Co-Development Opportunities Between Hydropower and Municipal Water and Wastewater Infrastructures

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Focal Area(s)

This white paper focuses on the energy-water nexus, specifically co-development and energy optimization opportunities provided by jointly considering preexisting or planned municipal water supply, treatment, and wastewater facilities with hydropower generating capacities. This primarily considers hydropower development opportunities with respect to raw water supply, raw water transport, supply treatment, and de facto reuse opportunities, rather than exploring micro- or pico-scale hydropower available through local post-treatment distribution.

Existing Challenge

The existing challenges to co-development (or new, joint development) between municipal water and hydropower span both technical and socioeconomic dimensions. Although new hydropower site development has slowed in the U.S. in recent years, new municipal water supply developments have continued, with major growth anticipated in the next 10-30 years. This is especially true in states facing water supply challenges, such as Texas, Colorado, and Georgia.

In Texas, construction of the $1.6 billion Bois d'Arc Lake was completed in 2022 and included a new major dam, 16,600-acre reservoir, treatment plant and pump stations, 60 miles of pipelines, and a transmission system (Freese and Nichols 2025). At least 23 major reservoirs (over 5,000-acre feet) and dozens of minor reservoirs, costing billions of USD, are planned for development across Texas by 2050 (TWDB 2022). In Colorado, the Northern Integrated Supply Project includes planned construction of two new reservoirs (40,000 acre-feet) for 15 water providers, several pump plants, and pipelines; also, expansion of Denver Water's Gross Reservoir for added water supply could provide 4.4 GWh of added annual generation (FERC 2025). Following the drought of 2006-2008, the Atlanta Metropolitan Planning District and the State of Georgia had eight major water supply expansion projects under planning with several completed and others under construction (McManamay et al. 2019; CCWA 2025). Hard Labor Creek Regional Reservoir Project was completed in 2018 providing almost 37,000 acre-feet of storage (WCWSA 2021).

All these projects faced some public opposition but were permitted by state, USACE, and other entities following environmental mitigation agreements. However, none of these projects included hydropower co-development, presenting a significant untapped resource potential. This suggests two potential challenges to co-development: 1) lack of social and organizational awareness (DeNeale et al., 2024) or undervaluing the energy services provided by hydropower, or 2) additional permitting, licensing, construction, and mitigation were considered cost- or time-prohibitive.

Analogous to models for new hydropower development siting (Kao et al. 2014), siting approaches for new water supply sources to meet growing demands have been developed (Okoye and McManamay 2025). These approaches include examining tradeoffs among water availability, water quality and treatment demands, energy demands for raw water transport, and costs for infrastructure and operation. Indeed, potential hydropower sites reported by Kao et al. (2014) and DOE Hydropower Vision (DOE 2016) were recently leveraged in a water supply optimization approach (Okoye and McManamay 2025). These approaches can also consider augmenting supplies with de facto reuse by co-locating wastewater treatment facilities near water supply sources. For instance, the George W. Shannon's Wetland and Water Reuse project (Tarrant Regional Water District) diverts 95 million gallons per day of water from the Trinity River (containing significant treated wastewater) into a 1,730-acre wetland for natural filtration before being pumped 50 miles back upstream to Richland Chambers reservoir for water supply distribution (TRWD 2025). When pumps are fully operating, it is estimated that the project alone uses 2% of the entire power production of the Texas electric grid. The energy demand presented by raw water distribution and treatment represents a significant opportunity and need for hydropower co-development.

Understanding the US-wide resource potential and cost estimation of conventional and pumped storage hydropower and municipal water supply co-development is a significant need to inform future research and investments. Additionally, understanding the potential technological, regulatory, and economics hurdles to the adoption of co-development measures is important to facilitate opportunities.

Near-Term Opportunity (Next 3–5 Years)

- Municipal water supply market trends: Compile a US-wide database and assessment of municipal water supply projects constructed (in the last 10 years), under construction, or planned to understand the scope of national trends, investments, stakeholders, and timelines of development. Based on reservoir and site characteristics, hydropower energy resource capacity can be estimated. This provides a template for understanding the opportunity space presented by co-development resource potential.
- Integrated siting and cost models: Combine water supply siting and cost models (Okoye and McManamay 2025) with hydropower siting models (e.g. Kao et al. 2014) and hydropower cost models (ORNL 2025a) to generate co-optimized water supply and energy production outcomes for basin-level planning. These modeled outcomes can include identifying how much energy for water distribution pumping requirements or water treatment can be offset with hydropower co-development. Models can also consider water supply augmentation via de facto re-use augmentation opportunities.

- Decision-Support Tools: Develop web-based platforms, making use of Hydrosource (ORNL 2025b), that provides mapping tools for visualizing, querying, and identifying co-development opportunities.
- Collaborative Co-Development Networks: Establish and strengthen multi-institutional partnerships among national labs, federal agencies (DOE, FERC, USGS), academia, water supply districts and utilities, electric utilities, and environmental groups to identify opportunities and challenges through workshops and publications.
- Case Studies: Select water supply projects where deep dives can generate rich detailed information informing realistic co-development opportunities: e.g., A case study of the potential energy value of hydropower to George W. Shannon's energy demand from pumping.
- Streamlined Regulatory Pathways: Collaborate with permitting authorities to clarify guidelines and reduce procedural barriers for co-development and opportunities for FERC exemption rules.

Success Measure

Success will be evaluated using quantitative and qualitative metrics derived from research progress, partnerships, pilot outcomes, and policy integration. Case studies provide critical real-world evidence linking these measures.

Quantitative Measures:

- Completion and validation of municipal water supply development and pipeline database.
- Identification of US-wide resource potential through models.
- Adoption of hydropower co-development opportunities in water plans by major water supply districts or state planning agencies (e.g., Texas Water Development Board).
- Development of streamlined technical standards supporting hydropower co-development with water supply projects.
- Documented use of decision-support tools by water supply districts and/or state water planning agencies.
- Publications documenting the market database, co-development resource potential and models, along with case studies.

Qualitative Measures:

- Formation and active engagement of multi-stakeholder research partnerships, evidenced by formal agreements, co-authored publications, and shared data platforms.
- Inclusion of modeling frameworks and decision-support tools in regulatory planning, with citations in water supply district documents.
- Positive stakeholder feedback on pilot project outcomes and tool usability, collected via workshops, interviews, or surveys.
- Increased recognition of co-development opportunities as a strategic energy-water resilience asset, reflected in federal research agendas and funding priorities.

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