

# NorthernGrid

Enrolled Parties and States  
Technical Workshop 2  
March 19, 2021

# Items from the Last Workshop

- NERC TPL-001 Reliability Standard



# Transmission Flows Today

Panel discussion with Dave Cathcart, Bonneville Power Administration, and Rikin Shah, PacifiCorp

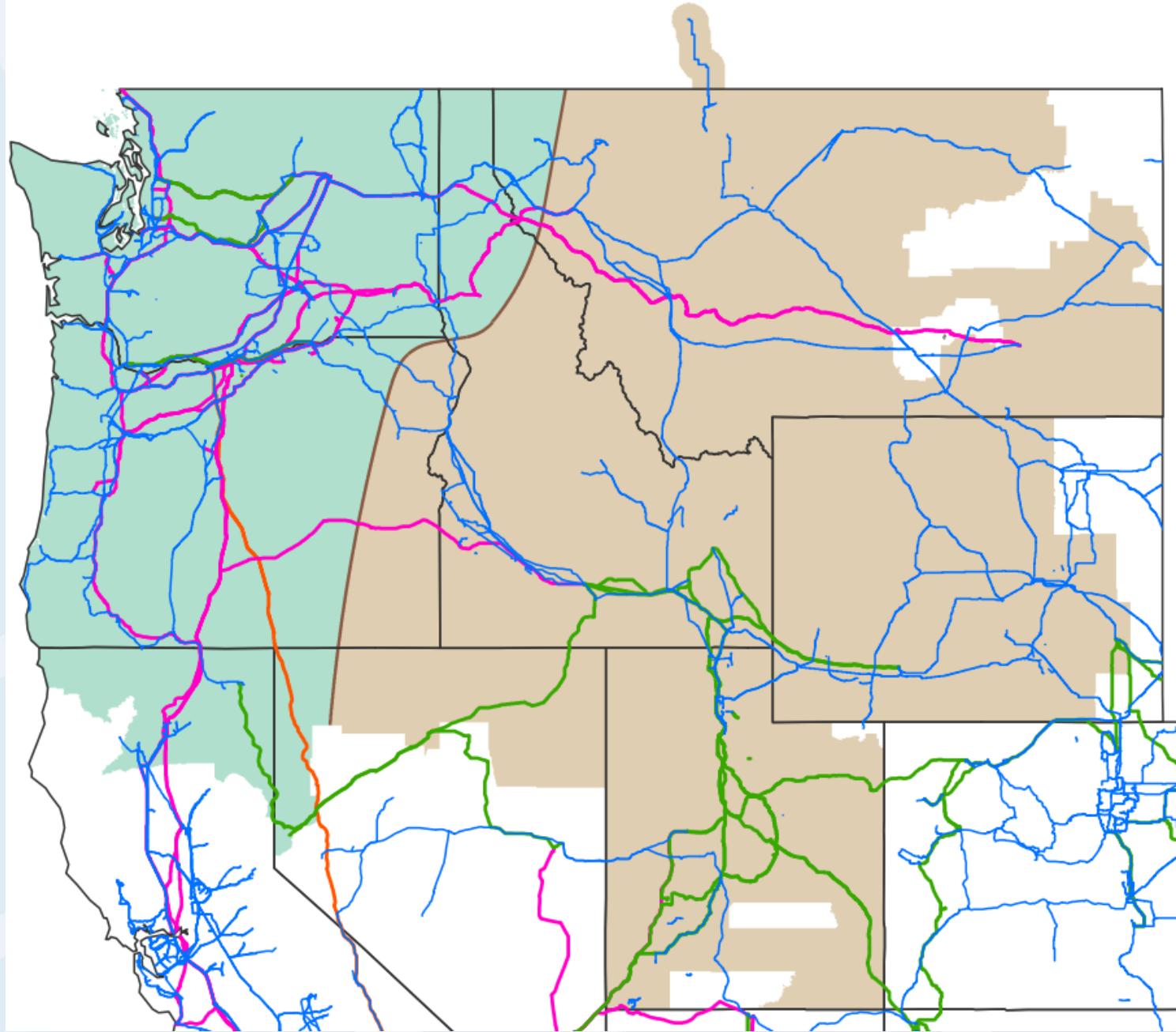
Moderator: Nadine Hanhan, Oregon Public Utility Commission



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# NorthernGrid Subregions

- Pacific Northwest
- Intermountain



# Transmission Flows Today (Dave Cathcart)

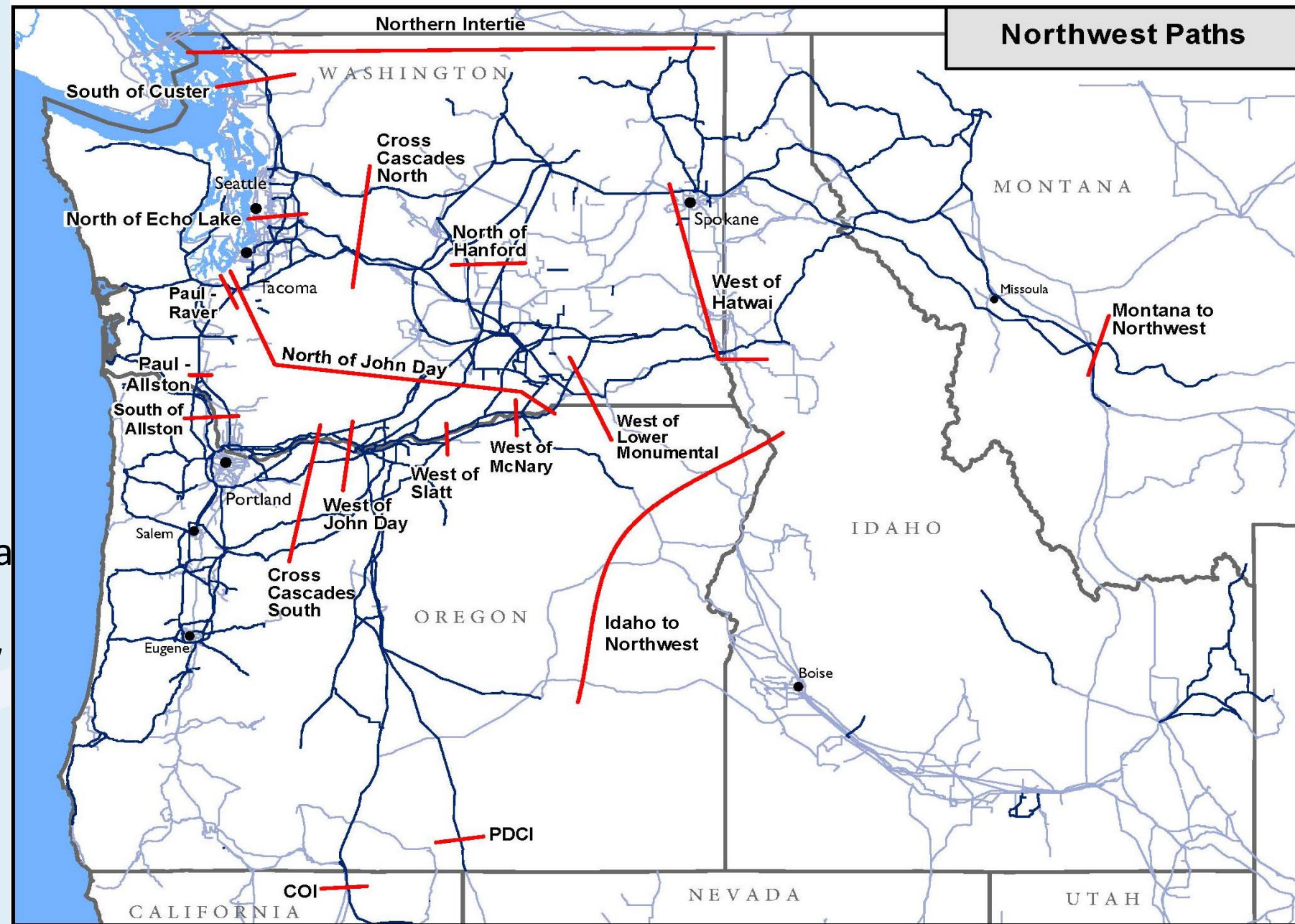
- The major paths, constraints, and usages
  - Paths covered in NG Region
  - Example of Path
- “Traditional” NW Flows: common worst-case conditions covered by Planners
- “Novel” NW Flows: new system usages covered by Planners today & in future





# Northwest Transmission

- BPA plans for 18 paths or interties (excludes ID-NW)
- Notable Resource hubs: Upper/Mid/Lower Columbia, Lower Snake, Lower Basin Wind/Thermal, I-5 Corridor, Puget Sound Area
- Notable Load hubs: NW WA, Willamette Valley/SW WA, Spokane, C.OR, Tri-Cities, Boardman, Hood River/The Dalles
- BPA “load areas” covered previously

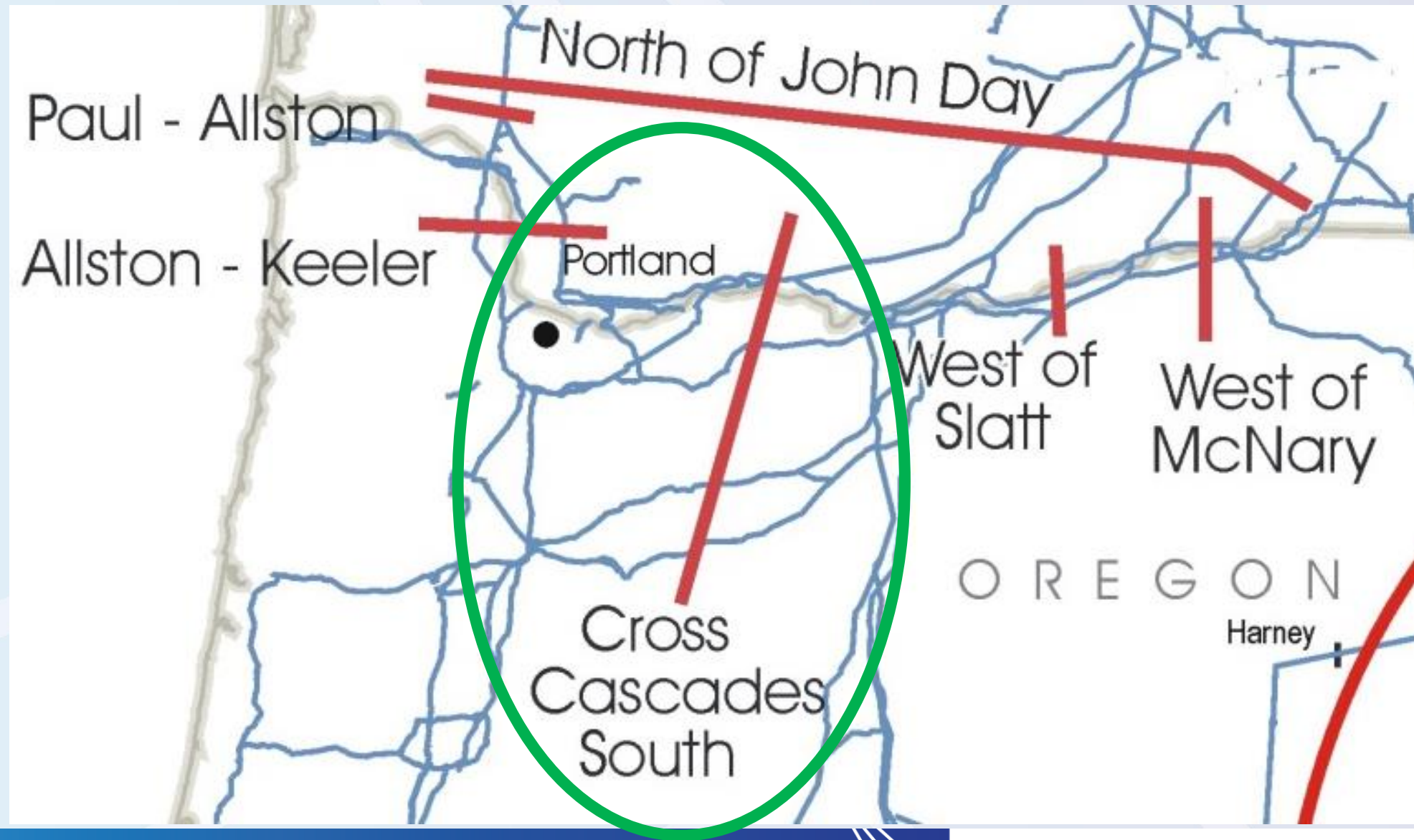


GIS Analyst: RLW Map Production Date: 9/28/2017



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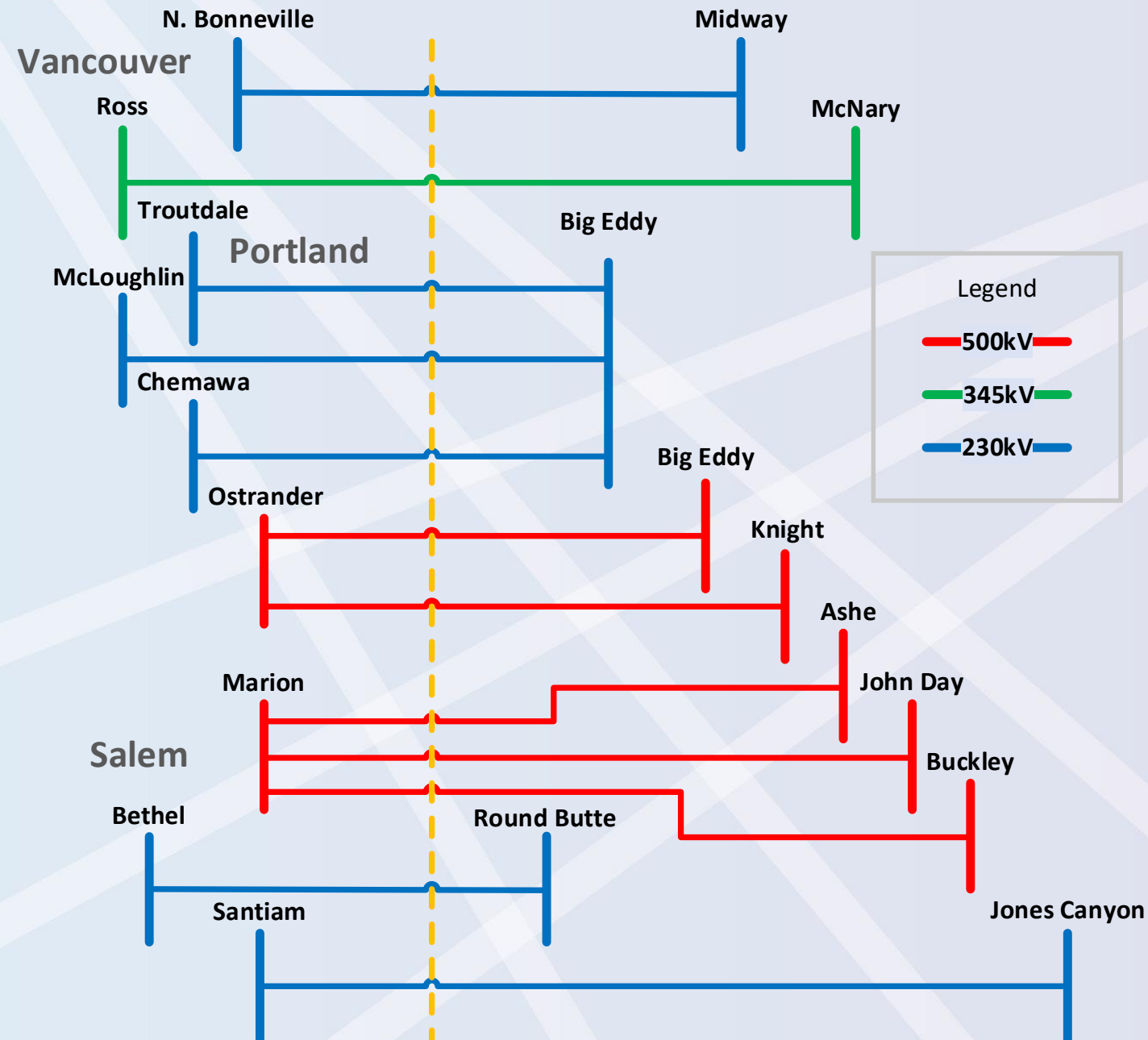
# Cross Cascades South





# Cross Cascades South Path

- Aggregate elements by geographic proximity for analysis
- Reliability is established by setting limits determined by studies
- Path limit is the highest total flow that can safely withstand loss of the most critical element(s), without exceeding facility ratings or uncontrollable system response





# Demonstration



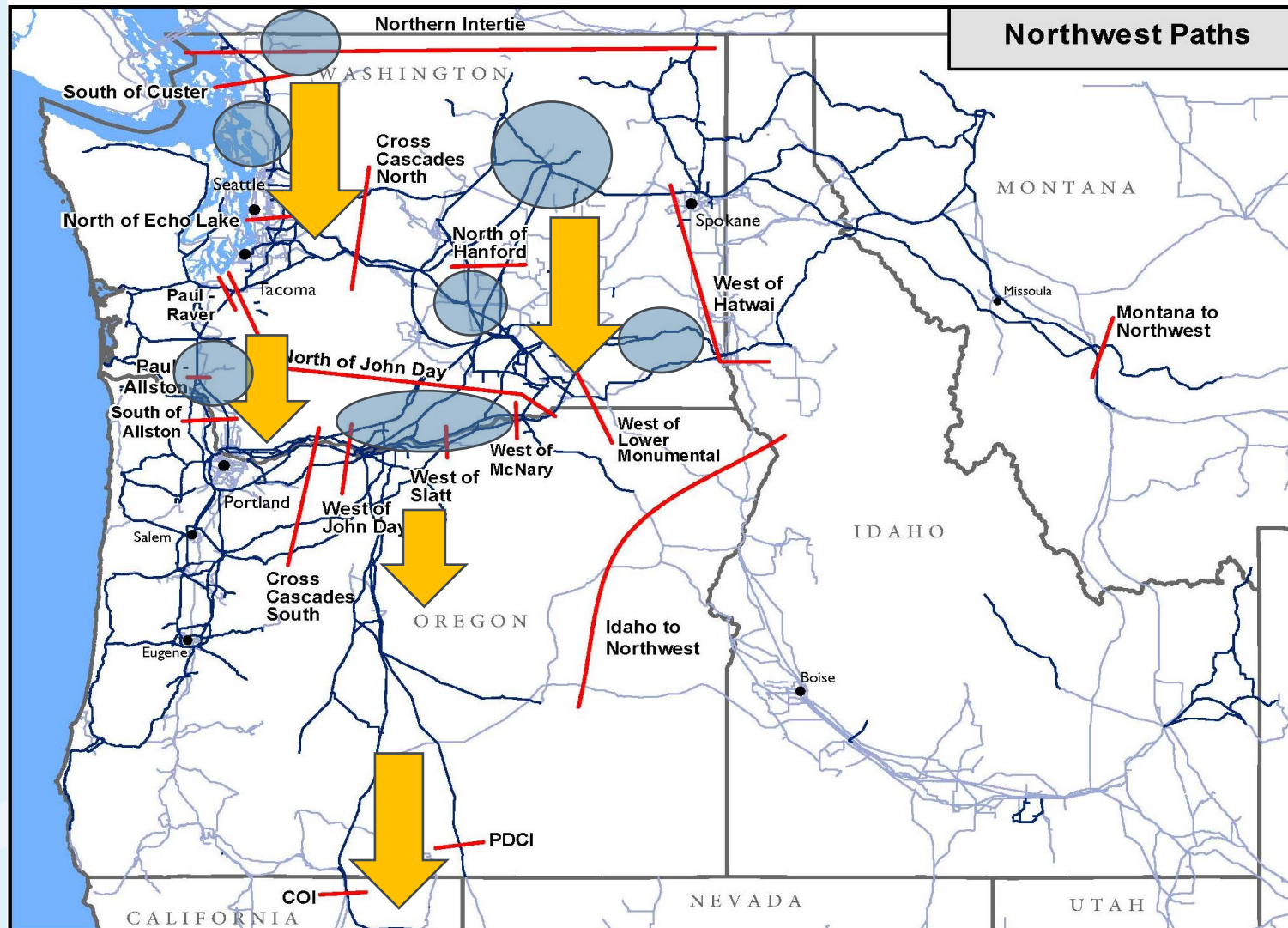
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# Some “Traditional” NW Flows & Conditions

- 1. Peak N-S: Heat-wave for WECC-wide loads, surplus NW resources exporting to California
- 2. Peak E-W: Heat-wave OR Cold-snap for NW loads, NW thermal & hydro high
- 3. Off-Peak E-W: <75% of NW annual peak loads (any season), surplus hydro from run-off conditions, maintenance seasons for some thermal plants
- 4. Dual Export: <75% of NW annual peak loads, surplus NW resources, simultaneously exporting North to Canada AND South to California



# Summer Peak N-S

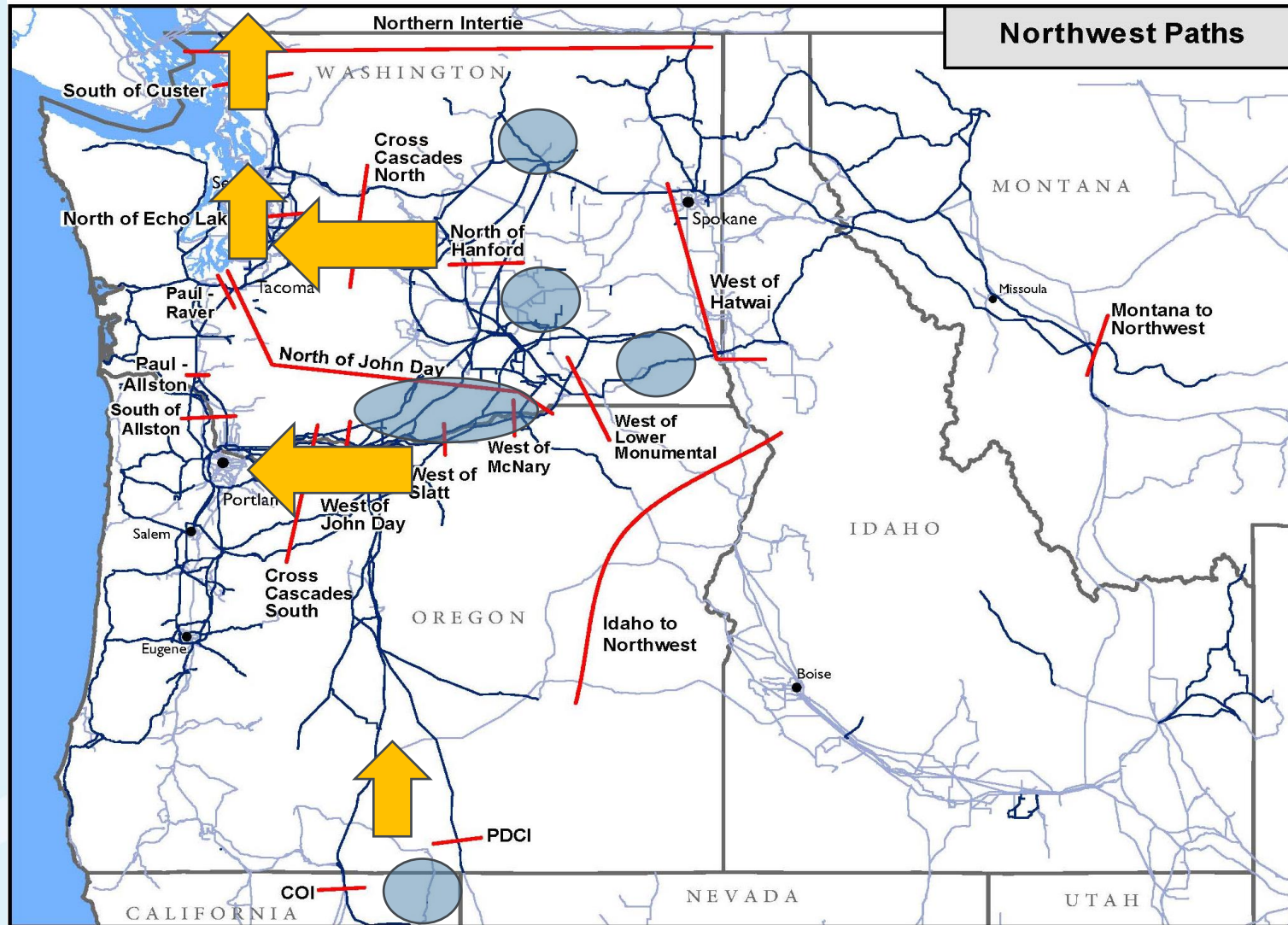


- Characterized by heat-wave NW loads, moderate-to-high COI/PDCI flows.
- Depending on dispatch pattern, limiting paths include: NOH, COI, PDCI, SOA and SOC.
- Surplus Resources can come from Canada, CRPS, NW Wind, or I-5 Corridor thermals

GIS Analyst: RLW Map Production Date: 9/28/2017



## 2. NW Peak Load E-W

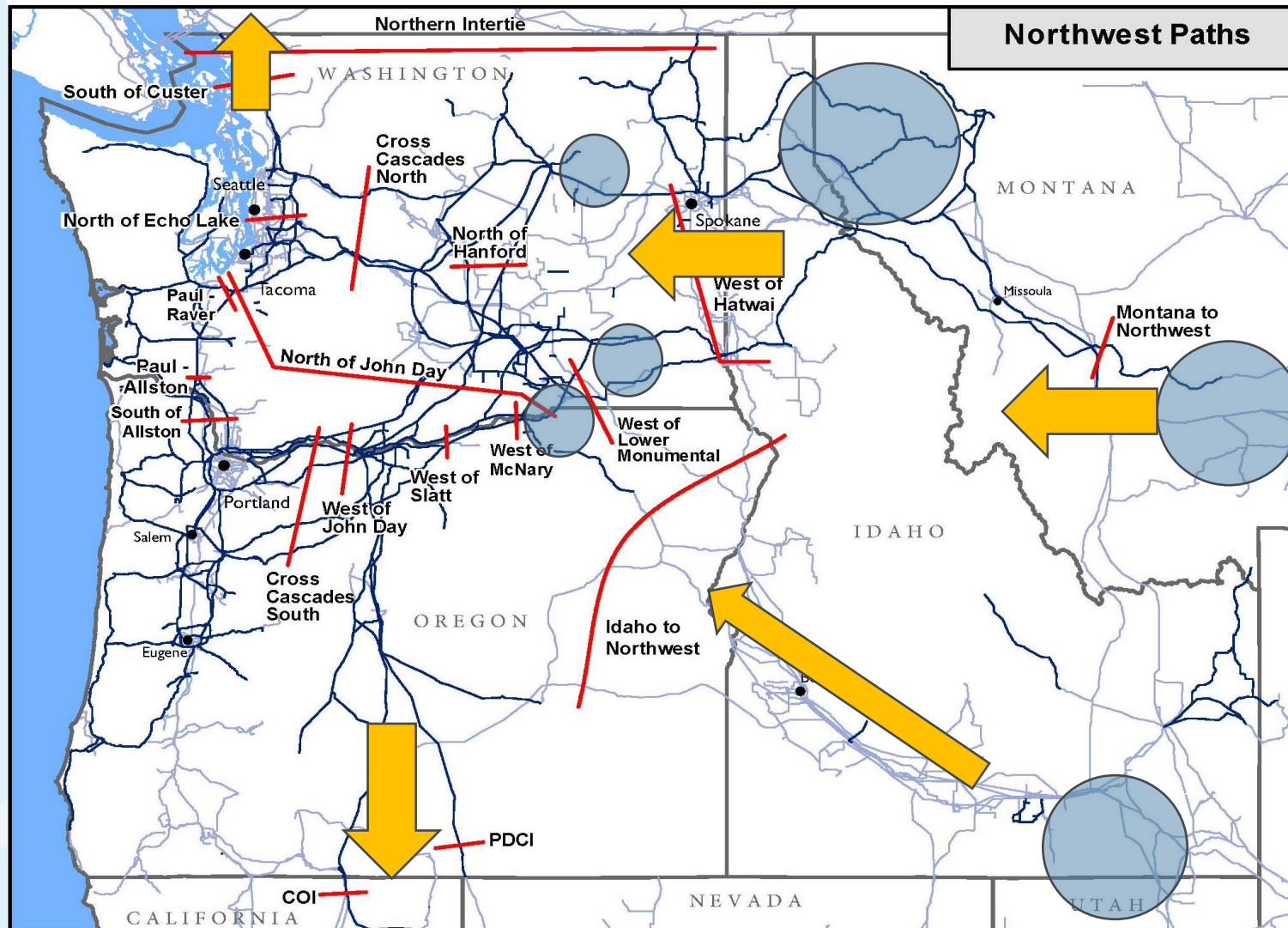


- Characterized by high west side peak loads. Usually cold-snap or heat-wave event
- High NW resource outputs (Hydro, thermal)
- limiting paths include: WOCN, WOCS, NOEL
- Exports to Canada as BC loads peak and hydro availability tapers.
- Historically, California imports to NW only occur in winter months (more on that later)

GIS Analyst: RLW Map Production Date: 9/28/2017



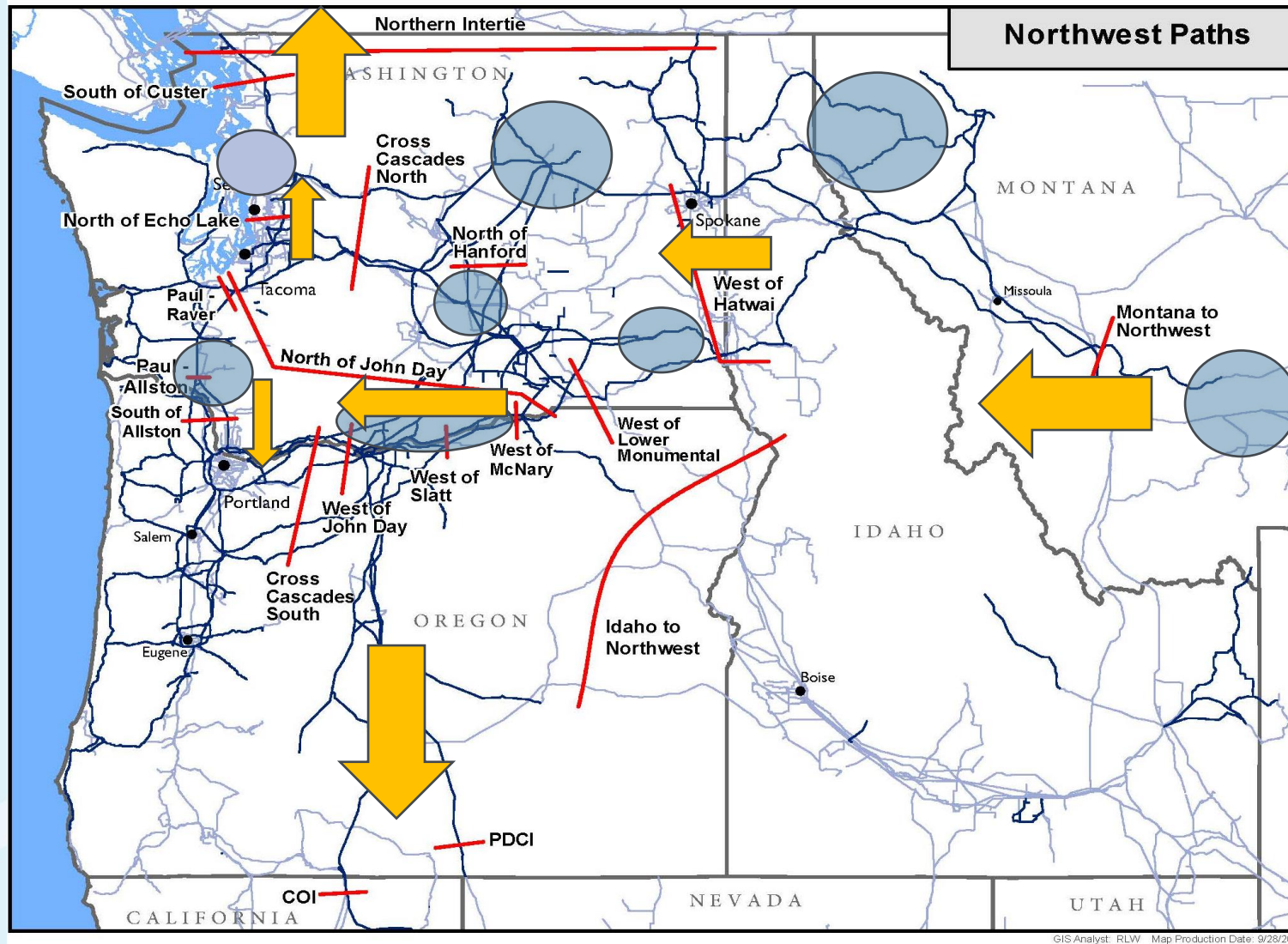
### 3. NW Off-Peak E-W



- Characterized by light NW loads, upper & mid Columbia hydro low, and surplus MT/ID resources (spring/Fall, light summer)
- Many west-side thermal plants offline, NW wind moderate-to-high
- Limiting paths include: WOH, MT-NW
- Usually exporting to Canada & California

GIS Analyst: RLW Map Production Date: 9/28/2017

## 4. NW Dual Export



- Characterized by light NW loads, lots of surplus NW resources
- Simultaneous High exports North to Canada & South to California
- Limiting paths include: COI/PDCI, NI/NOEL, MT-NW, WOM/WOS/WOJ.
- Moderate-to-High E-W flows, usually less than peak load conditions

GIS Analyst: RLW Map Production Date: 9/28/2017

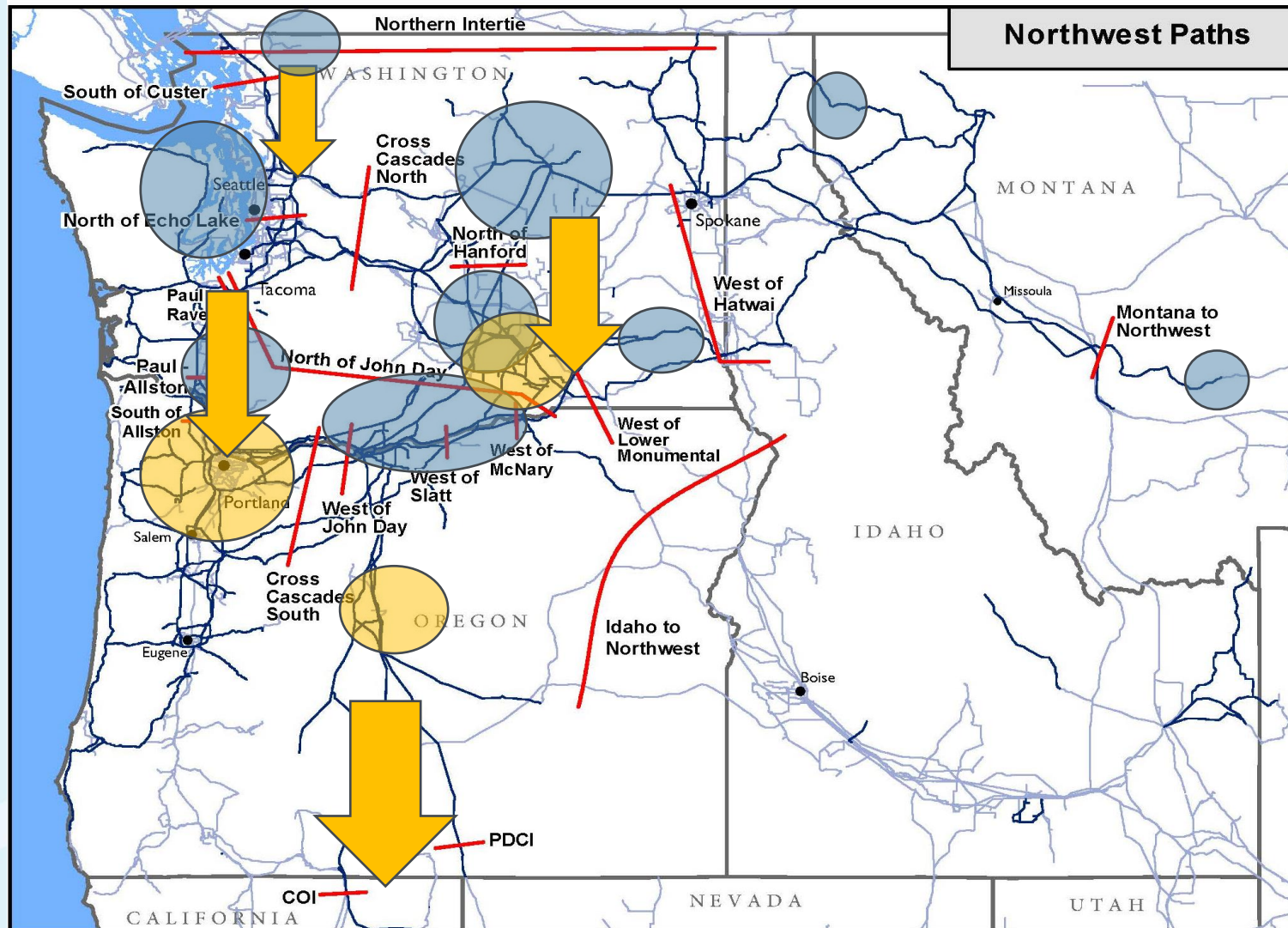


# Some “Novel” NW Flows & Conditions

- 5. Summer Off-peak “Sunset”: 75-90% of summer peak WECC-wide, high NW wind/high NW hydro, low CA solar conditions
- 6. Light NW load “high renewables”: <70% of typical peak NW loads, WECC-wide renewables high, WECC-wide thermals offline
- 7. Near-Peak NW summer load “high renewables”: 70-90% of typical NW peak load, WECC-wide renewables high, I-5 corridor gen low/offline
- 8. Near-Peak NW winter load “high renewables”: 70-90% of typical NW peak load, WECC-wide renewables high, I-5 corridor gen low/offline



# 5. Summer Off-Peak “Sunset”



- Characterized by evening following a WECC-wide heat wave, high COI/PDCI flows.
- Depending on NW resource pattern, limiting paths include: COI/PDCI, NOH, R-P, SOA, or SOC.
- Load area “sub-grids” also become limiting (PDX, Tri-C, C.OR)
- CA/AZ/NV solar offline, WECC thermal plants low, sending NW surplus resources to California.
- MT/ID resource surplus can also contribute

GIS Analyst: RLW Map Production Date: 9/28/2017



This map illustrates the Northwest Paths, highlighting major transportation corridors and regions in the Pacific Northwest. The map covers Washington, Oregon, and Idaho, with labels for various locations and paths.

**Regions and Locations:**

- Washington:** Northern Intertie, South of Custer, North of Echo Lake, Paul - Raver, Paul - Allston, South of Allston, Eugene, Portland, Salem, Tacoma, Seattle, Spokane, Missoula, Hatwai.
- Oregon:** Cross Cascades North, North of Hanford, North of John Day, West of Slatt, West of McNary, West of John Day, Cross Cascades South, PDCI, COI.
- Idaho:** Idaho to Northwest, Boise.
- Montana:** Montana to Northwest.
- Neighboring States:** CALIFORNIA, NEVADA, UTAH.

**Paths and Corridors:**

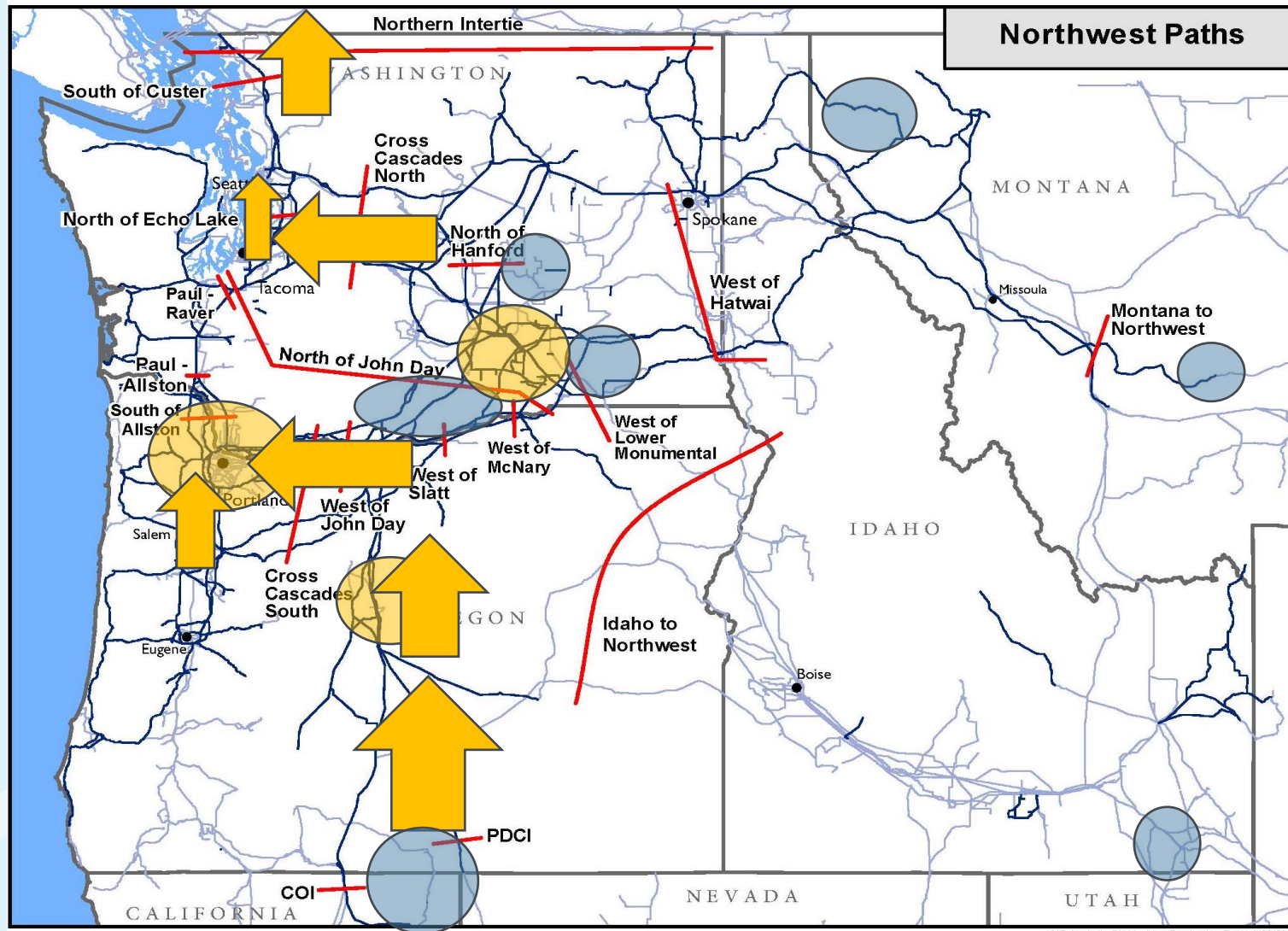
- Northern Intertie:** A red line running horizontally across the top of Washington.
- South of Custer:** A red line running horizontally across the top of Washington.
- North of Echo Lake:** A red line running horizontally across the top of Washington.
- Paul - Raver:** A red line running horizontally across the top of Washington.
- Paul - Allston:** A red line running horizontally across the top of Washington.
- South of Allston:** A red line running horizontally across the top of Washington.
- North of John Day:** A red line running horizontally across the top of Washington.
- West of Slatt:** A red line running horizontally across the top of Washington.
- West of McNary:** A red line running horizontally across the top of Washington.
- West of John Day:** A red line running horizontally across the top of Washington.
- Cross Cascades North:** A red line running horizontally across the top of Washington.
- Cross Cascades South:** A red line running horizontally across the top of Washington.
- Idaho to Northwest:** A red line running horizontally across the top of Washington.
- Montana to Northwest:** A red line running horizontally across the top of Washington.

**Other Features:**

- Yellow Arrows:** Indicate major transportation corridors or paths.
- Blue Circles:** Highlight specific regions or areas of interest.
- Red Lines:** Highlight specific transportation corridors or paths.

- GIS Analyst: RLW    Map Production Date: 9/28/2017

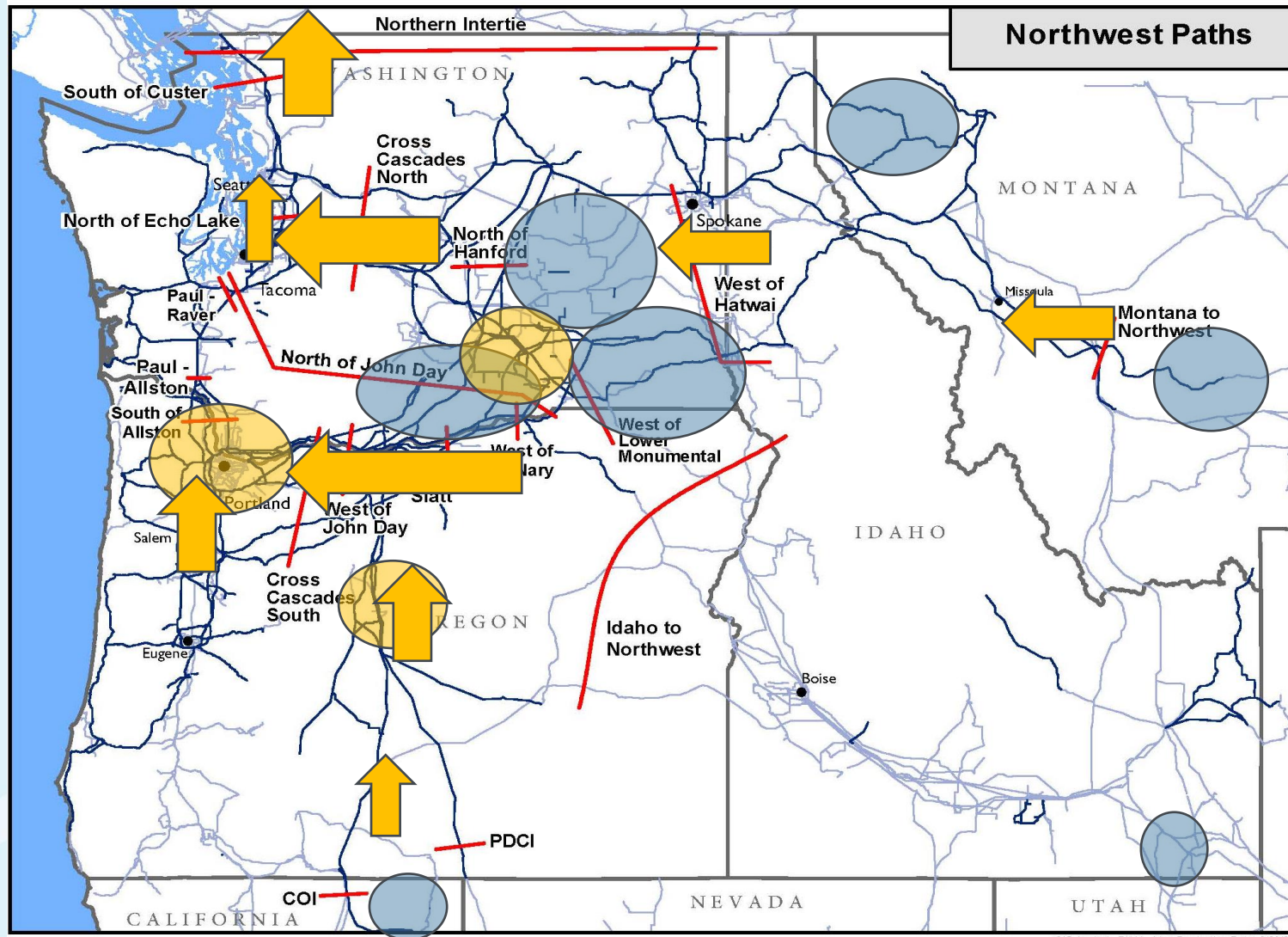
# 7. Near-Peak NW Load, High Renewables



- Characterized by moderate-to-high NW **summer loads**, WECC-wide renewables high, WECC-wide thermals offline
- Limiting paths include: WOCN, WOCS, NOEL, load area “sub-grids”
- Moderate-to-high Exports to Canada, depending on BC loads and hydro output
- Maximum imports from California due to solar
- Moderate NW renewable output in E.OR/E.WA



## 8. Near-Peak NW Load, High Renewables



- Characterized by moderate-to-high NW **winter loads**, moderate WECC-wide renewable output, WECC-wide thermals offline
- Limiting paths include: WOCN, WOCS, NOEL, load area “sub-grids”
- Moderate-to-high Exports to Canada, depending on BC loads and hydro output
- Moderate imports from California
- High NW renewable output in E.OR/E.WA/N./ID/MT

GIS Analyst: RLW Map Production Date: 9/28/2017

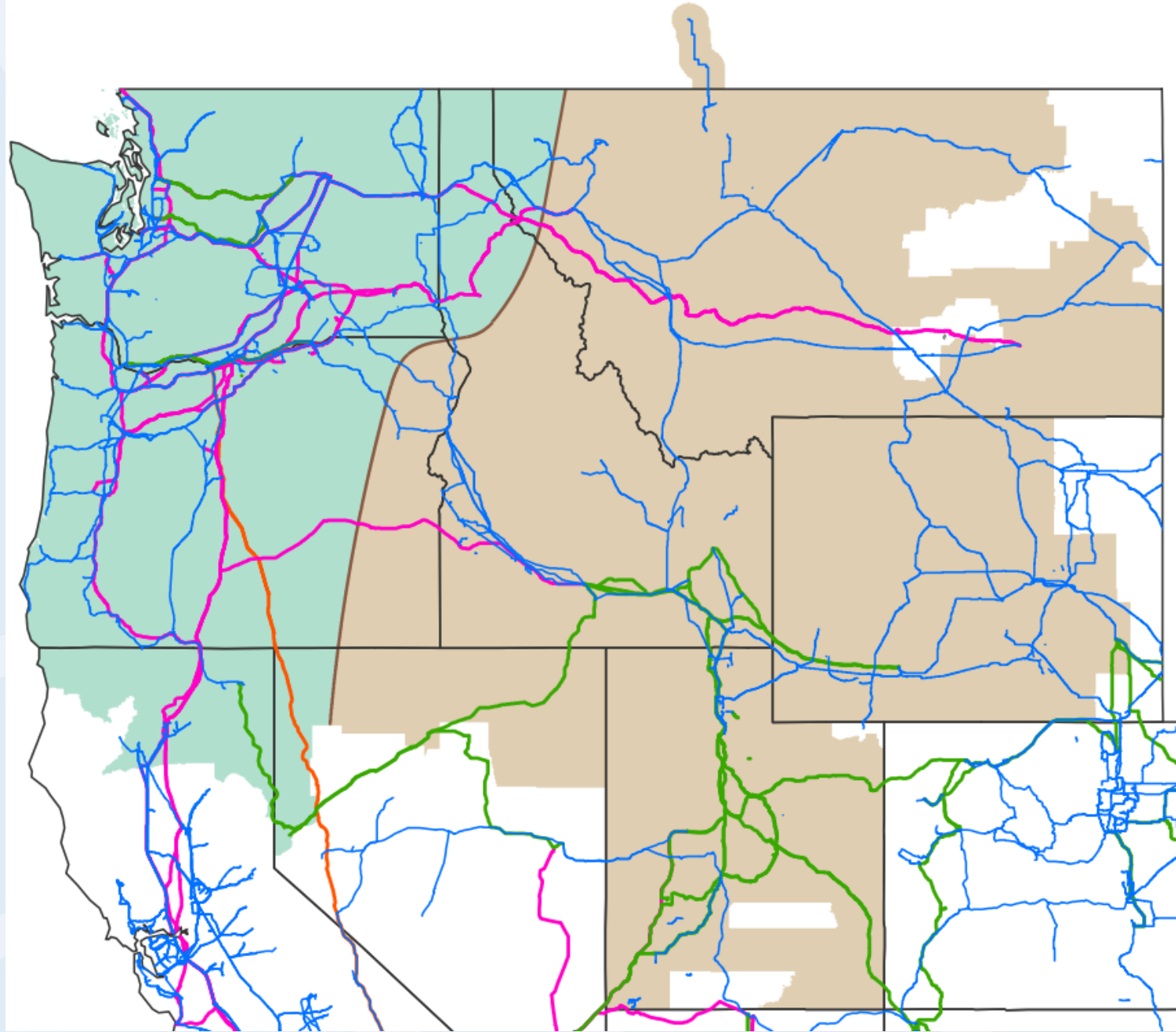
Q&A Break



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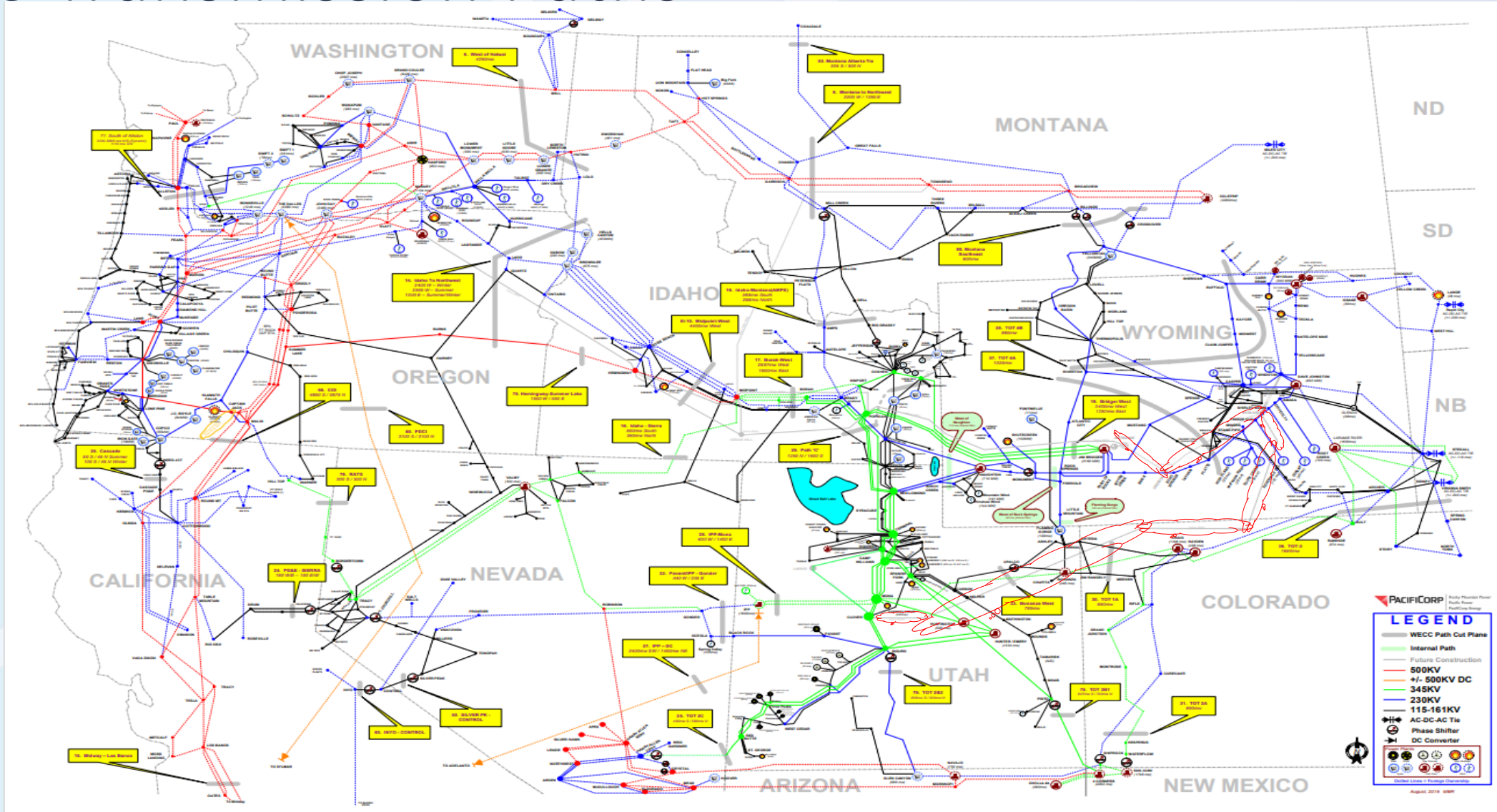


# Transmission Flows Wyoming to Idaho and Southern Utah Tie Lines



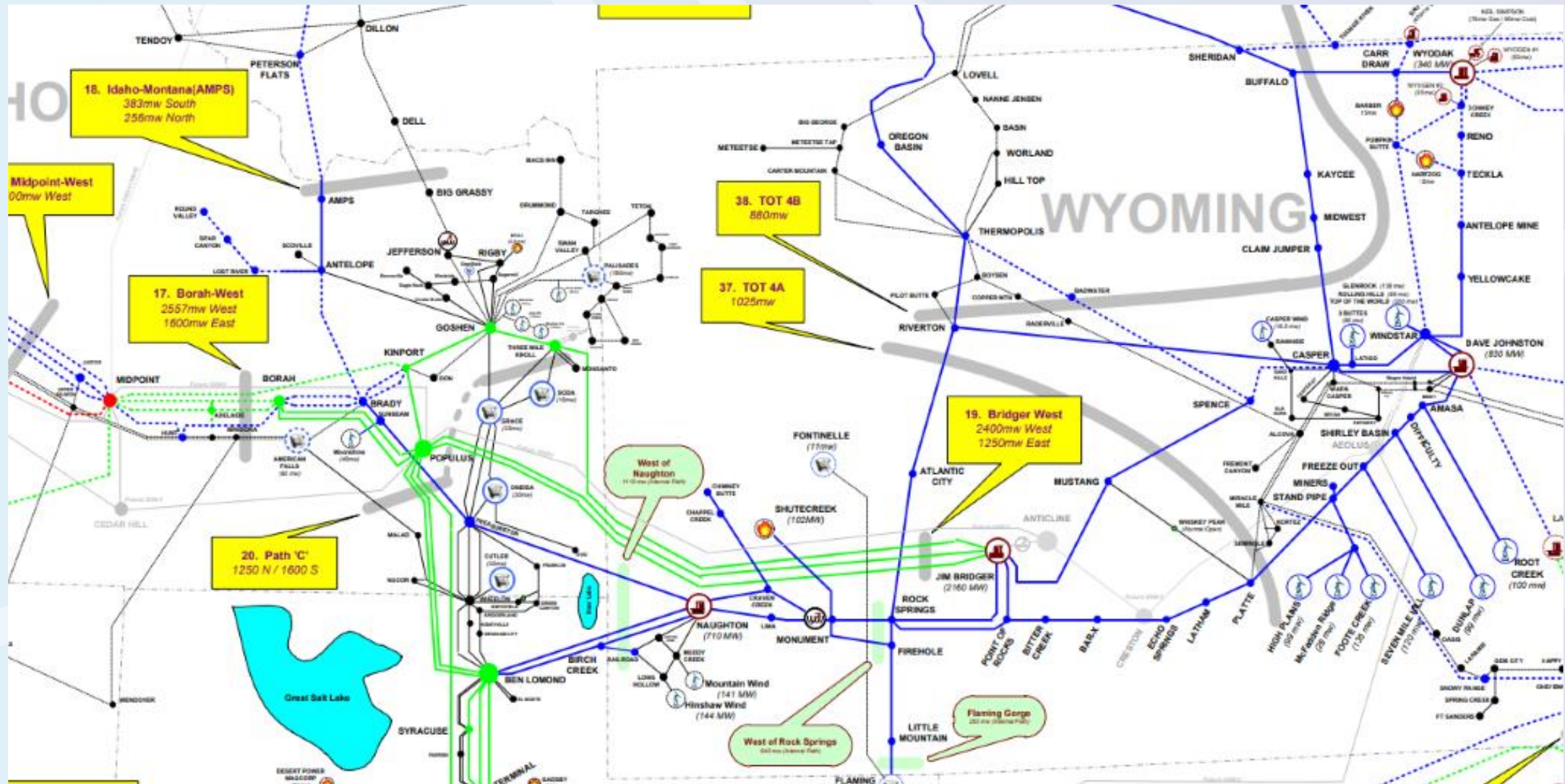
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# WECC Transmission Paths

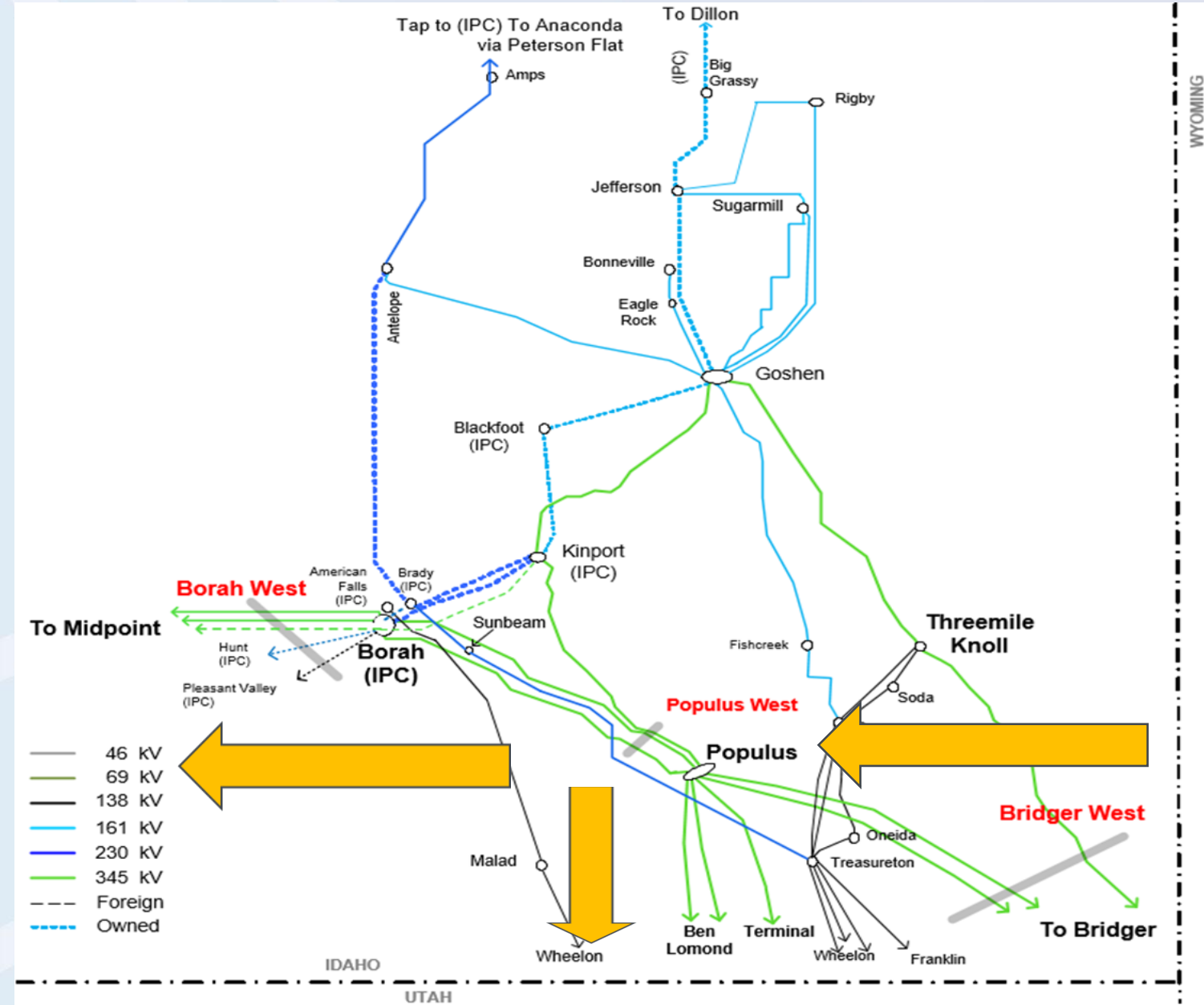




# Bridger West, Populus West & Path C



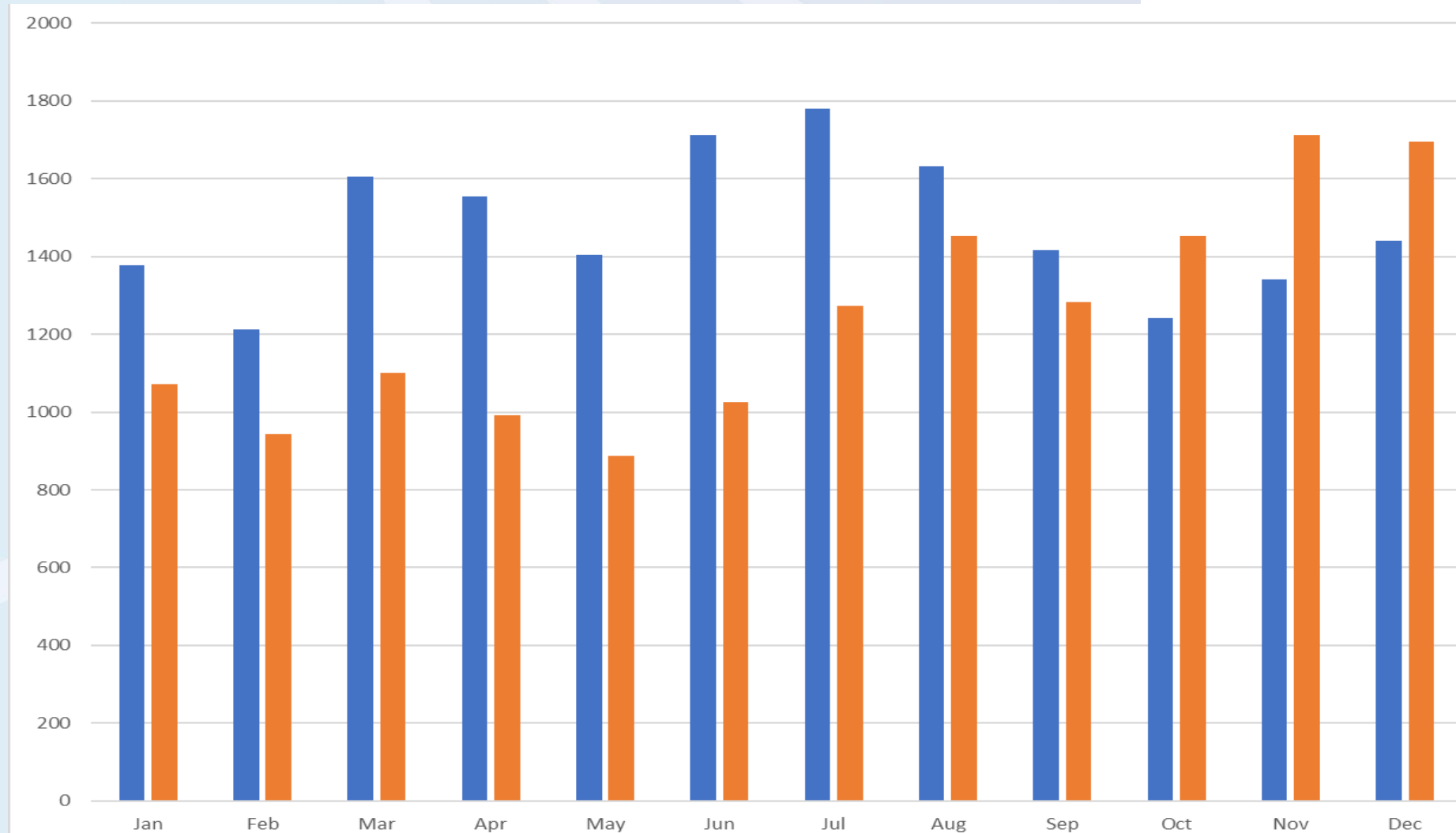
# Bridger West, Populus West & Path C





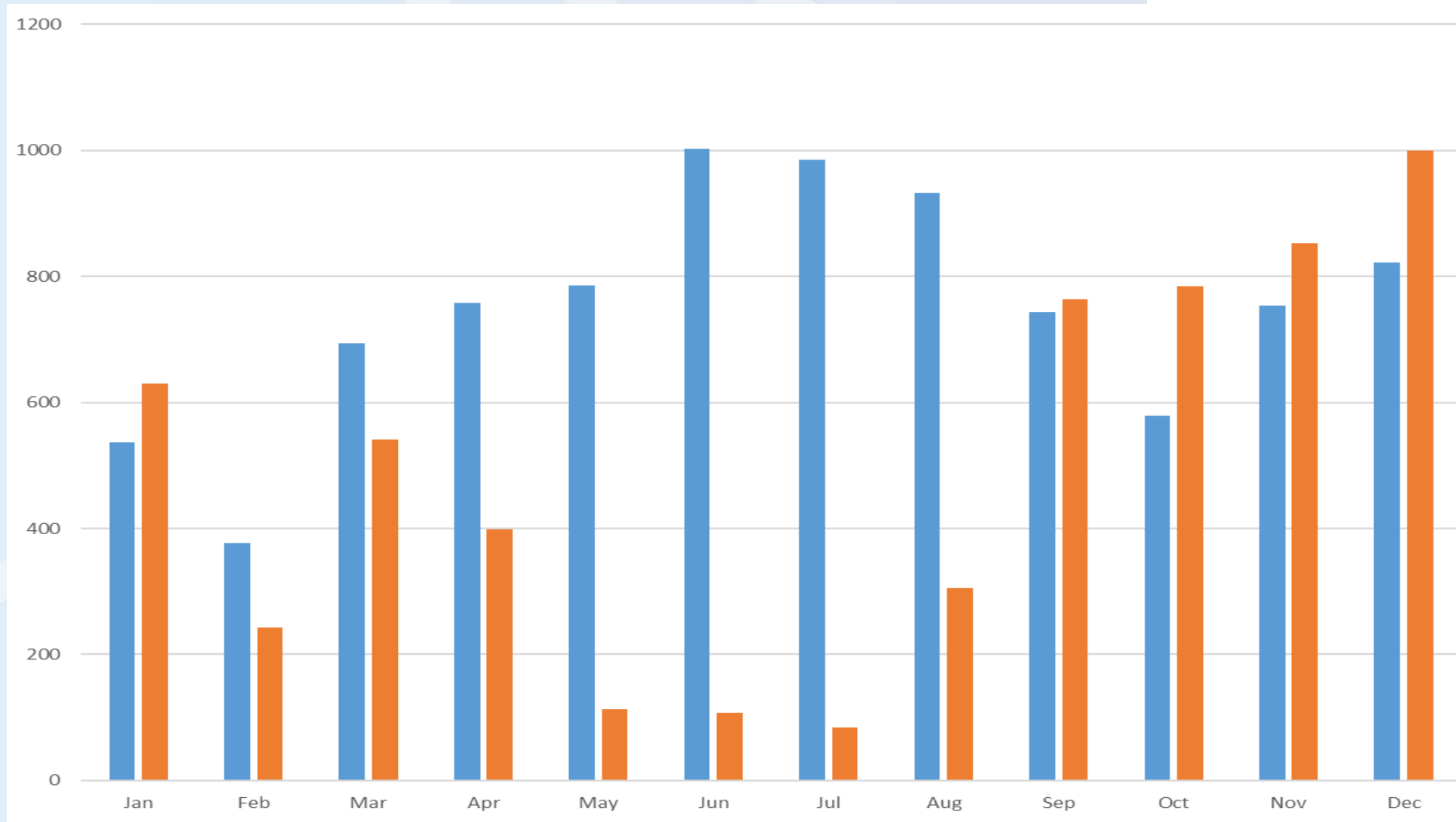
# Bridger West Power Flow Changes

- Bridger, WY to Goshen/Populus, ID
- Wyoming generation being transmitted to the Northwest & Utah.



# Populus West Power Flow Changes

- Populus, ID to Borah/Kinport, ID
- Under heavy load conditions, more north-to-south flows as compared to east-to-west flows.



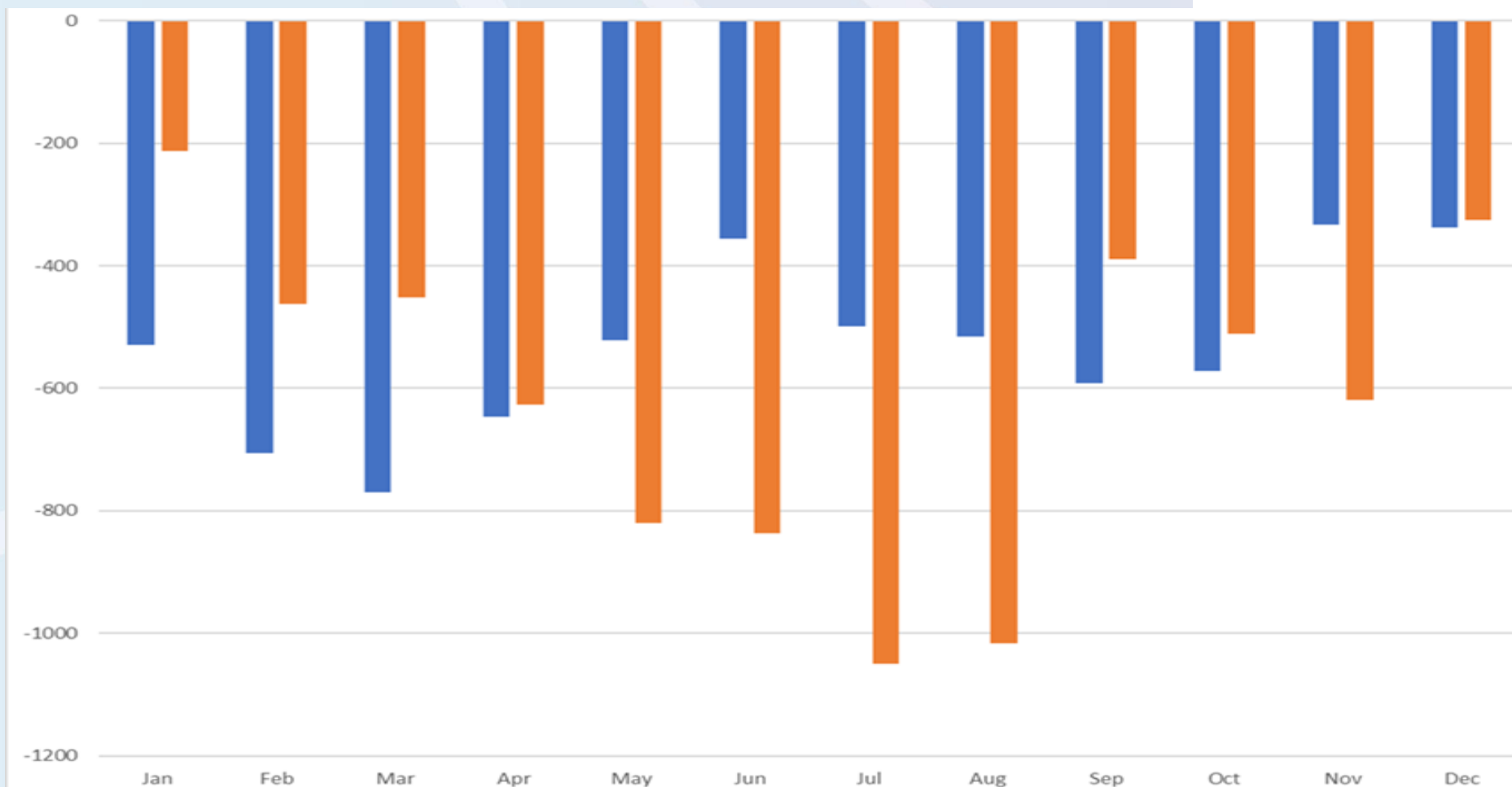
# Path C Power Flow Changes

## Values

■ Average of 2015

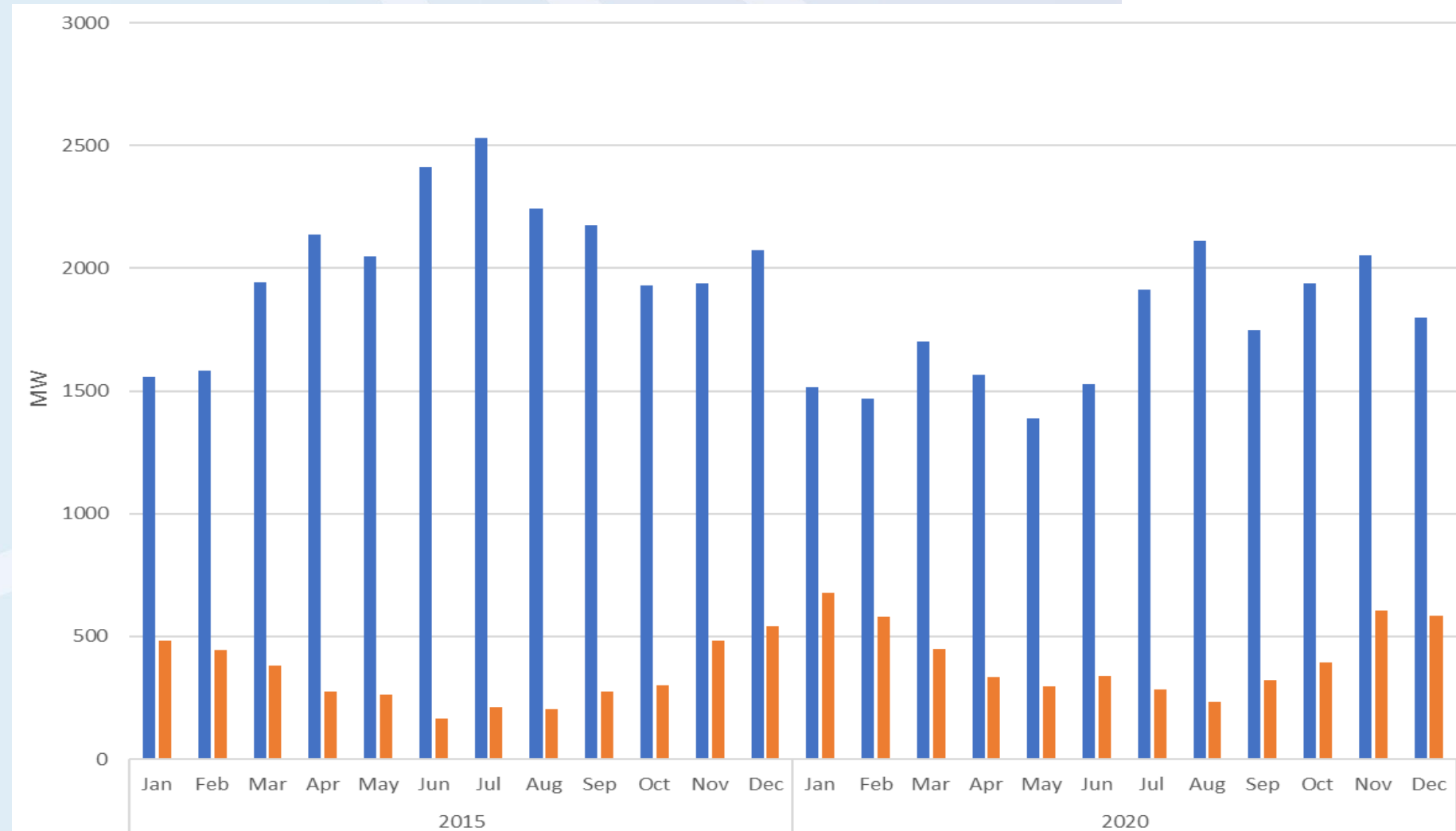
■ Average of 2020

- Populus (ID) to Terminal (UT)
- Under heavy load conditions, more north-to-south flows as compared to east-to-west flows.



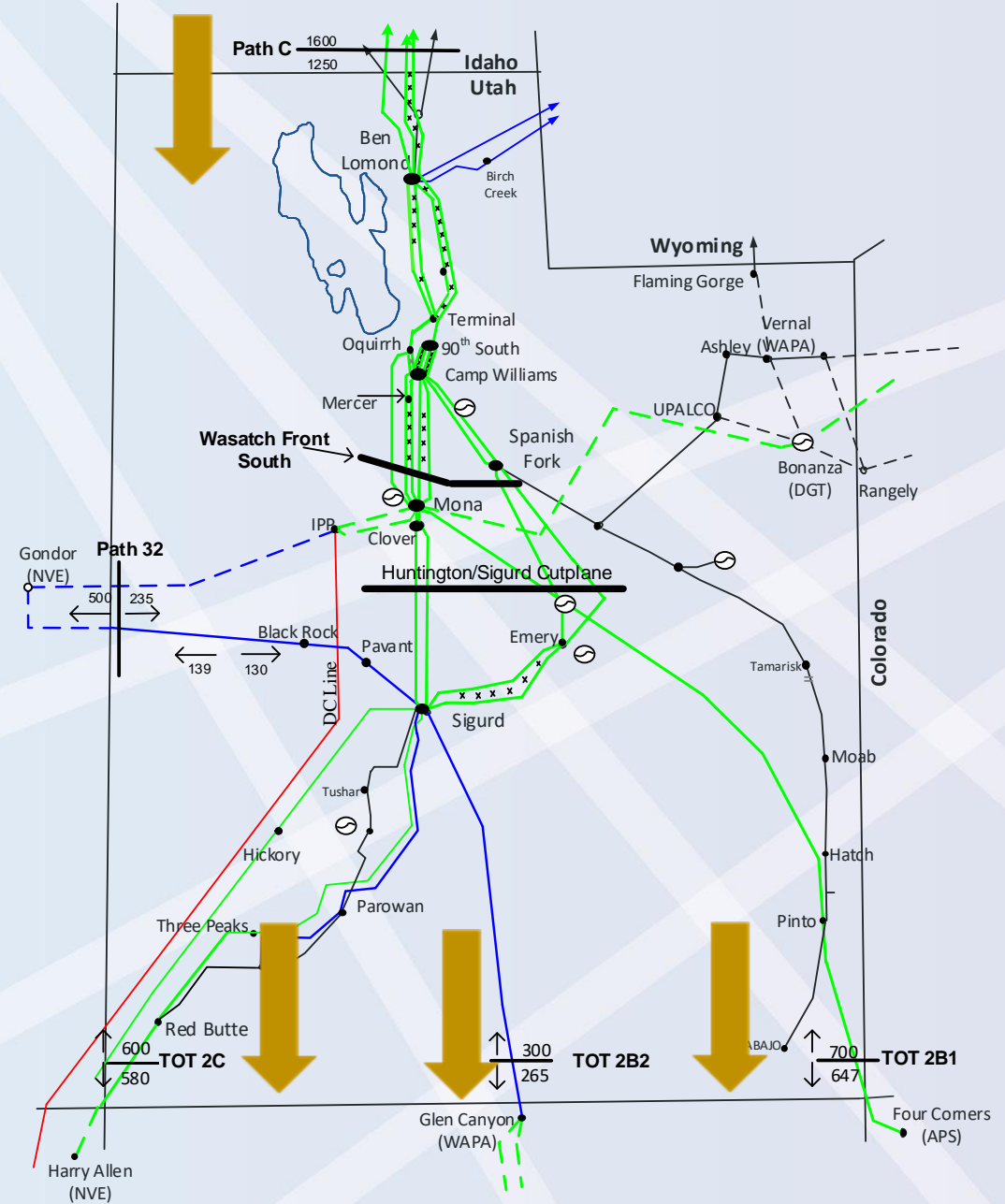


# Coal versus Wind across Wyoming



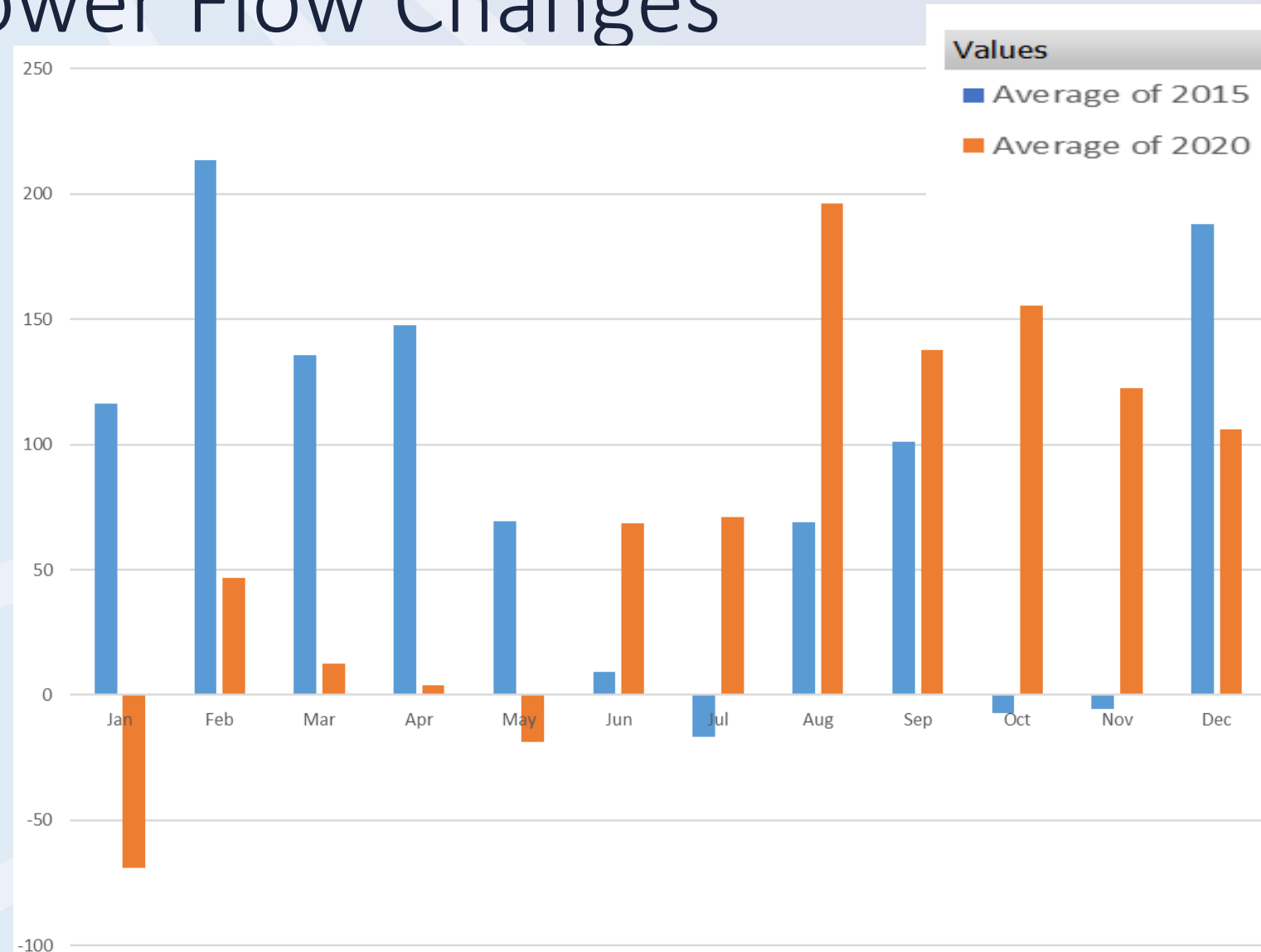
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# Southern Utah Transmission Paths



# Southern Utah Power Flow Changes

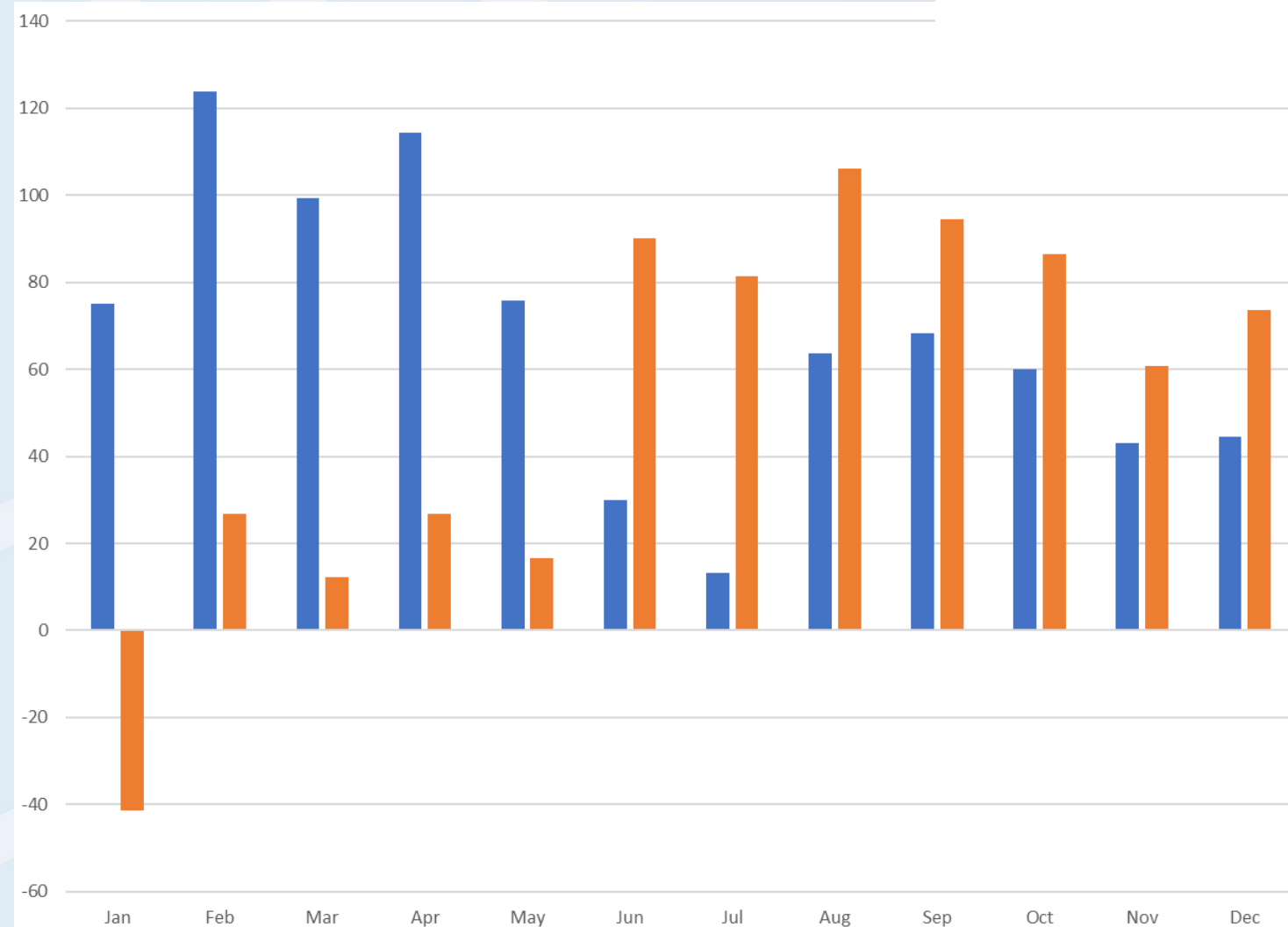
- Pinto (UT) to Four Corners (AZ)
- Heavy north-to-south flows during summer months during heavy load conditions
- Very few instances of south-to-north flows on the paths





# Southern Utah Power Flow Changes

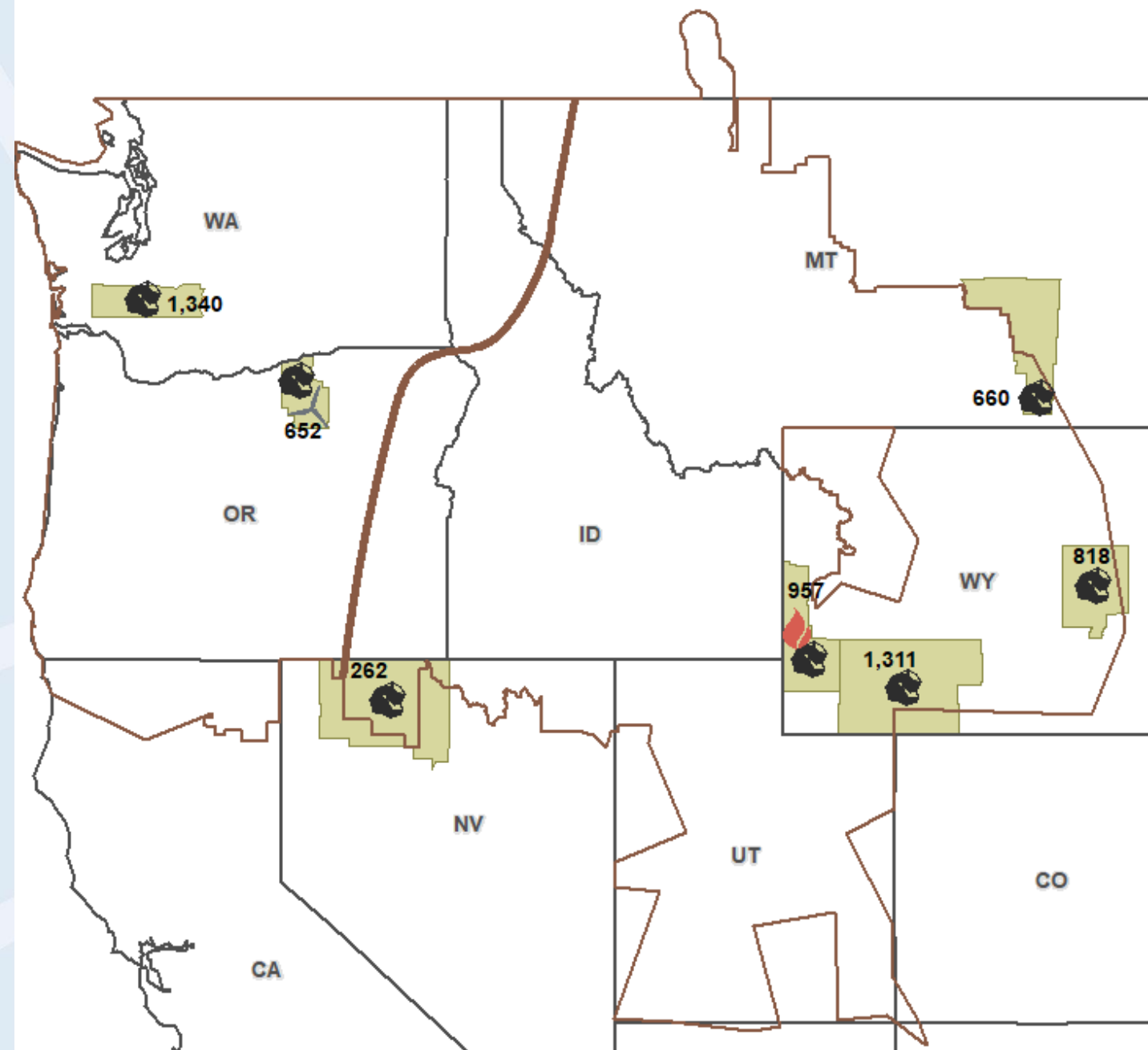
- Sigurd, UT to Glen Canyon, AZ
- Heavy north-to-south flows during summer months during heavy load conditions
- Very few instances of south-to-north flows on the paths



# Q&A Break

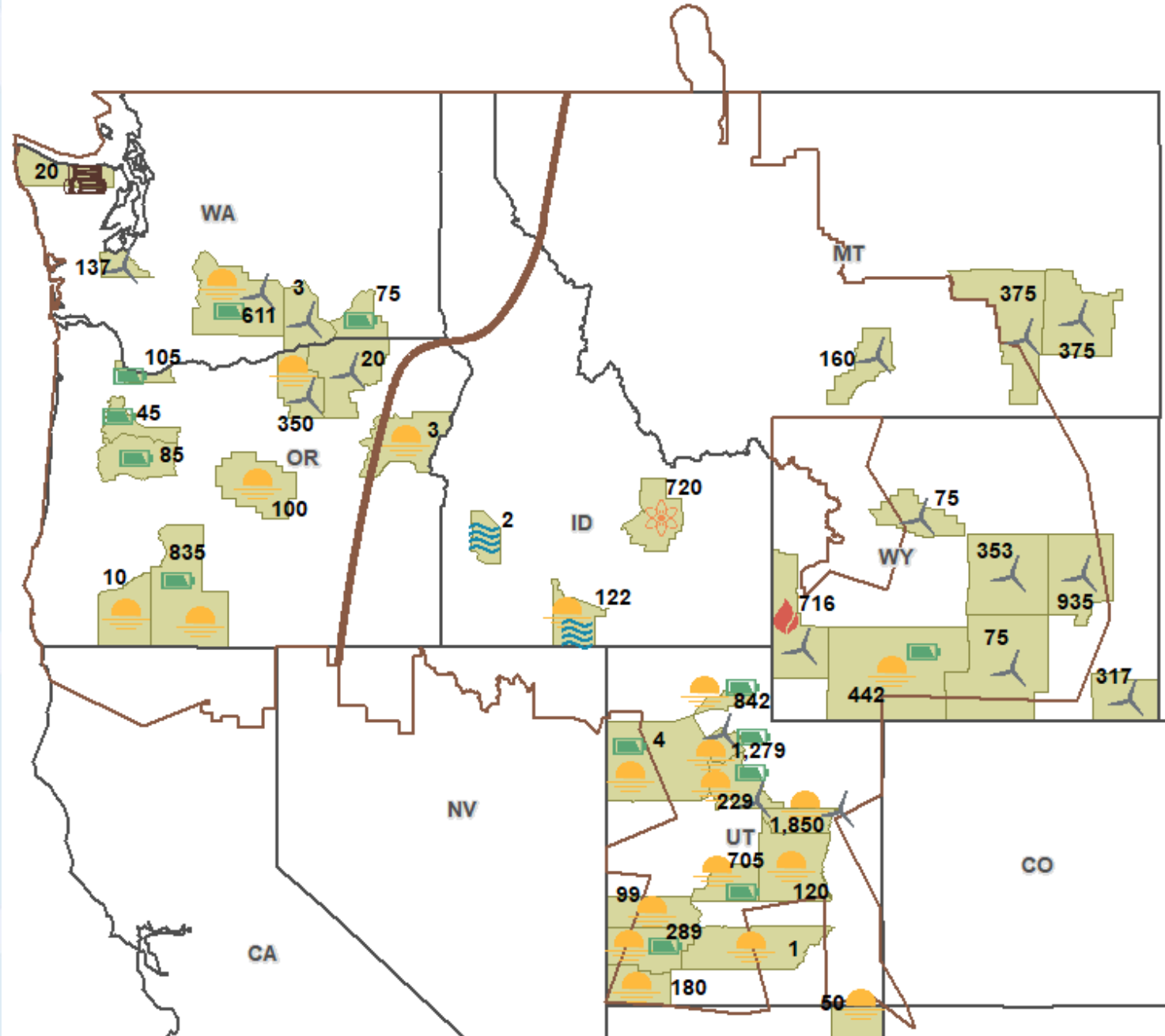


# Resource Retirements

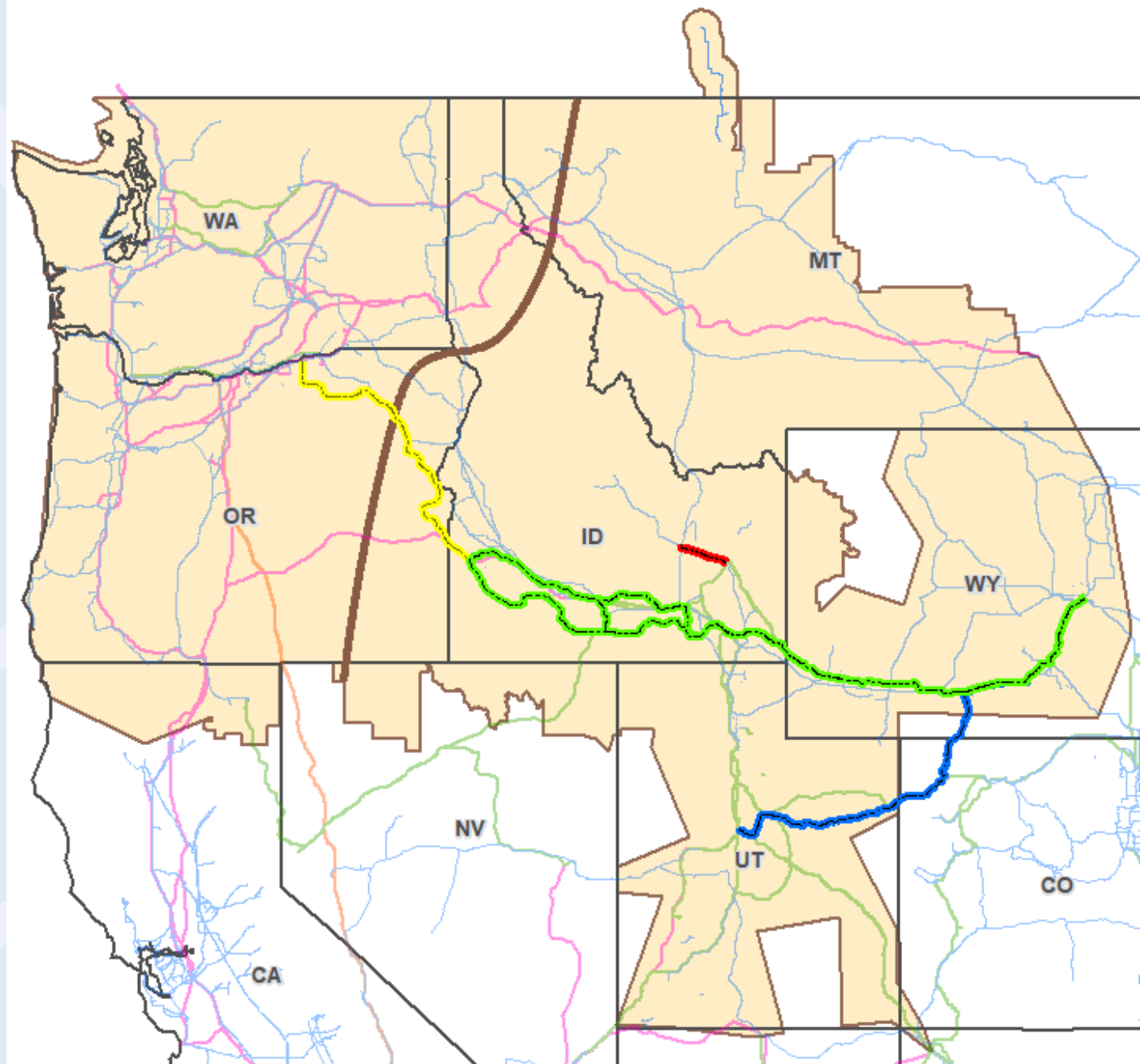




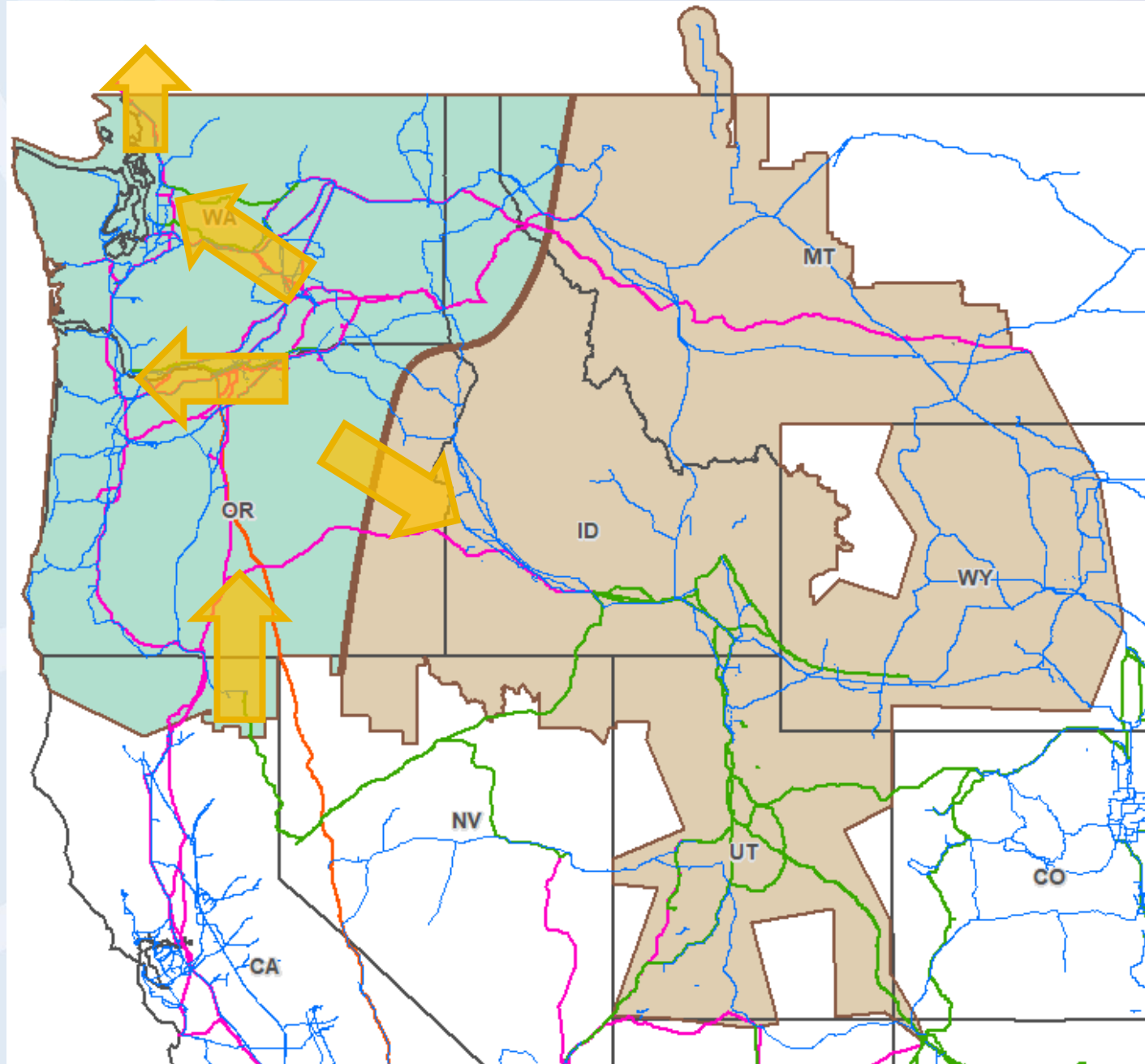
# Resource Additions



# Regional Transmission Additions

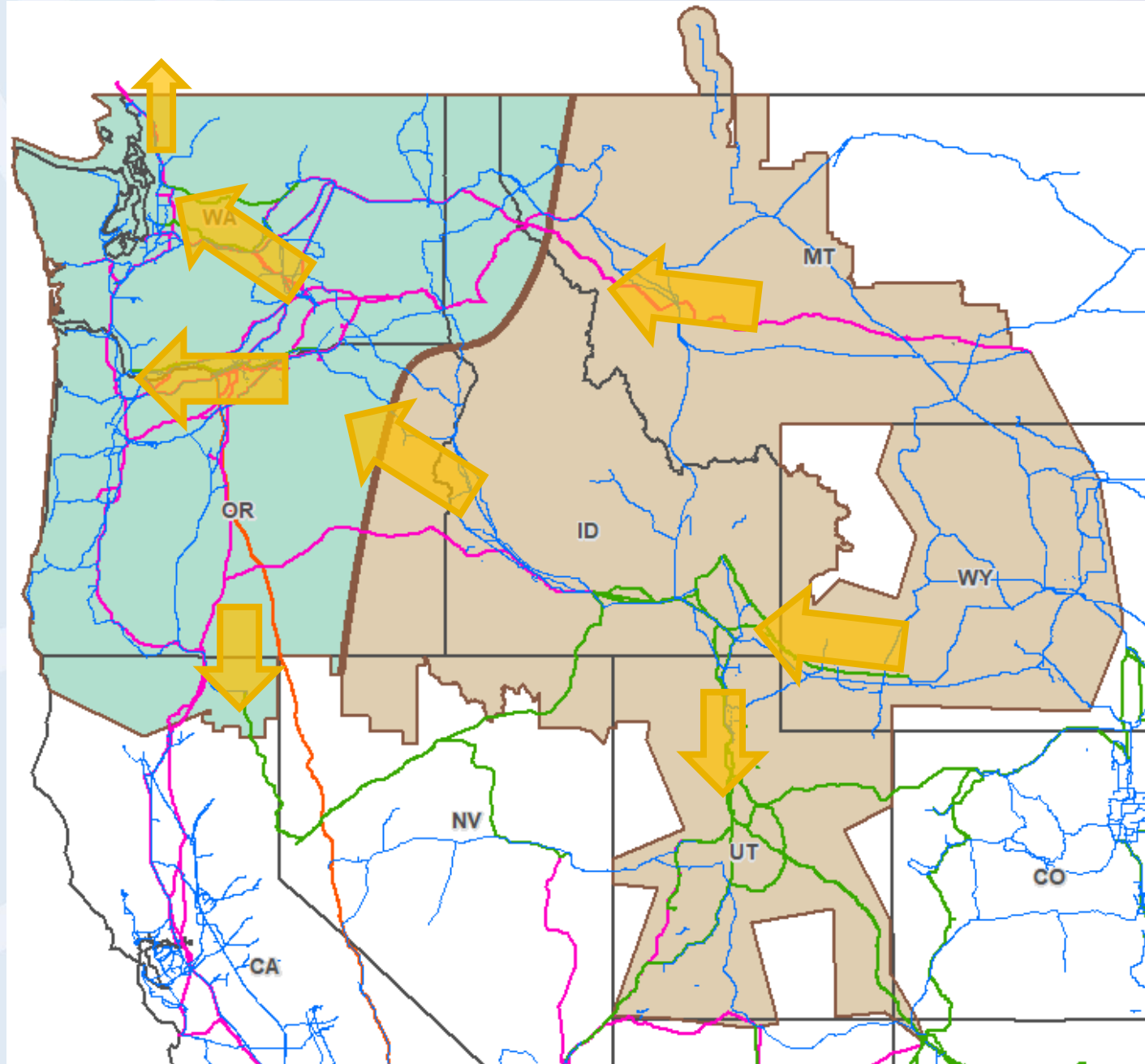


# Potential Future Peak Summer Flows with High Renewable Generation





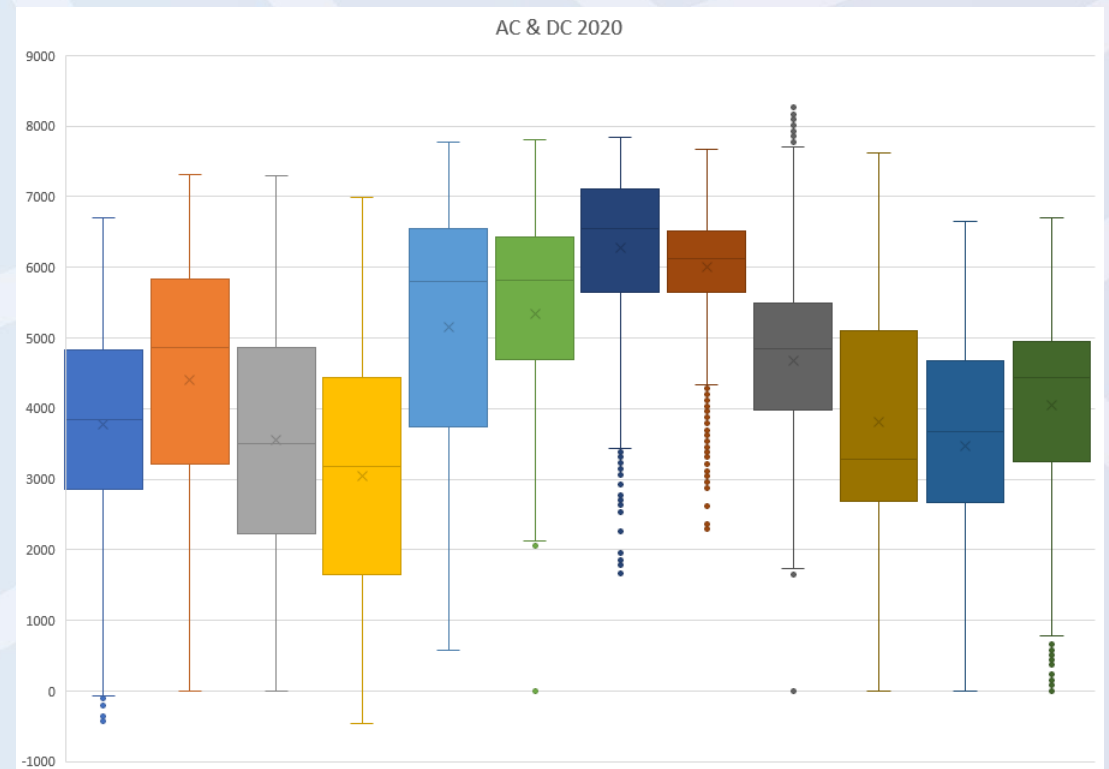
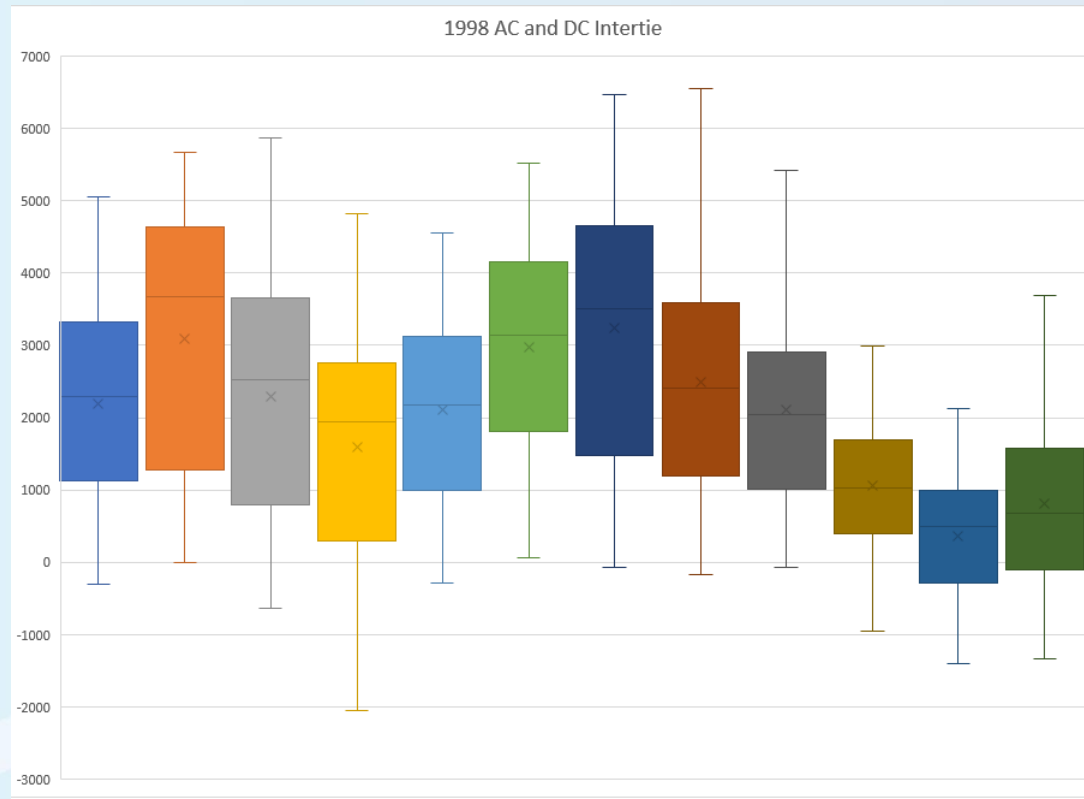
# Future Peak Wyoming Flows with High Renewable Generation



# AC and DC Intertie Monthly Transfers

**1998**

**2020**



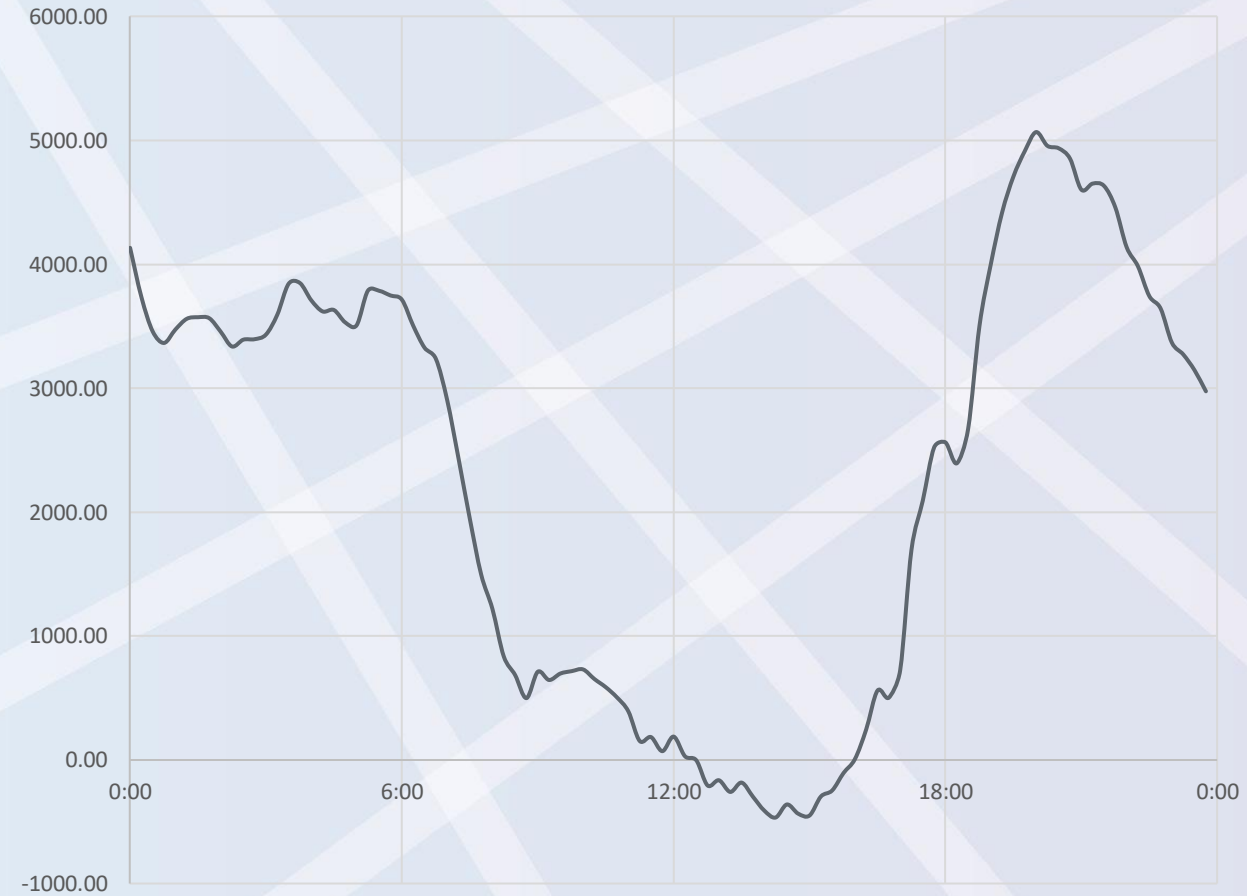
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# AD and DC Intertie Daily Transfers

ACDC 4/19/1998



AC and DC 4/19/2020

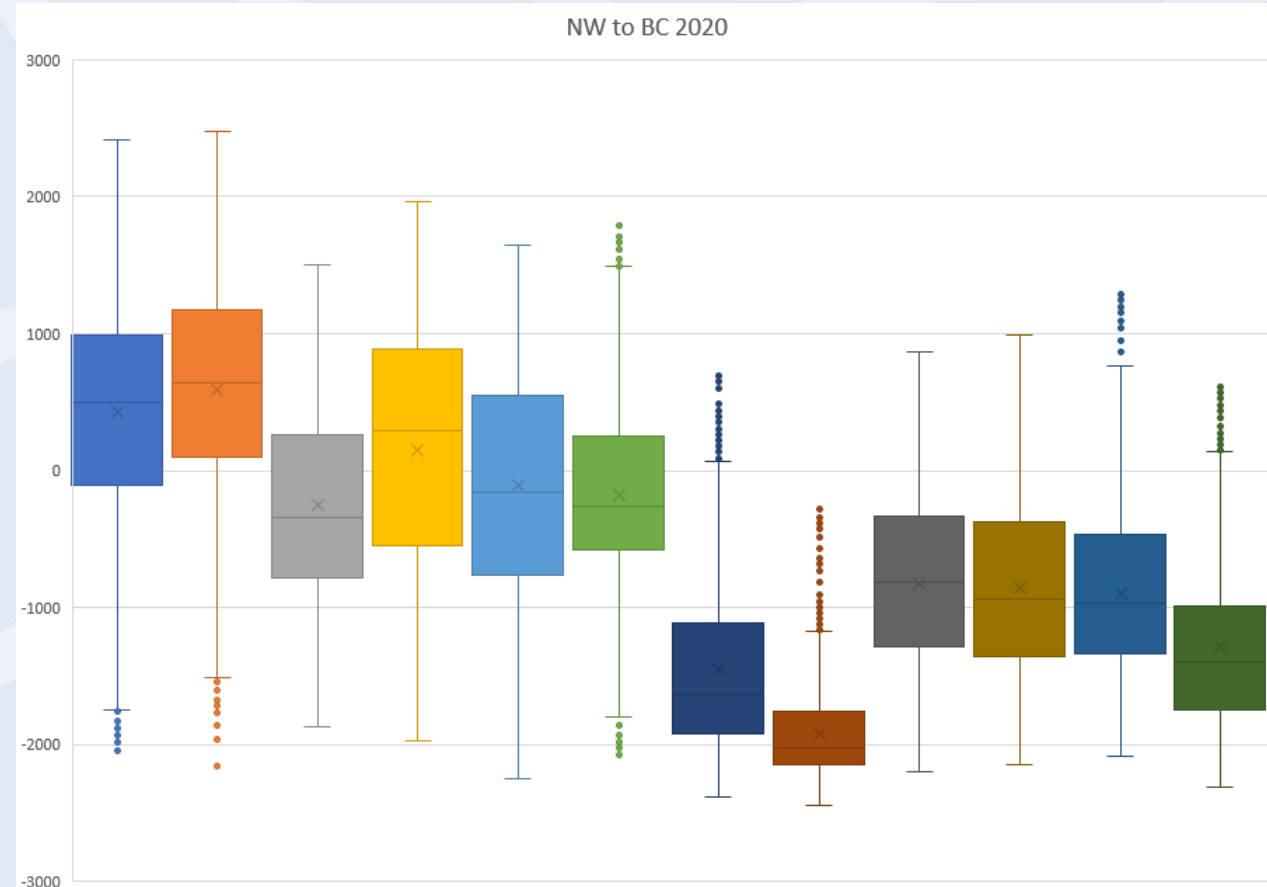
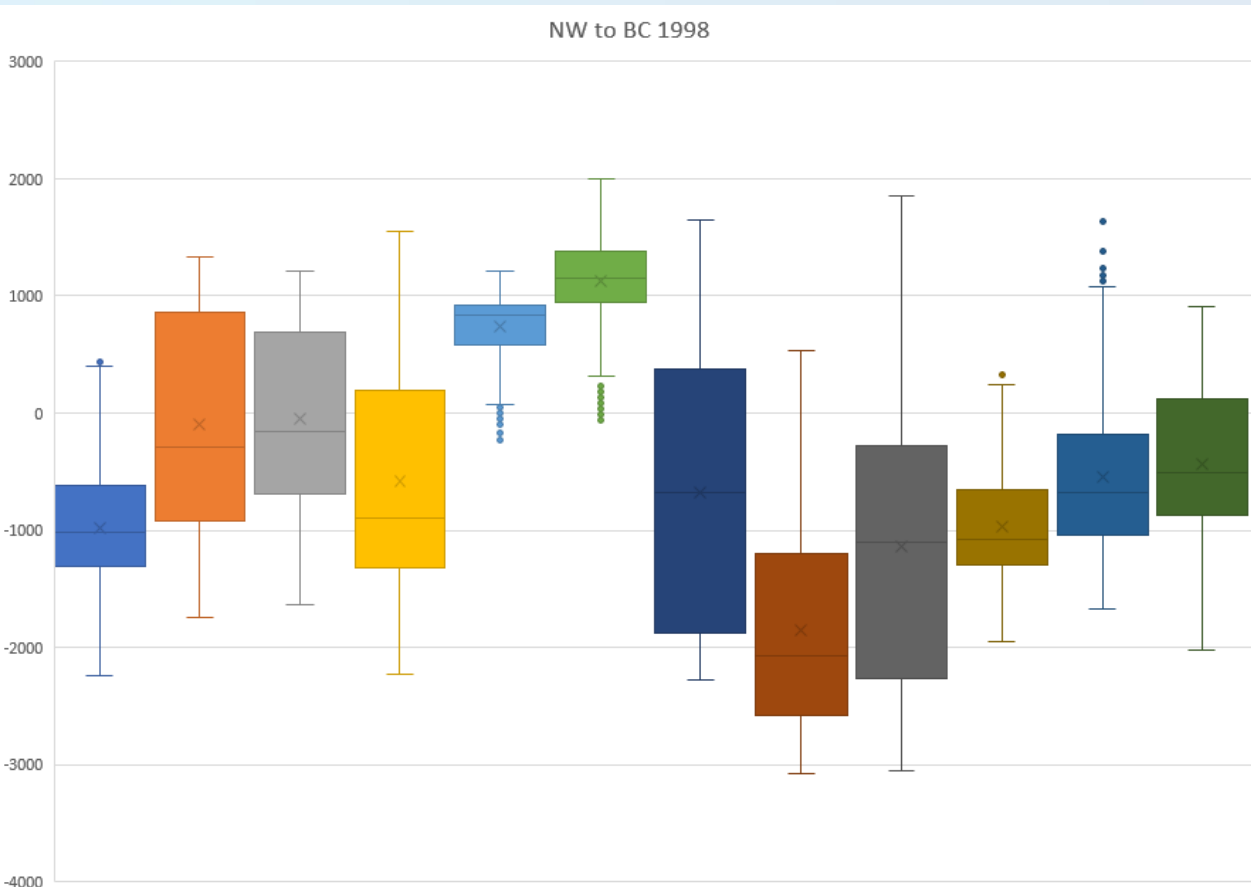




# NW to BC Monthly Transfers

**1998**

**2020**



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# NW to BC Daily Transfers

NW to BC 4/19/1998



4/19/2020

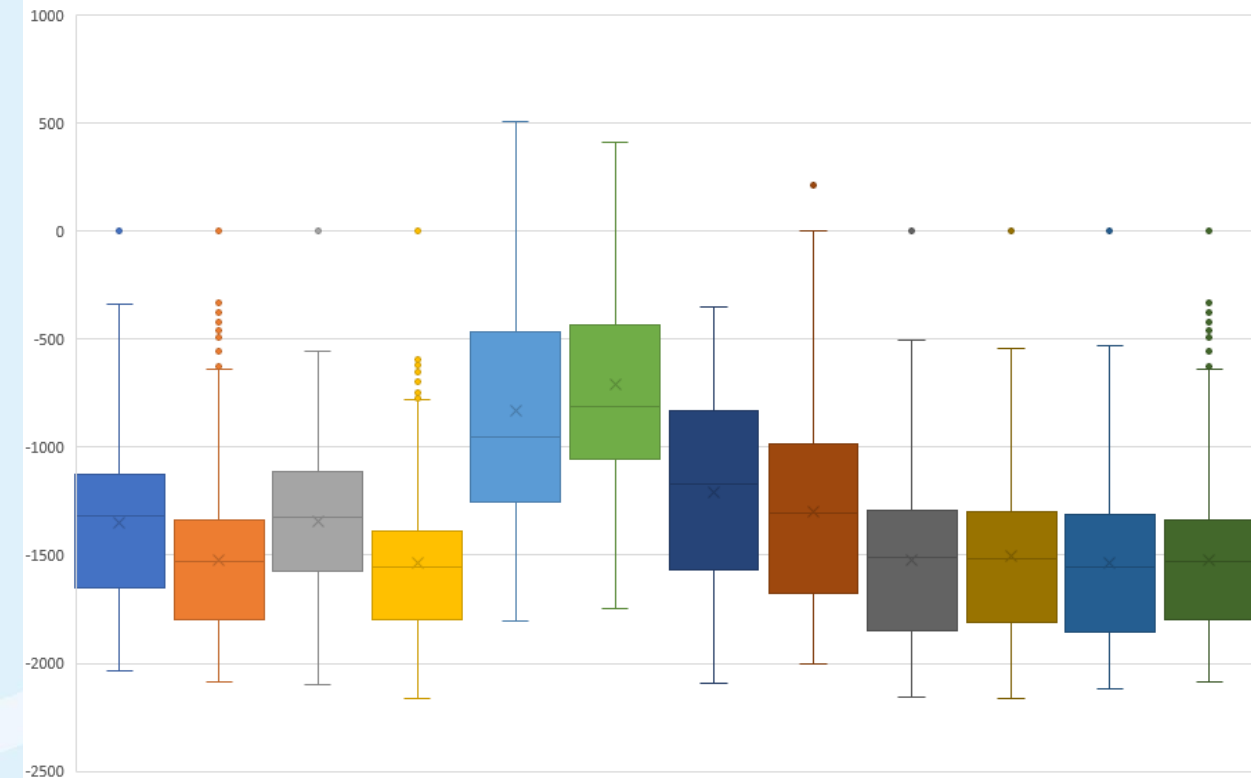


# Montana to NW Monthly Transfer

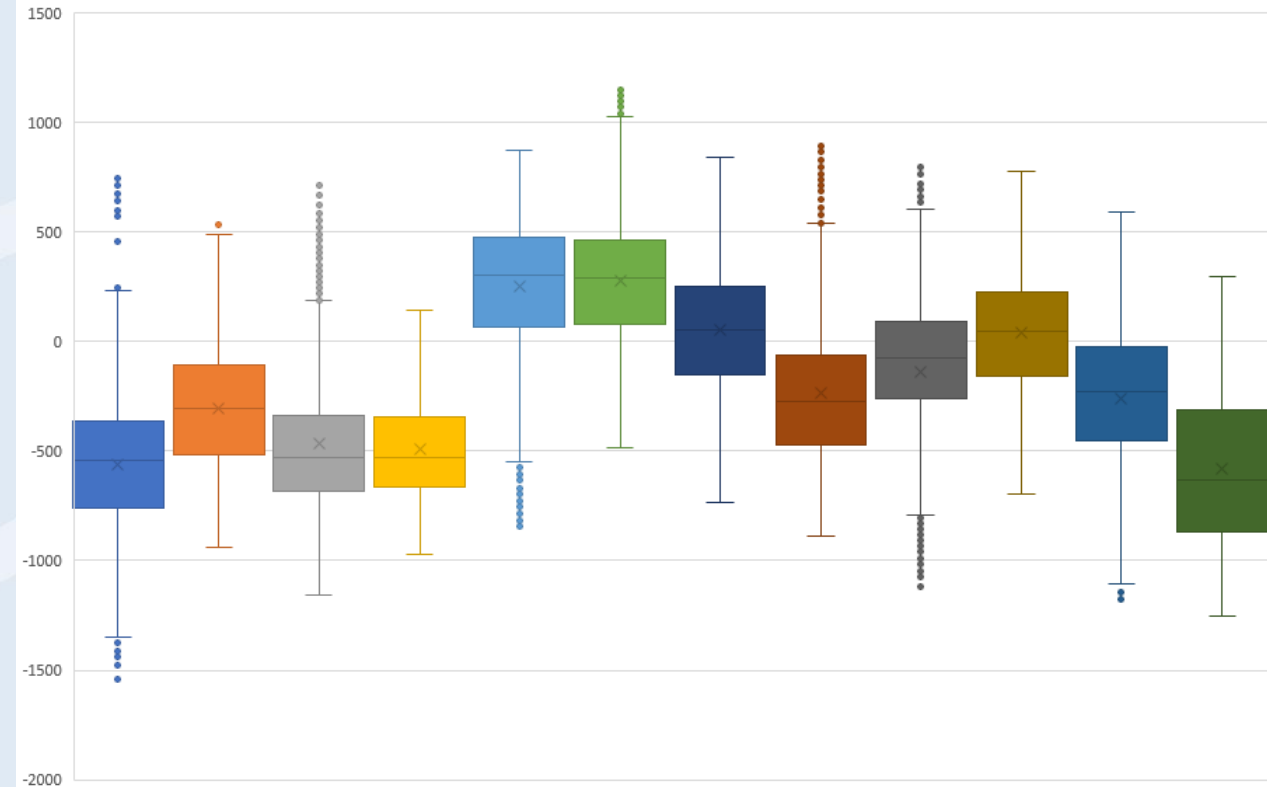
**1998**

**2020**

NWMT to NW 1998



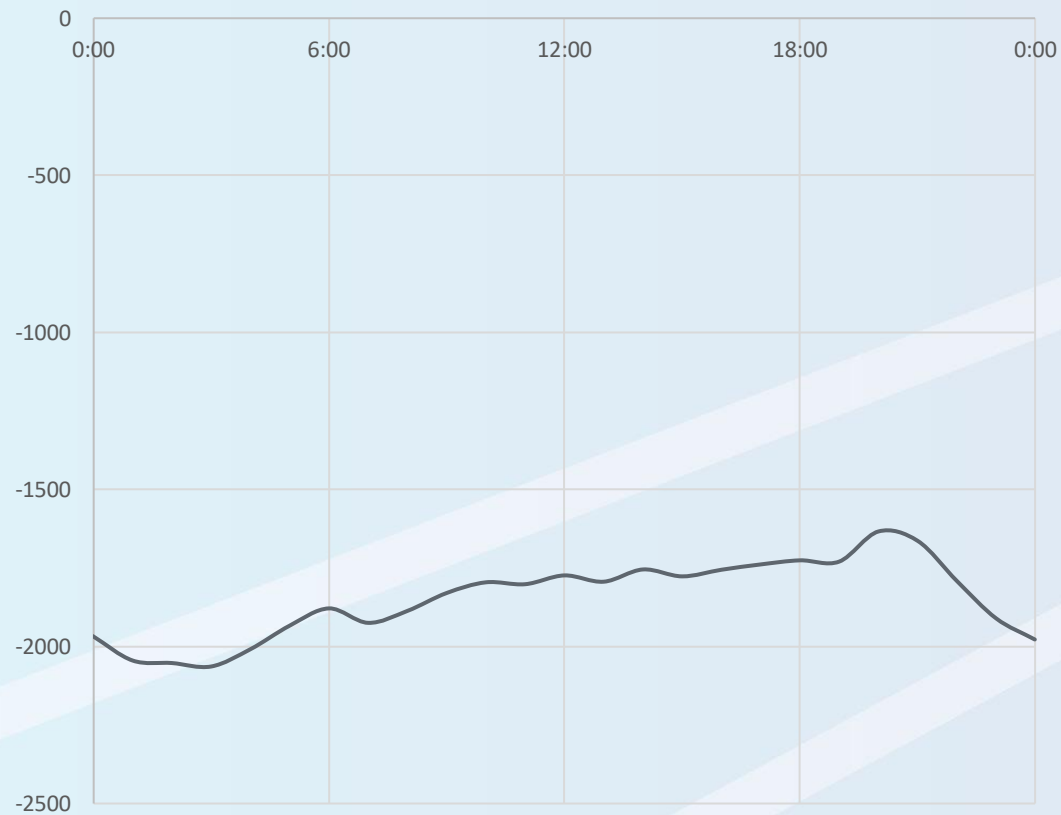
NWMT to NW 2020



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# NW to Montana Daily Transfers

NW to Montana 4/19/1998



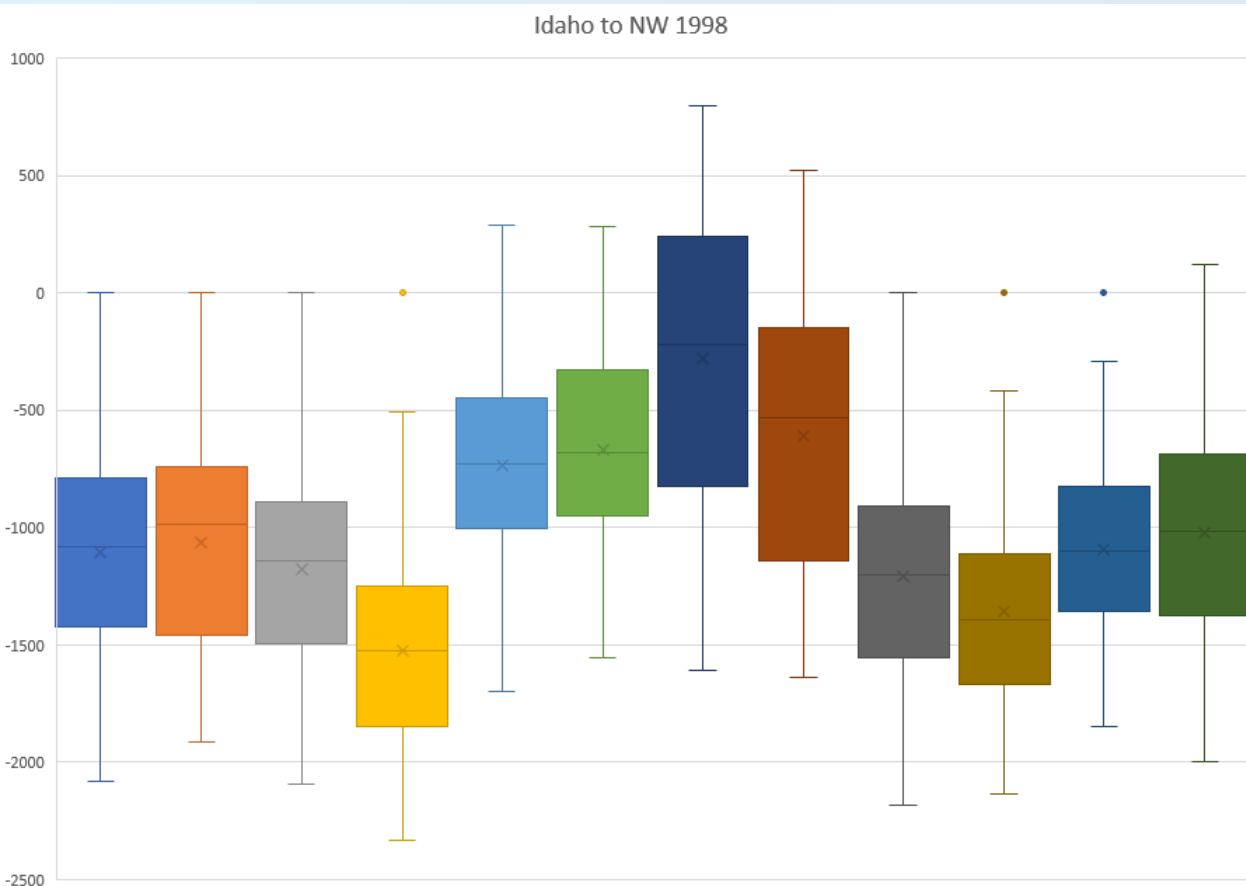
NW to Montana 4/19/2020



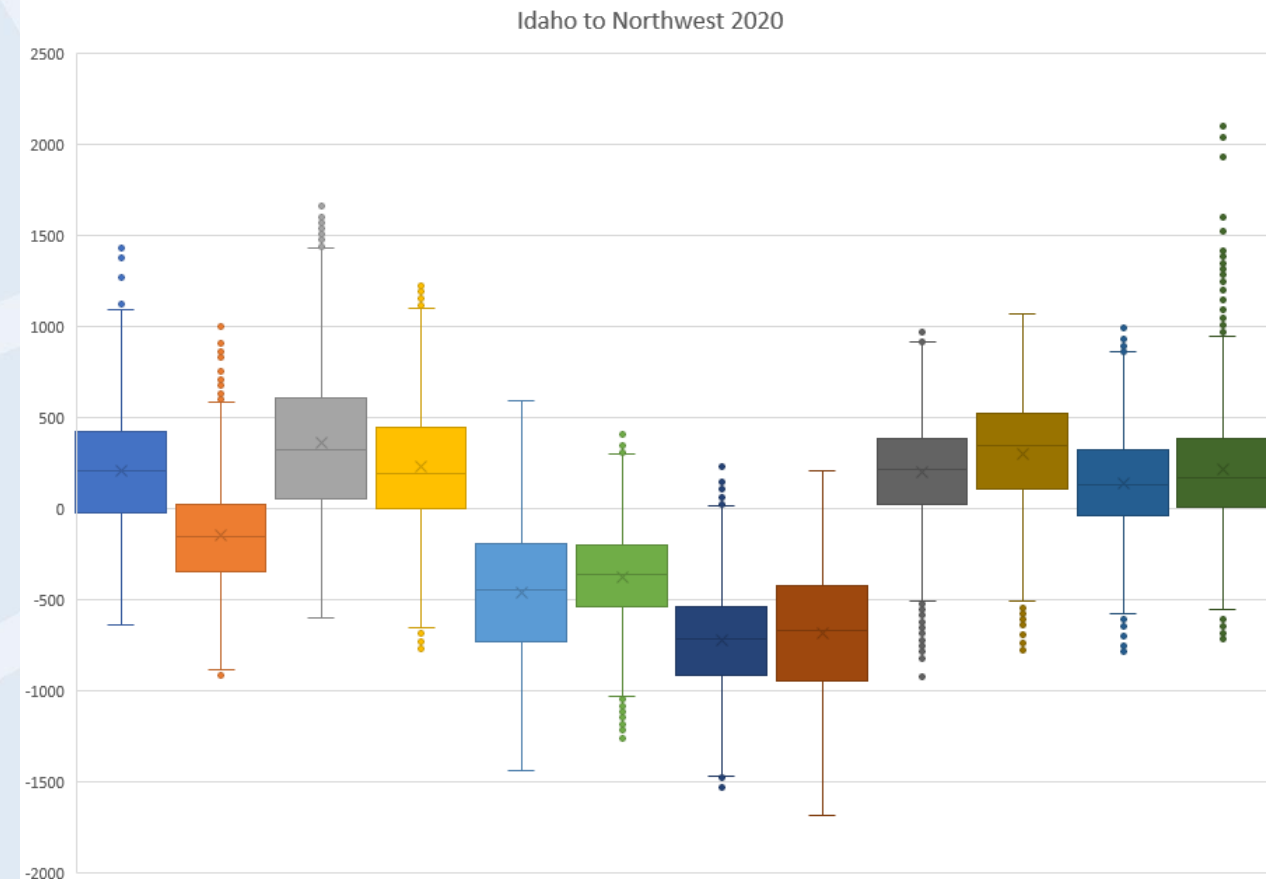


# Idaho to NW Monthly Transfers

## 1998



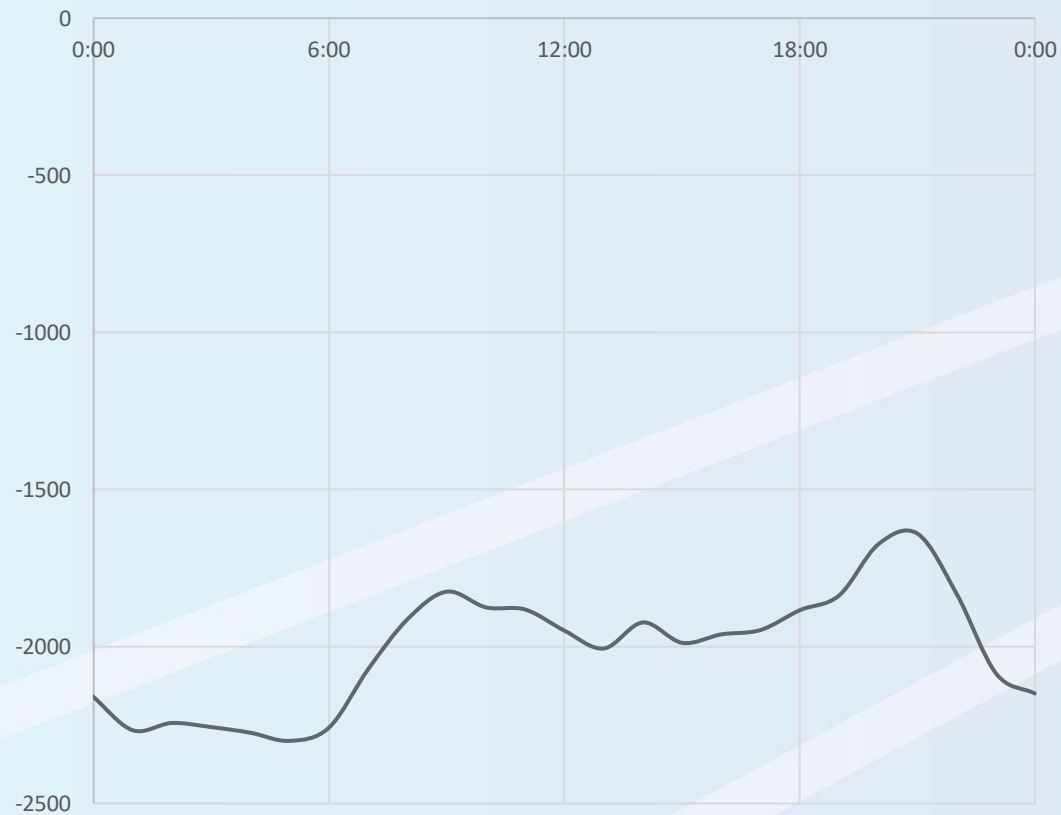
## 2020



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# NW to Idaho Daily Transfers

NW to Idaho 1998



NW to Idaho 2020



# Power Flow Analysis

Chelsea Loomis, Northwestern Energy

Erik Olson, Puget Sound Energy

Curtis Westhoff, Idaho Power



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# Demo Key Takeaways

- Approaches for mitigation using a local and regional perspective
- How corrective action plans are developed and how utilities meet compliance through the plans
- Impact of regional projects



# Terms Explained

- Base Case
- Bus
- Line
- Contingency
- Thermal overload
- Voltage excursion: high, low, difference
- Mitigation



# Power Flow Analysis Example

- Puget Sound Energy
- Simple example of how Planning works in the software
- Walk-Through of the software
- Run a contingency, observe the impact
- Simulate the Solution



# Power Flow Analysis Example

- Idaho to Northwest Path and the Boardman to Hemingway Project



# Q&A Break



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# Transmission Service and Types

- Transmission customers reserve MWs of capacity
  - The right to transmit power on the transmission lines/paths of a transmission provider (TP)
- Two primary types of transmission service
  - Point-to-point
    - Used to move power from one area to another over a posted transmission path  
A path can be a single line or a group of specific lines
  - Network
    - Used to serve load by load serving entities
      - utility merchant function groups and other suppliers
    - Requires the designation of both loads and resources to establish transmission
    - Uses entire TP transmission network

# Types of Transmission

- Point-to-point (PTP) transmission service
  - Long term Firm
  - Short term Firm
  - Non-Firm
- PTP transmission capacity is reserved in both quantity of power and quantity of time



# Types of Transmission

- Network Transmission Service
  - Network Integration Transmission Service – often referred to as NITS
    - Requires the designation of loads and resources
    - Resources can either be located “on-system” or “off-system”
      - interconnected to another TP
  - Secondary Network Service
    - Allows a network transmission customer to serve their designated load from non-designated resources
    - Only on an as-available basis



# Transmission Service Reservation Priorities

Priority	Acronym	Transmission Service Reservation Description
0	NX	Next-hour Market
1	NS	Secondary receipt and delivery points
2	NH	Hourly
3	ND	Daily
4	NW	Weekly
5	NM	Monthly
6	NN	Network Integration Transmission Service from resources that are not designated
7	F	Firm Point-to-Point Transmission
	FN	Network Integration Transmission Service from Designated Resources





# Transmission Capacity and Paths

- PTP transmission is made available over posted paths.
  - A path can be a single line or many lines
- Key Transmission Capacity Terms
  - TTC – Total Transfer Capability
  - ETC – Existing Transmission Commitment
  - ATC – Available Transfer Capability ( $ATC = TTC - ETC$ )
- TTC is based on system modeling under simulated stressed conditions using reasonable load and generation dispatch scenarios in order to find the maximum theoretical flow on a path



# Transmission Service Payments

- Customer pays for firm transmission service whether used or not
- Transmission service use must be scheduled through OASIS website
- If customer doesn't use the purchased transmission, TP can remarket as non-firm capacity
- Unsubscribed transmission capacity can be used by TP for participation in EIM, if a member



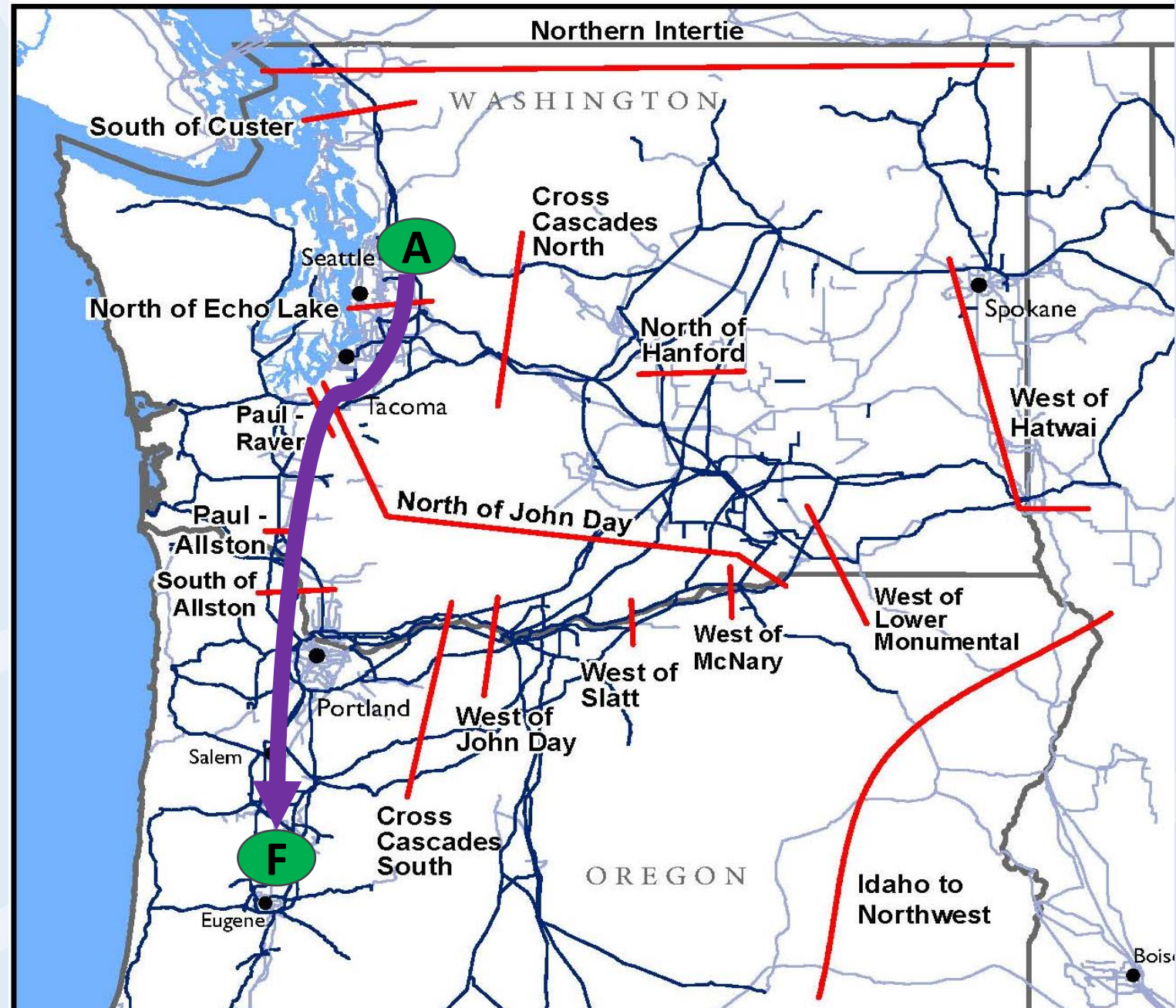
# Transmission Capacity and Paths

- Outside of the CAISO organized market, the west generally uses the contractual path methodology for establishing TTC and ATC on Paths
- Electrons do not follow contracts
- When paths get close to fully subscribed, they can become constrained
  - South of Allston or the California-Oregon Intertie
- Constraints can be limiting factors in the development of new resources.



# Contract versus Flow

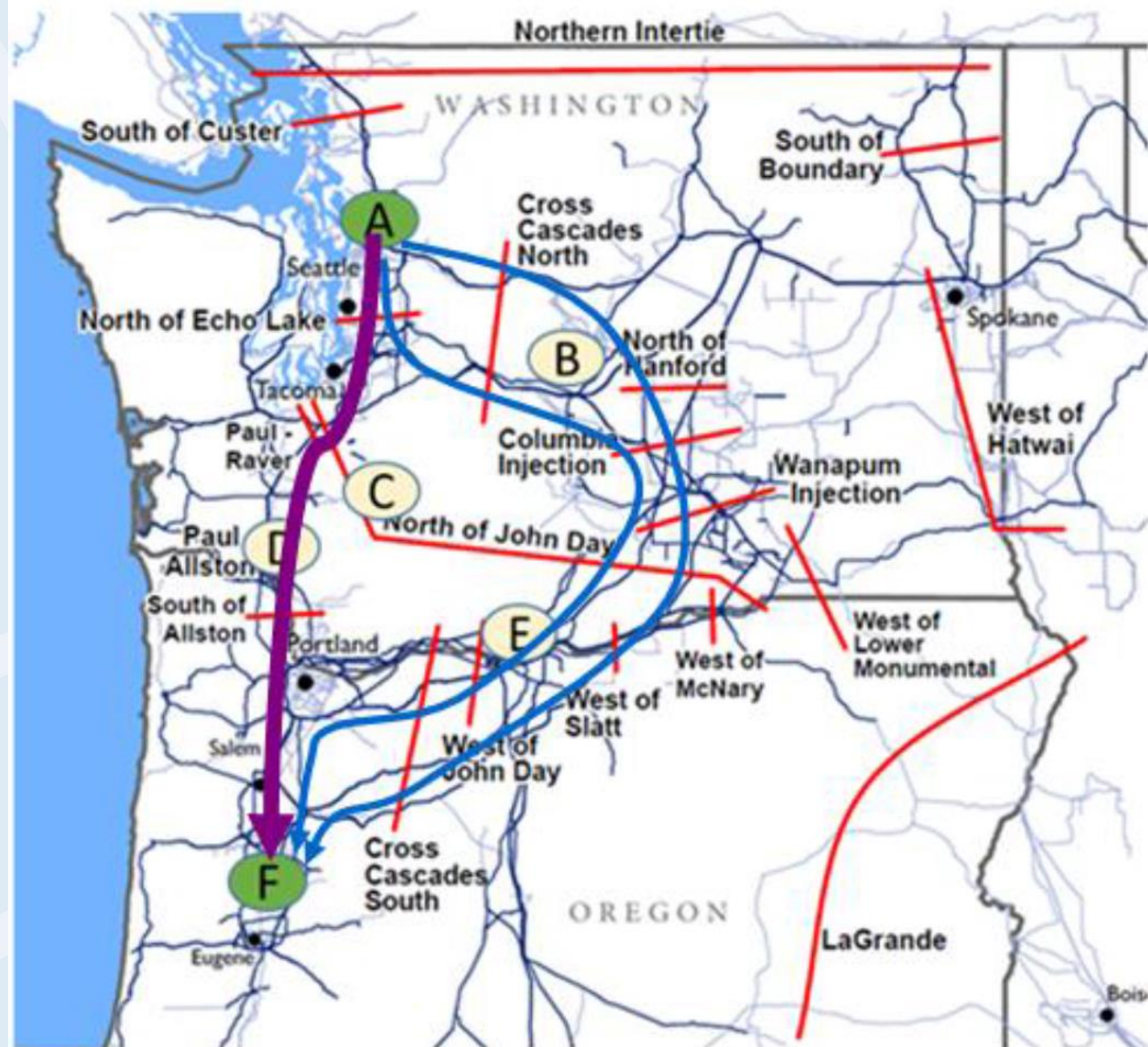
- Customer requests transmission to sell generation from location **A** near Seattle, WA to buyer accepting serving load at location **F** near Eugene, OR
- A transmission service contract is executed to move power from the point of receipt **A** to the point of delivery **F**





# Contract versus Flow

- Actual power flow follows laws of physics and automatically splits across multiple paths connecting **A** to **F**
- Paths not explicitly included in transmission service contract see a change in actual flow as a result of the contract



Thank you!



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