Implications of the NWPP Regional Resource Adequacy Program on Western U.S. Integrated Resource Planning

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Background

- Pacific Northwest (PNW) region could present resource adequacy (RA) issues as early as this year (E3, 2019)
- Northwest Power Pool (NWPP) is developing proposal for a voluntary regional RA program
- Integrated Resource Planning (IRP) is used by all Western U.S. states as a resource mix tool and a resource adequacy tool for load serving entities (LSEs)
- There is a need to understand the implications of a regional RA program on state-level IRP regulations

Topics in this webinar

- Research questions
- Overview of the NWPP Regional RA Program proposal
- RA Fundamentals and the role that IRP plays in resource adequacy
- The experience of the Southwest Power Pool
- Implications of the NWPP program on Western U.S. IRP
- Conclusion

Research Questions

How would typical IRP processes need to change if an LSE joined a regional RA program?

Which RA elements would remain under local (state) jurisdiction and which elements would become regional?

How much control would LSEs and states retain over their utility resource mixes?

The NWPP RA Program

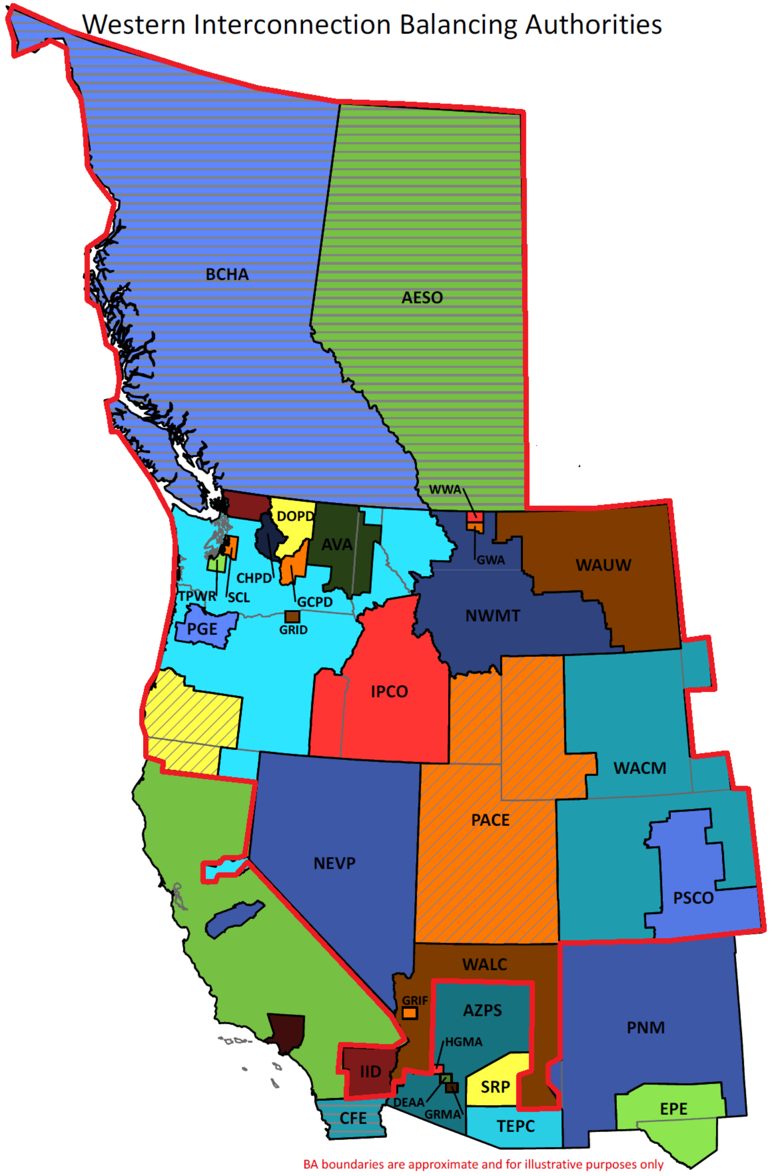
Regional RA programs – The NWPP proposal

- Pacific Northwest (PNW) region could present resource adequacy (RA) issues as early as this year (E3, 2019)

- Northwest Power Pool (NWPP) is developing proposal for a voluntary regional RA program

- What are the implications for IRP Planning?

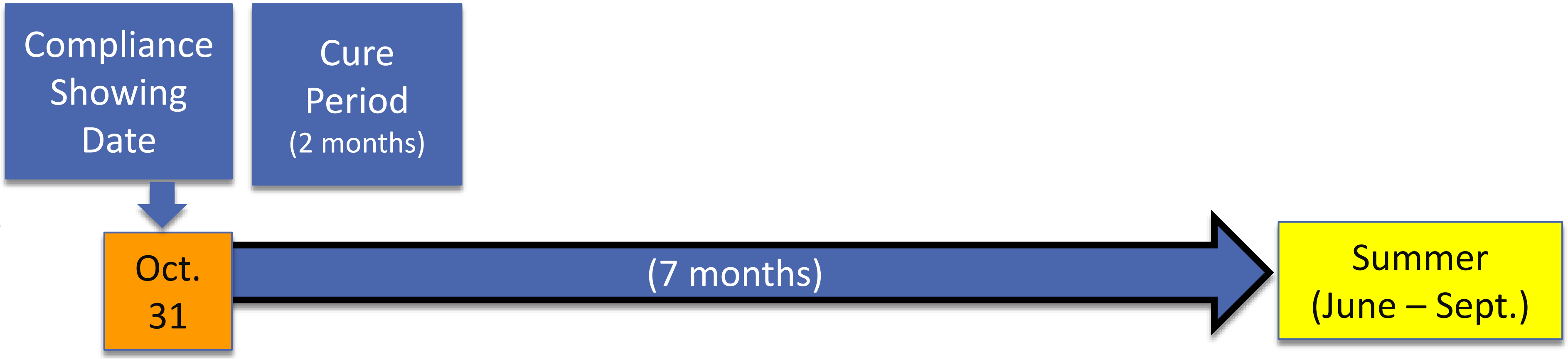
NWPP Footprint



Members of the NWPP

- Alberta Electric System Operator
- Avangrid
- Avista
- BANC
- BC Hydro
- Bonneville Power Administration
- Calpine
- Chelan PUD
- ColumbiaGrid
- Cowlitz PUC
- Douglas PUD
- Energy Keepers Inc.
- Eugene Water & Electric Board
- Fortis BC
- Grant PUD
- GridForce
- Idaho Power
- NaturEner
- Northwestern Energy
- NV Energy
- PacifiCorp
- Pend Oreille PUD
- Perennial Power
- Portland General Electric
- Puget Sound Energy
- Powerex
- Seattle City Light
- Snohomish PUD
- Tacoma Power
- Turlock Irrigation District
- U.S. Army Corps of Engineers
- U.S. Department of Interior Bureau of Reclamation
- Western Area Power Administration
- Xcel Energy

Forward Showing Program



1. Binding periods
   - Winter
   - Summer
2. Forward Showing
   - LSE members show they have resources to meet their expected peak load + reserve margin
   - 7months prior to the summer/winter periods
   - 2-month cure period to get new resources if LSE initially deficient
3. Program Administrator oversees regional program
   - Verifies LSE member capacity resources to meet their expected seasonal peak load
   - Penalty imposed on LSEs that fail to their resource requirements

Key Metrics for the NWPP RA Program

Program Metric	NWPP Conceptual Design
1. RA Reliability Target	Planning Reserve Margin (PRP) to meet 1 in 10-year Loss of Load Event (LOLE)
2. Load Forecast	1 in 2 peak load forecast for summer and winter seasons
3. Resource Capacity Credit:	
a. Variable Energy Resources (wind, solar, run of river hydro)	Effective Load Carrying Capacity (ELCC) by season and zones
b. Thermal resources (natural gas, coal generators)	Unforced Capacity (UCAP) methodology --- de-rates applied or additional actions related to firm transport or fuel supply events
c. Storage hydro	Develop common hydro model to verify capacity contribution under a range of hydrological conditions

NWPP Program - Operational Features

- Member benefits
  - Access to pooled regional resources to assist in meeting loads under a "systems-triggering-event"
- "Systems-triggering event"
  - When load, unplanned outages, variable resource deviations or a combination thereof, exceeds an entity's required planning metrics
- RA Program facilitates bi-lateral transactions
  - Links members that are short of resources to other members with surplus resources
  - Regional program taps into the diversity of the regional resources
  - Bilateral approach contrasts with other regional RA programs operated by ISOs/RTOs

RA in Integrated Resource Planning

RA principles and current practices

- RA Metrics
  - The traditional RA metric is the planning reserve margin (PRM), which is the percentage by which generation capacity exceeds the forecasted peak demand.
  - Probabilistic RA metrics are harder to compute because they require stochastic models, but they correspond more directly to reliability objectives and are becoming more important due to growing variable renewable energy (VRE).

Common probabilistic metrics used for resource adequacy

Metric	Unit	Description
LOLE	day/year	Expected number of days with loss of load events per year
LOLEV	event/year	Expected number of loss of load events per year
LOLP	%	Probability of loss of load event during a given time period
LOLH	hour/year	Expected number of hours of lost load events per year
EUE	MWh/year	Expected total quantity of unserved energy per year due to loss of load events

RA principles and current practices

- Approaches for Achieving RA
  - Traditionally, RA targets were defined and achieved at the individual utility level.
  - With electricity sector deregulation and the development of ISOs and RTOs, there are various approaches for achieving RA in different competitive electricity market areas.
    - **Energy-only markets** should not require any regulatory mandates to ensure RA (in principle) because investors in peaking power plants can recover their costs by selling power at very high prices during a few hours of the year. Reliability is a result of market choices rather than a direct input to planning.
      - Examples: ERCOT, Alberta Electricity System Operator (AESO)
    - **Centralized capacity markets** complement energy markets in some regions by directly procuring enough generation capacity to maintain desired PRMs several years into the future. The market procures capacity through an auction and compensates generators for the capacity they install.
      - Examples: ISO-NE, NYISO, PJM
    - **Bilateral capacity markets** do not directly procure capacity but rather allow utilities to negotiate bilateral contracts. This allows a utility to supplement its self-owned resources with contracted resources. Contract prices are established by the supply and demand for capacity.
      - Examples: MISO, CAISO, SPP

RA principles and current practices

- Current RA Assessments in the Western U.S.
  - All LSEs need to conduct RA assessments. This is often an implicit part of IRP to ensure that all considered future resource portfolios satisfy the necessary reliability standards.
  - There are several regional RA programs currently operating in the Western U.S.
    - **CAISO** introduced an RA program after the California Electricity Crisis of 2000-2001. It coordinates bilateral trades and procurement of RA capacity among IOUs, has the authority to procure backstop capacity and allocate costs, and operates procurement mechanisms for capacity deficits for reliability targets and transmission grid needs.
    - **SPP** operates a regional RA program for LSEs participating in its wholesale market, which spans all or parts of 14 states. SPP estimates the RA requirement for each LSE and verifies its compliance for summer and winter seasons each year.
  - Current regional RA assessments of the NWPP area are purely informational.
    - **WECC** publishes information on RA planning and investigates how to maintain future RA.
    - **NWPCC** finds Northwest power supply will become inadequate starting in 2021 (with 7.5% LOLP).
    - NWPP hired **E3** to conduct an RA assessment to inform the development of its RA program proposal.

The role of IRP in resource adequacy

- To understand how LSEs currently assess RA within the IRP context, we conducted a detailed review of 11 IRPs from LSEs in the Western and Midwest U.S.
- These LSEs are diverse in terms of geography and size, and they differ according to whether or not they fall under the jurisdiction of a regional RA program.

LSE	Full Name	Year	States	Population Served	Regional RA Program
APS (APS, 2017)	Arizona Public Service	2017	Arizona	2.7M	No
Avista (Avista, 2020)	Avista	2020	Washington and Idaho	0.4M	No
KC-BPU (KC-BPU, 2019)	Kansas City Board of Public Utility	2019	Kansas	0.07M	SPP
OG&E (OGE, 2018)	Oklahoma Gas & Electric	2018	Oklahoma, Arkansas	0.8M	SPP
PacifiCorp (PacifiCorp, 2019)	PacifiCorp	2019	Utah, Oregon, Washington, Wyoming, Idaho, and California	1.8M	No
PGE (PGE, 2019)	Portland General Electric	2019	Oregon	0.9M	No
PNM (PNM, 2017)	Public Service Company of New Mexico	2017	New Mexico	0.5M	No
SCE (SCE, 2019)	Southern California Edison Company	2017	California	15M	CAISO
SMUD (SMUD, 2019)	Sacramento Municipal Utility District	2017	California	1.5M	No
TEP (TEP, 2017)	Tucson Electric Power	2017	Arizona	0.4M	No
Xcel (Xcel, 2016)	Xcel Energy	2016	Colorado	1.2M	No

The role of IRP in resource adequacy

- RA Reliability Targets
  - RA targets are most often specified in terms of a PRM.
  - However, in some cases, the PRM is established by carrying out a sophisticated stochastic analysis that determines the PRM that is consistent with a desired probabilistic RA level (e.g., 1-day-in-10-year LOLE).
  - The lower 12% PRMs for the two SPP utilities were enabled (reduced from 13.6%) due to the benefits stemming from the regional RA program: increased load and resource diversity.
  - Comparing PRMs across LSEs is very difficult. For example, some LSEs deal with load uncertainty by forecasting load conservatively, while others aim for a higher PRM. Standardizing assumptions is an important role of a regional RA program.

LSE	Reliability Target	Note
APS	15% PRM	Based on a 1-day-in-10-year LOLE
Avista	5% LOLP	Results in an 18% PRM
KC-BPU	12% PRM	Same as the SPP PRM requirement
OG&E	12% PRM	Same as the SPP PRM requirement
PacifiCorp	13% PRM	
PGE	1-day-in-10-year LOLE	
PNM	13% PRM	Results in a LOLEV that is higher than two events every 10 years, which would require a PRM of about 17%
SCE	15% PRM	Same as the CAISO PRM requirement
SMUD	15% PRM	Same as the CAISO PRM requirement
TEP	15% PRM	
Xcel	16.3% PRM	Based on a 1-day-in-10-year LOLE

The role of IRP in resource adequacy

- Resource Capacity Values
  - Utilities must develop credible methods to estimate capacity values for VRE resources during peak hours.
  - The level of detail devoted to this issue and associated methods varies substantially across IRPs.
  - The effective load carrying capability (ELCC) of a resource captures the correlations among the resource's own output, the outputs of other supply resources, and loads.
  - The more advanced ELCC analyses in the IRPs reflect the widely perceived trend where the ELCCs of wind and solar resources decline as the amounts of these resources grow.
  - Significant hydro resources in the NWPP make energy adequacy an issue distinct from capacity adequacy.

LSE	Method	Note
APS	Peak period	Use the average capacity factors during the top 90 load hours
Avista	ELCC study	Add a stochastic component to historical hourly renewable generation shapes to capture renewable uncertainty
KC-BPU	Not stated	SPP accreditation
OG&E	Not stated	SPP accreditation
PacifiCorp	ELCC study	Use CF Method (Madaeni et al., 2012) to calculate peak capacity contribution values for renewables
PGE	ELCC study	Use RECAP model
PNM	ELCC study	Rely on historical data as well as manufacturer data
SCE	ELCC study	
SMUD	ELCC study	Use RECAP model with generation profiles from weather years between 2007 and 2016
TEP	Not stated	
Xcel	ELCC study	Follow ELCC methodologies in Keane et al. (2011) and Madaeni et al. (2012)

The role of IRP in resource adequacy

- Emerging Technologies
  - Some LSEs explicitly forecast the capacity contributions of **distributed generation** (e.g., PGE) while others treat it like a demand-side program (of uncertain magnitude) for developing load forecasts (e.g., Xcel).
  - The increasing presence of **electric vehicles** (EVs) in IRPs over the past several years reflects growing recognition of their importance.
    - 7 of the 11 IRPs mention the impacts of EVs and 5 of them explicitly treat EVs as their own component of the load forecast.
    - Avista and TEP use relatively simple methodologies to forecast EV load, while PGE, SCE, and SMUD apply more complex optimization models.
  - Most utilities include **energy storage** as a supply resource and study its economic benefits.
    - Some LSEs conduct an ELCC analysis on energy storage resources with different durations.
    - PGE calculates ELCC values for four types of storage and finds that longer-duration storage contributes more to peak demand. PacifiCorp finds that storage can provide nearly 100% ELCC as a substitute for peaking generation that only needs to supply power during short periods. However, the value of storage declines with more of it.

The role of IRP in resource adequacy

- Treatment of Uncertainty
  - In general, LSEs focus more on economic uncertainties than on RA uncertainties in IRPs.
  - All 11 LSEs do sensitivity or scenario analysis on load forecasts, but only some explicitly integrate uncertainty on demand-side programs, distributed generation, and EVs.
  - Relatively few LSEs analyze uncertainty on the relationship between VRE resource expansion and reliability, or on the availability of market imports at peak times.

Incorporation of uncertainty into RA assessment

LSE	Peak demand forecast	Demand-side resource contribution	Power Plant Retirement	Renewable contribution	Storage efficiency	Market availability	Construction
APS	✓	✓	✓	✓	✓		✓
Avista	✓	✓	✓			✓	
KC-BPU	✓		✓	✓			
OG&E	✓			✓			
PacifiCorp	✓	✓	✓	✓			
PGE	✓	✓		✓	✓	✓	✓
PNM	✓	✓	✓	✓	✓	✓	
SCE	✓	✓	✓	✓			
SMUD	✓		✓			✓	
TEP	✓	✓					✓
Xcel	✓	✓		✓	✓		

Implications of the NWPP RA program on IRP

Regional RA programs – The SPP Experience

- SPP has a **forward-showing RA program** based on a 12% PRM that assures a target LOLE.
- LSEs develop their **own load forecasts**, which is used by SPP for RA purposes providing that it is a one-in-two forecast (50th percentile or median).
- Ten out of 14 states members of SPP have IRP guidelines. Examples on their **IRP integration** with the SPP RA Program:
  - MO allows the inclusion of SPP's transmission planning outcomes providing they create economic benefit to MO ratepayers.
  - OK guidelines are less stringent; LSEs follow SPP's RA assumptions when developing their IRPs
- Transmission planning, capacity credit, and RA targets are **"inherited" from SPP's definitions into IRP**, either by statute or to minimize redundancy.
- SPP, in turn, plays the role of **integrating resource plans** developed within its footprint, aided by the numerous working groups and committees.

Results: Impact of Regional RA Components on IRP

IRP RA Component Impacted	Impact of Regional RA Program	Control Allocation
RA Reliability Targets		Regional
Load Forecast		Shared
Demand-side Resources		Local
Modelling Approach		Local
Resource Capacity Credit		Regional
Market Transactions		Local
Transmission Expansion		Shared
Emerging Technologies		Local
Load Uncertainty		Local
Power Supply Uncertainty		Local
Preferred Portfolio / Utility Resource Mix		Local

High Impact
Medium Impact
Low Impact

Summary

- A regional RA program may reduce costs of meeting reliability targets and may improve regional resource adequacy

- A regional RA program shares many components with IRP

- Despite this overlap, there are only moderate changes in IRP needed to assure consistency with a regional RA program

- States and utilities will need to consider the tradeoff between gaining the benefits of a regional RA Program and conforming their utility IRP practices to regional norms on reliability targets, resource capacity credits, and load forecasting.

- Find the paper here: https://emp.lbl.gov/publications/implications-regional-resource

Thank you!

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