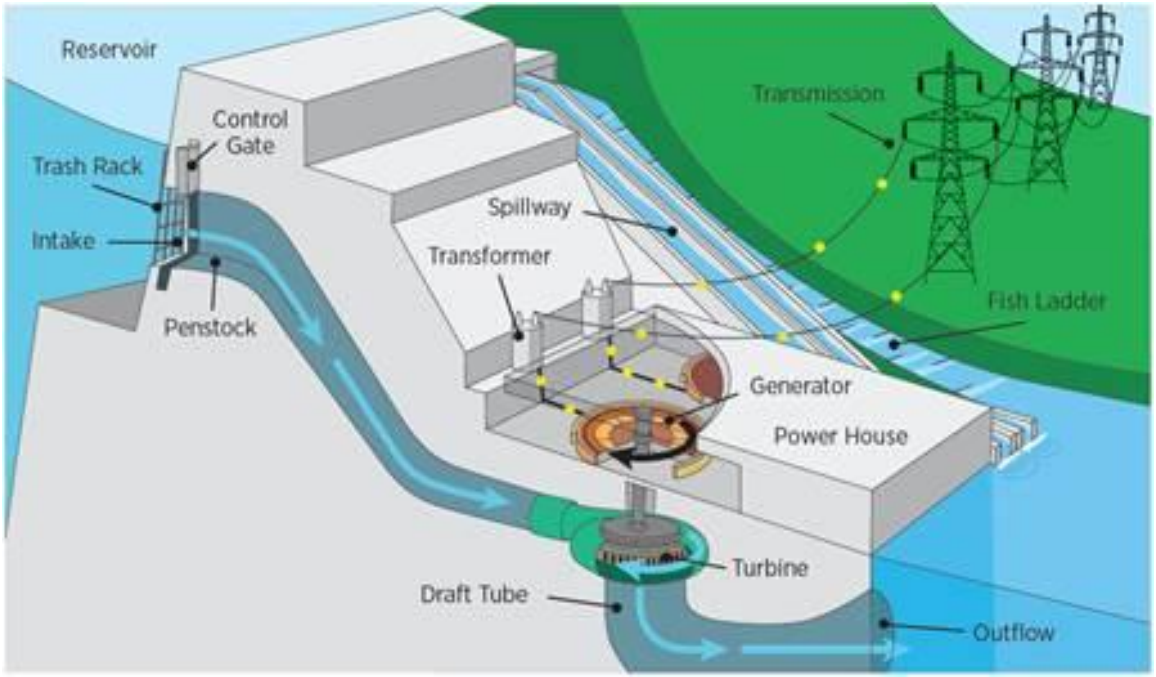

Cost Data Collection and Modeling for Hydropower

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Cost Data Collection and Modeling for Hydropower

Produces tools and insights to support WPTO in the analysis of hydropower R&D opportunities. Techno-economic modeling and analysis is a core program competency informing and enabling efforts across the R&D portfolio

The Challenge

Effective policy and R&D decision making to increase the competiveness of U.S. hydropower is not possible without a robust understanding of cost and economic realities

Partners

Electric Utility Cost Group (EUCG) Hydropower Productivity Committee (HPC), Knight Piesold, Generous industry stakeholders, National Renewable Energy Laboratory (NREL) Clean Energy Manufacturing Analysis Center (CEMAC)

Next Generation Hydropower (HydroNEXT)

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 PSH 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

Next Generation Hydropower (HydroNEXT)

Growth

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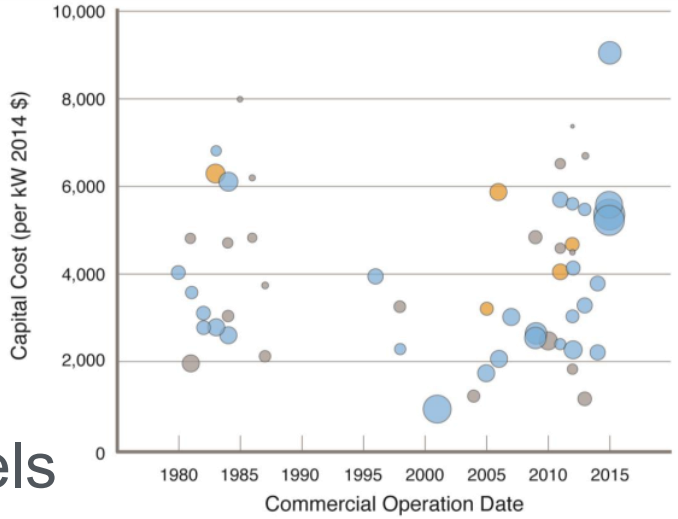
The Impact

- TARGET: Gather data, develop modeling capabilities, and conduct analyses to identify and investigate cost reduction/economic improvement opportunities to enable hydropower to compete in electricity markets
- Project facilitates data-driven decision making to benefit industry:
  - Enabling credible national-scale analysis of hydropower alongside conventional and other renewable technologies
  - Techno-economic modeling and identification of cost drivers and opportunities to support targeted R&D by DOE and industry
- Final Product: Core knowledge and tools to advance hydropower market analysis by all stakeholders

Technical Approach: National-Scale Assessment

Understanding the future role of hydropower in the United States requires an understanding of its costs and economics

1. Systematic Data Collection
   - Focus on QA/QC
   - Input to Hydropower Market Report
   - EUCG Partnership



2. High-level "Baseline Cost" models for new hydropower resources

3. Validate, apply, disseminate
   - *Hydropower Vision*
   - Policy research community

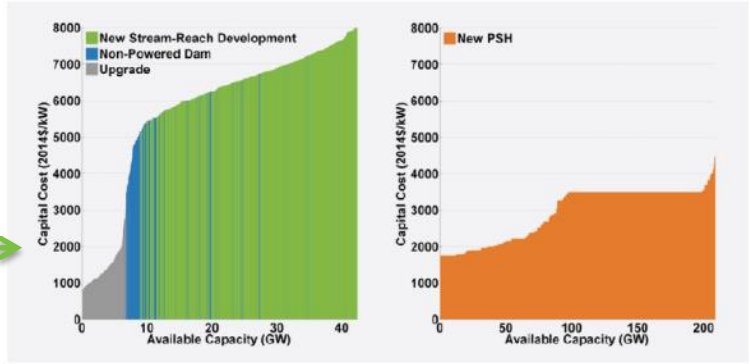


Figure B-8. 2014 Cost of hydropower resources in the *Hydropower Vision*

Technical Approach: Assessing Cost Drivers and R&D Impacts

What are the cost drivers, why, and how can technology address them?

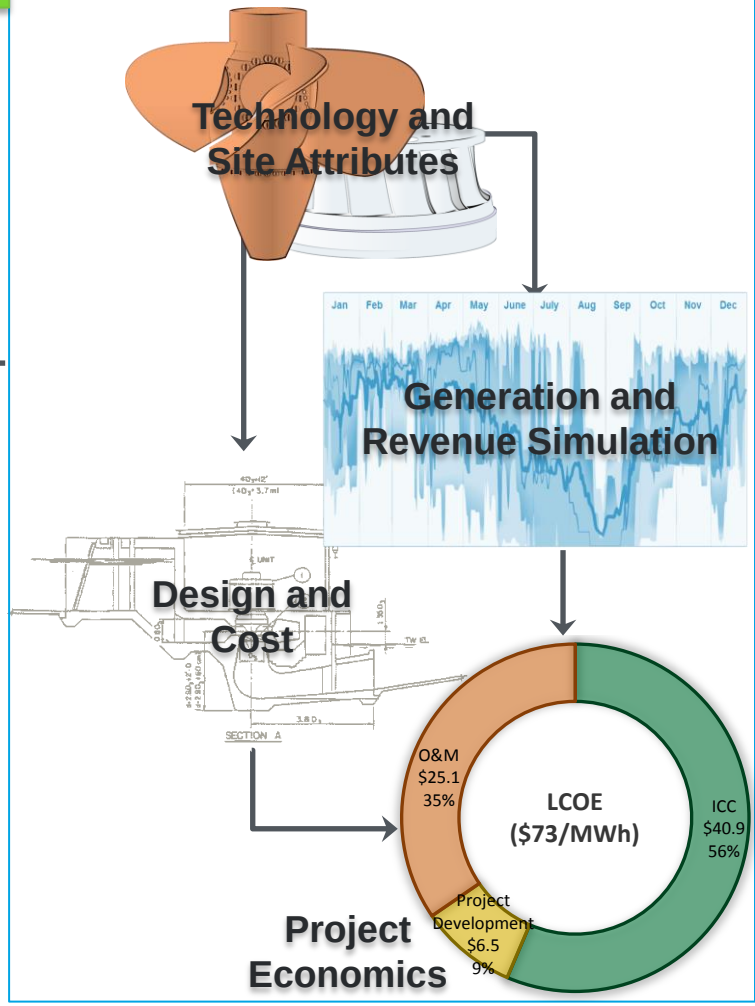
Approach: (1) Industry Engagement
(2) Build DOE Modeling Capability

Challenge: hydropower design is site specific… and so are technology and policy impacts!

Solution: leverage 100+ years of global small hydropower experience to couple site-specific modeling of equipment, civil design, and performance to economics

Outcome: Small Hydropower IDEA Model

Small Hydropower Integrated Design and Economic Assessment (IDEA) Model: Granular, reconnaissance-level, research focused, design, cost, performance estimation. Focus on US small, low-head resources.



Accomplishments and Progress

- For “new” DOE R&D program, Cost Model project developed **baseline knowledge and capabilities**
  - Data, insights from industry engagement, new models
- First U.S. national-scale cost models in **10+ years**
  - Cost inputs enabled realistic modeling in the *Hydropower Vision*
  - HydroVision 2015 Second Place Technical Paper of the Year in Market Trends and Strategies
- DOE seat at the table with **EUCG Hydroelectric Productivity Committee (HPC)**
  - Access to 100+GW of global expertise and detailed O&M data
  - Collaboratively improving benchmarking; 2015 joint HVI paper
- Small Hydropower **IDEA Model** published Q2 FY 2017
- Moving forward in FY 2017
  - Modeling capabilities to be tested, reviewed and exercised
  - Support DOE and industry technology analysis

Project Plan & Schedule

- Project initiated in Q1 FY 2014 with a planned completion in Early FY 2015
  - Initial scope was focused on data collection and QA/QC, to be followed by concurrent national-scale and techno-economic model development
- Schedule did not hold as planned
  - Unexpected loss of PI
  - *Hydropower Vision*
  - Modeling needs reprioritized to national-scale modeling and baseline cost
    - Understand potential and drivers first while building up core capabilities
- Schedule delays impacted timing but not content of deliverables

Project Budget

Budget History					
FY2014		FY2015		FY2016	
DOE	Cost-share	DOE	Cost-share	DOE	Cost-share
$2,000k	-	$0	-	$150k	-

- Project front-funded in FY 2013 and FY2014, but underspent across original schedule due to staff loss and *Hydropower Vision* prioritization

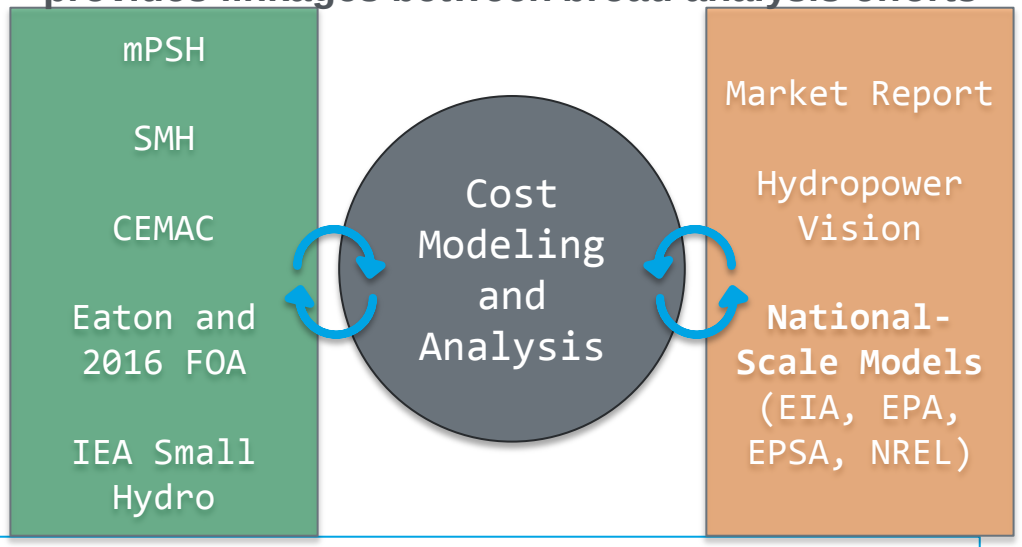
- Incremental funding received in FY2016 for partnership with NREL small hydropower manufacturing analysis project

Research Integration & Collaboration

Partners, Subcontractors, and Collaborators:

- EUCG HPC (Partner)
- Generous industry stakeholders (data)
- NREL CEMAC (partner)
- Knight Piesold (subcontractor)

Cost Model Project enables, improves, and provides linkages between broad analysis efforts



Communications and Technology Transfer:

- Award-winning conference paper analyzing national-scale economics
- November, 2015 Cost Reduction Opportunities Workshop convening diverse members of hydropower technology and development communities
- Baseline Cost and Workshop Reports, and open source Small Hydro IDEA Model available at https://hydropower.ornl.gov
- Cost+Resource data ultimately transferred to modelers and/or policymakers at EIA, Environmental Protection Agency, DOE Office of Energy Policy and Systems Analysis, NREL, and Texas A&M

Next Steps and Future Research

FY17/Current research:

- Continue benchmarking analysis partnership with EUCG
- Small hydropower manufacturing analysis with NREL
- WPTO levelized cost of energy baseline analysis and tracking strategy
- (Related) Eaton partnership.

Proposed future research:

- What wasn't built and why? Moving beyond what drives cost to what's killing projects.
- Quantifying project development risks
- The economics of projects in an uncertain world—volatile markets and a changing climate
- Valuing modularity.