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
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Program Strategic Priorities

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
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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.
Technical Approach - I

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).

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

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.

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.
## Accomplishments and Progress

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<th>FY14</th>
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<td>• HMR starts being funded</td>
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<td>• Development of report outline; data collection and analysis</td>
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<th>FY15</th>
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<tr>
<td>• Write-up, review and <strong>release of 2014 HMR</strong></td>
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<td>• Multipurpose hydro valuation report</td>
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<tr>
<td>• Hydropower stakeholder survey</td>
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<td>• Publication of updated key HMR metrics</td>
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<td>• Turbine manufacturer interviews</td>
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<td>• Analysis of project attrition rates in FERC pipeline</td>
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### 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 Plan & Schedule

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.
$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:


Next Steps and Future Research

**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