Northwest **Power** and **Conservation** Council

May 6, 2025

MEMORANDUM

TO: **Council Members**

FROM: **Dor Hirsh Bar Gai, Power System Analyst**

SUBJECT: **Final Approach to Wildfire Operational Risk Modeling**

BACKGROUND:

Presenter: Dor Hirsh Bar Gai

Summary: Staff will present the final approach to modeling the operational risks from wildfires.

Wildfires impact the power system in adverse ways and may pose adequacy challenges as well as influence new resource acquisition decisions. Staff worked with advisory committees and experts to capture the operational risk of transmission derating, smoke-induced reduction of solar generation capacity factors, and considerations of the location value of resources due to smoke cover. By embedding the operational risk of wildfires in the modeling and data, the goal is to have "wildfire-informed" planning included in across the scenario modeling.

Relevance: The Council is tasked with planning for an adequate, efficient, economic and reliable power supply. An important element is to represent the existing bulk power system and new resource potential – generation, loads, and transmission – and risks as best as possible. As recent years experienced several major wildfires in the Pacific Northwest that had significant impacts on the power system, re-evaluating and enhancing the Council's modeling representation of wildfires will help inform a more robust set of recommendations in the Ninth Power Plan.

Workplan: B. Preparation of Tools and Data for the Ninth Power Plan

Background: The previous wildfire representation in Council modeling work (2027 Adequacy Assessment, published January 2023) focused on creating a wildfire scenario that derated specific transmission lines in the region for one week. While the scenario was considered adequate, the tested risk was narrow in scope. Since then, there has been a growing attention to the impact of wildfire smoke that can cause prolonged reductions of solar generation. Through reviewing literature and engaging with utility and regional partners, Council staff set to better understand the impact and modeling of wildfires, and presented to the Council the initial concepts on January 15th 2025's Approach to Modeling Operational Risks from Wildfires.

Final Approach to Wildfire Operational Risk Modeling

Council Meeting

May 12, 2025

Dor Hirsh Bar Gai

Northwest Power and Conservation Council

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Agenda

- Reminder of Past Work
- Final Modeling Approach

2

Scope of Wildfire Operational Risks in Power Plan Context:

Impacts to bulk transmission and generation to capture influence on new resource decisions and adequacy

3

Reminder of Past Work

2027 Adequacy Assessment
- Wildfire scenario - Transmission derate only (January 2023)

Exploration of Wildfire Modeling Enhancements
- January 15, 2025 Council Meeting

Multi-Advisory Committee on Wildfire Risk Modeling
- March 7th 2025

Final Modeling Recommendation
- Summary recommendation shared with advisory committees on April 9th 2025

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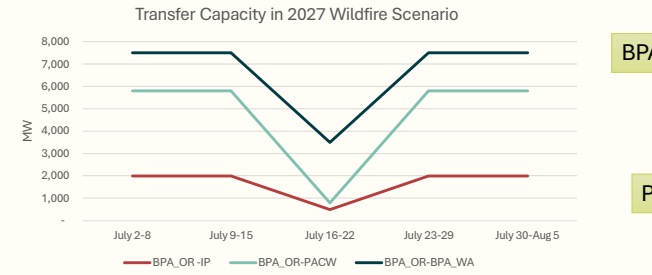
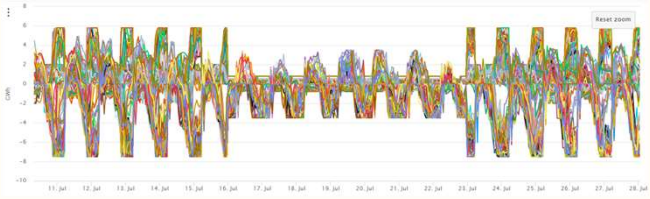
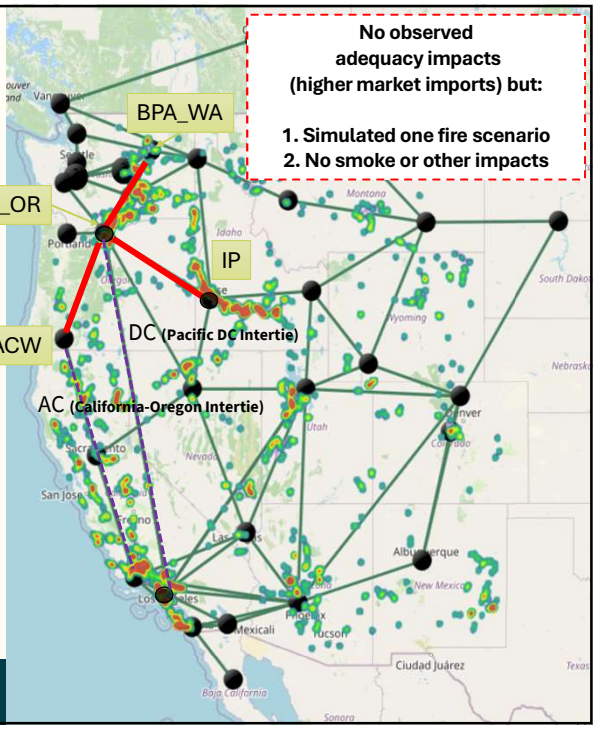
2027 Adequacy Assessment Wildfire Scenario







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Jan 15th Council Meeting

- High level overview of 2024 Wildfire Season
- Introduction of planning-level operational risks
- Considerations of wildfire smoke

Transmission derating
Transfer capacity reductions

Solar Generation
Smoke-induced capacity factor reduction

The Wiggle Effect
Sudden generation drops impact frequency stability

Location
Local and downwind impact

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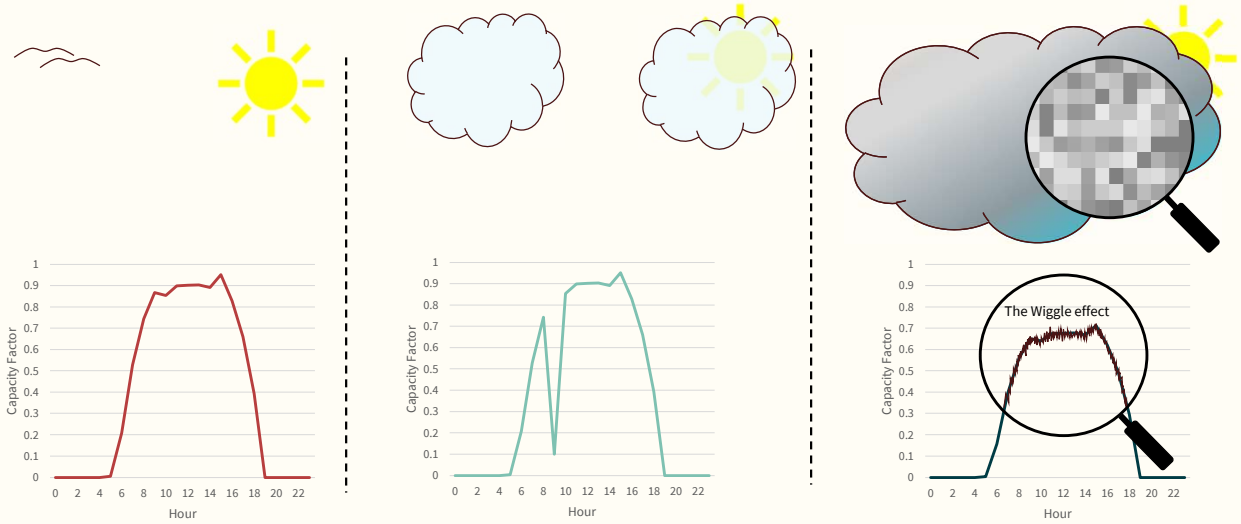
How are clouds different from smoke?



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Wildfire Operational Risk Multi-Advisory Committee

- Guest Speakers:
  - WECC Wildfire Data Analysis; Steve Ashbaker, Reliability Initiative Director, WECC
  - Wildfire Smoke Impact Quantification Methods and the Wiggle Effect; Long Zhao, PhD, Assistant Professor at South Dakota Mines
- Introduction of modeling recommendations
  - Transmission Impact (GIS analysis + average of historic WECC observations)
  - Solar Generation Smoke-induced Capacity Factor Reduction (GIS analysis + literature)
  - Considerations of Renewable Shape Clustering (shape analysis)
  - Wildfires Across Models
  - Wrap up & next steps

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Committee Feedback

Transmission – GIS analysis is useful, but questions remained about aligning specific derate duration and magnitudes, including when using probabilistic burn area considerations.

Solar generation impacts – key feedback was to use spatial and temporal wildfire smoke observations instead of solar plant proximity to historic wildfire burn areas.

Solar shape clustering – support for dividing the region into several sub-areas, including further separating the western area (Coastal OR and WA) into an OR area and WA area

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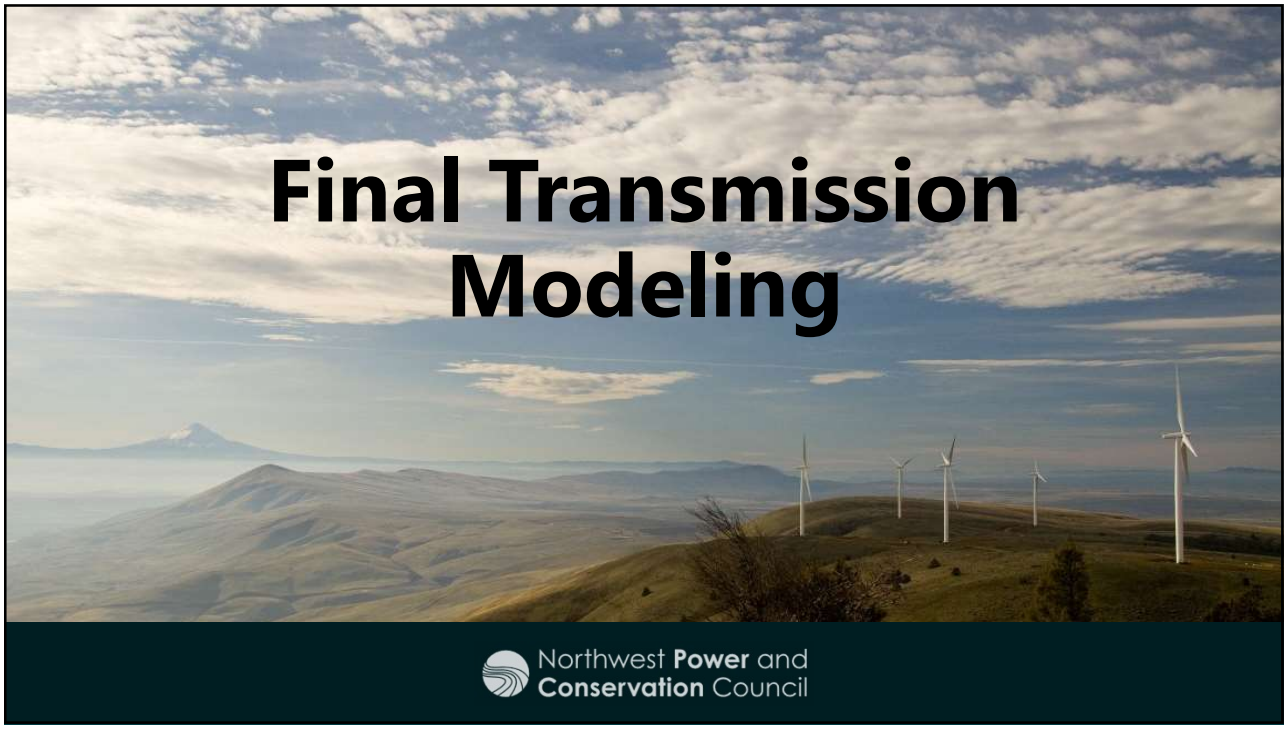

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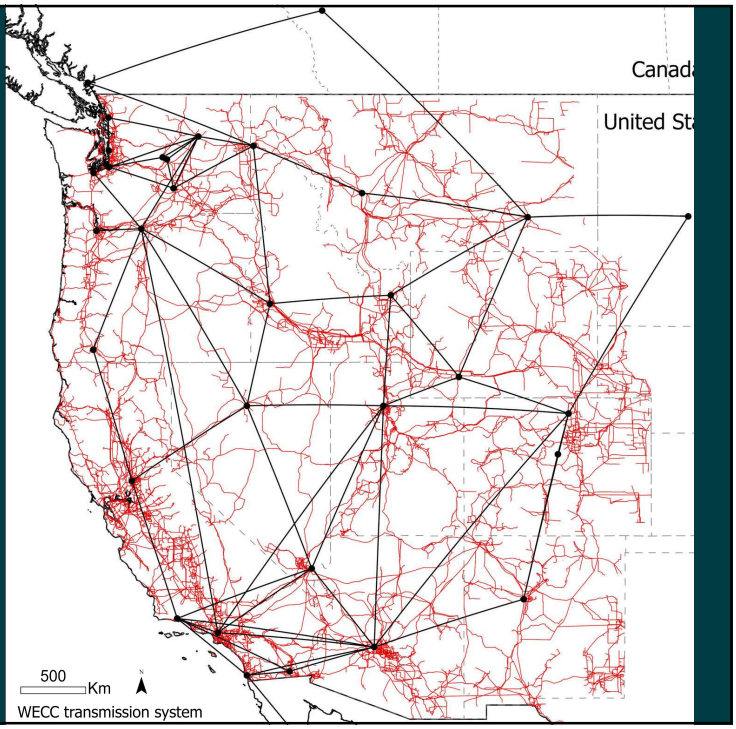
WECC & GENESYS Transmission Topology



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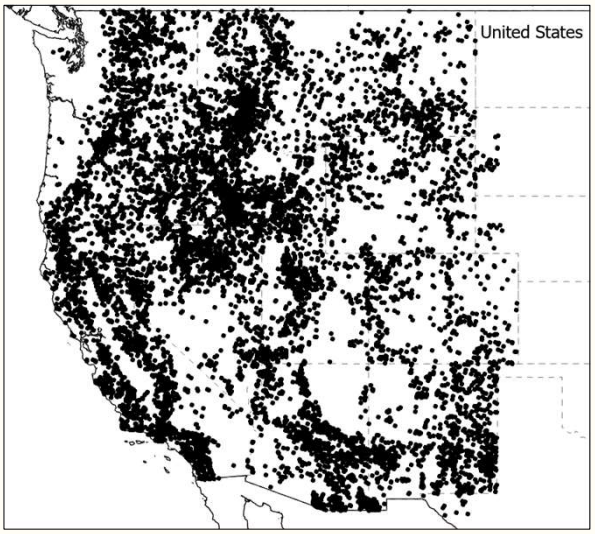
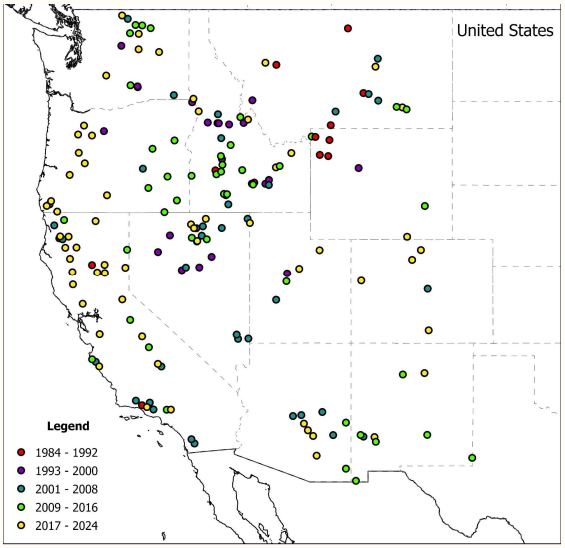
1984-2024 all fires



1984-2024 >100k acres burned (large fires)



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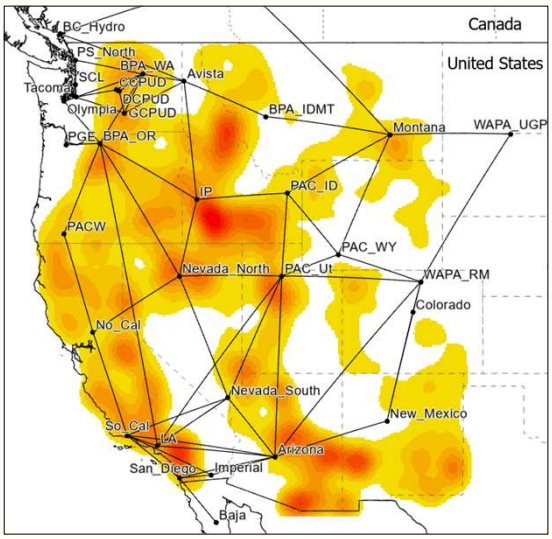
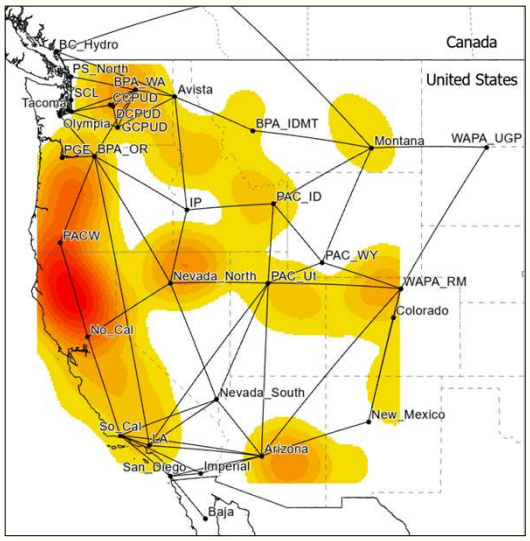
1984-2024 density for all fire



2017-2024 density for large fires



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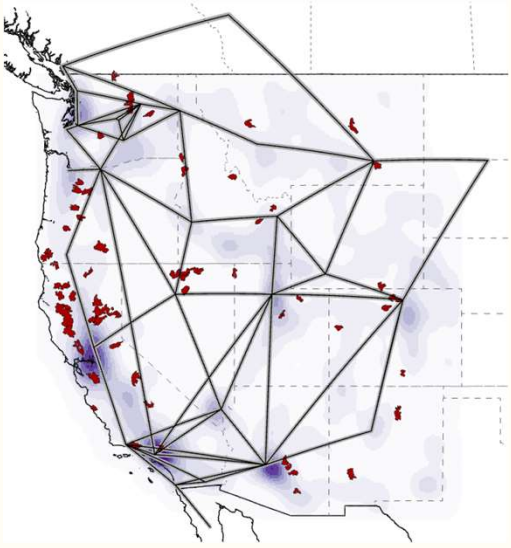
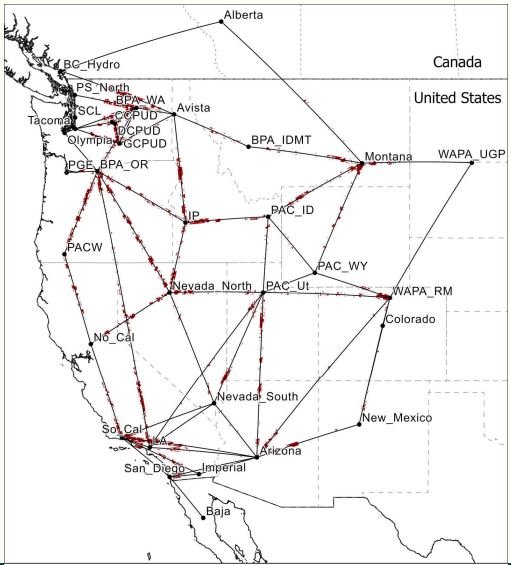
WECC transmission density with GENESYS 10km buffer and large fires 2017-2024



All fires intersecting GENESYS <10km



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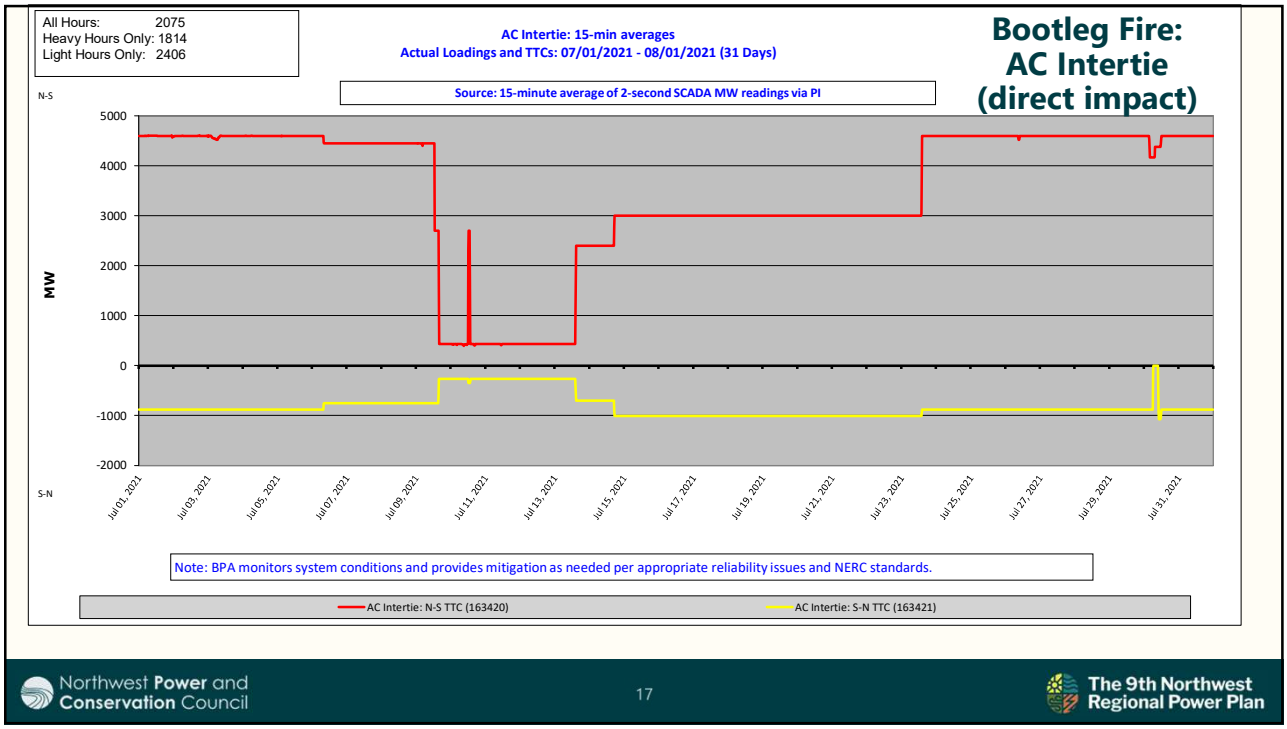
Wildfire GIS Analysis

YEAR	From Bus to Bus	Jul	Aug	Sep	Nov
2017	IP-Nevada_North				
2018	IP-Nevada_North				
	PACW-No_Cal				
2019	IP-PAC_ID				
2020	BPA_OR-BPA_WA				
	BPA_OR-LA				
	BPA_OR-PACW				
	BPA_WA-CCPUD				
	BPA_WA-DCPUD				
	BPA_WA-Olympia				
	BPA_WA-PS_Central				
	BPA_WA-PS_North				
2021	Avista-IP				
	BPA_IDMT-Montana				
	GCPUD-PS_Central				
	Montana-Alberta				
	Montana-PAC_WY				
	Montana-WAPA_UGP				
	PAC_ID-Montana				
	PACW-No_Cal				
2022	Avista-IP				
	BPA_OR-PACW				

Transmission Derate Modeling

Use actual Total Transfer Capacity (TTC) for the last 10 years (2015-2024) as reported in BPA's paths Operations Info (OPI) for the modeled in-region transmission lines and those connecting to other regions.


All Hours: 2075
Heavy Hours Only: 1814
Light Hours Only: 2406
AC Intertie: 15-min averages
Actual Loadings and TTCs: 07/01/2021 - 08/01/2021 (31 Days)
Source: 15-minute average of 2-second SCADA MW readings via PI
Bootleg Fire: AC Intertie (direct impact)
N-S
S-N
MW
5000
4000
3000
2000
1000
0
-1000
-2000
Jul 01, 2021
Jul 03, 2021
Jul 05, 2021
Jul 07, 2021
Jul 09, 2021
Jul 11, 2021
Jul 13, 2021
Jul 15, 2021
Jul 17, 2021
Jul 19, 2021
Jul 21, 2021
Jul 23, 2021
Jul 25, 2021
Jul 27, 2021
Jul 29, 2021
Jul 31, 2021
Note: BPA monitors system conditions and provides mitigation as needed per appropriate reliability issues and NERC standards.
AC Intertie: N-S TTC (163420)
AC Intertie: S-N TTC (163421)
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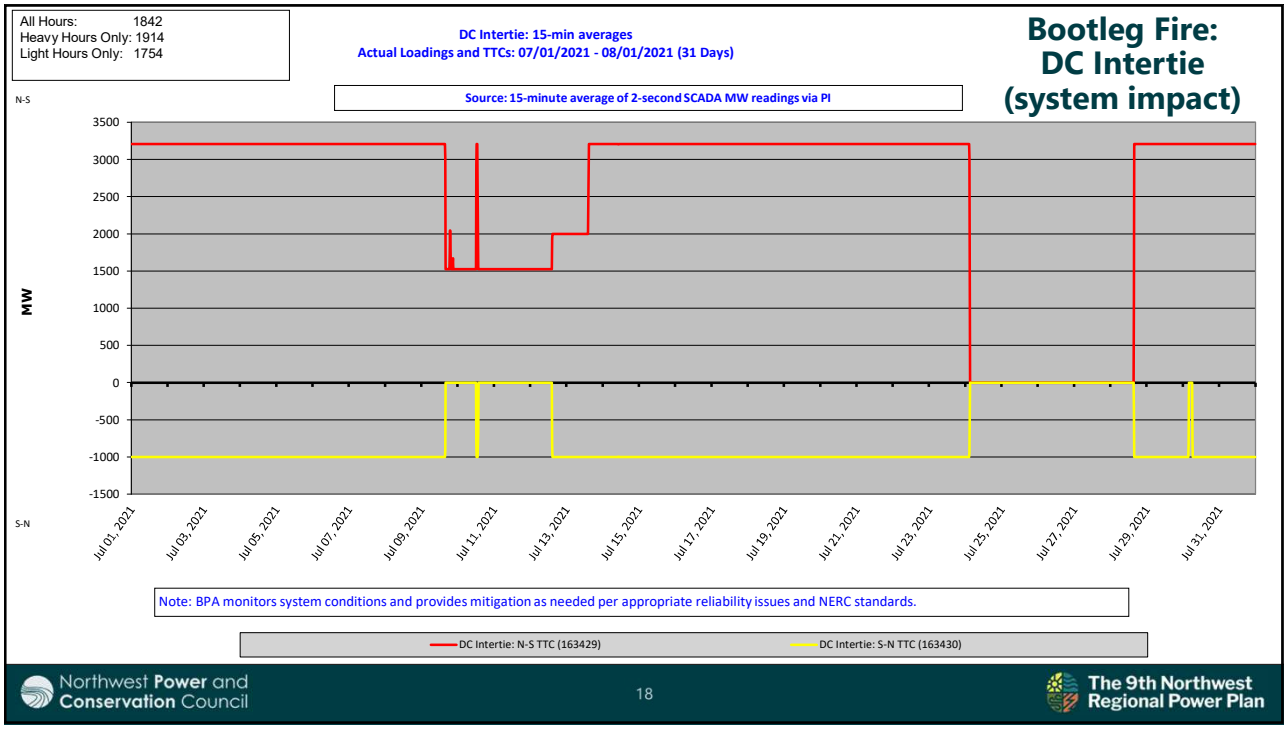
All Hours: 1842
Heavy Hours Only: 1914
Light Hours Only: 1754
DC Intertie: 15-min averages
Actual Loadings and TTCs: 07/01/2021 - 08/01/2021 (31 Days)
Source: 15-minute average of 2-second SCADA MW readings via PI
Bootleg Fire: DC Intertie (system impact)
N-S
S-N
MW
3500
3000
2500
2000
1500
1000
500
0
-500
-1000
-1500
Jul 01, 2021
Jul 03, 2021
Jul 05, 2021
Jul 07, 2021
Jul 09, 2021
Jul 11, 2021
Jul 13, 2021
Jul 15, 2021
Jul 17, 2021
Jul 19, 2021
Jul 21, 2021
Jul 23, 2021
Jul 25, 2021
Jul 27, 2021
Jul 29, 2021
Jul 31, 2021
Note: BPA monitors system conditions and provides mitigation as needed per appropriate reliability issues and NERC standards.
DC Intertie: N-S TTC (163429)
DC Intertie: S-N TTC (163430)
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Significance

- Capture the actual real-time derate impacts of wildfires
- Enable consistency and capture broader expected and unexpected transmission maintenance.

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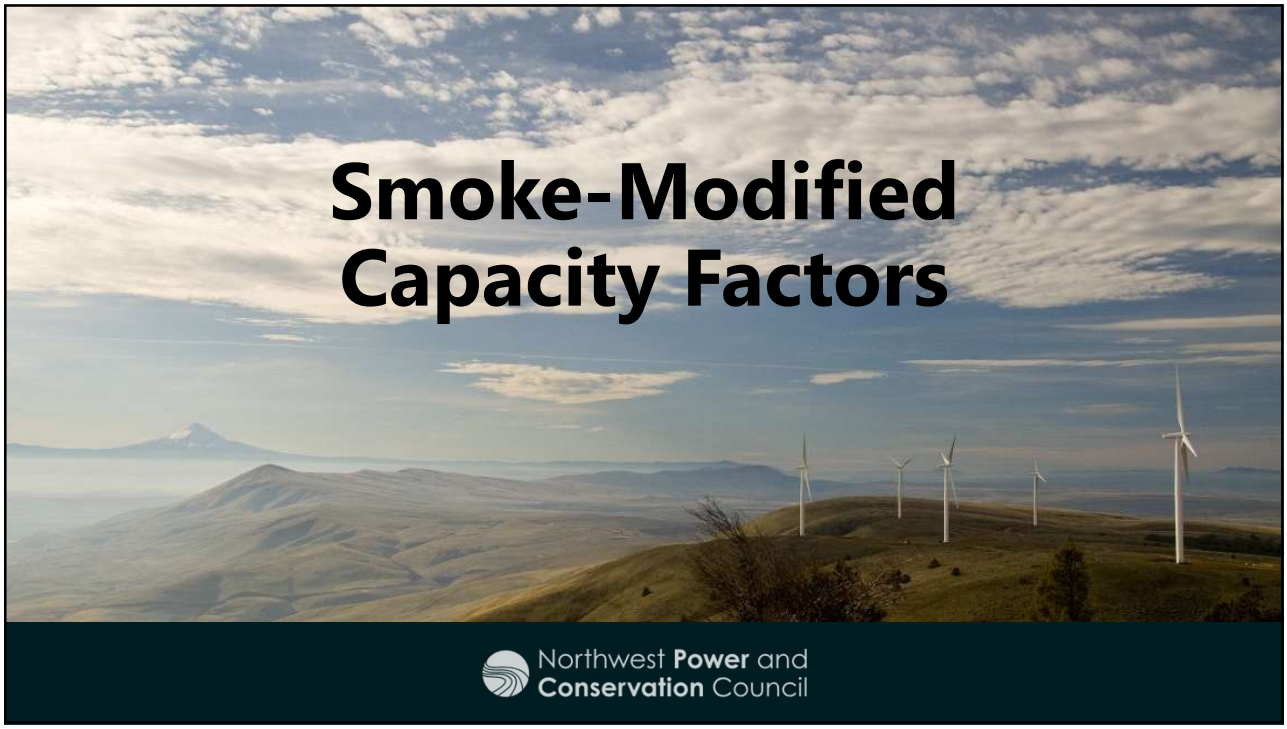

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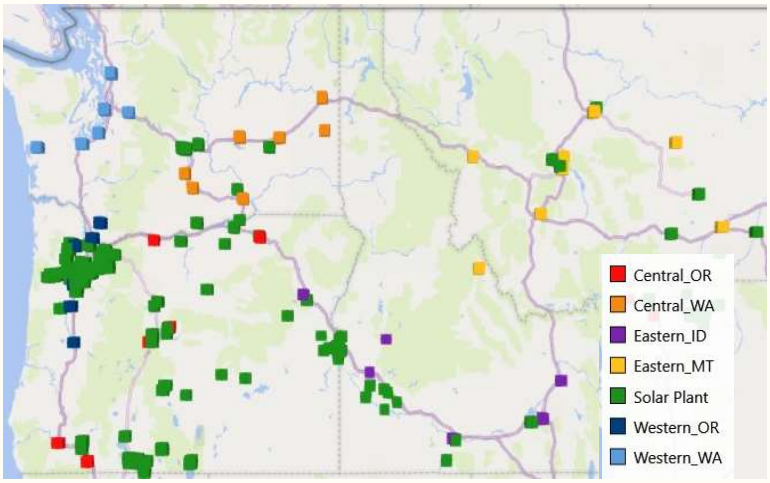
Smoke-Modified Capacity Factors

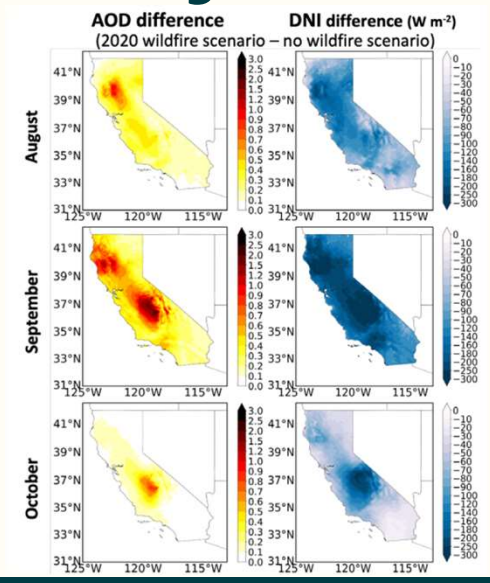
- Use daily PM2.5 measurements (recognizing their limitation) from the U.S. Forest Service AirFire Research Team, which include sensor level data across each state for the last 10 years (2015-2024).
- Cycle through different years in the simulation using annual smoke profiles to modify solar generation capacity factors by 8-12% on smoke days.

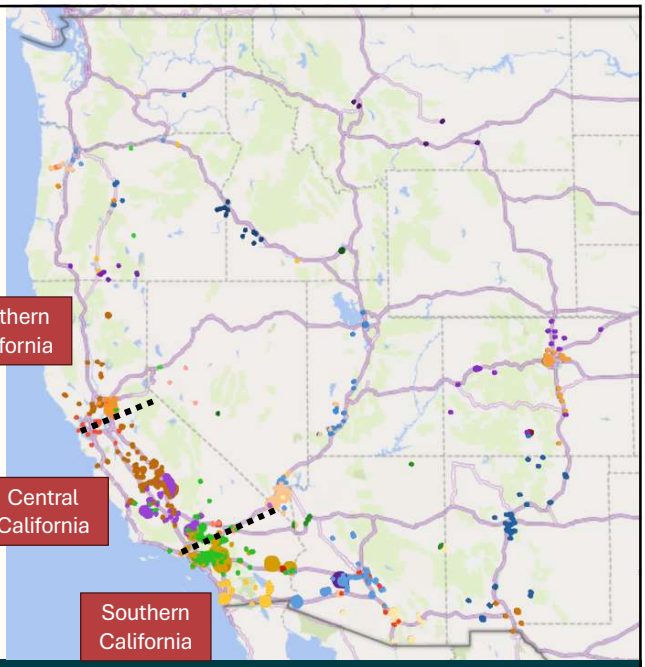
Process

- Track historic PM2.5 values above 35 across multiple sensors in each state for 2015-2024
- Average across the years to isolate the major smoke events



Out-of-region solar?





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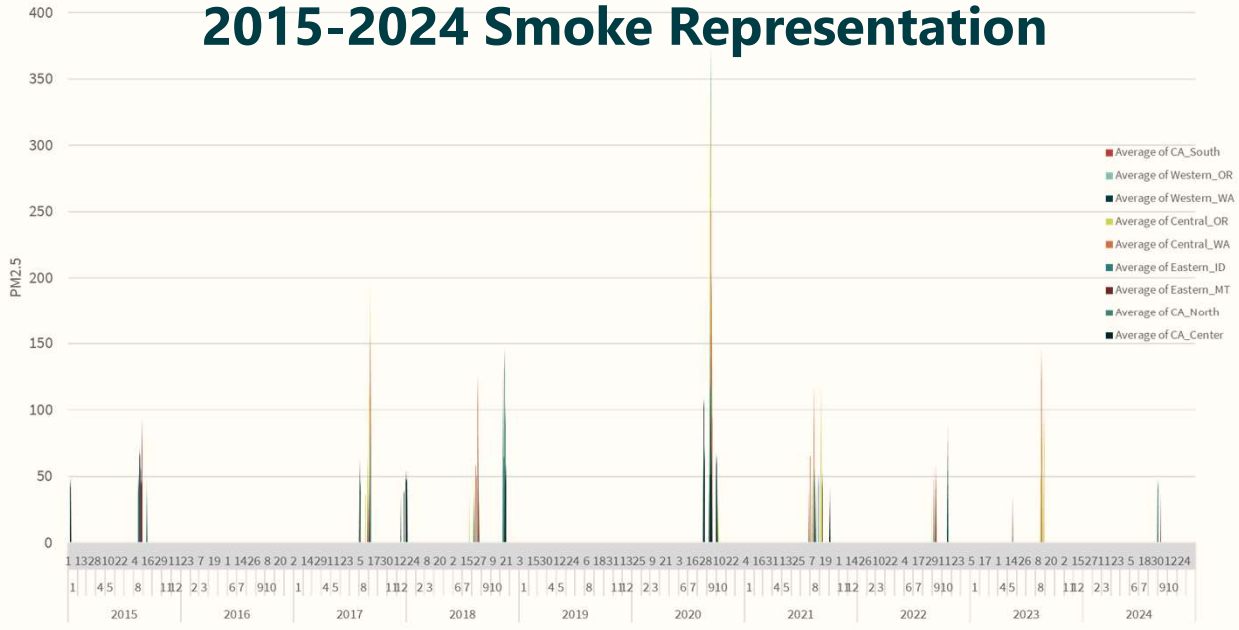
2015-2024 Smoke Representation



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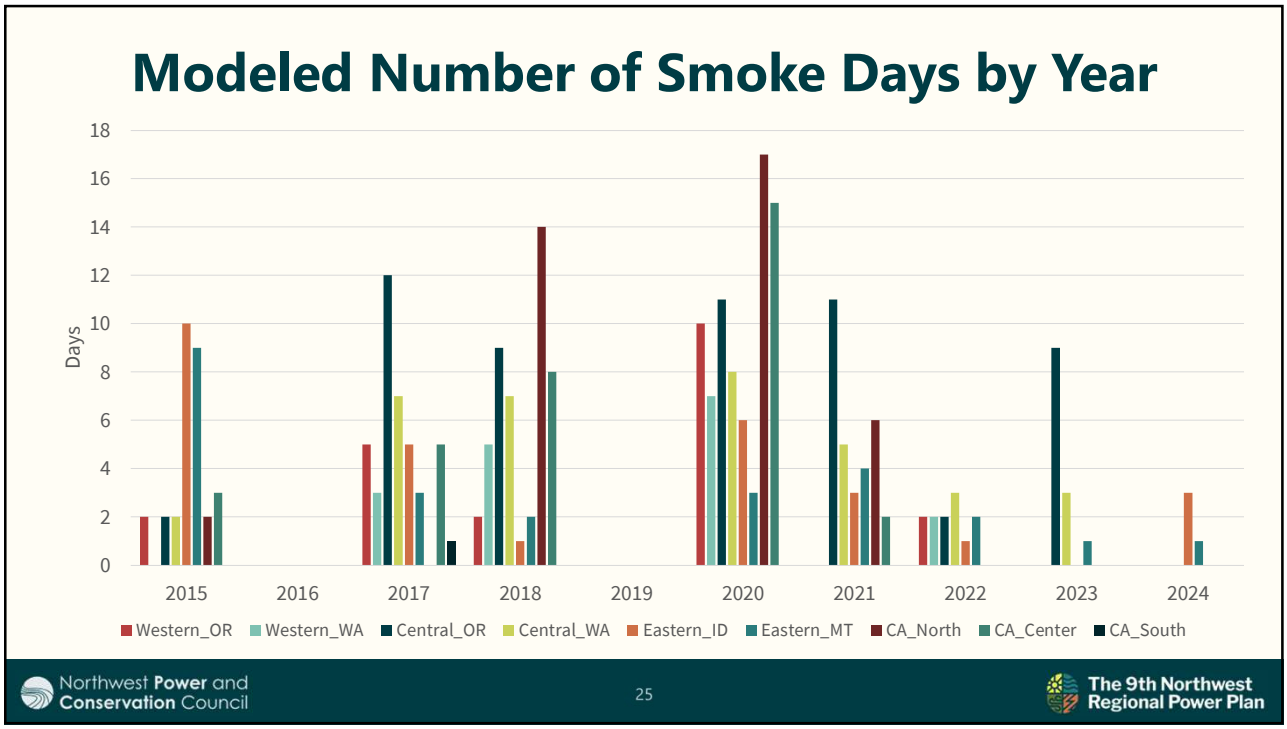
Modeled Number of Smoke Days by Year
Days
18
16
14
12
10
8
6
4
2
0
2015
2016
2017
2018
2019
2020
2021
2022
2023
2024
Western_OR
Western_WA
Central_OR
Central_WA
Eastern_ID
Eastern_MT
CA_North
CA_Center
CA_South
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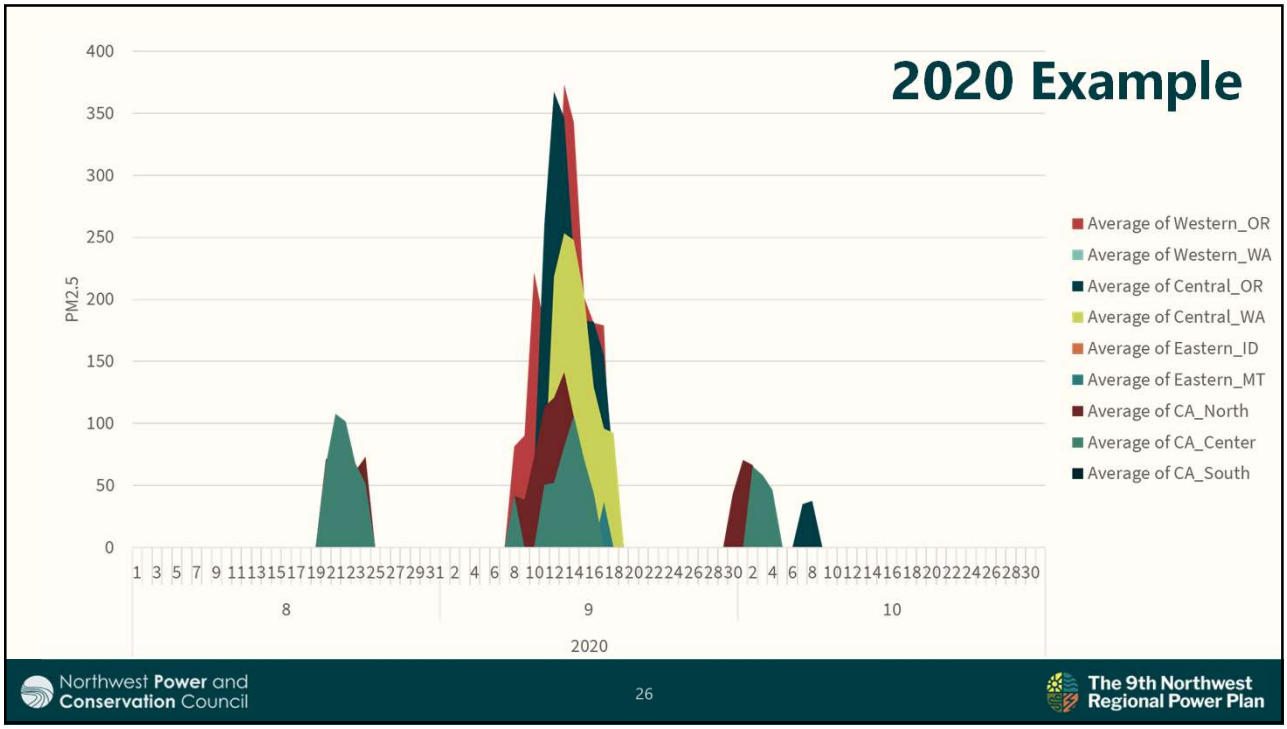
2020 Example
PM2.5
400
350
300
250
200
150
100
50
0
8
9
10
2020
Average of Western_OR
Average of Western_WA
Average of Central_OR
Average of Central_WA
Average of Eastern_ID
Average of Eastern_MT
Average of CA_North
Average of CA_Center
Average of CA_South
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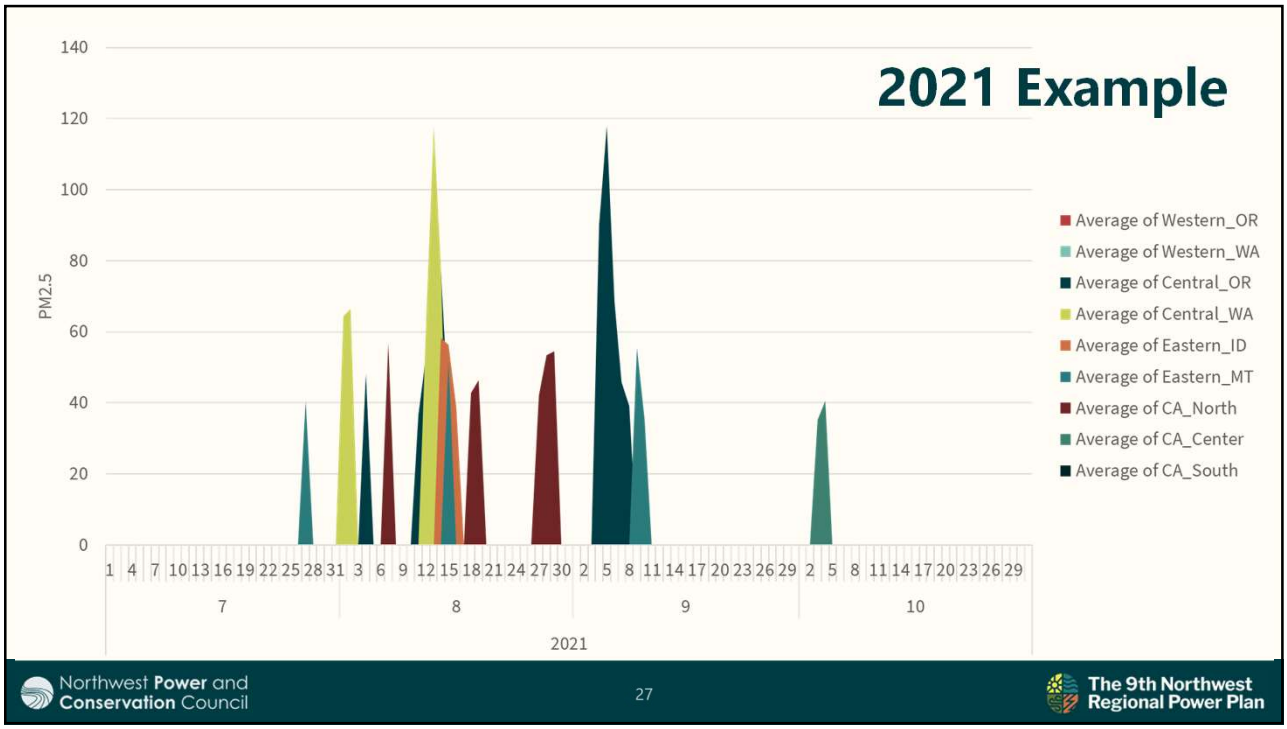
2021 Example
PM2.5
140
120
100
80
60
40
20
0
1 4 7 10 13 16 19 22 25 28 31 3 6 9 12 15 18 21 24 27 30 2 5 8 11 14 17 20 23 26 29 2 5 8 11 14 17 20 23 26 29
7
8
9
10
2021
Average of Western_OR
Average of Western_WA
Average of Central_OR
Average of Central_WA
Average of Eastern_ID
Average of Eastern_MT
Average of CA_North
Average of CA_Center
Average of CA_South
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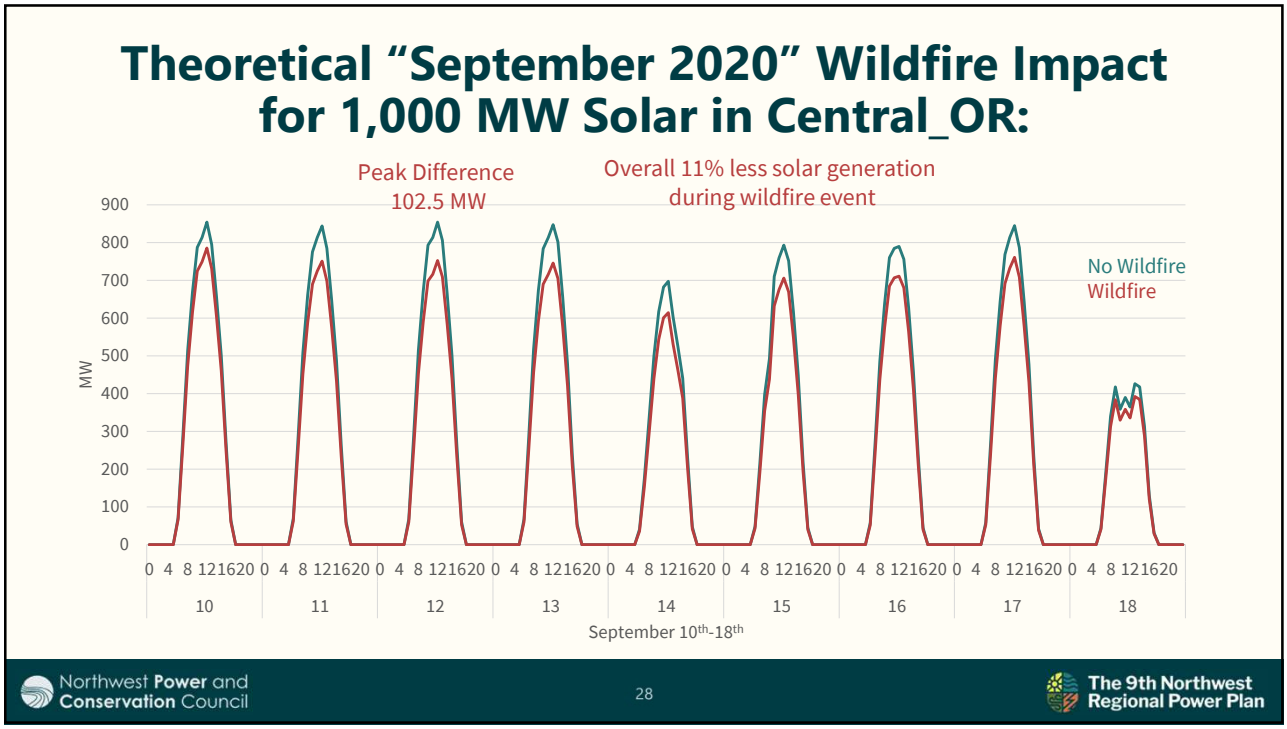
Theoretical "September 2020" Wildfire Impact for 1,000 MW Solar in Central_OR:
Peak Difference 102.5 MW
Overall 11% less solar generation during wildfire event
MW
900
800
700
600
500
400
300
200
100
0
0 4 8 12 16 20 0 4 8 12 16 20 0 4 8 12 16 20 0 4 8 12 16 20 0 4 8 12 16 20 0 4 8 12 16 20 0 4 8 12 16 20 0 4 8 12 16 20 0 4 8 12 16 20
10
11
12
13
14
15
16
17
18
September 10th-18th
No Wildfire
Wildfire
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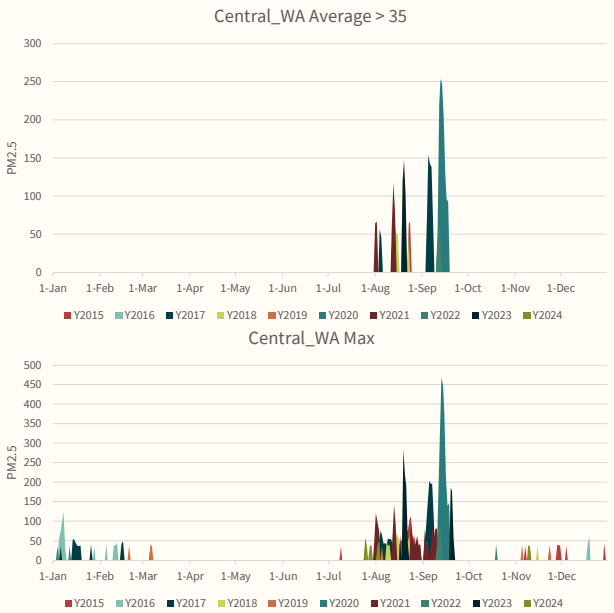
Significance

- Captures potential impacts of wildfire smoke across different days and reduction estimates
- **Approach is a planning level approximation**
  - Need to balance between localized and area-wide impacts (Reason staff recommend average, for conservative estimate)
  - Real-impacts may vary and staff will revisit smoke assumptions as new data becomes available in the future (post Plan)



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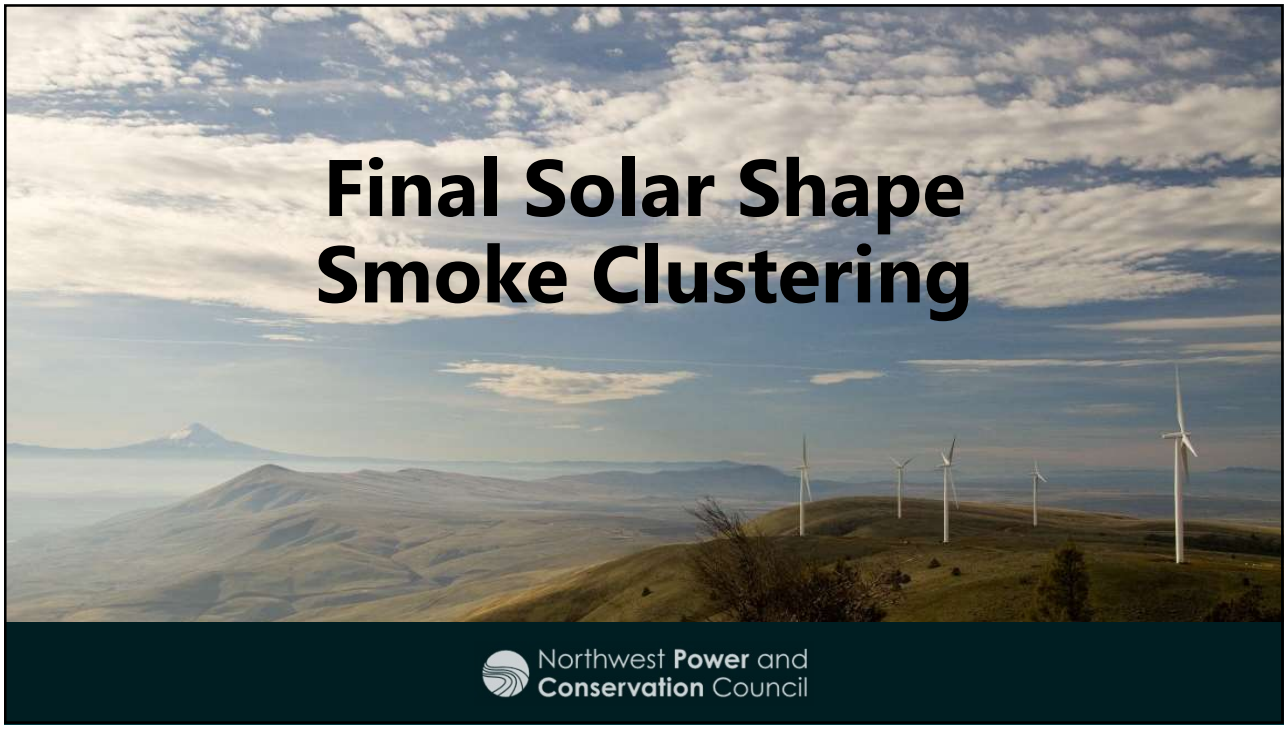

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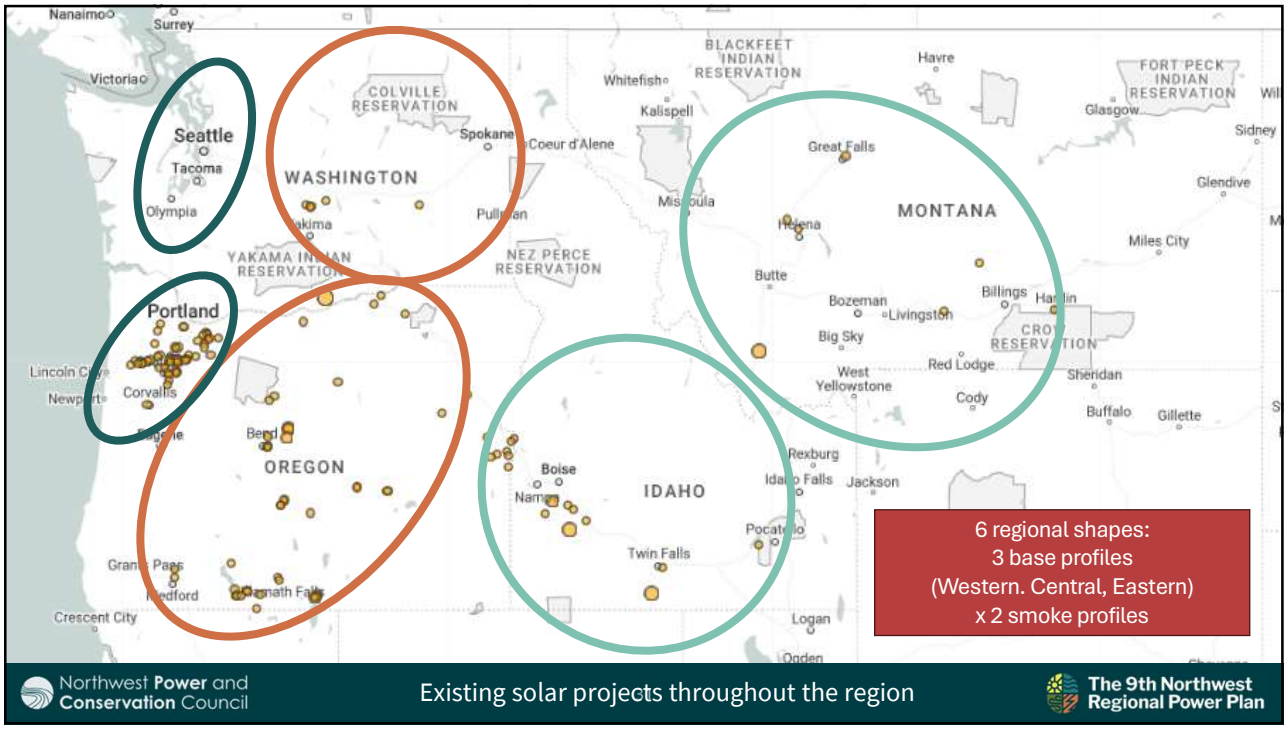
Nanaimo
Surrey
Victoria
Seattle
Tacoma
Olympia
COLVILLE RESERVATION
Spokane
Coeur d'Alene
WASHINGTON
Pullman
YAKAMA INDIAN RESERVATION
NEZ PERCE RESERVATION
Portland
Lincoln City
Newport
Corvallis
Bend
OREGON
Grants Pass
Medford
Crescent City
BLACKFEET INDIAN RESERVATION
Whitefish
Kalispell
Missoula
Great Falls
Havre
FORT PECK INDIAN RESERVATION
Glasgow
Sidney
Glendive
Miles City
MONTANA
Helena
Butte
Bozeman
Livingston
Billings
Big Sky
West Yellowstone
Red Lodge
Cody
Sheridan
Buffalo
Gillette
Boise
IDAHO
Rexburg
Idaho Falls
Jackson
Pocatello
Twin Falls
Logan
Ogden
6 regional shapes:
3 base profiles
(Western. Central, Eastern)
x 2 smoke profiles
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Existing solar projects throughout the region
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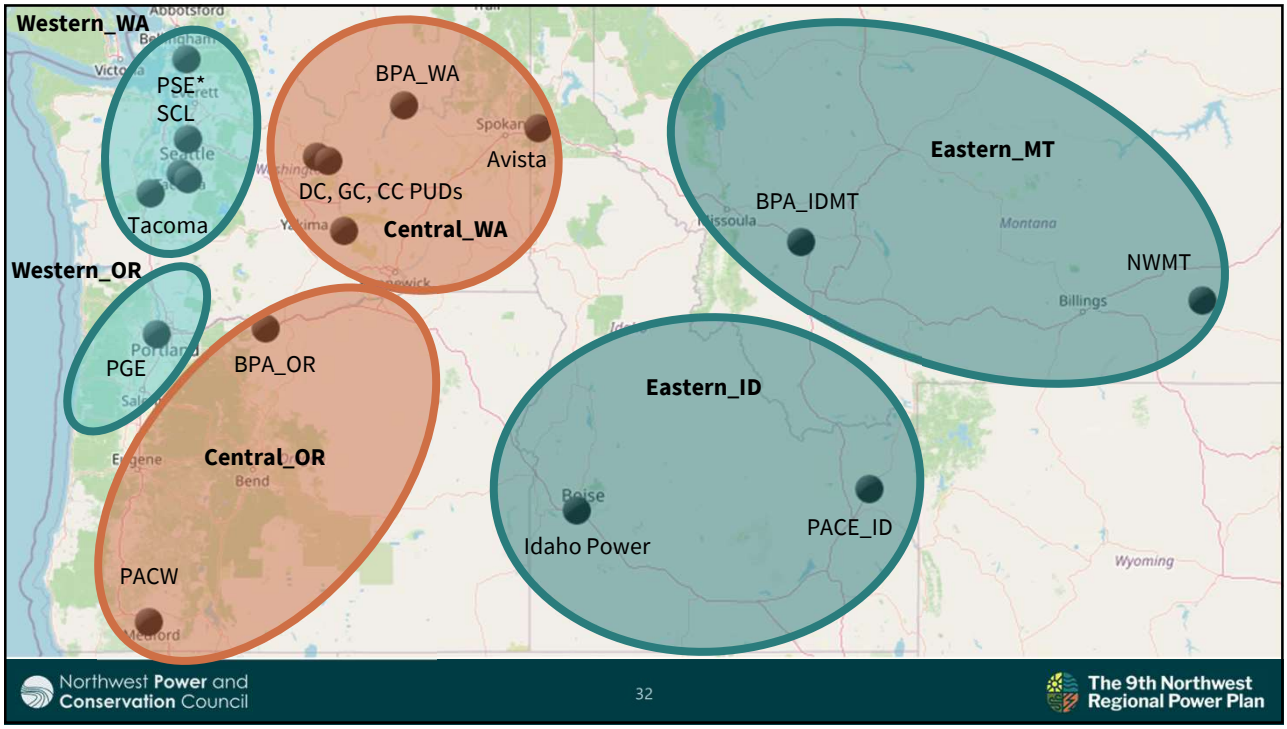
Western_WA
PSE*
SCL
Seattle
Tacoma
BPA_WA
Spokane
Avista
DC, GC, CC PUDs
Central_WA
Western_OR
PGE
Portland
BPA_OR
Central_OR
Bend
PACW
Medford
Eastern_MT
BPA_IDMT
Missoula
Montana
NWMT
Billings
Eastern_ID
Boise
Idaho Power
PACE_ID
Wyoming
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Wildfires Modeling Across Council Tools

Element	GENESYS (Adequacy model)	OptGen (Capital Expansion)	Aurora (Market buildout)
Transmission	Expected Weekly Transmission Derate	Chronological annual derate profiles (weekly and hourly time scale)	
Renewable Shape	Cycle through wildfire smoke shape modification years	Cycle coincident shape modification with transmission derate profiles (i.e. match transmission year with smoke year)	
Risk perspective	Impact on adequacy metrics + Adequacy Reserve Margin	Locational value of resources (in-region) + dynamic reserves calculation	Locational value of resources (out-of-region) and influence on buildout economics

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Questions?

Dor Hirsh Bar Gai

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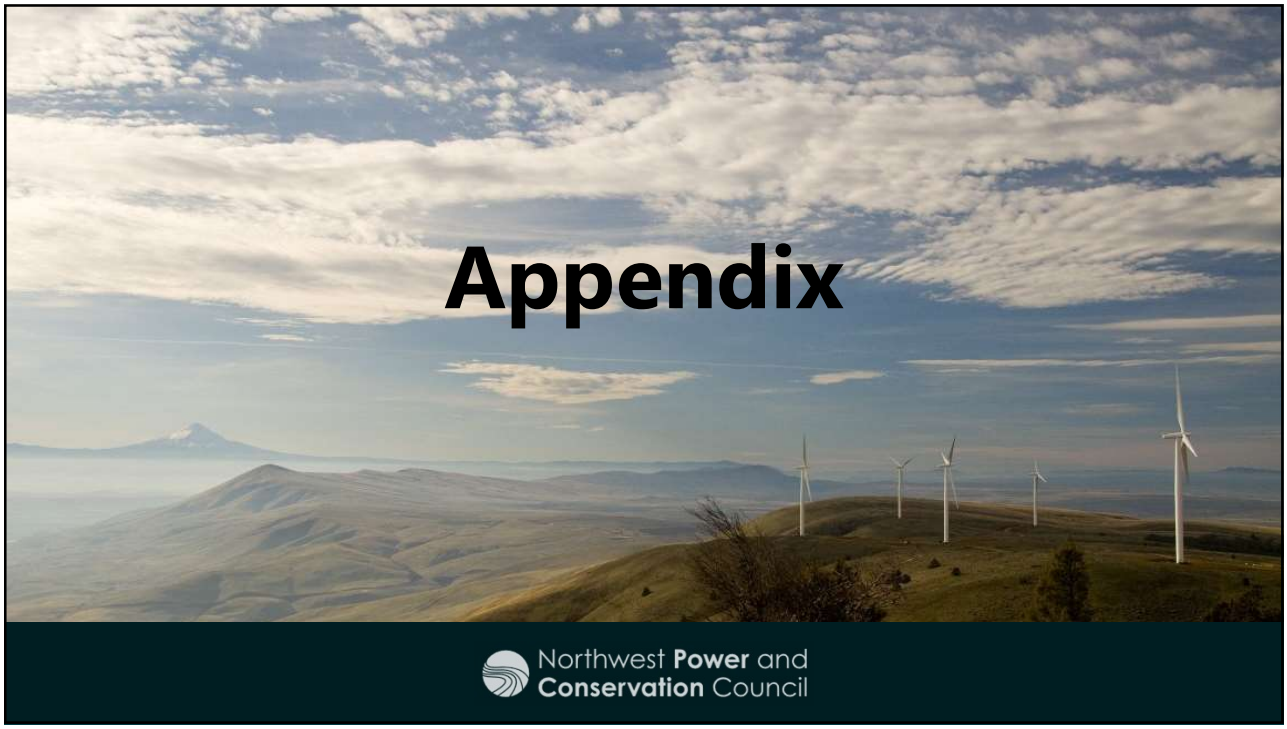
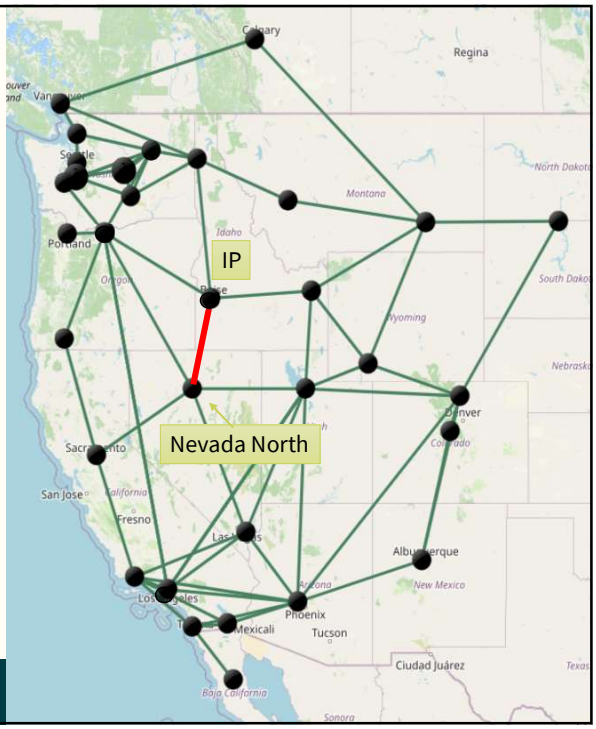


2017

i. IP <-> Nevada_North: capacity
   i. July 14



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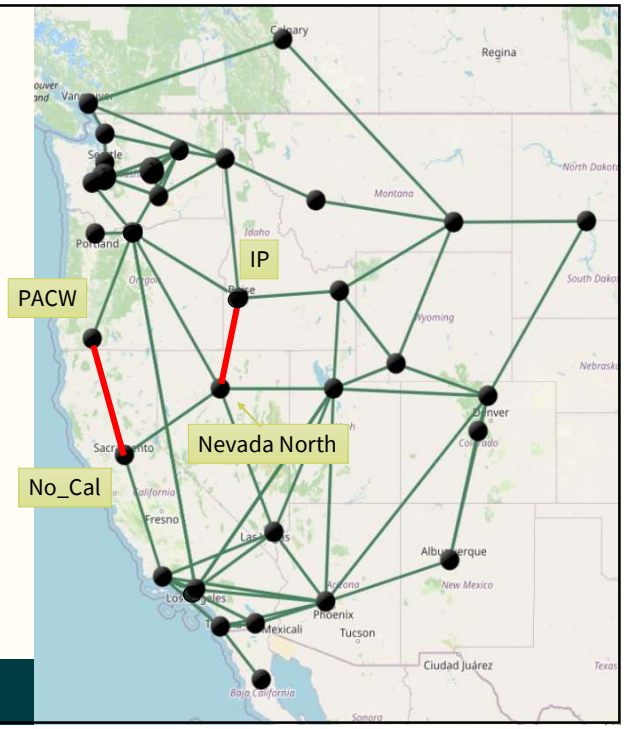
2018

i. IP <-> Nevada_North: capacity
   i. July 6
ii. PACW <-> No_Cal
   i. July 23
   ii. Nov 8



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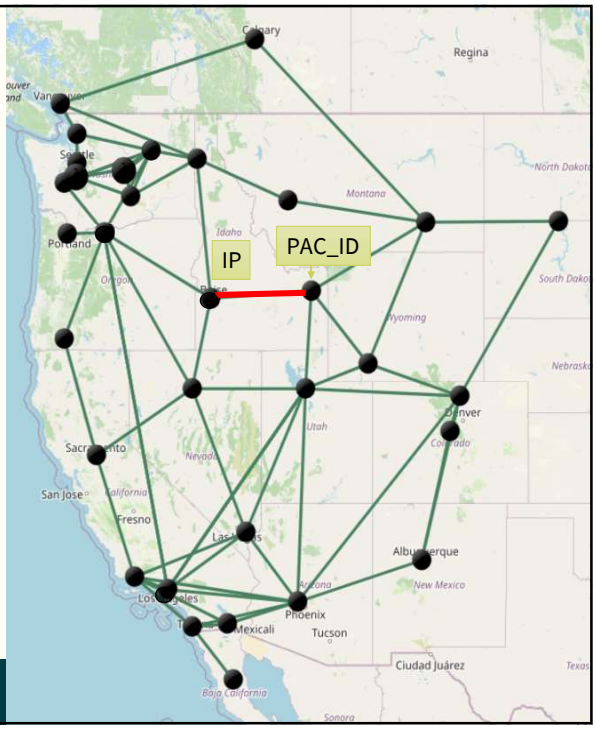
2019

i. IP <-> PAC_ID: capacity
   i. July 22



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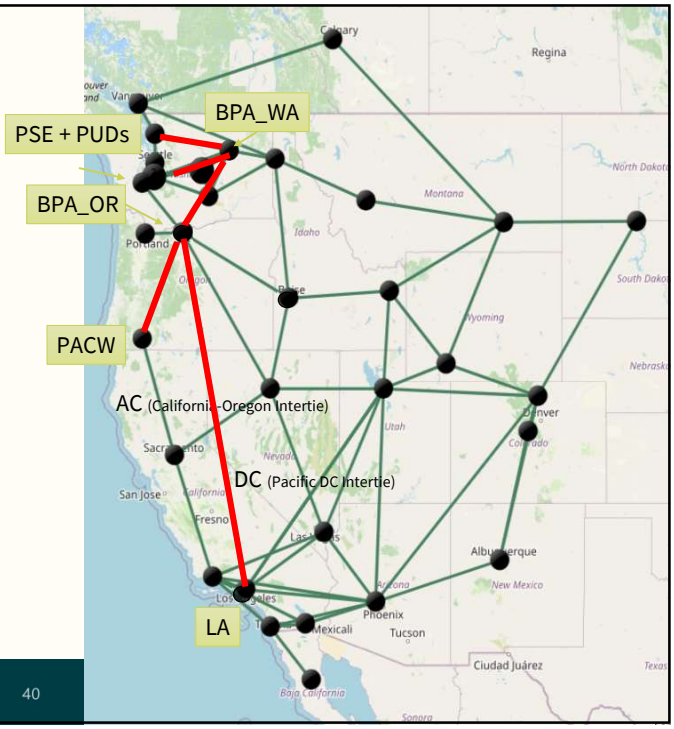
2020

i. BPA_OR **<->** PACW: **5,800 MW capacity**
   i. Sep 7

ii. BPA_OR **<->** LA: **2,000 MW capacity**
   i. Aug 19
   ii. Sep 9

iii. BPA_OR **<->** BPA_WA: **7,500 MW capacity**
   i. Aug 17

iv. BPA_WA <-> Olympia/PS_North/PS_CentralDC/CC/
   i. Sep 7



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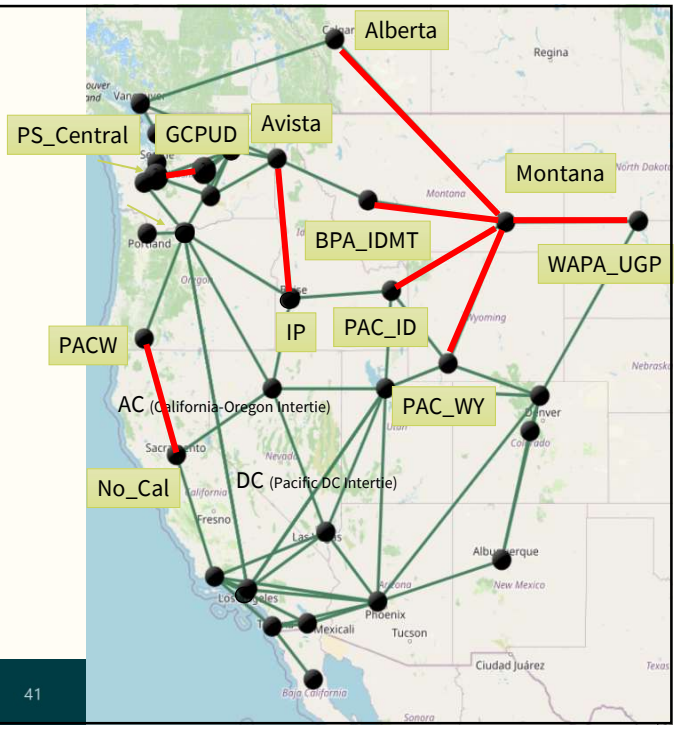
2021

i. Avista-IP
   i. July 9
ii. BPA_IDMT-Montana
   i. Aug 6
iii. GCPUD-PS_Central
   i. Aug 4
iv. Montana-Alberta
   i. Aug 8
v. Montana-PAC_WY
   i. Aug 8
vi. Montana-WAPA_UGP
   i. Aug 8
vii. PAC_ID-Montana
   i. Aug 8
viii. PACW-No_Cal (AC intertie)
   i. July 11



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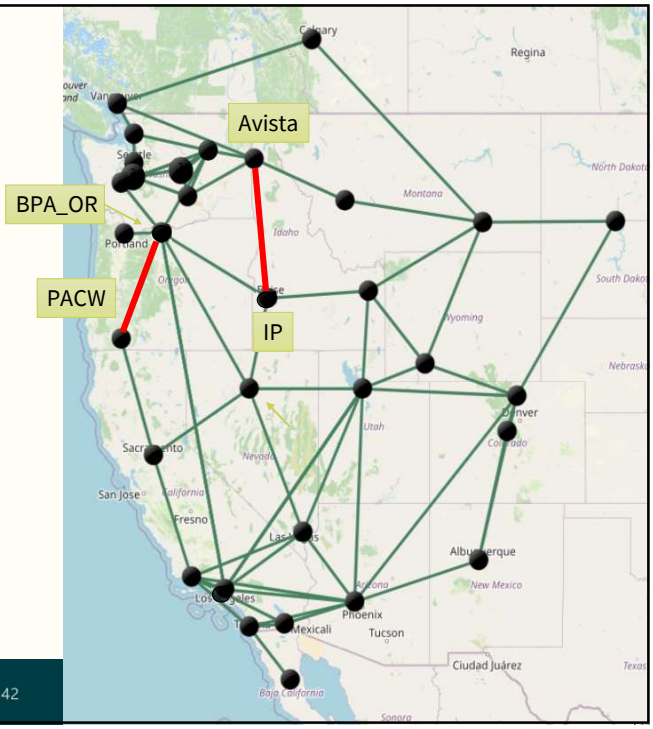
2022

i. Avista <-> IP: capacity
   i. Aug 30
ii. BPA_OR **<->** PACW: **5,800 MW capacity**
   i. Aug 3



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