# Cataloging and Quantifying Value Streams from Non-Powered Dam Conversion

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# Background

- Hydropower is a key resource in the United States' renewable energy transition
- Only 3% of existing dams in the United States currently generate electricity
- There is perception that hydro development has long payback periods
- In addition to electricity sale, powering some non-powered dams (NPDs) may unlock new value streams that could increase the feasibility of retrofit projects

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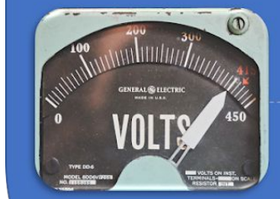
# Key Outcomes

- We catalog these value streams
  - Specify the stakeholder affected
  - Identify quantification methodologies
  - The intended purpose is to enable conversations between key stakeholders and elucidate pathways to remuneration
- Demonstrate the quantification of some value streams for a selected NPD site
  - Recreation
  - Fish habitat

# Catalog Structure




Value Streams

Power

Use

Owner-Operator Impacts

System Impacts

Remuneration

Non-Remuneration

Grid & Financial

Non-Power

Use

Non-Use

Existence

Bequest

Community & Environment

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# Catalog

- Each row in the catalog is a value stream that can results in positive, negative, or neutral impact
- The catalog distinguishes retrofit value streams as community, environment, or grid/financial impacts
- This is done to map to the sectors or stakeholders who may be relevant in discussing these potential value streams

# Columns in Catalog

- Category
  - community, environment, or grid/financial
- Power/Non-Power
- Use/Non-Use
- Owner-operator/System impacts
- Remuneration to owner-operator
- Affected entities
- Impact
- Description
- Metrics
- Valuation approaches
- Difficulty to undertake
- Relevant literature

| Category | Value stream | Power/Non-Power | Use/Non-use | Owner-Operator/ System Impacts | Remuner-ation to Owner-Operator | Affected Entities | Positive or Negative Impact | Description | Metrics | Valuation Approaches | Difficulty to Undertake |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Community | Improved energy reliability | Power | Use | NA | No | Industry/community/utility/ RTO or ISO | Positive | More reliable power for local industries may allow for increased economic growth for the company. | Probability, duration, frequency, time of outages by customer group (SAIDI, SAIFI, CAIDI, CAIFI, ASAI); Customer-level reliability metrics (CEMI, CEMSMI, CEMM, CELID) | Stated preference; market-based methods, regional economic modeling | If use existing tools (e.g., ICE calculator), fairly simple. If pursue independently, fairly difficult. |
| Community | Local economic development | Non-power | Use | NA | No | Local economy | Positive | Potential job creation, including temporary construction & permanent operational/maintenance jobs and related spending. Potential to bring additional industry to local communities. Local (dam community) job creation likely less with simple retrofits in comparison to hybrid projects. | Number of jobs created, regional impacts to GDP (direct, indirect, induced effects) | Input-output analysis, CGE models | Medium - data usually purchased from IMPLAN |
| Environment | Recreation | Non-power | Use | NA | No | Residents, recreational users | Mixed | Access to river, including for recreational uses, may be impacted. (Access impacts for local recreational use could be positive if dam redevelopment includes additional access points.) | Number of trips per year; Value attributed to recreational activities; willingness to pay for access to recreational areas | Travel cost method; stated preference | Easy if there is data available on recreational activity at the site |
| Environment | Reduction of emissions | Non-power | Use | NA | No | Society/local community | Positive | If replacing carbon-emitting generation, can avoid emissions. Societal costs associated with emissions can be reduced. Local air quality may also potentially be improved. | Tons CO2eq per year; value of social cost of carbon | Market observation | Relatively easy |
| Grid/Financial | Inertial reponse | Power | Use | System | No | Utility/PMA/ISO or RTO | Positive | Sub-second response to transfer kinetic energy into electrical energy. Enabled by batteries. Not a market product - avoided costs can be calculated. | Rate of change of frequency | Dynamic simulation | Simulation can be quite complex |
| Grid/Financial | Increased grid flexibility (e.g., ramping and load following) | Power | Use | System | No - Ramping and load following compensated though | Dam owner or operator/utility/ PMA | Positive | Generation can potentially allow flexibility with other resources and grid operations. Utilities may save costs which could be passed through. PMAs can offer contracts for short-term sales and purchases, as well as seasonal power sales. | Periods of flexibility deficit, expected unserved ramping, insufficient ramp resource expectation, cost and/or price volatility | Dynamic simulation | Simulation can be quite complex |

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# Grid/Financial Value Streams

- Hydropower can provide many services to the grid
- Some of these can be remunerated through market participation
- Some may require negotiating a bilateral contract
- Some such as reduced curtailment provided avoided costs to other parts of the grid
- Two value streams are costs

| Grid/Financial Value Streams |
| --- |
| **Benefits** |
| Energy revenue/savings<br>Price arbitrage<br>Capacity<br>Regulation<br>Blackstart<br>Transmission upgrade deferral and congestion relief<br>Distribution upgrade deferral<br>Primary frequency response<br>Voltage support<br>Reserves<br>Inertia<br>Grid flexibility<br>Reduced curtailment<br>Renewable Energy Credits |
| **Costs** |
| Operating costs<br>Capital costs |

# Community Value Streams

- None of these value streams are typically remunerated to the dam owner or operator
- Affect the populace near the site
- Some of these value streams are widely utilized for regional economic value
  - tax revenue, economic development
- Others have been identified as important metrics for equity analyses, but are rarely monetized
  - energy sovereignty, reduced energy burden
- Reliability and resilience are measured using a variety of metrics
  - SAIDI, SAIFI etc.

| Community Value Streams |
| --- |
| **Benefits** |
| **Reliability** |
| **Enabling industry** |
| **Property value** |
| **Tax revenue** |
| **Economic development** |
| **Renewable goals** |
| **Energy sovereignty** |
| **Reduced energy burden** |
| **Resilience** |

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# Environmental Value Streams

- Environmental value streams are not remunerated to the dam owner or operator
  - Important to the site's licensing and permitting.
- Many of these value streams have mixed impacts, dependent on site characteristics
  - Value stream could be neutral, negative, or positive in some circumstances.
  - Powering a dam may inhibit fish passage, but including new fish passage equipment as part of a retrofit project would improve passage

| Environmental Value Streams |
| --- |
| **Benefits** |
| Emissions reduction<br>Reservoir existence |
| **Mixed impact** |
| Fish passage<br>Recreation<br>Flood risk<br>Fisheries<br>Water availability<br>Water temperature<br>Flows<br>Forebay elevation<br>Dissolved oxygen<br>Nutrification/eutrophication<br>Erosion/turbidity<br>Stream/river existence |

# Quantifying Value Streams

- Quantification methodologies vary depending on the value stream
- Quantifying the value stream requires monetization of the impact
- Value streams that have impacts to power systems often have methods of measurement, even if they do not exist as a market product
- Several non-market valuation methods have been developed to understand the value of environmental goods and services:
  - travel cost models, hedonic property value methods, stated preference surveys, and resource equivalency analysis
- Community value streams can be quantified through methods like input-output analysis, computable general equilibrium models, stated preference, and market-based methods

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# Case Study: Site Description and Background

- We demonstrate the quantification of two value streams, recreation and fish habitat, at a proposed retrofit in Pennsylvania – the Allegheny Lock and Dam No. 2
- Rye Development has proposed a retrofit to incorporate 8.46 MW of hydropower generation at the site
- Project plans include the addition of:
  - Restroom facilities
  - Fishing platform with a ramp and walkway leading to it
  - Paved access and parking for eight vehicles

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# Case Study – Recreational Value

- We use the benefit transfer (BT) method to quantify the value of the potential recreational improvements
- BT uses values from a study at a different location and applies them to the current setting
- First, we estimated the number of annual visitors to the site based on surveys conducted as part of the FERC licensing process
- We use a meta-analysis value transfer for the total value of the current recreation in the area using Rosenberger (2016)
- Fishing, hiking, motor boating, and general recreation
- We use a single study transfer for the change in value from the proposed additions (Timmins and Murdock, 2007)
  - Addition of restroom, paved road and the parking lot

# Case Study - Recreation Value Results

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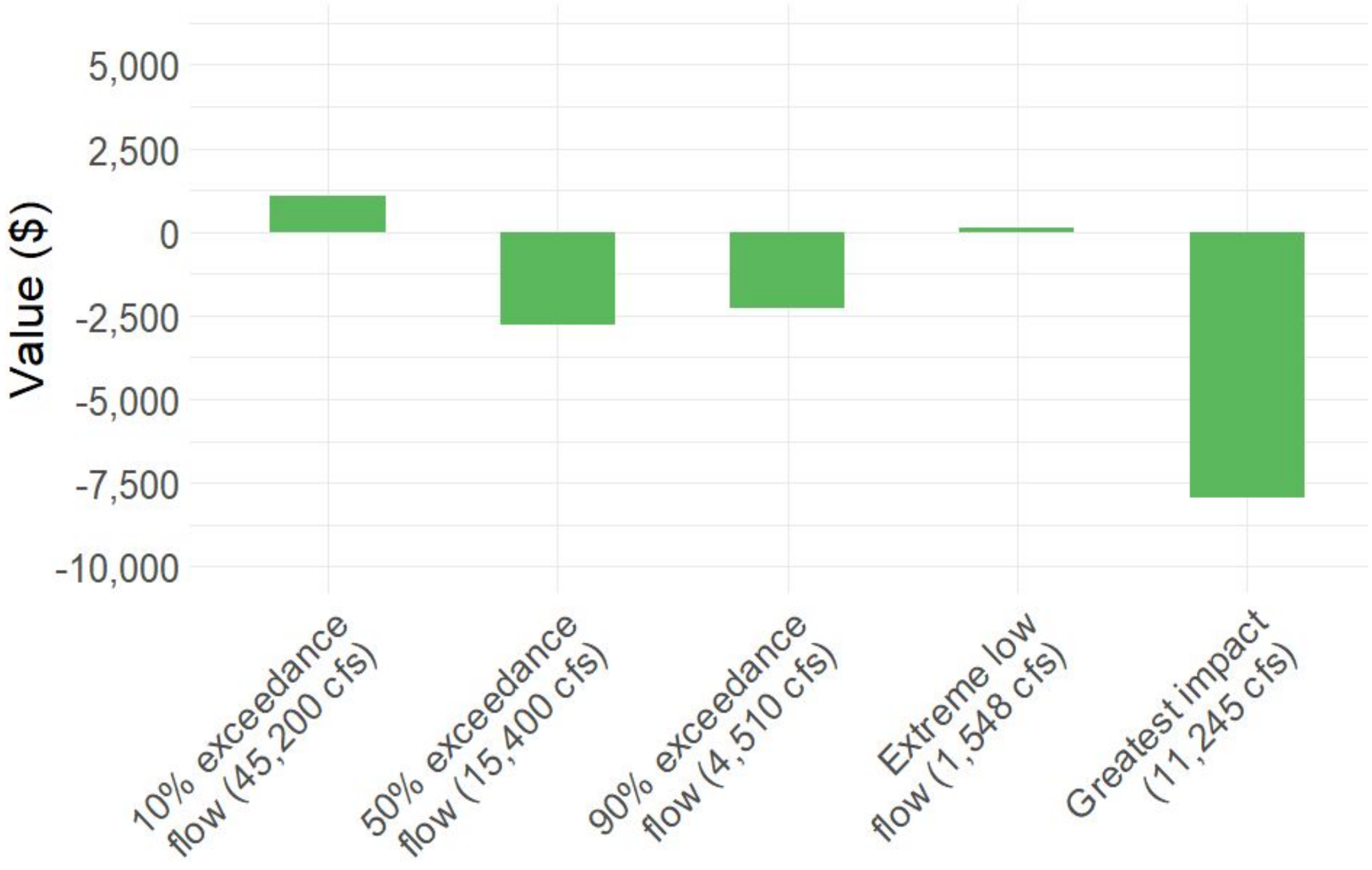
# Case Study – Fish Habitat Value

- FERC licensing documentation estimated changes in weighted useable area
- We use BT method to estimate monetary value of this fish habitat
- Johnston & Ramachandran (2014) - $0.025 per household per acre
- Used an estimate of 183,000 households that are within the city of Pittsburgh

# Case Study – Fish Habitat Results



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# Next Steps

- We are working on a site-specific NPD feasibility assessment tool that will include several modules
  - Site viability
  - Grid integration
  - Techno-economic analysis
  - Community benefits
- Results from this project are being developed to include in the community benefits module

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# Community Benefits Module

- Users can select a prospective dam
- Tool will combine many data sources and provide information about a potential retrofit project
- Users will be able to enter input data
- Tool will compute monetary value for these value streams
  - Recreation
  - Fish Habitat
  - Grid Resilience (Reduction in frequency or duration of outages)
  - Local economic development

# Conclusion

- The catalog can be used to identify potential value streams
- Methods outlined can provide a starting point for quantifying values
- Case study using benefit transfer demonstrates that values can often be quantifying without requiring the cost of an original study.

Report and catalog

Link to press release

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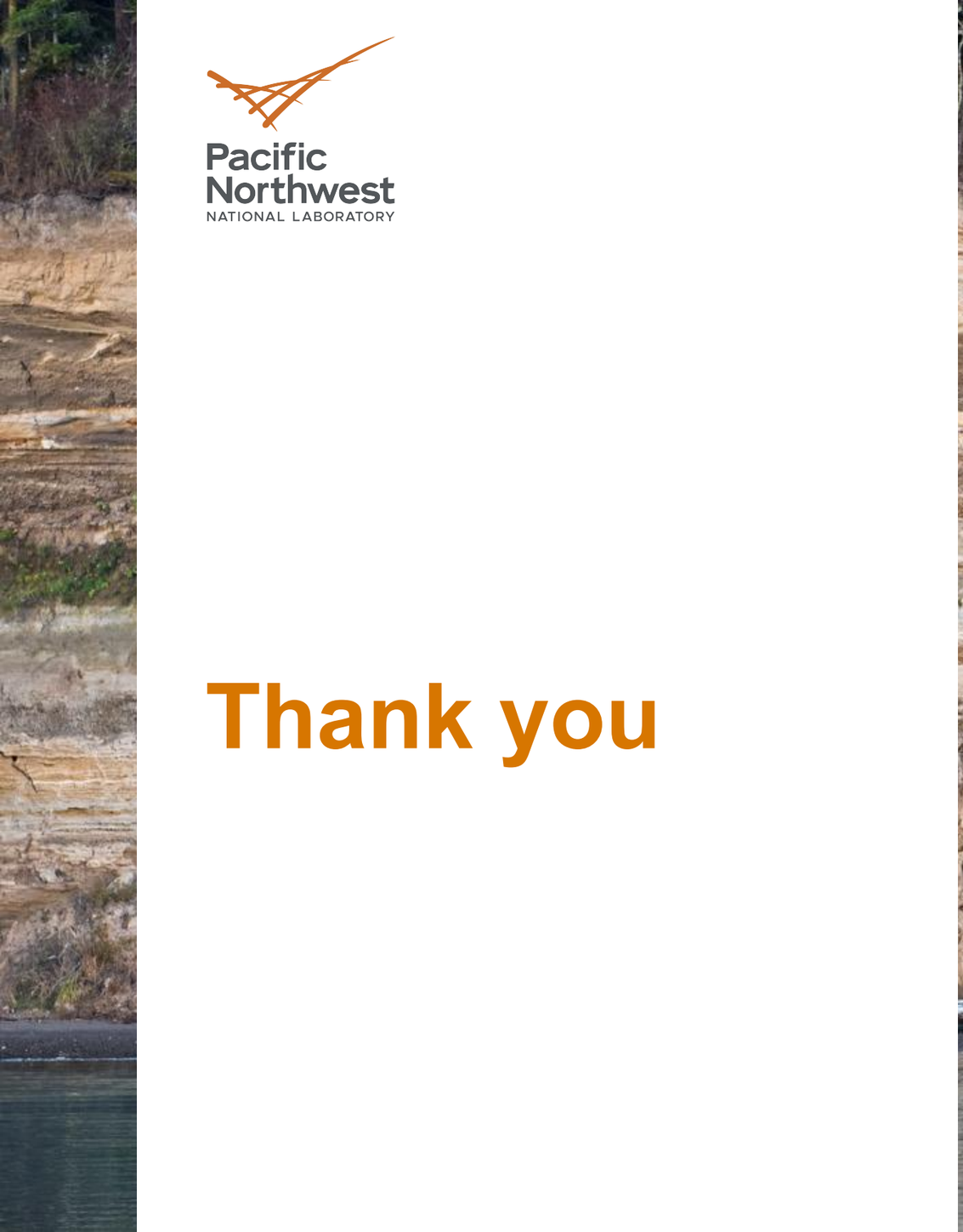
# Thank you



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