REINVIGORATING HYDROPOWER

A cornerstone of our clean, affordable, reliable electric future

Prepared by National Hydropower Association and Chelan County Public Utility District
Between 2019 and 2030, the federal operating licenses of 325 hydropower projects will expire (an installed capacity of over 16 gigawatts)

Licensees are evaluating whether and how to relicense projects, and at what acceptable cost.

- Markets that undervalue hydropower grid services
- State renewable portfolio policies limit hydropower eligibility and tax policy disfavors hydropower
- Corporate purchasing policies favor “new” wind and solar
- Hydropower has the longest licensing process of any generating resource
- Research budgets underfund hydropower compared to other resources
- Quality and contracting issues are affecting equipment longevity
Wind and solar power have grown exponentially over the last decade. Hydropower has remained fairly steady, depending on water availability.
Growth by Decade

U.S. hydropower (80 GW) and pumped storage hydropower (20 GW) annual capacity additions and cumulative capacity from 1890–2015 (GW)


Annual Capacity Additions (GW) | Cumulative Capacity (GW)
How does hydro fit into the reliability conversation?

- Carbon emission reduction should and will lead to more solar/wind.
- High levels of intermittent renewables create temperature excursion risk.
- Hydropower is uniquely positioned to support integration.
- Predictions for capacity shortfall in the Northwest would be exacerbated by hydropower retirements.
- Need for resource adequacy is apparent.
Hydropower is a premier generating resource.

<table>
<thead>
<tr>
<th>Resource Type</th>
<th>Flexible Capacity</th>
<th>Firm Capacity</th>
<th>Annual energy</th>
<th>Regulation</th>
<th>Spin reserves</th>
<th>Non-spin reserves</th>
<th>Long-Term Storage</th>
<th>Inertia</th>
<th>Black Start</th>
<th>Carbon-Free</th>
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<tbody>
<tr>
<td>Hydroelectric (large project)</td>
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<td>yes</td>
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<td>Gas (CCCT)</td>
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<td>yes</td>
<td>yes</td>
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<td>yes, could be limited</td>
<td>no</td>
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<td>yes</td>
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<td>no</td>
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<td>yes, limited by energy potential</td>
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<td>no, possibly using synthetic product</td>
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</table>

**Figure 6. Generator Reliability Attribute Matrix**

- **Essential Reliability Services (Frequency, Voltage, Ramp Capability)**
- **Fuel Assurance**
- **Flexibility**
- **Other**

- **Resource Type**
  - Hydro
  - Natural Gas - Combustion Turbine
  - Oil - Steam
  - Coal - Steam
  - Natural Gas - Steam
  - Oil/Diesel - Combustion Turbine
  - Nuclear
  - Battery/Storage
  - Demand Response
  - Solar
  - Wind
How does hydropower fit into the carbon conversation?

- Meeting decarbonization goals becomes significantly more challenging and costly should existing zero-carbon resources retire.
- The NW’s zero-carbon generation fleet includes 31,000 MW of hydroelectric capacity and 1,200 MW of nuclear.
- Zero-carbon fleet retirements would make it much more difficult and expensive to meet decarbonization goals.
- 2017 study by Energy and Environmental Economics found that replacing 3,400 MW of existing hydro and nuclear generation would require nearly 5,500 MW of new wind and solar generation as well as 2,000 MW of natural gas peaking at an annual cost of $1.6 billion by 2050.
Due to large fleet of existing zero-carbon resources, electric emissions intensity in the Pacific Northwest is already below other regions in the United States.

2013 Regional GHG Intensity of Electricity Supply (tons/MWh)

2013 emissions intensity: 0.26 tons/MWh (includes out-of-state coal resources)

Figure developed using data gathered from state 2013 GHG inventories for Washington, Oregon, and California; supplemented with data from EIA Annual Energy Outlook 2016.
Cost of GHG Reduction

Costs of achieving deep levels of decarbonization increase non-linearly
In the Reference Case, lost capacity and energy is replaced with natural gas generation.

In the 80% GHG Reduction Case, lost energy is replaced with 5500 MW of renewables and lost capacity is replaced with 2000 MW of gas generation.

Higher value in a carbon constrained world reflects the significant increase in cost to meet GHG policy goals should existing low carbon resources retire.

Energy + Environmental Economics
A Call to Action: Six Policy Recommendations

- Design Markets that Value Hydropower Services
- Choose Technology Neutral Policies for Carbon Reduction Goals and Levelize Incentives
- Improve the Hydropower Licensing Process
- Allow Reinvestment in Existing Hydropower to Meet “Additionality” Criteria
- Improve Project Performance (Increase R&D)
- Improve Contracting and Quality Control Practices
Hydropower is the quiet, overlooked sibling in the world of carbon-free, non-emitting resources.

Significant hydropower resources are aging and would be de-optimized without significant reinvestment.

Optimal policies can re-energize hydropower to support the next-level grid and achieve higher environmental targets at lowest cost.

There needs to be a conscious effort to reset and reshape policies based on today’s realities.