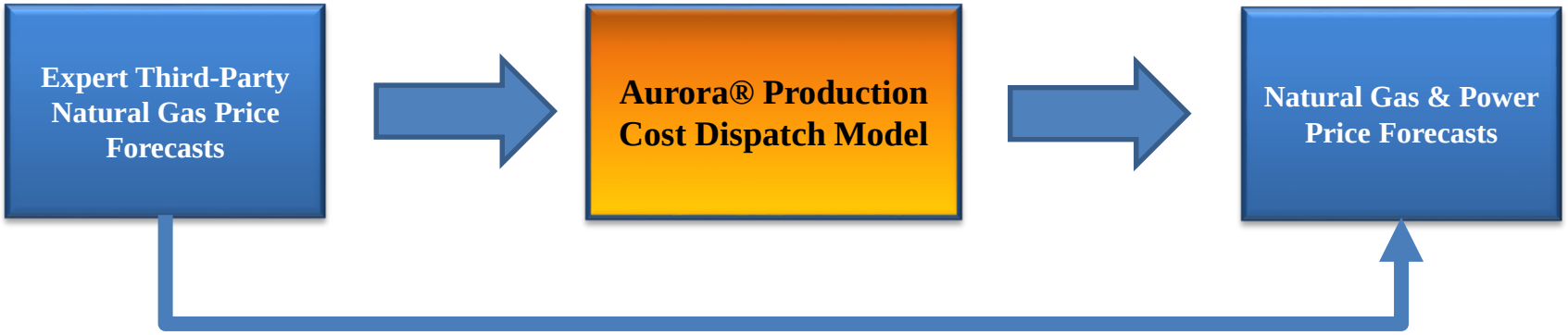
Official Forward Price Curve / Price Curve Scenarios

2017 IRP Price Scenarios – Modeling Convention



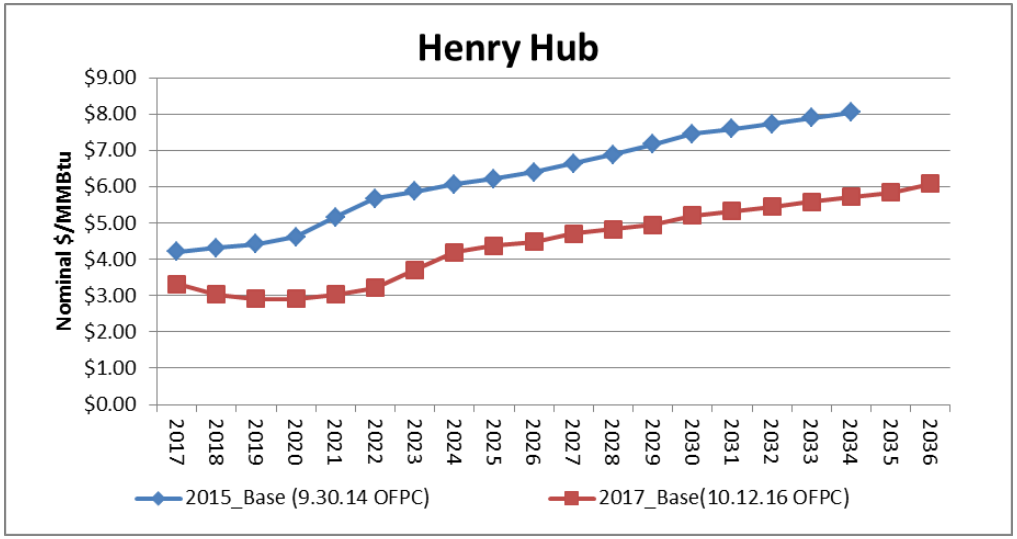
- Natural gas price forecasts based upon review of third-party expert projections.
- Natural gas prices are a key input to Aurora, a production cost dispatch model, which is used to generate a long-term wholesale power price forecast for each natural gas price scenario.
- Aurora is also configured with Clean Power Plan assumptions that align with scenarios developed for the 2017 IRP (CPP(a) and CPP(b)).
- The end result yields a unique and consistent set of natural gas price and wholesale power price scenarios for alternative CPP assumptions.

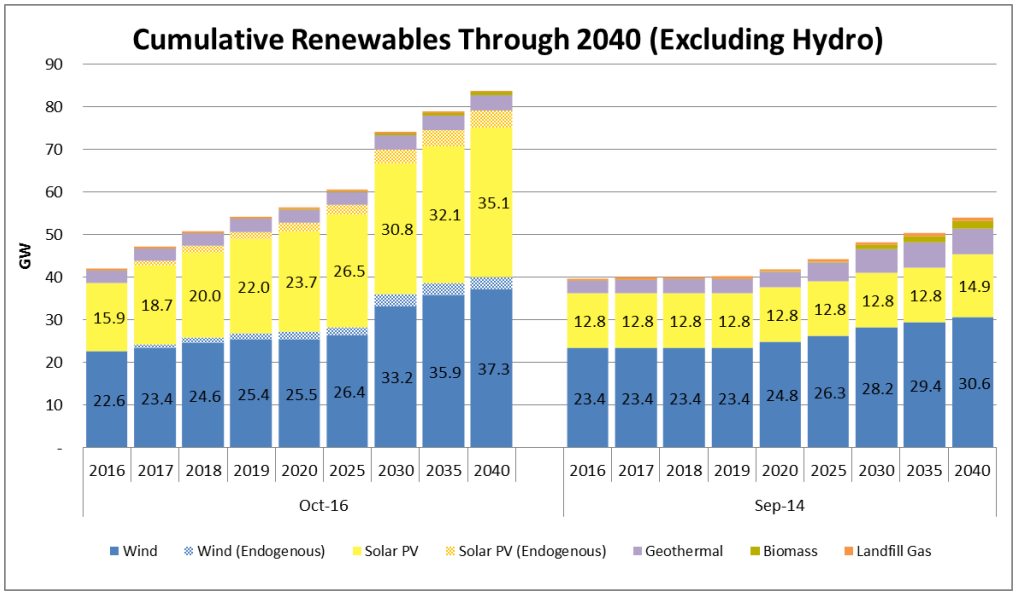
2017 IRP Price Scenarios

Scenario	Clean Power Plan (CPP) Case	CPP Attributes	Natural Gas	Power
10-2016 OFPC CPP(b) Base	U.S. WECC* Mass Cap B total allocation cap	New Source Complement included; generic combined cycles subject to constraint.	10-2016 OFPC (72-months market; 12-months blend; followed by base gas per Expert 2)	10-2016 OFPC (72-months market; 12-months blend; followed by fundamentals per Aurora®)
CPP(b) Low	U.S. WECC* Mass Cap B total allocation cap	New Source Complement included; generic combined cycles subject to constraint.	Low gas price per Expert 2	Fundamental price forecast per Aurora®
CPP(b) High	U.S. WECC* Mass Cap B total allocation cap	New Source Complement included; generic combined cycles subject to constraint.	Adjusted high gas price per Expert 2	Fundamental price forecast per Aurora®
CPP(a) Base	U.S. WECC* Mass Cap A total allocation cap	No New Source Complement; generic combined cycles not subject to constraint.	Base gas price per Expert 2	Fundamental price forecast per Aurora®
CPP(a) Low	U.S. WECC* Mass Cap A total allocation cap	No New Source Complement; generic combined cycles not subject to constraint	Low gas price per Expert 2	Fundamental price forecast per Aurora®
CPP(a) High	U.S. WECC* Mass Cap A total allocation cap	No New Source Complement; generic combined cycles not subject to constraint	Adjusted high gas price per Expert 2	Fundamental price forecast per Aurora®

OFPC – Official Forward Price Curve; * California is modeled using a CO_2 tax as a proxy for its cap-and-trade program established pursuant to the California Global Warming Solutions Act of 2006. As such, it is not modeled as being subject to the CPP limits.

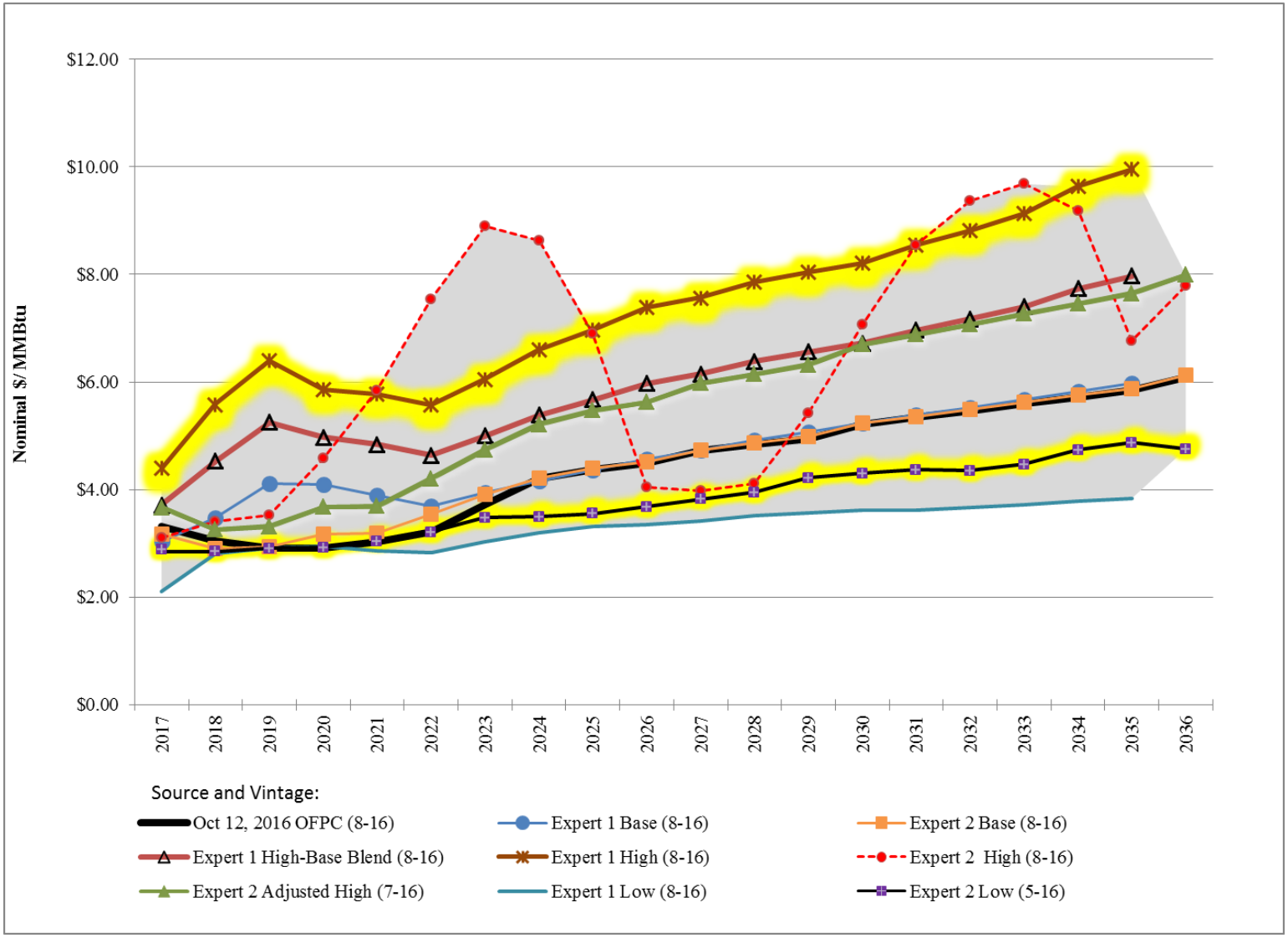
2017 IRP vs 2015 IRP : Key Changes to Natural Gas and Renewables



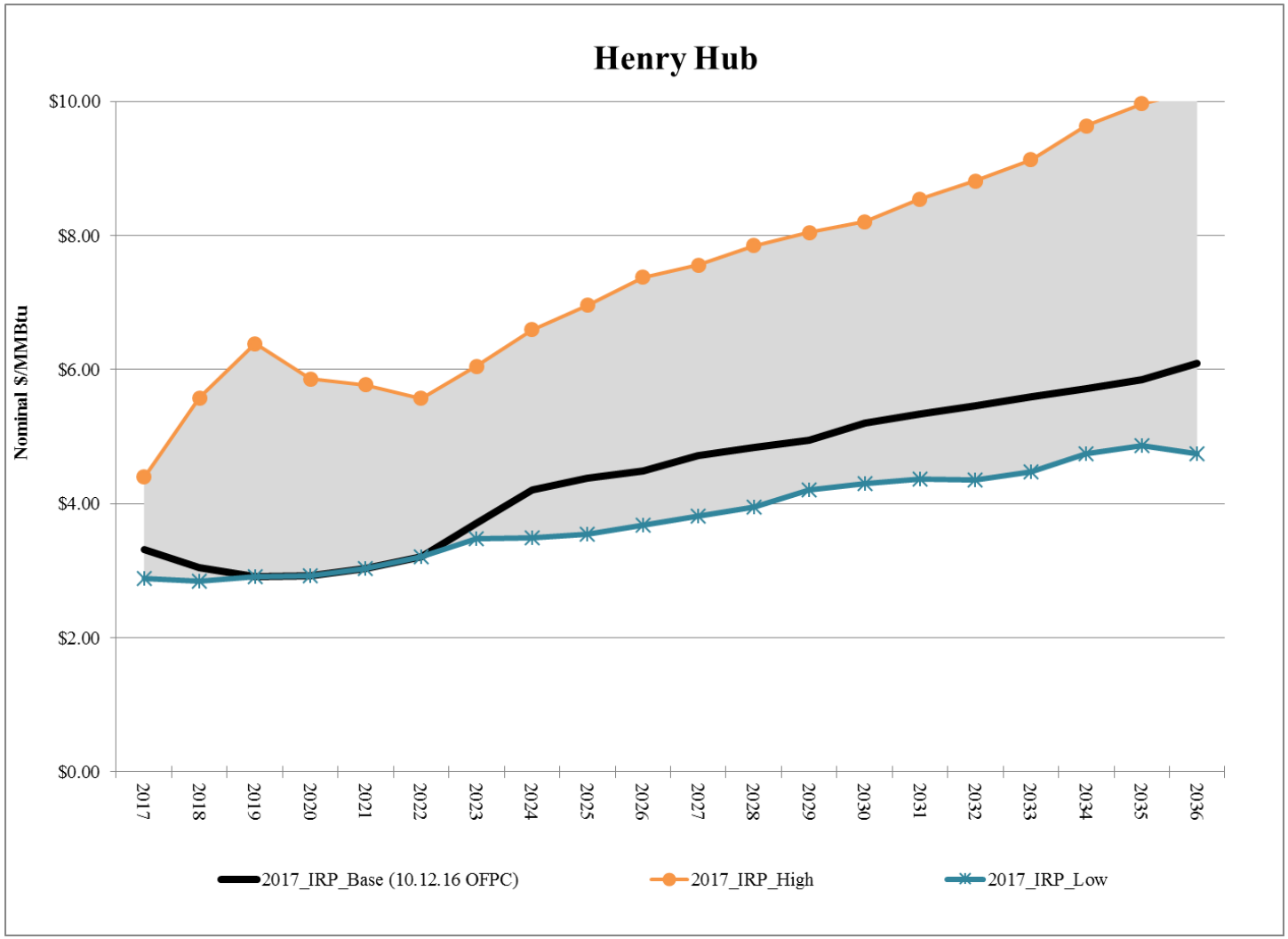


- The 2017_Base Henry Hub forecast is down more than 30% from that of the 2015_Base forecast. As a corollary, key western hub price forecasts are also down approximately 30%.
- Burgeoning supplies of low-cost Appalachian gas coupled with increased take-away capacity have displaced other (more expensive) North American supplies. Expected Appalachian production has increased by over 50% from those assumed in the 2015 IRP.
- Even with world call on U.S. supplies having increased since the 2015 IRP, the ever-flattening U.S. supply curve has more than offset demand.
- This long-term downward revision reflects the continued flattening of the supply curve from technological improvements as well as the potential for additional (price-inelastic) associated gas volumes.
- Pre-2020 is marked by surging LNG demand, industrial demand, and increased production and exports from Mexico. The start of a carbon tax in 2025 marks a generalized price increase for the length of the curve.
- Renewables have increased primarily due to the following, which are reflected in the October 2016 curve:
  - California Renewable Portfolio Standard increase from 33% to 50% by 2030
  - Oregon Renewable Portfolio Standard increase from 25% to 50% by 2040
  - Endogenous economic wind and solar builds

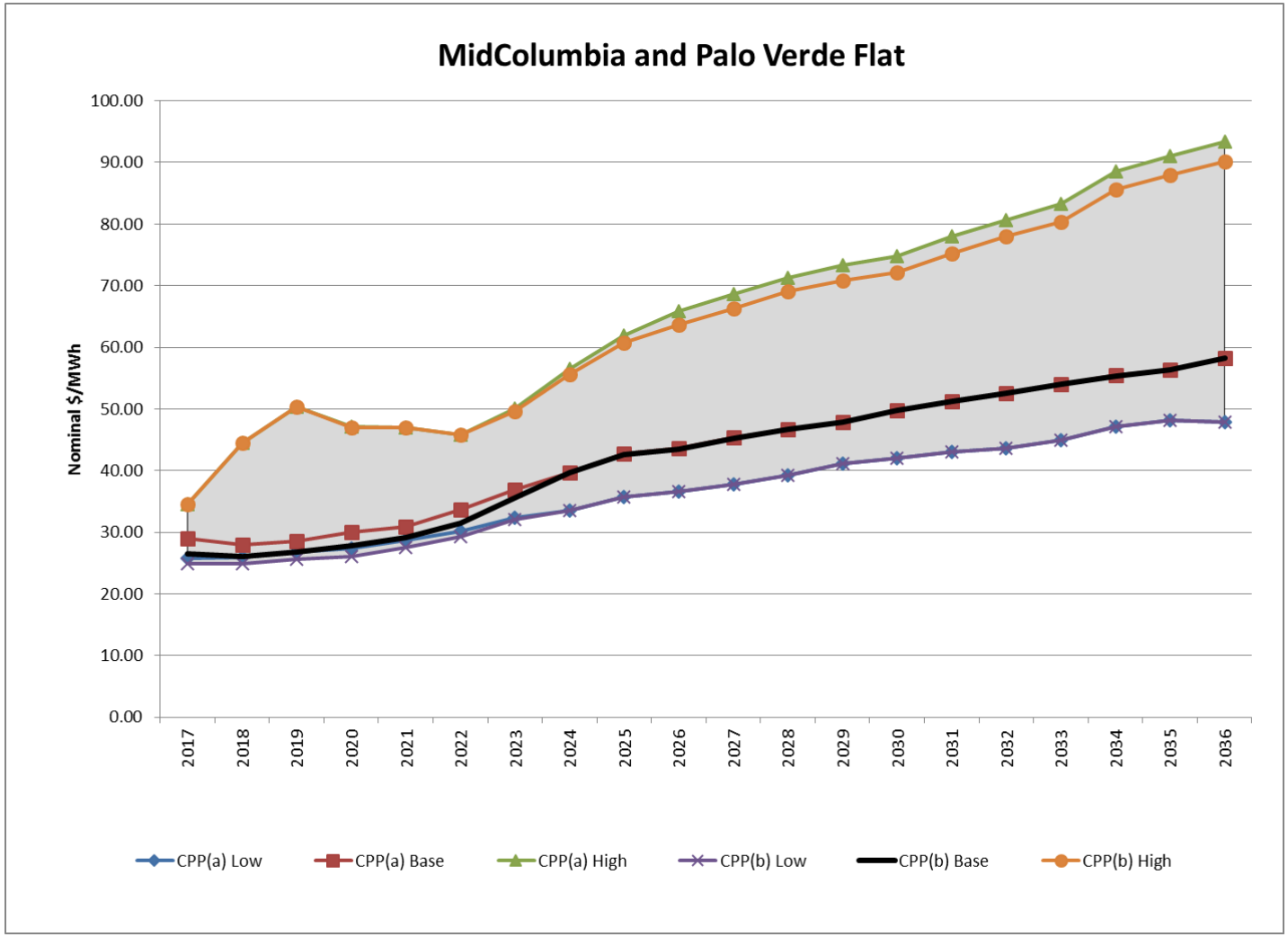
Expert Third-Party Natural Gas Price Forecasts



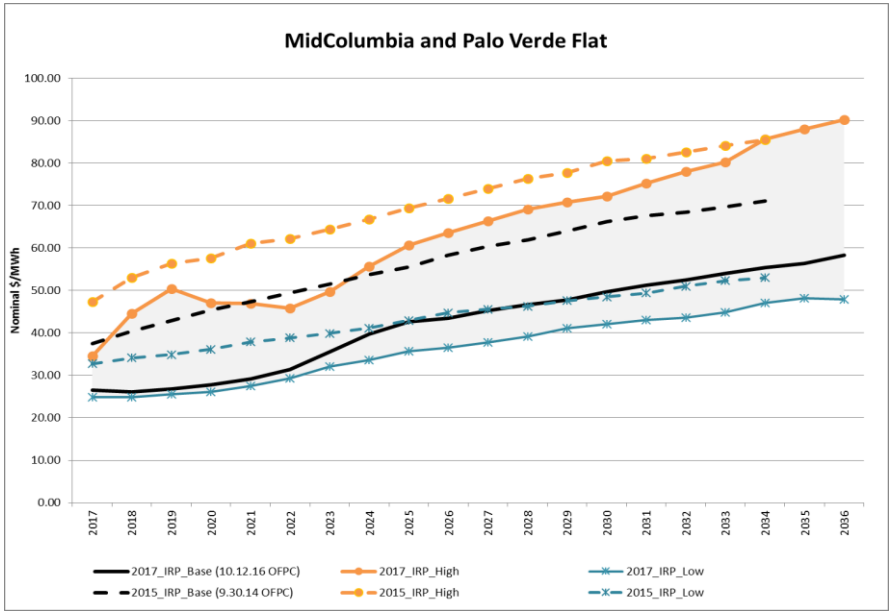
Results: Price Forecasts



Results: Price Forecasts



2017 IRP vs. 2015 IRP

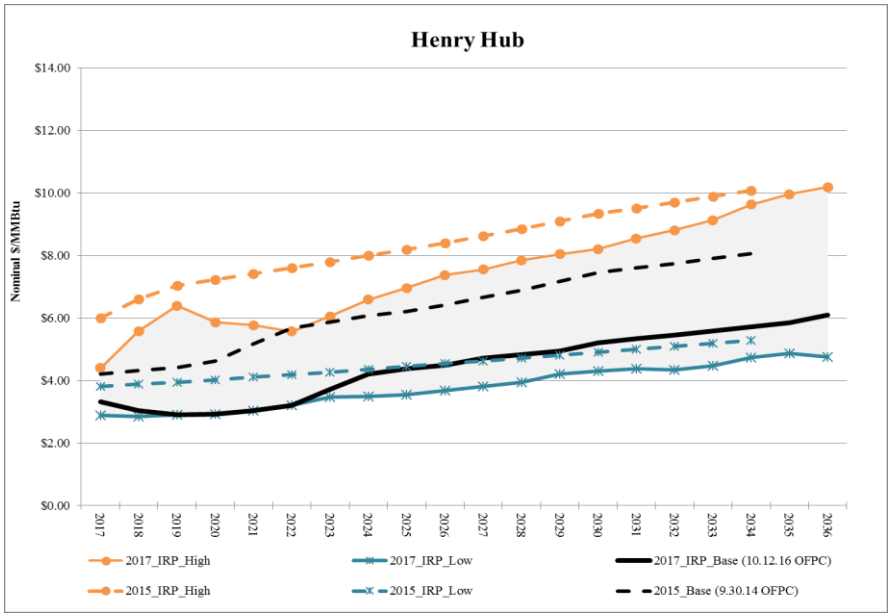


Vis-à-vis the 2015 IRP, Mid-Columbia and Palo Verde power prices are down the length of the curve:

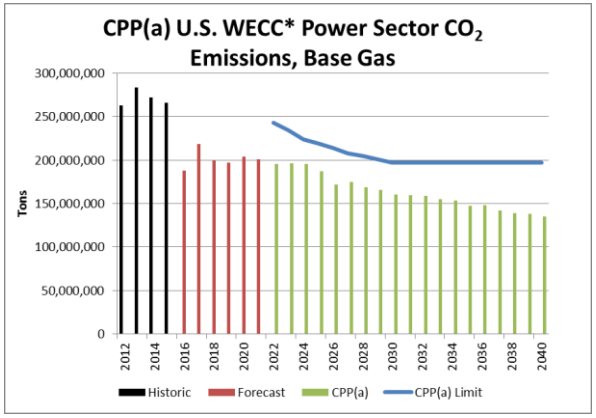
- ❑ Base Gas Power Prices decreased 29%
- ❑ High Gas Power Prices decreased 34%
- ❑ Low Gas Power Prices decreased 19%

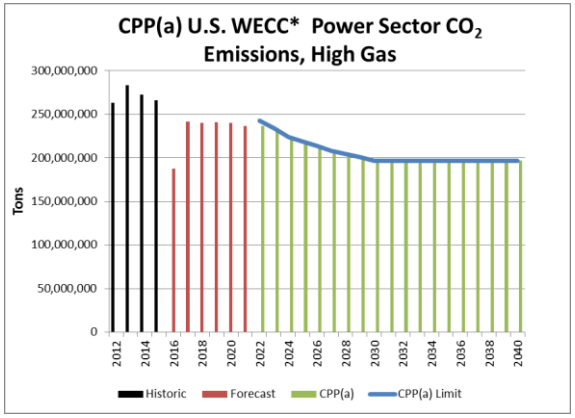
Vis-à-vis the 2015 IRP, Henry Hub prices are down the length of the curve:

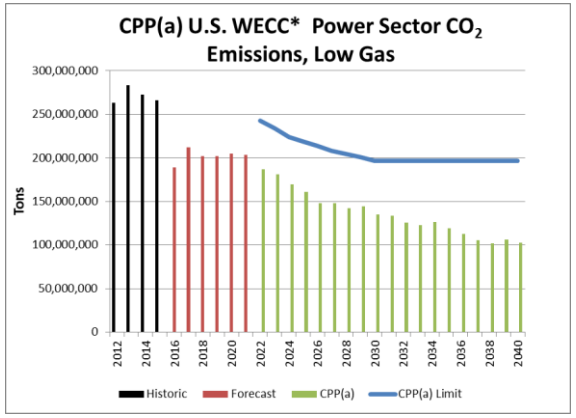
- ❑ Base Henry Hub Prices decreased 32%
- ❑ High Henry Hub Prices decreased 36%
- ❑ Low Henry Hub Prices decreased 19%

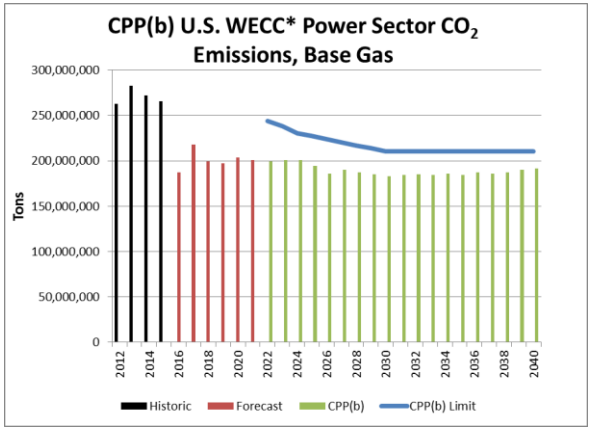


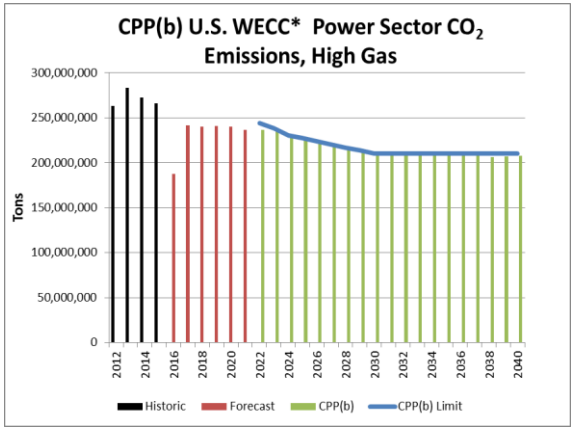
Results: U.S. WECC* CO_2 Emissions

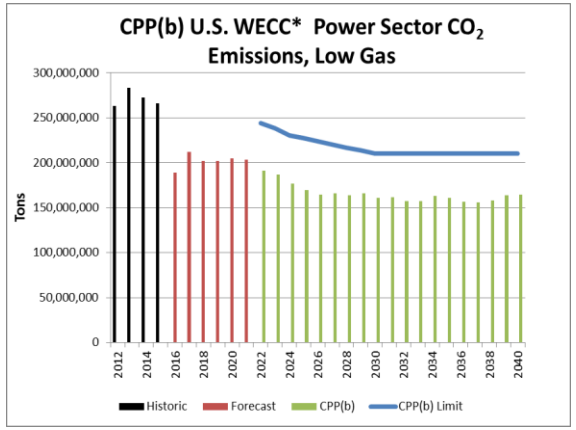












Note: Only the CPP(a) and CPP(b)-high gas scenarios produced shadow prices

* California emissions are not included in tons emitted or in CPP limits. California is modeled using a CO_2 tax as a proxy for the its cap-and-trade program established pursuant to the California Global Warming Solutions Act of 2006. As such, its emissions are subject to a more binding constraint than that of the CPP. Historic CO_2 emissions available through the Environmental Protection Agency Air Markets Program Data https://ampd.epa.gov/ampd





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Next Steps

Next Steps

- Next 2017 IRP Public Input Meeting
  - December 15-16, 2017
  - Topics:
    - Preliminary Volume III Studies and Portfolio Results (Dec 16)
      - Confidentiality Agreements to be provided in advance for signature (Oregon protective order filing)
    - Flexible Capacity Reserve Requirements Study
      - Solar reserve requirements
      - Wind and Solar Integration Cost Results

Additional Information

- Meeting presentation and materials:
  http://www.pacificorp.com/es/irp.html
- 2017 IRP Stakeholder Feedback Form:
  http://www.pacificorp.com/es/irp/irpcomments.html
- Email / distribution list contact information:
  - IRP@PacifiCorp.com

- Upcoming Public Input Meeting Dates:
  - December 15-16, 2016
  - January 26-27, 2017
  - February 23-24, 2017