# 2017 Integrated Resource Plan

Public Input Meeting 8 March 2-3, 2017





### Agenda

#### March 2 - Day One

- Introductions
- Draft Preferred Portfolio Overview
- Market Price Scenarios (Refresher)
- Lunch Break (1 hour) 11:30 PT/12:30 MT
- Regional Haze & Core Cases
- Sensitivity Cases (Time Permitting)

#### March 3 - Day Two

- Sensitivity Cases (Continued)
- Preferred Portfolio Selection Process
- Lunch Break (1 hour) 11:30 PT/12:30 MT
- Preferred Portfolio Selection Process (Continued)
- Next Steps/Wrap-up

# 2017 Integrated Resource Plan

#### Draft Preferred Portfolio Overview





## **Draft Preferred Portfolio Composition**

- In the first ten years of the planning horizon, PacifiCorp's incremental resource needs are met additional renewable resources, demand side management (DSM) resources, and front office transactions (FOTs).
- In the second ten years, there is an increased need for renewable resources, DSM, FOTs, and natural gas-fired generation to meet incremental load growth with assumed coal unit retirements.



# **Draft Preferred Portfolio Highlights**

#### **Renewable Energy**

- Repowering 905 MW of existing wind resources by the end of 2020 will provide production tax credit (PTC) benefits for ten years, increase energy production, and extend the asset life of these facilities, saving customers hundreds of millions of dollars.
- An additional 428 MW of incremental low-cost wind resources are added by the end of 2020, providing additional zero emission energy and PTC benefits for PacifiCorp's customers.
- By the end of the 20-year planning horizon, the portfolio includes 1,030 MW of new wind and 1,157 MW of new solar.

#### **Demand Side Management**

• Energy efficiency continues to play a key role in PacifiCorp's resource mix—over the front ten years of the planning horizon, accumulated acquisition of incremental energy efficiency resources meets 89% of forecasted load growth (up from 86% in the 2015 IRP).

#### **Front Office Transactions**

• Summer front office transactions average 673 MW over the four year action plan timeframe (down 27% from the 2015 IRP) and average 832 MW over the front ten years of the planning horizon (down 5% from the 2015 IRP).

#### **Existing Coal and New Natural Gas Resources**

- The resource mix reflects a cost-conscious transition that is increasingly less reliant on coal generation without major incremental emission control retrofits; focused on alternative compliance outcomes.
- Assumed coal unit retirements total 749 MW by 2025 and 3,649 MW by the end of 2036.
- The first new natural gas resource (436 MW CCCT) is added in 2029, one year later than in the 2015 IRP; 1,789 MW of new natural gas capacity is added by 2036 (1,389 of CCCT and 400 of SCCT).

# Wind Repowering

#### **Benefits of Wind Repowering**

- Projects capture an additional 10-years of production tax credits (PTCs) for the full output of each repowered facility—these savings are passed through to customers.
- Modern technology and longer blade lengths increase annual energy production by an estimated 14% to 32%, depending upon the project.
- Existing foundations and towers are utilized, resulting in minimal environmental impact and permitting requirements.



- New equipment reduces future operating costs.
- Project life extended 10-years.

#### **Repowering Overview**

- As recently reported in its 10K, PacifiCorp executed wind turbine generator (WTG) equipment purchases in December 2016 with General Electric and Vestas.
- These "Safe Harbor" equipment purchases support repowering of the Wyoming wind fleet (Glenrock, Rolling Hills, Seven Mile Hill, High Plains, McFadden Ridge, and Dunlap), the Marengo project in Washington, and the Leaning Juniper project in Oregon by the end of 2020, enabling the projects to qualify for 100% of PTCs.
- Other projects may be feasible (i.e., Foote Creek).
- Repowered WTGs must meet the Internal Revenue Service 80/20 test, meaning that the retrofitted WTG qualifies for PTCs if the fair market value of the retained property (i.e., tower and foundation) is no more than 20% of the facility's total value after installation of the new property (i.e., nacelle and blades).

### **Draft Preferred Portfolio: Renewables**

- In addition to repowered wind, the draft preferred portfolio includes 428 MW of new wind in 2021 (proxy for year-end 2020)—300 MW in Wyoming and 128 MW in Idaho.
- By 2036, new wind capacity totals 1,030 MW and new solar capacity totals 1,157 MW (357 MW in the west and 800 MW in the east).



# **Draft Preferred Portfolio: Energy Efficiency**

- Over the front ten years of the planning horizon, accumulated acquisition of incremental energy efficiency resources meets 89% of forecasted load growth (up from 86% in the 2015 IRP).
- Decreased selection of energy efficiency resources relative to the 2015 IRP is driven by reduced loads and reduced costs for resource alternatives (lower market prices and reduced renewable resource costs).
  - PacifiCorp has outperformed IRP DSM targets in recent years, acquiring cost-effective savings earlier than projected.
  - Cost effective lighting opportunities through 2026 have decreased by 30% relative to the 2015 IRP, reflecting
    increased LED adoption in the baseline and updated projections of LED efficacy improvements.
  - Measure-level acquisition rates were updated based on the Northwest Power and Conservation Council's 7<sup>th</sup> Power Plan.
  - Appliance recycling is no longer cost effective, reducing savings by approximately 20.5 aMW through 2026.



### **Draft Preferred Portfolio: Front Office Transactions**

- Through the first four years of the planning horizon, summer front office transactions (FOTs) average 673 MW, down by 27% relative to the 2015 IRP preferred portfolio.
- Across the front ten years of the planning horizon, summer FOTs average 832 MW, down by 5% relative to the 2015 IRP preferred portfolio.
- Summer FOT purchases are primarily in west side markets (MidC, COB, and NOB).
- East side summer FOTs, which are generally priced at a premium to markets in the west, do not appear in the preferred portfolio until 2026.



### **Draft Preferred Portfolio: Existing Coal Resources**

- 749 MW of existing coal-fired generation are assumed to have retired by the end of 2025; 3,649 MW of existing coal-fired generation is assumed to have retired by the end of the 20-year planning horizon.
- No incremental selective catalytic reduction (SCR) equipment is included in the preferred portfolio avoiding installation of this equipment will save customers hundreds of millions of dollars and retains compliance planning flexibility associated with EPA's currently litigated Clean Power Plan or other potential state/federal environmental policies.
- Individual Regional Haze unit outcomes will ultimately be determined by ongoing rulemaking, results of litigation, and future negotiations with state and federal agencies, partner plant owners, and other vested stakeholders—no individual unit commitments are being made at this time.

Coal Unit(s)	PacifiCorp Share of Capacity (MW)	Assumptions in the Draft Preferred Portfolio
Naughton 3	280	Assumed retirement at the end of 2018.
Cholla 4	387	Assumed retirement at the end of 2020.
Craig 1	82	Assumed retirement by the end of 2025.
Dave Johnston 1 – 4	762	Assumed end-of-life retirement by the end of 2027.
Jim Bridger 1	354	Assumed retirement by the end of 2028.
Naughton 1&2	357	Assumed end-of-life retirement by the end of 2029.
Hayden 1&2	77	Assumed end-of-life retirement by the end of 2030.
Jim Bridger 2	359	Assumed retirement by the end of 2032.
Craig 2	82	Assumed end-of-life retirement by the end of 2034.
Huntington 1	459	Assumed end-of-life retirement by the end of 2036.
Huntington 2	450	Assumed end-of-life retirement by the end of 2036.

### **Draft Preferred Portfolio: New Natural Gas Resources**

- The first natural gas resource, a west-side 436 MW G-class 1x1 combined cycle combustion turbine (CCCT) plant, appears in 2029, which coincides with the assumed retirement of the Jim Bridger 1 plant at the end of 2028.
  - One year later than the 2028 combined cycle resource in the 2015 IRP preferred portfolio.
- With assumed resource retirement over the long-term, additional natural gas resources are included in the out-years of the planning horizon.
  - 477 MW east-side CCCT in 2030.
  - 400 MW east-side SCCT in 2033.
  - 477 MW east-side CCCT in 2036.
- With reduced loads and incremental renewable resources, there are 1,062 fewer MW of new natural gas resources relative to the 2015 IRP preferred portfolio.
- Natural gas resources are added to the portfolio over the long-term; PacifiCorp will continue to evaluate potential long-term supply alternatives, including energy storage, through its on-going resource planning efforts.

# 2017 Integrated Resource Plan

#### **Market Price Scenario**

Refresher





### **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 <sup>®</sup>
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 <sup>®</sup>
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 <sup>®</sup>
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 <sup>®</sup>
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 <sup>®</sup>

OFPC – Official Forward Price Curve; \* California is modeled using a CO<sub>2</sub> tax as a proxy for its cap-and-trade program established in accordance with the California Global Warming Solutions Act of 2006. As such, it is not modeled as being subject to the CPP limits.

### **Henry Hub Natural Gas Prices**



# **CO<sub>2</sub> Shadow Prices**



- Shadow prices under Mass Cap B persist longer because the emissions cap includes new CCCT resources.
- Annual prices are influenced by timing of coal unit retirements (prices fall with assumed retirement of Jim Bridger 1 at the end of 2028).
- Overall, higher gas prices, which increases coal dispatch, produce higher CO<sub>2</sub> shadow prices.

# 2017 Integrated Resource Plan

#### **Regional Haze Sensitivities**





# **Regional Haze Cases**

Dlant	2015 IRP Update	2017 IRP	2017 IRP	2017 IRP				
Fidin	(Pref. Port.)	(Ref. Case)	(Alt. Case RH-1)	(Alt. Case RH-2)	(Alt. Case RH-3)	(Alt. Case RH-4)	(Alt. Case RH-5)	(Alt. Case RH-6)
Hunter 1	SCR 2021	SCR 2021	No SCR;NO <sub>X</sub> + 2021	No SCR	No SCR;NO <sub>X</sub> + 2026	SCR 2021 <sup>(1)</sup>	RH_1	SCR 8/4/2021
inditier 1	Ret. 2042	Ret. 2042	Ret. 2042	Ret. 2031	Ret. 2042	Ret. 2042	NII-T	Ret. 7/31/2021
Huntor 2	No SCR	SCR 2021	No SCR;NO <sub>X</sub> + 2021	No SCR	No SCR;NO <sub>X</sub> + 2027	No SCR;NO <sub>X</sub> + 2027 <sup>(1)</sup>	DU 1	SCR 8/4/2021
Hunter 2	Ret. 2032	Ret. 2042	Ret. 2042	Ret. 2031	Ret. 2042	Ret. 2042	KU-1	Ret. 7/31/2021
Huntington 1	SCR 2022	SCR 2021	No SCR	No SCR	No SCR;NO <sub>X</sub> + 2026	SCR 2021 <sup>(2)</sup>	DU 1	SCR 8/4/2021
Huntington 1	Ret. 2036	Ret. 2036	Ret. 2036	Ret. 2036	Ret. 2036	Ret. 2036	K11-1	Ret. 7/31/2021
Huntington 2	No SCR	SCR 2021	No SCR	No SCR	No SCR;NO <sub>X</sub> + 2027	No SCR;NO <sub>X</sub> + 2027 <sup>(2)</sup>	DU 1	SCR 8/4/2021
	Ret. 2029	Ret. 2036	K11-1	Ret. 7/31/2021				
it is positive a	SCR 2022	SCR 2022	No SCR	No SCR	No SCR	No SCR;NO <sub>X</sub> + 2022 <sup>(1)</sup>	рц р	SCR 12/31/2022
JIII BHUgel I	Ret. 2037	Ret. 2037	Ret. 2032	Ret. 2024	Ret. 2028	Ret. 2032	NI1-2	Ret. 12/30/2022
lim Bridgor 2	SCR 2021	SCR 2021	No SCR	No SCR	No SCR	SCR 2021 <sup>(1)</sup>	рц р	SCR 12/31/2021
Jill Bluger 2	Ret. 2037	Ret. 2037	Ret. 2035	Ret. 2028	Ret. 2032	Ret. 2037	NI1-2	Ret. 12/30/2021
Noughton 2	No Gas Conv.	Gas Conv. 2019 <sup>(3)</sup>	No Gas Conv.	Gas Conv. 2019 <sup>(3)</sup>	No Gas Conv.	Gas Conv. 2019 <sup>(3)</sup>	ר חם	No Gas Conv.
Naughton 5	Ret. 2017	Ret. 2029	Ret. 2017	Ret. 2029	Ret. 2017	Ret. 2029	N11-2	Ret. 2017
Cholla 4	Gas Conv. 2025	Gas Conv. 2025	No Gas Conv.	No Gas Conv.	No Gas Conv.	No Gas Conv.	RH_2	No Gas Conv.
	Ret. 2042	Ret. 2042	Ret. Apr-2025	Ret. 2020	Ret. Apr-2025	Ret. Apr-2025	NT-2	Ret. Apr-2025
Craig 1	SCR 2021	No SCR	No SCR	Gas Conv. 2023 <sup>(4)</sup>	No SCR	No SCR	RH_1	No SCR
	Ret. 2034	Ret. 2025	Ret. 2025	Ret. 2034	Ret. 2025	Ret. 2025	N11-T	Ret. 2025

### **Regional Haze Case (Footnotes)**

- 1) The Alternative Regional Haze Cases for Hunter units 1 and 2 and Jim Bridger units 1 and 2 have been developed for analysis purposes only with consideration given to the fact that the emissions profiles for the units are effectively identical in the Regional Haze context. The compliance actions in this scenario could effectively be swapped and provide the same Regional Haze compliance outcome. The matrix presentation of different compliance actions between the units is necessary for analysis data preparation, but does not dictate or represent pre-determined individual partner plant owner strategies or preferences or individual unit strategies or preferences.
- 2) The Alternative Regional Haze Cases for Huntington 1 and 2 have been developed for analysis purposes only with consideration given to the fact that the emissions profiles for the units are effectively identical in the Regional Haze context. The compliance actions for the units in this scenario could effectively be swapped and provide the same Regional Haze compliance outcome. The matrix presentation of different compliance actions between the units is necessary for analysis data preparation, but does not dictate or represent pre-determined individual unit strategies or preferences.
- 3) Naughton 3 will cease coal fueled operation by year-end 2017, under this scenario.
- 4) Craig 1 will cease coal fueled operation by end of August 2023, under this scenario.

### **Regional Haze Case 6**

- Regional Haze Case 6 allows endogenous retirements, in response to stakeholder feedback from the August 25-26, 2016 public input meeting and subsequent September 22-23, 2016 presentation.
- The endogenous retirement case allows System Optimizer to choose early retirement or Selective Catalytic Reduction (SCR) installation as a compliance outcome. (In contrast, Regional Haze Cases 1-5 represent a range of emission control installation costs and early retirement strategies applied as fixed inputs to the System Optimizer model.)
- In Regional Haze Case 6, operating cost impacts of early retirement alternatives are approximated for the following coal units: Hunter 1, Hunter 2, Huntington 1, Huntington 2, Jim Bridger 1, and Jim Bridger 2.
- Approximated cost impacts assume that early retirement, if chosen by System Optimizer, occurs at the end of the month prior to the month SCR equipment would otherwise be installed.

### **Regional Haze Sensitivity: RH-2a**

- In response to stakeholder feedback, Case RH-2a examines the impact of a Naughton 3 retirement yearend 2017 and a Craig 1 retirement year-end 2025 as an alternative to Case RH-2.
- As compared to case RH-2, system costs are reduced when Naughton 3 and Craig 1 are assumed to retire instead of converting to natural gas.
- However, these cost savings do not surpass the system cost benefits from Case RH-5.
- These results do not support modifying Regional Haze compliance assumptions.





### **Regional Haze Sensitivity: RH-5a**

- Case RH-5a assumes Naughton 3 continues to operate as a coal-fired facility through the end of 2018 and then is retired.
- Case RH-5a is a variant of Case RH-5, where Naughton 3 was assumed to cease coal-fired operation in 2017, convert to natural gas in 2019, and retire at the end of 2029.
- System costs are reduced in all scenarios; cost reductions are most significant with high natural gas price assumptions.
- Based on these results, PacifiCorp has adopted Regional Haze compliance assumptions from Case RH-5a for use in subsequent core case and sensitivity case studies being considered for the preferred portfolio.





# 2017 Integrated Resource Plan

**Core Cases** 





### **Core Cases: Summary**

Resource Class	Case 1 (OP-NT3)	Case 2 (FR-1)	Case 3 (FR-2)	Case 4 (RE-1a)	Case 4 (RE-1b)	Case 4 (RE-1c)	Case 5 (RE-2)	Case 6 (DLC-1)
Flexible Resources	Optimized	10% of Incremental L&R Balance	20% of Incremental L&R Balance	Optimized	Optimized	Optimized	Optimized	Optimized
Renewable Resources	Optimized	Optimized	Optimized	Just-in-Time Physical RPS Compliance (OR)	Just-in-Time Physical RPS Compliance (WA)	Just-in-Time Physical RPS Compliance (OR and WA)	Early Physical RPS Compliance (OR)	Just-in-Time Physical RPS Compliance (OR and WA)
Class 1 DSM Resources	Optimized	Optimized	Optimized	Optimized	Optimized	Optimized	Optimized	5% of Incremental L&R Balance
All Other Resources	Optimized	Optimized	Optimized	Optimized	Optimized	Optimized	Optimized	Optimized

OP=Optimized FR=Flexible Resources RE=Renewables DLC=Direct Load Control

- Note, Case OP-NT3 is identical to Case RH-5a.
- Case 4 is split into three steps (Cases RE-1a, RE-1b, and RE-1c) to isolate impacts on system cost independently for incremental Oregon and Washington RPS resources.
- Washington RPS banking restrictions make it infeasible to pursue early physical compliance, so early physical compliance under Case RE-2 only applies to Oregon.
- Based on draft results for cases FR-1 and FR-2 (presented at the January public input meeting), flexible resources are optimized for Cases RE-1a, RE-1b, RE-1c, and RE-2.

### **Core Cases: Descriptions**

- Case 1: Optimized Portfolio (OP-NT3)
  - Optimal regional haze case selected as Core Case 1 (which includes enhancements of full PTC value and Naughton 3 retirement). All resources optimized (selected endogenously by System Optimizer), and valued in the Planning and Risk model.
  - Consistent with the approach used in prior IRPs
- Case 2: Flexible Resources (FR-1)
  - A new fast ramp resource is added to Core Case 1 in the first year (2021)
  - Added capacity is at least 10% of the system L&R need (578 MW).
  - Fast-ramp resources available for selection include: SCCT Aero (i.e., LM6000); Intercooled SCCT Aero (i.e., LMS100); IC Reciprocating Engines; pumped storage, compressed air energy storage, and battery storage.
- Case 3: Flexible Resources (FR-2)
  - A new fast ramp resource is added to Core Case 1 in the first year (2021)
  - Added capacity is at least 20% of the system L&R need (1,157 MW).
  - Fast-ramp resources available for selection include: SCCT Aero (i.e., LM6000); Intercooled SCCT Aero (i.e., LMS100); IC Reciprocating Engines; pumped storage, compressed air energy storage, and battery storage.

# **Core Cases: Descriptions (Cont'd)**

- Case 4: Renewable Energy (RE-1)
  - Endogenous renewables from Core Case 1 are retained.
  - Additional renewables are added to physically comply with Oregon and Washington RPS:
    - RE1a Oregon
    - RE1b Washington (West Control Area renewable resources only)
    - RE1c Oregon and Washington
  - Additions are made beginning the first year in which there is a projected compliance shortfall (just-in-time compliance)
- Case 5: Renewable Energy (RE-2)
  - Endogenous renewables from Core Case 1 are retained.
  - Additional renewables are added to physically comply with projected Oregon RPS beginning 2021 (proxy for year-end 2020) to meet requirements throughout the planning period (early compliance).
- Case 6: Direct Load Control (DLC-1)
  - Additional Direct Load Control (DLC) is added to Core Case 1 in the first year (2021).
  - Added DLC capacity is at least 5% of the system L&R need (289 MW)
  - Renewable resource assumptions as in Core Case 4 (RE-1c)

### **Core Cases: System Optimizer PVRR**



- System Optimizer (SO) provides a least-cost resource portfolio optimization, enforcing emissions limits and providing the associated shadow price (\$/ton cost of meeting the assumed emission limit).
- While preferred portfolio selection considers Planning and Risk (PaR) measures, SO results provide an additional indicator and support for the subsequent PaR stochastic results.
- Among all of the core cases studied in SO, Case OP-NT3 reports the lowest PVRR.
- Flexible resource cases (Cases FR-1 and FR-2) report the highest PVRRs.

### **Core Cases: OP-NT3 and FR-1 Resource Portfolios**



- 450 MW of renewables added in 2021, rising to 2,761 MW by 2036.
- 200 MW of gas peaking resource is added in 2030, rising to 400 MW by 2032; 509 MW of CCCT capacity is added in 2029, rising to 985 MW by 2036.
- FOTs average 1,155 MW through 2025, and 1,939 MW beyond 2025 (includes Winter).
- 1,146 MW of incremental DSM by 2025, rising to 2,476 MW by 2036.



- 450 MW of renewables added in 2021, rising to 3,109 MW by 2036.
- 575 MW of gas peaking resource is added in 2021, rising to 774 MW by 2036; 477 MW of CCCT capacity is added in 2033.
- FOTs average 863 MW through 2025, and 1,808 MW beyond 2025 (includes Winter).
- 1,124 MW of incremental DSM by 2025, rising to 2,454 MW by 2036.

### **Core Cases: FR-2 and RE-1a Resource Portfolios**



- 346 MW of renewables added in 2021, rising to 2,237 MW by 2036.
- 1,149 MW of gas peaking resource is added in 2021, rising to 1,349 MW by 2030; 477 MW of CCCT capacity is added in 2033.
- FOTs average 552 MW through 2025, and 1,319 MW beyond 2025 (includes Winter).
- 1,075 MW of incremental DSM by 2025, rising to 2,251 MW by 2036.



- 451 MW of renewables added in 2021, rising to 3,896 MW by 2036.
- 382 MW of gas peaking resource is added in 2033; 477 MW of CCCT capacity is added in 2029.
- FOTs average 1,155 MW through 2025, and 1,963 MW beyond 2025 (includes Winter).
- 1,146 MW of incremental DSM by 2025, rising to 2,476 MW by 2036.

### **Core Cases: RE-1b and RE-1c Resource Portfolios**



- 530 MW of renewables added in 2021, rising to 3,055 MW by 2036.
- 200 MW of gas peaking resource is added in 2032, rising to 400 MW by 2036; 436 MW of CCCT capacity is added in 2029, rising to 913 MW by 2036.
- FOTs average 1,145 MW through 2025, and 1,839 MW beyond 2025 (includes Winter).
- 1,146 MW of incremental DSM by 2025, rising to 2,426 MW by 2036



- 531 MW of renewables added in 2021, rising to 3,631 MW by 2036.
- 200 MW of gas peaking resource is added in 2030, rising to 382 MW by 2036; 477 MW of CCCT capacity is added in 2029, rising to 913 mw BY 2036.
- FOTs average 1,145 MW through 2025, and 1,882 MW beyond 2025 (includes Winter).
- 1,146 MW of incremental DSM by 2025, rising to 2,476 MW by 2036

### **Core Cases: RE-2 and DLC-1 Resource Portfolios**



- 746 MW of renewables added in 2021, rising to 3,121 MW by 2036.
- 200 MW of gas peaking resource is added in 2030, rising to 400 MW by 2033; 436 MW of CCCT capacity is added in 2029, rising to 913 MW by 2036.
- FOTs average 1,118 MW through 2025, and 1,884 MW beyond 2025 (includes Winter).
- 1,146 MW of incremental DSM by 2025, rising to 2,473 MW by 2036



- 531 MW of renewables added in 2021, rising to 3,843 MW by 2036.
- 200 MW of gas peaking resource is added in 2030, rising to 321 MW by 2036; 477 MW of CCCT capacity is added in 2033.
- FOTs average 984 MW through 2025, and 1,961 MW beyond 2025 (includes Winter).
- 289 MW load control in 2021, 1,435 MW of incremental DSM by 2025, rising to 2,520 MW by 2036

### **Core Cases: Case RE-1a OR RPS Renewables**



- Just-in-time compliance for the Oregon RPS requires approximately 355 MW of additional renewable resources beginning 2030, rising to approximately 1,135 MW by 2036.
- The majority of the projects are located in the west; however there is approximately 200 MW of Wyoming wind added in 2031.



### **Core Cases: Case RE-1b WA RPS Renewables**



- Just-in-time compliance for the Washington RPS requires approximately 80 MW of additional renewable resources beginning 2021, rising to approximately 294 MW by 2033.
- All projects are located in the west; longer-term, west side solar resources are needed to hit current RPS targets.



### **Core Cases: Case RE-1c OR & WA RPS Renewables**



- Just-in-time compliance for the Oregon and Washington RPS requires approximately 80 MW of additional renewable resources beginning 2021, rising to approximately 870 MW by 2036.
- A higher proportion of wind vs. solar relative to Case RE-1a requires fewer overall MW to achieve Oregon RPS targets.



### **Core Cases: Case RE-2 OR RPS Renewables**



- Early compliance for the Oregon RPS requires approximately 296 MW of additional west wind beginning 2021, with incremental west solar needed beginning 2028.
- Earlier acquisition defers incremental renewable resource needs due to banking flexibility, which lowers overall renewables through the IRP planning horizon relative to Case RE-1a.



# 2017 Integrated Resource Plan

### Sensitivities Considered for Preferred Portfolio Selection





### **Sensitivity Case Assumption Overview**

#### Sensitivities Considered for Preferred Portfolio Selection

Sensitivity	Benchmark	Load	Private Gen	ivate Gen CO <sub>2</sub> Policy		Gateway
Wind Repower	OP-NT3	Base	Base	Mass Cap B	Base	None
Gateway 1	OP-NT3	Base	Base	Mass Cap B	Base	Segment D
Gateway 2	OP-NT3	Base	Base	Mass Cap B	Base	Segment F
Gateway 3	OP-NT3	Base	Base	Mass Cap B	Base	Segment D&F
Gateway 4	OP-NT3	Base	Base	Mass Cap B	Base	Segment D2
Gateway 4 & Repower	OP-NT3	Base	Base	Mass Cap B	Base	Segment D2
Energy Storage*	OP-NT3	Base	Base	Mass Cap B	Base	None

\*Not yet completed. To be evaluated in the March 31, 2017 filing.

## Sensitivity: Wind Repower (OP-REP)

- This sensitivity assumes 905 MW of existing wind resources are repowered by the end of 2020 (Glenrock, Rolling Hills, Seven Mile Hill, High Plains, McFadden Ridge, Dunlap, Marengo, and Leaning Juniper).
- The repowering projects provides significant customer benefits among all market price and Clean Power Plan scenarios.
- The 20-year planning horizon used for the IRP is insufficient to capture the incremental wind generation associated with the extended life of the repowered wind facilities.
  - Incremental annual energy production is in excess of 500 GWh over the existing life of the wind projects.
  - Incremental annual energy production beyond the current existing life exceeds 3,100 GWh.
- Capturing the benefits of the extended life by capturing costs and benefits through 2050 increases the present value of net customer benefits significantly.

PVRR(d) Cost/(Benefit) (\$ million)	SO	PaR Stochastic Mean							
	Mass B		Mass A		Mass B				
	Med Gas	Low Gas	Med Gas	High Gas	Low Gas	Med Gas	High Gas		
Change from OP-NT3 (2036)	(\$66)	(\$51)	(\$66)	(\$152)	(\$48)	(\$64)	(\$143)		
Change from OP-NT3 (2050)	(\$412)	(\$340)	(\$387)	(\$639)	(\$333)	(\$381)	(\$609)		



## Sensitivity: Energy Gateway 1 (GW1)



- Energy Gateway 1 includes segment D -Windstar to Anticline (assumed inservice 2022).
- In addition to the 300 MW of Wyoming wind in Case OP-NT3, the additional transmission enables 440 MW of Wyoming wind additions in 2022.
- The PVRR results indicate an overall increase to system costs, with improving benefits under high natural gas price assumptions.

	SO	PaR Stochastic Mean						
PVRR(d) Cost/(Benefit) (\$ million)	Mass B		Mass A		Mass B			
	Med Gas	Low Gas	Med Gas	High Gas	Low Gas	Med Gas	High Gas	
Change from OP-NT3	\$541	\$560	\$483	\$125	\$559	\$479	\$124	



## Sensitivity: Energy Gateway 2 (GW2)



	SO	PaR Stochastic Mean						
PVRR(d) Cost/(Benefit) (\$ million)	Mass B	Mass A			Mass B			
	Med Gas	Low Gas	Med Gas	High Gas	Low Gas	Med Gas	High Gas	
Change from OP-NT3	\$874	\$906	\$829	\$478	\$904	\$824	\$477	

- Energy Gateway 2 includes segment F -Windstar to Mona / Clover (assumed in-service 2023).
- In addition to the 300 MW of Wyoming wind in Case OP-NT3, the additional transmission enables 440 MW of Wyoming wind additions in 2023.
- The PVRR results indicate an overall increase to system costs, higher than Case GW1, with improving benefits under high natural gas price assumptions.



## Sensitivity: Energy Gateway 3 (GW3)



	SO	PaR Stochastic Mean						
PVRR(d) Cost/(Benefit) (\$ million)	Mass B		Mass A		Mass B			
	Med Gas	Low Gas	Med Gas	High Gas	Low Gas	Med Gas	High Gas	
Change from OP-NT3	\$1,363	\$1,453	\$1,316	\$724	\$1,452	\$1,308	\$726	

- Energy Gateway 3 includes segments D & F

   Windstar to Anticline and Aeolus to
   Mona / Clover (assumed in-service 2022 and 2023, respectively).
- In addition to the 300 MW of Wyoming wind in Case OP-NT3, the additional transmission enables 440 MW of Wyoming wind additions in 2022 and 760 MW in 2023; 150 MW of Goshen wind eliminated in 2021.
- The PVRR results indicate an overall increase to system costs, higher than Cases GW1 and GW2, with improving benefits under high natural gas price assumptions.



## Sensitivity: Energy Gateway 4 (GW4)



- Energy Gateway 4 includes segment D2 . - Aeolus to Anticline (assumed inservice year-end 2020).
- In addition to the 300 MW of Wyoming ٠ wind in Case OP-NT3, the additional transmission enables 900 MW of Wyoming wind additions in 2021 (proxy for year-end 2020); 150 MW of Goshen wind eliminated in 2021.
- This sensitivity shows improved ٠ economics relative to Cases GW1, GW2, and GW3, with favorable benefits under high natural gas price assumptions.

	SO	PaR Stochastic Mean							
PVRR(d) Cost/(Benefit) (\$ million)	Mass B		Mass A		Mass B				
	Med Gas	Low Gas	Med Gas	High Gas	Low Gas	Med Gas	High Gas		
Change from OP-NT3	\$107	\$295	\$205	(\$236)	\$295	\$199	(\$234)		



#### Increase/(Decrease) in Resources vs. OP-NT3

### Sensitivity: Energy Gateway + Repower (OP-GW4)



- Includes Segment D2 (assumed inservice year-end 2020) and 905 MW of wind repowering.
- In addition to the 300 MW of Wyoming wind in Case OP-NT3, the additional transmission enables 900 MW of Wyoming wind additions in 2021 (proxy for year-end 2020); 150 MW of Goshen wind eliminated in 2021.
- This sensitivity shows improved economics relative to Cases GW1, GW2, and GW3, with even more favorable benefits under high natural gas price assumptions relative to Case GW4.

	SO	PaR Stochastic Mean						
PVRR(d) Cost/(Benefit) (\$ million)	Mass B		Mass A		Mass B			
	Med Gas	Low Gas	Med Gas	High Gas	Low Gas	Med Gas	High Gas	
Change from OP-NT3	\$71	\$309	\$201	(\$315)	\$310	\$196	(\$310)	



## **Energy Gateway 4 (OP-GW4) Discussion**

- Initial studies indicate potential for a time-limited opportunity to align development of Energy Gateway sub-segment D2 with wind projects that can qualify for the full value of production tax credits.
- PacifiCorp will continue to evaluate Case OP-GW4 as a potential candidate for the preferred portfolio while preparing the IRP for filing by March 31, 2017.
- We will assess potential quantifiable benefits associated with reliability improvements, line loss savings, and energy imbalance market benefits.
- We will evaluate how the economics of this case are affected by proxy wind resource operations & maintenance assumptions, taking into consideration more current market information for new wind resource technologies and potential projects in eastern Wyoming.
- We will perform power flow and dynamic stability studies to refine transmission assumptions used in this sensitivity.

# 2017 Integrated Resource Plan

### Additional Sensitivity Studies





# **Sensitivity Case Assumption Overview**

#### Additional Sensitivities

Sensitivity	Benchmark	Load	Private Gen	CO <sub>2</sub> Policy	FOTs	Gateway
No Federal CO <sub>2</sub> Policy	OP-NT3	Base	Base	None	Base	None
Business Plan	OP-NT3	Base	Base	Mass Cap B	Base	None
East/West Split*	OP-NT3	Base	Base	Mass Cap B	Base	None
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\*Not yet completed. To be evaluated in the March 31, 2017 filing.

Additional Sensitivities Presented at the January 2017 Public Input Meeting

- CO<sub>2</sub> Price (CO2-1)
- CPP Mass Cap C (CPP-C)
- CPP Mass Cap D (CPP-D)
- Limited FOTs (FOT-1)

- 1 in 20 Load Growth (LD-1)
- Low Load (LD-2)
- High Load (LD-3)
- Low Private Generation (PG-1)
- High Private Generation (PG-2)

## **Sensitivity: Business Plan (BP)**

- This sensitivity complies with Utah requirements to perform a business plan sensitivity consistent with the commission's order in Docket No. 15-035-04.
  - Over the first three years, resources align with those assumed in PacifiCorp's Fall 2015 Business Plan.
  - Beyond the first three years of the study period, unit retirement assumptions are aligned with the draft preferred portfolio.
  - All other resources are optimized.
- PVRR results indicate the business plan portfolio is higher cost than the benchmark case.
- Implications of the preferred portfolio on the action plan will be addressed in the March 31, 2017 filing.





# Sensitivity: No CO<sub>2</sub> Policy (NO-CO2)

- As requested by stakeholders, the NO-CO2 Case examines the impact of having no incremental state or federal CO<sub>2</sub> emissions policy in place through the 2017-2036 study period.
- 150 MW of 2021 wind in Idaho is eliminated; however, the 300 MW of wind in Wyoming remains cost effective absent a CO<sub>2</sub> policy.
- Overall system costs decrease by between \$161m (System Optimizer) and \$194m (PaR) under base case price assumptions.





# 2017 Integrated Resource Plan

**Preferred Portfolio Selection** 





## System Optimizer PVRR



- System Optimizer (SO) provides a least-cost capacity-based optimization, enforcing emissions limits and providing shadow price measurement.
- Selection is based on Planning and Risk (PaR) model measures; SO results provide an additional indicator and support for subsequent PaR stochastic results.
- The completed Cores Cases OP-NT3 and OP-REP report the lowest PVRR under System Optimizer.

### **PaR Scatter Plots - Mass Cap B with Fixed Cost**



### **PaR Scatter Plots - Mass Cap A with Fixed Cost**



### **PaR Summary Rankings (Candidate Studies)**

- Case OP-REP ranks #1 on the risk adjusted PVRR metric, #2 on the average ENS metric, #8 on the upper tail ENS metric, and #11 on emissions.
- Overall, Case OP-REP performs very well in comparison to other top candidates for preferred portfolio.

	Risk Adjusted <sup>1</sup>			ENS Scenario Average			ENS Upper Tail Average			CO <sub>2</sub> Emissions			Average
		Change		Average			Average						
		from		Annual	Change		Annual	Change		Total CO2	Change		
		Lowest		ENS,	from		ENS,	from		Emissions,	from		
		Cost		2017-	Lowest		2017-	Lowest		2017-2036	Lowest		
	PVRR	Portfolio		2036	ENS		2036	ENS		(Thousand	Emission		
Case	(\$m)	(\$m)	Rank	(GWh)	Portfolio	Rank	(GWh)	Portfolio	Rank	Tons)	Portfolio	Rank	Rank
OP-NT3	25,167	\$452	4	12.5	9.5	10	31.4	23.1	10	770,651	13,323	10	8.5
OP-REP	24,715	\$0	1	11.3	8.4	2	31.0	22.7	8	771,283	13,956	11	5.5
OP-GW4	24,865	\$150	2	11.5	8.5	5	30.5	22.2	3	757,327	0	1	2.8
FR-1	25,695	\$980	9	12.7	9.7	11	31.5	23.2	11	766,344	9,017	6	9.3
FR-2	26,358	\$1,644	11	3.0	0.0	1	8.3	0.0	1	774,577	17,250	12	6.3
RE-1c	25,189	\$475	5	11.5	8.5	6	30.5	22.3	6	766,154	8,827	5	5.5
RE-2	25,148	\$433	3	11.5	8.5	7	30.3	22.0	2	769,738	12,411	9	5.3
DLC1	25,215	\$500	6	13.2	10.2	12	32.1	23.9	12	761,095	3,768	4	8.5
GW1	25,575	\$860	8	11.6	8.6	8	30.5	22.2	4	766,789	9,461	7	6.8
GW2	25,941	\$1,226	10	12.0	9.0	9	30.9	22.6	7	767,825	10,498	8	8.5
GW3	26,388	\$1,673	12	11.4	8.4	3	30.5	22.2	5	757,806	479	2	5.5
GW4	25,259	\$544	7	11.4	8.4	4	31.2	22.9	9	759,964	2,636	3	5.8

1 Based on average of 6 emissions/price scenarios

### **Risk-Adjusted PVRR Relative to the Lowest Cost Case**



Case OP-REP produces the lowest riskadjusted PVRR relative to other portfolios, except under high gas when Case OP-GW4 is lowest.

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\$3,000

 Cases GW3 and FR-2 consistently have the highest risk-adjusted PVRR.

### Stochastic Mean Average Annual ENS Relative to the Lowest ENS Case



All Cases have mean ENS levels that are a fraction of total load (annual mean ENS ranges between 2.8 and 13.8 GWh).

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 Relative to other Cases, FR-2, with incremental peaking capacity, consistently produces very low mean ENS levels (between 2.8 and 3.1 GWh).

# Upper Tail Average Annual ENS Relative to the Lowest ENS Case



- All Cases have upper tail ENS levels that are a fraction of total load.
- Relative to other Cases, FR-2, with incremental peaking capacity, consistently produces very low upper tail ENS levels.
- RE-2 produce similar upper tail ENS levels.

### **CO<sub>2</sub> Emissions Relative to the Lowest Emission Case**



Case GW3 and OP-GW4 consistently yield the lowest emissions among all Portfolios and reported higher renewables added. DLC1 did best in high gas.

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 Case OP-REP yields mid-to-high emissions relative to other cases among the scenarios.

# **Draft Preferred Portfolio: Conclusions**

The Company has identified OP-REP (OP-NT3 with Wind Repower) as the draft preferred portfolio.

#### **OP-REP Highlights**

- OP-REP produces the lowest risk-adjusted PVRR in 4 out of 6 price scenarios (low and medium gas price scenarios) and is among the top two in the high gas price scenarios.
- OP-REP is consistently among the top performing portfolios when ranked on mean ENS.
- OP-REP produces the lowest PVRR from System Optimizer relative to other candidate portfolios.

#### **Renewable Energy**

- Repowering 905 MW of existing wind resources by the end of 2020.
- An additional 428 MW of incremental low-cost wind resources are added by the end of 2020.
- By the end of the 20-year planning horizon, the portfolio includes 1,030 MW of new wind and 1,157 MW of new solar.

#### **Demand Side Management**

 Energy efficiency over the front ten years of the planning horizon yields an accumulated acquisition of incremental energy efficiency resources meeting 89% of forecasted load growth.

# **Preferred Portfolio: Conclusions, continued**

#### **Front Office Transactions**

 Summer front office transactions average 673 MW over the four year action plan timeframe (down 27% from the 2015 IRP) and average 832 MW over the front ten years of the planning horizon (down 5% from the 2015 IRP).

#### Existing Coal and New Natural Gas Resources

- The resource mix reflects a cost-conscience transition that is increasingly less reliant on coal generation without any incremental selective catalytic reduction (SCR) controls.
- Assumed coal unit retirements total 749 MW by 2025 and 3,649 MW by the end of 2036.
- The first new natural gas resource (436 MW CCCT) is added in 2029, one year later than in the 2015 IRP; 1,789 MW of new natural gas capacity is added by 2036 (1,389 of CCCT and 400 of SCCT).

Individual unit outcomes under any Regional Haze compliance case will ultimately be determined by ongoing rulemaking, results of litigation, and future negotiations with state and federal agencies, partner plant owners, and other vested stakeholders. No individual unit commitments are being made at this time.

# 2017 Integrated Resource Plan

#### Public Input Wrap-Up and Next Steps





### **Next Steps**

#### Items to Complete for March 31, 2017 Filing

- Complete outstanding sensitivities:
  - East/West Split
  - Energy Storage
- Update and expand sensitivities on Energy Gateway sub-segment D.
- Finalize preferred portfolio selection.
- Finalize action plan.
- Respond to outstanding stakeholder feedback forms.

### 2017 IRP Wrap-up Discussion

- 7 Public Input Meetings
  - Initiated June 21, 2016
  - 5 of the 6 meetings scheduled as two-day sessions
  - One phone conference
- 5 State-specific Meetings
  - Held over the course of June 2016
- Portfolio Modeling
  - 7 Regional Haze Cases
  - 8 Core Cases
  - 18+ Sensitivity Cases

- Updated/New Studies
  - Conservation Potential Study
  - Private Generation Study
  - Flexible Reserve Study
    - Wind integration costs
    - Solar integration costs
  - Planning Reserve Margin Study
  - Wind & Solar Capacity Contribution Study
  - Stochastic Parameter Study
  - Resource Adequacy Assessment
- Comments, questions, closing remarks

# **Additional Information**

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