OAK RIDGE NATIONAL LABORATORY

Optimizing Costs for the Future of US Hydropower



The Challenge: Addressing Information Gaps in Hydropower

Hydropower has long been a cornerstone of US renewable energy, contributing significantly to the nation's electricity supply. However, the industry faces challenges in maintaining its growth and competitiveness. A critical issue is the lack of reliable, comprehensive cost and performance data, particularly for non-powered dams (NPDs) and new stream development (NSD) projects—two areas with significant potential for expansion. Understanding the economics of environmental mitigation is also crucial for the feasibility of these projects.

The Solution: Hydropower Cost Modeling

To address these challenges, the US Department of Energy (DOE) launched the Hydropower Cost Modeling project, led by DOE's Oak Ridge National Laboratory (ORNL). This initiative provides essential data, modeling, and analysis to evaluate the costs and performance of existing and potential US hydropower plants, thereby improving decision-making processes for stakeholders at the national scale.

Key Objectives:

- **Enhancing Data Analysis:** Improve the capability to analyze complex hydropower data, enabling stakeholders to identify opportunities and make informed trade-offs.
- **Providing Accurate Cost Data:** Deliver detailed insights into cost drivers, environmental mitigation impacts, and the cost-effectiveness of new technologies.
- **Supporting Integrated Systems Development:** Facilitate the creation of systems that enhance access to integrated water data and support hydropower stakeholders.

PROJECT GOALS

SHORT TERM
understand technological needs

MEDIUM TERM
streamline facility development

LONG TERM
improve hydropower efficiency and resource management

Methods and Tools: Driving Innovation in Cost Analysis

The Hydropower Cost Modeling project employs a comprehensive suite of tools and methodologies to achieve its goals:

- **Baseline Cost Model (BCM):** An empirical model that estimates the costs of US hydropower based on data for existing and planned projects across six categories, including NPDs, NSDs, canals/conduits, pumped storage hydro, capacity expansions, and generator rewinds. The BCM is designed for rapid cost evaluation with limited data, making it a versatile tool for early-stage analysis.

R.C. Thomas Hydroelectric Project, Polk County, Texas (image courtesy of Simpson Gumpertz & Heger)

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- **smHIDEA Model:** This tool is used to estimate the early costs of potential hydropower projects, helping to determine whether a project is worth pursuing. It allows for detailed simulations that support comprehensive facility design and cost analysis based on user-provided inputs.
- **Cost Analysis for NPDs:** In collaboration with hydropower design experts, ORNL developed a report that provides updated cost estimates and insights into the site and design features that drive costs for NPD projects. This report helps developers assess the potential for adding hydropower generation to existing NPDs, saving time and resources.
- **Additional Analytical Methods:** The project also uses data analysis, clustering, literature reviews, and geographic information systems to enhance the accuracy of its models and provide comprehensive insights into hydropower costs.

Impact and Direction: Shaping the Future of US Hydropower

The Hydropower Cost Modeling project is delivering critical outputs that are shaping the future of hydropower in the United States. By providing updated levelized cost of energy baselines, detailed technical reports, and publicly accessible datasets, the project ensures that policymakers, researchers, and developers have the information they need to make informed decisions.

Outcomes and Future Work

- **Short-Term:** The project offers valuable insights into the technological needs for new hydropower development in the US, supporting the creation of more cost-effective and environmentally sustainable projects.
- **Medium-Term:** By reducing costs and time in federal and state authorization processes, the project aims to streamline development of new hydropower facilities. Additionally, the project is developing publicly available analytical tools to support further R&D and industry needs.
- **Long-Term:** The project seeks to improve hydropower decision-making processes, enhance river resource management, and contribute to workforce development through graduate training and research initiatives.

The Hydropower Cost Modeling project will continue to refine its tools and expand its impact by completing baseline cost analyses for NSD sites, developing a public workbook for NPD cost analysis, and evaluating the cost implications of new technological options. These efforts will support hydropower as a competitive and sustainable part of the US energy landscape.

Norris Dam, Anderson County, Tennessee (image courtesy of Brennan Smith)



CONTACT
Gbadebo A Oladosu
Senior Researcher
Environmental Sciences Division
Oak Ridge National Laboratory
oladosuga@ornl.gov
865-576-2485

ornl.gov/
waterpower

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