

Annex XVI – Hidden and Untapped Hydropower Opportunities

Oak Ridge National Laboratory Carly Hansen

ORNL is managed by UT-Battelle LLC for the US Department of Energy





Overview of inventory building and classification of opportunities in USA



Creating inventories of Hidden and Untapped Hydropower Opportunities: Experience in the US

- Inventories of non-powered opportunities in the US were conducted by Oak Ridge National Laboratory
 - Non-powered dams (2012)
 - Conduits (ongoing)
 - Municipal
 - Industrial
 - Agricultural
- Varying levels of detail or types of "potential"





Creating inventories of Hidden and Untapped Hydropower Opportunities: Challenges & Considerations

- Evaluate the current "state of the science" in preparing inventories of Non-powered dam opportunities
 - "Hydropower development potential at non-powered dams: Data needs and research gaps" in *Renewable and Sustainable Energy Reviews:* <u>https://www.sciencedirect.com/science/a</u> <u>rticle/pii/S1364032121003476</u>



Hydropower development potential at non-powered dams: Data needs and research gaps^{\pm}

ABSTRACT

Carly Hansen^{*}, Mirko Musa, Colin Sasthav, Scott DeNeale Ook Ridee Nedoral Laboratory, J. Bethel Veller Rd, Ook Ridee, TN, 37830, USA

ARTICLE INFO

Keywordz; Non-powered dam Retrofit Hydropower resource assessme Hydropower plays a key role in the evolving energy grid. In the United States, thousands of non-powered dama (NPDs) represent untapped opportunities for new energy production. This paper reviews past NPD resource assessments, with a particular focus on those in the United States, and evaluates where there is room for improving methods, data, and assumptions for estimating development potential. Through this review, we catalog the types of information that are available to stakeholders involved in NPD development. Past assessments have generally focused on interests of project developers (i.e. how much hydropower developm tential is available); however, needs of other stakeholders are not adequately addressed in literature. We thus suggest specific actions for improving methods and data used in assessing development potential: establishing istency among datasets, accounting for uncertainties, representing technology in a more robust way, and accounting for a broader sulte of factors that affect potential. To support development at NPDs, future research uld consider emerging technologies, explore co-development strategies, and incorporate so centives and constraints. Additionally, we survey recent NPD retrofit projects in the United States and identify patterns at successful projects (restrictions on additional flow alterations and water quality/ecological repuirements are common) and unsuccessful projects (surrendered licenses often cite lack of economic feasibility) comparison between retrofits and the remaining population of NPDs highlights that certain characteristics are tionately observed in successful retrofits (i.e. concrete dams with the primary purpose of navigation) Understanding the current state of the literature and recent patterns in NPD development will help improv future analyses of potential and support broader development-related interests.



Creating inventories of Hidden and Untapped Hydropower Opportunities: Challenges & Considerations

- Wide variety of data/sources
- Disparity in quality, lack of controlled vocabulary
- Difficult to represent hydroclimate uncertainty and operational variability
- Difficult to represent complexity of retrofit design solutions at a high level/large scale



Data source: USACE National Inventory of Dams



- Using inventories to drive classification:
 - Provides an efficient way to tackle problems involving large populations
 - Enables summaries and comparisons
- Diversity in data, stakeholders, and objectives has led to an effort to create flexible dam classification and exploration tools





Which characteristics does classification need to be based on?





How do you prioritize characteristics or subset data?



Data management platform needs to configure organizational structure to reflect selections made by an individual





Data from the inventory are applied, giving meaning to the classification structure



Ongoing development of tools enabling exploration/classific ation of the inventory

CAK RIDGE





Mapping or exploring distributions, variation of information across different classes

- Caveat: We must also consider when generalizations about a group or category of facilities may not hold
- Benefits of a flexible approach to classification of opportunities:
 - **Customized approach**: Tailor the structure of the taxonomy to the specific priorities and objectives of the individual
 - Accounts for uncertainty/data deficiencies:
 - Identify gaps in available data
 - Enable sensitivity analysis

