DEVELOPING VALUATION GUIDANCE FOR PUMPED STORAGE PROJECTS

Presented by:

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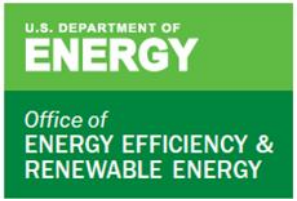
PROJECT OVERVIEW

Valuation Guidance and Techno-Economic Studies for Pumped-Storage Hydropower

- Study funded by Department of Energy's (DOE's) Water Power Technologies Office (WPTO)



- Initiated by Congressional budget language setting aside $3M for the analysis of value of PSH at two sites in areas with high RE generation

- Carried out by a collaborative comprised of five DOE National Laboratories

PROJECT TEAM

Valuation Guidance and Techno-Economic Studies for Pumped-Storage Hydropower

Argonne National Laboratory (Argonne) (Project Lead)

Idaho National Laboratory (INL)

National Renewable Energy Laboratory (NREL)

Oak Ridge National Laboratory (ORNL)

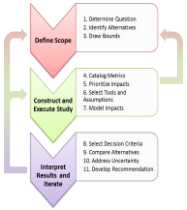
Pacific Northwest National Laboratory (PNNL)

THE BIG PICTURE

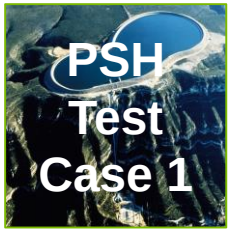
Key project activities

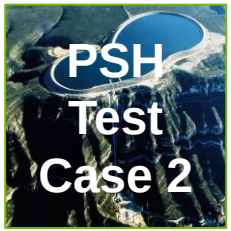
Develop Draft Valuation Methodology

Draft PSH Valuation Guidance



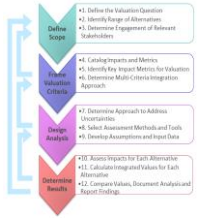
Test Valuation Methodology





Revise and Publish Valuation Methodology

PSH Valuation Guidance



TWO PSH PROJECTS WERE SELECTED THROUGH COMPETITIVE "NOTA" PROCESS

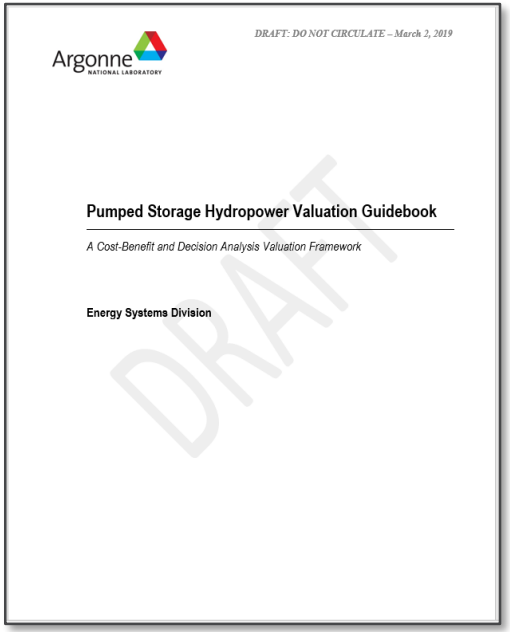
Congressional budget language called for two PSH sites in areas with high penetration of variable renewable generation

- DOE/WPTO announced NOTA selection in December 2018:
  - **Banner Mountain PSH**
  - **Goldendale PSH**
- Project Team and NOTA participants are currently establishing CRADA agreements for techno-economic studies
- Technical Advisory Group (TAG) has also been established to provide advice and guidance to the Project Team

NOTA – Notice of Opportunity for Technical Assistance

KEY PROJECT TASKS

- ✓Conduct valuation literature review (Completed)
- ✓Perform a cost and performance comparison of PSH and competing technologies (Completed)
- ✓Develop draft PSH valuation guidance (Completed)
- Conduct techno-economic studies for two selected PSH projects
- Analyze potential market revenues of two PSH projects
- Conduct two valuation case studies to test the guidance and its underlying methodology
- Revise PSH valuation guidance and document study findings



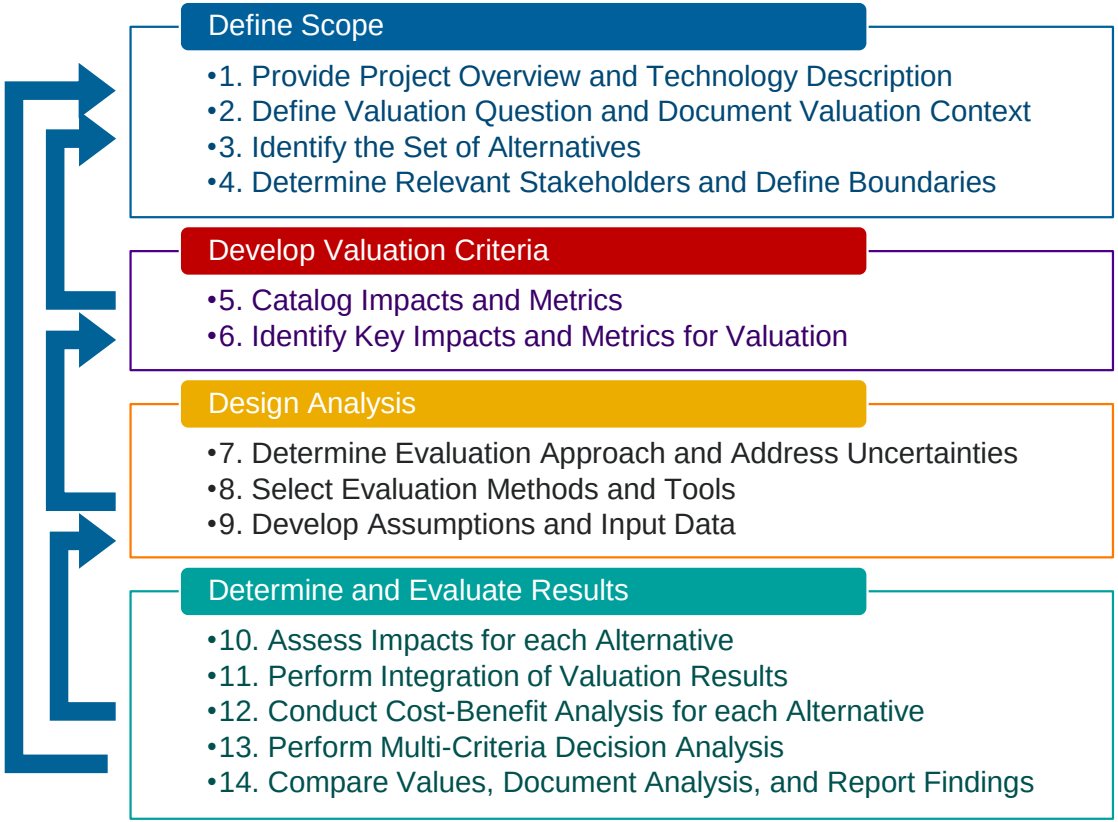
TECHNO-ECONOMIC STUDIES

A variety of analyses will be carried out to assess the costs and benefits of various PSH services and contributions to the grid

- Bulk power capacity and energy value over PSH lifetime
- Value of PSH ancillary services (regulation service, contingency reserves, etc.)
- Power system stability services (inertial response, governor response, transient and small signal stability, voltage support)
- PSH impacts on reducing system cycling and ramping costs
- Other indirect (system-wide or portfolio) effects of PSH operations (e.g., PSH impacts on decreasing overall power system production costs, benefits for integration of variable energy resources, and impacts on power system emissions)
- PSH transmission benefits (transmission congestion relief, transmission investments deferral)
- PSH non-energy services (water management services, socioeconomic benefits, and environmental impacts)

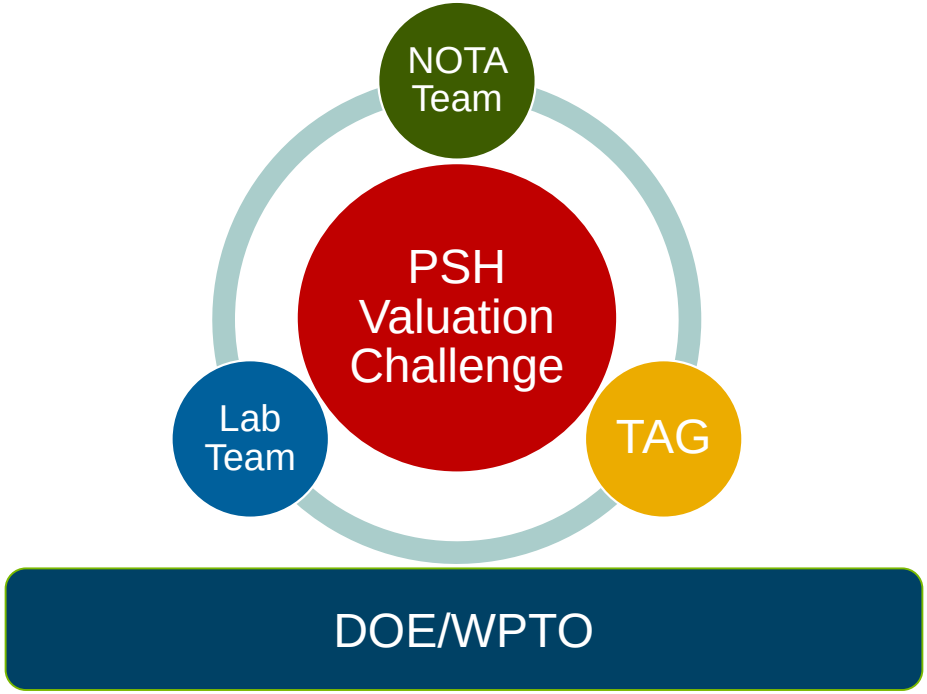
PROPOSED PSH VALUATION PROCESS

A Cost-Benefit and Decision Analysis Valuation Framework



COLLABORATIVE FORCES

Addressing the challenge of PSH valuation



THANK YOU FOR YOUR ATTENTION!
QUESTIONS?