The Evolving Grid

Update on the State of Transmission

Oregon Senate Interim Committee on Energy and Environment

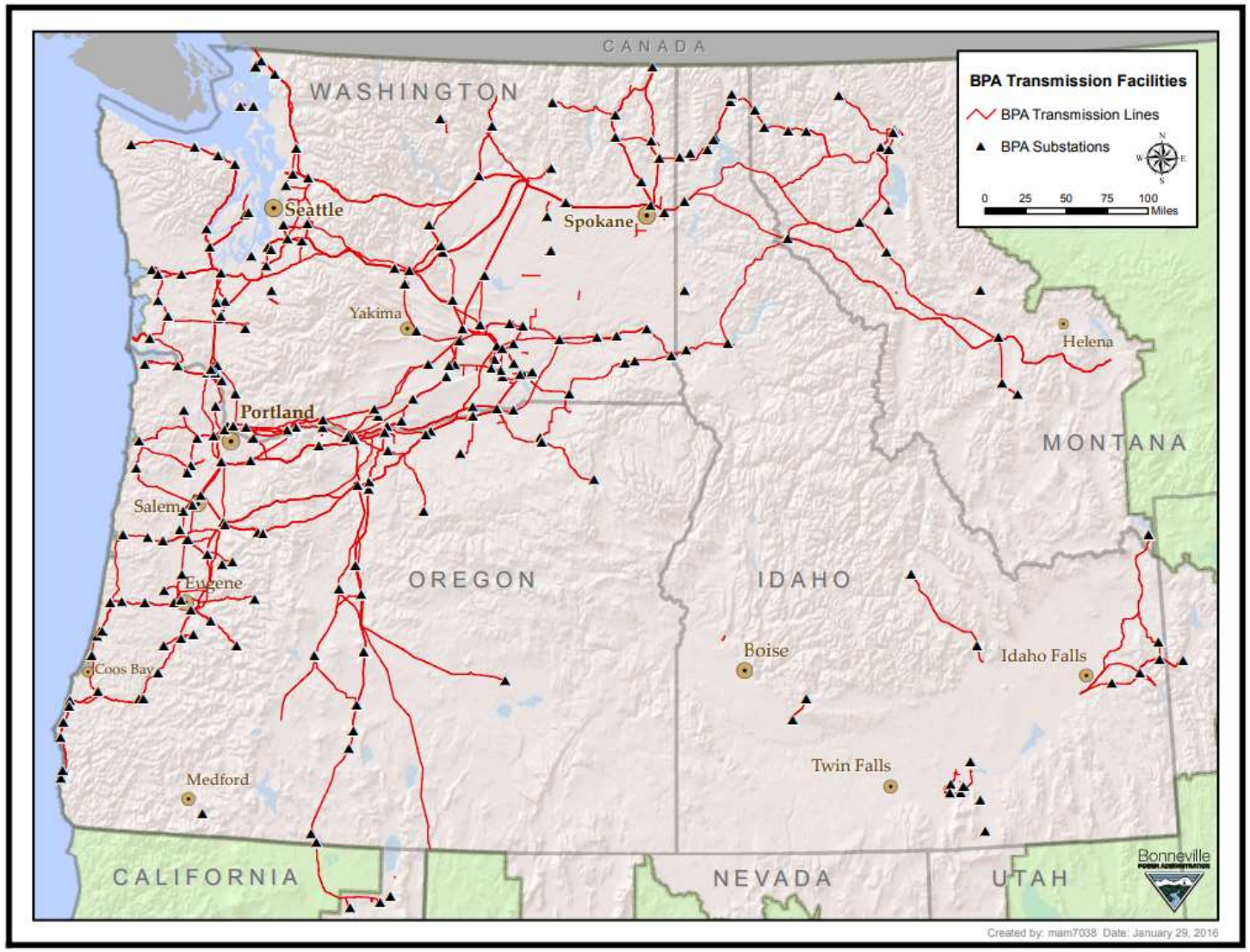
September 28, 2023

Today's Goal

The electric power industry is undergoing a generational transformation and transmission is the key to integrating carbon free resources. Today's goal is to raise awareness of:

- Changes in regional transmission needs
- Bonneville Transmission efforts underway to address those changes
- What customers and the region can expect in the future as we navigate the changing landscape

BPA Infrastructure



Key Influences and Drivers of Change

WA & OR Regional Clean Energy Targets & Policies

2030

National: Net greenhouse gas emissions to 50-52% below 2005 levels in 2030
Washington: All electric utilities greenhouse gas neutral
Oregon: 80% below baseline

2035

Washington: 100% clean electricity by 2035
Oregon: 95% below baseline

2040

Oregon: 100% below baseline

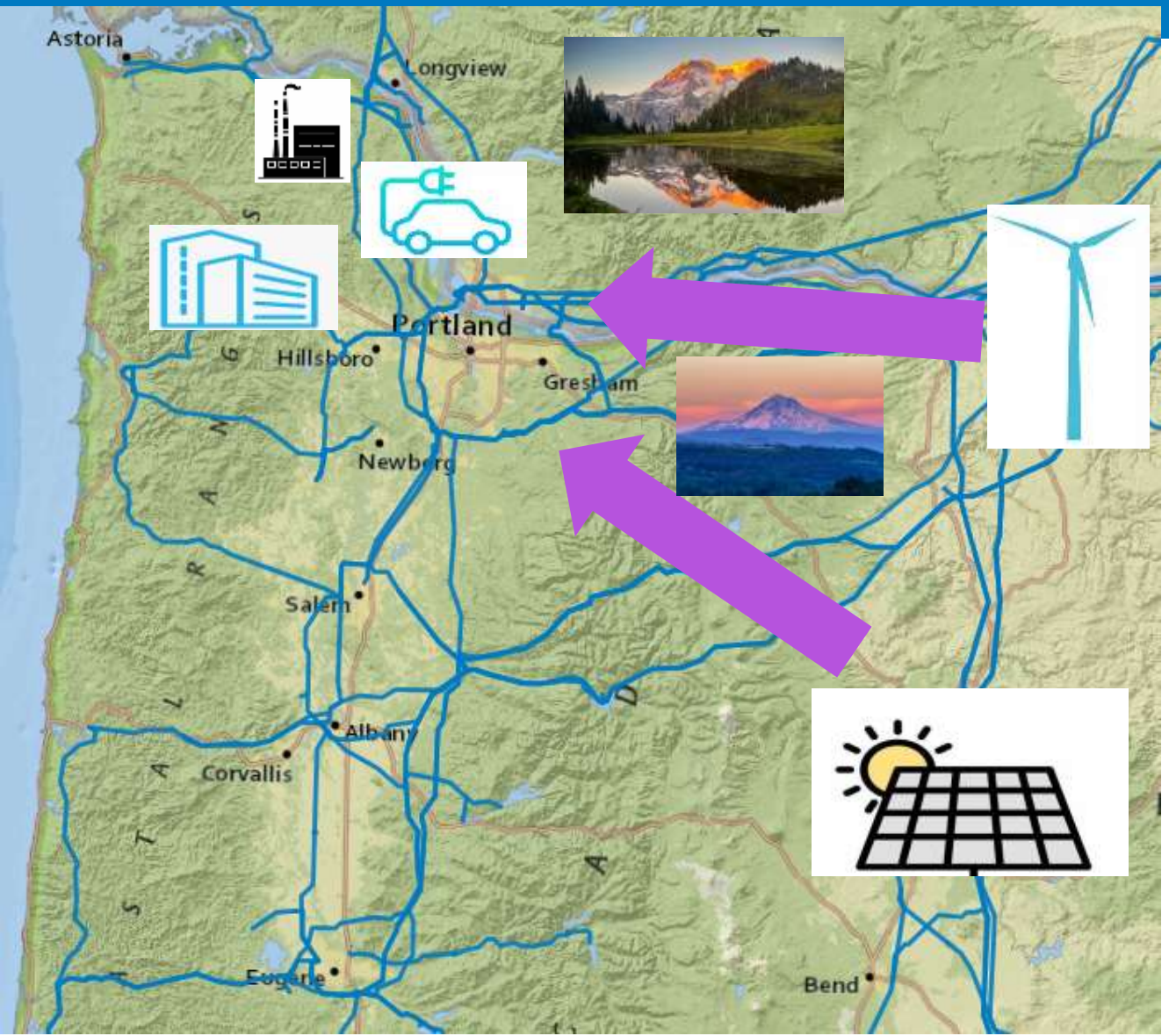
2045

Washington: All electric utilities 100% clean resources

2050

National: Net-zero greenhouse gas emissions by no later than 2050

PNW Landscape

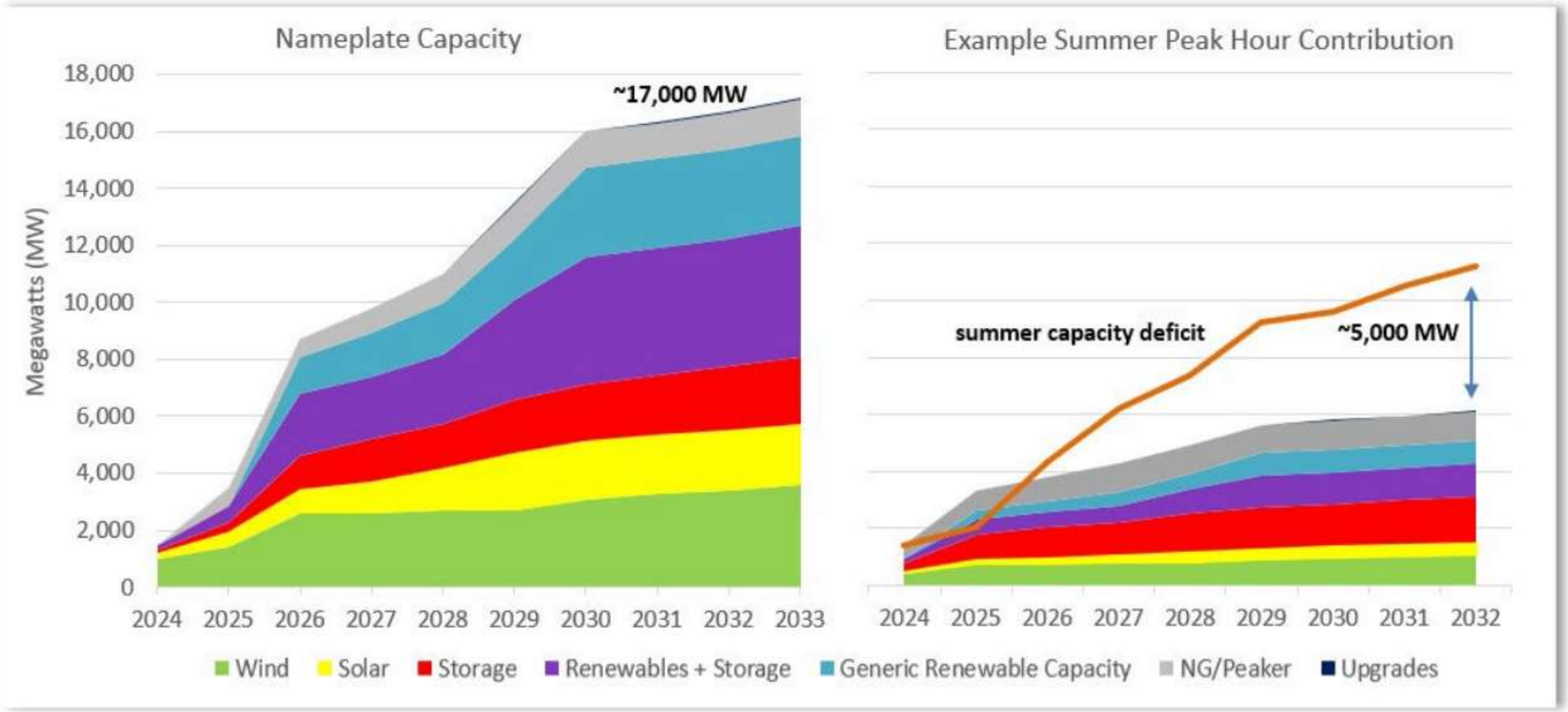


Drivers:

- Clean Energy Policies
- Electrification (transportation and buildings)
- Industrial load growth in Silicone Forest

- Transmission to enable electric load growth (industrial and electrification)
- Transmission to deliver remote, clean resources to Load Centers
- Transmission to meet resiliency needs

Expected Northwest Resource Additions (source PNUCC)



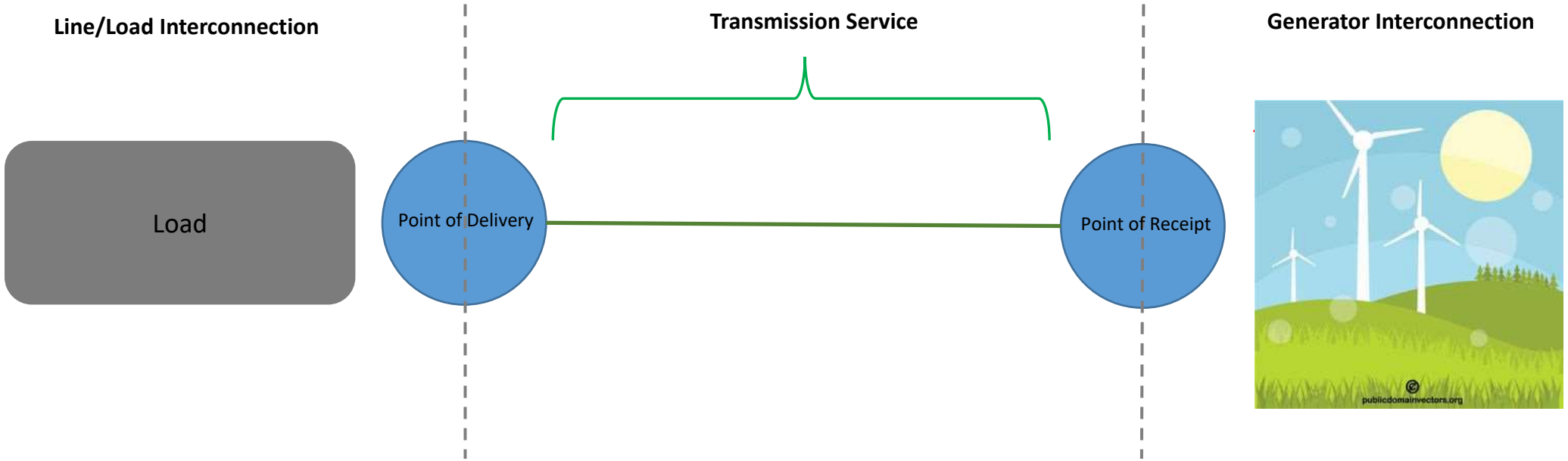
The region is expected get 17GW of new generating capacity in the next decade, mostly renewables and storage (2022 estimate was less than 12 GW of new resources)

Still, the region is expected be short on dispatchable capacity

Transmission Picture

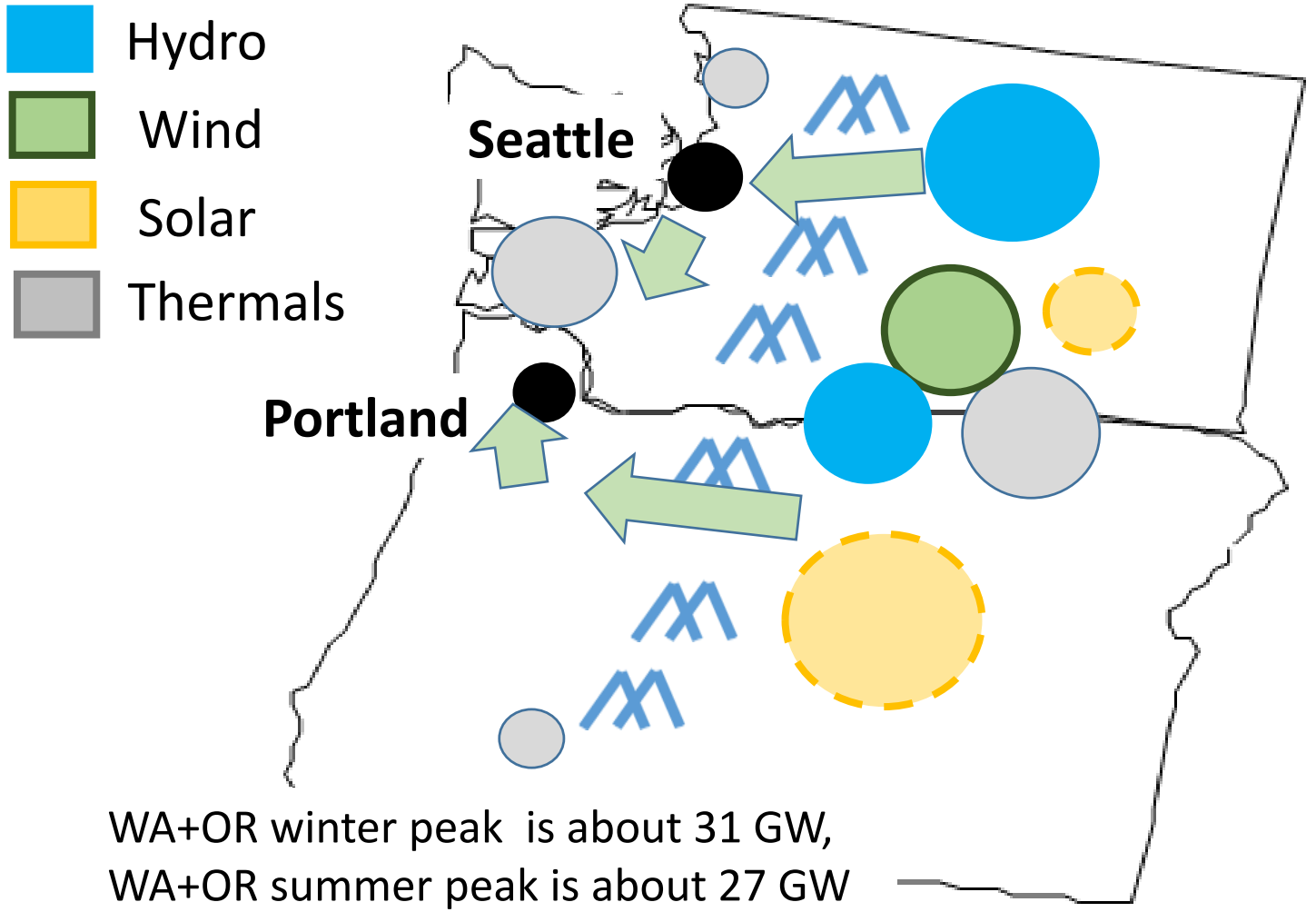
BPA administers three Queues as a part of the Planning process:

- Line/Load Interconnection
- Transmission Service
- Generator Interconnection



All three of these Queues are experiencing exponential growth.

Shift in Resource Locations



WA+OR winter peak is about 31 GW,
WA+OR summer peak is about 27 GW

Oregon and Washington states have about 8 GW of thermal generators.
About 5 GW is located on the west side of Cascades near Seattle and Portland load centers

Most of the existing and proposed renewables (wind and solar) are located on the east side of Cascades and require transmission infrastructure improvements to get to load centers on the west side:

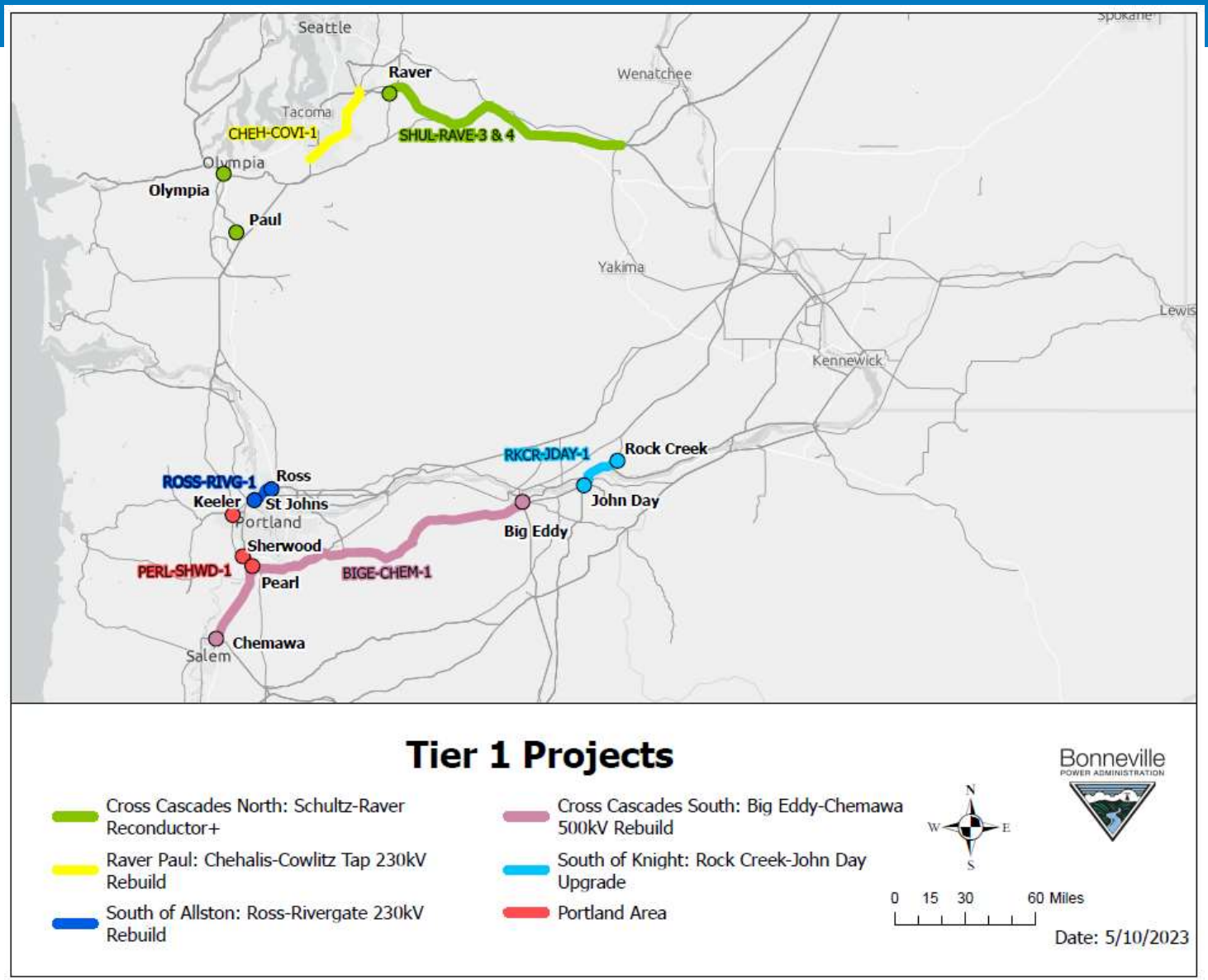
- Cross-Cascades North
- Cross-Cascades South
- Raver-Paul
- North of Pearl

Projects Needed to Meet the Needs of the Evolving Grid

Evolving Grid Projects

The following projects are needed in many future scenarios for reliability, expanded load service, and as renewable resources seek delivery to load:

* BPA has several Line and Load interconnections requests to enable economic development in the region. Additional projects will be required to enable these requests.



Additional Analysis working towards 2030 State Clean Energy Goals

2030 Studies

- 2030 BPA Decarbonization Studies
  - At what level can the Pacific Northwest loads can be served entirely with carbon-free resources (hydro, wind, solar and nuclear)?

- Western Power Pool 2030 Extreme Weather Studies
  - Transmission adequacy -- Does the region have adequate transmission to serve extreme winter and summer peak loads?
  - Transmission resiliency -- Is transmission resilient to continue reliable operations during large wildfire events?

2030 Decarbonization Studies

- Puget Sound Area studies (winter peaking)
  - We were able to reliably serve up to 90th percentile winter loads in Puget Sound Area with carbon-free resources east of Cascades with planned system upgrades*
  - 1,500 MW of dispatchable resources were needed in Puget Sound during winter peak loads

- Portland Area studies (summer peaking)
  - BPA's transmission system is capable of serving up to 80th percentile of expected Portland Area loads with modest upgrades planned to be in place by 2028.
  - Rapid load growth in Portland Area is likely; additional projects will be needed.

* Under all lines in service, additional local generation is likely needed under outage conditions

2030 Western Power Pool Extreme Weather Study

- The studies are in progress, the final report is scheduled to be released in Spring 2024

- Preliminary findings from extreme weather studies
  - Pacific Northwest needs to keep existing dispatchable resources to maintain reliable load service during extreme winter and summer peaks
  - With planned upgrades, the transmission system is adequate to serve winter and summer peaks in states of OR and WA

- Wildfire studies are in progress

Regional/Inter-regional Transmission Planning Discussions

Overview of Proposal

- BPA is in discussions with several regional and inter-regional entities to develop an effort that can better support future needs on a broader scale and scope:
  - Establish solutions to support a future clean energy grid
  - Address the long-term uncertainties and needs across diverse geographical regions of the western interconnection
  - Inter-regional perspective (beyond the Pacific Northwest/BPA Balancing Authority)
  - 10- 20 years outlook
- General Themes:
  - Different: Create a holistic and a creative approach that results in an actionable transmission plan for the western interconnect that considers a longer-term outlook under different plausible scenarios.
  - Expedient: Leverage existing tools, capabilities and other inter-regional resources in an agile approach (must balance with inclusivity)
  - Inclusive: Provide meaningful opportunities for stakeholders and regulators to provide input (must balance with expediency)

Next Steps

- The Western Power Pool will lead an informal engagement with a small set of stakeholders until a formal structure for this initiative can be proposed.
  - At a minimum, the approach would include engaging with a broader set of stakeholders including state regulators or their representatives.
  - No detail proposal at this time but expect within weeks/month a straw proposal for the broad set of stakeholders to consider and provide input.
- Expected deliverables and milestones
  - Any formal structure would include specific deliverables and a roadmap/timeline.
  - Any deliverable will include an opportunity for regional consideration and input

Queue Management Updates: Generation Interconnection

Generator Interconnection Reform

- BPA and the region have been engaged in settlement discussions for TC-25, a special Terms & Conditions proceeding to address accelerating adoption of and execution of certain reforms to BPA's large generator interconnection process.
- TC-25 primarily based on FERC-approved reforms:
  - Cluster study approach (all eligible requests studied simultaneously)
  - First-come, First-serve approach
- BPA staff issued its final settlement proposal and customers had until September 15 to notify BPA staff if they planned to object to the settlement.
  - Settlement and supporting documents are posted to the TC-25 Proceeding web page.
- BPA received no responses objecting to the proposed TC-25 settlement agreement therefore staff will move forward with proposing adoption of the settlement in the TC-25 tariff proceeding, which BPA expects to commence this fall.


Questions

APPENDIX

Helpful BPA Links

BPA Transmission Plan: https://www.bpa.gov/-/media/Aep/transmission/attachment-k/2022-bpa-transmission-plan.pdf

Transmission Availability : https://www.bpa.gov/energy-and-services/transmission/transmission-availability

Becoming a BPA Customer: https://www.bpa.gov/energy-and-services/transmission/becoming-a-transmission-services-customer

- *For assistance in the BPA application process, call BPA Transmission Sales (360) 619-6016 and request the assignment of a BPA Transmission Services Account Executive.*

Interconnection: https://www.bpa.gov/energy-and-services/transmission/interconnection

Transmission Service Request Study: https://www.bpa.gov/energy-and-services/transmission/acquiring-transmission/tsep

Rapidly Evolving NW Landscape

2000s
- California Energy Crisis, shutdown of aluminum industry
- Addition of 5.5 GW of natural gas plants in the NW
- Start of large scale wind integration

BPA Grand Coulee – Bell 500 kV
BPA Schultz – Wautoma 500 kV
BPA John Day, Rock Creek, Shepherd Flats, Central Ferry wind hubs

2010s
- Large scale wind integration continues, reached 7 GW, then slowed down
- Anemic load growth

BPA Bakeoven 500 kV series capacitors
BPA Central Ferry – Lower Monumental 500 kV
BPA McNary – John Day 500 kV
BPA Big Eddy – Knight 500 kV
Pacific HVDC Intertie Celilo upgrade

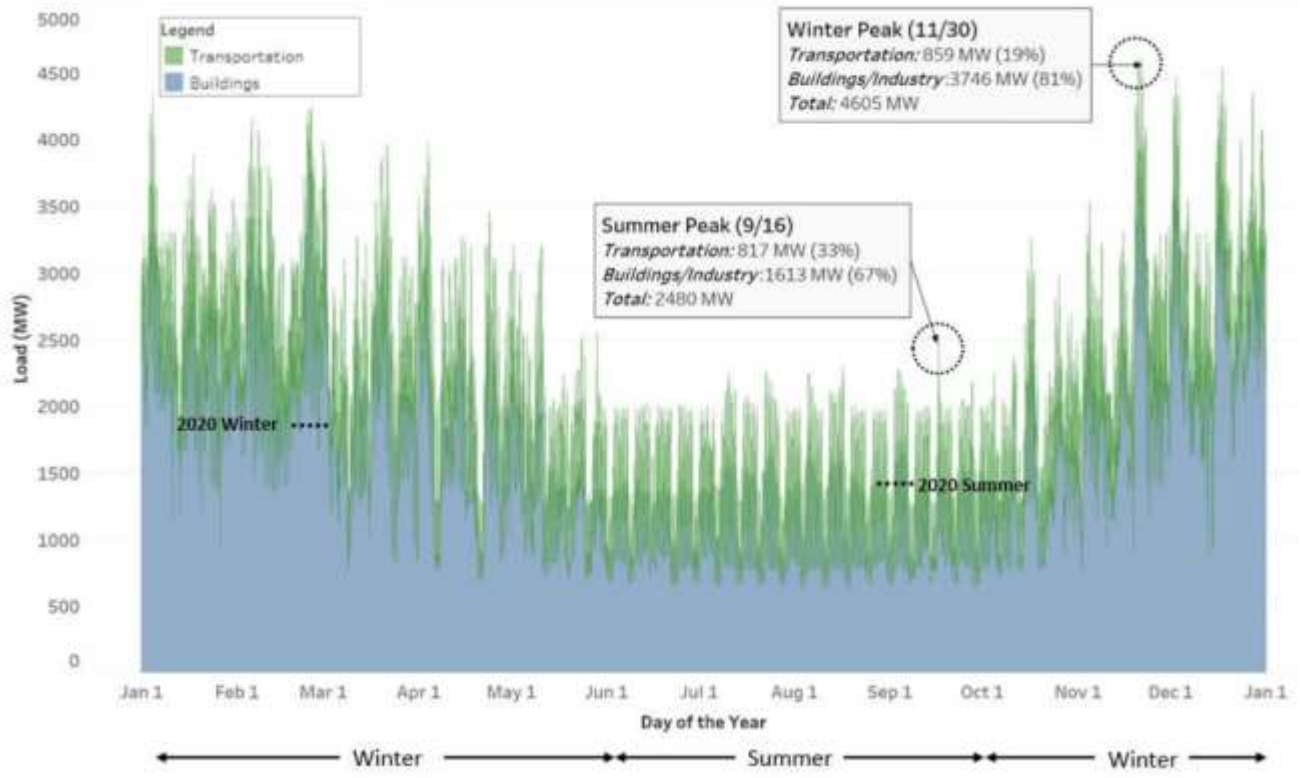
2020s
- Progressive de-carbonization policies in states of WA and OR
- Accelerated need for carbon-free resources
- Load growth accelerating – high tech industries attracted to NW
- Climate change challenges - extreme temperatures and wildfires

BPA Evolving Grid Projects

Electrification and Resiliency

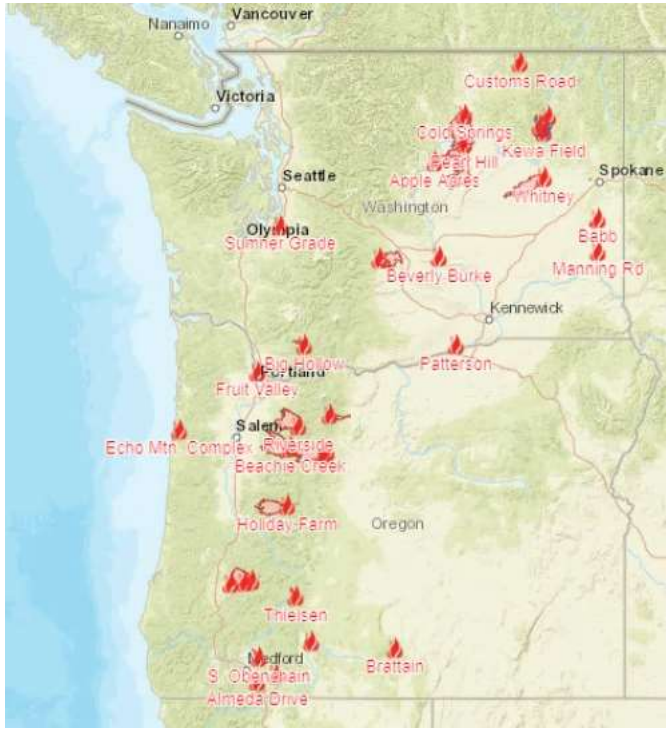
Studies show that impacts of full electrification adoption could be significant for load service – up to 75% increase in summer, 260% increase in winter

Source: EPRI - SCL Electrification Assessment



As sectors electrify, dependence on reliable and quality service increases, especially during extreme weather events.

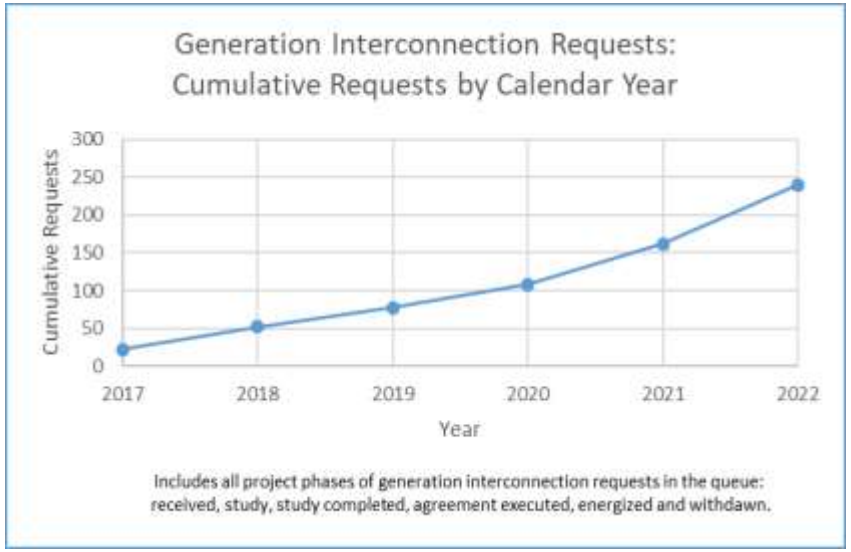
WA AG Calls for Banning Power Shut-offs[1] during heat waves

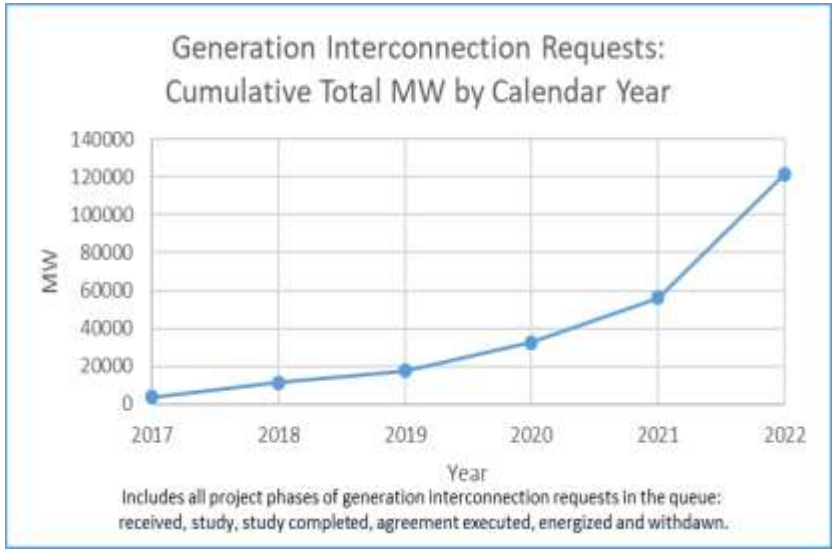


1 – Shut-offs refer to actions taken against delinquent accounts

Generation Interconnection

- Traditionally, 10-15% of Generation interconnection requests follow through to energization
- BPA has a proven track record and successfully integrated 7 GW of wind and 525 MWs of Solar, in part through successful builds of Coulee-Bell, Kangley-Echo Lake, Schultz-Wautoma, Big Eddy-Knight, McNary-John Day, Central Ferry – Lomo
- BPA's Generation Interconnection Queue is experiencing a significant increase in requests with no signs of easing
  - Majority of the requests are in the Central Oregon, Tri-Cities, Mid-C and Umatilla areas
- Washington CETA, Oregon HB2021, BIL and IRA likely to keep demand high for sometime
- FERC issued a Noticed of Proposed Rulemaking that takes aim at this nationwide problem.





BPA Generation Interconnection Queue

Photovoltaic

Fuel Source ● Solar

Total
49.4
Gigawatts

Top Counties	
County	GW
Sherman	8.0
Crook	7.3
Morrow	4.9
Benton	4.5
Wasco	4.2
Klamath	2.9
Grant	2.9
Marion	2.7

Wind Turbine

Fuel Source ● Wind Turbine

Total
21.4
Gigawatts

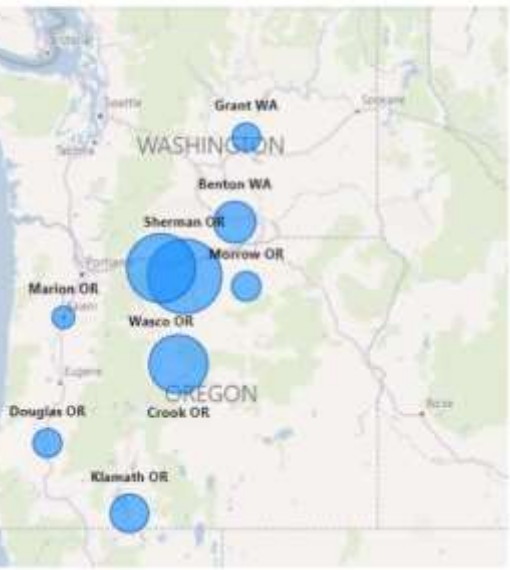
Top Counties	
County	GW
Douglas	3.1
Gilliam	2.9
Grays Harbor	2.5
Lane	1.7
Columbia	1.4
Sherman	1.4
Morrow	1.3
Klickitat	1.3
Wasco	1.3
Garfield	1.2
Benton	1.2

Energy Storage

Fuel Source ● Battery

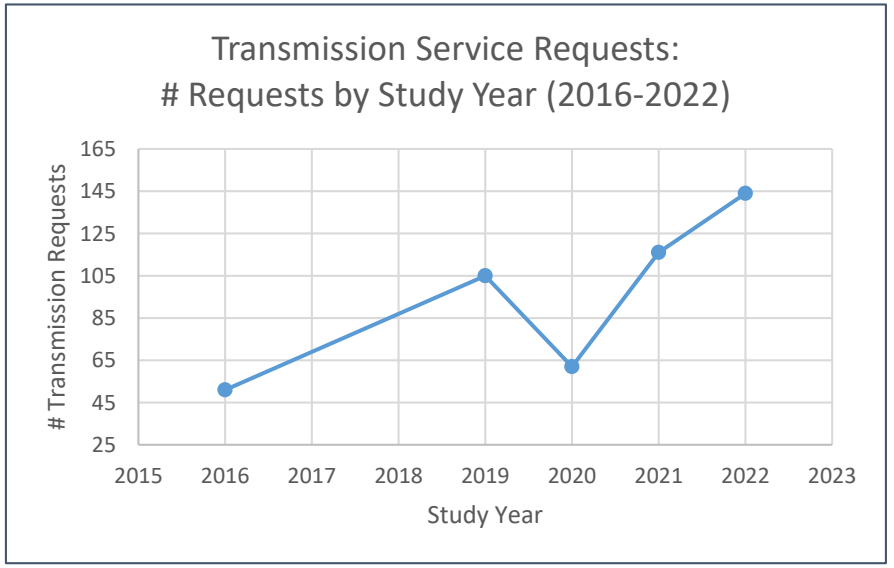
Total
51.5
Gigawatts

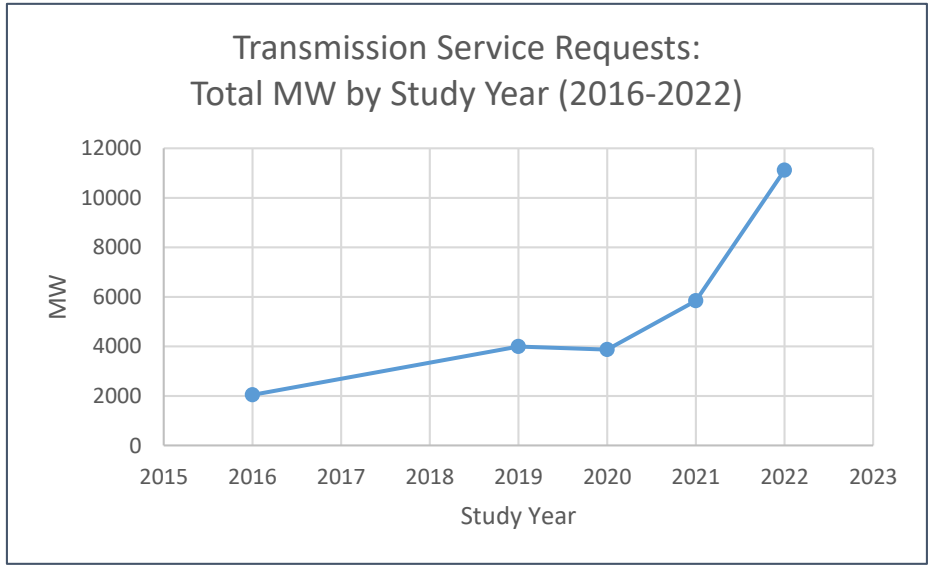
Top Counties	
County	GW
Sherman	6.2
Wasco	5.8
Crook	5.1
Benton	4.0
Klamath	3.7
Morrow	3.1
Douglas	3.0
Grant	3.0
Marion	2.7



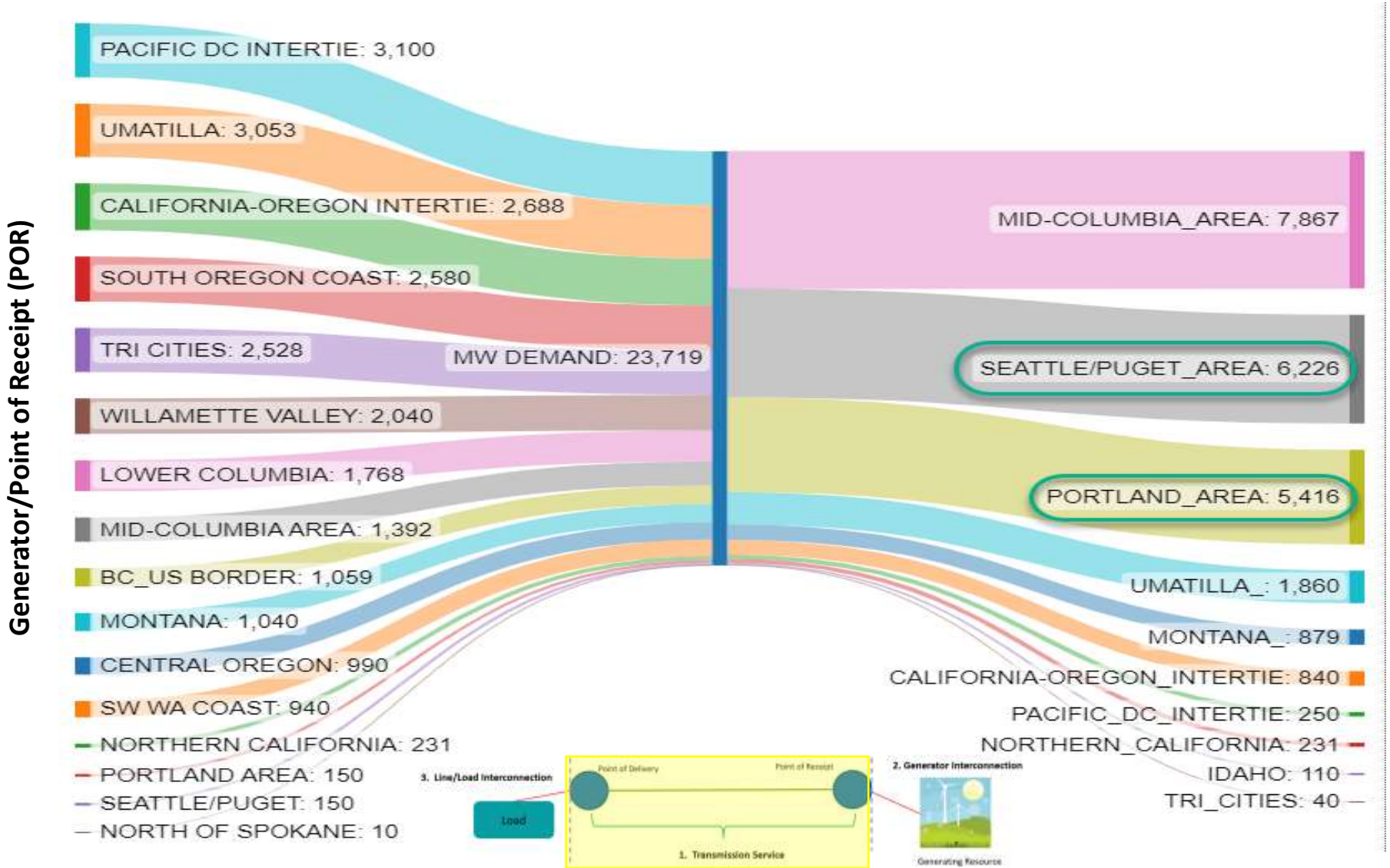
Transmission Service Requests

- WA & OR Clean Energy policies are driving an increase in TSR submittals
  - Since 2019, BPA has studied over 17,000 MW of requested transmission service primarily delivering to the Portland metro area or the Seattle/Puget Sound area
  - According to recent IRP data, the clean resource need to serve these regions is expected to be around 6,000 MW in total by 2030
  - The 2022 Cluster Study had more requested demand (~11.1 GW) than the 2020 and 2021 studies combined (~10 GW).
  - The 2023 Cluster Study will include ~17 GW of requests.
  - The requested transmission service is far outpacing the regional demand



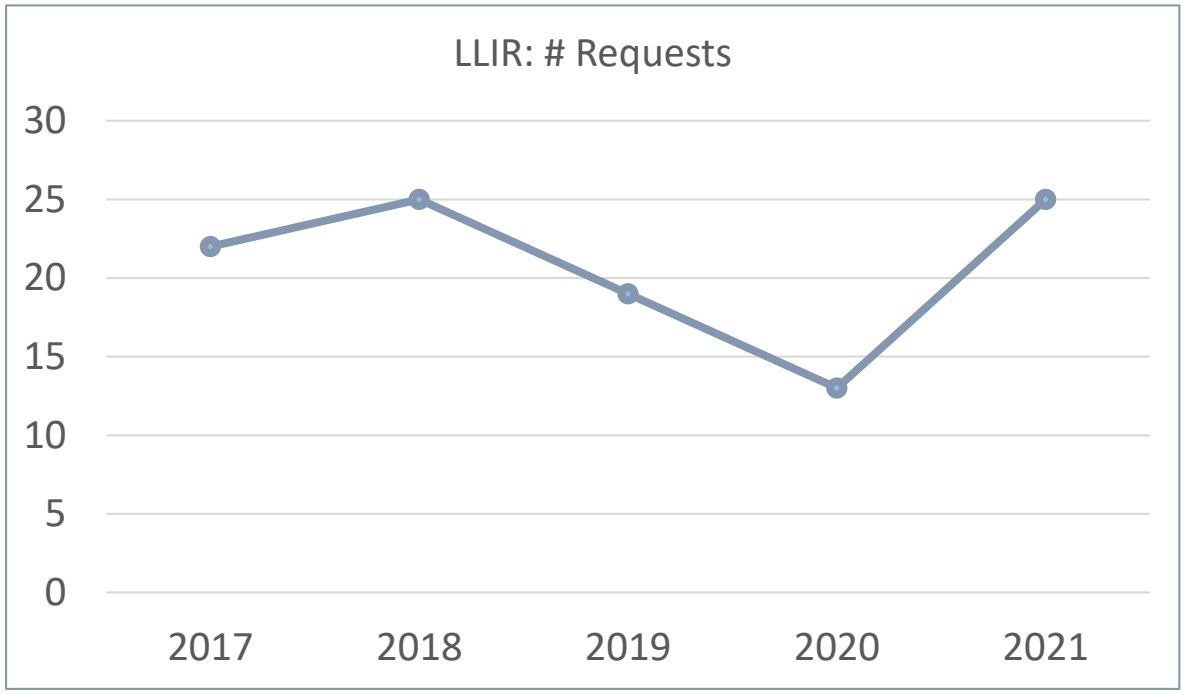


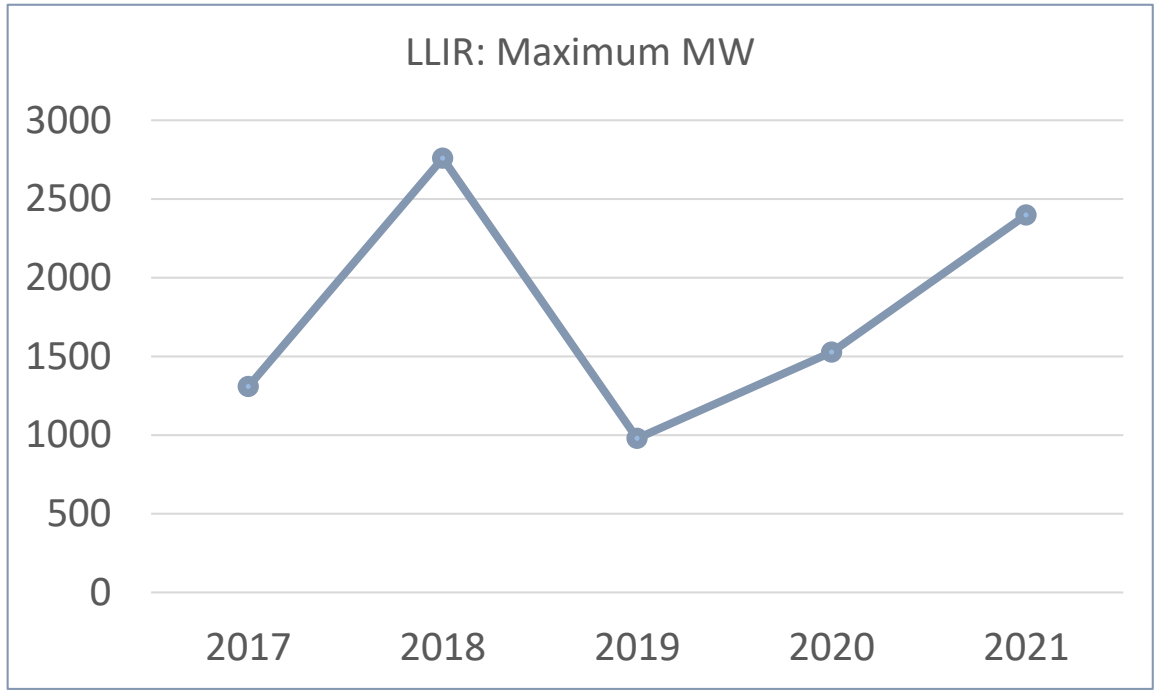
2023 Cluster Study Transmission Queue Details



Line & Load Interconnection Queue Activity

- Largest demand for growth around the system include **Central Oregon, Umatilla**, Pend Oreille, **Hillsboro/Forest Grove**, Longview/Cowlitz, Tri-Cities





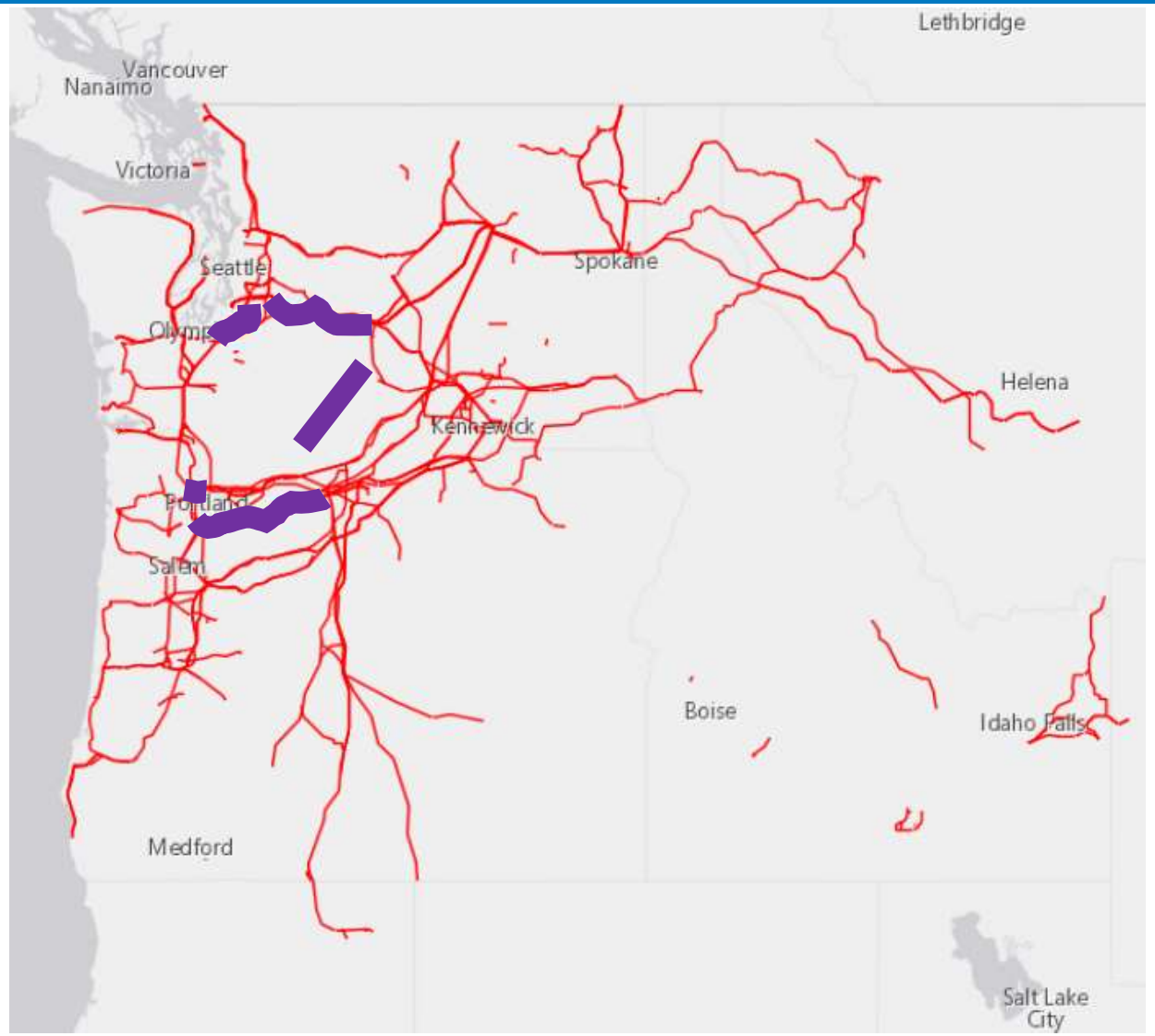
Load & Queue Growth

- Based on NT customer load forecasts growth is heavily concentrated in a few areas
  - 5 customers are forecasting 10-year load growth between 100% - 375%
  - Data center development is driving most of this growth
  - The majority of NT customers are forecasting slow or no load growth

TSEP Results Project Summary

The following projects are needed in many future scenarios for reliability, expanded load service, and as renewable resources seek delivery to load:

1. Portland Area Reinforcement
2. Cross-Cascades South (Big Eddy-Chemawa 500 kV Rebuild
3. Chehalis-Cowlitz Tap 230 kV Rebuild
4. Cross-Cascades North Reinforcement
5. Ross – Rivergate 230 kV Rebuild
6. Rock Creek-John Day 500 kV Rebuild

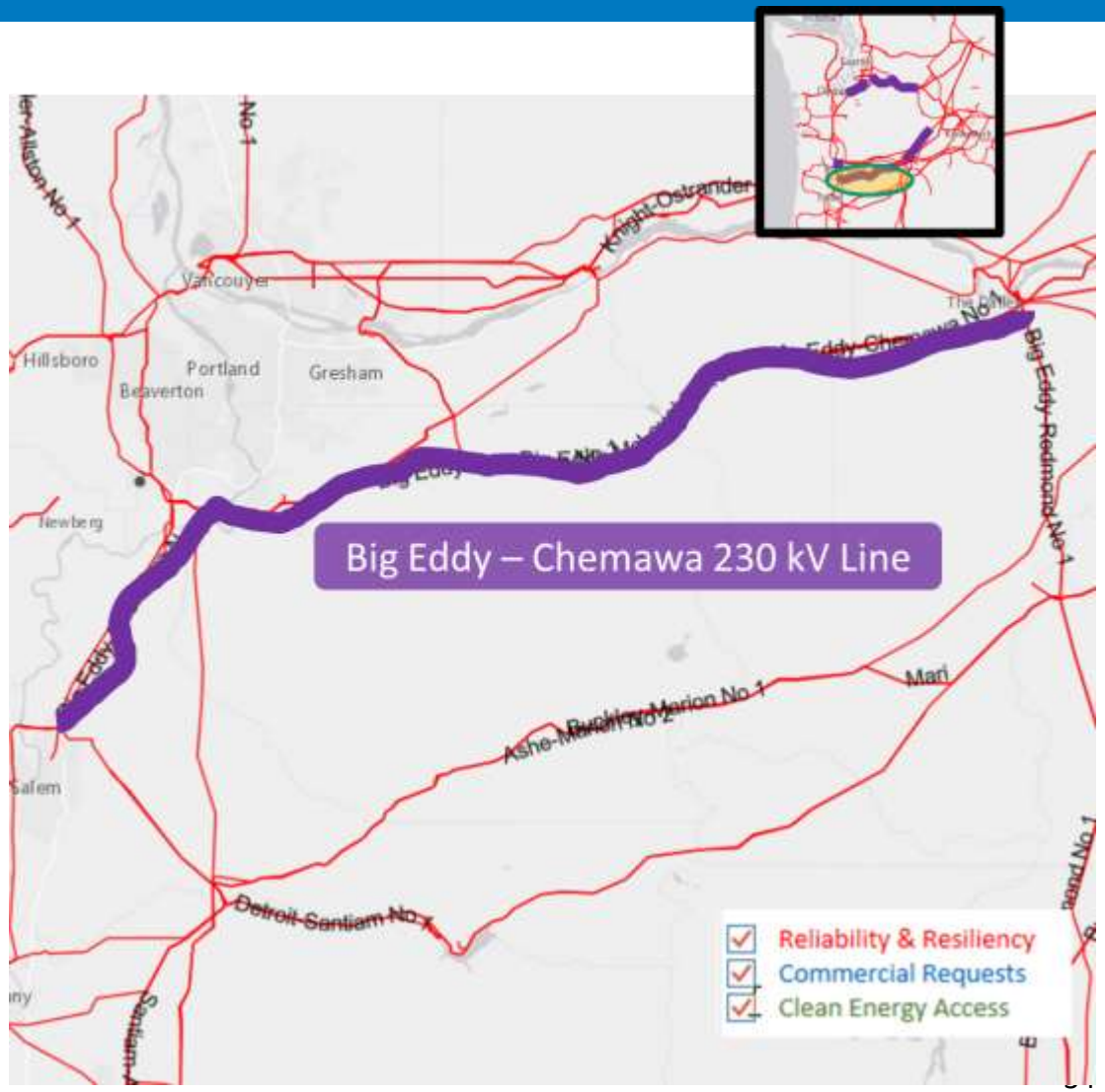


Portland Area

- Description:
  - Add second 500/230-kV transformer at Keeler substation
  - Develop Keeler 500-kV bus into breaker and half configuration
  - Re-termination and upgrades to Pearl – Sherwood 230-kV lines
- Estimated Cost: TBD
- Drivers:
  - TPL-001 Reliability Compliance
  - Rapid Load growth in Hillsboro
  - Enabling delivery of renewable resources to Portland
- Status:
  - Identified in 2021 and 2022 System Assessments
  - Preliminary Scoping

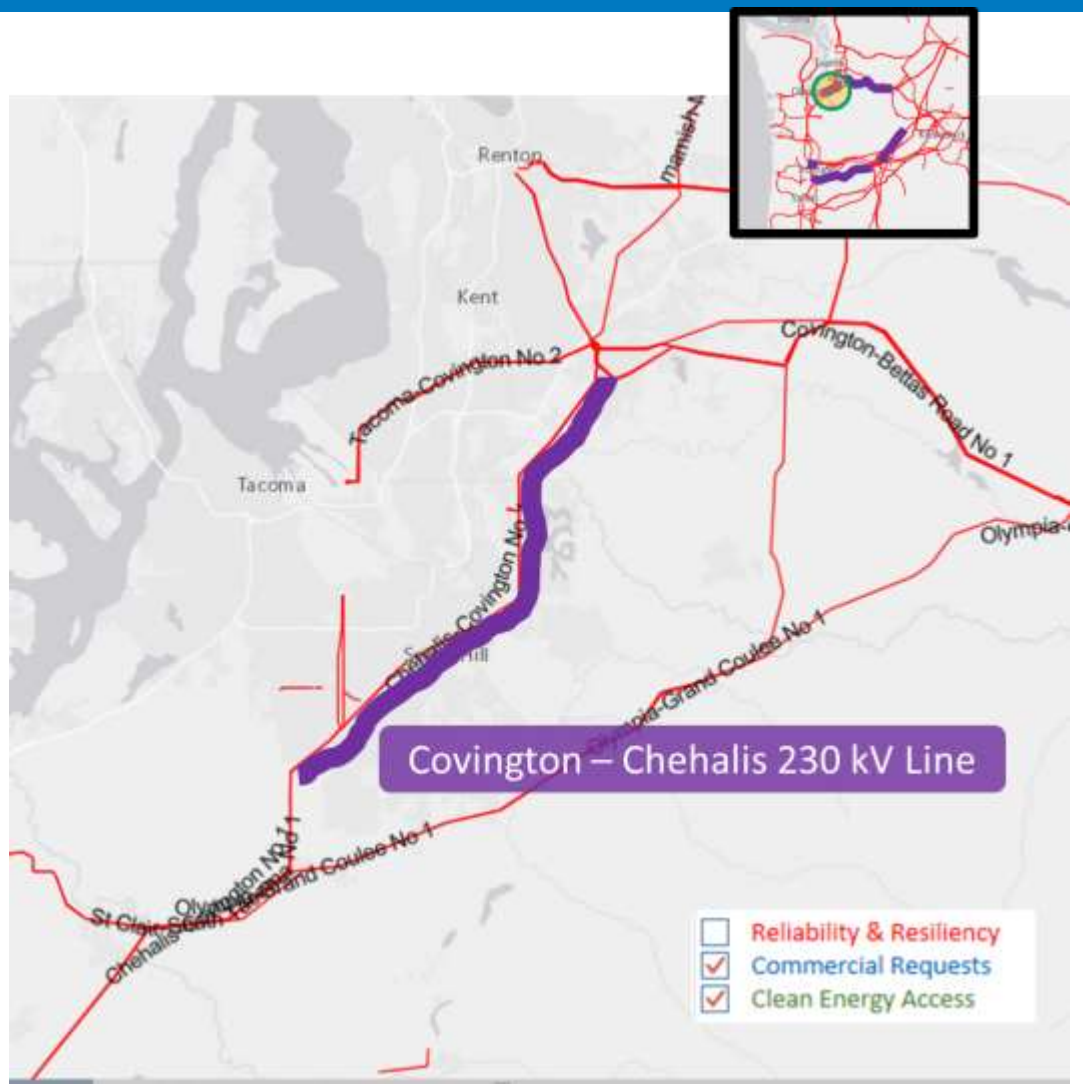
Cross-Cascades South Reinforcement

- Description:
  - Rebuild existing Big Eddy-Chemawa 230kV line as Big Eddy-Ostrander 500kV (70 mi), Ostrander-Pearl 500kV (20 mi), re-terminate the Pearl – Chemawa 230kV
- Estimated Cost: $233M (Direct)
- Drivers:
  - Enabling delivery of renewable resources to Portland
  - Resiliency of load service in Portland Area
- Status:
  - Identified by 2022 Transmission Service Expansion Process
  - Project Initiation Phase
  - PEAs have been signed (3,920 MW)
  - Proposed In Service Date: 2030



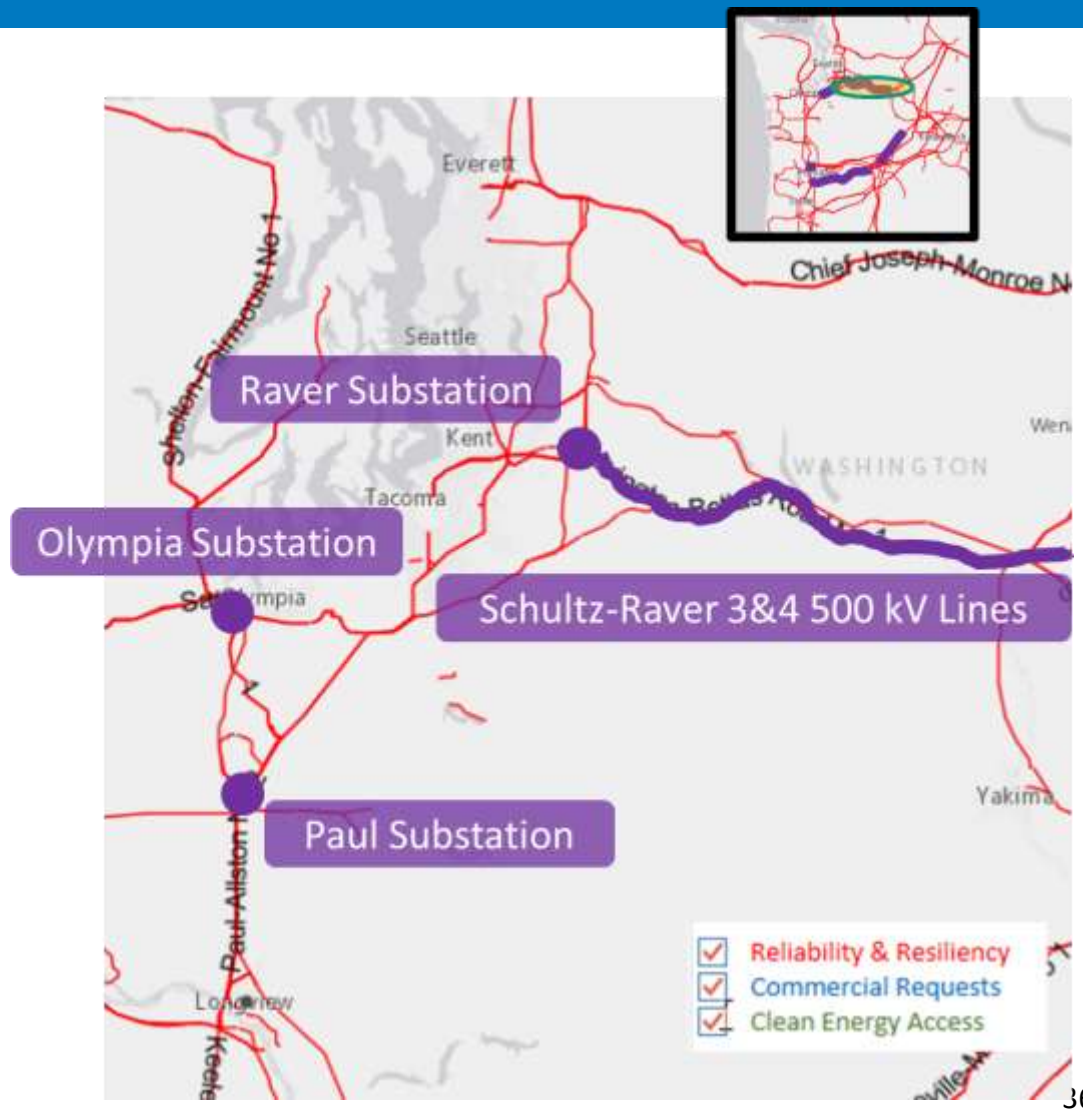
Raver-Paul Reinforcement

- Description:
  - Rebuild 53 miles of Cowlitz-Chehalis section of Covington-Chehalis 230kV line
- Estimated Cost: $35M (Direct)
- Drivers:
  - Enabling delivery of renewable resources to Portland
  - Mitigate impact of I5 gas generation retirement
- Status:
  - Identified by 2022 Transmission Service Expansion Process
  - Scoping Phase
  - PEAs have been signed (1,790 MW)
  - Proposed In Service Date: 2028



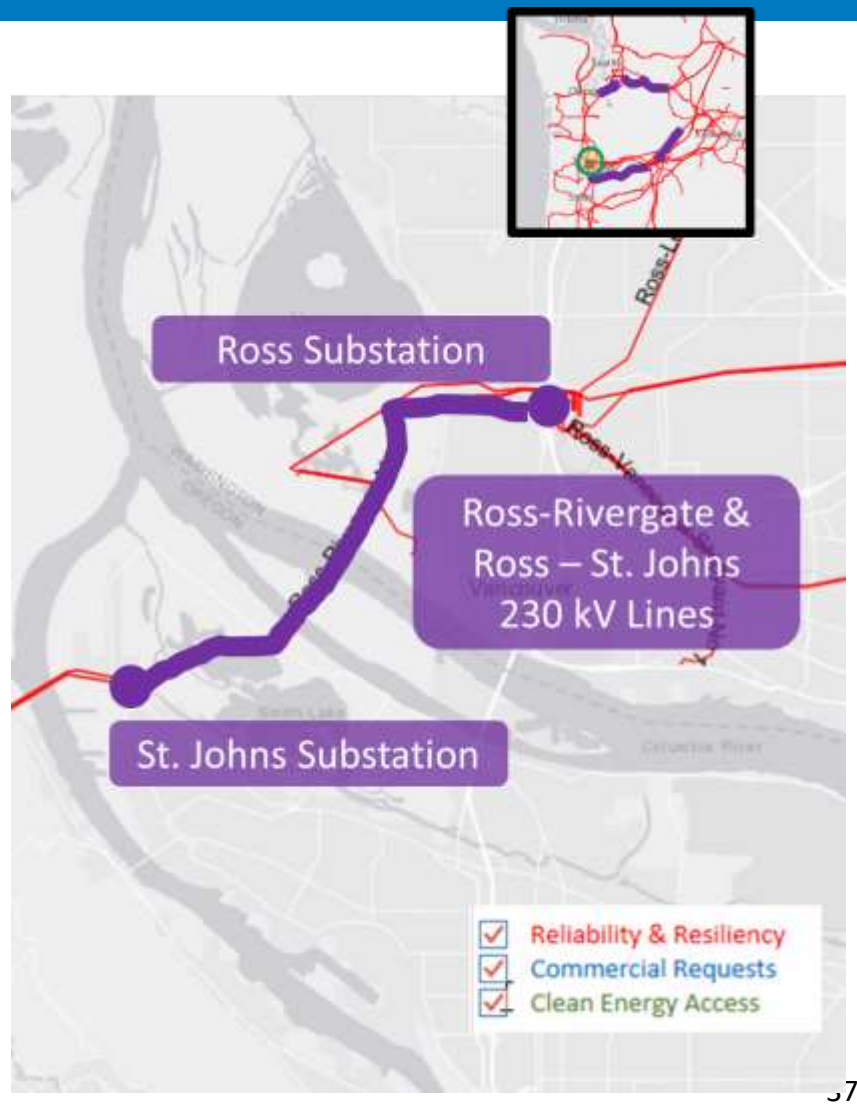
Cross-Cascades North Reinforcement

- Description:
  - Reconductor Schultz-Raver 3 & 4 500kV lines (100 mi total)
  - Schultz-Raver #4 500kV series capacitor upgrade (Phase 2)
  - Olympia 230kV 350 MVAR Statcom addition
  - Paul 500kV 221MVAR shunt capacitor addition
- Estimated Cost: $196M (Direct)
- Drivers:
  - Enabling delivery of renewable resources to Puget Sound
  - Resiliency of load service in Puget Sound and Olympic Peninsula
- Status:
  - Identified by 2022 Transmission Service Expansion Process
  - Project Initiation Phase
  - PEAs have been signed (3,140 MW)
  - Proposed In Service Date: 2030



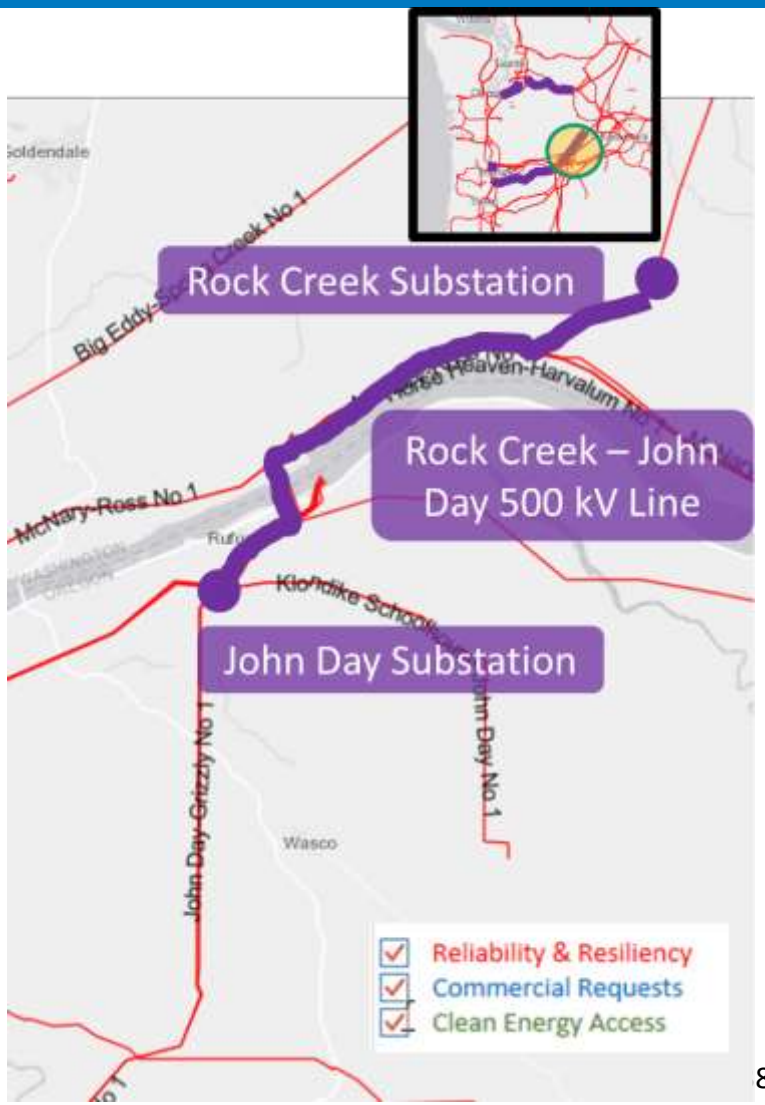
Ross-Rivergate

- Description:
  - Rebuild Ross – Rivergate / Ross – St. Johns 230kV line (7.5 mi)
- Estimated Cost: $149M (Direct)
- Drivers:
  - Enabling delivery of renewable resources to Portland
  - Resiliency of load service in Portland
- Status:
  - First identified in 2017 SOA no-build ADF
  - Identified by 2022 Transmission Service Expansion Process
  - Project Initiation Phase
  - PEAs have been signed (3,570 MW)
  - Proposed In Service Date: 2030



South of Rock Creek Reinforcement

- Description:
  - Rebuild Rock Creek – John Day 500kV line (20 mi)
- Estimated Cost: $39M (Direct)
- Drivers:
  - Enabling integration of renewable resources in Central Washington
  - Economical upgrade to the heart of the 500kV system, enabling overall capacity.
- Status:
  - Identified by 2022 Transmission Service Expansion Process
  - Project Initiation Phase
  - PEAs have been signed (630 MW)
  - Proposed In Service Date: 2028



Evolving Grid Projects