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



March 5, 2019

**MEMORANDUM**

**TO:** **Council Members**

**FROM:** **Mike Starrett**

**SUBJECT:** **Electric Transmission Utilization in the Northwest**

## BACKGROUND:

Presenter: Mike Starrett

Summary: Transmission congestion in the region is more often contractual than physical. This contractual encumberment could preclude the development of a least-cost resource plan by giving an outsized benefit in acquisition to resources which have already secured long-term firm transmission rights. It may also signal the need for what could be an otherwise unnecessary expansion of the electric transmission system at substantial cost. Contractual encumberment is a commercial issue, not a physical one.

This presentation will review how access to transmission is marketed in the Northwest and will describe whether and how this accounted for in the Council's work. An analysis of historic energy flows across several key paths will be shown and the presentation will conclude with some potential solutions to help ensure that resources are competing principally on their costs and benefits.

A future presentation will further expand on the implications around a choice of how to model and market access to the transmission system by comparing the bilateral Northwest against a generic centralized market.

Workplan: Prepare for 2021 Power Plan

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# Electric Transmission Utilization in the Northwest

Mike Starrett

March 12, 2019

Northwest Power and Conservation Council

## Introduction

- This presentation describes the **physical** utilization of the Northwest transmission system
- It is entirely possible (and common) that a given transmission path **could be fully contractually encumbered** on long-term firm basis **while still having substantial available physical capacity** most or all hours of the year
  - Long-term firm contracts are a reservation for transmission capacity between specific points
  - These reservations are maintained regardless of whether or not the capacity is physically utilized*
- This marketing and operating paradigm has substantial implications for planning and development and can be contrasted against areas with a market-driven dispatch

Focus for today:

How much water are the pipes actually carrying?

Is there room for more?

*By FERC Order, all unused transmission capacity must be marketed on OASIS for short-term utilization. However, for practical planning and development purposes, short term transmission access may have limited value to entities seeking to develop new resources in the Northwest because of deliverability risk in financing.

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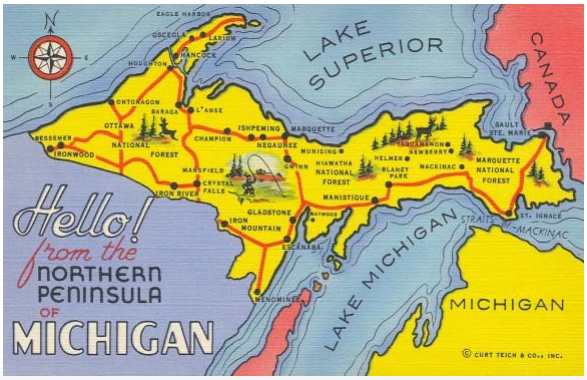
# Background: Operating through bilateral contracts in other contexts (1/2)




**Five reasons to love the Upper Peninsula**

1. Great hunting
2. Great fishing
3. Great food
4. Great people
5. Traffic only one day per year



# Background: Operating through bilateral contracts in other contexts (2/2)

*If you use a car to get around, which way would you prefer "once-a-year" traffic jams be dealt with?*

A)

| | | | |
|---|---|---|---|
| Use models to determine where people might be coming from and which highways they'll ultimately merge on to | Use models to determine how many cars those highways could reliably* support on the peak day. For example, it could be 10,000 cars. | Create and sell just enough travel permits to for this peak day (*e.g.* 10,000). Sell these for long-term use and put permitting system in effect all hours, all days. | Require everyone who didn't get one of those initial 10,000 long term permits to instead continually request short-term access, with no guarantees. |

*OR*

B)

| | | | |
|---|---|---|---|
| No permits. Anyone with a driver's license could consider getting on the road at any time. | Create a congestion price to signal to discourage travel from some areas during a limited number of hours. | Allow the price signal to change over time based on on-the-ground conditions. Expect this price adder to be low or zero most of the time. | In the event that price alone was not sufficient, reach out to individuals and deny their travel for a specific, limited day/time. |

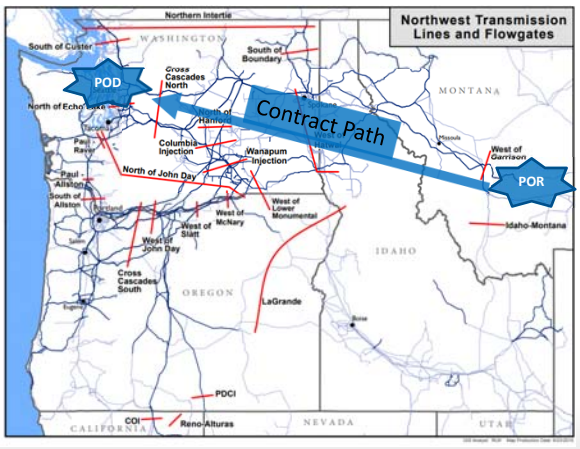
*Reliable even in the event of contingencies that reduces road capacity

# Motivation

- Given the bilateral Northwest:
  - ✓ **A presumption that resources can only be built where there is available long-term firm contract capacity can substantially increase costs** (through potentially undue transmission expansion, for example) **and can limit portfolio options**
  - ✓ **On the other hand, a presumption that resources can be built wherever there is physical capacity can overstate opportunity** based on typical procurement norms of requiring or preferring long-term firm capacity
- For Council's work, it's important to reflect on-the-ground realities when developing a plan across a regional footprint
  - ✓ For example, what is the realistic potential for resource development in certain areas with existing infrastructure and current transmission marketing paradigm, and how might that look with expansion or a different operating paradigm



# Initial Definitions



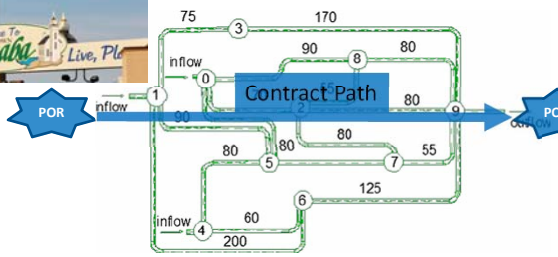

**Bilateral contract:** A contract between willing parties for transmission rights, energy, capacity, *etc*. In the case of energy, bilateral deals can create price stability for utility buyer and revenue certainty for resource seller which may not be available in spot market. In the case of transmission, a utility or resource owner can contract to secure a reservation to transfer energy on the transmission system.

**Point of Receipt (POR)/Point of Delivery (POD):** A specific grid connection point (*e.g.* a specific substation) where energy is picked up or delivered.

**Contract Path:** POR/POD pair. Actual power flow of energy received at POR can travel down many paths on way to POD.

**Path or Flow Gate:** A collection of lines with similar loading characteristics which are grouped together for data analysis and monitoring

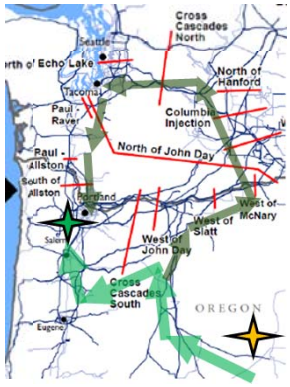
# Moving Energy Across the Grid – An Initial Example using Water


Some water coming out of the sink took the most direct path through the pipes, but some also probably came *via* the scenic route



# Moving Energy Across the Grid - Power Flow

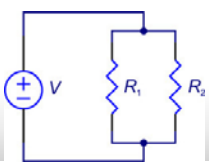



**Rules of the Power Flow Road***

1. Power will split and travel down many paths on it's way from source (POR) to sink (POD)
2. The way that power splits is based on the relative resistance of each line that it could potentially travel down
   - Longer lines have higher resistance
   - Bigger wires (500kV, *etc.*) have lower resistance
3. Power from a given source always splits the same way no matter what the rest of the grid is doing
4. You can look up what will happen in advance in an Excel workbook, it's all based on transmission line resistance
5. **No one can tell power what to do!**

**Exmple: Eastern OR to SW Portland Metro**

- 40% directly over the OR Cascades
- 30% through the Gorge
- 15% up through the WA Cascades and around through south of Alston
- The last 15% through other lines




*This text box is meant to be instructive at a high level. Some generalizations and simplifications were made.

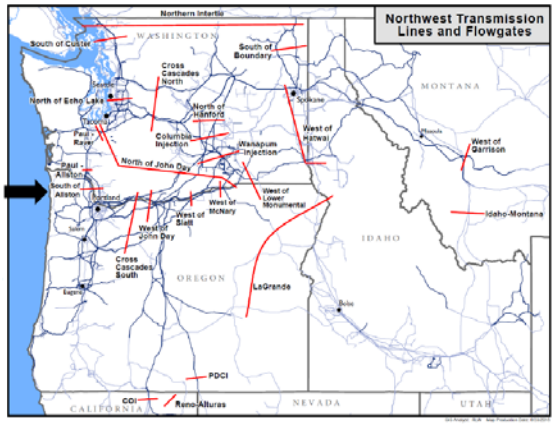
# What we can say about Power Flow so far

1. Power mostly travels down the path of least resistance, but it takes other routes with relatively higher resistance, too
2. Since we know the resistance of lines on the grid, we can know in advance how power from a given source will split and travel. Operational grid conditions don't change this.
3. Power will flow down a line according to resistance even if that line is near or at it's thermal limit
4. Since you can't tell power where to go, you have to either make an economic signal strong enough to turn a generator off or be sure you limit firm rights on specific paths to avoid potential overloads, even in a contingency scenario
   - If you go with the later, **you have to recognize that you're rigidly guarding against a worst case even though most days and hours will be fine**

*This is a relatively close example to the earlier car and traffic analogy*



# Western Washington & Northwest Oregon Trends




**Eastern Resources:**

- East to West over the Cascades year-round, heaviest in Jan – June

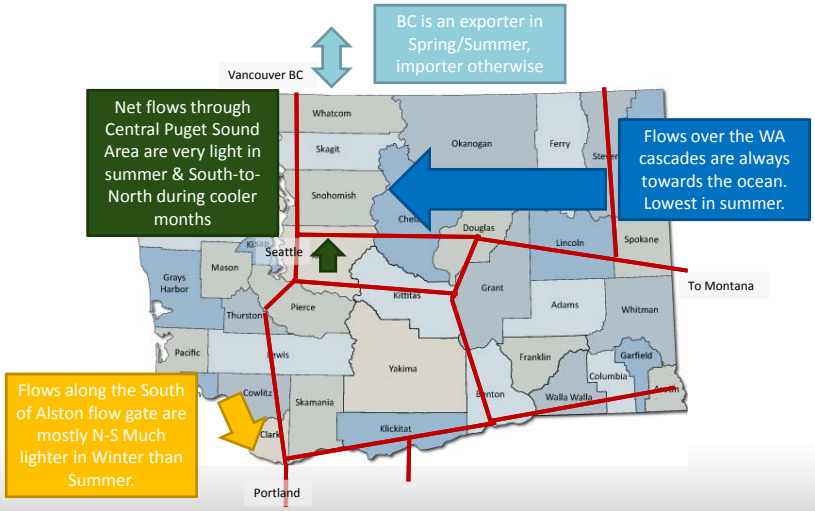
**Puget Sound Area:**

- Winter flows carry energy into the Puget Sound Area, with some modest exports traveling up through to BC
- Modest imports from BC in summer

**South of Allston:**

- Summer peaking path with substantially lower flows in other months

# Simplified Transmission Diagram

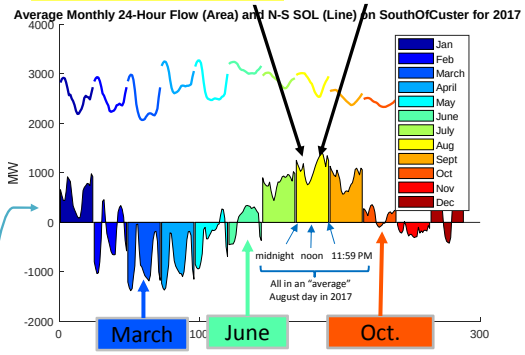





# Vancouver, BC area into Washington

'Average' August Morning in 2017: Overnight North-to-South flows out of BC beginning to decline

'Average' August Evening in 2017: After low mid-day volumes, exports again begin to flow out of BC and into the WA and beyond




**South of Custer**

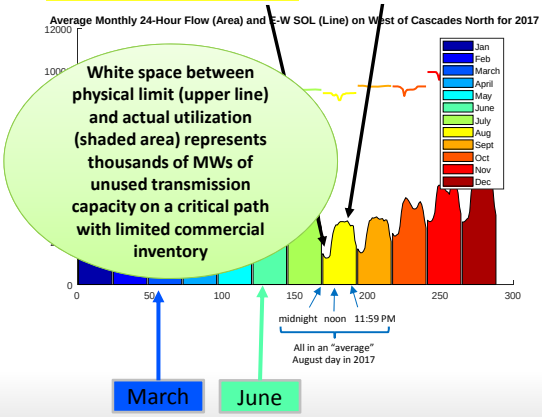
- BC generally exports North-to-South in Summer & imports in Winter
- Highest N-S loading during peak exports from BC in Spring & Summer & often correlated strongly with heavy COI flows
- TTC: 1,850 MW today, up to 2,200 MW after upgrade
  - **LTF Inventory: 100's of MW**

- *Each color represents a different month*
- *The plotted shape shows how flows looked on an "average" day in that month*
- *The colored line above the shape shows the "average" operating limit for the path over the same time period.*
- *The gap between the shaded area and the colored line is unused physical capacity on this path*

# Eastern Washington into Puget Sound Area

'Average' August Morning in 2017: Low night-time flows begin to pick up as morning arrives

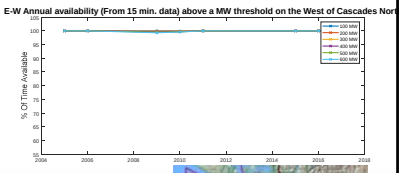
'Average' August Evening in 2017: Evening flows continue to be strong following the typical "single hump" summer peak




White space between physical limit (upper line) and actual utilization (shaded area) represents thousands of MWs of unused transmission capacity on a critical path with limited commercial inventory

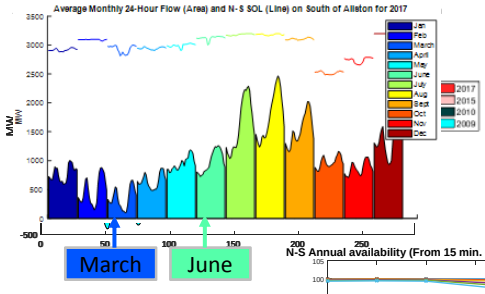
**West of Cascades North**

- Winter peaking path primarily serving Northwest Washington
- TTC: 10,250 MW
  - **LTF Inventory: 100's of MW for ~10 years**



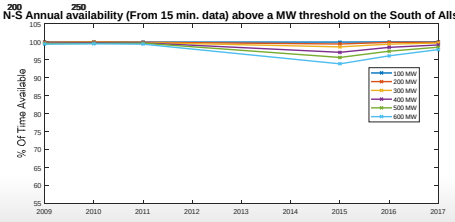



# Northwest Oregon from the North




**South of Alston**

- Summer peaking path serving the Willamette Valley and exports to California from BC and elsewhere
- TTC: 3,200 MW
  - LTF Inventory: 100's of MW recently released*




*New TTC resulted in part from engineering decision to no longer plan against a very unlikely contingency scenario

# What we can say about Power Flows shown so far

- There is some newly created commercial inventory of long-term firm transmission
  - Some of it is only available for ~10 years
- On most days and hours there is substantial unused transmission capacity
  - Makes sense give; most days are not peak days
- The energy being delivered is probably a least-cost dispatch of available resources owned or under contract by each individual utility, but maybe not a least-cost dispatch of entire footprint

But remember, **unused physical capacity implies nothing about commercial inventory** of long term transmission in bilateral Northwest

Also, since it is common for new resources to need long term firm transmission, **in an era of limited commercial inventory we can't say if the resources being developed on the grid are least-cost energy or just best available with transmission**



# Exploring the implications for resource planning and procurement

- Setting up the discussion for the next presentation,
  - A 100 MW RFP can prompt 1000+ MW of requests for transmission from various competing developers
  - In order to not give preference, transmission providers have to assume all 1000+ MW will come online
  - **If there were 99 MW of ATC, the study would show upgrades not for 1 MW (to meet the 100 MW RFP), but for 1000+ MW (to meet the combined total request across parties) and no transmission service offers would be made**
  - Resource competitiveness can be based on more than just costs and benefits! Does it have to be?

# Conclusions (1/3)

- A path with a limited inventory of long-term firm point-to-point transmission on a path could still have substantial physical capacity most or all days and hours of the year
- The only* way to access this transmission today is through non-firm transmission, which is probably not financeable
- This could lead to the preclusion of least-cost resource development and/or unnecessary transmission expansion

*Conditional firm is not available on all parts of the Northwest transmission system



# Conclusions (2/3)

- Even for paths which may have some inventory of long-term firm transmission (LTF ATC), transmission requests are processed with an assumption that everyone in a queue is coming online, even if several requestors are after a single RFP
- Even if there was just a single requestor, the study processes models the grid in the single heaviest hour of the year and assumes contingencies are in place

# Conclusions (3/3)

- Firm transmission through bilateral contracts is a very challenging paradigm in an era of RPS and/or low cost but intermittent renewable resources
- It could be the case that least-cost plans either can't be developed, or can only be developed with extremely expensive transmission expansion
- Not all areas operate in this way and there are potential solutions including:
  - Centralized market
  - Conditional Firm
  - Term Firm (*e.g.* just Q1 and Q2 for next 20 years)
  - Resource choosing a POD of mid-C and utility choosing POR of mid-C



# Next Steps

- A future presentation will further expand on the planning implications by comparing an example resource procurement and dispatch in the Northwest *vs.* in a centralized market
- The goal of that discussion will be to begin to consider whether and how to take physical *vs.* contractual encumberment into account in development of Plan
  - For example, could test the differences between an expansion model build out with current physical limits (most common) *vs.* remaining commercial inventory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