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

April 1, 2025

MEMORANDUM

TO: **Council Members**

FROM: **John Ollis, Manager of Planning and Analysis**

SUBJECT: **Primer on Regional Strategy Analysis Toolset (OptGen/SDDP)**

BACKGROUND:

Presenter: John Ollis

Summary: This presentation will review the tools used to understand cost and risk tradeoffs in regional strategy analysis and how that process ties into the overall Ninth Power Plan analysis.

Relevance: To make a recommendation to the region on how to meet the future needs for electricity most effectively, the Council (1) forecasts future demand, (2) assesses the capabilities of the existing system, (3) estimates the costs and capabilities of adding new resources to keep up with system demand, and (4) uses those to understand the costs of building and operating the system change with different strategies while meeting future energy needs. Since future system needs and costs of the system are uncertain, and understanding the cost and risk of certain strategies requires analyzing a wide range of potential outcomes, the Council employs software and develops methodologies that allow these aspects of the power system to be examined comprehensively.

The Council's current software used to help understand the change in fixed and production costs when adding new resources to the regional portfolio are OptGen and SDDP. More specifically, SDDP uses standard production cost modeling

techniques to minimize the cost of power system operations with a particular portfolio of resources in a particular future, while OptGen seeks to minimize both the fixed and production cost of an investment strategy over a range of futures while satisfying existing policies and system needs.

Workplan: B.3.3 Conduct scenario analysis to inform on regional resource and reserve needs

Background: In its regional power plans, the Council is responsible for developing a resource strategy based on independent analysis of the region's long-term energy needs and the costs and availability of a wide variety of energy efficiency and generating resources. In addition to minimizing system costs, the analysis addresses major uncertainties and strategies for mitigating risks.

The Regional Portfolio Model, or RPM, was a self-built, Council developed regional capital expansion and portfolio optimization model used by the Council to identify adaptive, least-cost resource strategies for the region. The RPM used a sophisticated and unique risk analysis methodology, developed by the Council, which involves simulating numerous candidate resource plans across a broad range of possible futures to identify tradeoffs between expected cost and risk.

The RPM was created in the 5th Power Plan (2006) to understand the risks and tradeoffs of that time which primarily were associated with understanding the attributes of adding new thermal generation or energy efficiency to address regional needs. The model was enhanced and used again in the 6th Power Plan (2011). The model was ported to a new more transparent software platform that allowed for easier stakeholder access and review and additionally enhanced for the 7th Power Plan (2016). The enhancements for the 7th Power Plan were substantial, as were the enhancements on the build up to the 2021 Power Plan.

While in past plans the RPM was used successfully as the primary analytical tool for understanding strategy tradeoffs, in the 2021 Power Plan, many of the previous assumptions that made its underlying structure convenient and efficient for understanding regional risks were challenged. Through the advisory committee process it became clear that without significant overhaul there were some limitations to the RPM structure that made it difficult to rely on the model without the context of the other Council power system models. These limitations arose due to effects on regional operations due to policies both internal and external to the region. Significant model enhancements and assumption changes were implemented to try and incorporate information necessary to make reasonable regional resource strategy decisions, however many of these methods relied on iterative techniques which made it difficult to deliver analysis in the compressed timeline of the planning process.

In September and October 2023, staff recommended, and the Council supported a shift towards commercial capital expansion and production cost modeling

software packages, OptGen and SDDP, respectively. These modules are from the same vendor as provides support and development work for the Council's adequacy and hydro operations model, GENESYS. The context for choosing and setting up these models has been to continue with the same philosophy that drove development of the RPM, which is to understand cost and risk under uncertainty. Since the beginning of 2024, staff has been building out a WECC-wide database or resources, loads and policies, with special focus on the region, and developing methodologies with OptGen and SDDP that, in conjunction with GENESYS, will not only replace the functionalities of the RPM but enhance them.

More info:

Historical Background on the RPM:
https://www.nwcouncil.org/regional-portfolio-model/
https://www.nwcouncil.org/sites/default/files/7thplanfinal_appdixl_rpm_0.pdf (7th Plan Appendix associated with RPM modeling)
https://www.nwcouncil.org/sites/default/files/SixthPowerPlan_Appendix_J_1.pdf (6th Plan Appendix associated with RPM modeling
https://www.nwcouncil.org/sites/default/files/Appendix_L_Portfolio_Model_1.pdf (5th Plan appendix describing the RPM model)

Recent Stakeholder Discussions on the RPM
Revisiting Council's Analytical Tools and Gaps (April 5, 2023 SAAC)
Council's Analytical Tools: Proposed Changes (September 5, 2023 SAAC)

Council Presentations on Selecting New Tool
Recommendation for New Capital Expansion Model (September 12, 2023)
Revisit Staff Recommendation for OptGen Capital Expansion Model (October 11, 2023)

Recent Discussions of OptGen and SDDP
Differences between RPM and OptGen Part 1 (November 6, 2024 SAAC)
Differences between RPM and OptGen Part 2 (November 6, 2024 SAAC)
Differences between RPM and OptGen Part 3 (February 5, 2025 SAAC)
Methodologies for Developing a Reserve Margin (February 27, 2025 SAAC)

Information about PSR Software
https://psr-energy.com/software/optgen-8.2.html (OptGen documentation)
https://psr-energy.com/software/sddp-17.3.html (SDDP documentation)

Primer on Regional Strategy Analysis Toolset

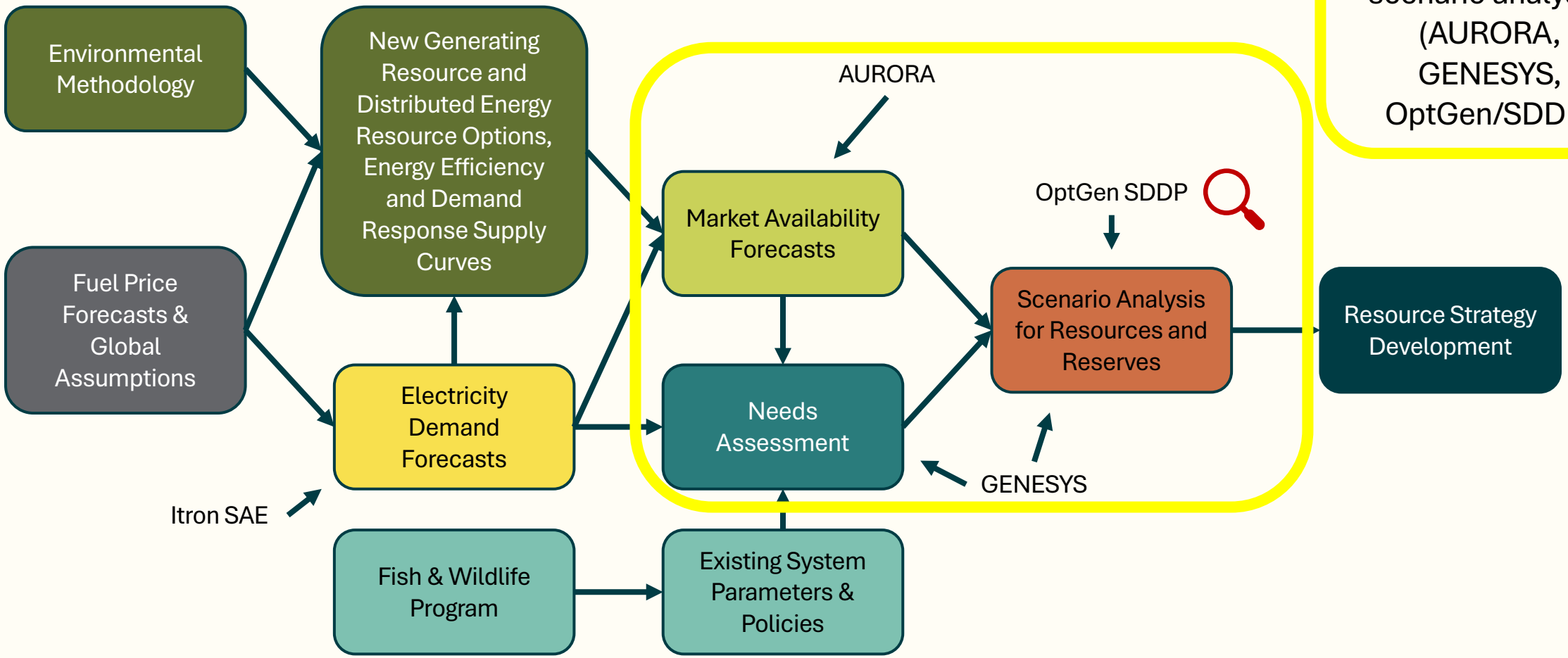
April 2025 Council Meeting

John Ollis

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

Power Plan Elements and Analytical Flow

All the power system models are used in tandem for scenario analysis. (AURORA, GENESYS, OptGen/SDDP)



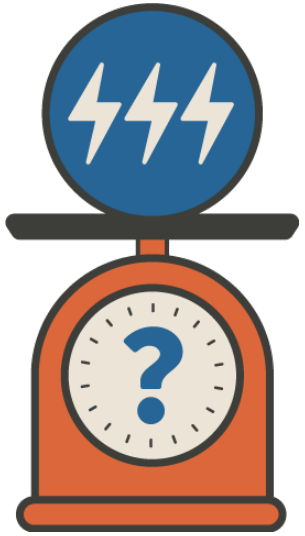
Agenda

- Planning Under Uncertainty
- Overview of OptGen and SDDP Modeling Capabilities
- Using Tools and Process to Assist Analytics

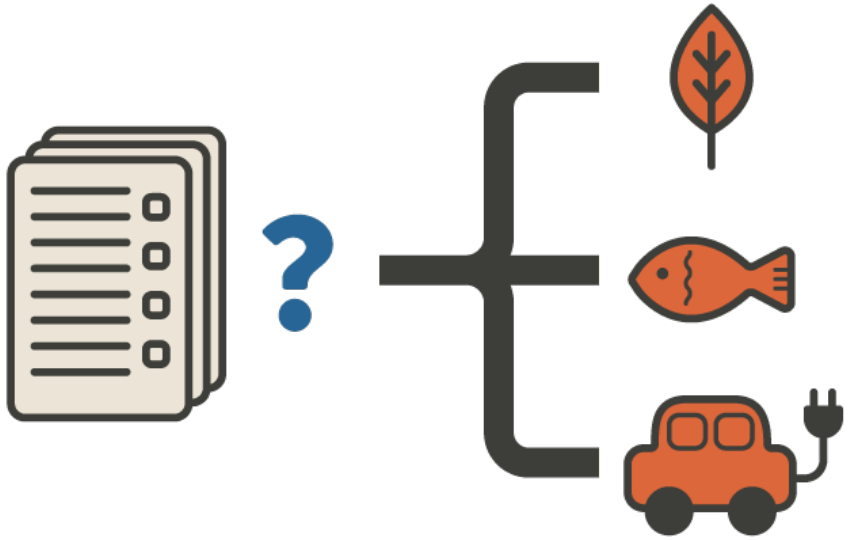
The need for power planning under uncertainty

- Council created in response to a significant misjudgment in energy needs; resulted in a cost burden the region still bears today
- Revisit the power plan every 5 years
- The pace of transition to a new energy mix brings up a question:
  Will energy be available when we need it?

Planning for uncertainty



Load uncertainty
How much energy will we need at any given time?

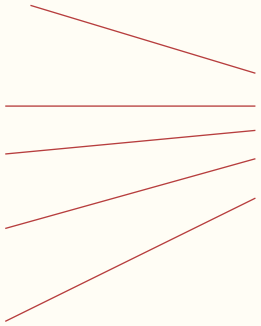


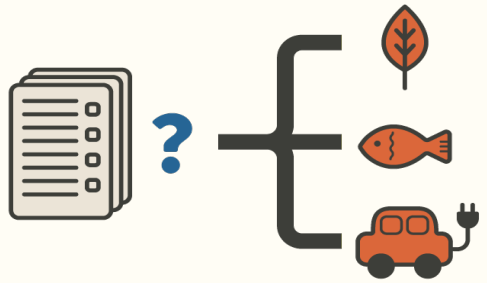
Policy uncertainty
Where are policies going, how to meet them and how might that impact the energy needs or choices?

Supply uncertainty
Will the energy supply be there when we need it?

Modeling Different Futures in the Capital Expansion Modeling

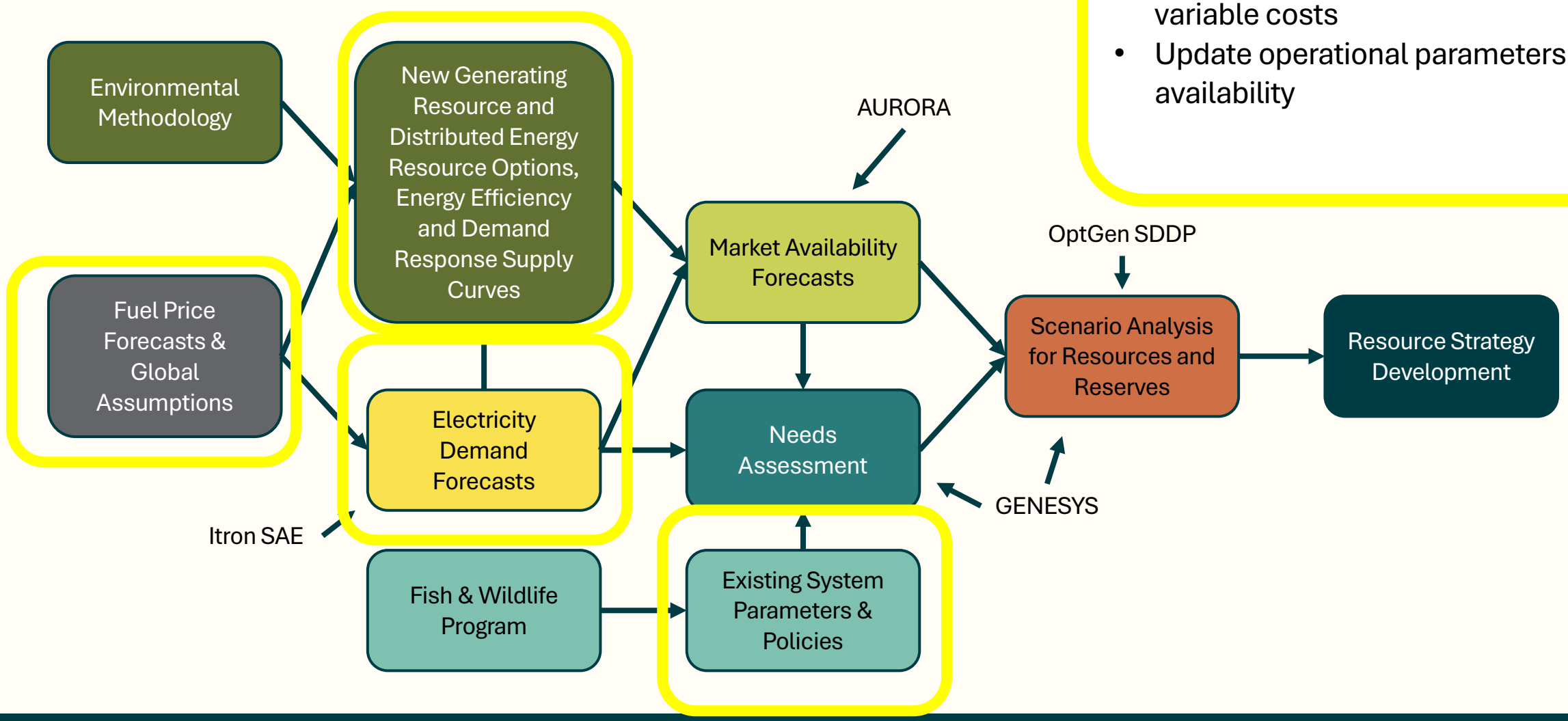
- We use ***futures*** to represent sources of risk to which the regional power system is subjected, and that we may use to test regional resource strategies over a particular policy scenario of interest.
- A capital expansion model future represents the sources of uncertainty including the following:
  1. **Weather Normalized Loads**
  2. **Hydro Conditions**
  3. Renewable Generation Availability
  4. Natural Gas Prices
  5. Electricity Prices/Market Availability





Each scenario tested over all the futures!

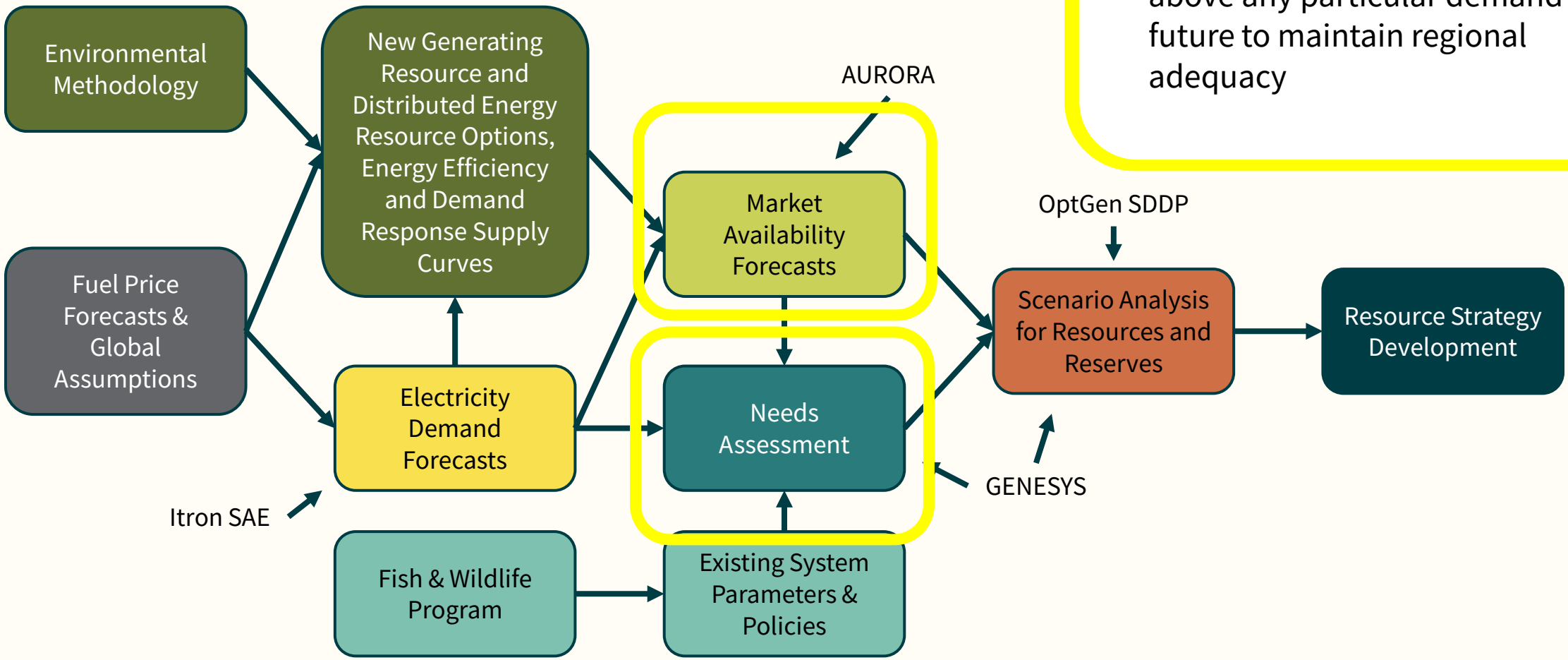
Council's OptGen/SDDP Setup: Data Updates Part 1



Update New Resource Parameters

- Update new resource fixed and variable costs
- Update operational parameters and availability

Council's OptGen/SDDP Setup: Data Updates Part 2



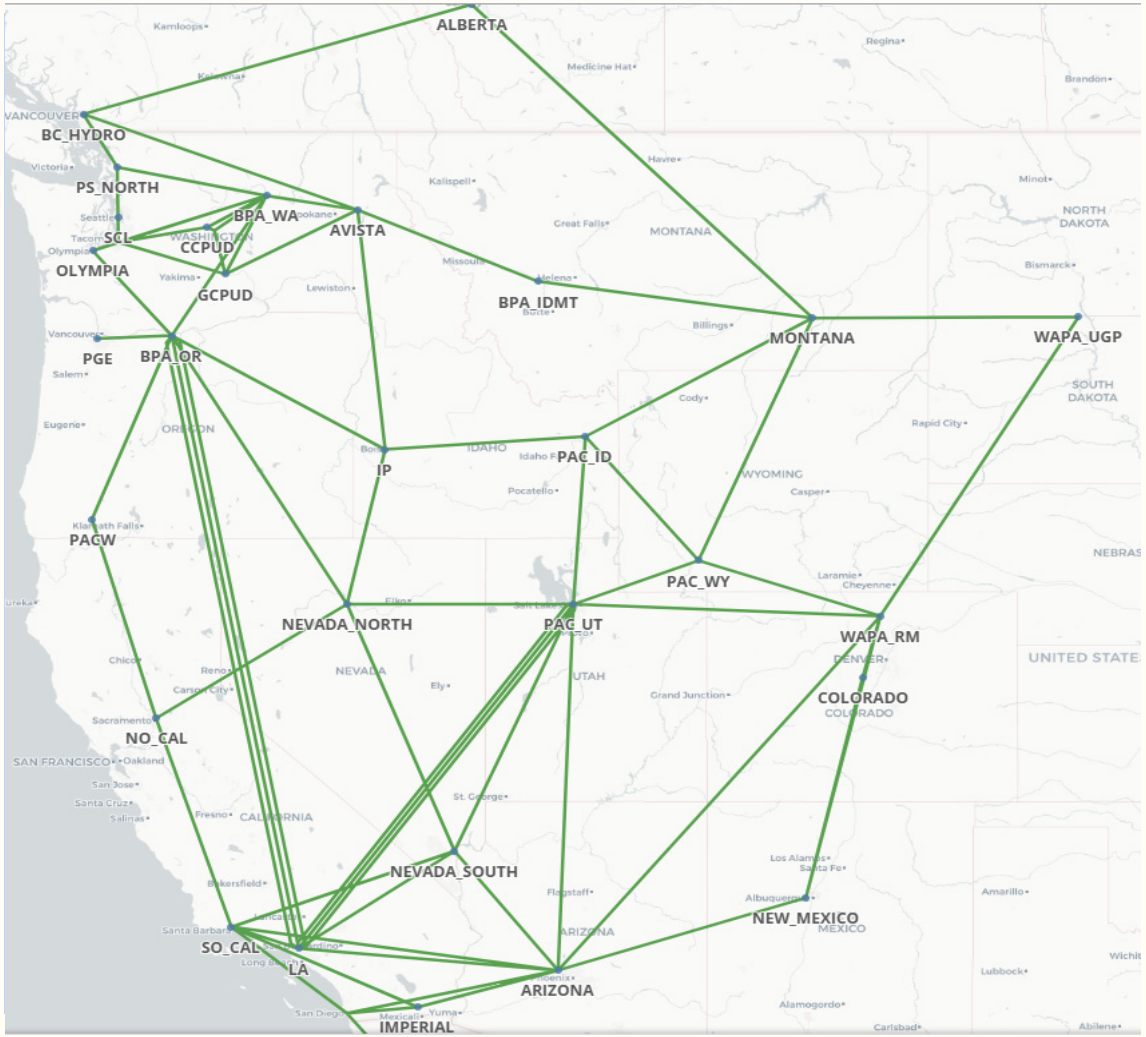
Needs Assessment

- Incorporate needs via reserve margins to represent the additional resource need over and above any particular demand future to maintain regional adequacy

Council's OptGen/SDDP Setup:
Solving for a Regional Strategy Within the Context of the WECC

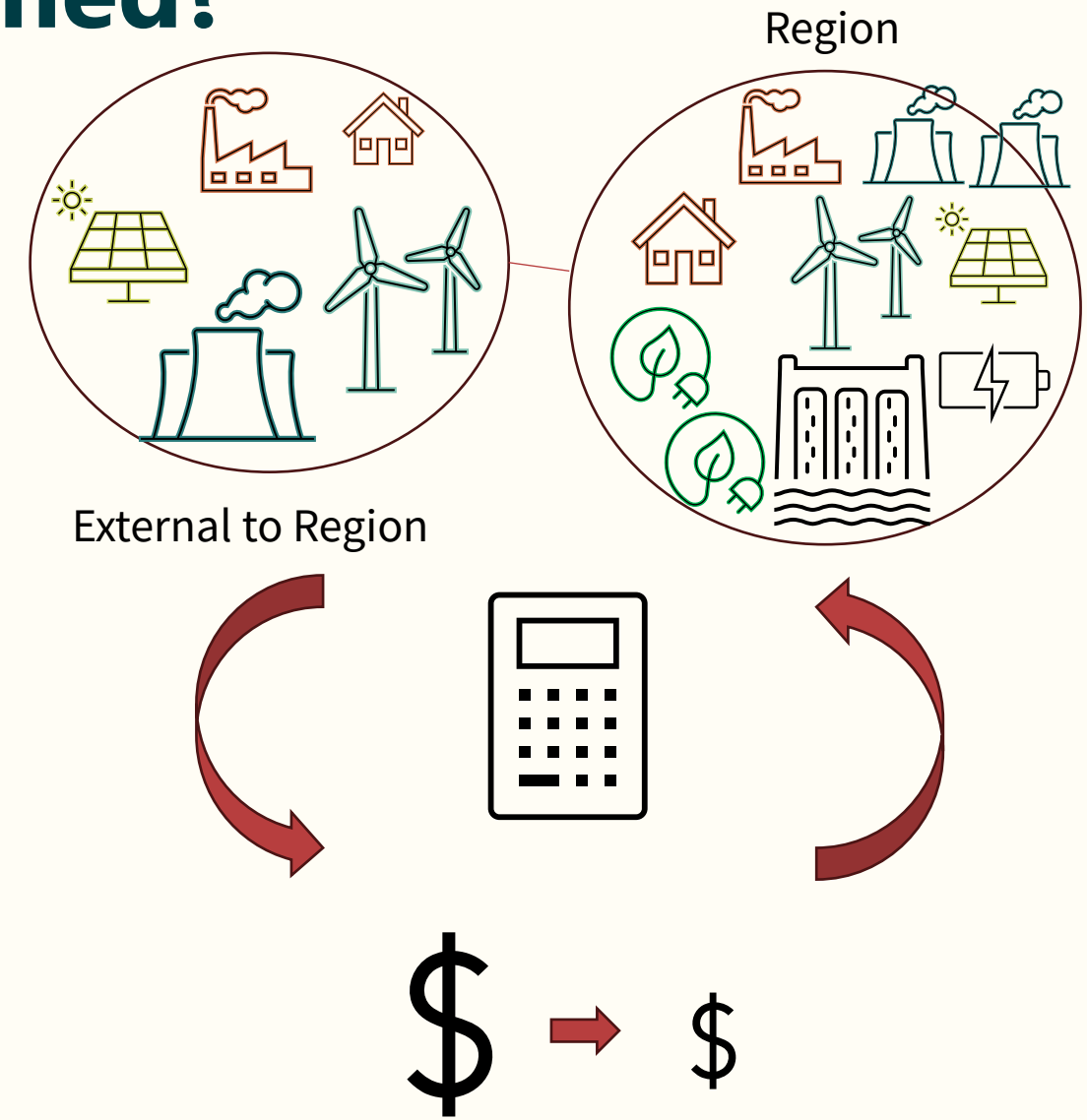
Capital Expansion in OptGen and Production Cost Modeling in SDDP

- Uses a simplified zonal (transport) representation of the wholesale power transactions for the western electric grid
- Each **zone** represents a **set of demands** and the **set of generation (supply)** that can meet that demand without incurring additional wheeling charges or transmission losses.
- Each **line** represents a **cumulative available transfer** between the zones, often associated with path ratings



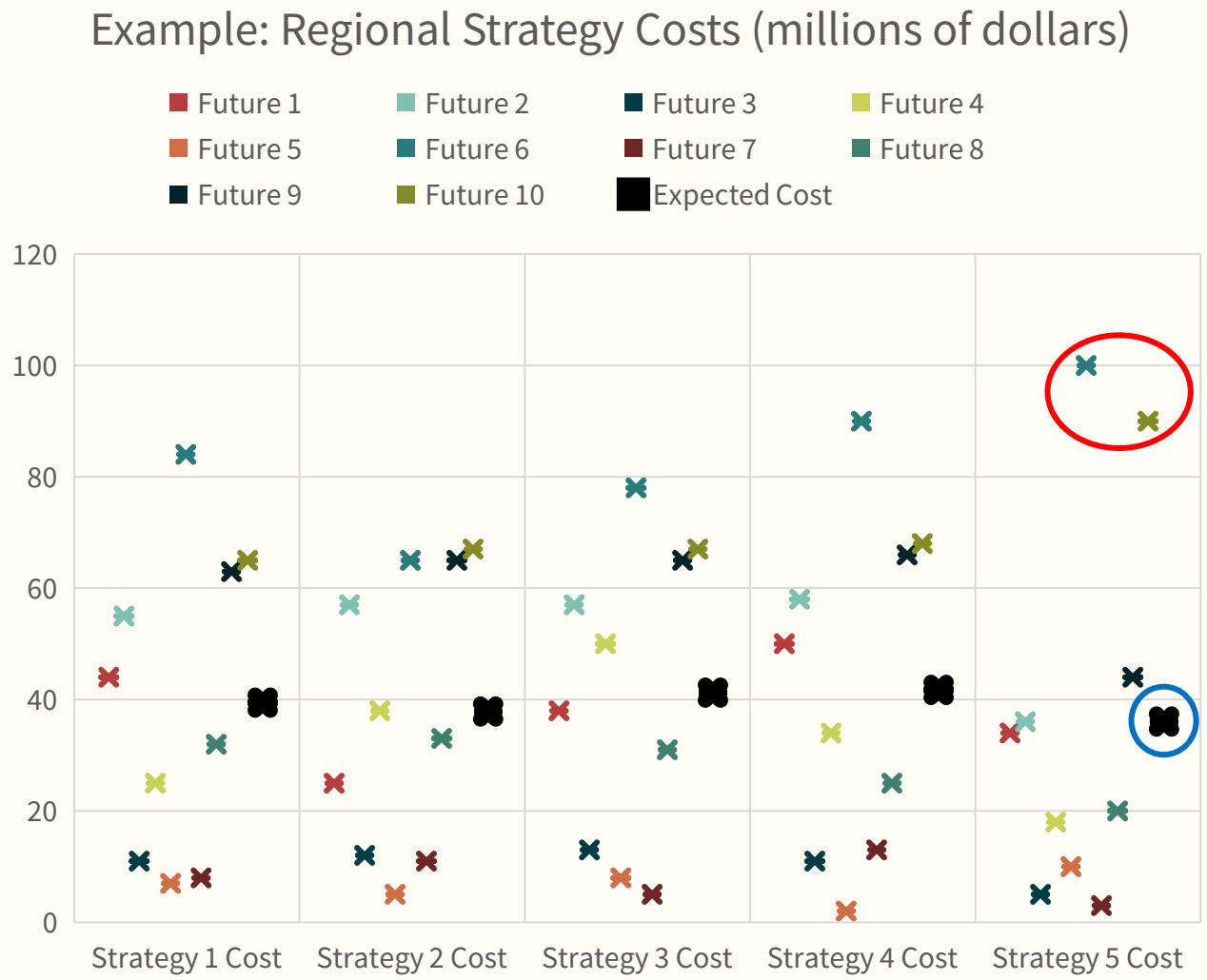
How is The Study Performed?
Least Cost Buildout

1. Simulate a set of capital investment decisions (new resource acquisitions) throughout the **region only**.
   - External to the region investments will be fixed per the results of the market availability study
2. Calculate the total fixed and variable costs of those decisions.
   - While we are only are allowing the model to choose regional resources, we are still simulating the all the net market transactions and operations of resources in the WECC over 20 years.
3. OptGen/SDDP iterates until finding the set of capital investment decisions **for the region** that have the least costs over all futures over the 20 years.

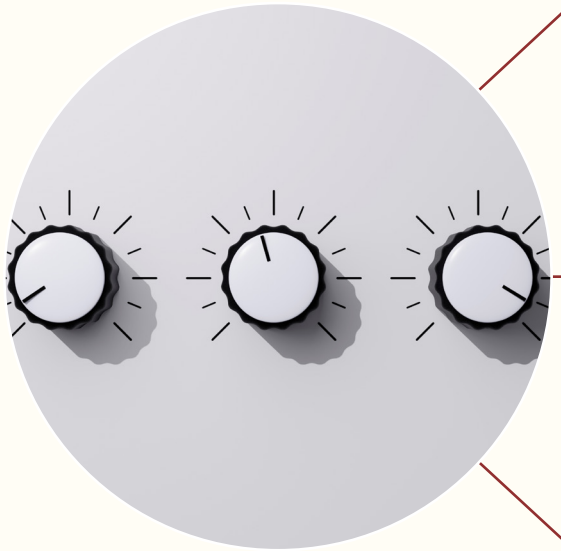


Evaluating Portfolio Costs Under Uncertainty

- The capital expansion within the region is optimized to minimize expected net present value over all the futures.
  - We can also evaluate the expectation of the highest cost futures (## percentile) to understand the risk of high-cost futures associated with particular strategies. (Conditional Value at Risk ##, often written CVAR##).
  - Note that in the example, the CVAR80 of Strategy 5 is 95 million dollars is the average of the 2 highest cost futures out of 10 possible futures, Strategy 5 has the lowest expected cost over all the futures.



Buildout Results, What Matters?



Economics of supply and demand

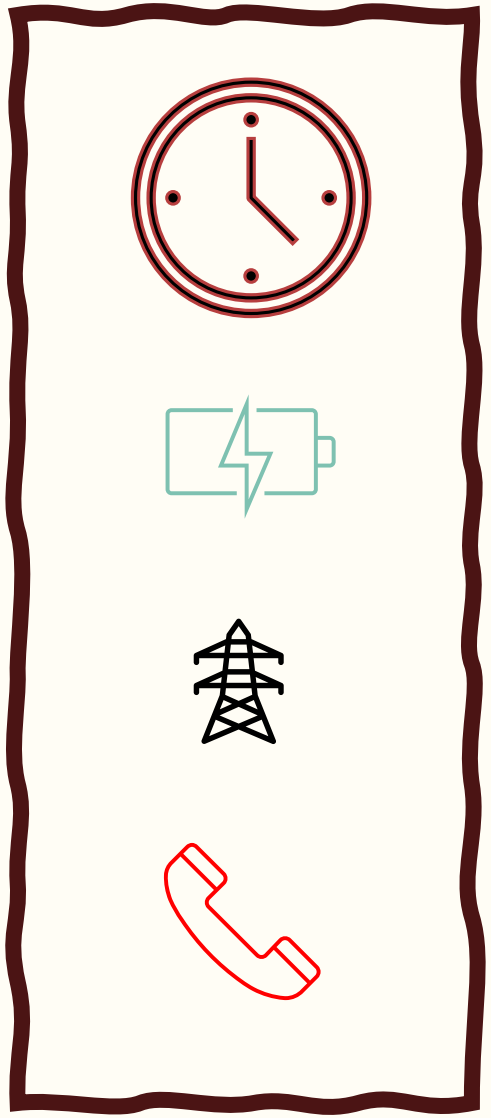
- Availability of VER and hydro generation and coincidence with demand
- Demand magnitude and shape
- Fuel price magnitude

Adequacy

- Availability of VER and hydro generation and coincidence with demand
- Demand magnitude and shape

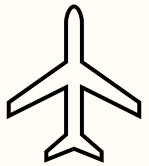
Policy obligations

- Annual availability of VER and Hydro
- Annual demand magnitude
- Magnitude of dispatch of emitting resources



Disruptive Elements

Review: Proposed Plan Scenarios and Analysis



Priority Scenarios

New Resource and Transmission Risk Scenario

Broad scenario to explore uncertainty around resource availability, resource costs, and transmission availability

Hydro Operations Flexibility Scenario

Exploring the implication for resource needs with varying hydro operations impacting the flexibility of the hydro system

Other Analytical Interests

Extreme Weather Analysis

Include extreme weather futures across all scenarios and using the results for focused exploration of this risk area

Load Growth Uncertainty Analysis

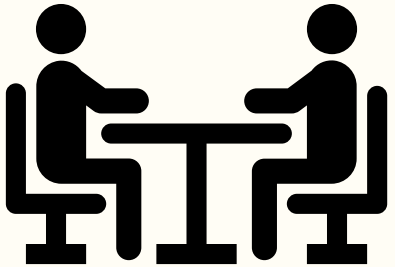
Include high load futures across all scenarios to inform risks of this uncertainty (including data centers, decarbonization loads, etc.)

Note: After more staff discussion, our proposal is to ensure appropriate model tuning to reflect other elements of operational flexibility

Key Enhancements to Discuss With Stakeholders in System Analysis Advisory Committee (SAAC)

Main improvements since 2021 Power Plan:

1. **Dynamic Probabilistic Reserve Requirement** (Q2 SAAC)
   - Represent changing reserve requirement over time due to magnitude, type and placement of VERs
2. **Typical Days Sampling** (Q2 SAAC)
   - More strategic simplification while still representing resource attributes
3. **Energy Limited Resources Modeling** (Q2/Q3 SAAC)
   - Hydro and storage resources
4. **Locational Value of Resources** (Nov 2024 and Q3 2025 SAAC)
   - Transmission topology and availability



Questions

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Planning Challenge During Energy Transition: *Maintaining Adequacy While Meeting Policies*

Fuel Diversity

- Is the fuel on-call and always available?

- If not, is the fuel available at a different time?

Locational Value

- Does the resource make good use of existing infrastructure/transmission requirements to serve load?
- Does the resource defer or replace additional infrastructure/requirements?

Either

Both

Meet Policies

- Is the resource non-emitting or qualify as renewable energy?

- Does it shift or reduce curtailment of qualifying energy?

Caveat: For this discussion all of these attributes are generalized. Any particular resource may or may not have these attributes.

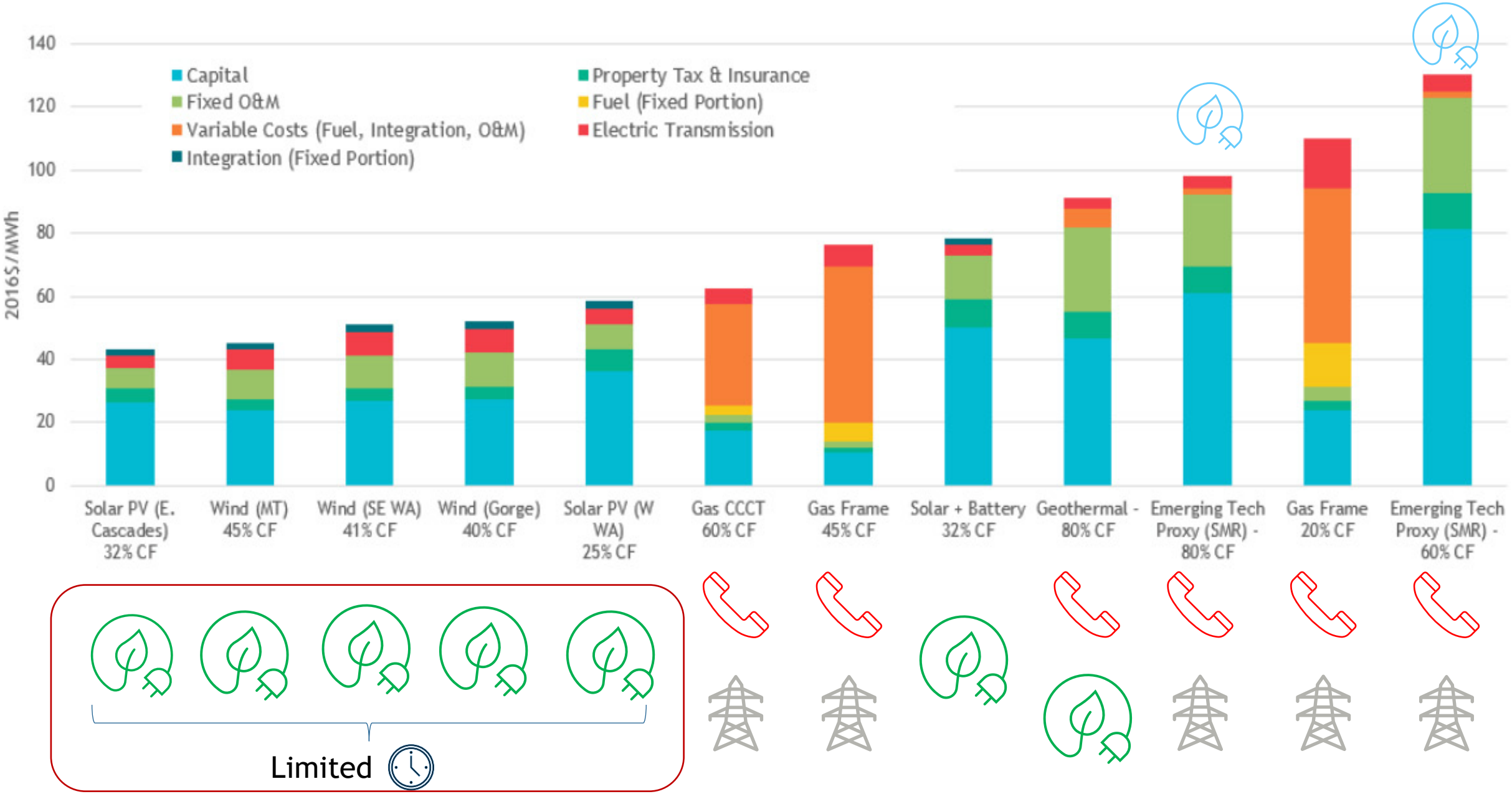
Leveraging The Existing Generation Wisely

Existing Hydropower Resources

- Shifting use of the existing hydro system will likely defer the need in the region for emerging resources
- Can be used for meeting policies and/or for integrating other resources that meet policy
- Very difficult to build new hydropower resources

Existing Thermal Resources

- Shifting use of the existing thermal system will likely defer the need in the region for emerging resources
- Can be used to integrate other resources that meet policy
- Very difficult to build new coal and gas resources


140
120
100
80
60
40
20
0
2016$/MWh
Capital
Fixed O&M
Variable Costs (Fuel, Integration, O&M)
Integration (Fixed Portion)
Property Tax & Insurance
Fuel (Fixed Portion)
Electric Transmission
Solar PV (E. Cascades) 32% CF
Wind (MT) 45% CF
Wind (SE WA) 41% CF
Wind (Gorge) 40% CF
Solar PV (W WA) 25% CF
Gas CCCT 60% CF
Gas Frame 45% CF
Solar + Battery 32% CF
Geothermal - 80% CF
Emerging Tech Proxy (SMR) - 80% CF
Gas Frame 20% CF
Emerging Tech Proxy (SMR) - 60% CF
Limited

What Should Be Considered for Planning?

The stand-alone cost may be high or uncertain, but the portfolio benefit of adding resources has the potential to be high.

1. Only considering the current commercial resource types may result in a less efficient, higher cost and riskier power system.
2. The cost and availability may become more certain over the next few years.

Resource Type	Cost	Availability	Attributes
"Clean" Peakers	Uncertain	Uncertain	
Small Modular Reactors	High/Uncertain	Uncertain	
Offshore Wind	High	Timing Uncertain	
Utility Scale Storage (long duration)	Uncertain	Now	
Distributed Storage	High	Now	
Emerging Tech EE	Uncertain	Uncertain	
Emerging Tech DR	Uncertain	Uncertain	
Transmission Upgrade/Add	High/Uncertain	Uncertain	
Coal to Gas Conversion	Medium	Limited