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

September 10, 2019

MEMORANDUM

TO: **Council Members**

FROM: **John Ollis, Power System Analyst**

SUBJECT: **Develop Cost-Effective Methods For Providing Reserves Process**

BACKGROUND:

Presenter: John Ollis

Summary: In preparation for the 2021 Power Plan, staff will be providing the Power Committee a series of presentations on different aspects to developing the plan. This presentation is on the development of methods for the provision of cost-effective reserves.

Relevance: Every five years, the Council reviews a 20-year "regional conservation and electric power plan," with special focus on the regional resource strategy required to meet the region's power needs for the next five or six years. Council staff uses a portfolio of modeling tools to analyze different resources strategies to inform the Council on costs and risks associated with particular resource strategy choices. The Regional Portfolio Model (RPM) is used to analyze the effectiveness of investments in new regional resources to meet power system needs and intra-regional policy requirements under uncertainty. AURORA incorporates a view of the extra-regional power system and associated policy drivers via market signals. GENESYS is used to check the capability of regional resource strategies to provide an adequate system at higher fidelity level than the RPM.

851 S.W. Sixth Avenue, Suite 1100
Portland, Oregon 97204-1348
www.nwcouncil.org

Steve Crow
Executive Director

503-222-5161
800-452-5161
Fax: 503-820-2370

Updated frozen efficiency loads, external electricity prices, fuel prices, energy efficiency and demand response supply curve data, reference plant parameters, existing state policies and information about the existing system, system adequacy parameters and hydro condition data, and financial assumptions are incorporated into the RPM. The RPM inputs are then modified to reflect whatever scenario is being tested and the model then simulates many investment strategies over many future conditions. Whichever strategy is least cost (or least risk) is then tested in GENESYS and AURORA, respectively, to check if it meets the regional adequacy standard and evaluate its effect on the overall western power system. Within the least cost (or least risk) strategy a sub portfolio of resources will be capable of will be able to best meet the different reserve needs of the system.

Per Section 839b(e)(3)(E), in the NW Power Act, the plan shall include the following element:
An analysis of reserve and reliability requirements and cost-effective methods of providing reserves to insure adequate electric power at the lowest probable cost.

Thus, part of the Council's overall regional resource strategy is a methodology for determining cost-effective provision of reserves. Since, an integrated approach is required to ensure cost-effective reserve provision, Council staff co-optimizes energy and reserves during power system operations simulations and passes that information along in the overall resource strategy analysis when assessing low cost and low risk resource strategies. Thus, the overall regional portfolio strategy should be implemented to ensure a cost-effective provision of reserves.

Workplan: A.5.2 Update models to get ready for 2021 power plan modeling

More Info: Discussion of cost-effective reserve methodology used in the 7th Power Plan is discussed in detail in Chapter 16.

Chapter 16: Analysis Of Cost Effective Reserves And Reliability
https://www.nwcouncil.org/sites/default/files/7thplanfinal_chap16_reservesandreliability_1.pdf

Develop Cost-Effective Methods for Providing Reserves

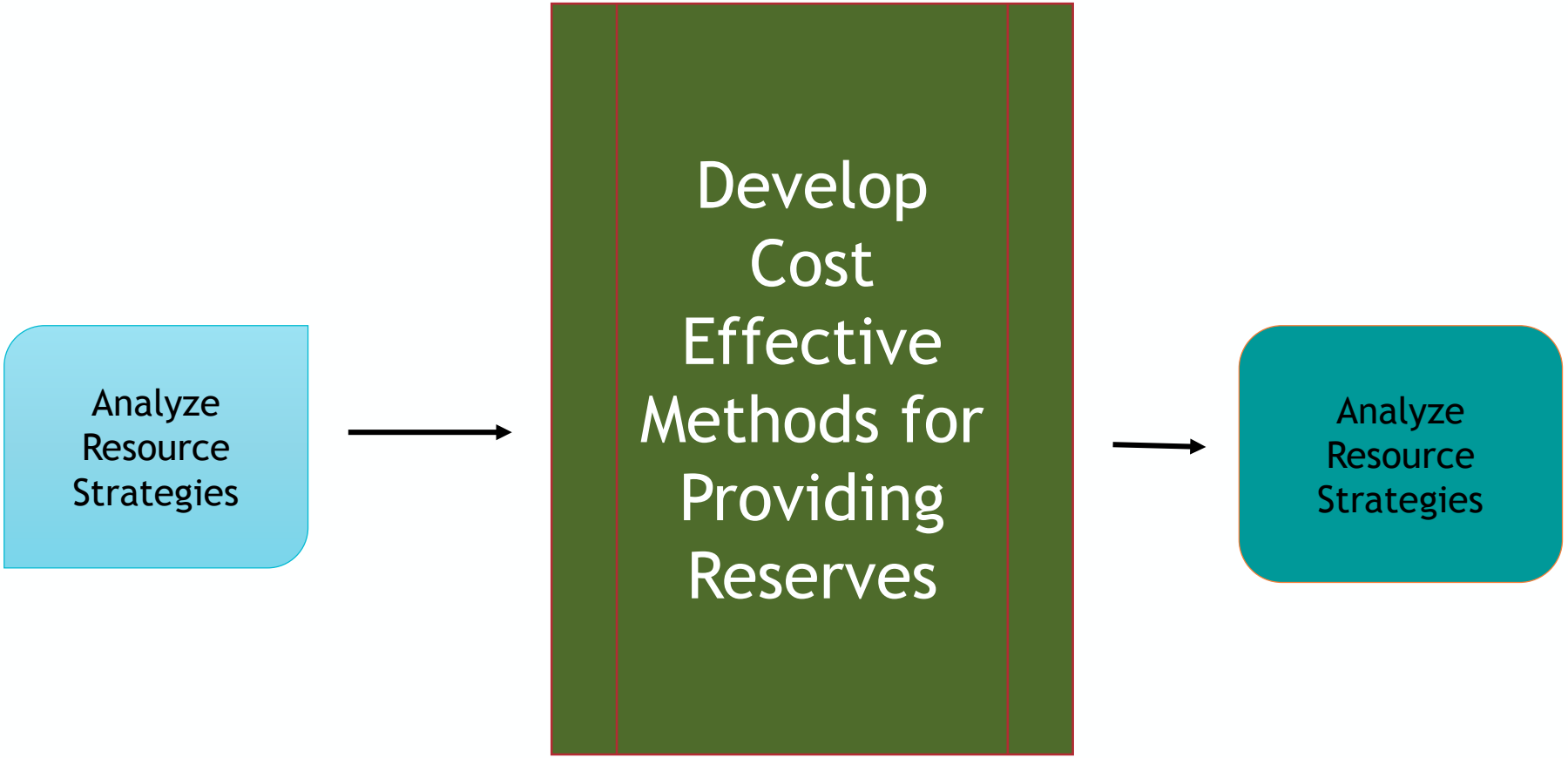
Power Committee

September 17, 2019

John Ollis, John Shurts

THE 2021
NORTHWEST
POWER PLAN

FOR A SECURE & AFFORDABLE
ENERGY FUTURE


Analyze Resource Strategies
Develop Cost Effective Methods for Providing Reserves
Analyze Resource Strategies

What We Are Discussing

1. Review Power Act language and definitions

2. Context of reserves in modern power system planning and markets

3. Integrated approach with resource strategy analysis

Why this Process is Important?

Per Section 4(e)(3)(D), in the NW Power Act, the plan shall include the following element:

A demand forecast of at least twenty years (developed in consultation with the Administrator, the customers, the States, including State agencies with ratemaking authority over electric utilities, and the public, in such manner as the Council deems appropriate) ***and a forecast of power resources estimated by the Council to be required to meet the Administrator's obligations and the portion of such obligations the Council determines can be met by resources in each of the priority categories referred to in paragraph (1) of this subsection which forecast (i) shall include regional reliability and reserve requirements,*** *(ii) shall take into account the effect, if any, of the requirements of subsection (h) of this section on the availability of resources to the Administrator, and (iii) shall include the approximate amounts of power the Council recommends should be acquired by the Administrator on a long-term basis and may include, to the extent practicable, an estimate of the types of resources from which such power should be acquired.*

Per Section 4(e)(3)(E), in the NW Power Act, the plan shall include the following element:

An analysis of reserve and reliability requirements and cost-effective methods of providing reserves designed to insure adequate electric power at the lowest probable cost

What is Cost-Effective?

Power Act definition:

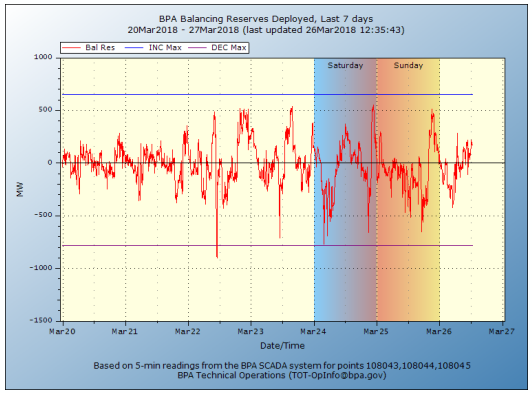
839a(4)(A). "Cost-effective", when applied to any measure or resource referred to in this chapter, means that such measure or resource must be forecast

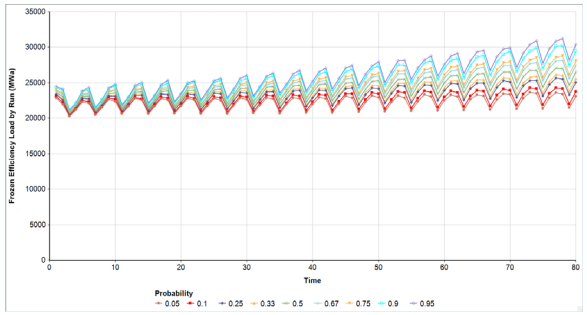
- 839a(4)(A)(i). to be reliable and available within the time it is needed, and [Northwest Power Act, §3(4)(A)(i), 94 Stat. 2698.]
- 839a(4)(A)(ii). to meet or reduce the electric power demand, as determined by the Council or the Administrator, as appropriate, of the consumers of the customers at an estimated incremental system cost no greater than that of the least-cost similarly reliable and available alternative measure or resource, or any combination thereof. [Northwest Power Act, §3(4)(A)(ii), 94 Stat. 2698.]

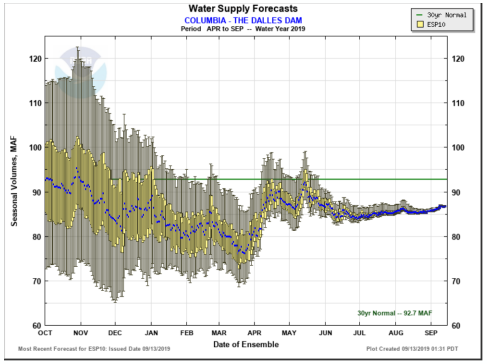
What are Reserves?

Power Act definition:

839a(17). "Reserves" means the electric power needed to avert particular planning or operating shortages for the benefit of firm power customers of the Administrator and available to the Administrator (A) from resources or (B) from rights to interrupt, curtail, or otherwise withdraw, as provided by specific contract provisions, portions of the electric power supplied to customers. [Northwest Power Act, §3(17), 94 Stat. 2700.]







Reserves in Today's Power System

- Reserves are used in planning and operations to account for the fact that forecasts of future conditions are imperfect on both, a long and short term basis.

Short Term Forecast Error

I remember that last storm where there was lots of wind and then there wasn't...?

How many new electric vehicles should we expect in the next 20 years ...?

It is cloudy again over the solar panels...?

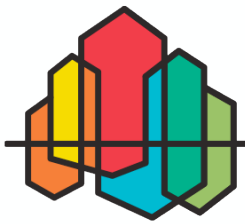
How much hydropower can we expect next year, or in five years...?

Everyone will be cooking their Thanksgiving turkey and the paper mill shuts off for the holiday....?

Hopefully the HRSG got fixed correctly during that last maintenance...?

Long Term Forecast Error

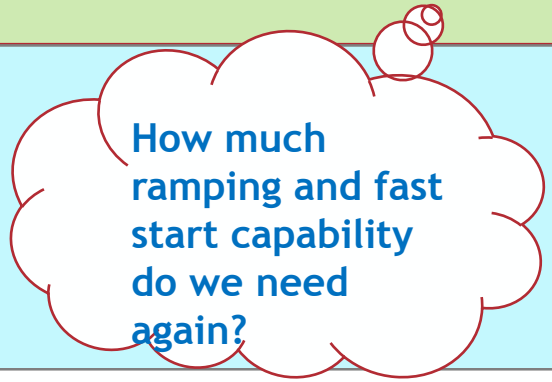
Examples of Power System Uncertainty	Tools to Address Uncertainty
Thermal plant forced outage	Contingency reserve and short-term market activity
Patchy cloud cover over solar plant	Balancing reserve (load following and/or regulation INC/DEC) and short-term market activity
Instantaneous demand spike	Balancing reserve (Regulation INC) and short-term market activity
Unexpected long-term demand growth	Periodic planning using planning reserve margins prepares with new generation, market or demand-side options
Low and early hydro runoff	Periodic planning using seasonal planning reserve margins and prepares with new diversely fueled generation, market or demand-side options
Gas pipeline rupture temporarily decreases gas supplies	Initial response may utilize contingency reserve, but important response will emerge from periodic planning using planning reserve margins, preparing with new diversely fueled generation, market or demand-side options
Lower wind and higher demand due to cold snap	Initial response may utilize balancing reserve but important response will emerge from periodic planning using planning reserve margins, preparing with new diversely fueled generation, market or demand-side options



Forecast Error Over Different Time Frames

Long-Term Forecast Error

- Timeframe: Many years to Day-ahead Market
- Variables: Commodity prices, weather, demand, hydro conditions, regulations, policies and supply availability
- Toolbox: Periodic resource planning, acquisition and retirement, diverse market products

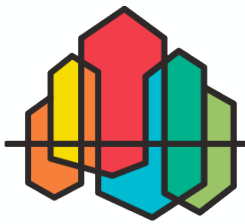


Forecast Error Over Different Time Frames

Short-Term Forecast Error

- Timeframe: Day-ahead Market to Delivery
- Variables: Commodity prices, weather, demand, hydro conditions, and supply availability
- Toolbox: Some market products, balancing and contingency reserves

How wrong could we be on our expected river runoff or demand forecasts?



Description of an Integrated Approach

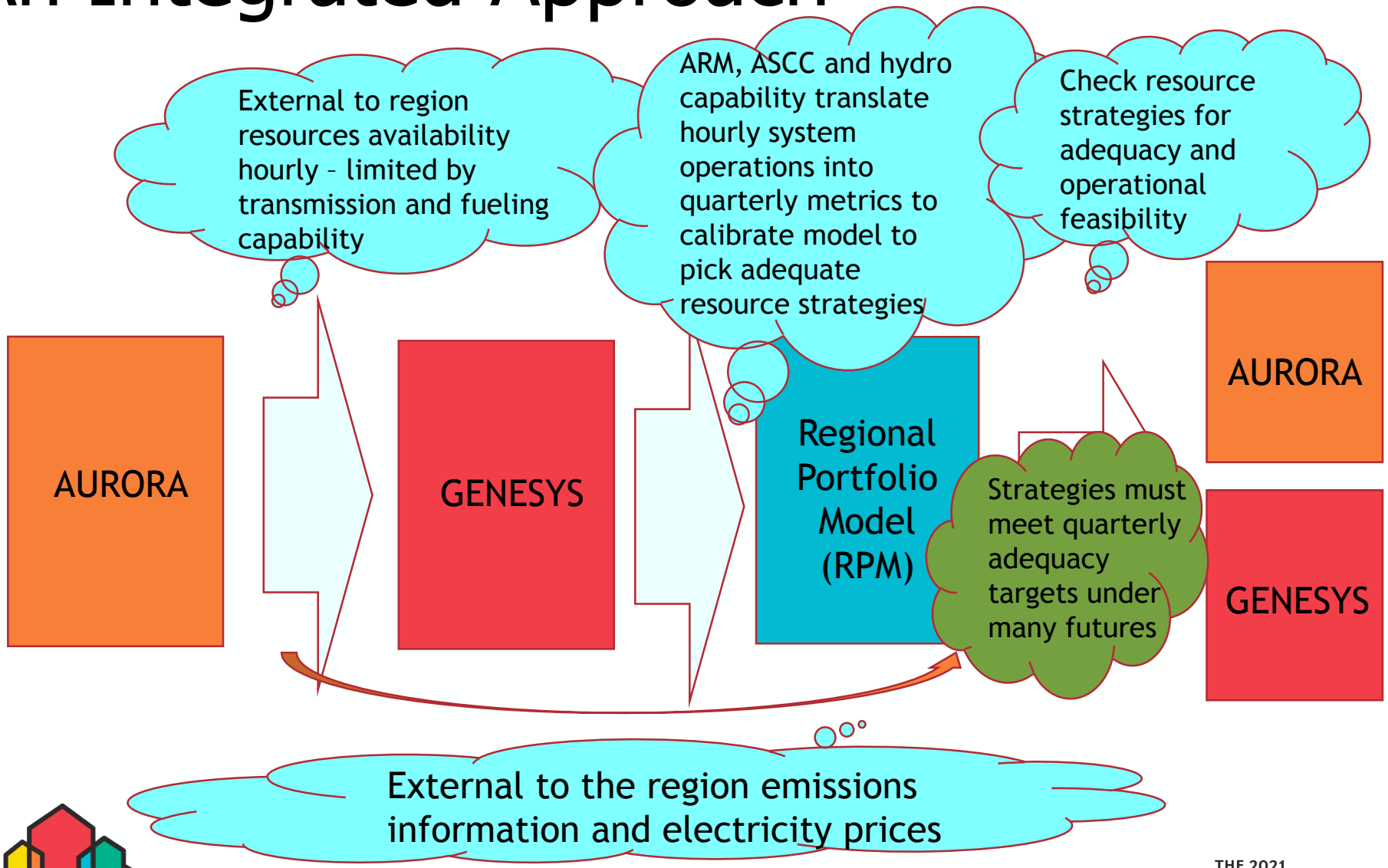
- Make long term resource decisions that address the following uncertainties in the context of an *adequate* system:

1. Annual and Quarterly Supply/Demand Uncertainty
   - Hydro runoff
   - Renewable generation
   - Demand
2. Sub Quarterly Uncertainty
   - Hydro runoff
   - Renewable generation
   - Demand

Reserves in Council Modeling

- **Operating reserves** are used to cover short-term mismatches between load and resources
  - Balancing and contingency reserve requirements for each balancing authority in GENESYS/AURORA
  - Provided by fast ramping resources with some certainty about fuel supply
    - Modeled as part of hourly dispatch and fuel accounting dispatch in GENESYS and AURORA, and results converted into Associated System Capacity Contribution (ASCC) in RPM
- **Planning reserves** should include any additional requirements to address long-term mismatches between load and resources
  - Planning reserve margins for external to the region areas in AURORA and adequacy reserve margin (ARM) in RPM
  - Provided by diverse portfolio resources and long term market products with some certainty about seasonal fuel availability and peaking capability
    - Implicitly considered as part of hourly dispatch and fuel accounting dispatch in GENESYS and AURORA, and results converted into Associated System Capacity Contribution (ASCC) in RPM
- **All reserves can be made up of generating resources and/or load-management actions.**

An Integrated Approach



Key Takeaways

- **A power plan must consider "cost-effective methods of providing reserves" per the Power Act.**
- **Reserves are held to account for forecast error over different time frames**
  - Uncertainty in demand, forced outages, hydro runoff and renewable resource availability can be addressed with varying tools from planning to operating reserves.
- **To evaluate reserves in the context of cost-effectiveness, take an integrated approach.**
  - Within the least cost (or least risk) strategy a sub portfolio of diverse generating and/or demand-side actions will be capable of will be able to best meet the different reserve needs of the system.
  - Since different resource strategy actions have differing fueling, ramping and scheduling/commitment characteristics, *1-to-1 reserve replacement options are uncommon*.