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



September 3, 2014

**MEMORANDUM**

**TO:** **Power Committee Members**

**FROM:** **John Fazio, Senior Systems Analyst**

**SUBJECT:** **Primer on Resource Adequacy**

**BACKGROUND:**

Presenter: John Fazio, NWPCC (jfazio@nwcouncil.org, 503-222-5161)

Summary: In power system planning, there has always been a tradeoff between cost and adequacy (or reliability). A utility can invest more money in its resource supply to better insure that power will be available more often and under more extreme conditions. But how much is enough? The Regional Portfolio Model (RPM) explicitly calculates the average cost and risk (tail-end cost) for various future resource plans. However, the Council has agreed that some level of minimum adequacy must be provided. That minimum level of adequacy is defined in the Council's standard, which limits the likelihood of a future shortfall to 5 percent or less (when counting only existing resources and those expected to be operational). This briefing describes the metric used by the Council to assess the adequacy of the regional power supply and also describes other adequacy metrics used around the world.

Relevance: As the Council proceeds with the development of its 7th power plan, it must insure that its final resource strategy will result in an adequate supply. The Council's adequacy standard must be incorporated into all of its planning models.

Work Plan: B. Assess adequacy for 2019

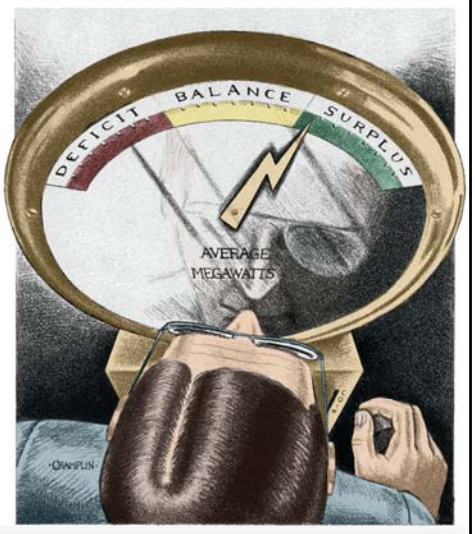
Background: Resource adequacy is one part of the Council's mandate, which is to develop a resource plan that will provide an adequate, efficient, economic

and reliable power supply for the Pacific Northwest. John will present background information on the method adopted by the Council in 2011 to assess resource adequacy.

More Info: http://www.nwcouncil.org/energy/resource/home/

# Primer on Resource Adequacy

Power Committee
September 9, 2014
Portland, Oregon

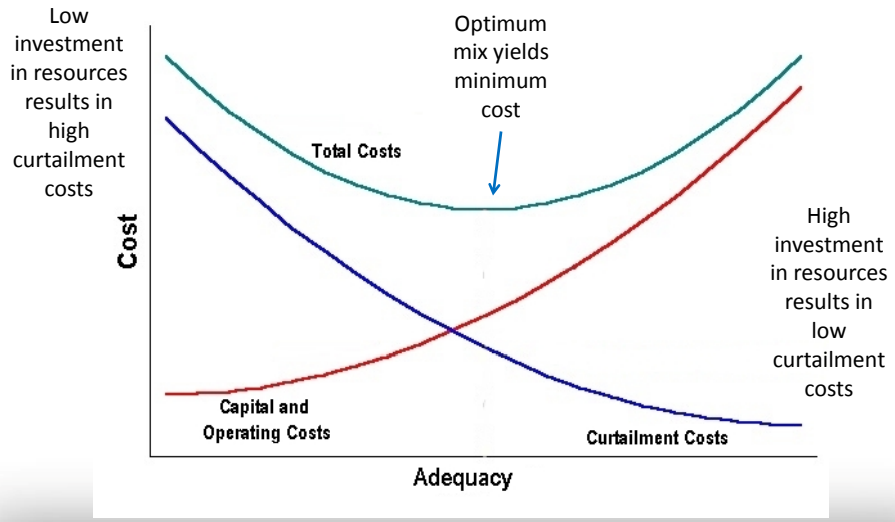





## Outline

- Tradeoff between cost and adequacy
- The GENESYS model
- The Council's Adequacy Standard
- Calculating LOLP
- Other adequacy metrics

# Tradeoff: Adequacy vs. Cost



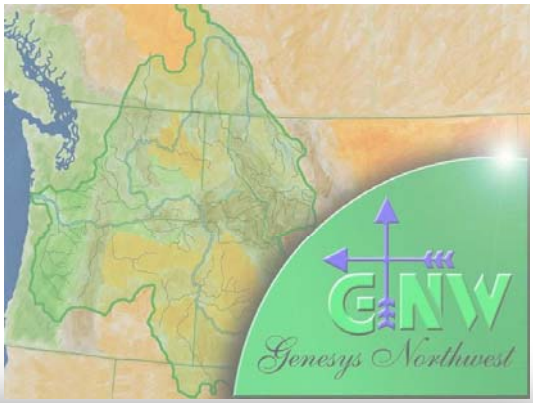


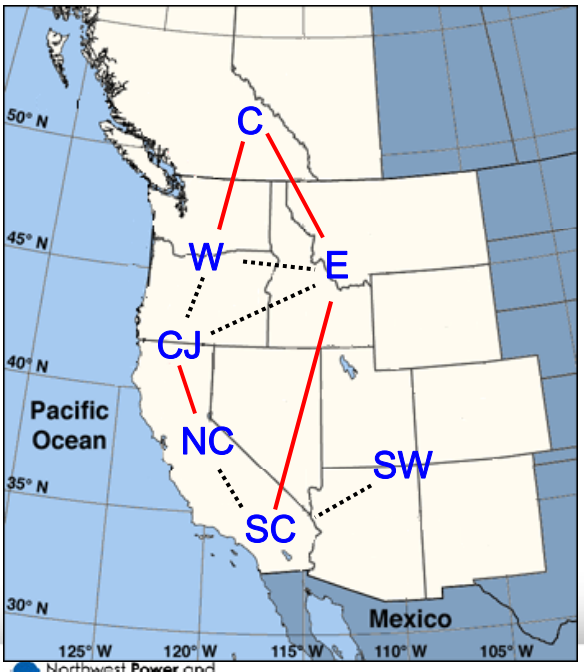

# The GENESYS Northwest Model

A Monte-Carlo model that simulates the operation of the NW power supply system over many different uncertain future conditions

**Uncertain Future Conditions:**
- Water supply
- Temperature (load)
- Wind generation
- Forced outages

**Specifics:**
- Detailed hydro simulation
- Dynamic Hydro/Thermal dispatch
- Economic dispatch
- Hydro blocks priced relative to specific thermal units
- Hourly time step






## Transmission Modeled in GENESYS

- Northwest is split into 2 nodes (East and West)
- New version adds a Southern Idaho node
- Models potential imports from California

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## Resource Dispatch Order

| Resource | Description | |
|---|---|---|
| Firm Hydro and Thermal | From lowest to highest operating cost | Modeled in GENESYS |
| Non-firm and Markets | In-region and out-of-region markets, surplus hydro, borrowed hydro | |
| Standby Resources Type 1 | Non-declared utility resources (diesel generators, etc.) | Modeled in Post Processor |
| Standby Resources Type 2 | Buy-back provisions on load | |
| Emergency Action 1 | More expensive non-declared resources or contract provisions | |
| Emergency Action 2 | Governor's call for conservation | Not Modeled |
| Emergency Action 3 | Rolling black outs or brown outs | |

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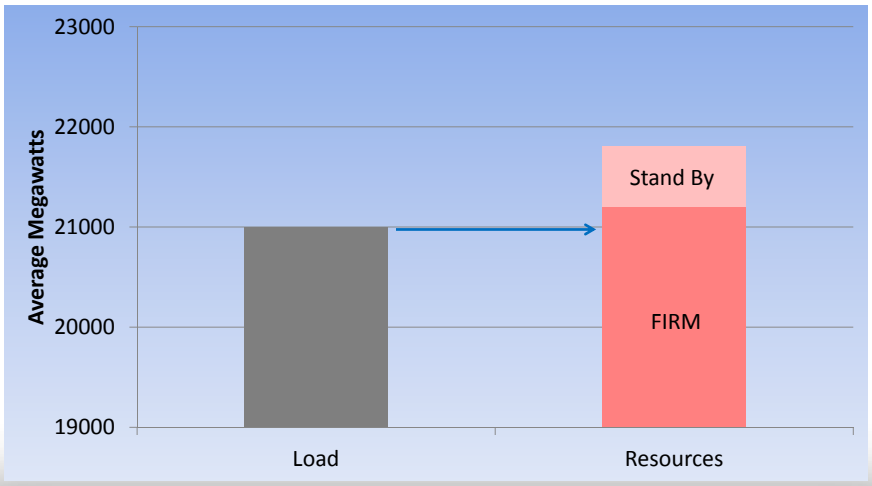
# Sample Future Number1

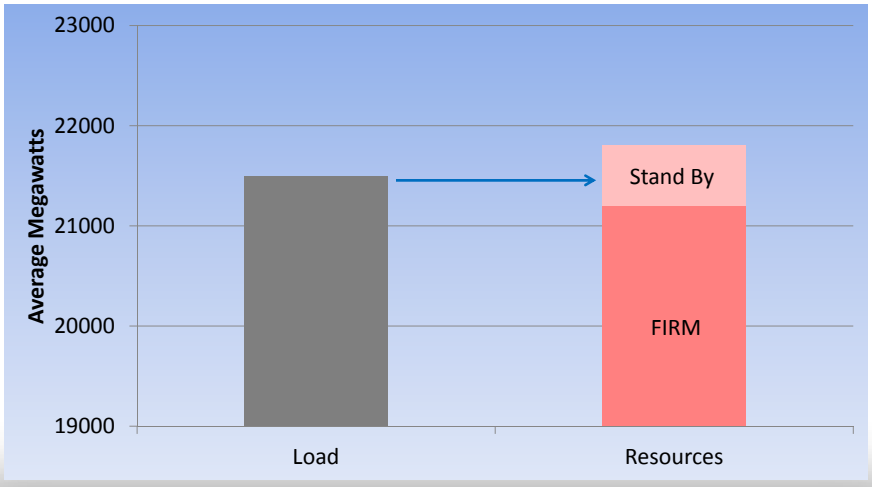
## No Curtailment – No Stand By





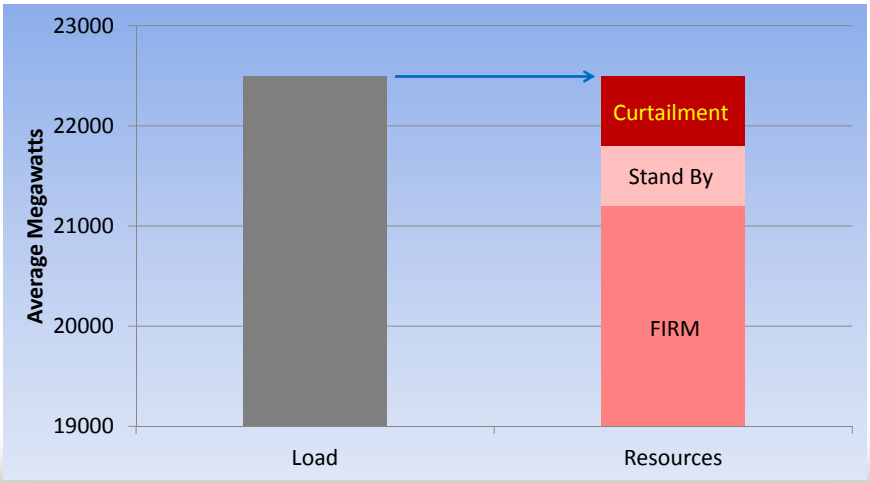

# Sample Future Number 2

## No Curtailment – Used Stand By



# Sample Future Number 3

## Curtailment





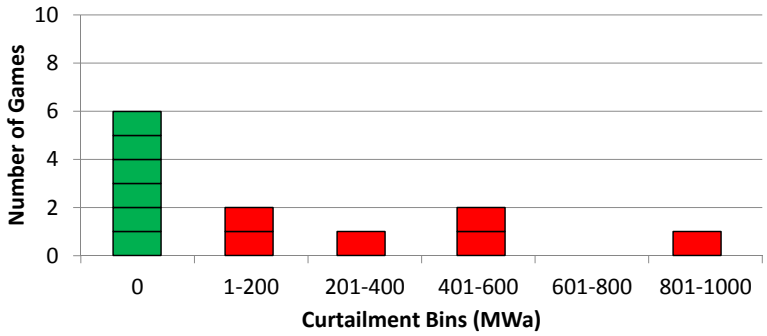

# Council's Adequacy Standard

(Adopted in Dec 2011)

- Goal
  Measure the likelihood of having at least one curtailment in a future year
- Method
  Number of games with at least 1 curtailment divided by the total number of games
- Metric
  Loss of load probability (LOLP)
- Threshold
  Maximum of 5%

# Counting Curtailments

(Step through games and fill curtailment bins)

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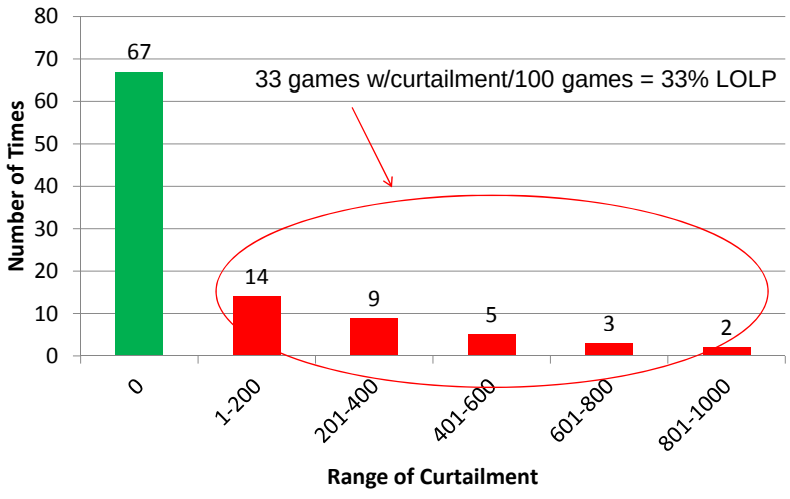
# Curtailment Histogram

100 Games

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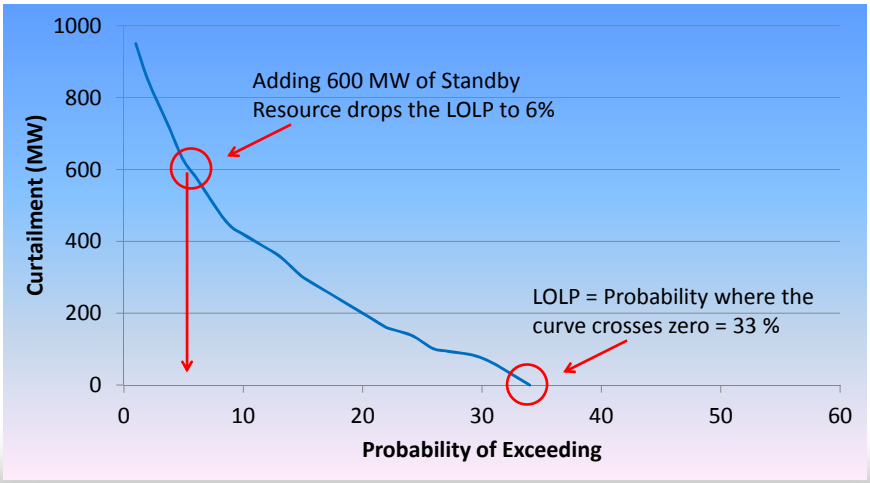
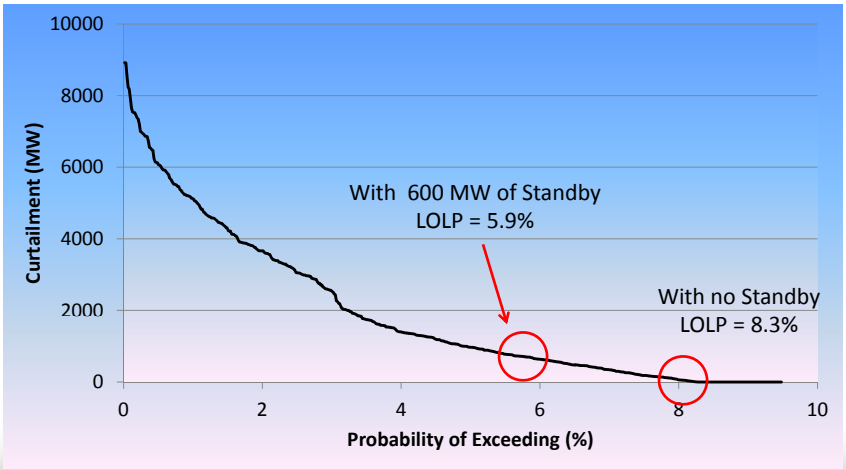
# Curtailment Probability Curve






# 2019 Adequacy Assessment

(Peak Curtailment Probability Curve)



# Other Adequacy Metrics

| Metric | Description |
|---|---|
| LOLP (%) | Loss of load probability = number of games with a problem divided by the total number of games |
| EUSRP (%) | Use of standby resource probability = Number of games that dispatch standby resources at least once divided by total games |
| CVaR - Energy (MW-hours) | Conditional value at risk, energy = average annual curtailment for 5% worst games |
| CVaR - Peak (MW) | Conditional value at risk, peak = average single-hour curtailment for worst 5% of games |
| EUE (MW-hours) | Expected unserved energy = total curtailment divided by the total number of games |
| LOLH (Hours) | Loss of load hours = total number of hours of curtailment divided by total number of games |
| PGC (%) | Percent of games with curtailment = Same as EUSRP |



# Adequacy Summary

| Metric | 2017 | 2019 | Units |
|---|---|---|---|
| LOLP | 6.6 | 5.9 | Percent |
| EUSRP | 9.7 | 8.3 | Percent |
| CVaR - Energy | 99,000 | 59,200 | MW-hours |
| CVaR - Peak | 4,000 | 3,337 | MW |
| EUE | 5,000 | 3,000 | MW-hours |
| LOLH | 2.7 | 1.7 | Hours/year |
| PGC | 9.7 | 8.3 | Percent |