



April 2019

REINVIGORATING HYDROPOWER

A cornerstone of our clean, affordable, reliable electric future



CHELAN COUNTY

Prepared by
**National Hydropower Association and
Chelan County Public Utility District**

Hydropower is a premier renewable resource. For over a hundred years, our nation's hydropower projects have helped optimize river systems to accomplish multiple objectives and provide inexpensive power. These hydropower projects were the catalyst for businesses to succeed and communities to grow. They control floods, manage droughts, supply water, irrigate crops, support fish species and natural resources and create recreational opportunities. Today, they play an increasingly critical role in the modern electric system as our nation pursues a low-carbon, affordable, reliable and resilient grid. **A new look at hydropower in the public policy arena can unleash the capabilities of this technology for the next 30 years.**

The Department of Energy recognizes hydropower as the country's first renewable resource¹, but does that mean hydropower is yesterday's generation? Policy debates often take hydropower for granted while focusing on other technologies. Yet, twenty-five years post-enactment of the wind production tax credit (and more than a decade after establishment of the 30 percent solar investment tax credit),² these technologies have matured into robust industries, making significant contributions to the nation's energy supply. In recent years, the public policy debate has turned to the value of capacity and the role of coal and nuclear resources in assuring grid resiliency. Where does this leave hydropower?

There are 101 gigawatts of installed hydropower capacity in the United States.³ It is the grid's silent partner, providing emission-free power and flexibility services ideally suited for a transforming electric system. Yet renewable hydropower labors under regulatory



Turbine Crew at Wanapum Hydroelectric Project in Washington State (photo courtesy of Grant County PUD)

policy designed for the past and market rules written to support other fuel types. Hydropower capacity grew significantly from the 1930s through the 1990s, and though some projects are being built and expanded today, only 3 percent of the nation's existing dams produce hydropower.⁴

By 2032, about 325 hydropower project licenses – representing 16 gigawatts of capacity – will expire.⁵ Owners must choose whether to relicense these projects or surrender and decommission them. To meet the demands of the new grid, substantial refurbishment investments are needed just to maintain existing capabilities. Meanwhile, the hydropower industry receives little public policy encouragement for its tremendous investments to co-optimize generation, recreation, flood control, and fish protection. Yet hydropower possesses the attributes necessary for a reliable, carbon-free, affordable modern electric grid. Hydropower is playing a largely unrecognized role as the nation reinvents the production and delivery of electric power. It can do more – if these benefits are recognized and its potential is unleashed.

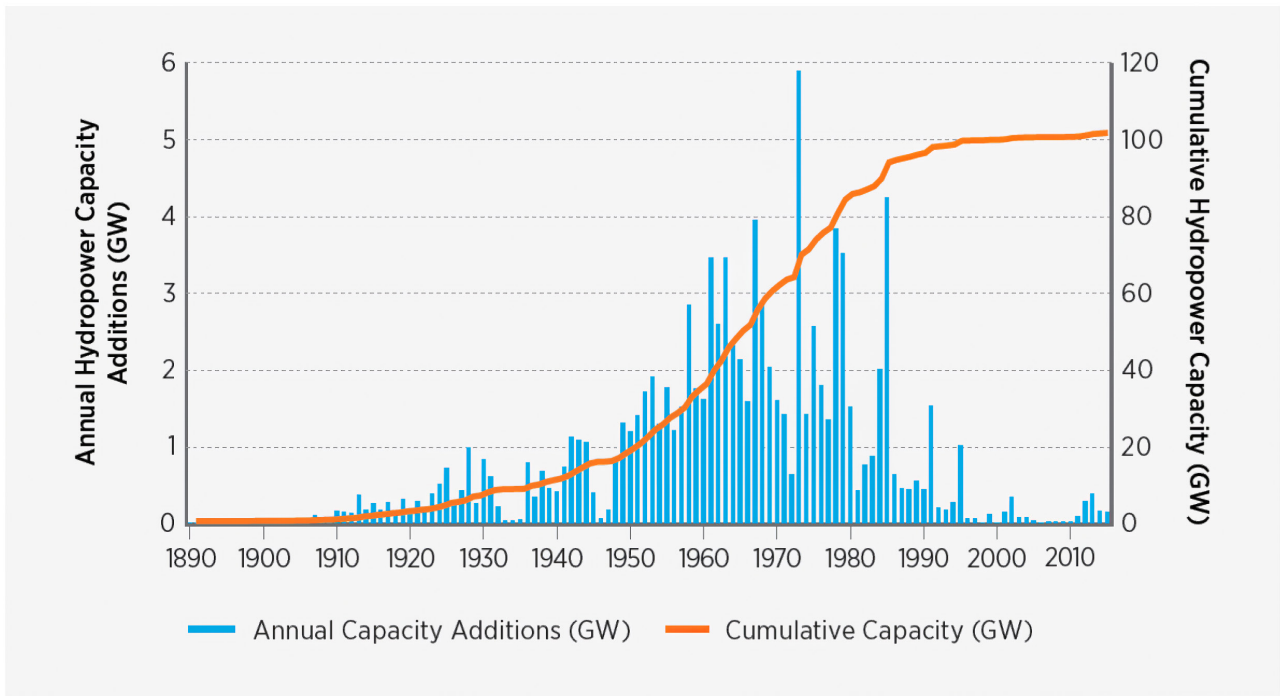
1. [Hydropower Vision: A New Chapter for America's 1st Renewable Electricity Source.](#)

2. *The Energy Policy Act of 1992 enacted the wind PTC. The Energy Policy Act of 2005 enacted the 30% solar ITC.*

3. *Ibid.* Data from 2015.

4. *Department of Energy. Top 10 Things You Didn't Know About Hydropower.* April 27, 2015.

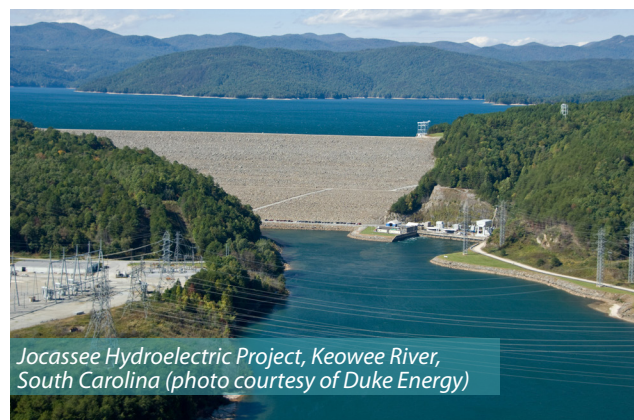
5. *FERC: Expected Relicense Projects FY2017-FY2032.*



U.S. hydropower and pumped storage annual capacity additions and cumulative capacity from 1890-2015 (GW).⁶

Today, the installed capacity of wind exceeds the conventional hydropower system,⁷ and solar has grown to 60 gigawatts.⁸ Successful policies for these resources revolutionized their potential. Now, it is time to reset the antiquated policies holding back a hydropower revolution. Regulation and market design need to reflect today’s realities. **Hydropower can be a strategic partner with wind and solar in achieving environmental outcomes and grid optimization.** But without significant public policy changes, the country risks losing hydropower capacity and associated grid benefits. To retain and expand our nation’s hydropower assets, policy makers should:

- Design markets that value hydropower grid services;
- Choose technology neutral policies that achieve societal goals for carbon reduction and levelize incentives;
- Allow reinvestment in existing hydropower to meet “additionality” criteria;
- Improve the hydropower licensing process;
- Expand federal and state R&D for hydropower and support the industry’s digital transformation;



Jocassee Hydroelectric Project, Keowee River, South Carolina (photo courtesy of Duke Energy)

6. *Hydropower Vision Report, Chapter 2, Figure 2-3.*

7. *Energy Information Administration, March 6, 2017. In 2016, there was 81,312 MW of wind versus 79,985 for hydropower. However, hydropower continues to have a higher average capacity factor.*

8. *U.S. Solar Market Insight, updated December 13, 2018.*

- Improve contracting and quality control practices to encourage long-term investments.



Why Hydropower?⁹

Hydropower is unique among generating resources because it can provide nearly all the attributes necessary for a reliable and resilient electric grid from dependable capacity to black start capability.¹⁰ Importantly, its ability to ramp up or down quickly in response to consumer demand or to offset variable energy resource production is valuable in a rapidly evolving electric system. As the grid integrates more and more variable energy resources such as wind and solar, hydropower's ability to provide firm capacity, frequency response, voltage support, load following and long-term storage is increasingly critical. While each plant is different and some (particularly larger projects) have greater capabilities than others, hydropower projects have the characteristics defined as necessary to affordably help meet the nation's reliability requirement. These are also high-value services:

- **Firm Capacity (i.e. Installed Capacity).** Hydropower systems are built to take advantage of high stream flows and hence have available capacity that can be called upon to meet system peaks.
- **Annual Energy.** Even though stream flows can vary, hydropower is a reliable resource that produces energy throughout the year. Hydropower generation can be forecasted with a high degree of accuracy. Reservoir storage at individual dams, and system-wide, can facilitate the best coordinated use of water.
- **Regulation and Frequency Response.** Hydropower projects can provide frequency regulation by responding within 4 seconds to meet reliability merely by allowing more water to pass through turbines using automatic generation control — or simply by relying on large machine inertia. Fast load ramping rates provide rapid frequency response without generating carbon emissions. The control systems used on hydropower units (governor controls) provide the arresting frequency response, as well as the initial recovery response to major system events, to protect consumer equipment and provide electric grid reliability.
- **Spinning Reserves.** Because hydropower projects generally have some turbines that are not being fully utilized, hydropower is a natural fit for supplying reserves that can respond to load changes in as fast as 10 seconds.

9. While this white paper focuses on traditional hydropower projects, the industry is made up of many technology sectors including pumped storage, conduit power and marine energy and instream hydrokinetic projects. All of these technologies have an important role to play in meeting our nation's energy and environmental goals within a modernized grid system.

10. See also Comments of the Public Utility District No. 1 of Chelan County, Grid Resilience in Regional Transmission Organizations and Independent System Operators, May 9, 2018. FERC Docket NO. AD18-7.

- **Non-Spinning Reserves.** Hydropower units are able to quickly turn on and provide power in less than 10 minutes, and can maintain output for an extended period using less than fully utilized turbines. Since hydropower is capable of responding in less than 10 minutes, some markets have begun to differentiate a fast ramp product, which can realize hydropower's value.
- **Flexible Capacity.** Many hydropower projects are flexible enough to adjust generation during the day to assure loads and resources stay in balance. This flexibility is critical in integrating wind and solar, especially during steep ramping events, such as those experienced in California and other regions.
- **Long-Term Storage.** Many large conventional hydropower projects can provide storage capability with reservoirs, providing opportunities to better balance loads and generating resources. Some storage projects have reservoirs that can store water for months at a time to release when needed. Run-of-river projects can often work with each other and other storage projects to optimize generation. In addition, pumped storage hydropower provides significant energy storage capacity, representing 95 percent of the energy storage in the U.S. today. It is the proven, cost-effective and reliable utility-scale energy storage innovation available.
- **Inertia.** Hydropower units are a source of inertia that help avoid widespread blackouts by providing large rotating mass. Inertia can stabilize the grid by

slowing frequency declines or increases and damping the oscillations that can occur when there is a sudden change of large generation or load. Some hydropower units can provide inertia to the grid without having to generate.

- **Black Start.** During outages, hydropower can help restart the power system without support from the transmission grid, enabling other generators to come online. Units can be operational very quickly (within minutes); their output can be continuously adjusted without impact; and they can provide stable system restoration.
- **Carbon-free.** Hydropower generation is carbon-free. Northwest electricity has roughly half the carbon intensity of the U.S. average, in large part due to hydropower.¹¹

Across the country, hydropower's attributes are increasingly being recognized by grid operators as essential to the safe and reliable functioning of the grid system. In PJM's 2017 Evolving Resource Mix and System Reliability report,¹² hydropower was rated as the resource that provides the most grid reliability and resiliency services. The report identified 13 generator reliability attributes. These included: 1) essential reliability services (frequency, voltage and ramp capability); 2) fuel assurance; 3) flexibility; and 4) other attributes (blackstart, no environmental restrictions, equivalent availability factor). PJM found hydropower to provide some or all of the needed attributes in 12 of the 13 categories (again, including blackstart) – the best result of all the resources analyzed. The chart is excerpted here.

11. EIA data. *The Northwest is defined as all generation in ID, MT, OR & WA plus Jim Bridger and 50% of Valmy. See The Value of Hydropower to the Northwest Grid.* PNUCC, November, 2016.

12. *PJM's Evolving Resource Mix and System Reliability.* March 30, 2017.



Figure 6. Generator Reliability Attribute Matrix

Resource Type	Essential Reliability Services (Frequency, Voltage, Ramp Capability)					Fuel Assurance		Flexibility			Other		
	Frequency Response (Inertia & Primary)	Voltage Control	Ramp			Not Fuel Limited (>72 hours at Eco. Max Output)	On-site Fuel Inventory	Cycle	Short Min. Run Time (<2 hrs./ Multiple Starts Per Day)	Startup/ Notification Time < 30 Minutes	Black Start Capable	No Environmental Restrictions (That Would Limit Run Hours)	Equivalent Availability Factor
			Regulation	Contingency Reserve	Load Following								
Hydro	●	●	●	●	●	○	◐	●	●	●	●	◐	●
Natural Gas - Combustion Turbine	●	●	◐	●	◐	●	○	●	●	●	●	◐	◐
Oil - Steam	●	●	●	●	●	●	●	●	○	○	○	○	◐
Coal - Steam	●	●	●	●	●	●	●	◐	○	○	○	◐	◐
Natural Gas - Steam	●	●	●	●	●	●	○	●	○	○	●	◐	◐
Oil/ Diesel - Combustion Turbine	●	●	○	●	○	○	●	●	●	●	●	○	◐
Nuclear	◐	●	○	○	◐	●	●	○	○	○	○	◐	●
Battery/ Storage	◐	◐	●	●	○	○	○	●	●	●	◐	●	●
Demand Response	○	○	◐	◐	◐	◐	◐	●	●	◐	○	●	●
Solar	◐	◐	○	○	◐	○	○	●	●	●	○	●	●
Wind	◐	◐	○	○	◐	○	○	●	●	●	○	◐	●

Comparison of Electric Power Resource Characteristics

	Flexible Capacity	Firm capacity	Annual energy	Regulation	Spin reserves	Non-spin reserves	Long-Term Storage	Inertia	Black Start	Carbon-Free
Hydroelectric (large project)	yes	yes, water dependent	yes, water dependent	yes	yes	yes	yes	yes	yes	yes
Gas (CCCT)	yes	yes	yes	yes	yes	yes, could be limited	no	yes	yes	no
Gas (SSCT)	limited	yes	yes, could be limited	yes	yes	yes, could be limited	no	yes	yes	no
Coal	no	yes	yes	limited	limited	no	no	yes	no	no
Nuclear	no	yes	yes	no	no	no	no	yes	no	yes
Biomass	limited	yes	yes	yes, could be limited	yes, could be limited	yes, could be limited	no	no	no	limited
Geothermal	no	yes	yes	yes	yes	yes	no	no	no	yes
Solar, PV	no	location dependent	yes, location dependent	yes, limited by energy potential	yes, limited by energy potential	yes, limited by energy potential	no	no	no	yes
Solar, thermal	no	limited to yes	yes, location dependent	yes, limited by energy potential	yes, limited by energy potential	yes, limited by energy potential	yes	no	no	yes
Wind	no	location dependent	yes, location dependent	yes, limited by energy potential	yes, limited by energy potential	yes, limited by energy potential	no	possibly, using synthetic product	no	yes

13. See also, *The Value of Hydropower to the Northwest Grid*. PNUCC, November, 2016. This table is an updated variation of Table 9, Appendix B.* *Hydropower Vision Report, Executive Summary* p. 1.



Boundary Hydroelectric Project, Pend Oreille River, Washington (picture courtesy Seattle City Light)

In addition, industry members are taking a more in-depth look at hydropower's grid services. In the next chart,¹³ developed by Chelan County Public Utility District (based on analysis from the Pacific Northwest Utilities Conference Committee, or PNUCC) a large hydropower project is compared to other resources across a broad spectrum of energy, capacity and ancillary services. While each generating resource has beneficial characteristics, hydropower is the superior resource when looking across the board.

In addition, hydropower is an important element of achieving a least-cost approach to carbon emissions reductions in the electric sector. The carbon emission profiles of hydro-rich regions of the country illustrate how hydropower contributes to state carbon reduction goals. Going forward, hydropower can support these states in a low-emission shift to building and transportation electrification. Finding least-cost approaches is important to economy-wide reductions, as the transportation and building sectors are likely to rely on clean electrification as an emissions reduction strategy. In order to be successful at this strategy, electricity should be made as affordable as possible.

Hydropower is a sustainable energy solution with ties to local communities. As the relationship between customers and energy providers changes, there are new possibilities for hydropower to illustrate how it brings holistic energy, water and recreation benefits to its customers. The Federal Energy Regulatory Commission (FERC), which licenses non-federal projects, requires recreation plans that describe project recreational facilities and public access areas. Most FERC-approved recreation plans are extensive. According to the Department of Energy, recreation is the most common secondary purpose of reservoirs at powered dams.¹⁴ Recreational access may stimulate tourism spending to benefit local economies, while land adjacent to hydropower projects can be desirable for private and commercial development. Reservoirs, parks, campgrounds and fishing access points provided by hydropower projects can help meet the needs of growing communities. Likewise, a decision not to relicense a project could have significant impacts on recreational opportunities.

Meanwhile, hydropower is modernizing environmental protection. Traditionally, fish passage and habitat impacts were significant challenges. Today, hydropower owners are meeting more rigorous environmental



Beaver Creek Diversion Dam near Arnold, California (photo courtesy of Northern California Power Agency)

14. Hydropower Vision Report, Page 81.

standards — and operating significant fish and wildlife enhancement programs. Some projects have been licensed two or even three times, and many have been through relicensing since rigorous environmental standards were adopted for hydropower projects in 1986¹⁵ to incorporate modern protection, mitigation and enhancement measures.

Able to offer such a comprehensive suite of benefits, hydropower should be poised to achieve the growth potential described in the DOE's 2016 *Hydropower Vision* report,¹⁶ from 101 GW to nearly 150 GW by 2050. However, public policy and market design are not keeping up with the needs of the future grid, threatening the viability of new and even existing hydropower projects. If public policy and market design fail to recognize hydropower's value to the electric grid, reinvestment in these resources is at risk. As acknowledged in the Vision report, "America's first renewable electricity source, hydropower, has been providing flexible, low-cost, and low-emission renewable energy for more than 100 years."¹⁷ Today, in many respects, the U.S. hydropower fleet is at a crossroads.

A Call to Action

Project licensees are already evaluating the future of facilities approaching relicensing, many of which will require massive new investments to replace operating equipment that is decades old. As the licensing process can take 10 years, many of these projects are approaching key planning and decision dates. In determining whether to relicense a project, a licensee must consider the costs and time investment of the relicensing process, the costs of measures to be carried out during the



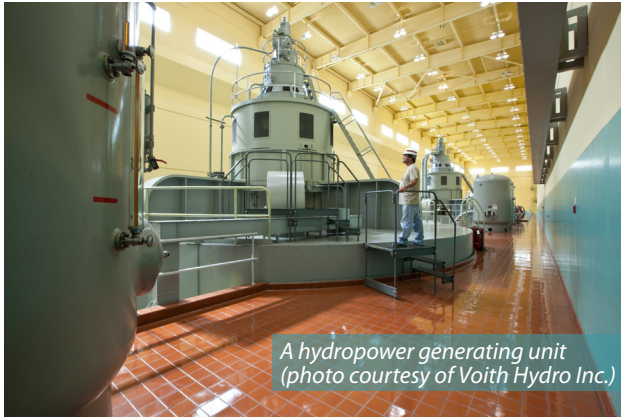
new license, and whether relicensing is likely to reduce project flexibility and, by extension, project economics. Even when simply replacing or rehabilitating existing units during a license term, a licensee considers reinvestment compared to other alternatives, including market purchases. The value of hydropower in the energy market is important. **When weighing hydropower investments, licensees take into account energy value, capacity value and even the carbon or renewable value (or lack thereof) of hydropower in a given state or market.** The more hydropower can be recognized for these values, the more likely hydropower reinvestment will occur.

Now is the time to address barriers to hydropower investment so that existing projects are incentivized to continue providing

15. *Electric Consumers Protection Act of 1986.*

16. *Hydropower Vision Report, Executive Summary p. 1.*

17. *Hydropower Vision Report, Executive Summary p. 1.*



affordable, emission-free, flexible capacity to the electric grid. Outlined below are key areas that must be addressed to facilitate long-term reinvestment in existing and new hydropower projects. Without addressing these issues, the reliability and resiliency of a transforming electric grid will be put unnecessarily at risk.

Design Markets that Value Hydropower Grid Services

Hydropower is such a multi-purpose performer that it would be highly successful in a resource-agnostic market. **To be sustainable over the long term, an equitable market must send appropriate price signals to hydropower owners and operators.** Markets fail when they value only some attributes (such as energy) while still transferring the benefit of others (such as associated grid services) without prescribing a value. Organized markets are in various stages of development throughout much of the country. In any market, the treatment of hydropower will be profoundly important to assure a least-cost approach to reliably meeting load while achieving carbon emission reduction goals. Policy makers must ensure that grid benefits are appropriately compensated. For example, if

hydropower owners provide products and services that avoid the need to build new generation resources or transmission, the total compensation for hydropower should reflect the value of those avoided costs.

In addition, a fully-optimized, integrated regional market should not discriminate between new and existing resources or between internal and external resources. Optimally, a resource-neutral market would pay for energy, capacity, carbon-free attributes and other services based on the provision of such services, and not the particular generating resource associated with it. Price formation in markets currently do not adequately compensate various forms of capacity and ancillary services, and renewable portfolio standards that exclude hydropower (including generation from existing projects) put it at a market disadvantage despite its carbon-free attributes. To spur new investment in hydropower, these practices should be modified.

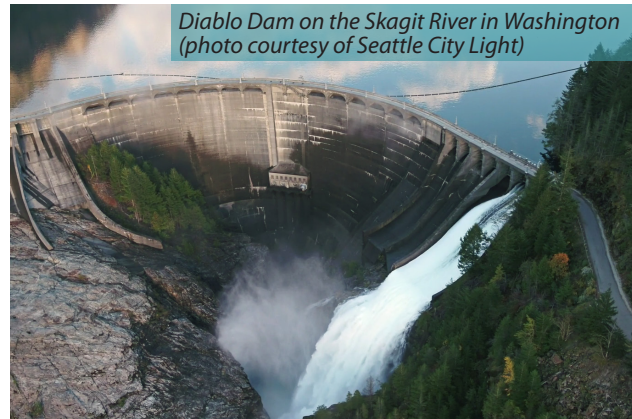
For example, hydropower faces unique challenges when participating in markets that do not recognize that it has a fuel supply (water) that should be optimally deployed. If a hydropower facility only has six hours of water for maximum generation over a 24-hour period, the price for hydropower should be set to assure generation occurs during the six hours the system most needs the energy. Otherwise, hydropower dispatch would be non-optimal, and potentially non-economic.

Consumers in organized markets should benefit from competitive wholesale electricity prices. However, a downside exists if markets are designed to disfavor a particular generation type through inadequate compensation. Failure to compensate generators for needed grid services can lead to suboptimal capacity

investments. Over time, this can lead to significant imbalances between supply and demand, which was the root cause of the 2001 West coast energy crisis. The national struggle to identify market mechanisms that appropriately incentivize capacity preservation and development is having negative consequences for hydropower. Regulators in each region should reexamine existing market design rules, practices and resource procurement programs to incentivize the generating attributes needed to achieve carbon reduction and reliability at low cost.

Choose technology neutral policies that achieve societal goals for carbon reduction and levelize incentives

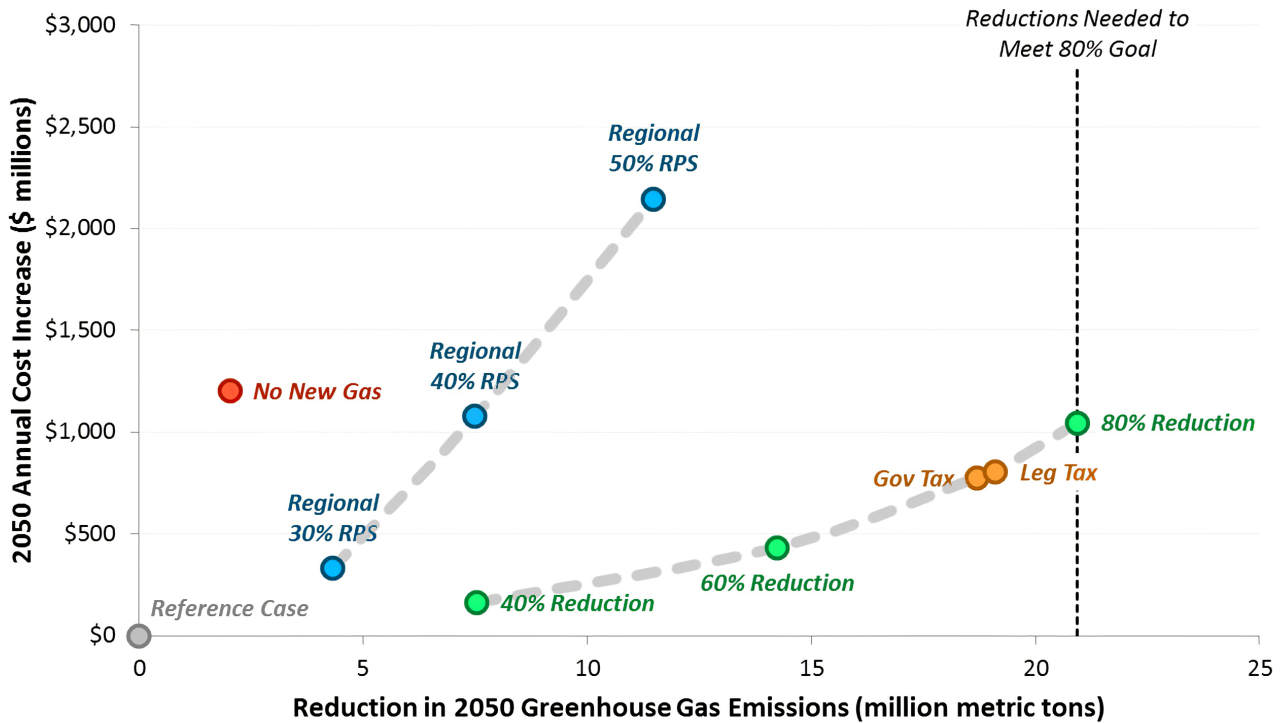
Public debate on how to address carbon emissions is happening at all levels of government – federal, regional, state and local – with many different policy solutions under consideration, including carbon taxes, clean energy standards, renewable portfolio standards, and others. At the state level, the primary policy mechanism to support renewables has been the renewable portfolio standard (RPS). State RPS programs began as a means to kick-start nascent technologies, such as wind and solar, while excluding existing hydropower resources. These technologies have grown and become fully realized contributors to our energy portfolio; however, expanded RPSs have continued to exclude hydropower from equal participation with other carbon-free and renewable resources. They often impose restrictions based on size, operations, or placed in service dates, if they do not exclude hydropower outright.



Diablo Dam on the Skagit River in Washington (photo courtesy of Seattle City Light)

New policies should be technology-neutral, sending market signals that incentivize any generating resources that meet emission goals. Such policies should also consider the best societal outcomes, including cost. A deeper review and comparison of policy proposals may lead to unexpected results. For example, in 2017, a study from Energy and Environmental Economics (E3)¹⁸ found that a price on carbon in Oregon and Washington could achieve emissions reductions at a much lower cost than an RPS, while helping to preserve existing hydropower assets in states that already get the majority of their electricity from hydropower projects. The next graphic offers one example of how a carbon price in the Pacific Northwest could achieve carbon emission objectives at a much lower cost than increasing RPS targets, under which a minimal amount of hydropower is currently eligible.

18. *Pacific Northwest Low Carbon Scenario Analysis. Achieving Least-Cost Carbon Emissions Reductions in the Electricity Sector. Energy + Environmental Economics. November 8, 2017*

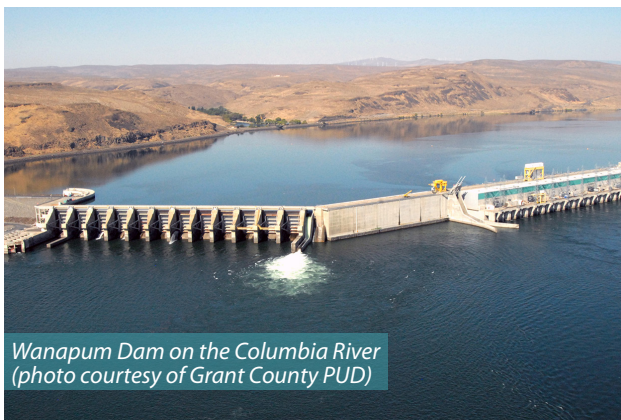


Policy development should focus on equitable encouragement of carbon-free resources (including hydropower) while accommodating cost and reliability concerns. Whether the Green New Deal or other proposals, hydropower should be treated equitably with other non-emitting renewables. Hydropower played a huge role in achieving the nation’s infrastructure, work force and manufacturing goals under New Deal programs that began in the 1930s. Going forward, hydropower should be an integral part of state and nation-wide efforts to modernize the electric grid.

Creating a level playing field for hydropower in the tax arena at both the federal and state levels is an associated issue. On the federal level, tax policy has become energy policy by default. Many tax incentives were intended to accelerate the development of wind and solar generation to accomplish improved economy of scale.

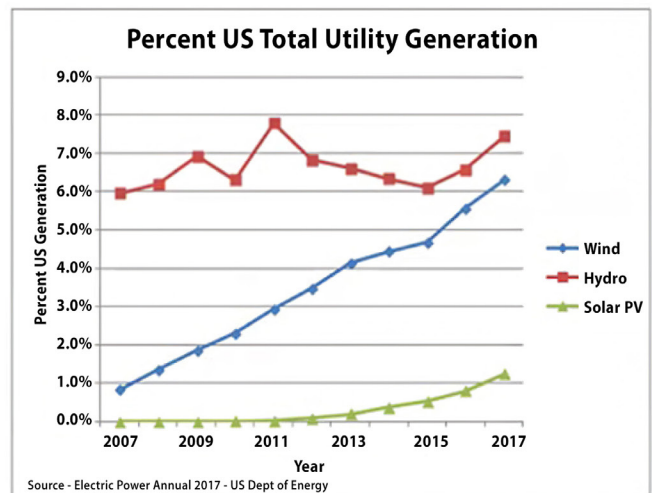
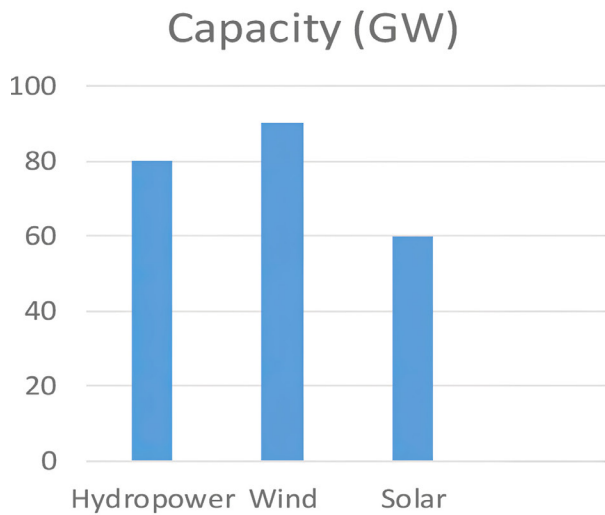
The current, relatively low offering prices and total installed capacity for these resources demonstrate these policies have been successful for the wind and solar industries.

But once again, hydropower’s treatment has put it at a distinct competitive disadvantage. The federal production and incentive tax credits, and particularly the long-term certainty provided for wind and solar projects has had



Wanapum Dam on the Columbia River (photo courtesy of Grant County PUD)

– and will continue to have – a significant impact on markets for years to come. Wind projects starting construction in 2019 may receive an inflation-adjusted production tax credit (PTC) of \$14 per megawatt hour for the next decade,¹⁹ or elect the investment tax credit (ITC) at a reduced rate. Likewise, solar projects entering service up to 2022 will receive the ITC at a gradually reducing rate from 30 percent; thereafter a transition to a permanent 10 percent ITC occurs. In some regions, the availability of the tax credits, particularly the wind PTC, has provided an advantage to projects that are then able to operate economically even during periods of negative pricing when there is more supply of zero-variable cost resources than there is load.



At the same time, the expiration of the hydropower production and investment tax credits, and the lack of policy certainty for the future regarding these and other incentives, has further impacted hydropower project deployment. This is particularly so in the eyes of investors who seek market signals that are clear, consistent and certain.

As such, hydropower should be recognized, valued and treated equitably in federal and state tax policy decisions.

Allow reinvestment in existing hydropower to meet “additionality” criteria

There has been a movement among commercial and industrial retail consumers to procure not only renewables, but to adopt a principle called “additionality.” The purpose is to ensure customers are supporting the addition of new renewable resources to the grid in order to reduce not just their own carbon emissions but reductions grid-wide. While well-intended, this policy can have unintended consequences when exclusionary of hydropower.

Hydropower is a renewable resource that produces no air emissions, and most of the large hydropower sites were built out decades ago.²⁰ There is also a substantial need for reinvestment

19. Annual Energy Outlook 2018 with projections to 2050. February 8, 2018. Energy Information Administration. Page 104.

20. While this is true for the larger sites, there are opportunities for new project development, particularly small hydropower; new hydro at currently non-powered dams; pumped storage and conduit projects.



Wise Powerhouse near Auburn, California (photo courtesy of PG&E)

to maintain capability as existing hydropower projects age. **Limiting the markets in which hydropower can compete reduces the value of all types of hydropower investment.**

Hydropower also provides a foundation for reliability that is necessary in a generation portfolio with high levels of variable energy resources. To achieve low levels of carbon emissions on the grid, renewable energy purchasers and those setting portfolio policies should view reinvestment in hydropower as meeting additional requirements. Similar issues are likely to arise as other renewable energy projects reach the end of their 20-year projected lives.

Improve the hydropower licensing process

Hydropower has the longest, most complex development timeline of any of the renewable energy technologies. The licensing process itself can cost millions of dollars and take 10 years or longer – even for projects being licensed for the second or third time. In addition, new licenses can cost in the tens or hundreds of millions of dollars to implement. Policy makers need to take a fresh look at

maximizing the efficiencies of the regulatory process if they want to keep hydropower projects online to serve the modernized grid.

Over the years, Congress and FERC have worked to improve the hydropower licensing process, making sustained incremental progress through several important initiatives:

- FERC adopted the Integrated Licensing Process (ILP) in 2003.
- Congress passed targeted licensing provisions in the Energy Policy Act of 2005 (EPAAct 2005).
- Congress adopted an expedited licensing process for conduit projects and required FERC to study a 2-year licensing process in the Hydropower Regulatory Efficiency Act of 2013.
- FERC approved a new license term policy for existing projects in 2017.²¹
- Congress required new FERC rulemakings for non-powered dams and closed loop pumped storage projects, and expanded the 2017 FERC new license term policy in the America's Water Infrastructure Act of 2018.²²

However, other aspects of hydropower licensing continue to be barriers to operations for existing projects and new project deployment. For example, there remain implementation issues with the licensing provisions of EPAAct 2005. In EPAAct 2005, Congress preserved agencies' mandatory conditioning authority (Federal Power Act or FPA sections 4(e) and 18). In doing so, Congress balanced this authority by requiring agencies to demonstrate that they considered a broad spectrum of values when developing conditions – such as energy supply, distribution, cost and use; flood

21. Under the Federal Power Act (FPA), FERC issues new hydropower licenses for terms between 30 and 50 years, basing the length of the license partly on the level of protection, mitigation, and enhancement measures required in a new relicensing package. Traditionally, FERC would not factor in the cost of any new investments made at an existing project toward the next license term. This practice created an environment where postponing work until relicensing was preferable. On October 19, 2017, FERC issued a Policy Statement on Establishing License Terms for Hydroelectric Projects. The Policy Statement established a 40-year default license term for hydropower projects, with the ability to receive 50 years under certain conditions, including pre-licensing investments.

control; navigation; water supply; and air quality. Agency regulations have not implemented this requirement, which continues to expose hydropower projects to operating limitations that may foreclose grid optimization, energy storage, emissions-free generation, and other societal benefits of hydropower. Congress should correct this by clarifying that agencies exercising mandatory conditions pursuant to FPA sections 18 and 4(e) must give “equal consideration” to developmental and non-developmental values when fashioning their conditions – just as FERC has been required to do since the 1986 amendments to the FPA. Congress should also ensure that other EAct 2005 provisions (i.e. trial-type hearings, alternative conditions), which apply to all parties, are not circumvented by imposing conditions under other statutory authorities where these protections are unavailable.

In addition, licenses are often delayed as FERC awaits late input from federal or state agencies, sorts through conflicting requirements, and considers additional study requests. Congress can make the licensing process shorter and less complex by establishing a federal arbiter for coordinating all permits and other authorizations for hydropower projects required under federal law. It should also direct FERC to develop a schedule for completing its licensing process, as well as other authorizations required under federal law, and to consult with other resource agencies in developing the schedule. One option to improve adherence to the schedule would be to allow FERC to refer late authorizations to the Council on Environmental Quality for resolution.

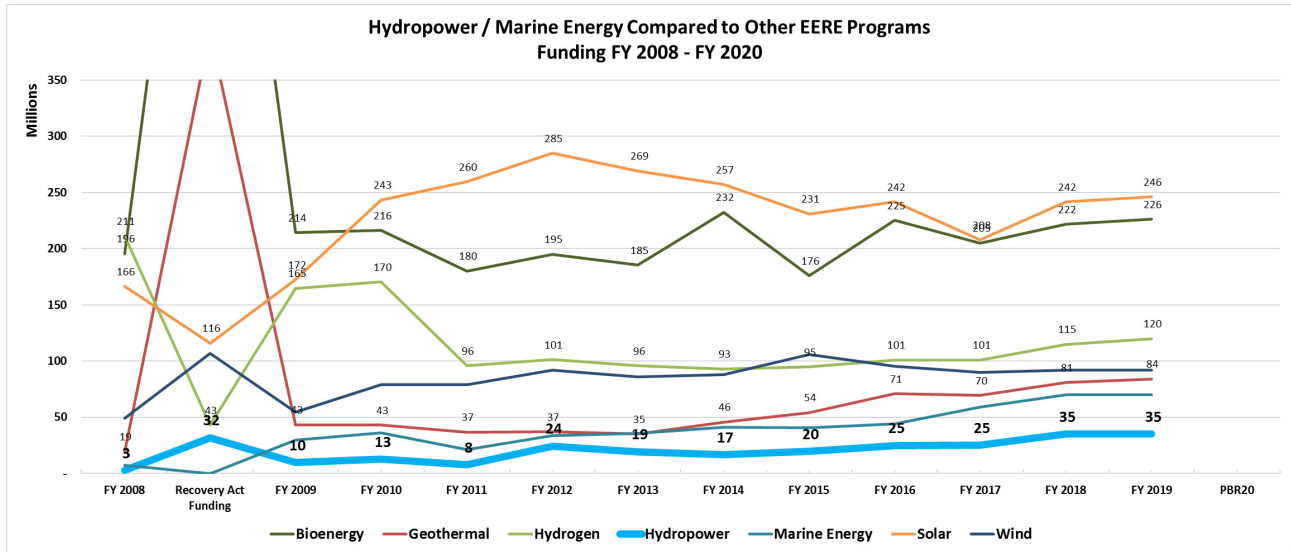


Over the past few years, the hydropower industry has worked with Members of Congress in a bipartisan fashion on several proposals to address these and other issues. The industry believes commonsense process improvements can be implemented to increase coordination under the licensing process while protecting natural resources and ensuring strong environmental performance.

Expand federal and state R&D for hydropower and support the industry's digital transformation

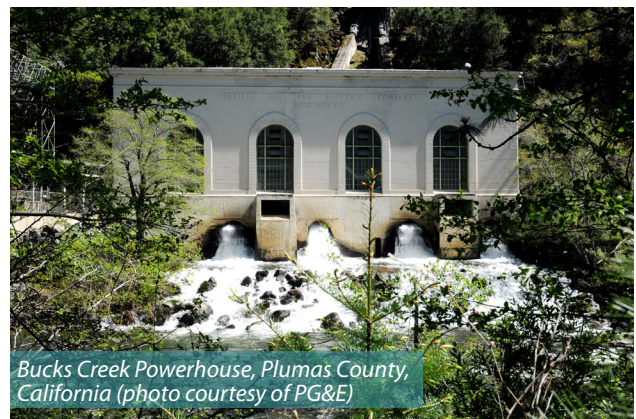
Given its aging infrastructure and contributions to grid resiliency and reliability, hydropower deserves more focus in the research portfolio. Federal and state governments should find room in their research and development (R&D) budgets to advance the R&D needs of the hydropower industry. Funding at the Department of Energy for hydropower R&D is dwarfed by monies available to competing technologies. Recent years have seen improvements in hydropower-related appropriations at the Water Power Technologies Office, but the disparity is significant, as shown in the following graph.

22. Under AWIA (Public Law 115-270), Congress expanded on FERC's Policy Statement, directing the agency to give "equal weight" to investments whether they are carried out early (and not credited toward the existing term) or proposed as part of a relicensing package. These changes will assure licensees that investments they make today will influence their next license term.



Reducing outages, particularly as the hydropower fleet ages, is a major opportunity for increasing hydropower reliability and energy output. Improving the performance of hydropower components to avoid unplanned outages would reduce uncertainties around project reinvestment and support electric grid performance. Generally, hydropower owners and operators evaluate aging equipment based on “placed in service dates” supplemented by condition assessments. Advances in sensor technology creates opportunity for more active monitoring while units are still in service – before age and condition become a major factor. This can improve industry’s understanding of the equipment aging process and allow operators to identify and mitigate performance risk. **New sensor technologies to monitor hydropower equipment, along with better aggregation and analysis of operational data, could transform hydropower operations and maintenance activities.**

The Hydropower Research Institute (HRI)²³ is a new data-driven collaborative of hydropower owners designed to empower the industry to optimize their projects and remain competitive in a changing electric system. Its mission is to ensure hydropower continues to be a premier electric generating resource through digital transformation and technology development. It will aggregate operational data, assist hydropower owners in the digital transformation, and facilitate R&D of new technology for hydropower facilities and equipment. Ultimately, improved predictive capabilities will enable hydropower owners and operators to efficiently



23. <https://www.hridata.org/>

plan major interventions and replacements prior to equipment failure, improving overall fleet availability. Federal and state collaboration on this and other industry initiatives would help enhance fleet resilience.

Improve contracting and quality control practices to encourage long-term investments

The hydropower industry can also help itself through a greater focus on enhancing quality. For example, licensees and vendors should work together to understand equipment design and operating procedures to establish criteria so that designs are resilient, easy to maintain and achieve their life expectancy. Hydropower investments are planned to last for 30 to 50 years, and turbines have historically lasted as long as 85 years. However, some hydropower components are not achieving design life, in part due to the impact of new operating conditions as a result of projects being asked to ramp up and down more frequently to assist in the integration of variable energy resources and to provide grid reliability services. This is an equipment issue that is only going to grow in scale in the coming years. **Collaborative arrangements between owners and vendors that lead to longer term warranties and increased operational data sharing can enhance quality in a manner that ensures actual life matches planned investment life.** This helps improve the business case for investment. This should be a high priority for the hydropower industry. The time is ripe to enhance collaboration between vendors and owners.

Most states and the federal government have laws governing public works procurement for public entities. Hydropower facilities are greatly affected by these procurement laws due to the number, variety and highly specialized nature of their assets. Traditionally, the laws limited hydropower facilities to the design-bid-build method (DBB) of construction project procurement. Under the design-bid-build method, hydropower owners must develop the design for the project before putting it out to bid, and then must award the contract to the lowest bidder. However, awarding a contract based on the lowest bid does not necessarily lead to the lowest life-cycle cost, nor the highest value for the investment.

In recent years, alternative methods of contracting have been developed which change both the process of procuring and the relationship between parties. Two of the most common methods are General Contractor/ Construction Manager (GC/CM) and Design Build, both of which may provide significant benefits for hydropower owners. For example, under the GC/CM method, the contractor is selected early in the design phase of the project. This creates a partnership with the facility owner, its engineer and the contractor working as a team to design the project considering key life-cycle factors, such as:



A Journeyman Mechanic unhooks crane cables
(photo courtesy of Chelan County PUD)

- Construction impacts on an operating facility;
- Safety considerations to benefit construction and operations;
- Design improvements to recognize constructability and operations and maintenance value;
- Better management of escalating market costs;
- Early procurement of long-lead items and larger quantity bundling;
- Ability to accommodate these long-lead items within the overall project planning;
- More equitable risk-sharing among the project team;
- Attractiveness to bidders in a competitive market.

One variant of the design build method, progressive design-build, is typically the most beneficial to hydropower facilities. Under progressive design-build, the owner and designer/builder develop the scope and cost of the project through a series of design steps. This approach is effective for highly-specialized construction activities. Over the years, alternative procurement methods have evolved

to better accommodate the construction needs of public agencies and changing capabilities of the construction industry. More awareness of, and access to, these alternate methods can benefit hydropower and electric customers by producing the better quality, longer lasting results appropriate to long-lived assets.

Conclusion

Hydropower is a premier renewable resource from a cost, emissions, resiliency and reliability perspective. Due to its long history and relative success, it has been taken for granted in public policy debates. But is it really true that hydropower will always be there? With aging equipment and a weak investment climate, hydropower can no longer be the silent partner in achieving our clean energy goals. Concerns about inadequate market compensation, regulations, quality assurance, and other challenges will come into sharper focus as licensees make reinvestment decisions prior to relicensing. While hydropower faces a number of challenges, the good news is that many of these disincentives and obstacles can be mitigated through feasible actions.

As policy makers consider the prospects of integrated power markets, escalating clean energy mandates, and grid reliability, hydropower's future is at stake. Will we allow hydropower to apply its unique attributes and operational capabilities to the country's changing grid needs and public preferences? The biggest threat to hydropower is indifference. But with attention and focus, hydropower can be a cornerstone of a modernized, clean, reliable and affordable electric system that leads to a healthy economy and environment.

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