Basin-Scale Hydropower and Environmental Opportunity Assessment Initiative

Investigating opportunities to improve hydropower and environmental outcomes in river basins of the U.S.

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Introduction

- Basin Scale Opportunity Assessment Overview
- Deschutes Pilot Assessment Process
- Opportunity Scenarios
- Data Visualization
- Rapid Scoping Assessments: Connecticut, Roanoke and Bighorn river basins
- Next Steps and Acknowledgements
Can we increase hydropower and improve environmental conditions within a given river basin?
Impetus for Initiating the Basin Scale Opportunity Assessment Project
MOU for Hydropower among DOE, DOI and DOA

- Signed in March 2010, MOU highlights 7 key areas for interagency collaboration.
  - Assessments of energy generation potential and analysis of potential climate change impacts to energy generation at federal hydropower facilities
  - Exploring opportunities for collaboration across entire river basins to increase generation and improve environmental conditions
  - Green Hydropower Certification
  - Federal Inland Hydropower Working Group
  - Joint development and demonstration of advanced technologies
  - Renewable Energy Integration and Energy Storage
  - Facilitate permitting for federal and non-federal projects at federal facilities

As stated in the MOU…

“A new basin-scale approach to hydropower development that emphasizes sustainable, low-impact, or small hydropower opportunities in river basins where hydropower generation could be increased while simultaneously improving biodiversity and taking into account impacts on stream flows, water quality, fish, and other aquatic resources.”

Agencies agreed to: “select one or more basins for a basin-scale opportunity assessment pilot project.” DOE funded, PNNL and ORNL technical leads.

Through interaction with National Steering Committee and stakeholder workshop, we developed guiding principles:

- Stakeholder collaboration—complement ongoing activities
- System-scale analysis
- Data aggregation, display, and dissemination
- Inform—Not meant to substitute for planning and regulatory processes
Who was involved?

- **MOU Agency Leads**—DOE, USACE, BOR

- **National Steering Committee**—
  - Hydropower and Environmental organizations, NOAA, BOR, DOE, USACE

- **Deschutes Basin Stakeholder Involvement**
  - Local, Basin-Based Logistics Team
  - Site Visits and Interviews—20+
  - Stakeholder Workshops (2) — 40+ individuals

- **Technical Team:** PNNL and ORNL
Differing Levels of Detail and Complexity

- **Phase 1 – Scoping Assessments** – rapid (approx. 6 months), initial identification, screening and classification of hydropower and environmental opportunities with a small group of basin stakeholders.

- **Phase 2 – Broad Stakeholder Engagement** - stakeholder-driven opportunity identification, prioritization, and scenario building.

- **Phase 3 – Technical Analysis** – refinement of the analysis and detailed investigation of interactions and tradeoffs between hydropower and environmental opportunities in the context of other water uses.
2. Deschutes Pilot Assessment Process (all 3 phases; 2011 to 2014)

Issues → Opportunities → Scenarios → Evaluate
Why the Deschutes?

- Model basin for collaborative problem solving with complex environmental and regulatory issues
- Central Oregon, three large sub-basins
- Unusual hydrology, ground water connectivity
- Private hydro (300+ MW facility at Pelton-Round Butte)
- Major irrigation reservoirs on Upper Deschutes and Crooked Rivers (Reclamation)
- 7 irrigation districts
- Recent experience with in-conduit hydropower and desire for more
Identify environmental issues and opportunities

- Water quality, instream habitat, groundwater recharge and natural storage, floodplain, protection status, etc.
- High-level scoping, fed by stakeholder engagement and review of existing assessments
- Focus on reach-specific opportunities related to changes in hydrologic regime
  - Enhance flow (timing, magnitude, duration, conservation)
  - Restoration (riparian health, bank stability, stream complexity)
- Previous key assessments
  - *Deschutes Subbasin Plan* (NPCC 2004)
  - *Upper Deschutes Subbasin Assessment* (UDWC 2003)
Identify hydro opportunities

- Powering non powered dams
  - BOR facilities, municipal facilities, opportunities related to irrigation reservoirs
- New small hydro in irrigation canals and conduits
- Flow shaping to maximize hydro value—Pelton-Round Butte
- Existing Reclamation, North Unit Irrigation District, Central Oregon Irrigation District assessments and stakeholder interviews
Work to Date in the Deschutes

Spring, 2011 — Site visit and meetings with environmental community, irrigators, and PGE.

- Tours of Crooked and Upper Deschutes: Bowman, Wikiup, Juniper Ridge, Ponderosa, etc.

Late Summer, 2011 — Bend, OR stakeholder workshop

- 48 stakeholders
- Opportunity identification
- Research agenda

October, 2011 — Preliminary Assessment Report

February, 2012 — Seattle modeling workshop with Bureau, OWRD, and DRC

July, 2012 — Site visit II: Scenario scoping with “Logistics Committee”

Feb1, 2013 — Second stakeholder workshop—Preliminary Results

Feb-July — Validation of new RiverWare model for daily flow evaluations

Final workshop with stakeholders in September 2014

Webinar to share final results in October

Evaluation interviews in October/November
Deschutes Phase 3

Evaluate Opportunities: ORNL Technical and Economic Feasibility Assessment for Hydropower

- Hydropower Energy and Economic Assessment (HEEA) Tool
  - Generate flow and power duration curves
  - Determine turbine design flow, net head, and technology type
  - Calculate monthly and annual power generation to determine design power capacity
  - Estimate project costs
  - Perform benefits and economic evaluations

- 14 NPDs and 15 irrigation canal/conduit sites
  - Four promising NPD sites (Wickiup, Bowman, North Canal Diversion, Ochoco)
  - Four promising canal sites (Mile 45, Haystack canal, 58-11, 58-9)
  - 19 MW capacity, 78 Gwh per year

- Power functions incorporated into PNNL RiverWare model

http://info.ornl.gov/sites/publications/Files/Pub44168.pdf
A Scenario is a Set of Multiple Interrelated Opportunities

Scenario A

- Line a canal
- Flow shaping of existing hydro

- Install new turbines
- Increase instream flows
Deschutes Scenario Scoping

- Increase minimum flow below Wickiup Dam during the non-irrigation season from 25 cfs (baseline) to 350 cfs in ~75 cfs increments

- Simulate water conservation measures by reducing baseline irrigation demand by 10 and 20 percent

Assess Tension and Tradeoffs

- Modify timing and amount of instream flow in upper Deschutes to benefit fish, water quality, and other ecological processes
- Analyze power benefits under modified flow scenarios
- Assess risk to irrigation under modified flow scenarios
Combinations of scoping variables are implemented in a mass-balance river model to simulate different management scenarios.

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Interpreting Tradeoffs and Scenarios

Data visualizations to support collaborative decision making are important.
Results

- 29 potential sites (14 non-powered dams, 15 canal/conduit sites) were evaluated for their technical and economic feasibility using ORNL’s Hydropower Energy and Economic Assessment tool.

- Results of the feasibility assessment indicated that 8 of the sites (4 non-powered dams, 4 canals/conduits) may be feasible and could add approximately 19 megawatts (MW) of hydroelectric capacity in the basin and generate over 78 gigawatt-hours (GWh) of energy per year.

- Two example scenarios were created to demonstrate the use of scenario-based modeling. The scenarios focused on exploring tradeoffs among three management goals in the Deschutes Basin:
  1) increasing hydropower assets by adding new generation at existing dams or diversions and in existing irrigation canals or conduits,
  2) increasing instream flows to benefit fish and aquatic ecosystems, and
  3) increasing water conservations and maintaining existing uses (primarily irrigation).
Next Steps: Beyond the Deschutes

- Rapid high-level assessment approach—(5 to 6 month process, rather than multiple years)
  - Driven with geodatabases and existing information
  - Map issues and opportunities to basin catchments
  - Associate hydropower opportunities with environmental issues through a rules-based approach
  - Identify site-specific hydro/environmental interactions
  - Look beyond site specific interactions to system-scale

- Rapid, Phase 1 assessments recently completed in the Roanoke and Connecticut basins, Bighorn basin assessment underway

- FY 14-15: Package tools and documenting methodologies
  - Outreach to other basin stakeholders wanting to use tools
Next Steps: Beyond the Deschutes

- Identification of Environmental and other opportunities, Roanoke river basin - VA
Next Steps: Beyond the Deschutes

- Identification of Environmental and other opportunities, Roanoke river basin - VA

New stream reach developments

- 27 sites evaluated
- 27 met screening criteria, representing combined capacity of 97.6 MW
Integrated Basin Scale Opportunity Assessment

Basin Scale Opportunity Assessment

Welcome to the Basin Scale Opportunity Assessment information portal.

Background

The Basin Scale Opportunity Assessment (BSOA) Initiative is one of seven action items in the March 24, 2010 MOU between US Department of Energy, US Bureau of Reclamation, and US Army Corp of Engineers. The goal of DOE’s Wind and Water Power Technology Office’s (WWPTO) (BSOA) initiative is to develop and implement an integrated approach to assess hydropower and environmental opportunities at the scale of a river basin. The project emphasizes sustainable, low-impact, or small hydropower and related renewable energies, while simultaneously identifying opportunities for environmental improvements in a given basin. The first two years of the BSOA project (FY11 and FY12) included a pilot study in the Deschutes River basin. Based on this experience, a three-phased assessment approach was developed and Phase 1 assessments were initiated in FY13 for the Connecticut, Roanoke and Bighorn River basins. The phases are:

- Phase 1 Scoping Assessments – rapid (approx. 6 months), initial identification, screening and classification of hydropower and environmental opportunities.
- Phase 2 Stakeholder Engagement – stakeholder-driven opportunity identification, prioritization, and scenario building.
- Phase 3 Technical Analysis – detailed analysis of interactions and tradeoffs between hydropower and environmental opportunities in the context of other water uses.

basin.pnnl.gov
We’d like to acknowledge our partnership with the U.S. Army Corps of Engineers and the Bureau of Reclamation, through the Sustainable Hydropower MOU.

The help and support from all the various basin stakeholders and our national steering committee.

And all the significant contributions of our technical team at PNNL and ORNL.