

## 1.2.2.605/37082– Scope Improvements to Power Flow and Stability Models



Source: <https://www.watereducation.org/aquapedia/orville-dam>

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Organization(s) PNNL, INL, NREL

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# Project Overview

## Project Summary

- We investigated, evaluated and prioritized modeling gaps of hydro generation representation in electrical models – (powerflow and dynamic models) that are used in power system operation and planning studies. In the evaluation we heavily relied on interaction with industry and simulation studies.

## Intended Outcomes

- Industry awareness of hydro generation misrepresentation
- Improvement of modeling practice
- Improvement of planning and operational studies
- Improved reliability of power system
- Accurate estimation of role of hydro in integration of other renewable resources.

## Project Information

Principal Investigator(s): Slaven Kincic

- Nader Samaan (PM), Sohom Datta, Abhishek Somani, Rojan Bhattarai (Co-PI), Tan Jin (Co-PI)

### Project Partners

- WECC and WECC Modeling Validation Subcommittee (MVS).

### Project Status

Completed

### Project Duration

- October 2020
- June 2021

### Total Costed (FY19–FY21)

\$200K

# Project Objectives: Relevance

## Relevance to Program Goals:

- Identification and elimination of modeling gaps in hydropower plants leads to more accurate evaluations of the contribution of hydropower to resilience and reliability of the rapidly evolving power system. This ties in closely with WPTO's mission to enable research on hydropower generation for a flexible and reliable grid.

# Project Objectives: Approach

## Approach:

- Heavy industry outreach: forums, one-to-one meetings, workshop
- Preliminary simulation studies – presented at workshop and learn more from industry experts

# Project Objectives: Expected Outputs and Intended Outcomes

## Outputs:

- A comprehensive review of identified modeling gaps in consultation with the industry stakeholders and recommendations on how to address them.
- Final Report including industry outreach, preliminary simulation studies results and recommendations
- Manuscript for conference article on the impacts of modeling gaps.
- Workshop and multiple presentations

## Outcomes:

- Industry awareness of hydrogeneration misrepresentation in power system models used for operation and planning studies.
- WECC MVS suspended number of outdated dynamic models.
- Continued engagement with industry to address and mitigate hydropower misrepresentation based on previously suggested recommendations
- Consequence: improved reliability as well as to help emphasize role and capabilities of hydro in integration of renewable resources.

# Project Timeline

FY 2021

- |            |   |
|------------|---|
| 12/31/2020 | Industry engagement report – Internal memo from results of industry engagement at the end of Q1   |
| 3/31/2021  | Industry engagement report – Internal memo from results of industry engagement at the end of Q2   |
| 3/31/2021  | Intermediate set of results from case studies   |
| 4/9/2021   | Organizing and hosting workshop with WECC (link below)<br><a href="https://wecc.webex.com/recording-service/sites/wecc/recording/bf67c56e93ef4078b803ec2e86d90642/playback">https://wecc.webex.com/recording-service/sites/wecc/recording/bf67c56e93ef4078b803ec2e86d90642/playback</a> |
| 6/30/2021  | Industry engagement report – Final report with prioritized list of gaps and manuscript on results from case studies that documents the impacts of overcoming a selected set of modeling gaps  |

# Project Budget

FY19	FY20	FY21	Total Actual Costs FY19–FY21
Costed	Costed	Costed	Total Costed
\$0K	\$0K	\$200K	\$200K



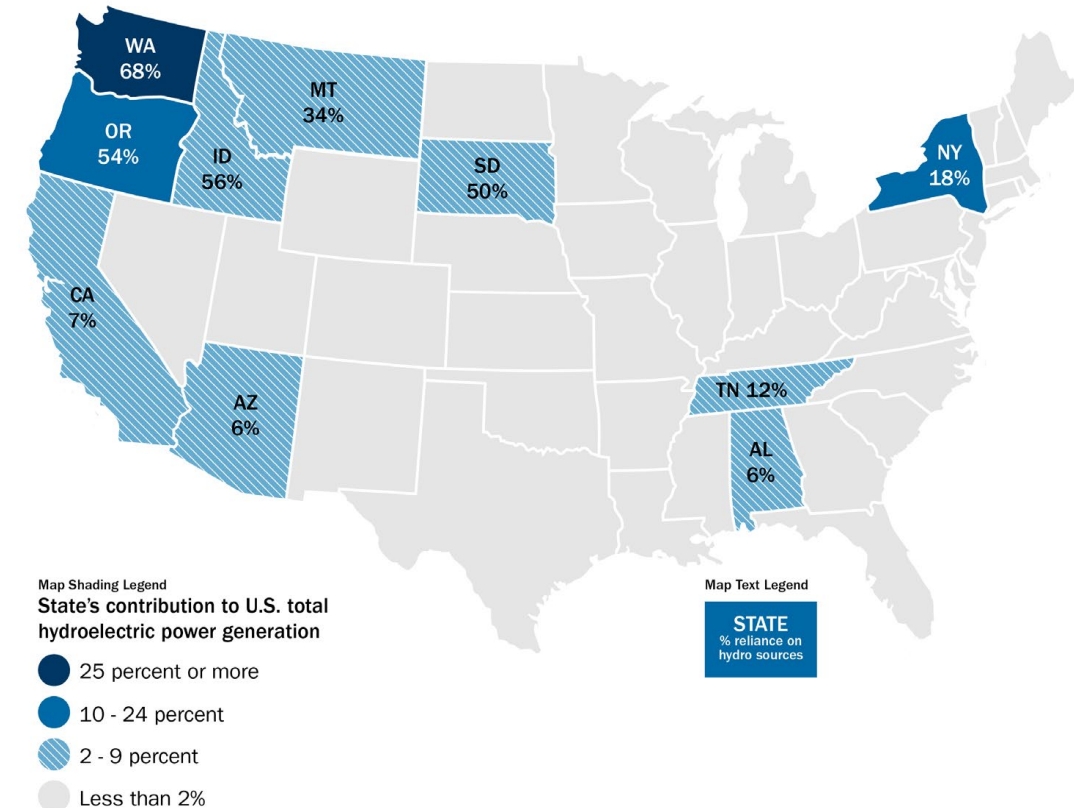
# End-User Engagement and Dissemination

- **Beneficiaries:** it is crucial to make regulators, power system operators and planners aware about possible issues that might arise due to misrepresentation of hydropower plants in planning and operational models.
- **Stakeholder and end-user engagement strategy:**
  - One-on-one interviews, workshop\* with industry members and direct engagement with WECC and WECC Modeling Validation Subcommittee and WECC System Review Subcommittee
  - One-on-one interviews with experts from regulatory agencies (WECC, NERC), TSO and BAs (CAISO, BPA, IPCO, SRP, BC-Hydro), DoE Agencies (BPA, USBR, USACE), power system software vendors (Powertech, GE PSLF, PowerWorld), independent consultants and the NWPP.

\* <https://wecc.webex.com/recordingservice/sites/wecc/recording/bf67c56e93ef4078b803ec2e86d90642/playback>

# End-User Engagement and Dissemination

- Project featured heavy engagement with WECC and WECC members
- Dissemination:
  - The technical report will be published as a HydroWIRES product and will be available on PNNL's Hydropower website
  - Multiple presentations on meetings and conferences
  - Regular, monthly follow up meetings with stakeholders





# Performance: Accomplishments and Progress

- Workshop with WECC MVS in April 2021
- Identified gaps relative to hydropower representation in steady-state and dynamic planning models
- Assess the impacts of these gaps
- Identify the priority ordering of these gaps through direct communication using survey questionnaire.
  - Which gaps are considered important by industry to fill?
  - Why haven't these gaps been overcome already?
  - Which gaps could become more important as the power grid changes?
- Share outcome of hydro gap modeling and generate awareness among vendors and utilities
- Obtained feedback and support from Industry (larger audience)

# Performance: Accomplishments and Progress

Hydro generation not adequately and inaccurately represented in planning and operation studies:

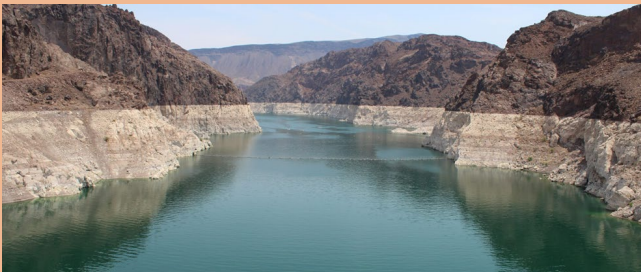
- Water availability not updated seasonally or modeled in basecases
- No interdependencies modeled between cascading hydro-plants
- Environmental constraints not represented
- Machine rough zones are not represented
- Dynamic models need to be updated
- Modeling data issues

Consequence: Over/under estimation of hydropower contribution in planning and operations studies

# Performance Example: Water Availability

## Key Industry Comments:

- “It’s a good idea to vary head parameter in dynamic models and observe the effect on studies”
- “For power system simulation programs, we should propose to build a new section ... to specify seasonal water flow condition on rivers, head information and ... to adjust steady state and dynamic model data accurately”



Source: Insight Climate News

<https://insideclimatenews.org/news/08082021/colorado-river-water-power/#:~:text=The%20Colorado%20River%20is%20tapped,government%20will%20declare%20a%20shortage.>

## Recommendations:

- To collect water data for different river basins for low and high-water conditions
- To establish water profiles for different water conditions for different river basins.
- Dependence among parameters (dynamic model)
- Many dynamic models do not allow to change water head
- To develop a tool that automatically impose water conditions on each river basins separately in steady state and dynamic models.

# Q&A

