Diversity in Approaches to Hydropower Flexibility in Water and Power System Adaptation Strategies Under Climate Change Conditions

Nathalie Voisin[1] and Alison Colotelo[1]

[1]Pacific Northwest National Laboratory

November 24, 2022

Abstract

Hydropower plants and large storage reservoirs upstream of water-dependent power plants represent physical assets with a substantial role in the function of both river and power grid systems. Hydropower has the potential to play an important role in decarbonization strategies as a means to achieve reliability and resilience in an increasingly complex grid; for example, as a means to offset variability in other renewable resources and provide long term energy storage. The power grid and river systems are interlinked through hydropower plants, resulting in hydropower operators needing to balance potentially competing interests of water management, as well as power demands. Despite this multisectoral dependency, the representation of hydropower in power system resource adequacy studies typically differs from the representation in water management adaptation studies, especially at the regional scale. The objective of this presentation is to clarify the concept of hydropower flexibility (and adaptation) in a way that can bridge gaps between the tools used by and expectations of water managers, hydropower operators and power system operators. The developed qualitative multisystem, multiscale approach to hydropower flexibility can be leveraged to highlight the value, facilitate the compatibility and complementarity, and inform on the generalization of technology innovation and climate change adaptation strategies.

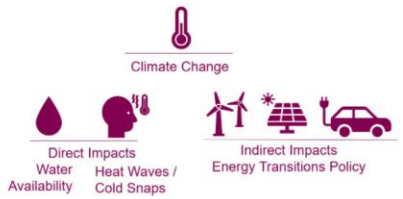
Diversity in Approaches to Hydropower Flexibility in Water and Power System Adaptation Strategies Under Climate Change Conditions

Nathalie Voisin, Alison Colotelo

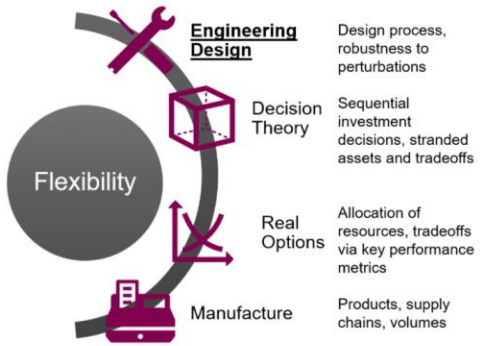
Pacific Northwest National Laboratory

Climate Change Impacts and Policy Require Hydropower Adaptation

Hydropower flexibility will play an important role in decarbonization strategies while also being impacted by the direct impact of climate change on water resources.

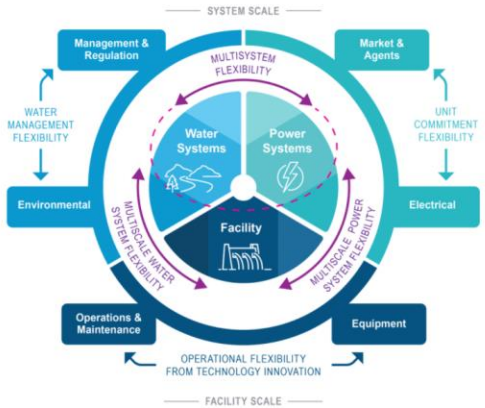


Flexibility Objectives Differ Across Adaptation Studies



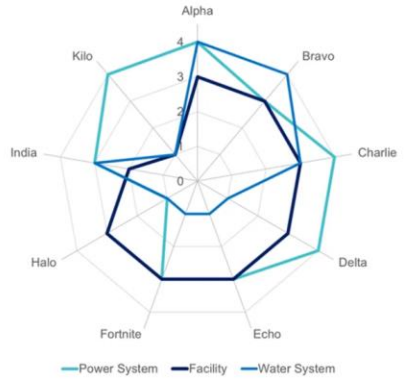
Flexibility As An Engineering Design takes Multiple Definitions Across Hydropower Systems and Scales.

Water and Power systems are connected through hydropower plants. Adaptation Studies need to specify which flexibility they advance, e.g. flexibility of what to what.



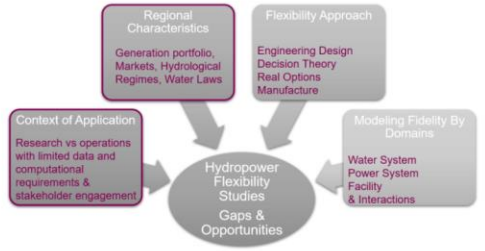
A Framework to Describe the Advances in Hydropower Modeling Across Water-Power Grid Studies

Hydropower representations in 9 anonymized flexibility studies with an engineering design perspective. Gaps represent challenges in immediate transferability across studies despite all advance flexibility of hydropower.



Extended Framework to Identify Gaps and Opportunities in Hydropower Adaptation Research

To integrate and transfer insight and methods across adaptation studies, application and regional characteristics also need to be specified



Moving forward

A systematic approach to categorizing and contextualizing Water-Power Grid Adaptation projects is needed to identify synergies and gaps across projects and inform collaborative opportunities and future research priorities.

Acknowledgements: The mission of the HydroWIRES (Water Innovation for a Resilient Electricity System) initiative from the US Department of Energy - Water Power Technologies Office is to understand, enable and improve hydropower's contributions to reliability, resilience, and integration in the rapdly evolving U.S. electricity system. We also thank the PIs of the 14 participating HydroWIRES projects.

AUTHOR INFORMATION | ABSTRACT | CONTACT AUTHOR | GET IPOSTER