Long-Duration Energy Storage – Utility Perspective

Bonneville Power Administration

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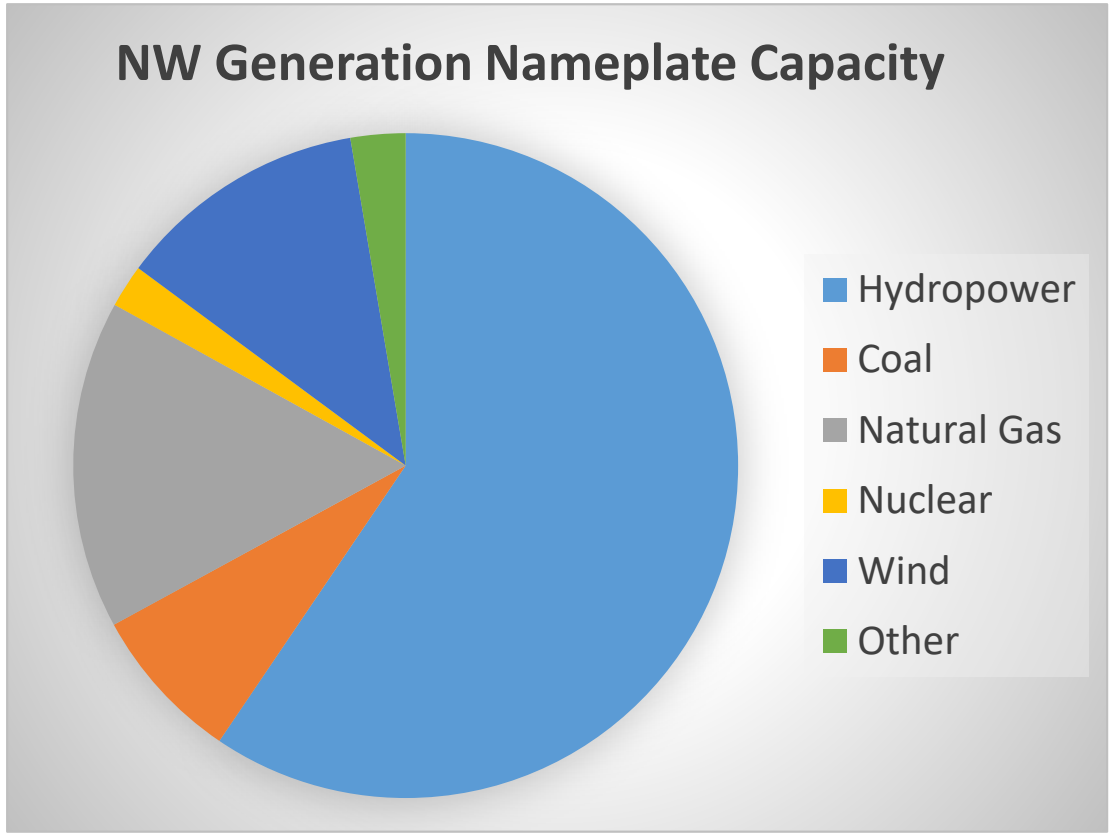
Long-Term Duration Storage to Address **Regional Resource Adequacy**

Demand Growth and Electrification

- Pacific Northwest is overall winter-peaking region:
  - Historic winter peak loads (States of WA, OR, ID, MT) are over 35 GW
  - Historic summer peak loads are about 30 GW
- We see significant increase in the hyper-scale data center loads in certain areas of states of Oregon and Washington (100s of MWs of new loads)
- There are efforts towards transportation electrification and end-use conversion from natural gas to electricity

PNW Generation Resource Decarbonization

- Historically, Pacific NW enjoyed generation surplus
- It is changing…
- State of Washington Clean Energy Transformation Act (CETA)
  - 2026 – no coal generation
  - 2030 – greenhouse neutral – limited (up to 20%) use of electricity from natural gas, if it is offset by other actions to be greenhouse neutral
  - 2045 - 100% renewable or non-emitting resources



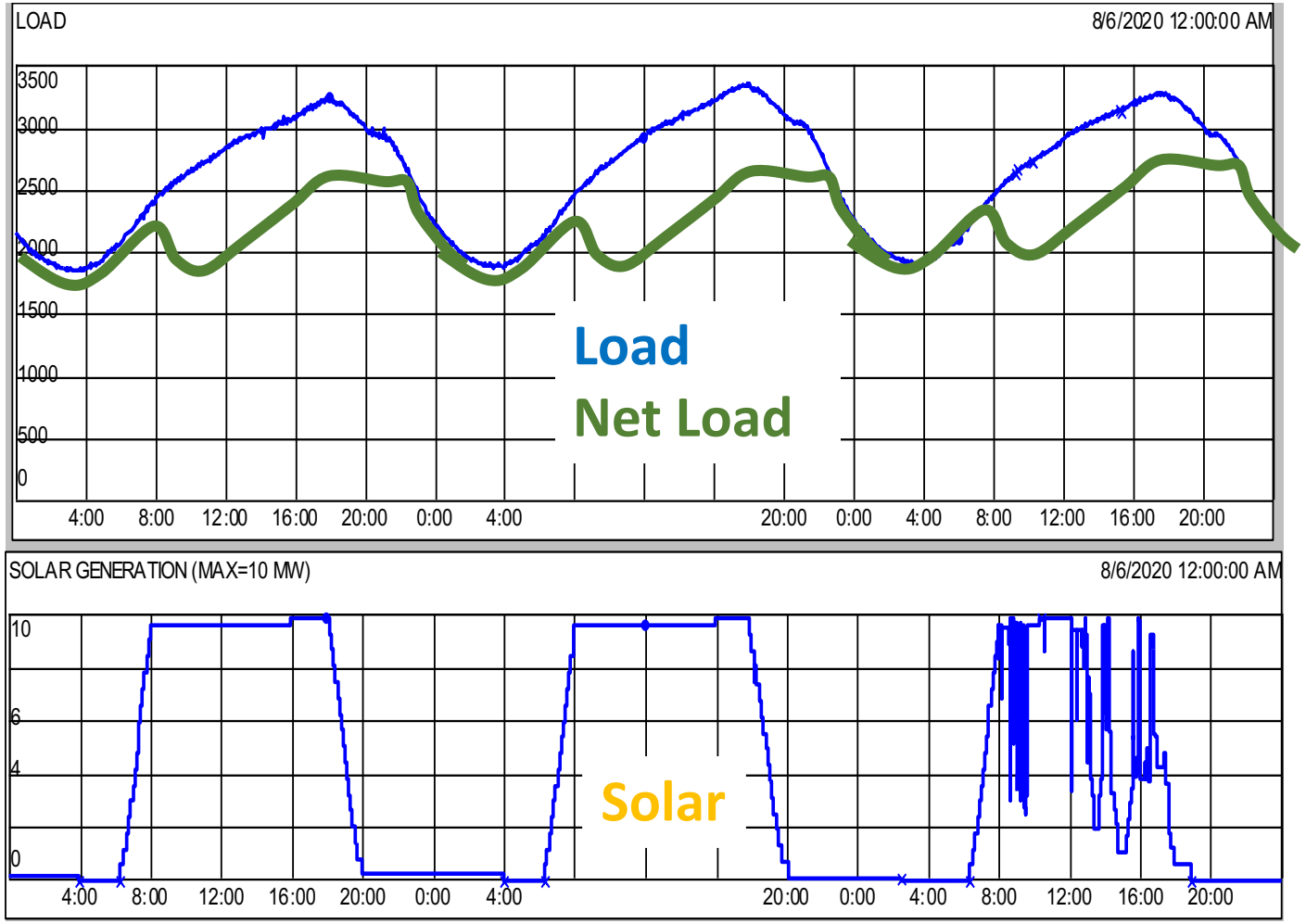
- North West Power Pool is taking steps towards designing and implementing a regional Resource Adequacy Program

Generation Resource Shift

- Generating resources are shifting away from major load centers (Seattle, Portland)
  - Fossil fuel resources near Portland and Seattle will be displaced with renewables mainly east of the Cascades
  - Transmission is a critical component of power delivery
  - Energy storage location close to load centers is important
- Current NW renewable generation portfolio lacks diversity
  - Columbia Gorge wind is highly correlated, often unavailable during extreme temperatures
  - Transmission will play a critical role to bring power from other regions

- Long term life cycle of storage devices
  - Long term life cycle of storage devices – replacement, maintenance, environmental impact
- Auxiliary service possibilities
  - Frequency response, redispatch, etc in addition to energy supply

3-Day Summer Heat Wave



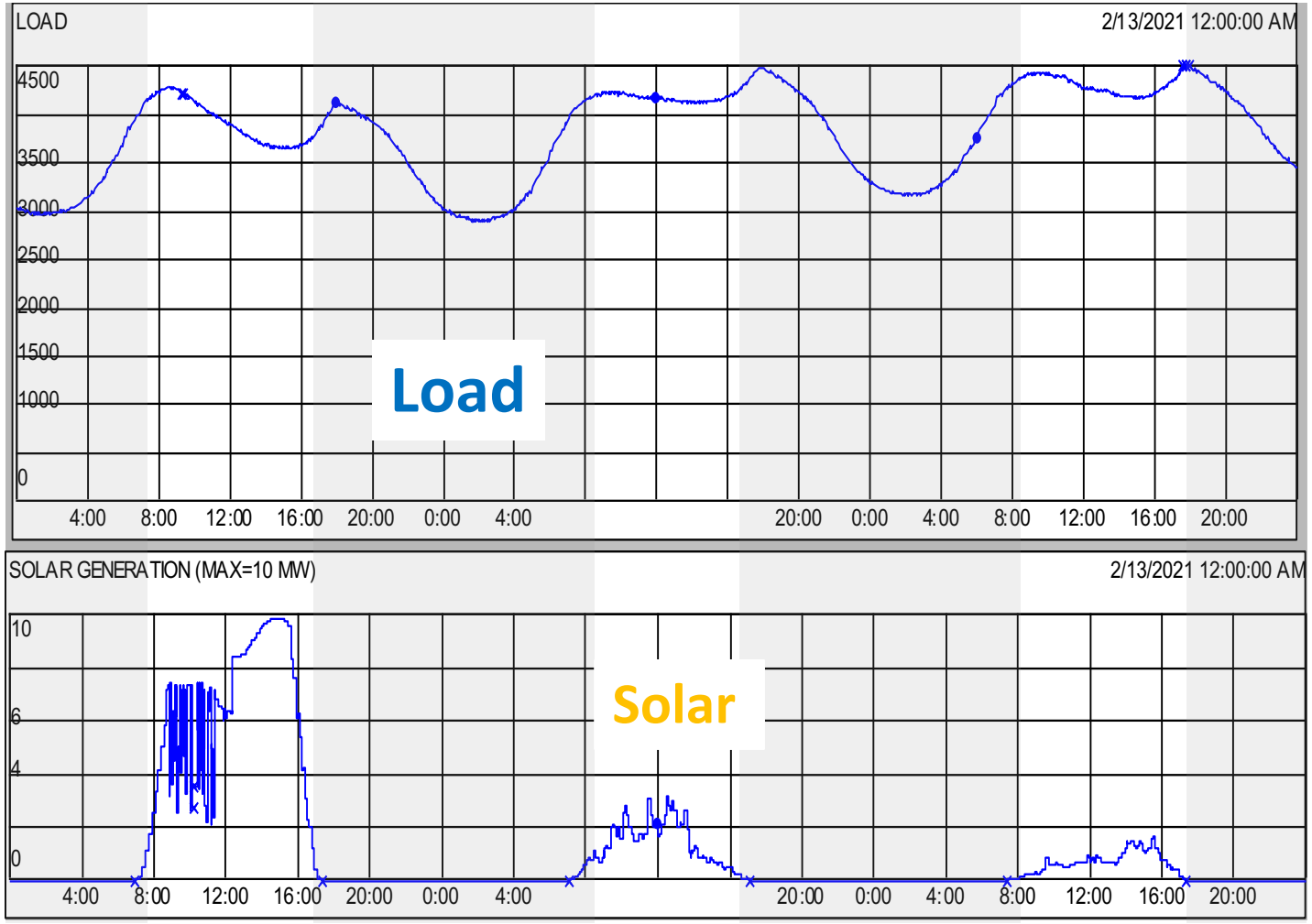
Load demand has a single afternoon peak between 4:30 and 6 PM

Solar generation helps reduce the net demand, but starts to decline (~50%) during the peak demand hours

Short-duration (4 hour) energy storage can be used effectively to further flatten the net demand during evening hours (6 to 10 PM) when the load demand is elevated and solar generation declines

The short-term storage can be charged by solar generation during daytime hours

3-Day Winter Cold Snap



Load demand has two peaks, morning between 7 and 8 am, and evening between 6 and 7 pm

The valley between the winter demand peaks is also fairly high

Solar generation

- Near 0 during the winter peak demand hours
- may be very low during the day due to snow cover

Long-duration energy storage capability is required for winter resource adequacy

Long-Term Duration Storage to Address **Resiliency During Extreme Events**

Pacific Northwest Wild Fires in September 2020

Source: USA Today

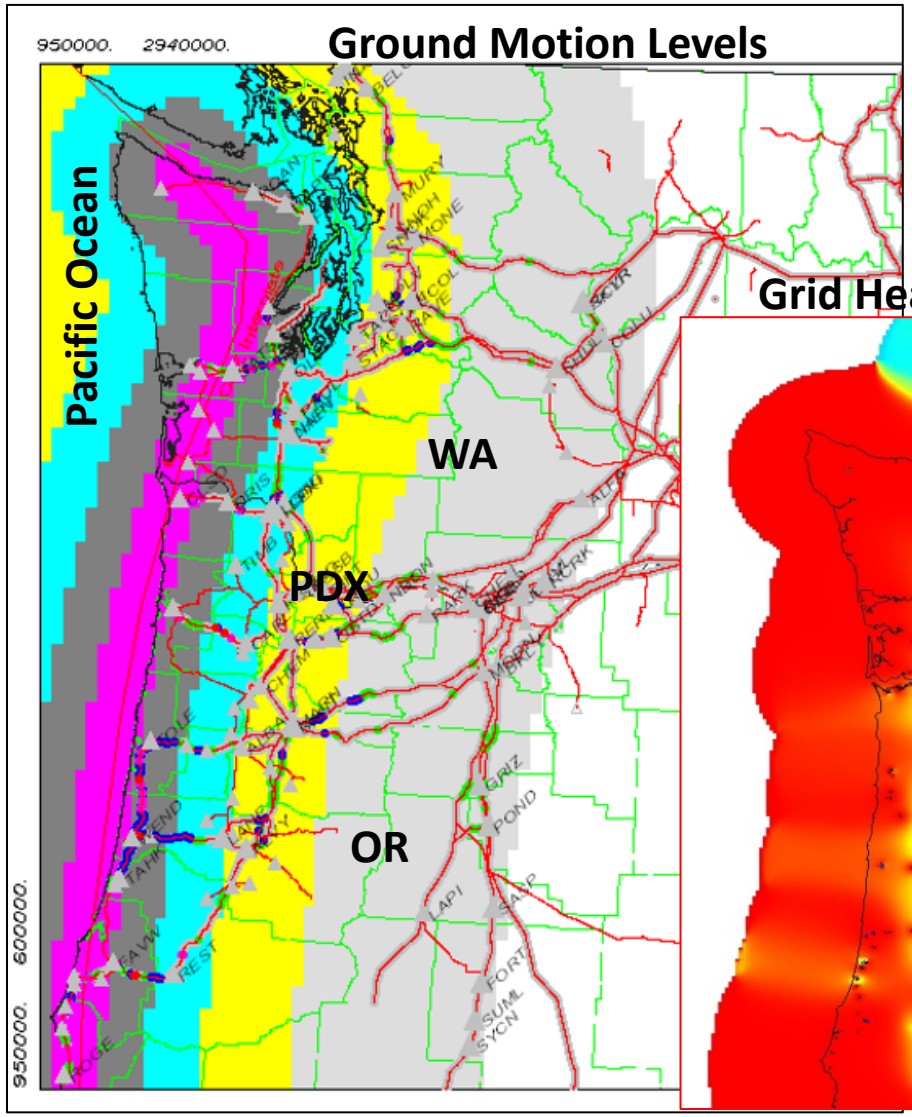
Pacific Northwest experienced horrific forest fires in September 2020, Portland Metro had hazardous air quality for almost a week

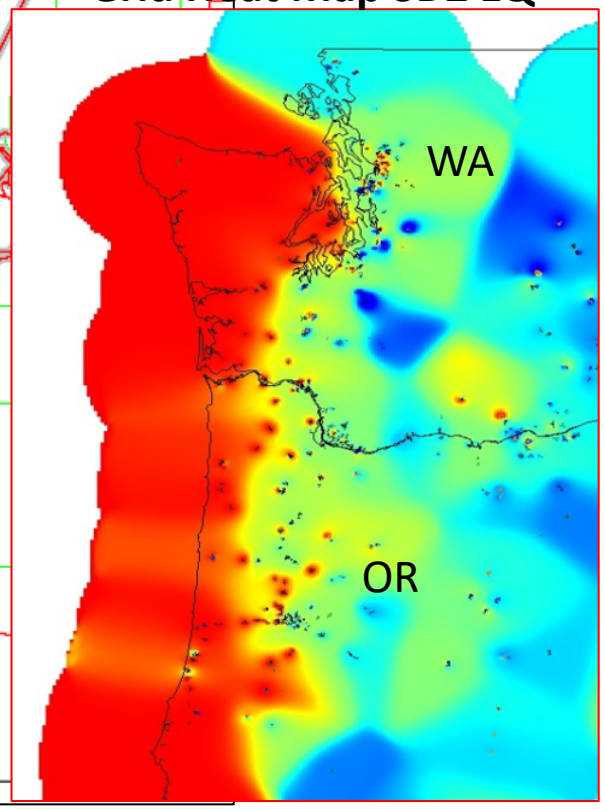
Several BPA 500-kV lines tripped due to smoke contamination
Telecom rings were impaired

Close to 1,000 MW of load in Oregon was at risk until the lines were successfully restored many hours later

Long-duration energy storage close to load centers would be very helpful to ensure the uninterrupted power service during extreme events when power is needed the most

Pacific Northwest Cascade Subduction Zone Earthquake





- **Hazards:** Ground Shaking, Liquefaction, Lateral Spreading, and EQ Generated Landslides
- **Vulnerability Assessment:** Transmission Lines, Substations, Telcom. and Building Facilities
- **Hardening Grid:** Substations and Building Facilities

SERA Scenario Report: 110 BPA Substations With Damage

ITEMS DAMAGED	MEDIAN	84TH/90TH
Transformers = MVA Loss	1410	9730
Transf. Functional Damaged Single Ph.	7	59
Transf. Functional Damaged Three Ph.	14	64
Yard Equip. Functional Damaged	192	1790
Damaged Items (Func. And Non. Func.)	486	2977
Landslides	529	1425
Towers Damaged due to Landslides	178	972
Trans. Line Outages (Substation/Tower)	65	173

Thank you