

# Water Power Technologies Office Peer Review Hydropower Program

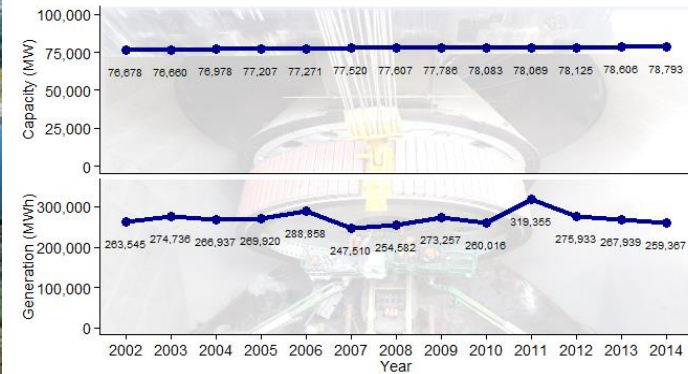
U.S. DEPARTMENT OF **ENERGY** | Energy Efficiency & Renewable Energy | WIND AND WATER POWER TECHNOLOGIES OFFICE



**2014 Hydropower Market Report**  
April 2015

Prepared for:  
The U.S. Department of Energy,  
Wind and Water Power  
Technologies Office

Prepared by:  
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## U.S. Hydropower Market and Trends Report

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**U.S. Hydropower Market and Trends Report:** It fills the existing gap regarding publicly available, accurate, and comprehensive information on U.S. hydropower fleet attributes, development activity (new projects and rehabilitations/upgrades), performance, value (as revealed by market transactions), and supply chain.

## **The Challenge:**

- The U.S. hydropower fleet is very diverse (50% federal; multipurpose nature of many facilities) and the data to describe it are fragmented.
- The slow pace of new development in recent years does not tell full story of hydropower industry activity.

**Partners:** No external partners are funded under this project

## U.S. Hydropower Market and Trends Report

### Optimization

- Optimize technical, environmental, and water-use efficiency of existing fleet
- **Collect and disseminate data on new and existing assets**
- Facilitate interagency collaboration to increase regulatory process efficiency
- Identify revenue streams for ancillary services

### Growth

- Lower costs of hydropower components and civil works
- Increase power train efficiency for low-head, variable flow applications
- Facilitate mechanisms for testing and advancing new hydropower systems and components
- Reduce costs and deployment timelines of new pumped storage hydropower plants
- Prepare the incoming hydropower workforce

### Sustainability

- Design new hydropower systems that minimize or avoid environmental impacts
- Support development of new fish passage technologies and approaches
- Develop technologies, tools, and strategies to evaluate and address environmental impacts
- Increase resilience to climate change

## U.S. Hydropower Market and Trends Report

### Optimization

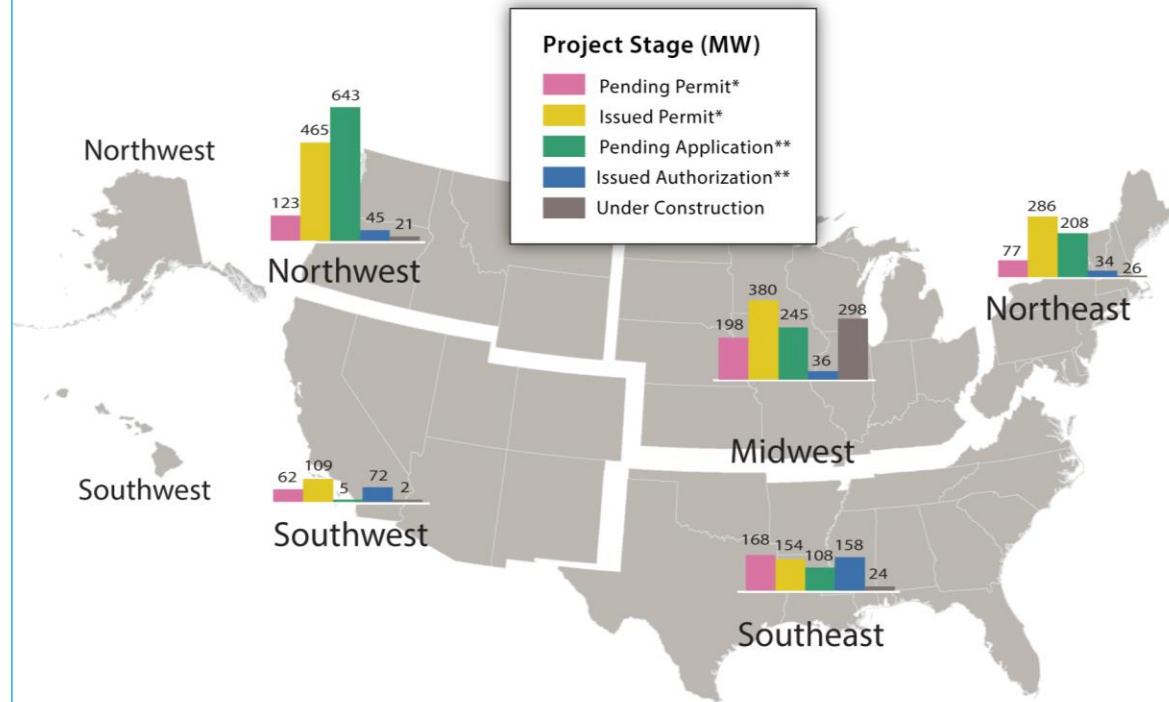
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### The Impact

- **TARGET:** develop new data sets covering topics for which comprehensive information was unavailable
  - Fleet ownership detailed categories
  - Additional purposes of hydropower dams
  - Capital investment and capacity increases associated to refurbishment and upgrades to the existing fleet
  - Attributes and development status of all active U.S. hydropower projects
  - Hydropower turbine installation activity by manufacturer and turbine type.
- Data sets and reports can be used for:
  - Improving knowledge and awareness of U.S. hydropower trends
  - Informing business decisions regarding hydropower investment and operation.
- The objective is for the Hydropower Market Report (HMR) to become a reference publication on U.S. hydropower development, performance, value, and supply chain.

## Method:

- 1. Define** a set of topics and questions to be addressed (with input from DOE and stakeholders) and map them into a report outline
- 2. Collect, standardize and analyze** data from multiple sources to develop a cohesive picture of trends shaping U.S. hydropower fleet and industry (e.g., characterize status of every U.S. hydropower project based on information from multiple sources)
- 3. Develop text, plots, and infographics** to communicate trends and snapshots of fleet attributes and industry activity (e.g., map U.S. hydropower capacity under development).



Source: <http://www.energy.gov/sites/prod/files/2016/05/f31/Hydropower-Market-Report-May-2016-Update.pdf>

## Hydropower project development pipeline by region and status (as of December 31, 2015)

# Technical Approach - II:

Different data sets require different collection and analyses approaches

## Example 1:

### Hydropower project attrition rates

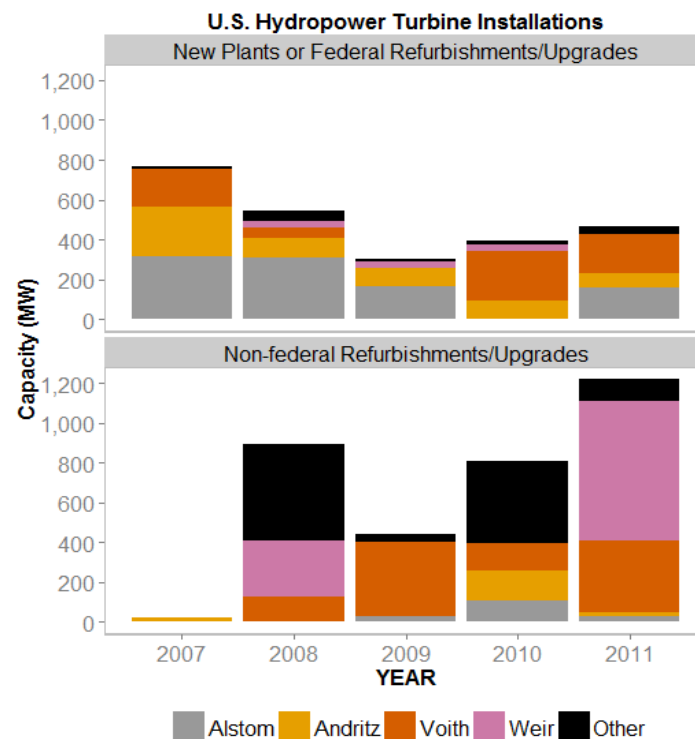
- Examine thousands of Federal Energy Regulatory Commission (FERC) dockets to extract key dates, project attributes and reasons for attrition.

| FERC Licensing Stage           | Attrition Rate |
|--------------------------------|----------------|
| Preliminary permit application | 38.67%         |
| Preliminary permit issuance    | 89.80%         |
| License application            | 21.82%         |
| Exemption application          | 21.53%         |

## Example 2:

### Hydropower turbine installation activity

- Combine data from National Hydropower Asset Assessment Program (NHAAP) and commercial project databases to capture total turbine installations
- Which fraction of installed turbines are manufactured domestically?
  - Interviews with domestic turbine manufacturers
  - Analysis of U.S. International Trade Commission (USITC) hydraulic turbine trade flow data
  - Request to USITC for more granular reporting of turbine-generator set trade flows to identify hydropower-related volumes.



**FY14**

- HMR starts being funded
- Development of report outline; data collection and analysis

**FY15**

- Write-up, review and **release of 2014 HMR**
- Multipurpose hydro valuation report

**FY16**

- Hydropower stakeholder survey
- Publication of updated key HMR metrics
- Turbine manufacturer interviews
- Analysis of project attrition rates in FERC pipeline

## 2014 HMR Impact/Recognition:

- 1504 unique downloads from DOE website (775 full report; 729 report highlights)
- Two interviews: local radio station (WUOT) and *TIME* magazine
- Invited article submission to *Irrigation Leader Magazine*
- Invited presentations: Renewable Energy World conference, National Hydropower Association CEO Council
- Data requests from a variety of hydropower stakeholders.

## Project schedule:

- Project start: FY14
- Project end: TBD
- Milestones have been met on time
  - Exception: Delay in implementation of HMR stakeholder survey due to unforeseen need for approval by ORNL Institutional Review Board.

## Go/No-Go decisions:

- FY15: Based on 2014 HMR feedback summary and status of new research, DOE decides on timing of next release
  - Outcome: full report will not be published annually but key metrics will be updated at annual intervals and published as slide decks
- FY16: DOE makes a decision on whether/when to publish a new iteration of the HMR
  - Outcome: second installment of report to be published in FY18.



| Budget History |            |        |            |        |            |
|----------------|------------|--------|------------|--------|------------|
| FY2014         |            | FY2015 |            | FY2016 |            |
| DOE            | Cost-share | DOE    | Cost-share | DOE    | Cost-share |
| \$0K           | \$0K       | \$0K   | \$0K       | \$300K | \$0K       |

Note: New Budget Authority received

- \$1,085K was received at the end of FY13 and was distributed across FY14 and FY15
- 72.6% of the project budget has been expended to date

## Partners, Subcontractors, and Collaborators:

- Postmasters researcher (Megan Johnson) subcontract with Oak Ridge Associated Universities
- Collaboration with U.S. federal hydropower owners to collect data on value of multipurpose hydropower projects.
- Collaboration with NREL's Clean Energy Manufacturing Analysis Center on hydropower supply chain analysis
- HMR provided input to DOE *Hydropower Vision* process

## Communications and Technology Transfer:

Uría-Martínez, R., O'Connor, P.W., & Johnson M. M. (2015). "2014 Hydropower Market Report." Washington, DC: Wind and Water Power Technologies Office, U.S. Department of Energy. DOE/EE-1195.

Johnson, M. M., & Uría-Martínez, R. (2015). "Assessing Hydropower in the West." *Irrigation Leader* 6 (6): 22-24

Uría-Martínez, R., O'Connor, P.W., & Johnson, M. M. (2015). "Development and Performance Trends in U.S. Hydropower." Invited presentation at Renewable Energy World Conference and Expo 2015. Las Vegas, Nevada.

Johnson, M.M., & Uría-Martínez, R. (2015). "Logistic Trends in the U.S. Hydraulic Turbine Market." Poster presentation at HydroVision International 2015. Portland, Oregon

Uría-Martínez, R., Johnson, M.M., & O'Connor, P.W. (2015). " Evolution of U.S. Hydropower Fleet Ownership and Its Implications for Incentive Design and Mode of Operation." Poster presentation at HydroVision International 2015. Portland, Oregon.

Bonnet, M., Witt, A., Stewart, K., Hadjerioua, B., & Mobley, M. (2015). "The Economic Benefits of Multipurpose Reservoirs in the United States Federal Hydropower Fleet." ORNL/TM-2015/550.

Uría-Martínez, R., Johnson, M.M., & O'Connor, P.W. (2016). "Hydropower Market Report Update". April 2016.

## FY17 Workplan:

**Thrust #1:** Improve and update existing data sets to maximize their value in answering key questions (e.g., track effectiveness of initiatives aimed at accelerating new U.S. hydropower development)

- Publish updated slide deck of HMR metrics and plots (FY17Q2)

**Thrust #2:** Develop additional content for answering new questions in next HMR

- How do U.S. hydropower development trends compare to those in other world regions?  
→International development trends (FY17Q1)
- Who buys and sells hydropower assets and output and at which price?  
→Hydropower power purchase agreements and asset sales trends (FY17Q3)
- How much does it cost to construct and operate U.S. hydropower facilities?  
→Cost and performance trends (FY17Q4)

## FY18 Workplan:

Complete full draft of HMR for review in FY18Q2 and release on April 2018

## Proposed future research:

- Collect market data from independent system operators to gain insight on hydropower operation patterns and hydropower value
- Analyze panel data set of hydropower performance variables (e.g., capacity factor) using econometric techniques to assess explanatory power of plant and regional attributes