



An Assessment of Conduit Hydropower Potential at Public Drinking Water Systems — Pilot Study

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Hydropower Program

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Project Summary

- This project was awarded to Telluride Energy and ORNL by the DOE Small Business Vouchers Pilot Program (SBV; www.sbv.org) in FY2017.
- The project developed a geospatial assessment method to estimate the total undeveloped conduit hydropower potential at public water systems (PWSs) that might be retrofitted with hydropower to take advantage of the expedited permitting process through the Hydropower Regulatory Efficiency Act (HREA) of 2013 and its amendments in 2018.
- Multiple public and nonpublic datasets were collected and analyzed in a pilot study for Oregon and Colorado. The assessment can be further expanded to quantify the national PWS conduit hydropower potential.

Project Objective & Impact

- Hydroelectricity potential from man-made water conduits (e.g., pipelines, aqueducts, and irrigation ditches) has been estimated as being relatively small but as having the highest development feasibility.
- Conduit hydropower does not require the construction of new dams or impoundments, involves minimum environmental concerns, entails reduced development risks, is eligible for net metering in most states, and is likely to qualify for the expedited HREA regulatory approval process.
- Mainly due to data limitations, the total conduit hydropower potential across states and/or regions is currently unknown. The resource estimate is needed to support DOE and the broader hydropower community for further policy and development planning.

Project Information

Project Principal Investigator(s)

- Shih-Chieh Kao, ORNL

WPTO Lead

- Corey Vezina

Project Partners/Subs

- Telluride Energy

Project Duration

- Project Start Date: Jul 2017
- Project End Date: Jul 2028

Hydropower Program Strategic Priorities

Environmental R&D and Hydrologic Systems Science

Big-Data Access and Analysis

Technology R&D for
Low-Impact
Hydropower Growth

R&D to Support
Modernization,
Upgrades and Security
for Existing Hydropower
Fleet

Understand, Enable,
and Improve
Hydropower's
Contributions to Grid
Reliability, Resilience,
and Integration

Understand, Enable, and Improve Hydropower's Contributions to Grid Reliability, Resilience, and Integration

- Understand the needs of the rapidly evolving grid and how they create opportunities for hydropower and PSH.
- Investigate the full range of hydropower's capabilities to provide grid services, as well as the machine, hydrologic, and institutional constraints to fully utilizing those capabilities.
- Optimize hydropower operations and planning—alongside other resources—to best utilize hydropower's capabilities to provide grid services.
- Invest in innovative technologies that improve hydropower capabilities to provide grid services.

- HREA created a unique opportunity for cost-effective small hydropower development by combining lowered permitting costs with the capability of a water treatment plant to sell energy at an economically attractive rate via net metering.
- Technologies to identify regions with higher conduit hydropower potential could help inform potential sites and expedite the growth of national low-impact hydropower development.

FY 2017		FY 2018		Total Project Budget FY 2017 - FY 2018	
Costed		Costed		Total costed	Total authorized
\$15K		\$60K		\$75K	\$75K

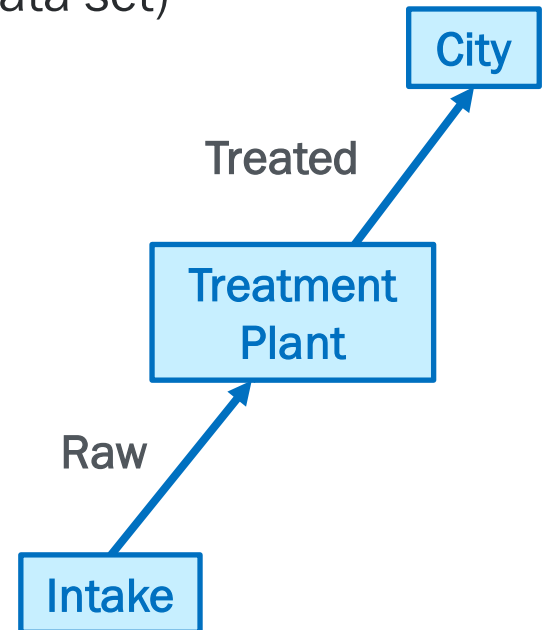
- **This project was awarded to Telluride Energy and ORNL by the DOE Small Business Vouchers Pilot Program (SBV; www.sbv.org)**
 - Additional \$15K in-kind support from Telluride Energy is not included in the WPTO budget
- **Project executed under a Cooperative Research And Development Agreement (CRADA)**

Management and Technical Approach (I)

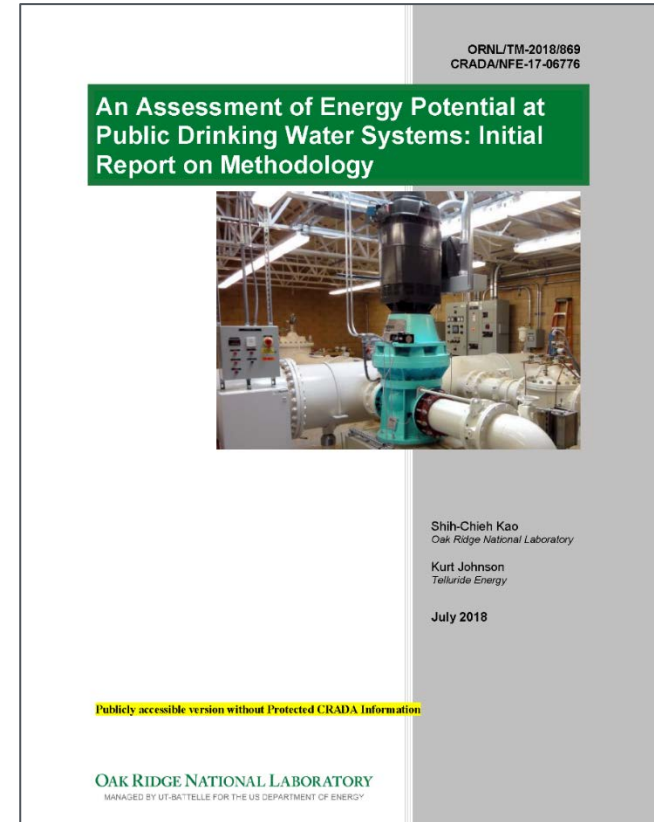
- **Data is the biggest challenge.**
 - When possible, publicly and nationally available data are used.
 - Water intake information is required but not publicly available in most states. Data Non-Disclosure Agreement was established with States and EPA.

Data Type	Source
Water intake location *	Data Acquired through Non-Disclosure Agreement
Treatment plant location	EPA Facility Registry Service (FRS)
PWS service population	EPA Safe Drinking Water Information System (SWDIS)
City boundary	Census Bureau TIGER data set
Historic water use	USGS National Water-Use Science Project
Digital elevation	USGS National Elevation Dataset (NED)
Existing hydropower asset	DOE/ORNL NHAAP/HydroSorce
Non-power dams	DOE/ORNL NHAAP/HydroSorce; USACE National Inventory of Dams

- **2-part analysis**
 - **Part 1 – raw water**, from water intake to water treatment plant
 - **Part 2 – treated water**, from water treatment plant to city center
- **Flow**
 - Average annual flow = service population (from EPA SWDIS) * historic water use (from USGS county-level data set)
- **Head**
 - Elevation drop minus estimated head loss
- **Power and energy**
 - Assume all flow can be used for generation
 - Capacity factor = 80%
 - Efficiency = 85%

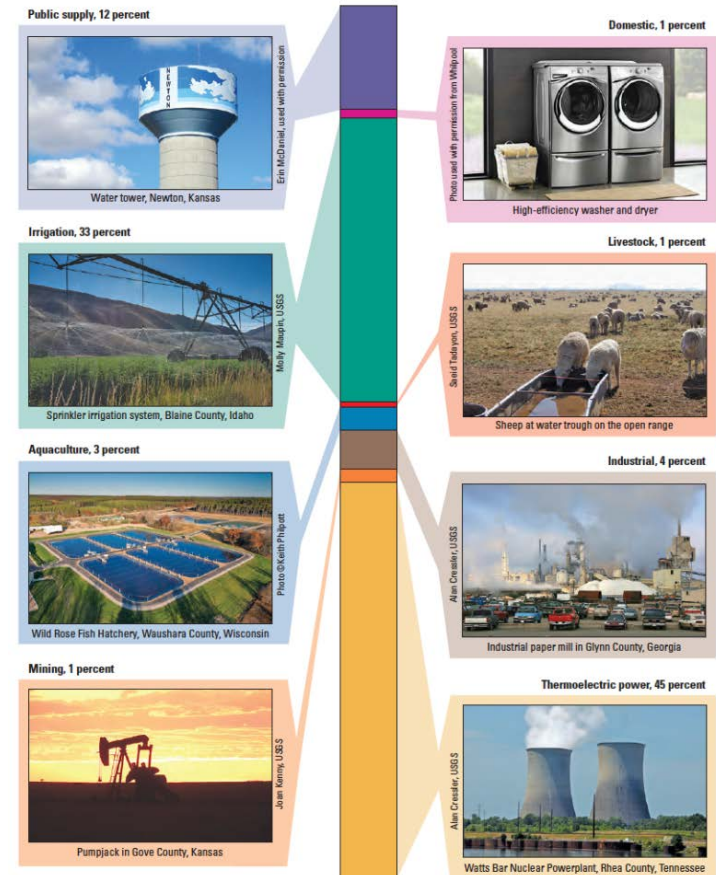


- Complete pilot study for States of Oregon and Colorado
 - EERE Success Story—[Small Business Voucher Awardee Develops Approach for Evaluating Hydropower Potential from Conduits](#)
- Main results:
 - Conduit hydropower potentials using surface water with a positive gravitational net head are identified in 89 PWSs in Oregon and 63 PWSs in Colorado.
 - The assessment shows a total 12,380 kW of potential conduit hydropower capacity in Oregon and 33,990 kW in Colorado.
 - Corresponding annual hydroelectricity energy generation is estimated to be 65,068 MWh/year in Oregon and 202,475 MWh/year in Colorado.



- **The unique nature of SBV allows close collaboration between national laboratories and industrial partners**
 - Ensure that the research outcome can be suited to the end-user's need.
 - Report available at the ORNL Hydropower Program website ([link](#))
- **The main product of this project is a publicly accessible hydropower resource assessment report that aggregates data to estimate total potential without publicly identifying individual sites**
 - To avoid revealing sensitive and site-specific data information
- **This project has a potential to transform the small hydro market.**
 - Currently, many managers of water agencies have limited knowledge of the federal reforms created by HREA and have little understanding of how small hydropower can be quickly built using existing water infrastructure. The products of this assessment can help raise public awareness more effectively.
 - As the small hydro industry develops, it should ultimately reach the point where all water agency managers realize that they should explore whether their existing water infrastructure includes opportunities for installation of small hydro generating equipment.

- **Expansion to other states**
 - Data non-disclosure agreements established with:
 - California State Water Resources Control Board (CWRCB)
 - Environmental Protection Agency (EPA)
- **Evaluate other types of conduit hydropower potential**
 - Municipal Conduit Hydropower
 - (PWS considered in this pilot study)
 - Agricultural Conduit Hydropower
 - Industrial Conduit Hydropower
- **These are to be addressed in the upcoming national conduit hydropower resource assessment**
 - New project pending final WPTO approval



Water withdrawals by sector
(Maupin et al., 2014)