



OAK RIDGE NATIONAL LABORATORY

Standard Modular Hydropower Technology Acceleration

What is Standard Modular Hydropower?

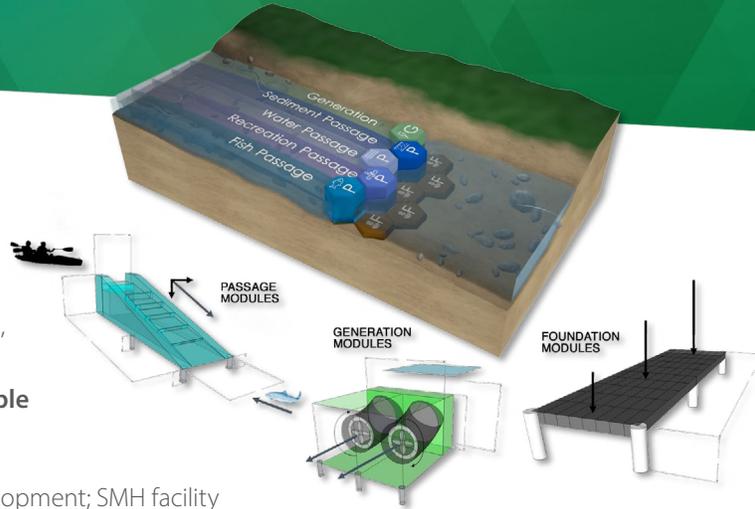
Oak Ridge National Laboratory's Standard Modular Hydropower (SMH) project promotes the standardization, modularity, and environmental compatibility of SMH technology as three enabling principles of a low-cost, environmentally sustainable hydropower acceleration strategy. The SMH project poses the question: **Can we develop low-cost, modular, replicable hydropower facilities that preserve or enhance river functions?**

The project's three core research tasks are SMH module research and development; SMH facility research and development; and SMH for non-powered dam (NPD) development. As evidenced in these tasks, the SMH project aims to achieve a holistic approach to new, small hydropower development, supported by three research pillars:

- 1 Site classification** to identify and evaluate similarities in US stream- and infrastructure-related characteristics;
- 2 Exemplary design** to develop technical, economic, and environmental specifications for new modular technologies; and
- 3 Simulation and modeling** to develop tools that improve the performance of new technologies and characterize their environmental and techno-economic impacts.

SMH project research considers how these three research pillars and the three enabling principles of SMH can address the challenges and complexity involved with small hydropower development toward improving design, engineering, construction, and environmental impact mitigation strategies that are cost-effective and scalable.

Prior SMH-funded research also investigated hydraulic testing and validation needs for small hydropower, the results of which are being leveraged to support ongoing scoping of technology testing needs, capabilities, and priorities applicable to hydropower. Additionally, SMH research findings prompted further US Department of Energy investigation into geotechnical foundations, resulting in a recently published ORNL Technical Report and the development of the Groundbreaking Hydro Prize.



Standardization

Standard siting methods, designs and technologies, manufacturing, project review, regulatory pathways, construction sequencing, and so on **to reduce site specificity and costs**



Modularity

Physical organization of a hydropower facility into discrete functional units, allowing scalability **to deliver energy and environmental benefits at varied sites**



Environmental Compatibility

Facilities sited and operated as coupled human-natural systems to minimize disturbances **to maintain stream functionality and ecosystem health**

Research Tasks and Hydropower Resource Areas

The SMH project pursues scientific understanding regarding how to design, simulate, validate, and demonstrate SMH technologies and concepts. Over the first 4 years of the project, research focused primarily on how SMH concepts apply to new stream-reach development sites.

In 2019, ORNL began efforts to extend the foundational SMH project's enabling principles and research pillars to NPDs (i.e., dams without installed hydroelectric generating equipment). Outcomes of preliminary research efforts were shared with stakeholders via virtual workshops held in December 2020, July 2021, and December 2021; additional information is available on the [SMH project website](#). SMH principles could apply equally well to other hydropower resource areas, such as opportunities for canal/conduit hydropower and pumped storage hydropower solutions.

SMH module and facility research and development has resulted in several key products and US Department of Energy funding opportunities, including the following:



A Multi-Year Plan for Research, Development, and Prototype Testing of Standard Modular Hydropower Technology: [This plan](#) presents a strategy for specifying, designing, testing, and demonstrating the efficacy of SMH as an environmentally compatible and cost-optimized renewable electricity generation technology.



Exemplary Design Envelope Specification for Standard Modular Hydropower Technology: [This specification](#) offers a new model for small hydropower technology development based on the premise that standardization, modularity, and preservation of stream functionality must be essential and fully realized features of next-generation hydropower technologies and project designs.



SMH Explorer: [This geo-visual analytics platform](#) empowers user-guided, energy-water-environment-module data analyses and inquiries in support of the SMH project. The tool can be used to establish scoping-level insights into the type of foundation, generation, water quality, fish passage, recreation, and sediment modules that may be necessary for stream-reach hydropower development.



NPD Explorer and NPDamCAT: These applications enable geo-visual analytics, subsetting, and classification of NPD data. Both tools leverage the US Non-Powered Dams Characteristics Inventory. [NPD Explorer](#) follows the example set by SMH Explorer. The [NPDamCAT](#) framework allows for custom analysis and taxonomy of NPDs.

Funding Opportunity Announcement [DE-FOA-0001836](#)

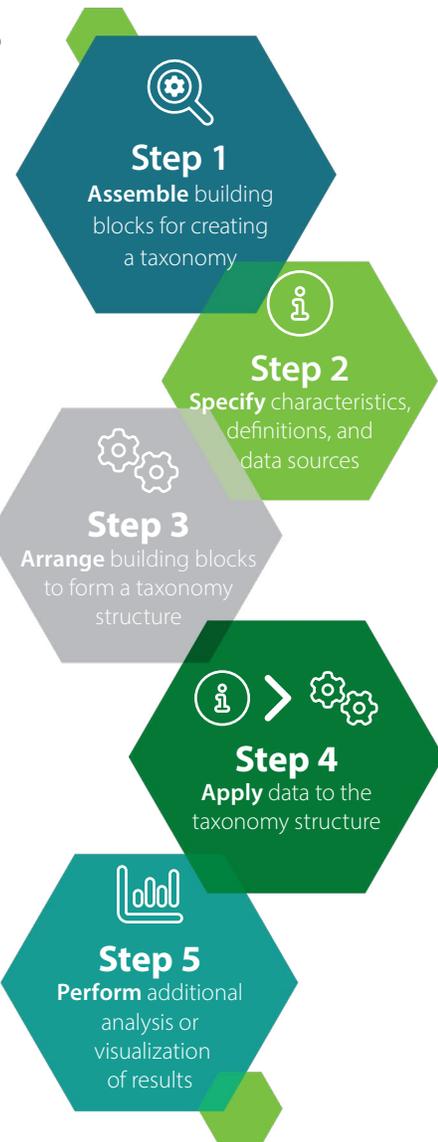
Topic Area 1: Facility Design Concepts for Standard Modular Hydropower Development

- **Topic Area Purpose:** "Stimulate innovative designs for small, low-head hydropower facilities capable of lowering the capital costs and reducing the environmental impacts of development at new stream-reaches." **Partners:** Littoral Power Systems, Natel Energy

Funding Opportunity Announcement [DE-FOA-0002080](#)

Area of Interest 2a: Modular Technologies for Low-Head Hydropower Applications

- **FOA Objective:** "Support projects that aim to increase affordability of hydropower and marine energy, strengthen U.S. manufacturing competitiveness, and build on Department-wide energy storage initiatives to improve the capability of technologies to deliver value to the grid." **Partners:** Littoral Power Systems, Natel Energy, Percheron Power, University of Minnesota



Framework for NPD Custom Analysis and Taxonomy (NPDamCAT)

Outcome: Improved NPD classification & data access

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