2019 IRPAG Meeting #2

August 28, 2018

Welcome

- Opening remarks
- Safety message

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Meeting objectives

- Stakeholders understand how PSE is using their input from the May 30 meeting
- PSE listens to stakeholder input on the IRP
- Stakeholders gain familiarity with the IRP process and resource needs
- Stakeholders gain familiarity with electric resource costs

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Today’s agenda

- ✓ Welcome, safety message, introduction, review agenda and meeting objectives
- Updated IRP stakeholder participation process
- Outcomes and action items from previous IRPAG meeting and TAG meeting
- PSE IRP Discussion: IRP overview, load forecasts, planning standards and electric resource costs
- Next steps
- IRP comment period
- Adjourn and public meet and greet

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Updated IRP stakeholder participation process

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Outcomes from IRPAG meeting #1

Stakeholders provided comments to incorporate several key elements into the IRP modeling elements:

1. Greater carbon reduction scenarios than PSE's 50% reduction of 2016 emissions by 2040
   - Include 80% reduction in CO_2 from 2005 levels
2. No new fossil fuel generation in PSE's portfolio
3. Retire all PSE's fossil fuel power plants by end of 2025
4. No Tacoma Liquefied Natural Gas facility for gas utility peaking needs
5. Present analysis of historical temperature data to demonstrate PSE's consistency with the regional analysis is reasonable

OUTCOME

PSE will include scenarios and sensitivities in 2019 IRP

PSE will evaluate impact on resource mix, rates, portfolio costs, and operations

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Action items from IRPAG meeting #1 (May 30, 2018)

Action #	Description	PSE Action	Status
1	Answer all submitted pre-meeting resource costs questions in writing	PSE partnered with HDR and addressed all question in writing; distributed to the TAG on August 8	Complete
2	Identify contact for PSE's carbon reduction goals	PSE is planning a fall listening session with PSE executives for the public	In progress
3	Include carbon impact in scenarios or sensitivities	PSE will model various carbon impacts such as zero carbon electric modeling	In progress

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Action items from IRPAG meeting #1 (continued)

Action #	Description	PSE Action	Status
4	Invite tribes to participate in IRP stakeholder process	PSE sent letters to 31 federally-recognized tribes plus the Duwamish tribe	Complete
5	Reach out to an individual stakeholder concerning her PSE gas experience	PSE made several attempts but was unable to make contact using contact information provided	Unable to complete
6	Share work plan submitted to UTC on July 13	Distributed on July 16 to the IRPAG via email and available at www.pse.com/irp	Complete

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Action items from TAG meeting #1 (July 26, 2018)

Action #	Description	PSE Action	Status
1	Include larger renewable projects in the modeling assumptions to take into consideration greater economies of scale	PSE will incorporate larger renewable projects in final report	In progress
2	Accept comments from TAG members on HDR's electric resource costs report	All comments were considered by PSE and HDR, and are available at www.pse.com/irp	In progress
3	Make past years' capacity factor numbers available	PSE provided capacity factors for PSE's combined cycles for the last two years; available at www.pse.com/irp	In progress

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Action items from TAG meeting #1 (continued)

Action #	Description	PSE Action	Status
4	Verify confidentiality of information from individual bids from the 2017 Green Direct RFP process	All content in the bids from Green Direct RFP are confidential; PSE provided them to HDR under a non-disclosure agreement for comparison	In progress
5	Clarify and share information about the nomination process for TAG membership	PSE will clarify through an updated TAG charter for review at the next TAG meeting	In progress
6	Update charter	Updated IRPAG charter available at www.pse.com/irp	In progress

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IRP overview

August 28, 2018 IRPAG Meeting #2

IRP rules from WA state legislature

WAC 480-100-238

(1) Purpose. Each electric utility regulated by the commission has the responsibility to meet its system demand with a least cost mix of energy supply resources and conservation.

In furtherance of that responsibility, each electric utility must develop an "**integrated resource plan**."

Complete rules can be found online here:
http://apps.leg.wa.gov/wac/default.aspx?cite=480-100-238

IRP definitions

WAC 480-100-238

(2) Definitions. (a) "Integrated resource plan" means a plan describing the mix of energy supply resources and conservation that will meet current and future needs at the lowest reasonable cost to the utility and its ratepayers.

IRP definitions

WAC 480-100-238

(2) (b)"Lowest reasonable cost" means the lowest cost mix of resources determined through a detailed and consistent analysis of a wide range of commercially available sources.

At a minimum, this analysis must consider resource cost, market-volatility risks, demand-side resource uncertainties, resource dispatchability, resource effect on system operation, the risks imposed on ratepayers, public policies regarding resource preference adopted by Washington state or the federal government and the cost of risks associated with environmental effects including emissions of carbon dioxide.

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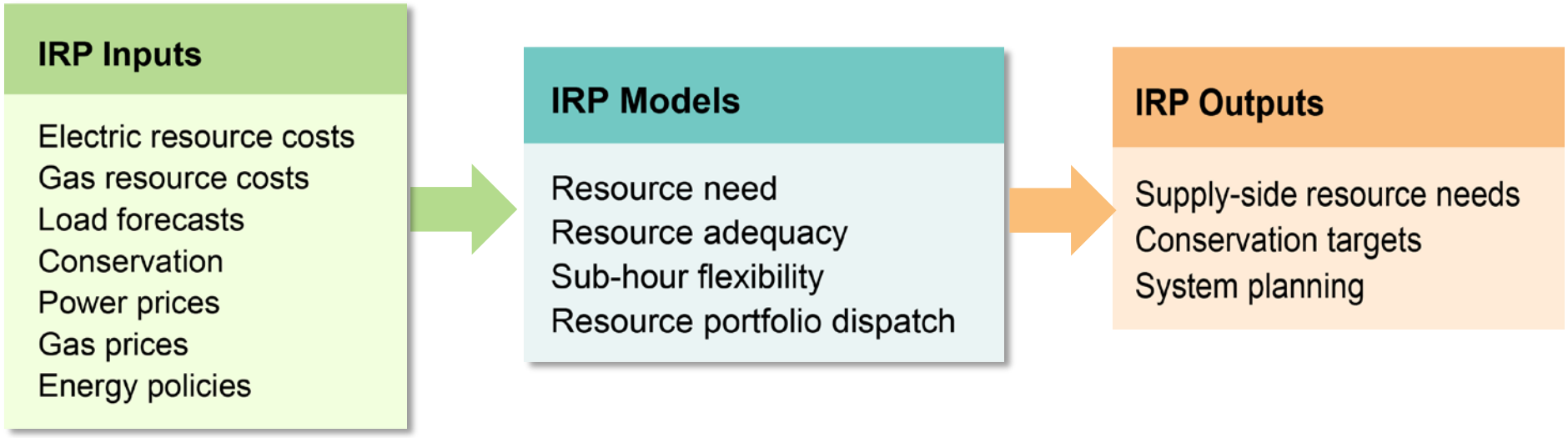
IRP analytical process overview

PSE has established an analytical framework to develop its **20-year forecast of conservation and supply-side resources** that appear to be cost effective to meet the growing needs of our customers.



IRP's role in the regulatory process

PSE's central focus is to make prudent resource decisions on behalf of its customers:

- If the IRP identifies a capacity, energy, or renewable resource need within three years, then PSE conducts a Resource Acquisition Process to secure the resources to meet that need.

- The WUTC makes a ruling on prudence of resource acquisitions.

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Load forecasts

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Load forecast overview

- PSE updates its long-term load forecasts each year for a 20-year period
  - ✓ The 2018 update will be used for the 2019 IRP
- The forecast developed for the IRP is an estimate of:
  - ✓ Customer counts
  - ✓ Energy sales
  - ✓ Peak demand
- The estimates of energy sales and peak demand do not include future demand side resources (DSR)
  - ✓ The resource plan will identify the most cost-effective amount of DSR

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Load forecast methodology

Typical Drivers:
- Population
- Housing permits
- Employment

Typical drivers:
- Employment
- Energy retail rates
- Personal income
- Weather

STEP 1: Compile actual history
- ✓ Compile actual PSE sales data and drivers
- ✓ Determine the *relationship* of drivers to customer growth and sales

STEP 2: Forecast the future
- ✓ Compile forecasts of economic and demographic drivers, normal weather
- ✓ Apply historical *relationships* to forecasts of drivers and normal weather

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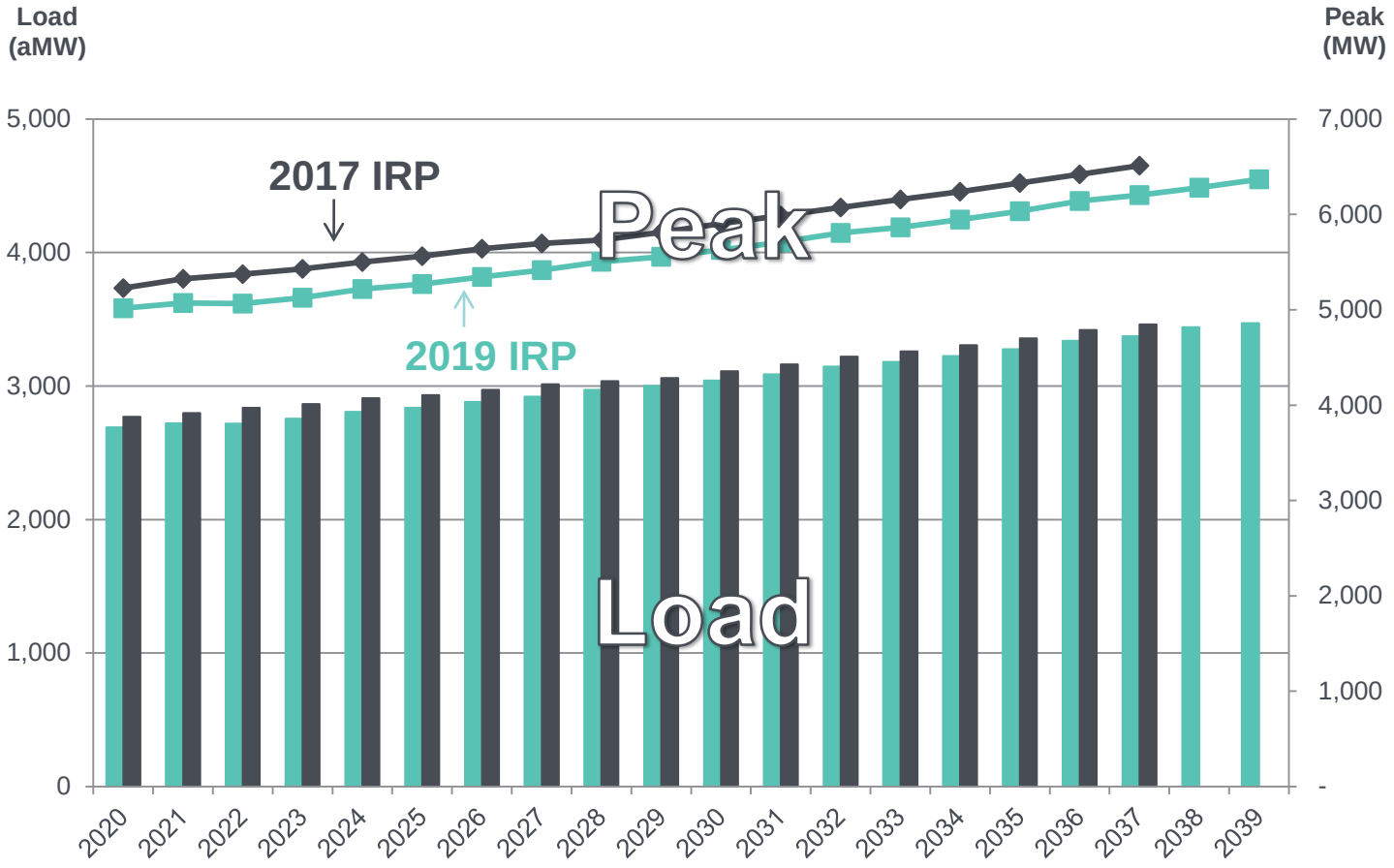
Electric load and peak demand forecast

Does not include conservation/demand-side resources



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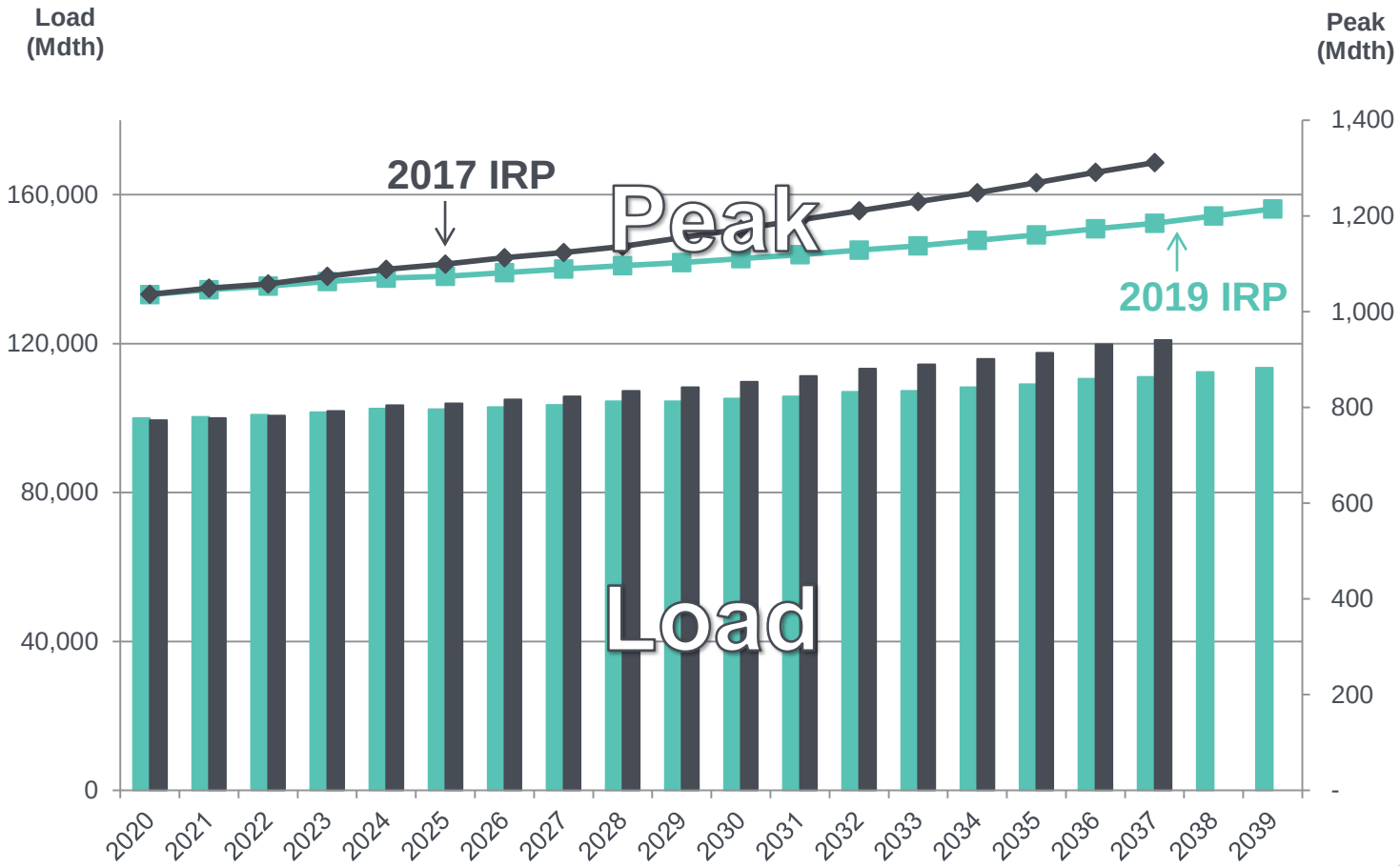
Gas load and peak demand forecast

Does not include conservation/demand-side resources



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Planning standards and resource needs

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Planning standards

- PSE must reliably meet the physical needs of our customers while complying with regulatory requirements

- Physical needs include:

  Maximum (peak) capacity, in megawatts, to ensure adequate resources to meet customer demand with sufficient margin and reserves

  Energy, in megawatt-hours, to meet customer demand every hour

  Renewable energy, in renewable energy credits (REC), to meet renewable portfolio standards where 15% of energy sales by 2020 must be provided by renewable energy

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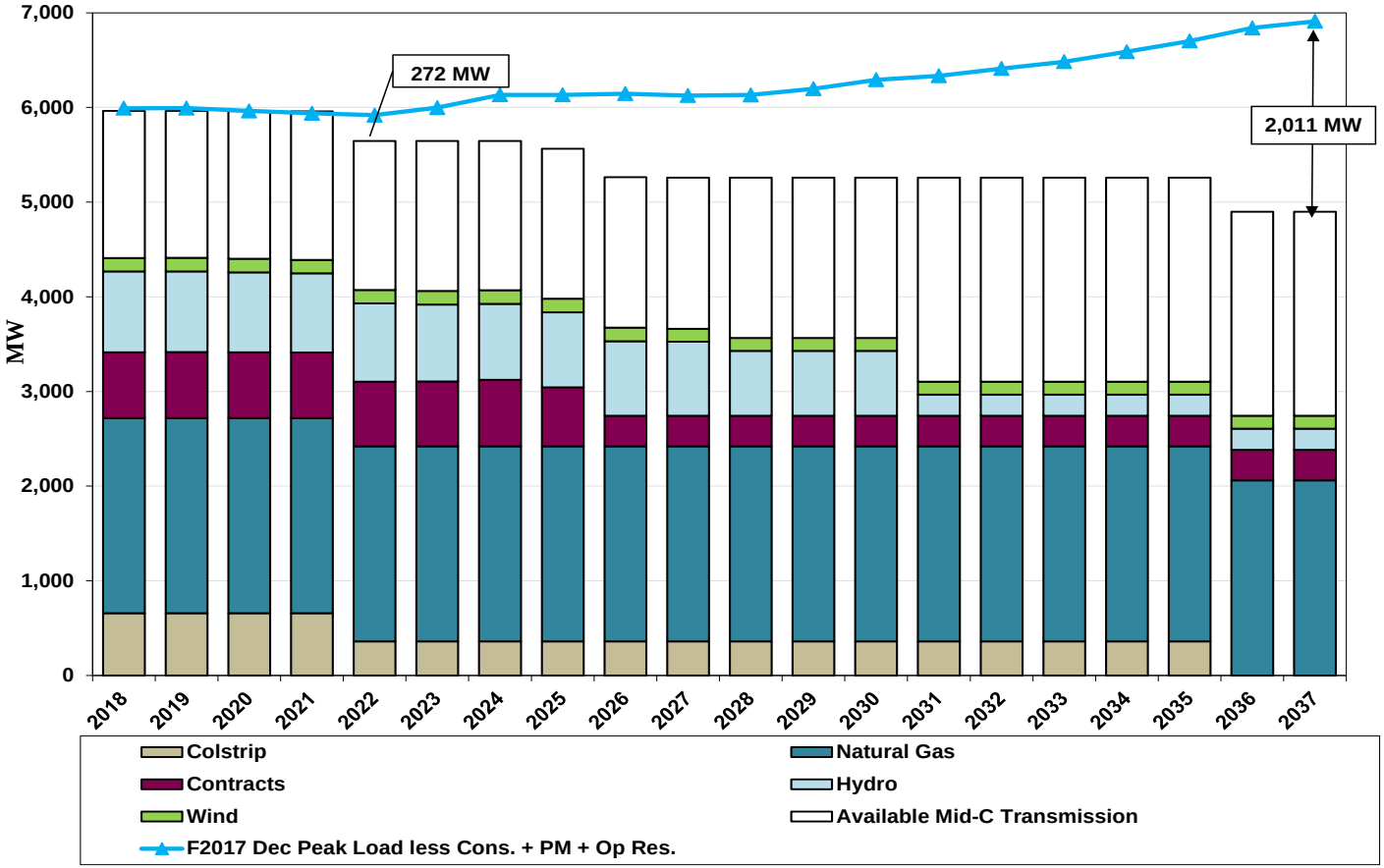
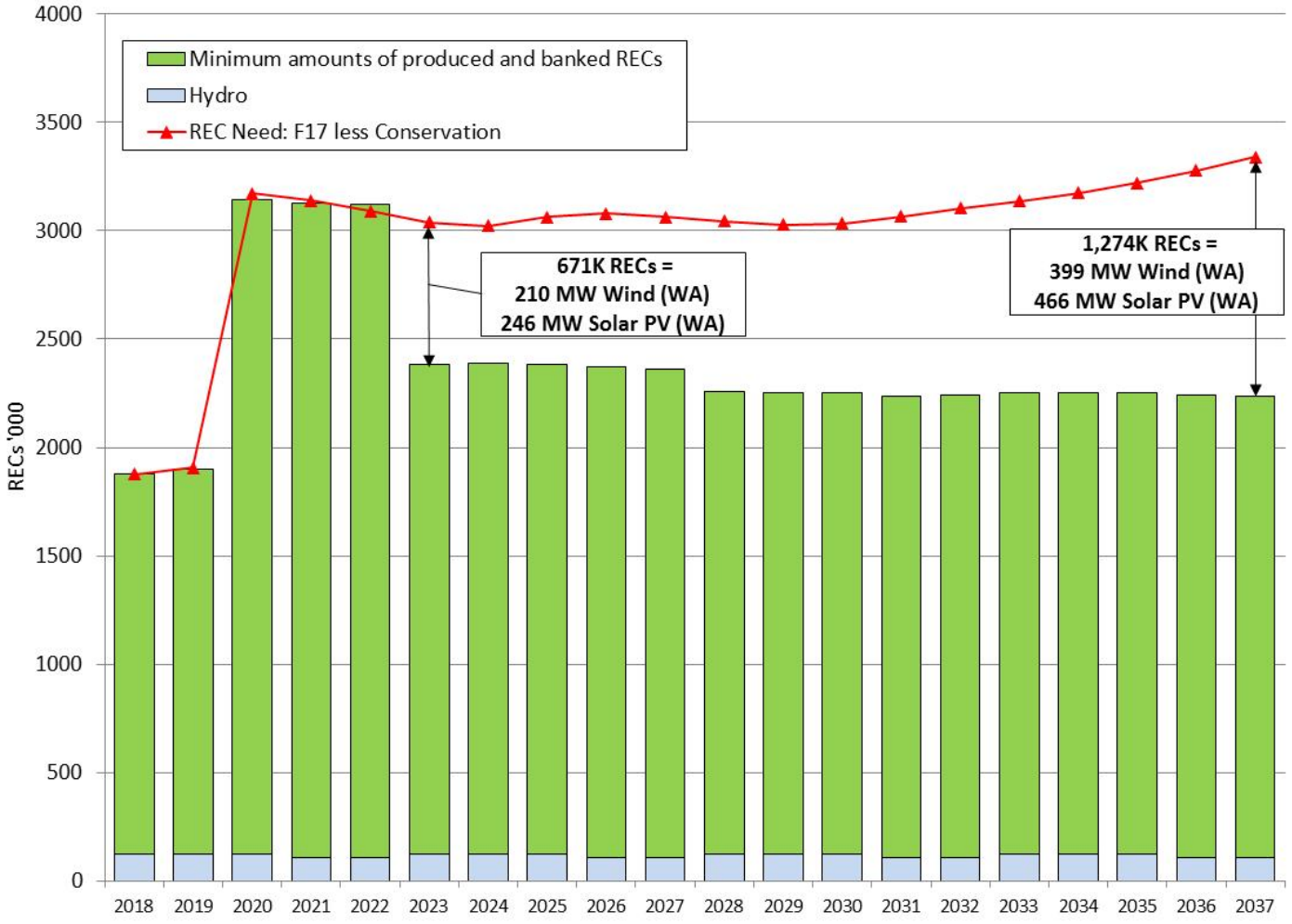
December peak capacity need (example)



Renewable resource need (example)



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Electric resource costs: report from TAG meeting #1

August 28, 2018 IRPAG Meeting #2

Development of electric resource costs

- Energy portfolio modeling simulates how resources will be economically dispatched in the market
- PSE asked the engineering firm, HDR, to develop generic resource costs
- PSE presented on resource costs on July 26 and the TAG provided verbal and written feedback
- PSE considered all stakeholder feedback and is working with HDR to update their report as appropriate

Comparison of electric resource costs

	2017 IRP			2019 IRP			Change in costs from 2019 IRP to 2017 IRP		
2018 $/kW	EPC Cost	Owner's Costs + Interconnection	Total Costs	EPC Cost	Owner's Costs + Interconnection	Total Costs	EPC Cost	Owner's Costs + Interconnection	All in Costs
CCCT	$1,020	$358	$1,378	$898	$269	$1,167	($122)	($89)	($211)
Frame Peaker (Fuel Fuel)	$526	$172	$698	$554	$271	$825	$28	$99	$127
Recip Engine (NG only)	$1,030	$312	$1,341	$842	$350	$1,192	($188)	$38	($149)
WA Wind	$1,548	$656	$2,204	$1,656	$386	$2,042	$108	($270)	($162)
MT Wind	$1,471	$1,312	$2,783	$1,633	$1,111	$2,744	$162	($201)	($39)
Solar	$1,497	$874	$2,371	$1,352	$570	$1,922	($145)	($304)	($449)
Biomass	$4,084	$207	$4,291	$7,036	$2,659	$9,695	$2,952	$2,452	$5,404
Offshore Wind	$5,717	$1,795	$7,512	$5,000	$1,547	$6,547	($717)	($248)	($965)
Li-Ion Battery 2-hr	$1,313	$342	$1,655	$1,331	$599	$1,930	$18	$257	$275
Li-Ion Battery 4-hr	$2,116	$552	$2,668	$2,346	$708	$3,054	$230	$156	$386
Flow Battery 4-hr	$1,870	$674	$2,544	$1,493	$618	$2,111	($377)	($56)	($433)
Flow Battery 6-hr	$2,447	$882	$3,329	$2,050	$708	$2,758	($397)	($174)	($571)
Pumped Storage	$2,503	$127	$2,630	$1,800	$879	$2,679	($703)	$752	$49

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TAG feedback on resource costs

- HDR will update solar and wind resource costs to reflect greater economies of scale, which PSE can then break down into smaller sizes, assuming PSE purchases a portion of the resource
- HDR will be reexamining locations to focus on better than average wind sites, which would better reflect where developers would seek to build plants first
- PSE revised Montana wind transmission losses with stakeholder input
- Other feedback is still under consideration

Next steps and timeline

August 28, 2018 IRPAG Meeting #2

Next steps

Date	Action
September 7	PSE distribute meeting notes with action items
September 13	IRPAG attendees review meeting notes and provide comments to PSE
September 20	PSE post final meeting notes on IRP website: www.pse.com/irp

IRP comment period

August 28, 2018 IRPAG Meeting #2

Thank you