The National Renewable Energy Laboratory, along with other labs and partners, are aiming to improve the reliability and resilience of the power sector by enabling utilities to evaluate impacts and risks associated with water resources. *Photo by Rafael Kaup, U.S. Department of Energy*

Preparing the Power Sector To Navigate Climate and Water Risks

About 90% of the United States' energy comes from hydropower and thermal energy sources—including natural gas, nuclear, and coal—all of which share a critical need: water. Power plants need water to keep their systems cool and safe, and hydropower uses water as renewable fuel. As the climate changes, so will water availability and other ambient conditions, threatening the reliability of today's power system and tomorrow's clean energy grid.

That's why researchers at the National Renewable Energy Laboratory (NREL)—along with those at Sandia National Laboratories, Oak Ridge National Laboratory, the City University of New York, the Electric Power Research Institute, and the National Energy Technology Laboratory—are studying both regional and national climate and hydrologic changes to provide a comprehensive assessment of climate and water impacts and risks to the U.S. power grid.

This year, the team developed a state-of-the-art modeling framework to assess climate and water impacts as well as other risks to the grid, including sensitivities to varying hydrologic drivers and infrastructure scenarios. The research provides key insights that utilities and system operators need to mitigate and adapt their power grid assets and systems to climate and water risks, so utilities and policymakers can make better-informed planning decisions.

Integrated Climate, Energy, and Water Modeling and Analysis

To evaluate how changes in the complex relationships between climate, energy, and water might impact power systems, researchers will:

- Execute energy-water models with high spatial resolution (e.g., runoff, river flow and temperature, thermal stratification, thermal power water use and constraints, and reservoir operations) to estimate water availability and ambient conditions at the level of individual grid assets
- Analyze climate-water vulnerabilities and risks to thermal power and hydropower to improve understanding of trade-offs in grid operations under increasingly limited water supplies
- Perform energy-water system risk analyses to improve stakeholder understanding of climate and water impacts and ensure risks are considered in grid planning
- Produce energy-water scenarios for long-term grid planning based on stakeholder input.

Visualization and Analysis Tool

To help utilities and system operators mitigate risks associated with future climate and water scenarios, researchers will:

- Create a standardized interactive visualization platform that enables stakeholders to evaluate climate-water impacts, risks, and adaptation measures for power systems
- Perform outreach with industry (independent system operators, regional transmission operators, utilities operators), the Department of Energy, academia, and the public to increase awareness of how climate impacts and water risks affect power system planning and operations
- Showcase a range of climate and hydrological conditions and alternative power system contexts for policy, market, and technology using data and results from the modeling framework
- Gather stakeholder feedback on model results, metrics, and analyses, which is essential for implementing and developing a successful analysis and visualization platform.

Contact

Ariel Miara, Ariel.Miara@nrel.gov

Hydropower projects—like the Willamette Falls, pictured here—have played a key role in providing flexible, low-carbon electricity to the U.S. electricity system for over a century. *Photo by Rafael Kaup, U.S. Department of Energy*

NREL Transforming ENERGY

National Renewable Energy Laboratory
15013 Denver West Parkway, Golden, CO 80401
303-275-3000 • www.nrel.gov

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