Impact of environmental variability and climate change on CRB hydropower and BPA financial risk

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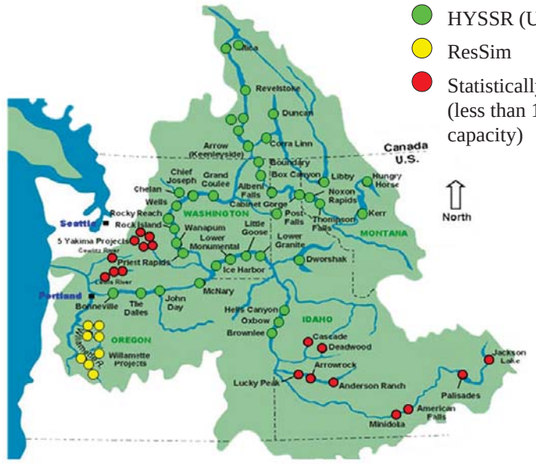
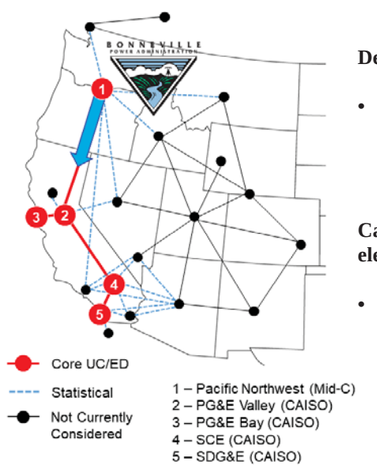
Model Description

Hydrologic/Operational model



- One third of the U.S.'s hydropower capacity (33,000 MW)
- **60%** of the regional demand serviced by **hydropower**

Multi-zone Unit Commitment/ Economic dispatch



Deterministic Optimization

- minimizes cost of meeting demand for electricity and operating reserves

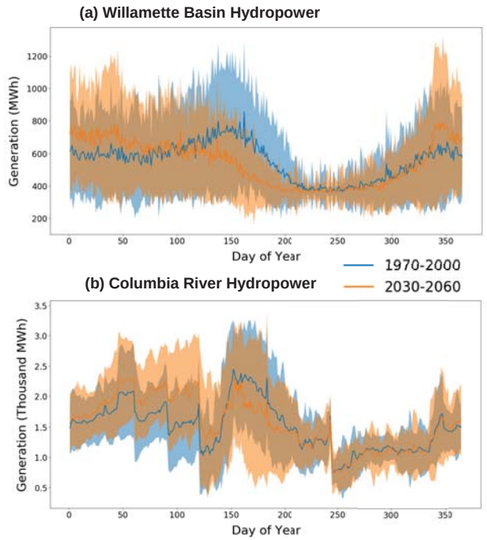
Calculates market prices for electricity

- Mid-Columbia and CAISO hourly prices

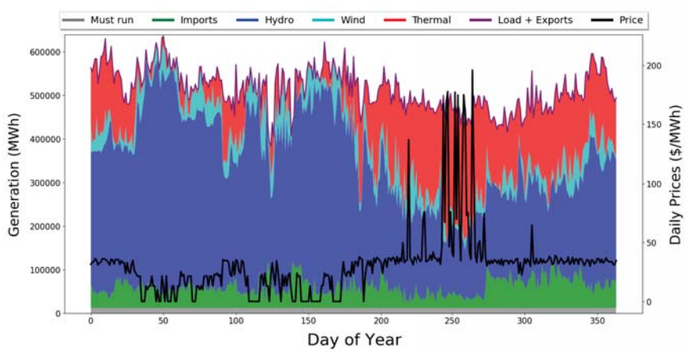
- Mid-Columbia (Mid-C) is the primary PNW trading hub for power.
- CAISO-Mid-C interactions allows West Coast power markets to capitalize on the **seasonal diversity between the PNW and the SW**

Climate Change & Power Systems

Electric power systems are susceptible to changes in hydrologic and meteorological conditions. **Temperature impacts electric demand (heating and cooling), and precipitation (streamflow) impacts the timing and volume of hydropower generation**. In the Pacific Northwest, power systems are especially vulnerable to hydrologic and metrological conditions given the high reliance on hydropower generation to meet demand.



Figures above show (a) Willamette Basin hydropower and (b) Columbia River Basin hydropower under BAU climate (HadGEM2-CC RCP8.5). See *Climate Projections for the Willamette Basin* for more information on this climate scenario.



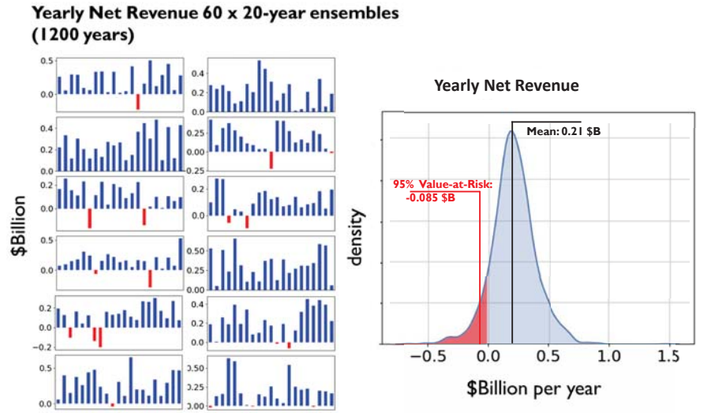
Simultaneous increased summer cooling demand and earlier peak hydropower generation will impact wholesale electricity prices. The figure above shows one year of daily generation and demand in the PNW from a future ensemble (2030-2060) under BAU climate. This particular year has very low wholesale prices in the spring and several days of maximum price ($200/MWh in our model) in the summer.

BPA financial risk

The **Bonneville Power Administration** (BPA) is the regional balancing authority in the PNW.
BPA markets a substantial part of the hydropower produced in the region (more than 30%). BPA is a federal entity but is **financially independent from the federal government** and needs to recover all its costs from sales.
Most of BPA power (**firm power**) is sold at cost to regional public power utilities and industries through long term contracts. The **surplus** is delivered to the highest bidder on the power regional markets (Mid-C and CAISO). If the generated power is not enough to meet the contracted obligations, **make up power** is bought at the lowest price on the power regional markets.

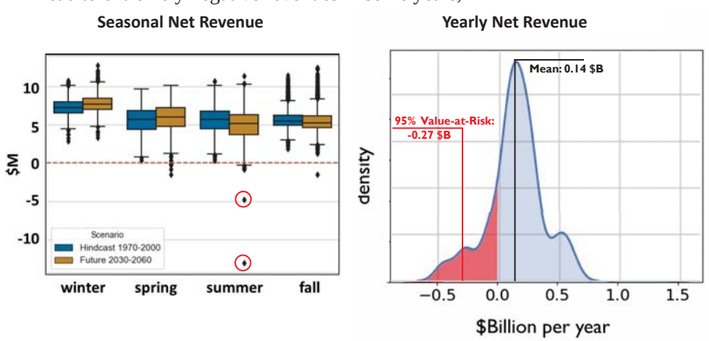
Stochastic analysis – stationary conditions

Variable hydrology and demand lead to variable revenues for BPA which can experience years of negative net revenues:



Climate change analysis

Under BAU climate (HadGEM2-CC RCP8.5) BPA is expected to increase its mean revenue during winter and spring. However, **summer shortfalls** can lead to extremely negative revenues in some years,



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