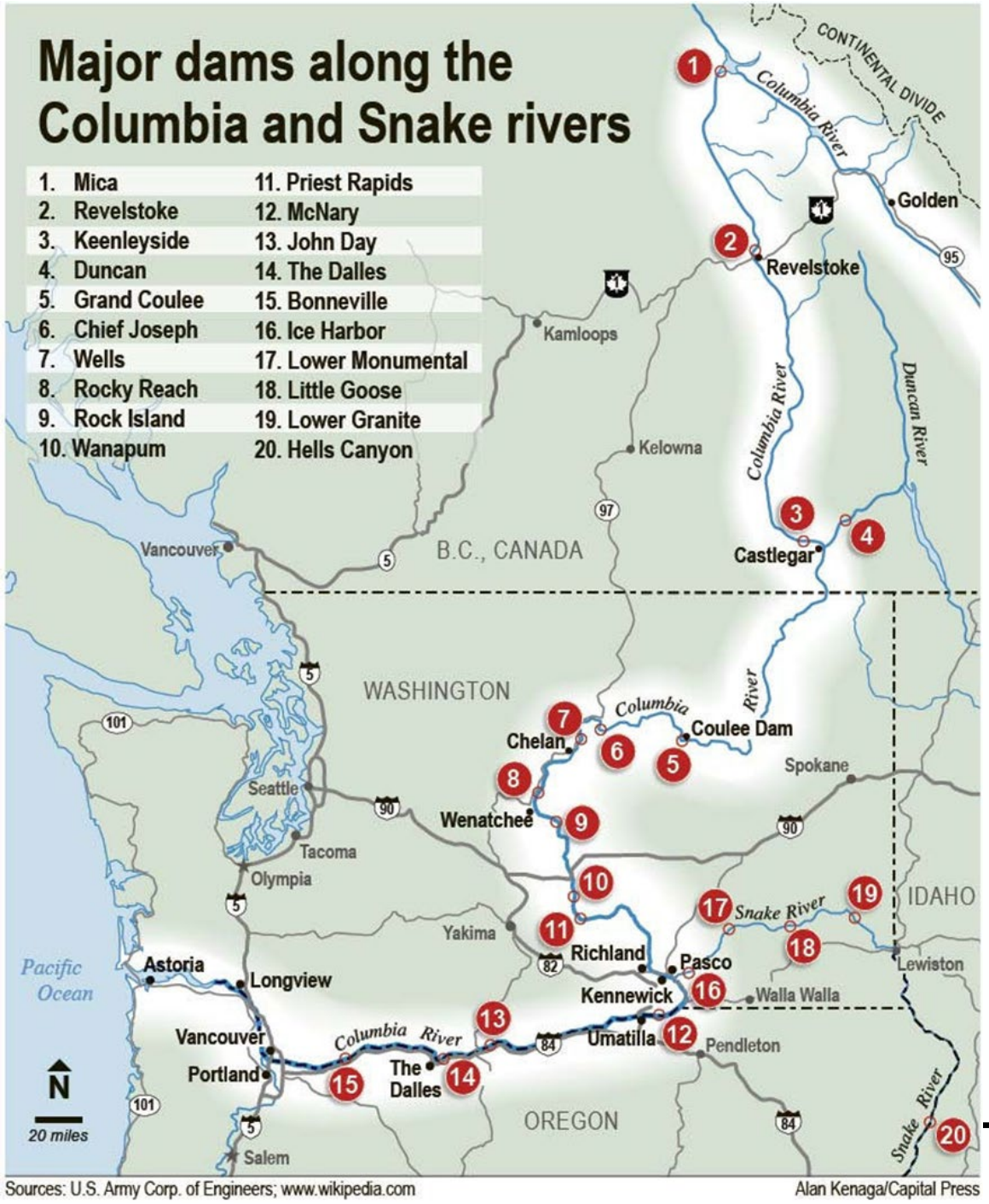

Resource Adequacy and the Columbia River Power System

IWUA Water Law and Resource Issue Seminar

August 17, 2021

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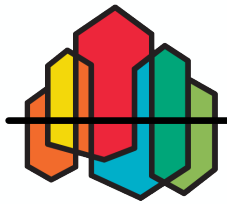
NW Power and Conservation Council

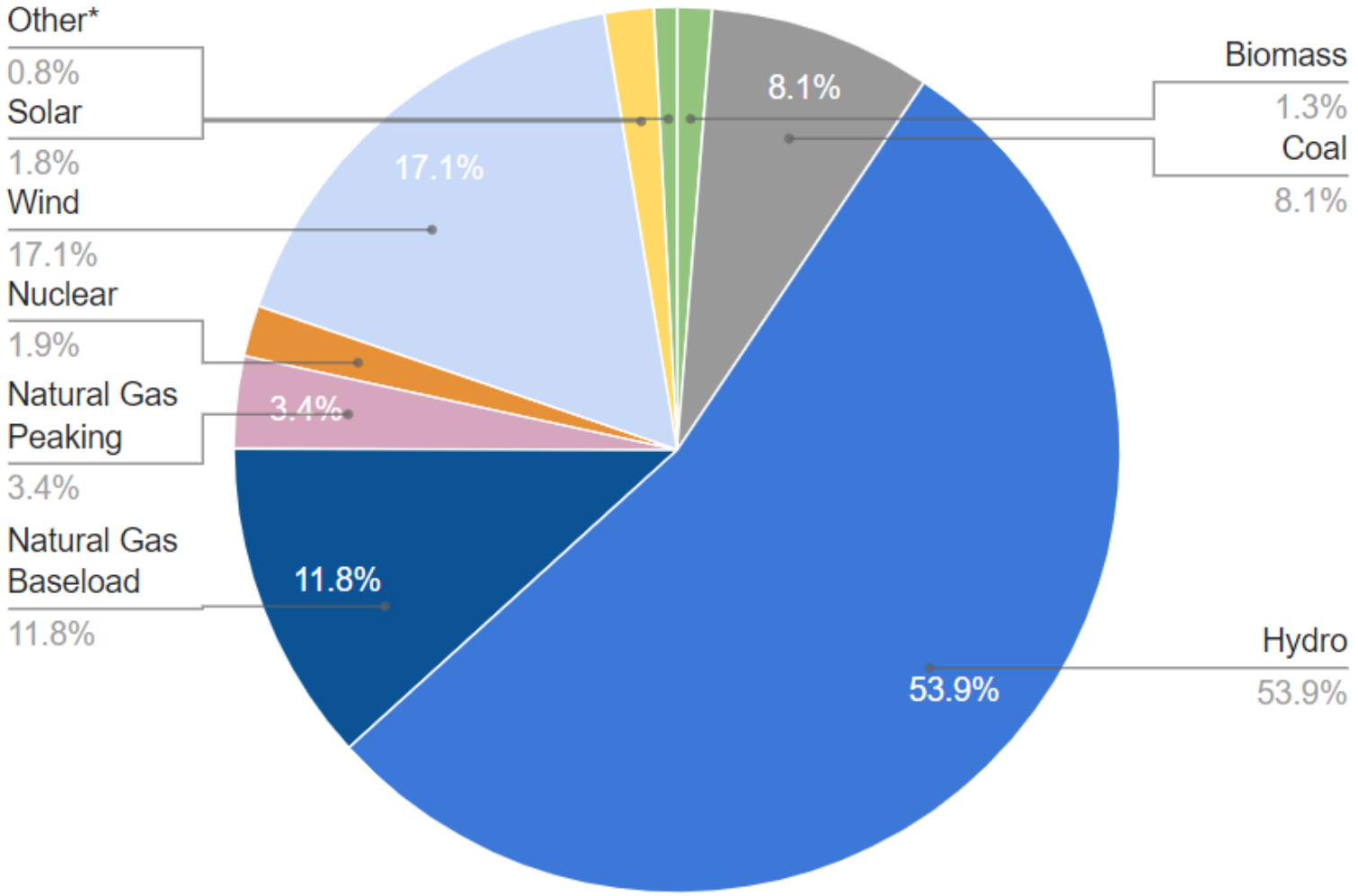
THE 2021 NORTHWEST POWER PLAN

Topics for Discussion

- Pacific Northwest power supply
- Multiple uses of the Columbia River
- Assessing power supply adequacy
- The effects of climate change
- Preliminary adequacy assessment



Pacific Northwest Generating Capacity: 64,340 mw*



Multiple Uses for the Columbia River System

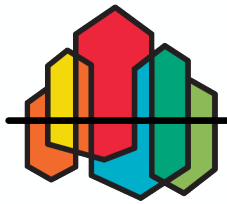
- Flood Control
- Hydroelectric Power
- Navigation
- Irrigation
- Fish and wildlife, including spawning and rearing habitat and juvenile migration for anadromous and resident fish and habitat for wildlife
- Recreation, including fishing, boating and camping
- Water supply, especially for municipal and industrial use
- Scenic and cultural resources

With international, federal and state laws that govern its use (often in conflict with each other)

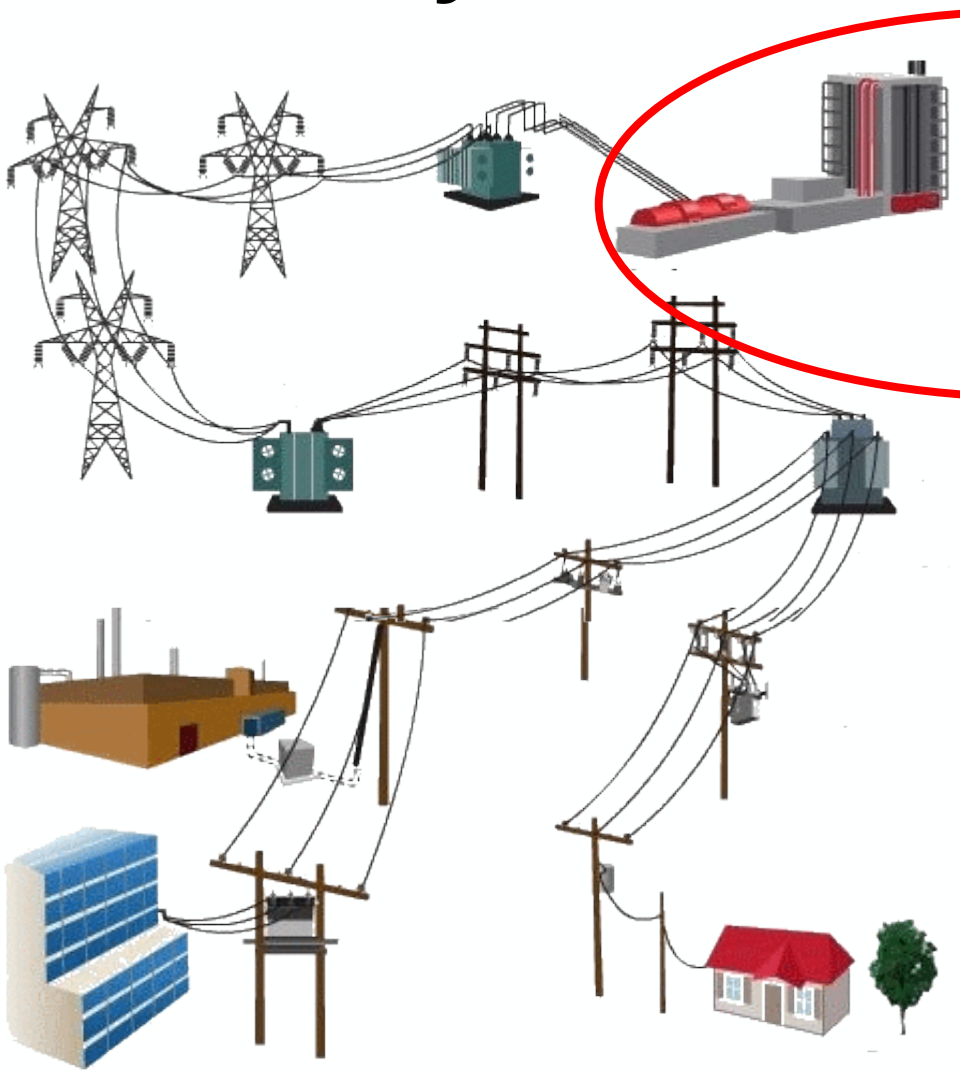
Reliability vs. Adequacy

- Adequacy and Reliability have specific meanings in the power industry. Adequacy is a component of reliability. A power system is reliable if it is both adequate and secure.

- An adequate power supply satisfies, to a high degree of probability, the aggregate demand for electrical energy for all customers, considering scheduled and reasonably expected unscheduled outages of system elements.
- A secure electrical system can withstand sudden disturbances, such as electric short circuits or unanticipated loss of system elements.



Three Major Areas for Assessment



Generation

Transmission

Distribution

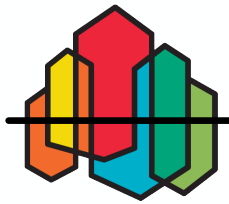
Most adequacy standards for long-term resource planning focus only on generation

How the Council defines Resource Adequacy

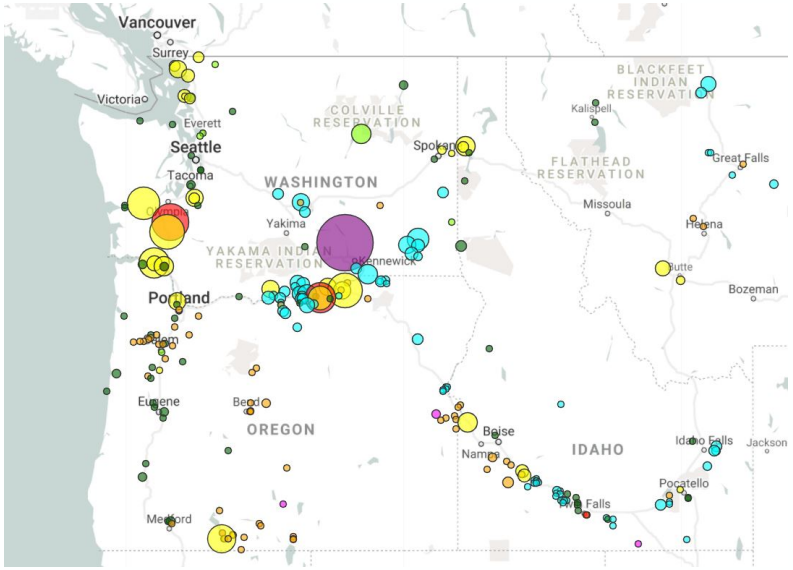
- An adequacy standard is composed of two parts:
  - Metric (measure of frequency, magnitude or duration of shortfalls)
  - Threshold (limit for each metric)

- No industry-wide standard – the most used standard is the 1-day-in-10-year loss of load expectation (LOLE).

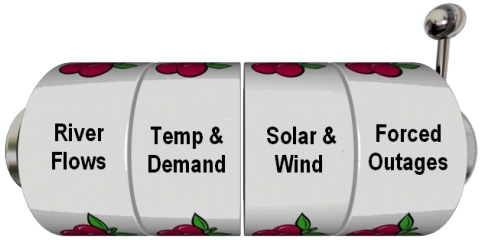
- The Council uses a loss of load probability (LOLP) metric.



Assessing Resource Adequacy for the PNW



- **GENESYS**: Chronological hourly simulation of all PNW resources for one year
- Thousands of simulations with different combinations of future unknowns



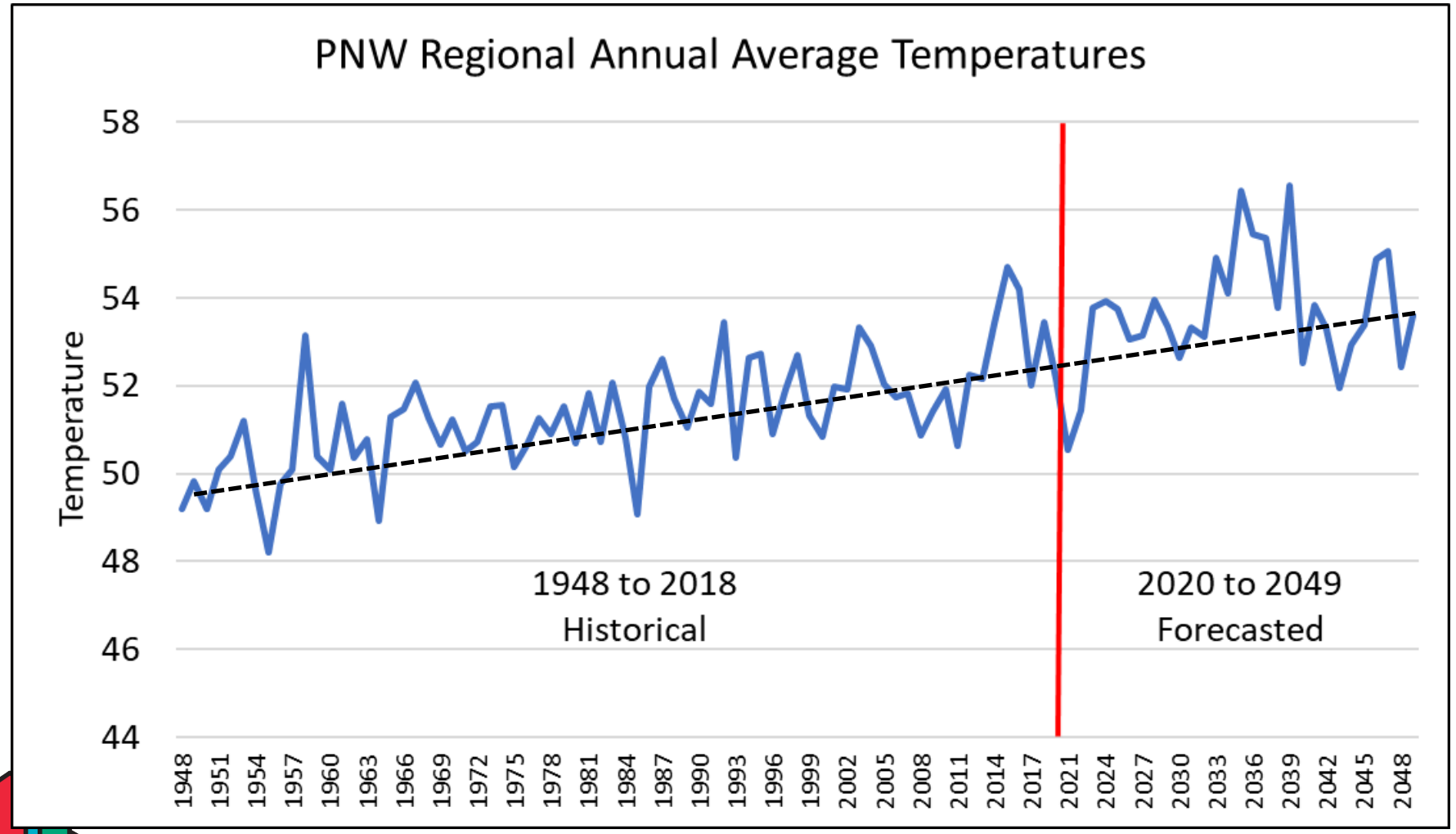
The Council deems the power supply to be adequate if the likelihood of having one or more shortfalls in a future year is less than or equal to 5 percent (i.e., LOLP ≤ 5%)

- Record all hours when load cannot be served
- Annual Loss of Load Probability:

$$\text{LOLP} = \frac{\text{Number of simulations with shortfalls}}{\text{Total number of simulations}}$$

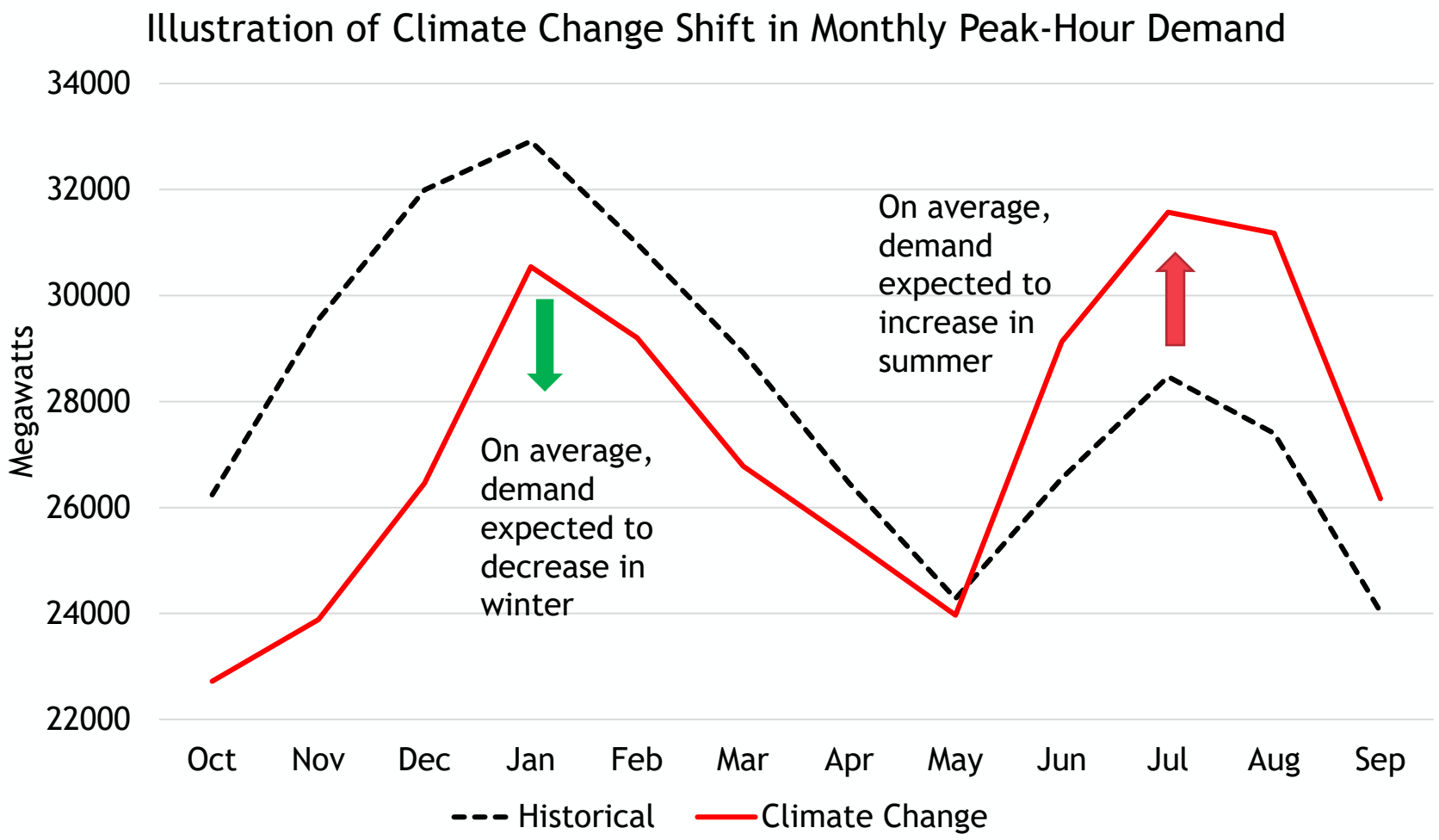
Long-term Trends in Temperature 1949-2049

Historic (observed) 1949-2018 and Forecasted 2020-2049

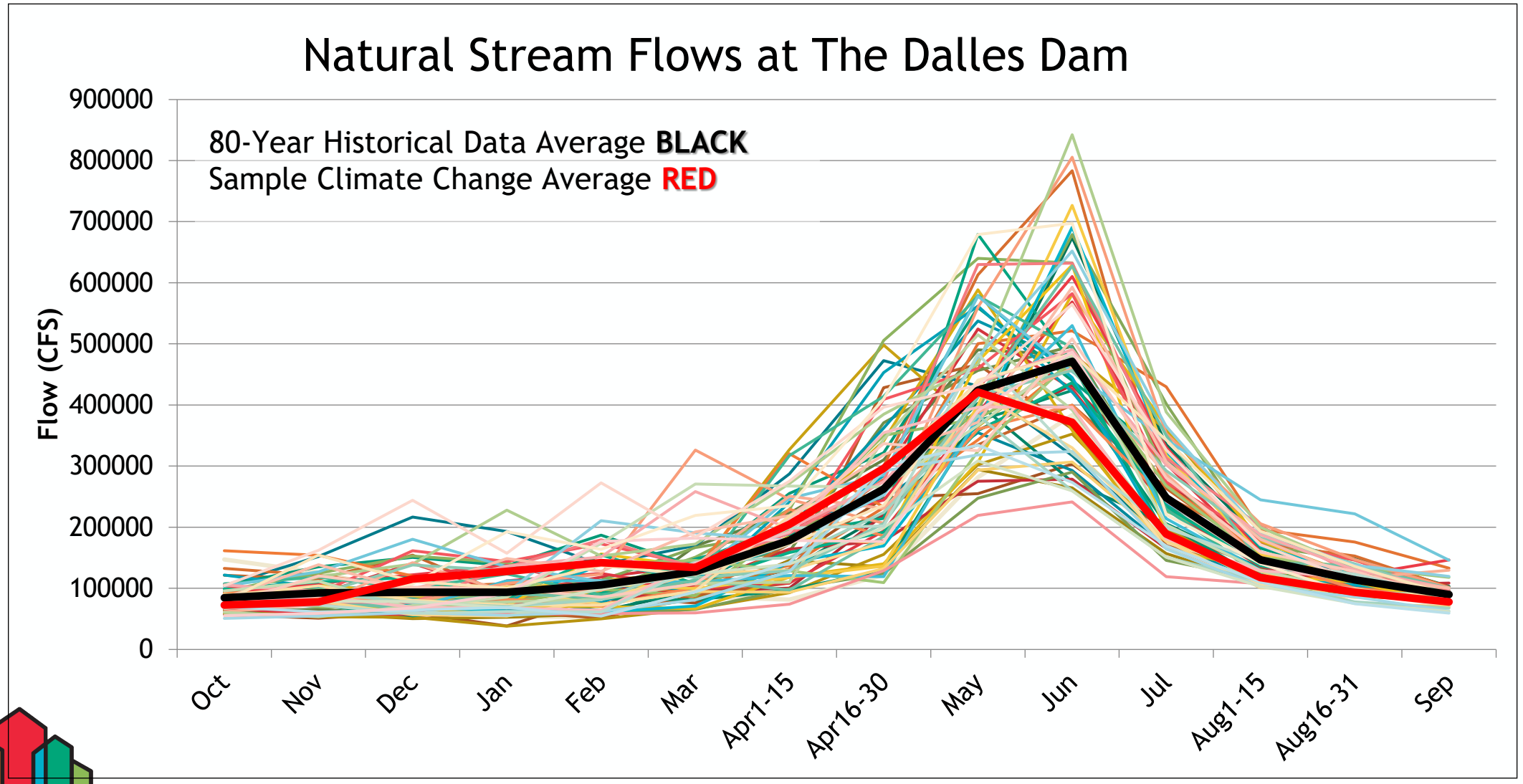


Data show a clear trend toward increasing annual temperatures

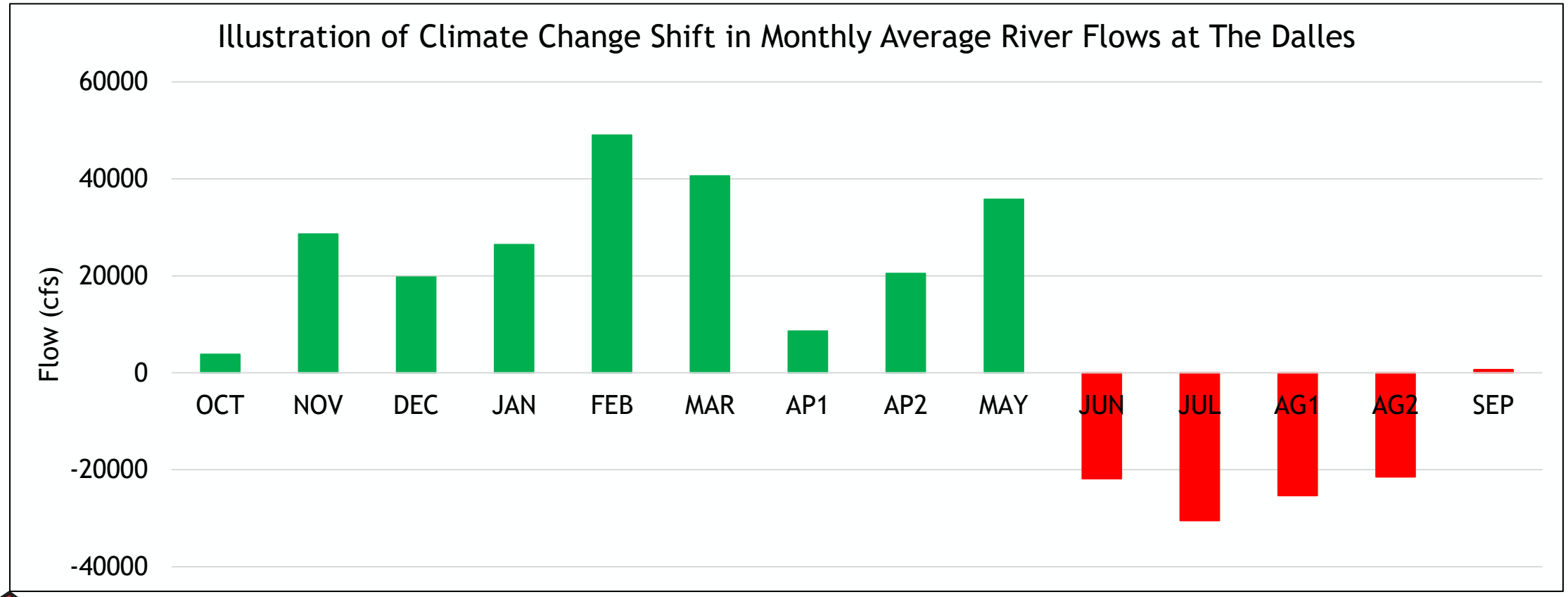
Climate Change Shifts Seasonality of Electricity Demand



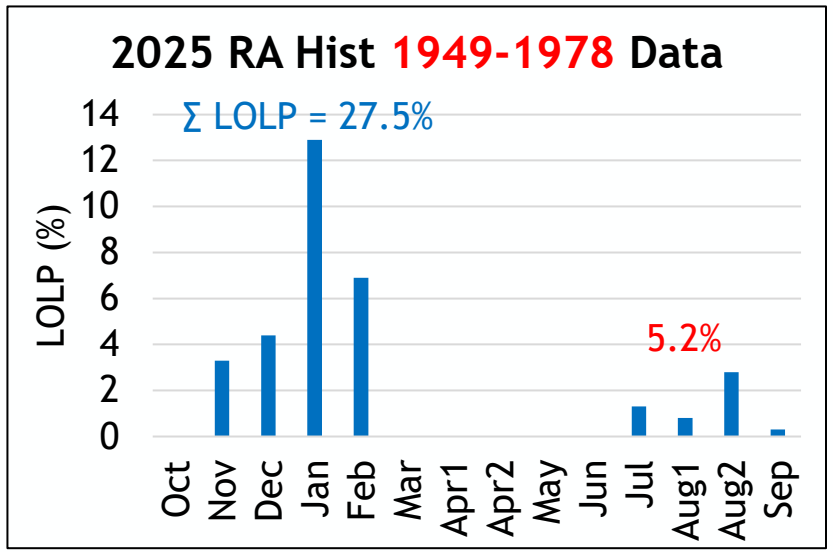
Variation in Monthly Flows Dwarfs Expected Average CC Shift

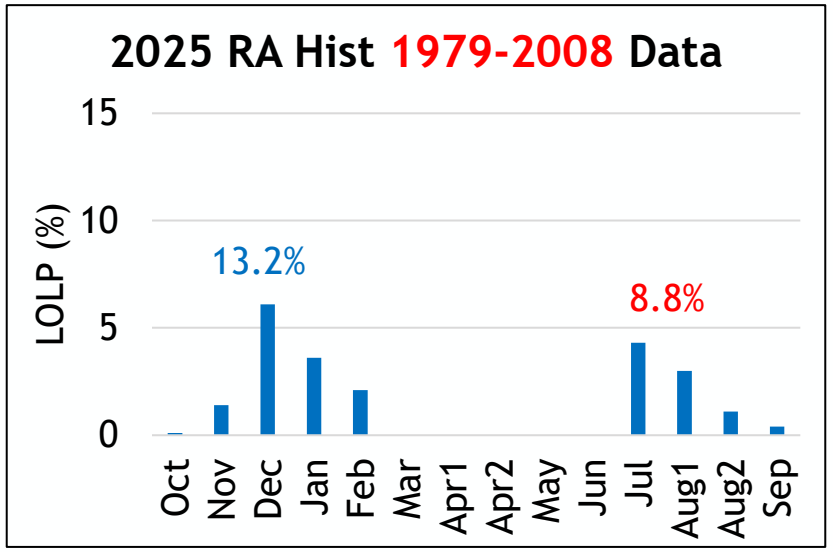


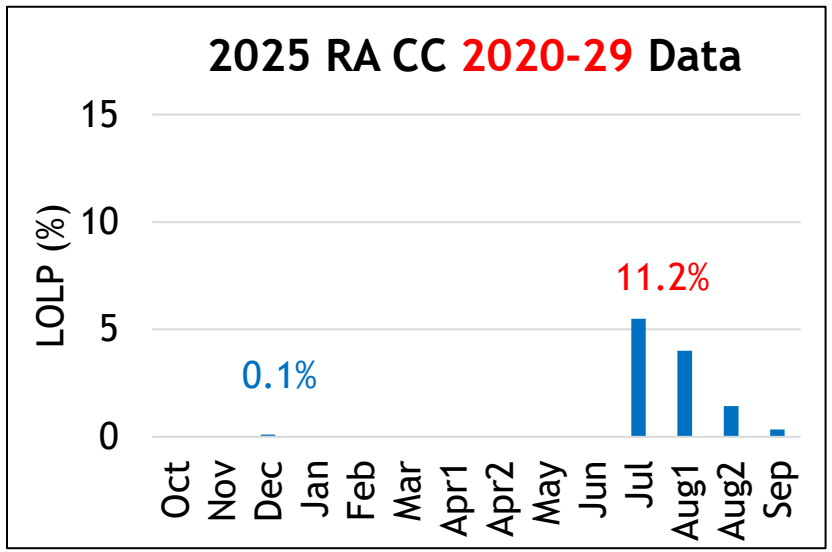
Climate Change Shifts Seasonality of River Flows



Seasonal Shift in LOLP over Time Periods







This is an illustration of the climate change shift in seasonal adequacy

- Left chart uses historical data from 1949-1978 (30 years)
- Middle chart uses historical data from 1979 to 2008 (30 years)
- Right chart uses CC data from 2020-29 for three CC scenarios (30 years total)

Over time, total winter LOLP declines as total summer LOLP increases

Preliminary Resource Adequacy Assessment

Loss of Load Probability	2023	2025
Original GENESYS	16%	23%
Redeveloped GENESYS	0%	0%

- Recently, the Council redeveloped its adequacy model (GENESYS) to more accurately account for hourly resource dispatch in an increasingly more diverse west-coast power supply and evolving energy market.
- The somewhat surprising result is that the redeveloped model shows no loss of load probability – quite a stark contrast to the results from the original model.
- The Council is still reviewing results from the new model, but it appears that the high LOLP results from the original model are due to very conservative assumptions regarding market supply and hydro flexibility.
- To provide support for the new results, the region's generating capability is compared to its expected electricity demand (shown on the next slide) to show that the region is surplus in both years that are examined.

Preliminary Resource Adequacy Assessment

Load/Resource Balance (%)	2023	2025
Annual Energy Surplus	14%	12%
Winter Peak Surplus	19%	17%
Summer Peak Surplus	10%	9%

- Surplus = Resource Capability – Expected Load
  Expected Load

- For adequacy, many utilities set a minimum limit on the surplus, referred to as a planning reserve margin, usually in the 15% to 20% range, but…

  because the PNW surplus is based on critical (lowest) river flow and does not include market supplies, the implied PRM for adequacy can be negative (since the likelihood of critical river flow is about 3% and the likelihood of having no market supply is about 5% and the likelihood of both happening is less than 1%).

- For perspective, the surplus percentage in 2001 during the West Coast Energy Crisis was about negative 20%.