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

September 6, 2023

MEMORANDUM

TO: **Council Members**

FROM: **John Ollis**

SUBJECT: **Recommendation for New Capital Expansion Model**

BACKGROUND:

Presenter: John Ollis, Manager of Planning and Analysis

Summary: Staff will present on the capabilities of Council and available alternative tools to support regional portfolio modeling going forward. The presentation will include a recommended change in approach that will enable the improvement of the Council's analytical capability in the lead up to the next power plan.

During Council business, staff is seeking authorization to contract with PSR to renew the GENESYS license, continue maintenance and technical support, and add the OptGen module. It is this last piece, the OptGen module, that is core to this discussion with the Power Committee and staff's recommended approach. Staff is seeking a head nod from the Power Committee in advance of the Council decision.

Relevance: While model enhancements allowed for completion of the 2021 Power Plan using the current model and modeling infrastructure, staff has identified considerable gaps in the current capability and scope of the Regional Portfolio Model (RPM) in exploring the risks faced by today's power system.

In April and September of 2023, staff engaged with the System Analysis Advisory Committee to discuss the perceived gaps of the model and found many throughout the region struggling with similar issues in maintaining the long-term analytical support for their respective organizations. Whether it be modeling the structure of changing markets, understanding locational value due to transmission limitations, or appropriately representing the attributes and economics around new resource types, most regional entities are changing the ways they consider the tools used to support long term integrated resource planning. Per those discussions and staff's research a recommendation of a path forward will be presented with enough lead time before the next power plan to continue to explore, and when needed develop, methodologies to assess risk and familiarize the advisory committees and other council stakeholders.

Workplan: B.1.2 Tool Enhancement: Explore new capital expansion modeling approach to provide better optimization for future power system 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, is 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 uses 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.

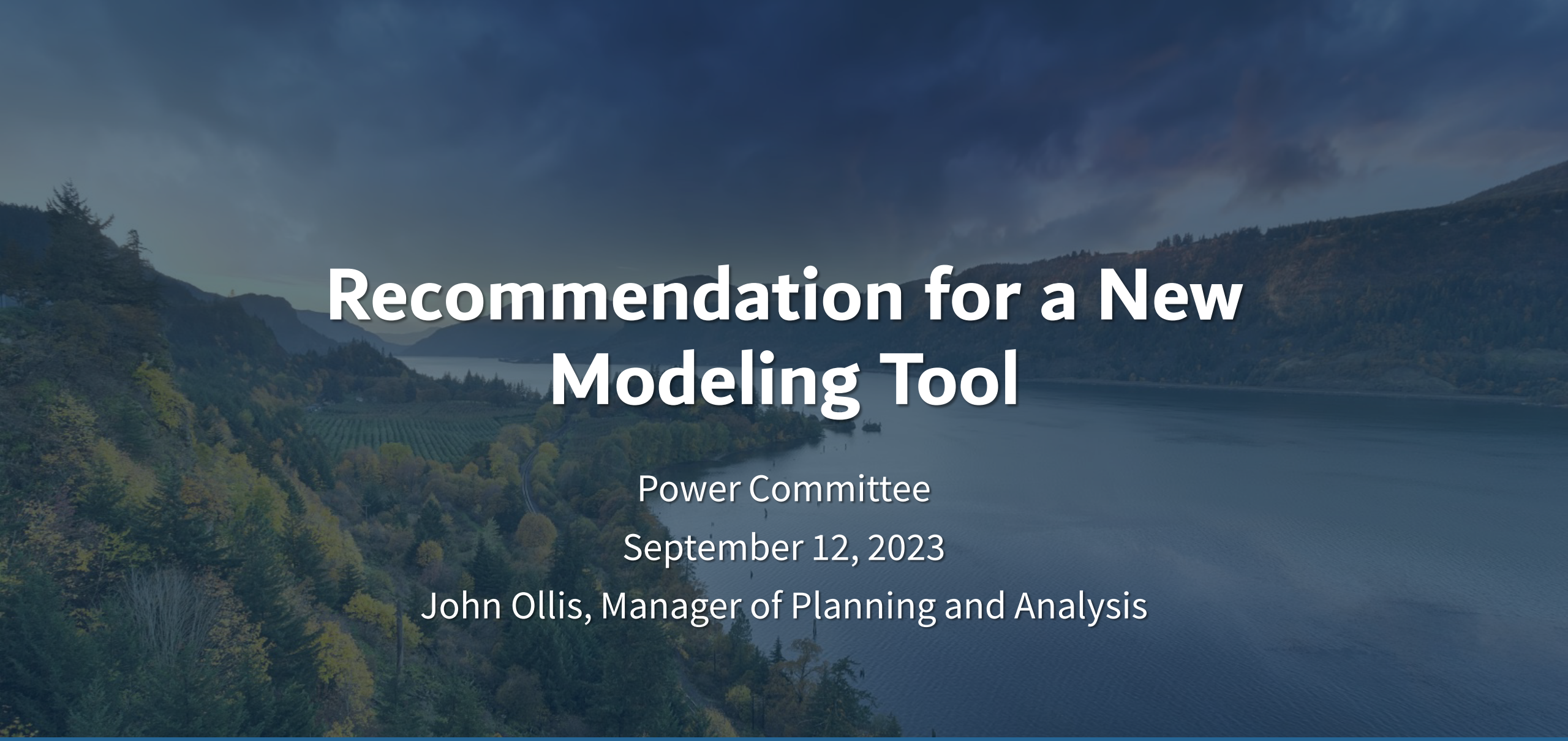
While in past plans the RPM has been used successfully as the primary analytical tool for understanding strategy tradeoffs, in the 2021 Power Plan, many of the previous assumptions that made its underlying structure convenient and efficient for understanding regional risks were challenged. Through the 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.

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)



Recommendation for a New Modeling Tool

Power Committee

September 12, 2023

John Ollis, Manager of Planning and Analysis

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

Planning for a road trip. Hoping to do a little camping on the way…

The old road trip car needs some engine work…

This Photo by Unknown Author is licensed under CC BY-SA

?

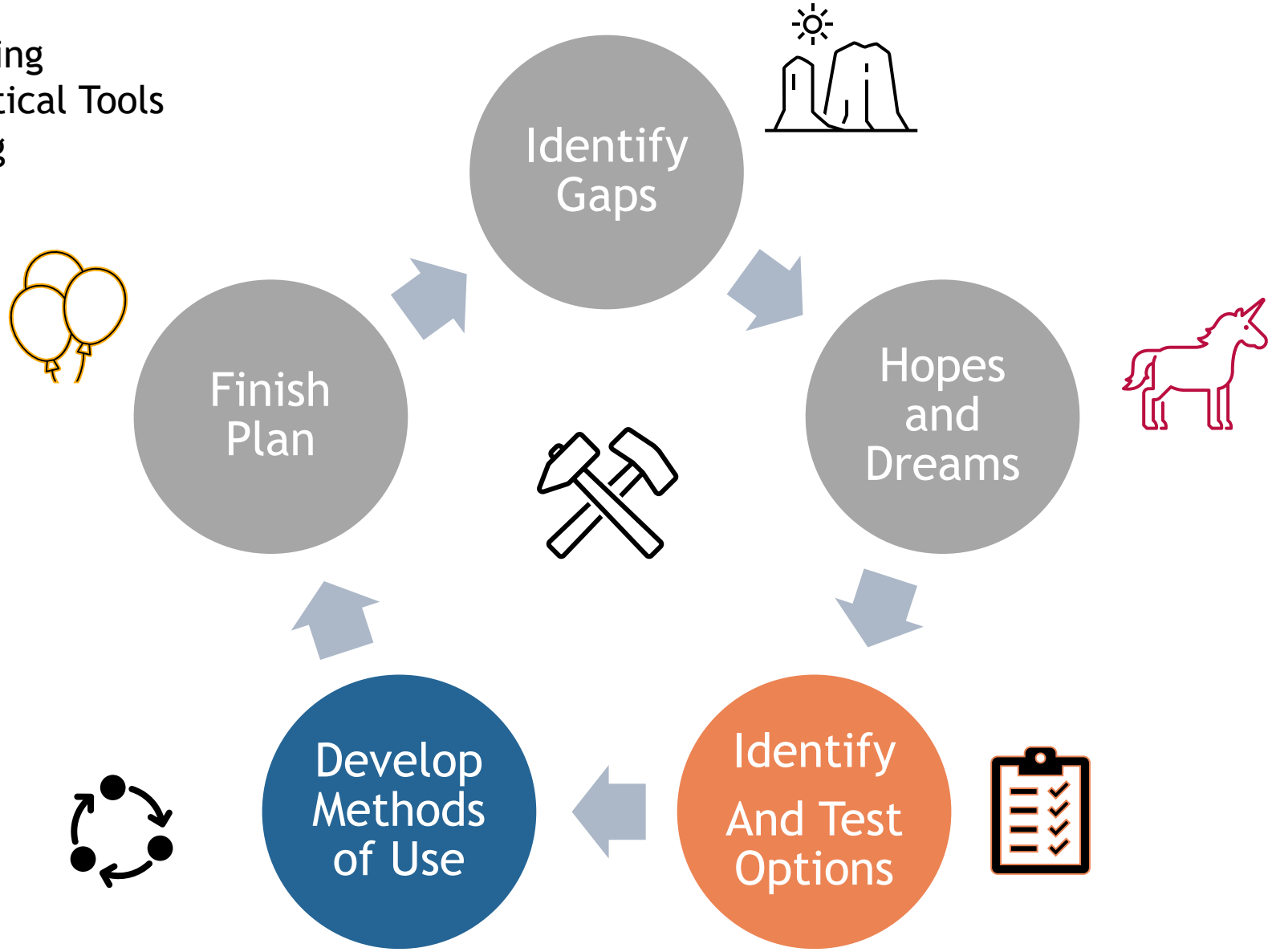
This could work but not quite big enough to camp. May have stay in more hotels.

This Photo by Unknown Author is licensed under CC BY-SA

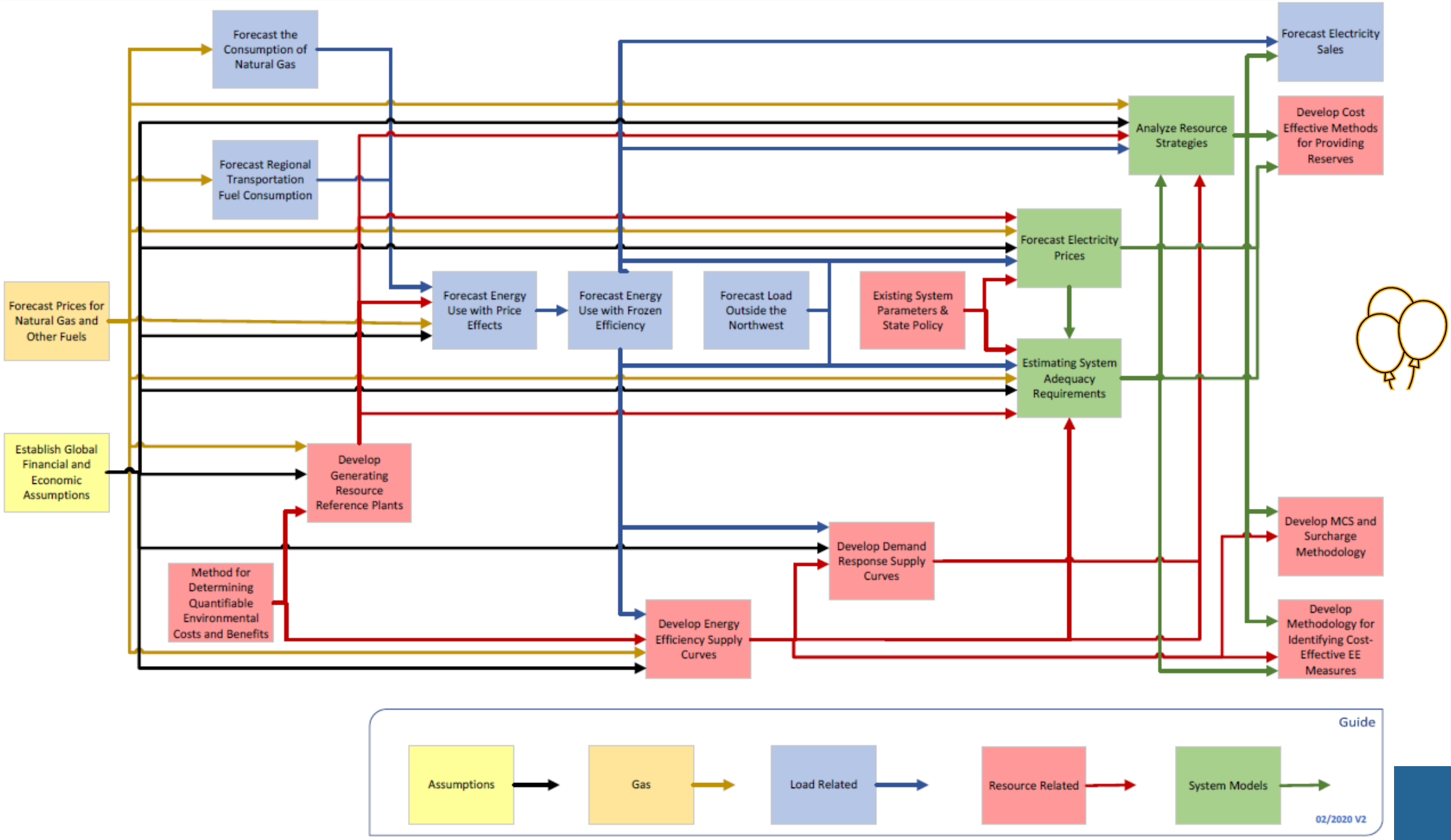
Get a new vehicle with lots of new features that should be great for camping but has unknown challenges.

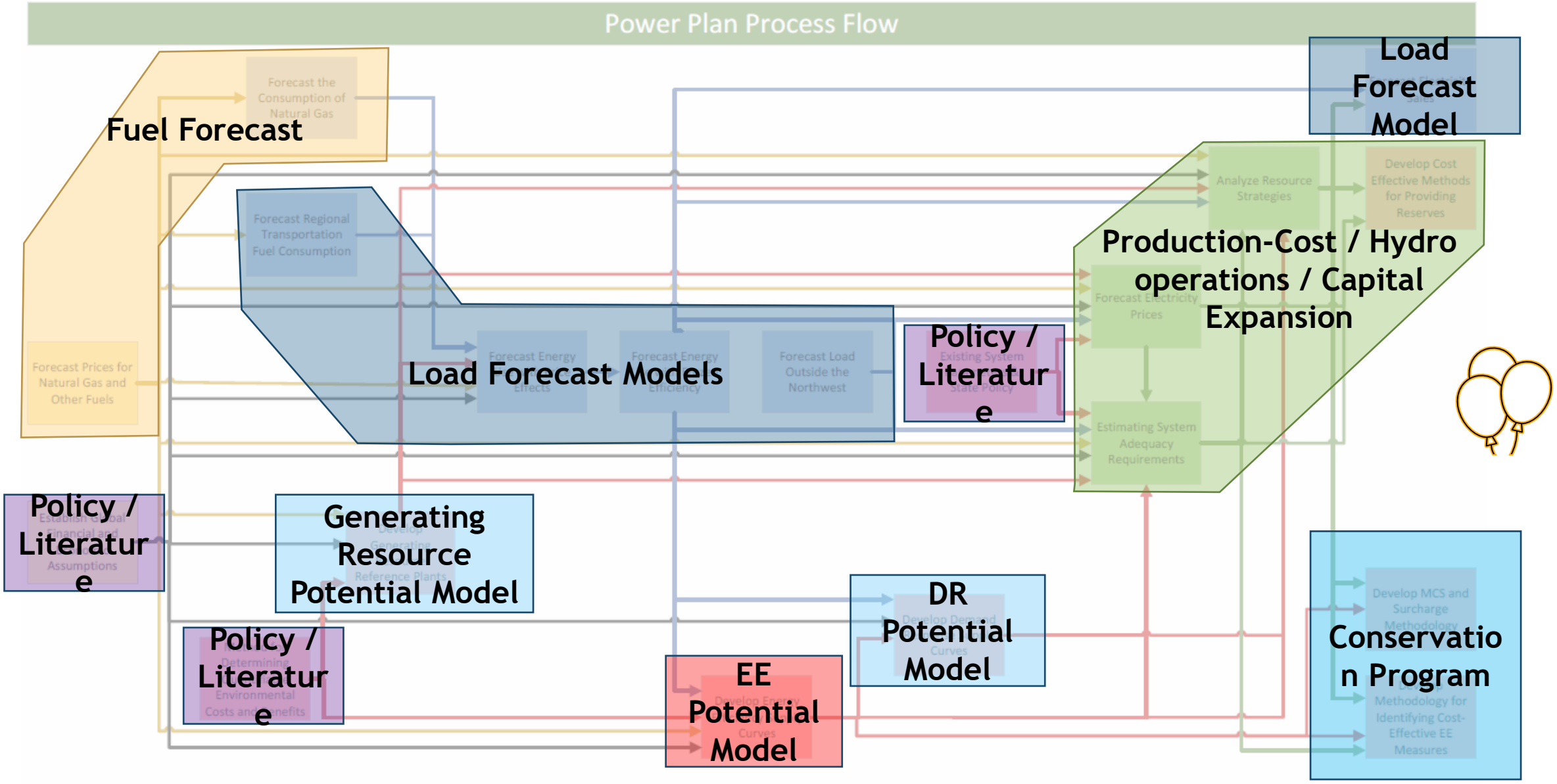
Keep what we know and fix it, not knowing if something else might break.

Cycle of Determining Appropriate Analytical Tools for Power Planning

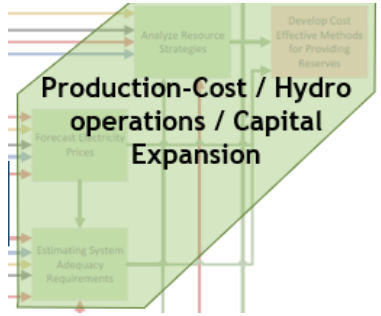


Power Plan Process Flow



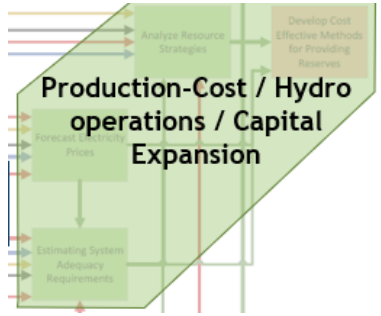

Power Plan Process Flow
Fuel Forecast
Forecast the Consumption of Natural Gas
Forecast Prices for Natural Gas and Other Fuels
Load Forecast Model
Forecast Regional Transportation Fuel Consumption
Load Forecast Models
Forecast Energy Effects
Forecast Energy Efficiency
Forecast Load Outside the Northwest
Policy / Literature
Existing System State Policy
Production-Cost / Hydro operations / Capital Expansion
Analyze Resource Strategies
Develop Cost Effective Methods for Providing Reserves
Forecast Electricity Prices
Estimating System Adequacy Requirements
Policy / Literature
Assumptions
Generating Resource Potential Model
Reference Plants
Policy / Literature
Environmental Costs and Benefits
DR Potential Model
Develop Demand Curves
EE Potential Model
Develop Energy Curves
Conservation Program
Develop MCS and Surcharge Methodology
Methodology for Identifying Cost-Effective EE Measures
Guide
Assumptions
Gas
Load Related
Resource Related
System Models
02/2020 V2

Model Ecosystem Considerations

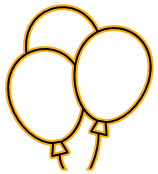


- Discussion today focused primarily on the following:
  - **Production Cost Modeling**
    - Power system tool that simulates the operations of the power system given a set of resources and optimize operations per physical, contractual and policy limitations to produce the lowest variable cost outcome.
    - Usually requires assumed capital expansion if simulating fundamentals of future systems
  - **Capital Expansion/Portfolio Optimization Modeling**
    - Power system tool that simulates the optimal investment in the whole or part of the power system given a set of resources, loads, desired adequacy levels and policy and physical system constraints.
    - Usually significantly simplifies system operation for investment decision

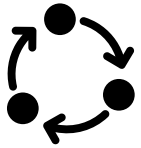
Analytical Deliverables Using Power System Models



- Power Plan
  - Approximately every 5 years
  - Comprehensive update of parameters and inputs
  - ***Regional Strategy Analysis***
  - ***Needs Assessment***
  - ***Wholesale Market Price and Avoided Emissions Rate Analysis***

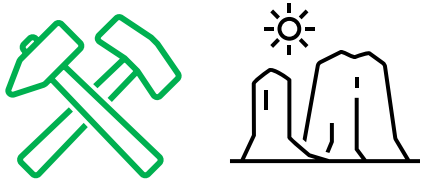


- Annual Assessments
  - Approximately every year as a check on the regional strategy in the plan
  - Piecemeal update of parameters and inputs
  - *Fuels Forecast*
  - *Load Forecast*
  - ***Adequacy Assessment***
  - ***Wholesale Market Price and Avoided Emissions Rate Analysis***



- *One-off Studies*
  - ***Hydro Flexibility***

Regional Hydro Operations, Needs and Adequacy Assessments: *GENESYS*



Use Case

- Production cost and detailed hydro operations model for plan work and annual studies

Vintage

- Redeveloped between 7th Plan and 2021 Plan

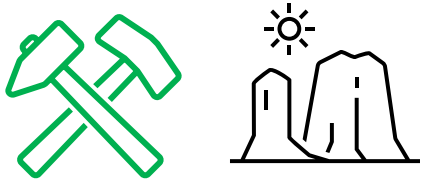
Pros/Growth opportunities:

- Currently, models the regional resources in detail, could model all the WECC resources in detail (could produce electricity prices and emissions rate forecast in future in conjunction with west wide capital expansion model)
- Currently models zonally, could model nodally (transmission fidelity)
- Currently models only Columbia basin hydro in detail, could model WECC hydro

Gaps/Limitations:

- **Significant work required to validate hydro operations**
- **Significant work to keep run time down and maintain appropriate fidelity on system operation**

Wholesale Market Price and Emissions Rate Studies: *AURORA*



Use Case

- Capital Expansion and Production Cost model for plan work and annual studies

Vintage

- Enhanced via vendor upgrades, local infrastructure setup well to deliver work products

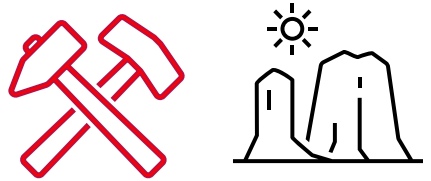
Pros/Growth opportunities:

- Easy to modify to needs, lots of modeling flexibility
- Could expand current risk modeling fairly easily using portfolio modeling needs
- Great regional user community
- Models policies and all new generating and existing resources in detail well, many options for resource modeling.

Gaps/Limitations:

- **Does not model hydro resources well enough for all Council use cases without the guidance of a more nuanced hydro operations model**
- **Difficult to enhance outside of vendor priority**
- **Updates on regional database require significant validation**
- **Significant work to keep run time down and maintain appropriate fidelity on system operation**

Regional Capital Expansion Modeling: *Regional Portfolio Model*



Use Case

- Capital Expansion and Portfolio Modeling for plan work

Vintage

- Created for the 5th Plan, redeveloped between 6th and 7th Plan and enhanced for 2021 Plan

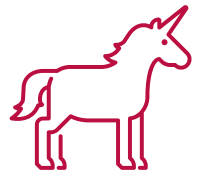
Pros/Growth opportunities:

- Good contractor expertise allows for expedited enhancements
- Could expand current risk modeling fairly easily

Gaps/Limitations:

- **Does not model current market interactions well enough to distinguish all cost/values of resources (economics)**
- **Does not model current power system well enough to distinguish all cost/values of resources (policy accounting, consistency with adequacy)**
- **Does not solve the current solution space without massive analyst time in preparation and operation, would require significant enhancement or time to remedy**

Compiled Hopes and Dreams Coming Out of 2021 Power Plan (Council Staff)



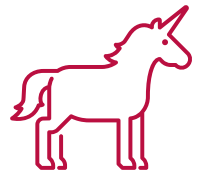
Want future modeling to better capture the following:

- Limitations to flexibility of existing system resources
- DER and storage value streams
- Consequences of additional reserve requirements
- Changing market, transmission and policy implications
- Emerging tech implications
- Better understand net coincident peak load impacts
- BPA portfolio
- Resiliency

Will require the following input improvements:

- Location specific information on loads and resources
- Higher fidelity shape information on loads and DERs.

Compiled Hopes and Dreams Coming Out of 2021 Power Plan (April SAAC Meeting)



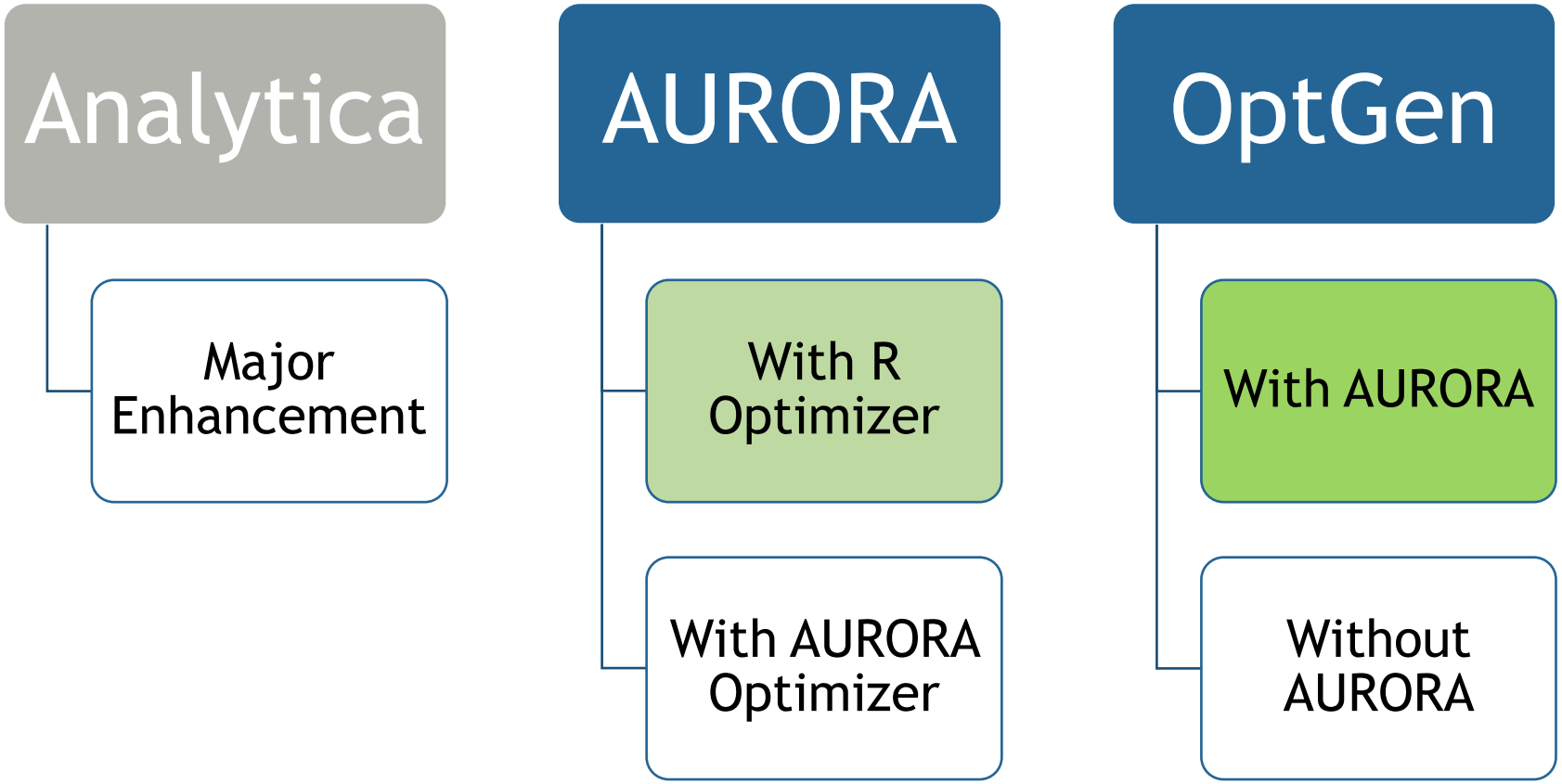
Mentimeter

Which aspects of the Council's capital expansion modeling need improvement?

Most Issues Can be Addressed by Adding Two Main Modeling Functionalities

Functionality	Existing System Flexibility	DER and Storage Value	Increasing Reserve Reqts	Markets, Transmission and Policy	Emerging Tech	Net Coincident Peak load	BPA Portfolio
Zonal Transport Topology by Balancing Authority	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Sample daily shape by month of load and resource behavior	Yes	Yes	Yes	Yes	Yes	Yes	

Proposed Strategies for Next Plan



All options shaded blue have zonal transport modeling by balancing authority and more granular representation of load and resource behavior (sample day by month)

Implications of Not Changing Model Ecosystem

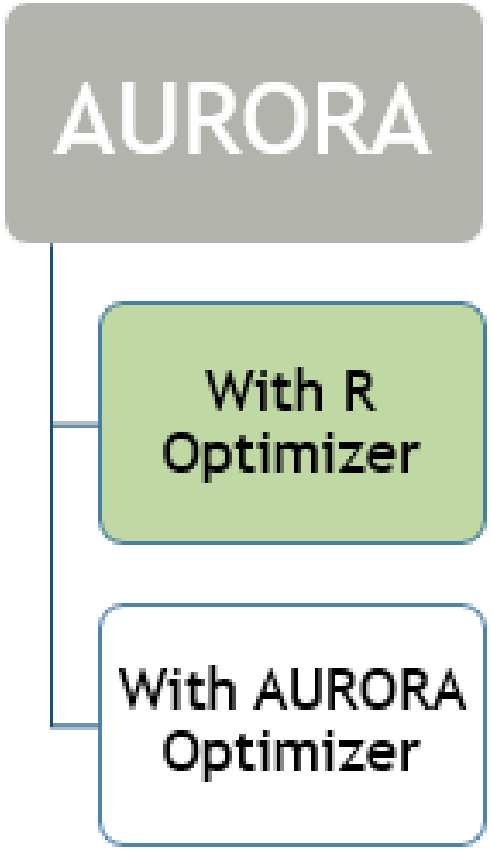
- Pros
  - Customizable, familiar, flexible and transparent.
  - Built around modeling value streams of EE
  - Advanced risk modeling
  - Optimization is dynamic with capital expansion
  - Agent based modeling is a good representation of planning under uncertainty
- Cons
  - Bespoke data requirements and dated optimization formulation caused increased staff time, slower scenario work turnaround time.
  - Does not currently delineate value streams of non-EE resources as well as EE(especially energy limited resources storage, DR)
  - Does not currently delineate locational value of resources as well as a transport model
  - No other utilities in the region use for capital expansion
  - Needs external hydro modeling to capture NW hydro variability
  - **Significant redevelopment would likely delay preparation for the next plan**

Analytica

Major Enhancement

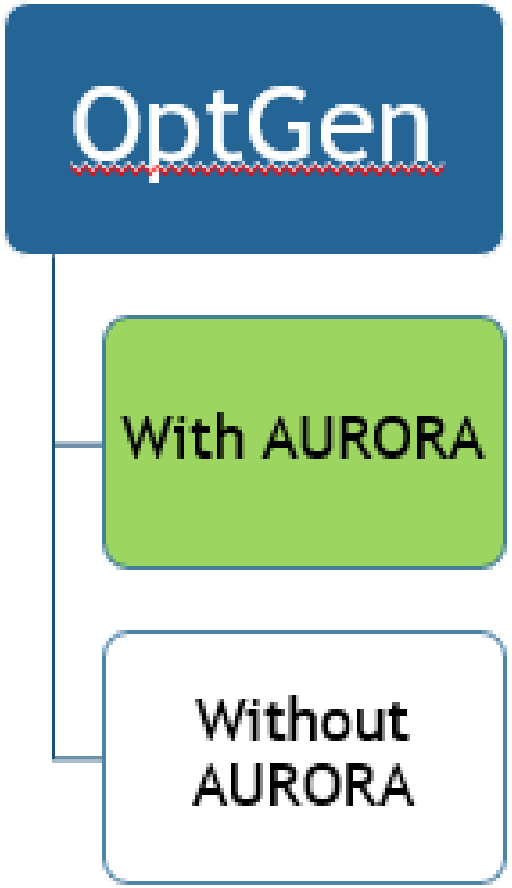
Implications of Dropping Analytica and using AURORA for Regional Capital Expansion

- Pros
  - Customizable, familiar, easy to use, flexible and fairly transparent.
  - Production cost, capital expansion and portfolio optimization all in one model
  - Can be parameterized to be fast
  - Detailed operations modeling helps model many resource types
  - Zonal topology explicitly captures locational value of resources
  - Many NW utilities use which helps buy in and validation
- Cons
  - Two-part portfolio optimization is not ideal for planning under uncertainty and may be limited
  - No agent-based modeling
  - Unwieldy risk modeling
  - Limited capability to model EE resources simply
  - Needs external hydro modeling to capture NW hydro variability

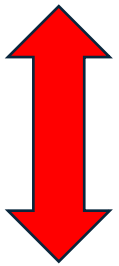


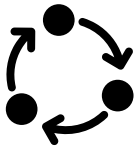
Implications of Dropping Analytica and using OptGen for Regional Capital Expansion and/or Production Cost Modeling

- Pros
  - Fairly customizable, flexible and transparent.
  - Can be parameterized to be fast and easy to use (same interface and data as GENESYS).
  - Production cost, capital expansion and portfolio optimization all in one model
  - Zonal topology explicitly captures locational value of resources
  - Detailed operations modeling helps model many resource types well, including hydro
  - Advanced risk modeling
  - Optimization is dynamic with capital expansion
  - Rolling horizon capital expansion for planning under uncertainty captures a similar aspect as agent-based modeling
  - Dynamic reserve requirement calculation
  - Option to replace AURORA long-term if it works
- Cons
  - Limited current capability to model EE resources simply
  - No NW user community
  - Without AURORA external to region model and data development may require significant testing and work for timely results



Proposed Analytics Approach for Next Plan





Primary Strategy

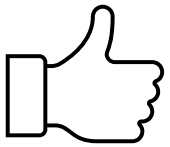
- **OptGen**
  - AURORA for markets
  - GENESYS for adequacy

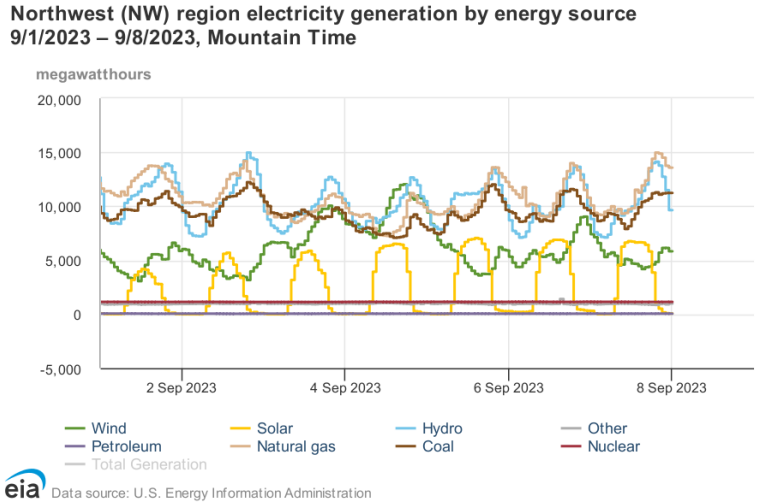
Backup Strategy

- **AURORA**
  - R for Portfolio Optimization
  - GENESYS for hydro operations and adequacy

September System Analysis Advisory Committee Meeting

- September 5th, 2023 meeting had a utility panel discussing modeling challenges.
  - Many utilities struggling with current tool sets
  - Many other utilities considering similar factors and using similar justifications to make tool changes.
  - Seems to be tacit support for the proposed two track approach





Proposal Summary:

Actions:

1. *Purchase OptGen this year*
2. *Drop Analytica next year*
3. *Maintain GENESYS and AURORA*

Similar cost now with a good possibility to reduce costs in the future

Two path process hedges against software implementation risks

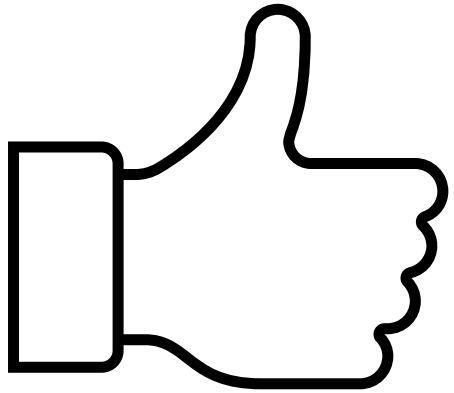
Faster computation via cloud computing and limited development requirements frees up staff for analysis

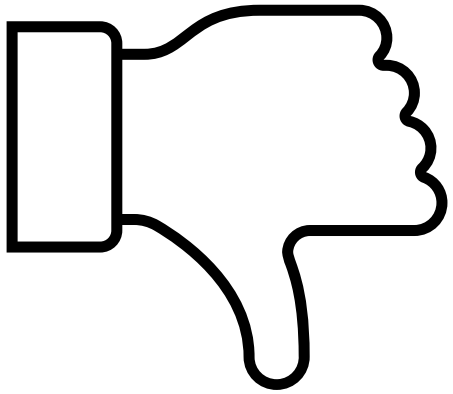
Increased functionality will improve analytics, while maintaining some of the most rare and valuable characteristics of the previous model

Seeking Power Committee Head Nod on Proposed Approach in Advance of Council Business Tomorrow

Is the committee supportive of the path suggested by staff?

Are there any further questions?





Questions

jollis@nwcouncil.org