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

August 9, 2022

MEMORANDUM

TO: **Power Committee**

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

SUBJECT: **Update on GENESYS Model Assumptions Refinement Process**

BACKGROUND:

Presenter: John Ollis

Summary: Staff has been undergoing an effort focused on revisiting assumptions to better understand the operating limitations of the Northwest hydro system. This effort was split into three parts.

The first part of this project was to document in detail all the known operating limitations and capabilities on the system represented in the GENESYS on a project-by-project basis. The second part is to holistically validate and interpret of the constraints within the context of the GENESYS model. The third part is vet the revised limitations and capabilities and review the simulated operations from GENESYS with operators, stakeholders and regional experts to prepare the model for the upcoming adequacy assessment and further work.

The first part of this project is complete, the second ongoing and the third part is upcoming in late August and September of 2022

Relevance: The GENESYS model is one of the major quantitative tools used to develop the Council's regional power plan and annual adequacy

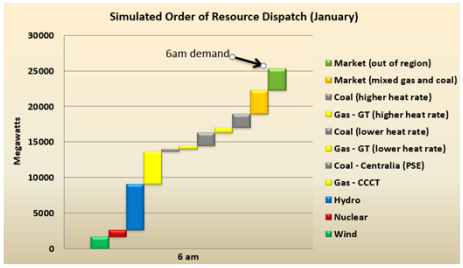
assessments. GENESYS is primarily used to assess the adequacy of the regional power supply, but it also provides hydroelectric system output to both the AURORA model and the Council's Regional Portfolio Model. In addition, GENESYS is used to validate that the power plan's resource strategy will produce adequate supplies. Because of the critical role that GENESYS plays in developing the Council's power plan, the model was evaluated and enhanced in the lead up to the 2021 Power Plan to improve forecasting reliability as well as to improve its data management capabilities and to make it less cumbersome to use.

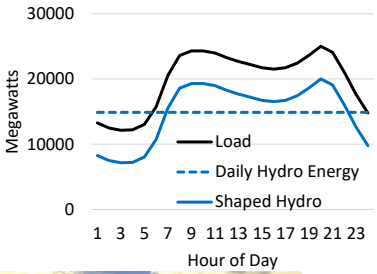
Background: Leading up to the plan staff had attempted to vet the GENESYS model and the underlying assumptions with stakeholders. Many of the assumptions were locked in early in the planning time period with not enough time to revisit them during the plan. As staff learned more about the actual system operations it became clear that some of those planning assumptions would need to be refined to better represent the hydro system operations on a project-by-project basis.

During the late stages 2021 Power Plan, there was limited capability and time to make drastic assumption changes in the model. However, it was deemed valuable during the plan to hold a technical workshop to walk through hydro system on a project-by-project basis with regional stakeholders. After the plan, an effort was made set aside time to revisit feedback from stakeholders and assumptions in the model on a more holistic basis to better understand limitations and capabilities of the regional hydro system.

More Info: GENESYS Technical Workshop

GENESYS Home Page



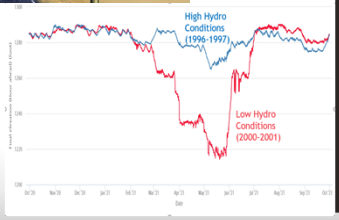


Update on GENESYS Model

August 16, 2022

Power Committee

John Ollis



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Past, Present and Future

Past
- Needed redevelopment to better address future energy system for power plan and beyond
- Regional stakeholders understood and accepted classic model

Present
- Development deadline for the plan
- Incorporate feedback from plan
- Regional stakeholders see value in model, but have questions about current assumptions

Future
- Further assumption improvements, enhancements and collaboration with experts
- Regional stakeholders understand and accept redeveloped model

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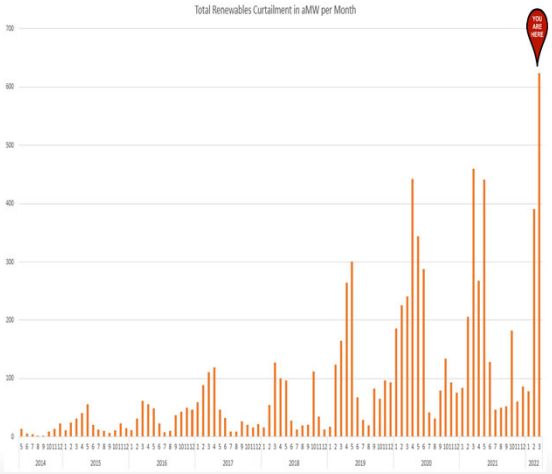
Where We Were (2016-2019)

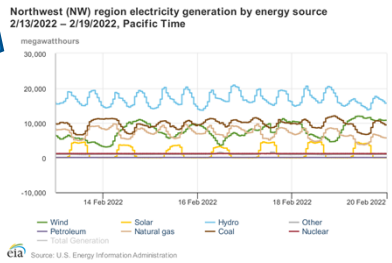
- Seventh Power Plan identified via two action plan items that the classic GENESYS model should be redeveloped by the next power plan
- Recognized a need to have an adequacy and hydro operations model that acknowledged the operational challenges of changing market fundamentals due to high variable energy resource penetration
  - In 2015, California Senate Bill 350 kicked off a cascade of policies throughout the WECC mandating more renewable resources.

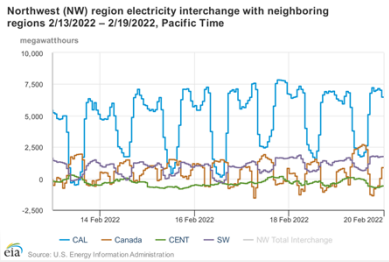


Where We Were

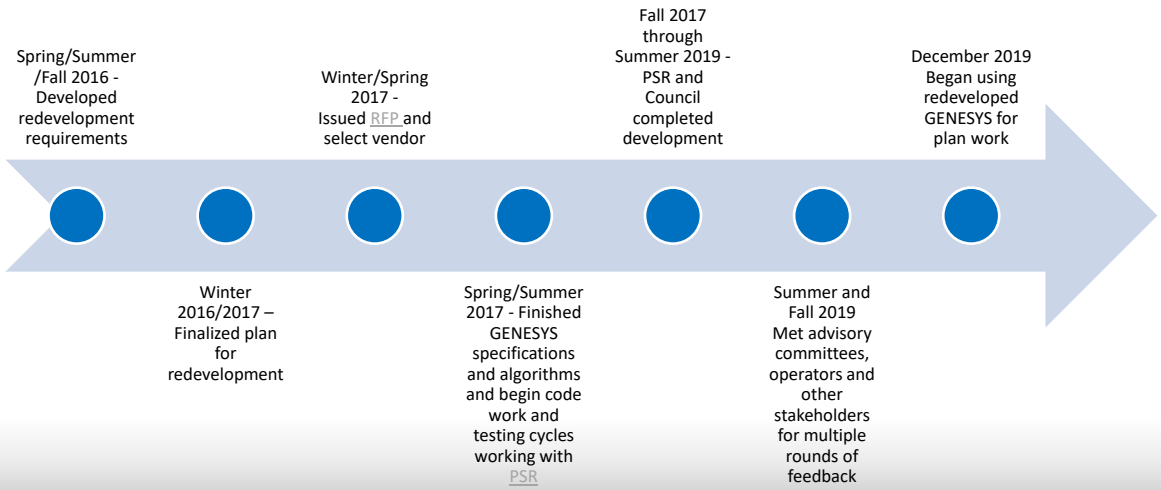
More variable energy resources in the WECC seemed to imply changing market fundamentals that would likely bring new adequacy risks

- Increased generation forecast error
- Increased unit commitment challenges for thermal units
- Increased flexing intraday by hydro operations
- Increased transmission congestion





Pre Plan Project Timeline



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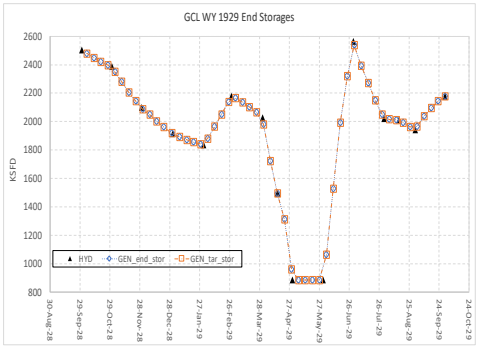
Where We Were During the Plan (2019-2021)

- Finished primary model development at end of 2019.
- Made an **assumption** to *align with HydSim water balances* on a weekly basis as a way ensure consistency on an energy basis (target storage methodology)
- Validated that model could perfectly align with HydSim targets before hourly constraints and operational data incoporated



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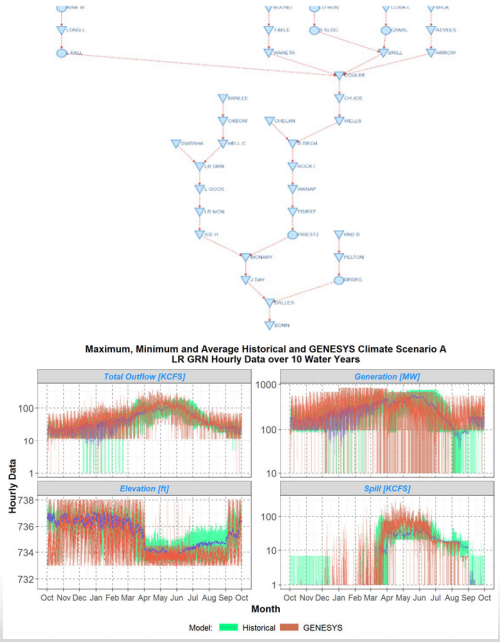
Adjusting During the Plan to Stakeholder Concerns

- Per feedback from the Resource Adequacy Advisory Committee, an **assumption** was made to *limit the net market import* similarly to the classic GENESYS market reliance restrictions.
  - The assumption is to be revisited after the plan after investigating more detailed modeling of risks outside the region
- Per feedback from a variety of stakeholders and staff concerns, there was concern about flexibility of the hydro system under plan assumptions.
- Plan timeline put a constraint on further refinement of model assumptions before end of plan.
  - Hold a technical workshop to elicit stakeholder feedback.

GENESYS Technical Workshop

- In response to stakeholder concerns from advisory committee process about hydro operations in redeveloped GENESYS model, staff scheduled a three-day technical conference to walk through 55 individual hydro projects.
  - https://www.nwcouncil.org/meeting/raacsaac-adequacygenesys-technical-conference-august-4-2021
- Regional stakeholders made some very specific suggestions about the modeling.



Specific Next Steps for Improving GENESYS from August 2021 Technical Conference	Staff Action Since Conference
Investigate whether storage vs. elevation table needs more or different data points	Made changes to improve interpolation
Update MOP constraints on Lower Granite to estimate the variable flow floor modifying MOP range (look at min flow constraint at Dworshak and modify floor on MOP)	Implemented MOP constraints based on calculated variable flows
Remove MOP constraints on McNary, The Dalles, Bonneville, return to normal operating range year-round	Implemented normal operating range year-round.
Check MOP effective date ranges per the Biological Assessment	Checked date ranges
Return to normal operating storage on John Day when MOP not in effect	Implemented normal operating range when MOP not in effect
Investigate whether updated MOP on above plants effects operating range on Chief Joseph	Changed operating range on Chief Joseph
Increase priority of constraint and modify modeling to better enforce min outflows at Priest Rapids and Bonneville	Implemented a method to evaluate two different priority penalties for minimum flow at Priest Rapids and Bonneville
Investigate implementation of Noxon forebay elevation ramp limitation modeled as a discharge rate (more movement in new GENESYS than we would expect)	Modeled directly via forebay elevation ramp limitation
Concerns about operation not being smooth enough in general	Implemented a general process designed to flatten penalty constrained operations

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Example of GENESYS Enhancement: Variable Flow Operative Storage Limitations at Lower Granite Dam

Used an iterative estimation process:

1. Calculated simulated outflows out of the model from Dworshak and Hells Canyon
2. Summed those flows plus sideflows as estimates for inflows into Lower Granite
3. Calculated the variable MOP elevations based on flow
4. Input updated variable MOP elevations and updated simulations

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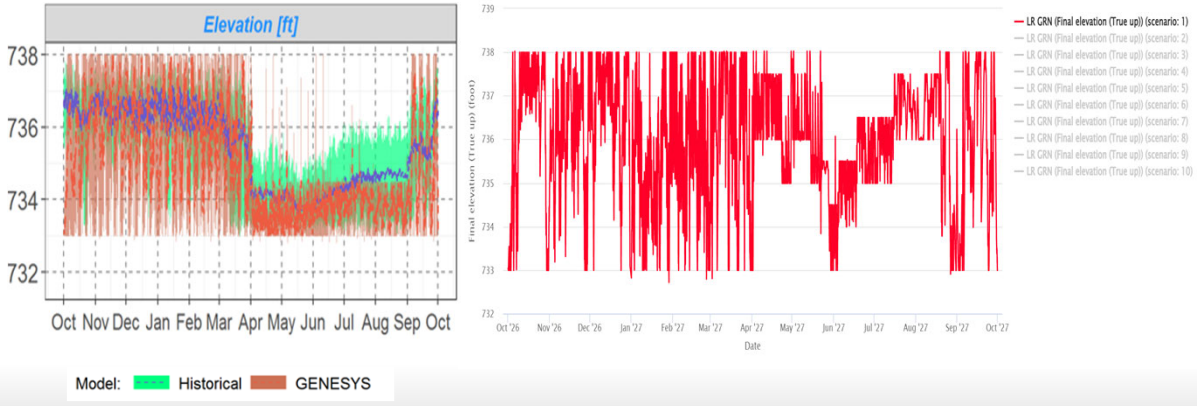
Improved Operations in GENESYS:
Variable Flow Operative Storage Limitations at Lower Granite Dam



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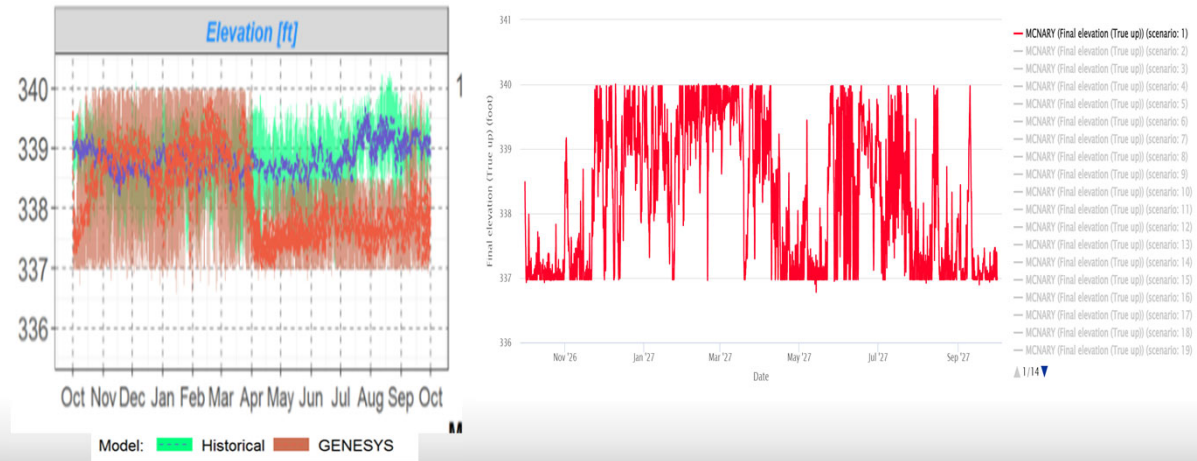
Improved Operations in GENESYS:
Corrected assumption to normal operating range year-round, removed MOP constraints on McNary, The Dalles, Bonneville



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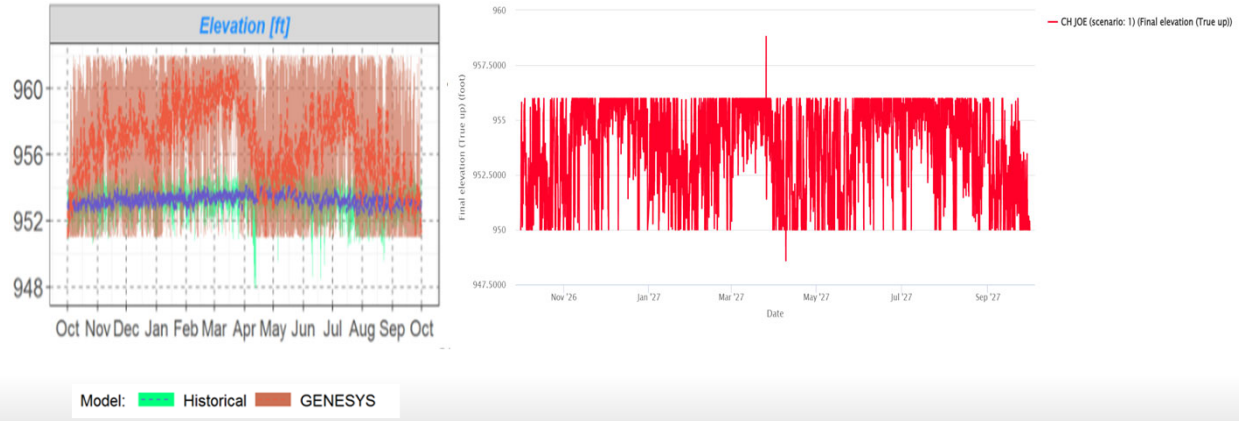
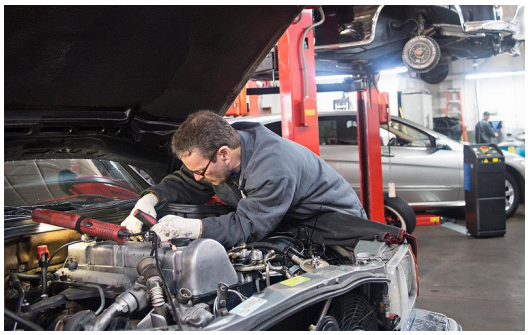
Improved Operations in GENESYS: Updated Operating Range on Chief Joseph to better match historical operations



Where We Are Now (Summer 2022)

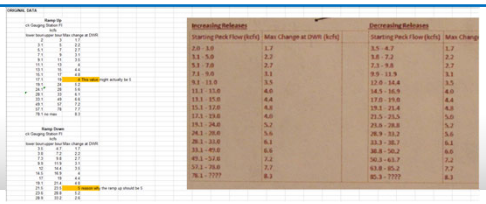
- 2021 Power Plan complete
- Time to revisit assumptions and recommendations by stakeholders
  1. Hydro Operations
  2. Market Fundamentals



Where We Are Going First – Hydro Operations

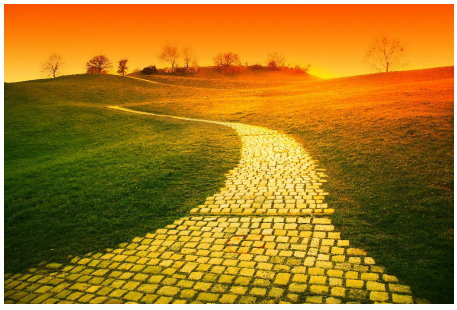
Checking all constraints implied by treaty and non-treaty agreements, licenses, current fish passage and water management plans and reconciling with HydSim assumptions

1. Reevaluating constraints and priorities for each dam ★
2. Cataloguing modeling choices into a data repository – In progress
3. Validating modeling choices with operators and experts - Upcoming



What have we found along the way so far…

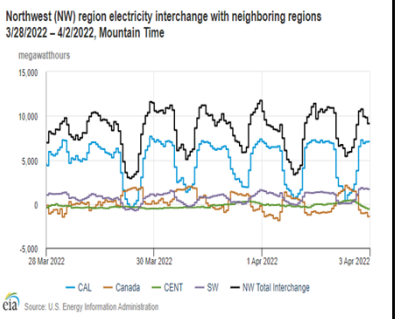
- HydSim represents limitations and capabilities on the system very differently than GENESYS
  - Prioritized constraints solved iteratively rather than simultaneously.
- Many projects are modeled as having zero storage capability in HydSim actually have storage capability on a weekly or daily basis and our previous modeling underrepresented available system storage.
- Understanding the hourly operations in detail has required some additional model enhancements to better represent system ramping capability.

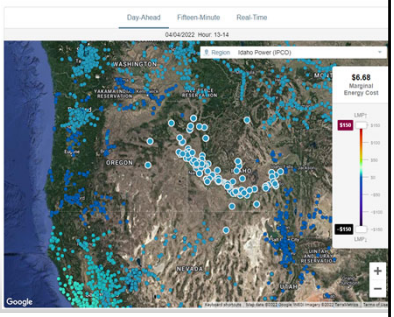


Where We Are Going Next – Market Fundamentals

Stakeholders identified three main areas of concern when adding the market limitation

1. Input renewable and hydro resources throughout WECC (capture impacts of more forecast error and fuel uncertainty)
2. Investigate risks around transmission availability (planned and unplanned outages, congestion)
3. Understand more about thermal unit commitment challenges WECC-wide





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Staff is updating model with all the documented changes in preparation for meetings with operators Late August and early September

Target completion of next iteration of hydro operations review by staff by end of Q2 2022

Vet any assumptions changes with stakeholders one-on-one, in advisory committees and/or forums by end of Q3 2022

Continue to collaborate with stakeholders in an open process about model assumptions and capabilities in future adequacy assessments and other studies.

Timeline of Next Steps

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Questions

- John Ollis - jollis@nwcouncil.org
- GENESYS Information
- 2021 Plan Info

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18.4% More Useable Storage in US in Redeveloped GENESYS

Units of Useable Storage	Classic GENESYS	Redeveloped GENESYS
KSFD	13,132	15,553
MAF	26.0	30.8

Plants modeled as ROR in HYDSIM that are modeled as reservoirs in new GENESYS:
Alder
Boundary
Cabinet Gorge
Diablo
Gorge
Hells Canyon
Mayfield
Oxbow
Pelton
Priest Rapids
Rock Island
Rocky Reach
Wanapum
Wells

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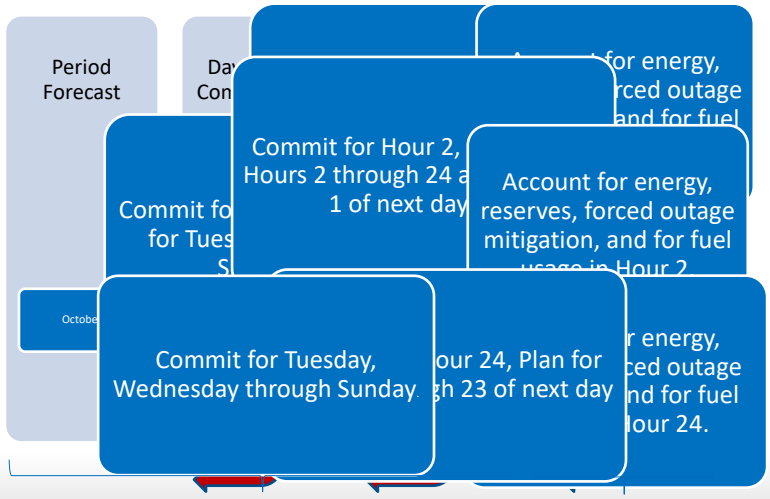
How Does Redeveloped GENESYS Simulate Hourly Operation?



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