2021 IRP Webinar #3: Transmission Constraints

Planning Assumptions for the Electric Portfolio Model

June 30, 2020



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Agenda



- Safety moment
- Speaker introductions
- IRP modeling process
- Transmission constraint background
- Transmission capacity constraints
- Transmission cost assumptions
- Final Q&A



Safety Moment: Hiking safety

Ten essential items that every hiker should carry

- 1. **Navigation** Always carry a detailed map of the area that you are hiking in and a compass (even if use a GPS or smartphone)
- 2. Hydration It is essential to drink a lot of water while hiking
- **3.** Nutrition Always bring extra food when hiking in case an unexpected situation delays your return
- 4. Rain gear and insulation Always tuck rain gear into your backpack and bring along layers of clothes. Avoid cotton clothing in favor of wool or poly blends that wick moisture away from your skin
- 5. Fire starter Always bring along waterproof matches in a water-tight container and have a dry or waterproof striker
- 6. First Aid Kit Make sure you have the supplies to deal with major injuries, and make sure you have the knowledge
- 7. Tools Knives or a multi-tool is indispensable
- 8. Illumination A light source is vital if you get caught in the woods after dark.
- 9. Sun protection Sunglasses are a must
- **10. Shelter** An emergency tarp or space blanket can help protect you through a sudden storm or shelter you through an unexpected night outdoors

Other items to consider – insect repellant, watch, whistle, gloves, extra socks, and hand sanitizer *This session is being recorded by Puget Sound*





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Public participation in the 2021 IRP





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How to participate with Zoom



Virtual webinar

link: <u>https://us02web.zoom.us/j/88985995321?pwd=c0IEV1</u> JIcTY1S2tzSUh3SIVFRHhnZz09

Password: 582653

Webinar ID: 889 8599 5321

Call-in telephone number: 1-253-215-8782



- Mute your mic while others are speaking
- We will ask for comments and questions along the way
- Participate using the chat box or ask questions verbally
- Use the "Raise hand" feature to signal you'd like to ask your question verbally
- Wait to be called on
- Please stay on topic; there may be time for additional questions and comments at the end
- Please be polite and respect all participants on the webinar





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Alexandra Streamer & Alison Peters Co-facilitators, Envirolssues



The 2021 IRP will follow a 6-step process for analysis:

- 1. Establish peak capacity, energy and renewable energy need
- 2. Determine planning assumptions and identify supply-side and demand-side resource alternatives
- 3. Analyze scenarios and sensitivities using deterministic and stochastic risk analysis
- 4. Analyze results
- 5. Develop resource plan
- 6. Develop 10-year Clean Energy Action Plan





Meeting dates are available on <u>pse.com/irp</u> and will be updated throughout the process. This is a tentative timeline subject to revision. This session is being recorded by Puget Sound Energy. Third-party recording is not permitted.



Details of upcoming meetings can be found at <u>pse.com/irp</u>

Date	Торіс
July 14, 1:30 - 4:30 pm	Demand Side Resources including Demand Response
July 21, 1:30 – 4:30 pm	Social Cost of Carbon
August 11, 9:30 am – 12:30 pm	Portfolio sensitivities development (electric & gas) CETA assumptions Distributed energy resources
September 1, 1:00 – 5:00 pm	Demand forecast (electric & gas) Resource adequacy Resource need: peak capacity, energy & renewable energy need
October 20, 1:30 – 4:30 pm	Portfolio sensitivities draft results Flexibility analysis
November 4, 1:30 – 4:30 pm	Clean Energy Action Plan 10-year Distribution & Transmission Plan
December 9, 1:30 – 4:30 pm	Portfolio draft results Stochastic analysis Wholesale market risk

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IRP modeling process



Electric IRP Models



Transmission constraint background



Significant renewable resource capacity will be needed to support CETA

- Renewable resource need increased by over 2,000 MW by 2030 in order to meet the 80% renewable requirement from CETA instead of the 15% RPS.
- Transmission constraints must be in place to ensure these additions are feasible.
- Modeling transmission constraints for new resources is new for the 2021 IRP.



Transmission constraints shape how power delivery is modeled



- AURORA is a fundamentals-based • model that employs a multi-area, transmission-constrained dispatch logic to simulate real market conditions
- Loads must be served by **both** generation and transmission
- Therefore, new resource builds will be • influenced by **both** generation and transmission characteristics
- Cost and capacity are key transmission constraints



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Matching renewable generation with transmission capacity will be a challenge for PSE

- PSE has a relatively small territory, localized in NW Washington
- Renewable resources are scattered across the WECC
- PSE must work with surrounding balancing authorities to secure transmission across the WECC



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Modeling transmission constraints

- The AURORA Portfolio model is a two area system zonal model encompassing PSE territory and the Mid-C hub.
 - The zonal model is a generation optimization and capacity expansion model, not a transmission capacity model.
- Resource Groups in AURORA will allow different resources to be aggregated into unique 'transmission regions' sharing a fixed transmission capacity.
- The transmission capacity will be modeled as a build limit for the resource group.
- Allows MIP optimization to select the best resource to fit portfolio need within each Resource Group.



Transmission capacity constraints



Participation Objectives

 Stakeholders to share input on transmission capacity constraint modeling methodology

Att

 Stakeholders to share input on transmission capacity constraint magnitudes

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Stakeholders to share input on how to model transmission capacity uncertainty



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PSE's generic renewable resources are geographically diverse



- W Washington Solar
- E Washington Solar
- Offshore Wind
- Washington Wind
- Montana Wind
- Idaho Wind
- E Wyoming Wind
- W Wyoming Wind

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PSE must work with existing, largely BPA, transmission to bring new resources to PSE territory





The PSE Energy Delivery team has identified 7 Resource Group regions which align with existing transmission resources





Each Resource Group region will contain a distinct mix of generic resources

		Generic Resource													
Resource Group Region	WA Wind	MT Wind	Offshore Wind	ID Wind	East WY Wind	West WY Wind	ссст	Frame	Recip	Biomass	Solar Residential	Solar Utility	Pumped Storage	Battery	
PSE territory*							x	x	x	x	x			X	*I P
Eastern Washington	x									x		x	x	x	C a
Central Washington	x									x		x	x	x	S
Western Washington	x		x							x		x	x	x	
Southern Washington/Gorge	x									x		x	x	x	
Montana		x													
Idaho / Wyoming		This s	assion	, X	X	X	hy Pu	net Sr	nund						
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*Not including the PSE IP Line (cross Cascades) or Kittitas area transmission which is fully subscribed

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The PSE Energy Delivery team has assessed the status of transmission availability in the PNW and quantified potential new transmission capacity into four tiers:

Features	Tier 0	Tier 1	Tier 2	Tier 3
First year Available	2022	2022	2030	2030+
Amount (MW)	Unconstrained	1,050	3,070	5,205
Confidence		High	Moderate	Lowest
Composition		Repurposes Existing Tx	+ New Tx	New Tx with Longer Lead Times

Transmission capacity – Central Washington

- All tiers take advantage of 1,500 MW of Mid-C transmission reserved for Market Purchases
 - Give transmission a **dual purpose** to serve both market purchases and renewable resource generation
 - Quantity of repurposed transmission*
 increases with each tier
- Tier 2 and Tier 3 include 125 MW of new transmission on the Grant County PUD system for delivery of Kittitas area solar

*PSE has no available transmission rights to pair with proposed 2020 RFP resources. PSE's capacity need forecast for the 2020 RFP accounts for all of PSE's current transmission rights as existing capacity paired with either a specific generation resource or market purchases. The 2020 RFP seeks incremental capacity (i.e., capacity in addition to these existing resources) to meet PSE's projected capacity need.



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Transmission capacity – Eastern Washington

- PSE may attain between 150 and 640 MW of transmission to the Lower Snake River phased self-builds through BPA Cluster study requests
 - New capacity ramped by tier: 150, 300, 640 MW
- Redirect BPA transmission freed up by sale of Colstrip Unit 4 may add 185 MW to Tier 3
- Between 150 and 315 MW of third-party transmission rights maybe acquired via:
 - Project developers including transmission in RFP submittals,
 - Third-party retirements
 - New capacity ramped by tier: 150, 375, 690 MW





Transmission capacity – Western Washington

- 100 MW of BPA transmission for PSE's TransAlta PPA expires in 2025 and may be repurposed in Tier 2
- 335 MW of transmission for the Mint Farm CCCT could be **dual purposed** to prioritize renewable generation at Tier 3
- 200 MW of Tier 3, third-party transmission rights maybe acquired via:
 - Project developers including transmission in RFP submittals,
 - Third-party retirements





Transmission capacity – Southern Washington / Gorge

- 330 MW of transmission for the Goldendale CCCT could be **dual purposed** to prioritize renewable generation in Tier 2
- Between 150 and 310 MW of third-party transmission rights maybe acquired via:
 - Project developers including transmission in RFP submittals,
 - Third-party retirements
 - New capacity ramped by tier: 150, 375, 685 MW



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Transmission capacity – Montana

 Repurposing of transmission freed up by sale of Colstrip Unit 4 and removal of Unit 3 from PSE portfolio adds 350 and 565 MW to Tier 1 and Tier 2, respectively





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Transmission capacity - Idaho and Wyoming

- PSE may invest in new transmission projects including the proposed Boardman-to-Hemingway (B2H) and Gateway West projects
 - Adding between 400 and 600 MW to Tier 2 and Tier 3, respectively





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Transmission capacity – Summary

future load

PSE has identified viable transmission acquisition pathways for each of the Resource ٠ Group Regions at four tiers

	Added Transmission (MW)			
Resource Group Region	Tier 0	Tier 1	Tier 2	Tier 3
PSE territory*	unconstrained+	unconstraine	ed ⁺ unconstrained ⁺	unconstrained+
Eastern Washington	unconstrained	300	675	1,515
Central Washington	unconstrained	250	625	875
Western Washington	unconstrained	0	100	635
Southern Washington/Gorge	unconstrained	150	705	1,015
Montana	565	350	565	565
Idaho / Wyoming	600	0	400	600
	generally			
TOTAL	unconstrained	1,050	3,070	5,205
*Not including the PSE IP Line (cross Cascades) or Kittitas as subscribed *Not constrained in resource model, assumes adequate PSE	rea transmission which i transmission capacity to	is fully T re o serve E	his session is being ecorded by Puget Sound nergy. Third-party ecording is not permitted	PUGET SOUND ENERGY 31

Transmission capacity modeling approaches

- Option 1 Model tiers as distinct sensitivities:
 - Transmission capacity will be constrained by tier (sensitivity) 2022 to 2030
 - Transmission capacity will be unconstrained from 2031 to 2045 to assess new transmission need

Transmission sensitivities	Transmission unconstrained to
at Tier 1/2/3	assess new transmission need

2022 2023 2024 2025 2026 2027 2028 2029 2030 2031 2032 2033 2034 2035 2036 2037 2038 2039 2040 2041 2042 2043 2044 2045

- Option 2 Model transmission capacity as time-dependent periods:
 - Tier 1 amount attainable by 2025 // Tier 2 amount attainable by 2030 // Tier 3 amount attainable by 2035
 - Transmission capacity will be unconstrained from 2036 to 2045 to assess new transmission need



Transmission Capacity By % of Nameplate

- PSE's historical policy is to secure long-term firm (LTF) transmission up to the nameplate capacity of a resource, including renewable resources
- PSE is considering a change to policy to secure less than 100% LTF for renewable resources
 - Short-term transmission (redirects or purchases) scheduled as needed on firm and/or non-firm available transmission capacity
 - Approach different for wind, solar, and other renewables
 - Need to consider risk of delivery if short-term transmission is unavailable
 - Potentially model by resource region
- Model as a sensitivity (i.e. 80% nameplate in LTF)



Distributed resources are needed to balance constrained transmission

- Transmission Tiers 1 and 2 may not provide adequate transmission to meet the CETA renewable need.
- Western Washington solar in the PSE service territory* is a 'transmission-free' resource which will allow for CETA compliance in these sensitivities.
- Lower capacity factors in Western Washington solar will influence the total MW of renewable resources needed for CETA compliance.



*Not including the PSE IP Line (cross Cascades) or Kittitas area transmission which is fully subscribed



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Transmission capacity constraint summary and feedback

- Review
 - Renewable resources will be collected in Resource Group regions within AURORA Portfolio Model
 - Opt 1
 - Transmission capacity for each Resource Group region will be constrained by tier for the period 2022 – 2030
 - Transmission capacity will be unconstrained from 2030 2045
 - Opt 2
 - Tier 1: 2025 Tier 2: 2030 Tier 3: 2035
- Feedback
 - Share your thoughts on the general modeling approach and magnitudes of transmission availability
 - Input on Option 1 versus Option 2 modeling approaches

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5-minute break

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Transmission cost assumptions



Participation Objectives

 PSE is informing stakeholders of transmission rates and losses to be used in the 2021 IRP

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Various methods exist for setting transmission costs

- BPA Tariffs cost included as an ongoing variable operation and maintenance cost
 - Formula Power Transmission (FPT)
 - Point-to-Point (PTP)
 - Network Integration (NT)
 - Regional Intertie Rates
- Build new transmission cost included as a one-time capital cost adder



Transmission Path	Cost (\$/kW-Year)
Kittitas - MidC (Wanapum) (PSEI PTP)*	24.91
Wanapum Energy Transfer	Unknown
MidC (Wanapum) - PSEI (BPA) ⁺	22.20
Balancing Services – Solar (BPA) ⁺	8.28
TOTAL	55.39



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https://www.oasis.oati.com/psei/index.html

+https://www.bpa.gov/Finance/RateInformation/Pages/Current-Transmission-Rates.aspx

Transmission Path	Cost (\$/kW-Year)
Central Ferry - PSEI (BPA)	22.20
Generation Imbalance (Band 1 & 2) *	Variable
Balancing Services – Wind (BPA)*	11.16
Intentional Deviation Penalty*	Variable
TOTAL	33.36

*<u>https://www.bpa.gov/Finance/RateInformation/Pages/Current-</u> <u>Transmission-Rates.aspx</u>





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Transmission Cost – Western Washington

Transmission Path	Cost (\$/kW-Year)
BPA Transmission	22.20
Balancing Services – Wind (BPA)	11.16
Marine Transmission	Under Review
TOTAL	33.36



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Transmission Cost – Southern Washington / Gorge

Transmission Path	Cost (\$/kW-Year)
Goldendale - PSEI (BPA)	22.20
Generation Imbalance (Band 1 & 2)	Variable
Balancing Services - Solar (BPA)	8.28
Intentional Deviation Penalty	Variable
TOTAL	30.48



Spin/Supplemental Reserve Requirement of \$0.02/kWh also included

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Transmission Path	Cost (\$/kW-Year)
Colstrip/Broadview - Townsend (PSEI)*	10.22
Townsend - Garrison (BPA) ⁺	6.07
Garrison - PSE (BPA) ⁺	22.20
Estimated Wind Integration Costs (PSEI)	11.16
TOTAL	49.65





https://www.oasis.oati.com/psei/index.html

*

+<u>https://www.bpa.gov/Finance/RateInformation/Pages/Current-Transmission-Rates.aspx</u>

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Transmission Path	Cost (\$/MW)
Shirley Basin (Aeolus) to Bridger/Anticline	216,000
Bridger/Anticline to Populus	578,000
Populus to Hemingway	778,000
Boardman to Hemingway (B2H)	585,000



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Modeled as capital cost for transmission build

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Transmission Cost – Idaho / Wyoming



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- ID Wind
 - Near Populus
 - \$1.36M / MW
- West WY Wind
 - Near Anticline
 - \$1.94M / MW
- East WY Wind
 - Near Aeolus
 - \$2.16M / MW



Transmission losses

- Losses due to the resistance in transmission lines are modeled using a loss factor for each transmission route
- BPA publishes an assumed loss of 1.9% on across their network
 - PSE will apply this loss to all Washington transmission wheels (N, S, E, W)
- Line losses for transmission between Colstrip and PSE have been estimated at 4.6%*
 - PSE will apply this loss to Montana transmission
- Line losses for transmission between Wyoming and PSE are under review
 - PSE will apply this loss to ID and WY transmission

*Does not include 5% losses for third party resources on MT Intertie



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	Cost		
Resource Group Region	туре	Units	Total Cost
PSE territory			0
Eastern Washington	Tariff	\$ / kW-yr	33.36
Central Washington	Tariff	\$ / kW-yr	55.39
Western Washington	Tariff	\$ / kW-yr	33.36
Southern Washington/Gorge	Tariff	\$ / kW-yr	30.48
Montana	Tariff	\$ / kW-yr	49.65
ID / W. WY / E. WY	Capital	\$M / MW	1.36 / 1.94 / 2.16



Consultation update – generic resource overnight capital cost

- Pumped Storage Hydro overnight capital costs revised to include more data sources and averaged across vintage year 2021 instead of 2020.
- Added a wind + battery resource; 100 MW WA wind with a 25 MW 2hr Lithium Ion battery.
- PSE has adopted the NREL ATB cost curves.
- Lithium Ion 2-hr battery and flow 4hr and 6-hr battery added.

(2021 Vintage,	Overnight Capital Cost			
2016 U.S. Dollars)	(\$/kW)			
	2019 IRP	2021 IRP draft	2021 IRP proposed	
СССТ	991	927	943	
Frame Peaker	618	660	664	
Recip Peaker	931	1,248	1,256	
Solar Utility	1,422	1,226	1,264	
Solar Residential		2,848	2,957	
Onshore Wind	1,438	1,484	1,421	
Offshore Wind	5,730	4,971	4,377	
Pumped Storage	2,176	2,515	2,145	
Battery (4hr, Li-Ion)	2,427	1,900	1,542	
Battery (2hr, Li-Ion)	1,455		849	
Battery (4hr, Flow)	1,625		2,051	
Battery (6hr, Flow)	2,244		2,860	
Solar + Battery	2,698		1,901	
Wind + Battery			2,043	
Biomass	7,744	5,119	5,246	



Consultation update – generic resource all-in capital costs

- AFUDC assumed at 10% for all resources
- Interconnection costs include substation costs, 5 miles of transmission to system, and 5 miles
 of pipeline for natural gas

(2021 Vintage,	Overnight	AFUDC	Interconnection	Total All-In	
2016 U.S. Dollars)	Capital		Costs	Capital cost	
СССТ	943	94	91	1,128	
Frame Peaker	664	66	134	865	
Recip Peaker	1,256	126	143	1,525	
Solar Utility	1,264	126	100	1,489	
Solar Residential	2,957	296		3,252	
Onshore Wind – WA	1,421	142	47	1,610	
Onshore Wind – MT	1,421	142	44	1,608	
Onshore Wind – ID/WY	1,421	142		1,563	\leq
Offshore Wind	4,377	438	65	4,878	
Pumped Storage	2,145	214	47	2,406	
Battery (4hr, Li-Ion)	1,542	154	367	2,063	
Battery (2hr, Li-Ion)	849	85	367	1,301	
Battery (4hr, Flow)	2,051	205	367	2,624	
Battery (6hr, Flow)	2,860	286	367	3,513	7
Solar + Battery	1,901	190	420	2,511	F
Wind + Battery	2,043	204	373	2,620	E
Biomass	5,246	525	607	6,378	n

(\$/kW)		Transmission Cost	Total Cost	
-	ID Wind	1,363	2,926	
\checkmark	WY W. Wind	1,641	3,504	
	WY E. Wind	2,157	3,720	

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Consultation update – operating and maintenance costs

(2021 Vintage,	Fix O&M		Variable O&M			
2016 U.S. Dollars)	(\$/kW-yr)		(\$/MWh)			
	2019 IRP	2021 IRP draft	2021 IRP	2019 IRP	2021 IRP draft	2021 IRP
			proposed			proposed
CCCT	13.68	12.12	11.66	2.44	3.18	3.01
Frame Peaker	3.80	6.95	6.95	6.34	7.12	7.12
Recip Peaker	3.61	5.80	5.80	5.12	6.38	6.38
Solar Utility	21.16	15.77	20.14	0.00	0.00	0.00
Solar Residential						
Onshore Wind	35.75	36.79	36.79	0.00	0.00	0.00
Offshore Wind	115.96	99.73	99.73	0.00	0.00	0.00
Pumped Storage	14.06	14.84	14.50	0.00	0.00	0.00
Battery (4hr, Li-Ion)	31.08	39.42	28.93	0.00	0.00	0.00
Battery (2hr, Li-Ion)	19.85		21.28	0.00		0.00
Battery (4hr, Flow)	29.76		19.71	0.00		0.00
Battery (6hr, Flow)	38.91		34.40	0.00		0.00
Solar + Battery	41.63		41.42			0.00
Wind + Battery			58.06			0.00
Biomass	333.58	187.53	187.53	6.38	5.62	5.62



20.14 + 22.20 + 8.28 = 50.63 \$/kW-yr

Question and Answer

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Next steps

- Submit Feedback Form to PSE by July 7, 2020
- A recording from today's webinar will be posted to the website **tomorrow**
- PSE will compile all the feedback in the Feedback Report and post all the questions by July 14
- By **July 21**, PSE will make a decision on what transmission constraints to use. The documentation for the decision made will be released in a Consultation Update that will be posted to the website



Details of upcoming meetings can be found at <u>pse.com/irp</u>

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Thank you for your attention and input.

Please complete your Feedback Form by July 7, 2020

We look forward to your attendance at PSE's next public participation webinar: Demand Side Resources July 14, 2020



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