2018

Troubled Water: Building a Bridge to Clean Energy through Small Hydropower Regulatory Reform

Samuel J. Panarella
Alexander Blewett III School of Law at the University of Montana, samuel.panarella@umontana.edu

Troubled Water: Building a Bridge to Clean Energy Through Small Hydropower Regulatory Reform

Jody D. Lowenstein[1] *and Samuel J. Panarella*[2]

Roll on, Columbia, roll on
Roll on, Columbia, roll on
Your power is turning our darkness to dawn
So roll on, Columbia, roll on[3]

TABLE OF CONTENTS

---

[1] J.D. Candidate, Alexander Blewett III School of Law at the University of Montana. Thank you to my parents for their support and guidance.
[2] Associate Professor of Law & Director of the Max S. Baucus Institute, Alexander Blewett III School of Law at the University of Montana. Thank you to my colleagues and my family for their assistance and critical reviews of this paper.
[3] Woody Guthrie, *Roll on Columbia*, *on* Columbia River Ballads (Bonneville Power Admin. 1941).

I. INTRODUCTION

The Columbia River begins in the Canadian Rockies and runs over twelve hundred miles through Idaho, Oregon, and Washington before reaching the Pacific Ocean near Astoria, Oregon.[4] In 1941, the recently created Bonneville Power Administration (BPA) was searching for a way to draw positive public attention to its founding mission: the sale of electricity

---

[4] Kevin Lillis, *The Columbia River Basin provides more than 40% of total U.S. hydroelectric generation*, U.S. ENERGY INFO. ADMIN. (June 27, 2014), https://www.eia.gov/todayinenergy/detail.php?id=16891 [https://perma.cc/NPG3-JZDL] [hereinafter *The Columbia River Basin*]. The Columbia is the 15th longest river in North America, draining 219,000 square miles of land in the United States and 39,500 square miles of land in Canada. BONNEVILLE POWER ADMIN., ET AL., FED. COLUMBIA RIVER POWER SYS., THE COLUMBIA RIVER SYSTEM INSIDE STORY 4 (2nd ed. Apr. 2001), https://www.bpa.gov/news/pubs/generalpublications/edu-the-federal-columbia-river-power-system-inside-story.pdf [https://perma.cc/9XN2-RZPQ].

generated by a series of newly constructed hydroelectric dams along the Columbia River to utilities in the Pacific Northwest.[5] Chief among these new Columbia River dams were the enormous Grand Coulee Dam in eastern Washington,[6] and the slightly older and much smaller Bonneville Dam, about 50 miles upstream from Portland, Oregon.[7] These dams, along with several others in the Columbia River Basin,[8] resulted from a protracted, deeply political process pitting multiple interest groups against one another. Most prominent among those groups were anti–monopolists, who worried about large private companies controlling the supply of electricity to rural areas, and

---

[5] The Bonneville Power Project, which was later renamed the Bonneville Power Administration, was created to distribute electricity from Columbia River dams under the Bonneville Power Act of 1937. John Harrison, *Bonneville Power Administration: History*, NW. POWER & CONSERVATION COUNCIL (Oct. 31, 2008), https://www.nwcouncil.org/history/BPAHistory [https://perma.cc/2QMV-56G5]. Today, dams along the Columbia River and its tributaries account for nearly half of all hydroelectric generation in the United States and more than half of all electricity used in the Pacific Northwest. *See The Columbia River Basin*, *supra* note 4; *see also* John Harrison, *Dams: History and Purpose*, NW. POWER & CONSERVATION COUNCIL (Oct. 31, 2008), https://www.nwcouncil.org/history/DamsHistory [https://perma.cc/EE7S-RQJ8] [hereinafter *Dams: History and Purpose*].

[6] The Grand Coulee Dam commenced operations generating hydroelectric power on March 22, 1941, after a seven-year construction process. *See* John Harrison, *Grand Coulee Dam: History and Purpose*, NW. POWER & CONSERVATION COUNCIL (Oct. 31, 2008), https://www.nwcouncil.org/history/GrandCouleeHistory [https://perma.cc/NP3Q-P6DQ]. The Grand Coulee Dam is the largest concrete structure ever built and is currently capable of generating 6.8 GW of electricity during the summer season, making it the single largest producer of hydroelectricity in the United States and the sixth largest in the world. *Id.*; *The Columbia River Basin, supra* note 4.

[7] The Bonneville Dam was completed in 1938, with a second powerhouse added in 1982. *Bonneville Dam—Hydroelectric Project Information*, COLUMBIA BASIN RESEARCH, http://www.cbr.washington.edu/hydro/bonneville [https://perma.cc/T34W-DAAP]. At the time of its construction by the U.S. Army Corps of Engineers, Bonneville Dam had an annual hydroelectric generating capacity of more than 500 megawatts. William F. Willingham, *Bonneville Dam*, OR. ENCYCLOPEDIA (Apr. 17, 2015), https://oregonencyclopedia.org/articles/bonneville_dam/#.WWz7wITyvIU [https://perma.cc/57VG-63JA].

[8] In addition to portions of Idaho, Oregon, and Washington, the Columbia River Basin includes parts of Montana, Nevada, Utah, and Wyoming. *The Columbia River Basin*, *supra* note 4.

the aforementioned private utilities, which stood in strong opposition to any federal ownership of hydroelectric power.[9] Federal construction of the Columbia River dams had not begun until President Franklin Roosevelt took office in 1933 and created a massive public works initiative to spur the American economy out of the Great Depression.[10]

In its search for publicity, BPA decided to produce a movie about the damming of the Columbia River and the hydroelectric power the dams generated.[11] This movie, which was given the working title "The Columbia," needed a soundtrack to accompany its visual depictions of the majestic Columbia River dams.[12] The songwriter selected to compose and perform this soundtrack was a young folk singer from Okemah, Oklahoma, named Woodrow Wilson Guthrie, or Woody to his friends. Over the course of his one-month contract with BPA, Guthrie traveled to several dams on the Columbia and penned nearly a song a day about what he saw, including the iconic "Roll on Columbia," and other well-known titles such as "Jackhammer Blues," "Grand Coulee Dam," and "Pastures of Plenty."[13] The twenty-six songs that Guthrie wrote during his short employment with BPA are known as the "Columbia River Songs." Collectively they tell a heroic tale, of man's taming of a mighty river to provide water to irrigate the previously parched

---

[9] *Dams: History and Purpose*, *supra* note 5.

[10] *Id.*

[11] *BPA Celebrates 75th Anniversary of Woody Guthrie's Columbia River Songs*, BONNEVILLE POWER ADMIN. (May 26, 2016), https://www.bpa.gov/news/newsroom/Pages/BPA-celebrates-75th-anniversary-of-Woody-Guthries-Columbia-River-songs.aspx [https://perma.cc/LWY8-7M4G] [hereinafter *BPA Celebrates 75th Anniversary*].

[12] "Columbia" was conceived as a followup to "Hydro", a BPA-produced movie about hydroelectricity that was released to the public in 1938. William Murlin, *Woody Guthrie and the Columbia River*, OR. ENCYCLOPEDIA, https://oregonencyclopedia.org/articles/guthrie_woody_and_the_columbia_river/#.Wm4Q5qinFPZ [https://perma.cc/XSD2-RENW]. The project was abandoned because of the advent of World War II and not completed until 1949. *BPA Celebrates 75th Anniversary*, *supra* note 11.

[13] Murlin, *supra* note 12. Guthrie's total compensation for this work was $266.66, which works out to a little more than ten dollars per song. *Id.* Stephen B. Kahn, the BPA public information officer responsible for hiring Guthrie, later called this one of the best bargains the U.S. government ever received. *Id.*

farmland and electricity to brighten the theretofore dark corners of America's rural northwestern corner.

Viewed today, when much of the discussion regarding large dams is focused on pathways toward their removal, it seems odd that the BPA hired Guthrie—a progressive populist who had the slogan, "This Machine Kills Fascists," painted on his acoustic guitar—to write songs extolling the virtues of concrete monoliths, owned by stodgy regulated utilities, that caused immense damage to aquatic species and altered the geography of many formerly wild places. But when Guthrie began his travels along the Columbia in 1941, many of the deleterious effects of large dams on fisheries and river health were not well understood by the general public. In fact, the primary rationales given in support of the dams—a supply of cheap electricity to rural users, as well as irrigation and flood control for subsistence-level farmers and ranchers in the parched interior Northwest—were precisely the kind of salves for the common man favored by old-school progressives like Guthrie.[14]

One imagines that if Guthrie was alive today and was asked to undertake a similar task, he might decline the offer and view it as inconsistent with his political views and environmental ethos. But what if instead, the twenty-first century Guthrie was asked to lend his artistic talents to support the large-scale construction of small hydropower projects that could harness the energy of free-flowing rivers to produce carbon-free electricity in our rapidly warming world without damaging the environment or significantly impeding fish? What songs might he sing then? It seems a safe bet that the plainspoken lefty folk singer would have something to say about the existential threat to human survival posed by global warming and the desperate need to increase use of non-fossil-based energy sources to help stem this looming environmental catastrophe.

It is beyond credible dispute that the planet is heating up at an alarming rate and that the ecological effects of global warming pose real questions about the continued viability of human and non-human life on earth in the not-too-distant

---

[14] *See* THE COLUMBIA RIVER SYSTEM INSIDE STORY, *supra* note 4, at 5.

future.[15] A primary cause of global warming is the burning of carbon-based fuels—mainly coal, natural gas, and oil—to generate electricity and for other purposes.[16] The carbon dioxide released into the atmosphere from this activity makes up the bulk of the so-called greenhouse gases, the ever-increasing presence of which are primarily responsible for global warming.[17] To take the chief offender, China emitted 2.8 billion metric tons of carbon dioxide into the atmosphere from fossil fuel combustion in 2014 alone, the vast majority of which was created by burning coal and gas to generate electricity.[18] For its part, in the same year, the United States added 1.4 billion metric tons of carbon dioxide to the environment from the burning of fossil

---

[15] *See, e.g.*, Naomi Oreskes, *The Scientific Consensus on Climate Change*, SCI., Vol 306, 1686 (Dec. 3, 2004), http://science.sciencemag.org/content/sci/306/5702/1686.full.pdf [https://perma.cc/9ZEL-DCDD] (stating that "all major scientific bodies in the United States whose members' expertise bears directly on the matter" have concluded that human activities, including combusting fossil fuels to generate electricity, are the leading cause of global warming).

[16] *Global Warming FAQ*, UNION OF CONCERNED SCIENTISTS, https://www.ucsusa.org/global-warming/science-and-impacts/science/global-warming-faq.html#bf-toc-1 [https://perma.cc/6FVD-Q9S9] ("The primary cause of global warming is human activity, most significantly the burning of fossil fuels to drive cars, generate electricity, and operate our homes and businesses.").

[17] Amanda MacMillan, *Global Warming 101*, NAT. RES. DEF. COUNCIL (Mar. 11, 2016), https://www.nrdc.org/stories/global-warming-101 [https://perma.cc/6KHP-4C2N] ("Global warming occurs when carbon dioxide (CO2) and other air pollutants and greenhouse gasses collect in the atmosphere and absorb sunlight and solar radiation that have bounced off the earth's surface. Normally, this radiation would escape into space—but these pollutants, which can last for years to centuries in the atmosphere, trap the heat and cause the planet to get hotter. That's what's known as the greenhouse effect.").

[18] Tom Boden, et al., *Fossil-Fuel CO_2 Emissions by Nation*, CARBON DIOXIDE INFO. ANALYSIS CTR., http://cdiac.ess-dive.lbl.gov/trends/emis/top2014.tot [https://perma.cc/MJP4-FF4L]; *see also* ZHU LIU, HARV. KENNEDY SCH. BELFER CTR. FOR SCI. & INT'L AFFAIRS, CHINA'S CARBON EMISSIONS REPORT 2016: REGIONAL CARBON EMISSIONS AND THE IMPLICATION FOR CHINA'S LOW CARBON DEVELOPMENT 1 (Oct. 2016), http://www.belfercenter.org/sites/default/files/files/publication/China%20Carbon%20Emissions%202016%20final%20web.pdf [https://perma.cc/VB47-JKM7] (noting that China was responsible for nearly three-quarters of the growth in global carbon dioxide emissions between 2010 and 2012).

fuels.[19] The two countries together were responsible for 45 percent of the total global carbon dioxide emissions from fossil fuel combustion in 2014.[20] Ironically (or perhaps understandably), in the same year, China and the U.S. were first and third in the world, respectively, in installing new wind energy capacity.[21] Electricity generated from wind is more than eighty times "cleaner" from a carbon dioxide emissions standpoint than is electricity generated by burning coal, and it is nearly forty times cleaner than natural gas combustion.[22] Despite the massive public and private investments in renewable energy development in China and the United States in recent years, however, the two countries remain the two largest contributors of greenhouse gases to the environment.[23] In the U.S., burning fossil fuels to produce electricity accounts for nearly one-third of the country's annual greenhouse gas emissions.[24] Clearly, more must be done, and done soon, to stave off the worst impacts of global warming.[25]

---

[19] Boden, *supra* note 18.

[20] *Global Greenhouse Gas Emissions*, U.S. ENVTL. PROT. AGENCY, https://www.epa.gov/ghgemissions/global-greenhouse-gas-emissions-data [https://perma.cc/VB7Z-HWF3].

[21] RENEWABLES 2015 GLOBAL STATUS REPORT, RENEWABLE ENERGY POLICY NETWORK FOR THE 21ST CENTURY 135 (2015), http://www.ren21.net/wp-content/uploads/2015/07/REN12-GSR2015_Onlinebook_low1.pdf [https://perma.cc/N9AZ-2XSH]. China installed 20.7 gigawatts (GW) of new wind energy capacity in 2014, and the United States installed 4.9 GW. *Id.* Germany was second in the world with 5.3 GW of new wind energy capacity installed in 2014. *Id.*

[22] *Biomass Compared to Fossil Fuels, Solar and Wind*, VIASPACE http://www.viaspace.com/biomass_versus_alternatives.php [https://perma.cc/QPW2-VKH7].

[23] Michael Hanley, *Which countries emit the most greenhouse gas?*, WORLD ECON. FORUM (July 21, 2015), https://www.weforum.org/agenda/2015/07/countries-emitting-most-greenhouse-gas [https://perma.cc/4TGN-E2E2].

[24] *Benefits of Renewable Energy Use*, UNION OF CONCERNED SCIENTISTS, http://www.ucsusa.org/clean-energy/renewable-energy/public-benefits-of-renewable-power#.WXjd6oTyvIU [https://perma.cc/YST4-8T2U] (last modified Dec. 20, 2017).

[25] *See, e.g.*, INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE, CLIMATE CHANGE 2014: SYNTHESIS REPORT. CONTRIBUTION OF WORKING GROUPS I, II AND III TO THE FIFTH ASSESSMENT REPORT OF THE INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE 8 (2014), http://www.ipcc.ch/pdf/assessment-report/ar5/syr/AR5_SYR_FINAL_SPM.pdf [https://perma.cc/7JPC-J5NE]

Drastically reducing global carbon emissions features prominently in any serious proposal to combat global warming.[26] Given that humans are unlikely to willingly give up the massive recreational, economic, health, and quality-of-life benefits that accrue from access to plentiful, cheap, and reliable electricity, however, any reductions in carbon-generated electricity will likely have to be made up for by massive increases in non-carbon-based means of energy generation, such as wind, solar, and hydroelectricity.[27] Due to economies of scale problems and the high initial capital costs required to build a renewable

---

(stating that a continuation of global greenhouse gas emissions at current rates "will cause further warming and long-lasting changes in all components of the climate system, increasing the likelihood of severe, pervasive and irreversible impacts for people and ecosystems.").

[26] The United Nations Framework Convention on Climate Change (popularly known as the "Paris Agreement") is the most well-known and comprehensive of such proposals, with the stated goal of "[h]olding the increase in the global average temperature to well below 2°C above pre–industrial levels and pursuing efforts to limit the temperature increase to 1.5°C above pre–industrial levels, recognizing that this would significantly reduce the risks and impacts of climate change. . . ." The Paris Agreement Regarding the U.N. Framework Convention on Climate Change, art. 2, Dec. 12, 2015, T.I.A.S. No. 16-1104. Each of the Paris Agreement's 197 signatory countries, which included the U.S., China, and Germany, agreed to reduce their greenhouse gas emissions to achieve this goal, but how these emissions reductions will occur are left to the individual countries. *Id.* The Paris Agreement went into force on November 4, 2016 after reaching its threshold of 55 countries representing 55 percent of global greenhouse gas emissions depositing their instruments of ratification, acceptance or accession with the Secretary-General of the United Nations. *Paris Agreement—Status of Ratification*, U.N. FRAMEWORK CONVENTION ON CLIMATE CHANGE, http://unfccc.int/paris_agreement/items/9444.php [https://perma.cc/KL5T-GXUB]. On June 1, 2017, President Donald Trump announced that the United States would withdraw from the Paris Agreement. Michael D. Shear, *Trump Will Withdraw U.S. From Paris Climate Agreement*, N.Y. TIMES (June 1, 2017), https://www.nytimes.com/2017/06/01/climate/trump-paris-climate-agreement.html.

[27] *See, e.g.*, Noah Long & Kevin Steinberger, *Renewable Energy Is Key to Fighting Climate Change*, NAT. RES. DEF. COUNCIL (June 26, 2016), https://www.nrdc.org/experts/noah-long/renewable-energy-key-fighting-climate-change [https://perma.cc/RZB7-249S] (calling the continued growth of renewable energy "one of the most effective tools we have in the fight against climate change."); UNION OF CONCERNED SCIENTISTS, *supra* note 24 ("Increasing the supply of renewable energy would allow us to replace carbon-intensive energy sources and significantly reduce U.S. global warming emissions.").

energy facility,[28] the bulk of this theoretical increase would likely need to come from privately-funded construction of large industrial-scale renewable energy projects, such as the recently built Amazon Wind Farm US East in North Carolina, which has an annual nameplate-generating capacity of 208 megawatts.[29]

But there is also an important role for distributed generation of electricity in this new energy future, burdened though that process is with significant financing challenges that must be addressed.[30] Distributed generation is the production of electricity using small-scale generation facilities at or near the

---

[28] The cost to install an onshore commercial-scale wind farm is approximately $1.66 million per megawatt of installed capacity, so a 200 megawatt wind farm (a large but not enormous project) would require $332 million of upfront capital to construct. Installing a commercial scale solar photovoltaic project requires capital equal to $2.9 million per megawatt of installed capacity, meaning a 200 megawatt solar photovoltaic project would require upfront capital of $580 million. For comparison's sake, the capital required to construct a large dam is considerably lower at $580,000 per megawatt of installed hydroelectric capacity. *Construction cost data for electric generators installed in 2015*, U.S. ENERGY INFO. ADMIN. (May 19, 2017), https://www.eia.gov/electricity/generatorcosts [https://perma.cc/4LLT-K8LK].

[29] AM. WIND ENERGY ASS'N, U.S. WIND INDUSTRY FIRST QUARTER 2017 MARKET REPORT 3 (Apr. 27, 2017), http://awea.files.cms-plus.com/FileDownloads/pdfs/1Q2017%20AWEA%20Market%20Report%20Public%20Version.pdf [https://perma.cc/D3AK-YFPT] (noting that all of the electricity generated by the project will be sold to Amazon Web Services). The U.S. added 2,000 megawatts of new wind energy capacity in the first quarter of 2017, more than first three quarters of 2016 combined. *Id.*

[30] U.S. DEP'T OF ENERGY, HYDROPOWER VISION: A NEW CHAPTER FOR AMERICA'S 1ST RENEWABLE ELECTRICITY SOURCE 130 (July 26, 2016), https://energy.gov/eere/water/articles/hydropower-vision-new-chapter-america-s-1st-renewable-electricity-source [https://perma.cc/U47Q-867N] [hereinafter HYDROPOWER VISION] ("Developers of small projects face additional challenges based on the limited scale and relative small dollar value of their projects to potential investors. Large hydropower owners ensure investor interest through bond issues or loan prospects for which smaller projects do not have sufficient leverage. In cases where small projects are able to secure the interest of large, conventional financing sources (such as commercial banks), their financing costs are usually higher on a relative basis (per MW). While all hydropower projects are subjected to rigorous due diligence, the cost of this process is spread across fewer MW for small projects relative to their larger counterparts. This suggests that innovative financing solutions are necessary in the small hydropower market.").

point of consumption.[31] One of the most common uses of distributed generation in America is solar photovoltaic panels installed on private homes that produce some or all of the electricity required to power the home.[32] The installation of residential solar distributed generation in the United States has increased at an astounding rate in recent years due to multiple factors, including available state and federal tax credits and, most importantly, the precipitous drop in price for residential solar panels.[33]

Electricity production from small hydropower installations is another form of distributed generation. While small hydropower—defined as hydroelectric facilities with an annual generation capacity of ten megawatts or less—alone cannot supply anything close to the low-emissions electricity generation required to power the U.S. market and help combat global warming, it can be a piece of the puzzle that must be assembled to reach those goals. A recent study estimated that small hydropower has the capacity to provide more than one hundred thousand megawatts of new electricity production in the U.S. annually.[34] Although wind and solar energy are driving most of renewable energy's growth in the U.S.,[35] adapting federal

---

[31] *What is Distributed Generation (Also Distributed Energy)?*, BLOOMENERGY, http://www.bloomenergy.com/fuel-cell/distributed-generation [https://perma.cc/3UN9-NGPC].

[32] *Distributed Generation of Electricity and its Environmental Impacts*, U.S. ENVTL. PROT. AGENCY, https://www.epa.gov/energy/distributed-generation-electricity-and-its-environmental-impacts [https://perma.cc/VXG6-ZWF].

[33] The price of residential solar panels dropped 99.2 percent between 1977 and 2015. *Cost of Solar Panels Over Time*, UNDERSTANDSOLAR (July 20, 2015), https://understandsolar.com/cost-of-solar [https://perma.cc/T8QC-VV5B].

[34] *See* U.S. DEP'T OF ENERGY, FEASIBILITY ASSESSMENT OF THE WATER ENERGY RESOURCES OF THE UNITED STATES FOR NEW LOW POWER AND SMALL HYDRO CLASSES OF HYDROELECTRIC PLANTS v (Jan. 2006), https://www.energy.gov/sites/prod/files/2013/12/f5/doewater-11263.pdf [hereinafter WATER ENERGY RESOURCES OF THE UNITED STATES]; *see also* HYDROPOWER VISION, *supra* note 30.

[35] *Table 10.1: Renewable Energy Production and Consumption by Source*, U.S. ENERGY INFO. ADMIN., https://www.eia.gov/totalenergy/data/browser/index.cfm?tbl=T10.01# [https://perma.cc/A2ER-99N9]; Daniel Cusick, *Wind and Solar Growth Outpace Gas*, SCIENTIFIC AM. (Jan. 12, 2017), https://www.scientificamerican.com/article/wind-and-solar-growth-outpace-gas [https://perma.cc/4BWV-44Z3] (noting that 60 percent of the approximately

energy law and policy to effectively confront the trends of climate change will also require rethinking the future of hydropower, and small hydropower may offer a less contentious approach to tapping America's vast water resources.

The legislative and policy fixes to big dam hydropower needed to strike the difficult balance between encouraging more hydroelectric generation, on the one hand, and ameliorating the significant impacts these dams have on rivers and the people and animals that rely on them, on the other, while complicated and deserving of significant attention,[36] are outside the scope of this analysis. Instead, this Article focuses on potential regulatory changes that should be enacted to encourage the growth of small hydropower in the U.S. Aside from nuclear power, hydropower is the most heavily regulated electricity-generating source in the U.S.[37] The current regulations governing small hydropower discourage investment and unnecessarily burden developers by requiring them to navigate a costly, complex, and time-consuming regulatory framework. This framework may be appropriate for large dams, given the environmental and ecological damage they can cause, but it represents regulatory overkill when applied to the comparatively tiny impact of a small hydropower project. With low-impact small hydropower technology offering a politically promising approach to utilizing untapped hydropower potential in America while also allowing fisheries to thrive, rivers to run free, and the environment to remain largely unaltered, such a heavy-handed regulatory scheme is ripe for reform.

This Article is presented in four Parts. Part II outlines the

---

24,000 megawatts of new electricity generation capacity installed in the U.S. in 2016 was from utility-scale wind and solar installations).

[36] For enlightening discussions of the ongoing environmental, economic, and social impacts of large dams, *see generally* Reed D. Benson, *Dams, Duties, and Discretion: Bureau of Reclamation Water Project Operations and the Endangered Species Act*, 33 COLUM. J. ENVTL. L. 1 (2014); Michael C. Blumm & Andrew B. Erickson, *Dam Removal in the Pacific Northwest: Lessons for the Nation*, 42 ENVTL. L. 1043 (2012); Michael C. Blumm, *Saving Snake River Water and Salmon Simultaneously: The Biological, Economic, and Legal Case For Breaching The Lower Snake River Dams, Lowering John Day Reservoir, and Restoring Natural River Flows*, 28 ENVTL. L. 997 (1998).

[37] Lea Kosnik, *Consolidation and ownership trends of nonfederal hydropower generating assets, 1980–2003*, at 30 ENERGY ECON., 715 n. 28 (2007).

history of hydropower regulation in the U.S., including the environmental, geographic, and human effects of big dam hydropower development that ultimately engendered the onerous regulations currently governing all hydropower development. Building off of this history, Part III discusses America's hydropower potential, the available methods for tapping it, and the possible environmental impacts of these methods. Part IV provides an overview of the current regulations governing small hydropower. Part V concludes by proposing areas where the regulatory framework for low-impact small hydropower should be reformed to properly and responsibly encourage its development, including by (1) making a regulatory distinction between low-impact and more physically intrusive methods of hydropower generation; and (2) streamlining and expediting the approval process for low-impact small hydropower projects.

II. A BRIEF HISTORY OF HYDROPOWER REGULATION

A. The Era of Big Dam Development

For most of early American history, hydropower played an important but decidedly local role in power generation. The energy generated by dams, water wheels, and other similar devices was used at or very near where it was generated, a practice known today as distributed generation. This began to change in the late nineteenth century with the appearance of the first small pieces of what would eventually become the national electrical grid. In 1880, sixteen streetlights powered by a spinning water turbine at a local chair factory illuminated Grand Rapids, Michigan.[38] Two years later, on the Fox River near Appleton, Wisconsin, the first commercial hydroelectric power plant in the U.S. began providing electricity to two local businesses.[39] That same year, the possibilities of off-site

---

[38] *History of Hydropower*, U.S. DEP'T OF ENERGY (July 1, 2015), http://energy.gov/eere/water/history-hydropower [https://perma.cc/7YMW-QDK5].

[39] Laura Gardner, *Power flow: the first large-scale use of alternating current as a means of transmitting electricity was at a hydroelectric scheme at Niagara*

centralized generation became manifest when the Edison Electric Illuminating Company's Pearl Street coal-fired power station sent electricity coursing through lower Manhattan to set eight hundred new incandescent light bulbs aglow.[40]

The rise of hydropower in America during the late nineteenth and early twentieth centuries was driven by a rapidly increasing need for new sources of large-scale electricity generation, as Americans began replacing their gaslights and oil lamps with Edison's light bulb.[41] But Edison's favored means of distributing electricity—direct current, or DC, where electrons constantly flow in one direction[42]—would not be the primary means by which America fed its ever-growing appetite for electricity.[43] Before the 1880s were over, the limitations of DC power became widely apparent.[44] Principal among these deficiencies were the limited distances (often a mile or less) that it could be transmitted from the generation source before it dissipated.[45] Relying on DC power to energize the growing nation would require the construction of huge numbers of generating stations, a prospect that did not make economic or environmental sense.[46]

With businessmen and investors like George Westinghouse sensing an opportunity, alternating current (AC) power was proffered as an alternative to Edison's direct

---

Falls, PROF'L ENG'G MAG., Apr. 2011, at 67; Gina S. Warren, *Hydropower: It's a Small World After All*, 91 NEB. L. REV. 925, 931 (2013) [hereinafter *It's a Small World After All*]. The Fox River plant generated 12.5 kilowatts of electricity. Gardner, *supra*.

40 SIMON WINCHESTER, THE MEN WHO UNITED THE STATES: AMERICA'S EXPLORERS, INVENTORS, ECCENTRICS, AND MAVERICKS, AND THE CREATION OF ONE NATION, INDIVISIBLE 364–65 (2014).

41 *Id.*; *see also* Steve Voynick, *From Lighting to Writing*, WORLD AND I, May 2003, at 132 (noting that by 1910, General Electric was mass-producing millions of lightbulbs).

42 Sarah Wagoner, *Current Obsession: AC/DC*, U.S. DEP'T OF ENERGY (Aug. 31, 2015), https://energy.gov/eere/articles/current-obsession-acdc [https://perma.cc/VB6W-X9ED].

43 WINCHESTER, *supra* note 40, at 366–67.

44 MARGARET CHENEY, TESLA: MAN OUT OF TIME 46 (First Touchstone Edition 2001).

45 WINCHESTER, *supra* note 40, at 366–67.

46 *Id.*

current.[47] AC power, which involves electrons moving in all directions through a transmission line, can be transmitted great distances with minimal line losses, allowing a single generating station to supply electricity to homes and businesses located great distances from the station.[48] Within only a few years of its inception, AC power had become the dominant electrical system in the United States,[49] powering not only light bulbs across the country, but also the electric motor, which gave rise to in-home refrigeration and other transformative domestic technologies.[50]

The advent of centralized generation and the national electrical grid required the development of utility-scale electricity generation throughout the country. One potential source of such generation could be found in the great rivers crisscrossing America. Before long, hydropower would be transformed from a small-scale localized power source into a large-scale national industry that produced nearly half of the increasingly industrialized nation's electricity by the end of the nineteenth century.[51]

The federal government has played a central role in hydropower development and regulation since the beginning of its growth in the U.S. energy sector. In 1890, Congress assumed sole authority over the permitting of hydropower projects through the enactment of the Rivers and Harbors Act, which

---

[47] CHENEY, *supra* note 44.

[48] Another benefit of AC power was the relative ease with which it could be converted to different voltages by the use of a transformer. DC power, on the other hand, required the installation of an expensive and short-lived rotating device, which made the process "formidably uneconomical." WINCHESTER, *supra* note 40, at 368; Wagoner, *supra* note 42. The first high voltage transmission line in America was completed in 1889, bringing electricity generated by hydroelectric turbines housed in a power station at Willamette Falls, Oregon to consumers in Portland, Oregon. Richard S. Nichols, *The First Electric Power Transmission Line in North America–Oregon City, Oregon*, 7 IEE INDUS. APPLICATION MAG. 7 (July–Aug. 2003).

[49] After Westinghouse's clear demonstration of AC power's superior reliability and economy to DC power at the Columbian Exposition of the 1892 Chicago World's Fair, AC power would become the primary means by which electricity was transmitted in the United States. WINCHESTER, *supra* note 40, at 374–75.

[50] *Id.* at 368.

[51] *See* Wagoner, *supra* note 42; *see also* WINCHESTER, *supra* note 40, at 367 (describing the outcome of the War of the Currents as turning electricity into a national utility and a public good).

required that all obstructions on inland waterways, including hydroelectric dams, be authorized by Congress, the Secretary of War, and the Chief of Engineers.[52] A contentious policy debate between conservationists and private developers quickly ensued as to whether Congress's regulatory authority under the Act reached beyond the navigable stretches of America's waterways.[53] Settling this dispute in 1899, the United States Supreme Court ruled that the Commerce Clause empowered Congress to not only regulate the development of hydroelectric dams on navigable waters, but also on those non-navigable stretches that impacted navigation downstream.[54] For the next thirty years, Congress would review proposed hydropower projects on all jurisdictional waters on a case-by-case basis, as provided in the Rivers and Harbors Act.[55]

At the turn of the nineteenth century, conservationists were empowered by the ascendancy of a new president, a fellow conservationist, naturalist, avid bird watcher, big game hunter, and former cattle rancher.[56] Ushering in the new American century, President Theodore Roosevelt pursued an ambitious progressive agenda that championed the common man and sought to create a governmental check on those he considered

---

[52] Charles R. Sensiba, *Who's in Charge Here? The Shrinking Role of the Federal Energy Regulatory Commission in Hydropower Relicensing*, 70 U. Colo. L. Rev. 603, 612 (1999) (citing Rivers and Harbors Act of 1890, ch. 907, 26 Stat. 426; Rivers and Harbors Act of 1884, ch. 229, 23 Stat. 133); Max J. Mizejewski, *FERC's Abdication of Jurisdiction Over Hydroelectric Dams on Nonnavigable Rivers: A Potential Setback for Comprehensive Stream Management*, 27 ENVTL. L. 741, 745–46 (1997).

[53] Mizejewski, *supra* note 52.

[54] U.S. v. Rio Grande Dam & Irrigation Co., 174 U.S. 690 (1899).

[55] *See, e.g.*, First Iowa Hydro-Elec. Coop. v. Fed. Power Comm'n, 328 U.S. 152, 180 (1946) (noting that the FWPA replaced the "piecemeal, restrictive, negative approach of the River and Harbor Acts and other federal laws previously enacted").

[56] Theodore Roosevelt would assume the presidency on September 14, 1901 after the assassination of President William McKinley in Buffalo, New York. H.W. BRANDS, T.R.: THE LAST ROMANTIC 411–16 (1997); *see also* EDMUND MORRIS, THE RISE OF THEODORE ROOSEVELT (Modern Library 2001) (1979) (chronicling Roosevelt's study of ornithology and zoology, as well as his years as a cattle rancher in North Dakota).

"malefactors of great wealth."[57] As a part of this agenda, conservationists in the administration, like Chief of the United States Forest Service Gifford Pinchot, sought to perfect America's vast natural resources to provide the "greatest good of the greatest number,"[58] which included realizing the utilitarian potential of "large multiple-purpose dams and reservoirs."[59] With seemingly endless opportunities, the American West would become a workshop for this new resource ethic.[60] In 1902, Roosevelt, in defiance of his party's congressional leaders, pushed the National Reclamation Act of 1902 (Reclamation Act) through Congress.[61] The Reclamation Act created what would become the Bureau of Reclamation and established a program that sought to "reclaim" the arid and largely unpopulated West through a vast network of irrigation and hydropower projects that would disperse the agricultural and electrical benefits of water to subsistence farmers throughout the region.[62]

---

[57] Theodore Roosevelt, U.S. President, Address of President Roosevelt on the Occasion of the Laying of the Corner Stone of the Pilgrim Memorial Monument (Aug. 20, 1907), https://www.archive.org/stream/addressofpreside00roo/addressofpreside00roo_djvu.txt [https://perma.cc/XD9S-NUQ9]; *see also* EDMUND MORRIS, THEODORE REX 507 (Modern Library 2002) (2001) (noting Roosevelt's penchant for labeling multimillionaires like John D. Rockefeller and E.H. Harriman "the criminals of great wealth.") [hereinafter THEODORE REX].

[58] This enduring phrase that came to embody the conservationist ideal was first coined by Gifford Pinchot in 1905. Charles Wilkinson, *"The Greatest Good of the Greatest Number in the Long Run": TR, Pinchot, and the Origins of Sustainability in America*, 26 COLO. NAT. RES., ENERGY & ENVTL. L. REV. 69, 72 (2015).

[59] Dan Tarlock, *Hydro Law and the Future of Hydroelectric Power Generation in the United States*, 65 VAND L. REV. 1723, 1728 (2012) [hereinafter *Hydro Law*].

[60] By 1902, a "water monopoly" had been created in the West, favoring the irrigation of moneyed farmers and disadvantaging subsistence family farms. THEODORE REX, *supra* note 57, at 115.

[61] Representative Joseph Gurney Cannon, a Republican congressman who would become Speaker of the House a year after the enactment of the National Reclamation Act, was the leading anti–conservationist in Congress, and resisted Roosevelt's preoccupation with reclaiming the arid West. *Id.* at 114–15.

[62] Shelly C. Dudley, *The First Five: A Brief Overview of the First Reclamation Project Authorized by the Secretary of the Interior on March 14, 1903*, 306 (The Bureau of Reclamation: History Essay from the Centennial Symposium Volumes I and II 2008), https://www.usbr.gov/history/Symposium_2008/Historical_Essays.pdf [https://perma.cc/K77C-CXP3]; THEODORE REX , *supra* note 57, at 114–15.

In 1907, dissatisfied with regulated utilities' outsized influence over congressional decisions concerning hydropower development, Roosevelt put in place an Inland Waterways Commission to prepare "a comprehensive plan for the improvement and control of the river systems of the United States."[63] Three years later, with hydropower solidifying its place in American electricity production, Roosevelt pushed Congress to adopt the first general licensing scheme for the private development of hydropower on waters under federal jurisdiction via the General Dam Act.[64] But despite Congress's stated intention that the General Dam Act would promote privately funded hydropower development,[65] the licensing scheme was widely seen as a failure, "hinder[ing] rather than facilitating hydroelectric power development,"[66] and resulting in the construction of only five privately-funded, federally-authorized hydropower projects between 1910 and 1920.[67]

It was not until 1920, with the enactment of the Federal Water Power Act (FWPA)[68]—rechristened the Federal Powers Act (FPA) in 1935[69]—that Congress formulated a comprehensive approach to licensing hydropower facilities on waters under

---

[63] D.H. Cole, *Reviving the Federal Power Act's Comprehensive Plan Requirement: A History of Neglect and Prospects for the Future*, 16 ENVTL. L. 639, 654 (1986). In his speech to the Deep Waterways Convention, Roosevelt, true to his progressive ideals, declared that "[t]here is an intimate relation between our streams and the development and conservation of all the other great permanent sources of wealth." THEODORE REX, *supra* note 57, at 496 (quoting M. NELSON MCGEARY, GIFFORD PINCHOT: FORESTER-POLITICIAN 94 (1960)); *see also* Cole, *supra* note 63, at 654 (noting that Roosevelt's "comprehensive plan" language would be the precursor to the comprehensive licensing objective of the FPA).

[64] General Dam Act of 1910, ch. 360, § 4, 36 Stat. 593, 595 (1910); Cole, *supra* note 63, at 655–56; *Hydro Law*, *supra* note 59, at 1731.

[65] Sensiba, *supra* note 52, at 613.

[66] James C. Duda, *The 'Comprehensive Plan' Requirement of the Federal Power Act: A Senator's Dream, A Congressional Mandate, and a Parameter for Agency Discretion*, 28 B.C. L. REV. 523, 531 (1987).

[67] *Id.* at 531 n. 57.

[68] Federal Water Power Act of 1920, ch. 285, 41 Stat. 1063.

[69] Public Utility Act of 1935, ch. 687, 49 Stat. 803, 838 (amending the FWPA and changing its name to the Federal Power Act).

federal jurisdiction.[70] The depletion of America's strategic coal and oil reserves during World War I spurred the Wilson administration to pursue a regulatory overhaul to spark American hydropower development.[71] The FWPA vested exclusive licensing authority over hydropower development in the Federal Power Commission (FPC), the predecessor of the Federal Energy Regulatory Commission (FERC).[72] As the Supreme Court noted in *First Iowa Hydro-Electric Coop. v. Federal Power Comm'n*,[73] it was the intention of Congress in passing the FWPA to secure a complete regulatory scheme "which would promote the comprehensive development of the water resources of the Nation, in so far as it was within the reach of the federal power to do so."[74] The Court held that the detailed provisions of the FWPA preempted any contradictory or superfluous state regulations.[75]

At the close of the 1920s, America was mired in the worst economic depression in the nation's history.[76] The failure of the Hoover administration's substantial efforts to stem the tide of depression, and the general public repudiation of Hoover's presidency that followed, illustrated the seemingly boundless depths of the depression and suggested even bolder measures would be required to "unstick" the U.S. economy.[77] Seeking to stimulate economic recovery, stabilize capitalism, and provide

---

[70] Federal Power Act, ch. 285, 41 Stat. 1063 (1920) (codified as amended at 16 U.S.C. §§ 792–828c (2012); Dan Tarlock, *The Legal-Political Barriers to Ramping Up Hydro*, 86 CHI.-KENT L. REV. 259, 265 (2011).

[71] Mizejewski, *supra* note 52, at 746; There was a sense among senators that had the United States had a greater installed hydropower capacity, Germany may have been deterred from entering into WWI. Sensiba, *supra* note 52, at 613–14 n. 78.

[72] The Federal Water Power Act of 1920 (Pub. L. No. 66-280); Sarah C. Richardson, *The Changing Political Landscape of Hydropower Project Relicensing*, 25 WM. & MARY ENVTL. L. & POL'Y REV. 499, 500 (2000).

[73] First Iowa Hydro-Elec. Coop. v. Fed. Power Comm'n, 328 U.S. 152 (1946).

[74] *Id.* at 180.

[75] *Id.*

[76] DAVID M. KENNEDY, THE AMERICAN PEOPLE IN THE GREAT DEPRESSION: FREEDOM FROM FEAR, PART ONE 58–59 (2003).

[77] *Id.* at 83, 94 (chronicling Hoover's fall from his status as "the most revered American" to "the most loathed and scorned figure in the country" and the measures he took during the Great Depression that would "revolutionize the American financial world" and "lay the groundwork" for the New Deal).

economic security for the millions of Americans impoverished by the depression, Hoover's successor, Franklin D. Roosevelt, embarked on a bold agenda to enact a broad set of government measures, which collectively came to be known as the New Deal.[78] A central piece of Roosevelt's New Deal was the establishment of massive federal public works programs to create jobs for millions of unemployed Americans.[79] New government agencies, such as the Rural Electrification Administration[80] and the Tennessee Valley Authority (TVA),[81] were created to oversee massive public work programs designed to provide jobs for out-of-work Americans and cheap electricity to rural communities racked by debilitating poverty.[82]

One of the primary means of rural electrification was the construction of large multipurpose hydroelectric dams.[83] Among these New Deal–era dam projects was the Hoover Dam, which began generating power in 1936 and embodied the new vision of resource development in America.[84] In the words of President Roosevelt, where there once "flowed dangerous, turbulent river[s] . . . running unused to the sea," the government would create "great national possessions" for irrigation, electrification, and flood control.[85] In a prescient address at the Grand Coulee Dam in 1934, Roosevelt extolled the virtues of this new "dam minded" resource policy, predicting that electricity would be

---

[78] *Id.* at 363–80 (recounting the numerous economic reforms and social innovations that comprised the New Deal and its leitmotif of "[j]ob security, life-cycle security, financial security, [and] market security").

[79] ROBERT DALLEK, FRANKLIN D. ROOSEVELT: A POLITICAL LIFE 153–159 (2017); *see* KENNEDY, *supra* note 76, at 153.

[80] Rural Electrification Act of 1936, 7 U.S.C. §§ 901–950 (2012) (original version at ch. 432, 49 Stat. 1363 (1936)).

[81] Tennessee Valley Authority Act of 1933, 16 U.S.C. 831 (2012) (original version at ch. 32, 48 Stat. 58 (1933)).

[82] DALLEK, *supra* note 79, at 153, 155, 220; *see* KENNEDY, *supra* note 76, at 252.

[83] *See* KENNEDY, *supra* note 76, at 128, 147–49.

[84] Hoover Dam, constructed on the Colorado River, would generate 705 MW in 1939, making it the largest hydroelectric facility in the world at the time. *Hoover Dam*, U.S. BUREAU OF RECLAMATION https://www.usbr.gov/lc/hooverdam/history/articles/chrono.html [http://perma.cc/L9AK-7MVH].

[85] Franklin D. Roosevelt, U.S. President, Address at the Dedication of Boulder Dam (Sept. 30, 1935), http://www.presidency.ucsb.edu/ws/?pid=14952 [http://perma.cc/X4SC-K4X6].

"made so cheap that [it] would become a standard article of use, not merely for agricultural and manufacturing, but for every home within the reach of an electric transmission line."[86] By the end of the 1930s, the Roosevelt administration had "erected mammoth dams—Grand Coulee and Bonneville on the Columbia, Shasta on the Sacramento, Fort Peck on the Missouri—that were rivertamers and naturebusters, to be sure, but jobmakers and regionbuilders, too."[87] In its role as both dam regulator and dam developer, the federal government became the main architect of energy production on America's navigable rivers.

As America emerged from the depression and entered as a combatant into the Second World War in its new role as the "great arsenal of democracy,"[88] the country's hydroelectric dams were able to partly meet the enormous demand for electricity to manufacture the airplanes, ships, and munitions necessary to fight the war.[89] Hydropower was even at the center of a new, and soon to be world-changing, industry, with the Bonneville and Grand Coulee dams electrifying "three atomic piles and four chemical separation plants" at the new Hanford plant along the banks of the Columbia River, where workers "squeezed out plutonium from grudging nature."[90]

By 1945, at war's end, America "commanded fully half of the entire planet's manufacturing capacity and generated more than half of the world's electricity."[91] The U.S. held near-monopolies on "the emerging growth industries of aerospace and

---

[86] Franklin D. Roosevelt, U.S. President, Remarks at the Site of the Grand Coulee Dam, Washington (Aug. 4, 1934), http://www.presidency.ucsb.edu/ws/?pid=14732 [http://perma.cc/R9YR-NG5Z].

[87] KENNEDY, *supra* note 76, at 379.

[88] The "great arsenal of democracy" was a phrase coined by Roosevelt during a radio broadcast on December 29, 1940. DAVID M. KENNEDY, FREEDOM FROM FEAR: THE AMERICAN PEOPLE IN DEPRESSION AND WAR, 1929–1945 468–69 (1999).

[89] *See BPA powered the industry that helped win World War II*, BONNEVILLE POWER ADMIN. (Oct. 31, 2012), https://www.bpa.gov/news/newsroom/Pages/BPA-powered-the-industry-that-helped-win-World-War-II.aspx [https://perma.cc/3SNQ-FM66].

[90] KENNEDY, *supra* note 88, at 665.

[91] *Id.* at 857.

electronics," and an absolute monopoly on atomic power.[92] Nine out of ten American farms had electricity, an increase from only two out of ten a little more than a decade earlier, when fifty million rural Americans cooked with wood stoves and lit their houses with oil lamps.[93] In the words of Winston Churchill, America truly stood "at the summit of the world," a perch attained in no small part by electrifying nearly every corner of the country.[94]

B. The Tide Shifts on Hydropower

In the years following World War II, big dam hydropower development flourished.[95] From 1950 to 1970, U.S. hydropower generation capacity nearly tripled, increasing from 100,000 to 275,000 gigawatts per year.[96] The frenetic pace of dam building in these years set the nation on a course to have over 75,000 dams at least six feet in height installed by the end of the twentieth century.[97] Dam development brought undeniable benefits to the country, turning portions of the arid West into irrigated and productive agricultural land, taming floodwaters that had previously afflicted that region, and producing inexpensive electricity that supported the booming American economy.[98] However, hydropower dams and reservoirs also transformed large portions of America's geography, altering the natural flow of rivers and reshaping wildlife and aquatic habitats. Iconic landscapes were scarred with concrete slabs, and formerly scenic canyons were now manmade lakes. By the 1960s, the harmful effects of big dams had become readily

---

[92] *Id.*

[93] KENNEDY, *supra* note 76, at 252.

[94] KENNEDY, *supra* note 88, at 856 (citing DAVID CANNADINE, ET AL., BLOOD, TOIL, TEARS AND SWEAT: THE SPEECHES OF WINSTON CHURCHILL 282 (Houghton Mifflin 1989)).

[95] ROCÍO URÍA-MARTINEZ ET AL., 2014 HYDROPOWER MARKET REPORT, fig.1 (Apr. 2015), http://www.energy.gov/sites/prod/files/2015/04/f22/2014%20Hydropower%20Market%20Report_20150424.pdf [http://perma.cc/PFN8-F3CH]; Christine A. Klein, *On Dams and Democracy*, 78 OR. L. REV. 641, 642 (1999).

[96] HYDROPOWER VISION, *supra* note 30, at 76.

[97] Klein, *supra* note 95, at 670.

[98] *Id.* at 647.

apparent, and the era of big dam development began to ebb, as a nascent American environmental movement began to reshape the discussion surrounding dams and reservoirs.

Two mid–twentieth century conflicts between big dam development and environmentalism foreshadowed the controversies that would surround dams later in the century and contribute to the eventual decline of hydropower from its apogee in the post–WWII era. In 1948, with the Truman administration advancing Franklin Roosevelt's vision of federally managed rivers in the West, the Bureau of Reclamation proposed building a dam on the Green River in Dinosaur National Monument in Echo Park, Colorado.[99] The Echo Park Dam was to supply electrical power to the ever-expanding atomic weapons industry in Utah.[100] Environmentalists, led by Howard Zahniser of the Wilderness Society and David Brower of the Sierra Club, quickly mounted a full-throated national campaign opposing the dam, even employing the literary talents of Wallace Stegner for a 1955 work that publicized the monument and advocated for its preservation.[101] Facing an escalating groundswell of public and political resistance, President Dwight Eisenhower signed a bill in 1956 that included "a provision that prohibited dams in any area of the national park system along the Colorado River," ultimately precluding the construction of the Echo Park Dam.[102]

In 1965, a decade after the Echo Park Dam controversy, Brower would lead another public awareness campaign to galvanize resistance against two dams proposed in the Grand Canyon.[103] Although neither dam was to be located within the Grand Canyon National Park, the reservoir created by the lower dam would inundate the canyon throughout the national

---

[99] Mark W.T. Harvey, *Battle for Dinosaur: Echo Park Dam and the Birth of the Modern Wilderness Movement*, 45 MONT.: THE MAG. OF W. HIST. 33, 36–37 (Winter 1995).
[100] *Id.* at 37.
[101] *Id.* at 37–41.
[102] *Id.* at 42.
[103] Byron E. Pearson, *Salvation for Grand Canyon: Congress, the Sierra Club, and the Dam Controversy of 1966–1968*, 36 J. OF THE SW. 159, 161 (Summer 1994).

monument and into a substantial stretch of the park.[104] The grassroots effort to save the Grand Canyon created something of a national referendum on the theretofore largely unquestioned policy of dam development, sparking a debate about the severe environmental effects of dams and reservoirs.[105] Within a year of the dams' proposal, articles in the *New York Times*, *Life*, *Newsweek*, and *Reader's Digest* made plain that the fate of the Grand Canyon was becoming a national issue.[106] The Grand Canyon dam proposal expired in Congress in 1968, as a result of the environmentalists' public awareness campaign led by environmentalists, as well as divisions among the dams' supporters and questions about the economic feasibility of alternative sources of electrical generation in the region.[107] But the fact that the Grand Canyon dam proposal had been put forth in the first place, let alone that it advanced so far in the process, showed how the balance between development and conservation of America's waterways had tipped toward nearly unfettered growth. Sixty-two years before the proposal to inundate the Grand Canyon, President Theodore Roosevelt, during his great tour of the West, declared that the Grand Canyon could not be improved: "[t]he ages have been at work on it, and man can only mar it."[108] Something significant had been lost in the intervening decades. Roosevelt, who believed in utilizing America's natural resources to grow the economy, also understood the importance of placing limitations on development and of preserving certain places in their natural state. The Grand Canyon dam controversy demonstrated just how far America's hydro resource policy had devolved since the early twentieth century.

Although pro-environment forces were not wholly responsible for the defeat of the Echo Park and Grand Canyon dams, the build-versus-preserve arguments raised during the controversies fed an already growing public interest in the protection of rivers and streams and the preservation of wildlife

---

[104] *Id.* at 160–61.
[105] *Id.* at 161.
[106] *Id.* at 161–63.
[107] *Id.* at 174–75.
[108] THEODORE REX, *supra* note 57, at 226.

and scenic landscapes. In the late 1960s and early 1970s, Congress responded by passing several expansive federal laws that drastically altered the rules for private and public use of America's natural resources, including the Clean Water Act,[109] the Endangered Species Act,[110] and the Clean Air Act.[111] One of the opening salvos in this legislative revolution was the passage of the Wild and Scenic Rivers Act (WSRA) in 1968.[112] The WSRA was part of a series of comprehensive environmental protection laws that directly impacted the feasibility and economy of U.S. hydropower development and contributed to its eventual decline.

In passing the WSRA, Congress declared a new national policy: that dam construction in America would be preempted by the preservation of certain "remarkable" rivers in their free-flowing condition, in order to protect, among other things, vital conservation interests for present and future generations.[113] In this spirit, the WSRA prevented the licensing of any private dam "directly affecting" any free-flowing river that was designated, either by the Secretary of the Interior after petitioning from states or other parties or by Congress, as "wild or scenic."[114] Within a few decades of its enactment, the WSRA had barred hydropower development on thousands of miles of rivers and streams with energy-generative potential.[115]

---

[109] Federal Water Pollution Control Act Amendments of 1972, Pub. L. No. 92–500, § 101, 86 Stat. 816 (1972) (codified as amended at 33 U.S.C. §§ 1251–1376 (2012)).

[110] Endangered Species Act of 1973, Pub. L. No. 93-205, § 4, 87 Stat. 884 (1973) (codified as amended at 7 U.S.C. § 136 (2012) and 16 U.S.C. §§ 1531–1544 (2012)).

[111] Clean Air Amendments of 1970, Pub. L. No. 91–604, § 4, 84 Stat. 1676 (1970) (codified as amended at 42 U.S.C. § 7521 (2012)). Examples of other significant environmental legislation passed by Congress during this period includes the Marine Protection, Research, and Sanctuaries Act in 1972 (16 U.S.C. § 1431–1445c–1 & 33 U.S.C. §§ 1401–1445) and the Resource Conservation and Recovery Act in 1976 (42 U.S.C. §§ 6901–6992k).

[112] Wild and Scenic Rivers Act, Pub. L. No. 90–542, 82 Stat. 906 (1968) (codified as amended at 16 U.S.C. §§ 1271–87 (2012)).

[113] 16 U.S.C. § 1271 (2012).

[114] 16 U.S.C. §§ 1271–87 (2012); Klein, *supra* note 95, at 699–700; Riette van Laack, *Protection of a Wild and Scenic River Against Nonfederally Funded, Nonpower Water Projects Reducing the Volume of Water Feeding into that River*, 72 TENN. L. REV. 875, 875–76 (2005).

[115] *It's a Small World After All*, *supra* note 39, at 938–39.

A year after passing the WSRA, Congress added another layer of regulatory oversight of hydropower development by enacting the National Environmental Policy Act (NEPA).[116] Under NEPA, before licensing a private hydropower project, FERC must conduct extensive environmental reviews to assess whether the proposed project would have significant effects on "the quality of the human environment."[117] NEPA also requires FERC to consider alternatives to licensing a project that involved "unresolved conflicts concerning alternative uses of available resources."[118] Additionally, NEPA requires FERC to measure the cumulative impacts of a proposed project when added to other past, present, and reasonably foreseeable future actions, such as existing hydropower facilities on a waterway on which additional development is proposed.[119] NEPA further subjects FERC's licensing authority to "an element of direct democracy"[120] by directing the agency to allow an opportunity for the public to review and comment on a proposed hydropower project.[121] Ultimately, NEPA's provisions add significant time, cost, and bureaucratic complexity to FERC's licensing process for hydropower projects. [122] Crucially, the level of oversight and regulatory burden under NEPA was not tuned to the size of the proposed project, despite the often starkly disproportionate environmental impacts of small and large dams. The result was an outsized regulatory impact on small hydro developers who often lacked the financial wherewithal to absorb such impact into their development budgets.

The Endangered Species Act of 1973 (ESA) further compounded hydropower's regulatory complexity.[123] Pursuant to the ESA, FERC was now obligated to determine, after consulting

---

[116] 42 U.S.C. §§ 4321–4347 (2012).
[117] *It's a Small World After All*, *supra* note 39, at 940 (citing 42 U.S.C.A. § 4332(2)I).
[118] 42 U.S.C. § 4332(E) (2012).
[119] National Environmental Policy Act—Regulations, 40 C.F.R. § 1508.7 (2011); David K. Eckberg, *Cumulative Impacts of Hydropower Development Under NEPA*, 16 Envtl. L. 673, 690 (1986).
[120] Klein, *supra* note 95, at 700.
[121] 42 U.S.C. § 4332(2)(C) (2012).
[122] *It's a Small World After All*, *supra* note 39, at 940.
[123] *See* 16 U.S.C. §§ 1531–44 (2012).

with applicable federal, state, and local agencies and before licensing, whether a proposed hydropower facility, regardless of its size or foreseeable environmental impact, would not likely have an adverse effect on any endangered or threatened species or their critical habitat.[124] Furthermore, the ESA imposed liability, including civil and criminal penalties, on federal and nonfederal parties for taking any endangered or threatened species (which could include the killing or injuring of fish or wildlife) or significantly modifying or degrading their habitat in a deadly manner.[125] It only took five years from enactment for the ESA to prove to be an effective check on the negative environmental effects of big dam hydropower: In 1978, the Supreme Court famously enjoined the Tennessee Valley Authority's completion of the Tellico Dam on the Little Tennessee River to prevent the extirpation of the endangered snail darter.[126] A subsequent amendment to the ESA in 1982 lessened the statute's impact somewhat, though, providing that federal agencies such as the TVA and FERC could obtain an incidental take authorization from the National Marine Fisheries Service to avoid liability for the taking of fish or wildlife resulting from a hydropower project.[127]

In 1972, FERC's plenary licensing authority over hydropower dams was further eroded—though the extent of this erosion was mostly unknown at the time[128]—with the enactment of the Clean Water Act (CWA).[129] Under the CWA, states were charged with setting water quality standards for waterways within their borders.[130] To ensure obtainment of these standards, states were also granted permitting power over any project subject to federal licensure that would discharge any

---

[124] *It's a Small World After All*, *supra* note 39, at 941–42.
[125] James M. Lynch, *Effect of ESA Listings on the Operation of FERC-Licensed Projects: The Hells Canyon Example and Beyond*, 10 FORDHAM ENVTL. L.J. 271, 295 (1999).
[126] Tenn. Valley Auth. v. Hill, 437 U.S. 153 (1978); Klein, *supra* note 95, at 687.
[127] Lynch, *supra* note 125, at 296.
[128] Daniel Pollack, *S.D. Warren and the Erosion of Federal Preeminence in Hydropower Regulation*, 34 ECOLOGY L. Q. 763, 786 (2007).
[129] 33 U.S.C. §§ 1251–387 (2012).
[130] 33 U.S.C.A. § 1251; Pollack, *supra* note 128, at 774.

pollutant into a navigable waterway within the state.[131] Among those activities constituting a discharge was the release of water from a hydroelectric turbine.[132] As a result, states could now impose permitting conditions on any private hydropower project, and FERC was obligated to incorporate the conditions entirely or be forced to refuse licensing.[133] Consequently, the CWA effectively loosened FERC's absolute authority over hydropower development, placing direct and significant influence in the hands of the states. Ultimately, the enactment of the CWA created an even more complex multi-party, multi-phase process for hydropower developers of all sizes to navigate.[134]

C. The Overbreadth of Hydropower Regulations

Due to the additional layers of licensing process oversight and costly measures required to mitigate unavoidable environmental harm brought about by the environmental legislation of the 1970s, as well as the shrinking number of undammed steep canyons remaining after the building boom of the first half of the twentieth century, the pace of big dam development in the U.S. slowed significantly by the end of the 1970s.[135]

---

[131] 33 U.S.C.A. § 1341(a); Pollack, *supra* note 128, at 775.

[132] S.D. Warren Co. v. Me. Bd. of Envtl. Prot., 547 U.S. 370, 371 (2006).

[133] 33 U.S.C.A. § 1341(d); Lisa M. Bogardus, *State Certification of Hydroelectric Facilities Under Section 401 of the Clean Water Act*, 12 VA. ENVTL. L.J. 43, 45 (1992).

[134] *It's a Small World After All*, *supra* note 39, at 951.

[135] URÍA-MARTINEZ, *supra* note 95, at 8 ("[T]he large drop in new installed hydropower in the 1970s was largely because of hydropower-specific factors (e.g., legislative changes, less attractive available sites.)"); Reed D. Benson, *Reviewing Reservoir Operations: Can Federal Water Projects Adapt to Change?*, 42 Colum. J. Envtl. L. 353, 356 (2017) ("The 1970s brought increasing environmental awareness and a series of major federal laws including the National Environmental Policy Act, Clean Water Act, and Endangered Species Act, helping bring about the end of the big dam era"); Klein, *supra* note 95, at 697 ("Socio-political factors also contributed to the decline of dams, as the nation's awakening environmental consciousness led to the pass of new legislation"); Michael P. Lawrence, *Damming Rivers, Damning Cultures*, 30 Am. Indian L. Rev. 247, 260 (2005) ("Due to the advent of environmental laws and the lack of large dam sites remaining, the nation's focus on dams has switched from construction to operations and, some say, demolition").

With the exception of a brief but substantial hydropower boom in the early 1980s,[136] America's overall hydropower capacity would remain relatively constant over the next forty years.[137] In response to the energy crisis of the 1970s, there was a renewed interest in energy security and domestic sources of electricity production. Congress passed the Public Utility Regulatory Policies Act (PURPA) in 1978 to promote energy conservation and spur the use of domestic energy, including renewable energy sources.[138] Between 1981 and 1983 alone, over five thousand hydropower applications were submitted to FERC, a major increase from the approximately one hundred applications submitted in 1979.[139] However, the new hydropower projects installed during this period were not the massive dam-and-reservoir projects of the early twentieth century, but rather the more modestly sized projects favored under PURPA, which guaranteed independent producers of electricity a market for their smaller facilities generating under eighty megawatts of electricity.[140] The mini-boom of the 1980s saw almost six hundred new hydropower projects installed, but because of their relatively small size, the overall increase in national hydroelectric generating capacity was trivial in comparison with previous decades.[141]

In response to this brief flurry of hydropower development stimulated by PURPA,[142] and with FERC largely ignoring the environmental mandates of NEPA, the ESA, and the CWA in its licensing of hydropower projects,[143] Congress passed the Electric Consumers Protection Act of 1986 (ECPA).[144]

---

[136] URÍA-MARTINEZ, *supra* note 95, at 8.
[137] HYDROPOWER VISION, *supra* note 30, at 76 ("Since the 1970s, average total energy produced by hydropower plants has remained consistent, at around 275 TWh per year.").
[138] 16 U.S.C.A. §§ 2611 (2012).
[139] These applications involved over 65 watersheds nationwide. Eckberg, *supra* note 119, at 674–75.
[140] Megan Hooker, *Recreation and Aesthetics in the Public Interest: History and Overview of Hydropower License Denials by the Federal Energy Regulatory Commission*, 29 ENVTL. L. & LITIG. 87, 104 (2014).
[141] URÍA-MARTINEZ, *supra* note 95, at 8.
[142] *Id.* at 3.
[143] Klein, *supra* note 95, at 691.
[144] Electric Consumers Protection Act, Pub. L. No. 99-495, 100 Stat. 1243 (1986).

In part, the ECPA amended the FPA to require FERC to give environmental interests equal consideration to the interests of hydropower development.[145] The ECPA directed FERC to consider the protection and mitigation of damage to fish and wildlife species and their habitats, as well as recreational opportunities and the general stewardship of environmental quality, in its licensing of hydropower projects and imposition of licensing conditions.[146]

Despite the brief spike in hydropower development during the 1980s, by the 1990s, as the Commissioner of the Bureau of Reclamation, Dan Beard, reflected, "[t]he dam building era in the United States [was] now over."[147] And yet, the regulatory framework stitched together over the latter half of the twentieth century had far-reaching impacts beyond merely impeding big dam hydropower development. To a great extent, the regulations governing big dam hydropower imposed the same onerous requirements on small, low-impact hydropower methods. As a consequence, small hydropower saw its growth rate reduced to a sluggish state along with big dam hydropower, just as other means of generating carbon-free electricity, such as wind and solar energy, were beginning to gain traction in U.S. energy policy. The current hydropower regulations, created in part to manage and curtail the destructive effects of big dams on America's watersheds,[148] place unwarranted burdens on the development of small hydropower given its relatively minimal environmental, recreational, and aesthetic effects. As the planet continues to warm at an alarming rate and private and public funds pour into developing renewable energy resources, the time has come to unleash small hydropower from its regulatory shackles so that it can take its place with wind and solar as a clean energy solution to traditional fossil-based electricity production.

---

[145] *Id.*; Klein, *supra* note 95, at 692.

[146] Electric Consumers Protection Act, Pub. L. No. 99-495, 100 Stat. 1243 (1986); Klein, *supra* note 95, at 692.

[147] *Id.* at 697.

[148] *See* the Wild and Scenic Rivers Act,_16 U.S.C.A. §§ 1271–87 (1968) (discussed *infra* at II.B; Electric Consumers Protection Act, Pub. L. No. 99-495, 100 Stat. 1243 (1986) (discussed *infra* at II.C).

III. WHY SMALL HYDROPOWER?

A. Defining "Small Hydropower"

The definition of what constitutes "small hydropower" varies greatly, both in terms of generating capacity and qualifying methods of generation. Globally, qualifying small hydropower facilities range from less than ten kilowatts to over twenty-five megawatts.[149] These facilities utilize small-scale dams and impoundments, diversion methods, or "run-of-the-river" technologies.[150] In the United States, Congress has statutorily defined "small hydropower" as any hydropower facility with a total installed capacity of ten megawatts or less that generates electricity either from an existing dam, or from a natural water feature without utilizing a dam, a manmade impoundment, or any retention of water for storage and release.[151] Congress has further delineated two additional methods of energy generation that qualify as "small hydropower": conduit hydropower and hydrokinetic.[152]

Congress's definition of small hydropower is technologically inclusive, as it simply articulates the size and overall physical impact of a qualifying facility without specifying any particular type of hydropower-generating facility.[153] This

---

149 Oliver Paish, *Small hydro power: technology and current status*, 6 RENEWABLE & SUSTAINABLE ENERGY REVIEWS 537, 538 (2002).

150 Unlike traditional large dams that rely on reservoirs to store energy for on-demand electricity generation through planned releases of the impounded water through the dam's turbines, run-of-the-river hydroelectric systems utilize the natural flow of the river or stream to generate electricity, most often with no impoundment of water, and cannot schedule generation of electricity. The rare run-of-the-river systems with water storage are described as having "pondage" and can regulate water flows to control generation times. Edwin Cey, et. al., *Energy Education, Run-of-the-River systems*, ENERGY EDUC., http://energyeducation.ca/encyclopedia/Run-of-the-river_systems [https://perma.cc/4JH5-D7KL].

151 18 C.F.R. § 4.30(b)(29) (2017).

152 FED. ENERGY REG. COMM'N, FEDERAL ENERGY REGULATORY COMMISSION LICENSING HYDROKINETIC PILOT PROJECTS (Apr. 14, 2008), https://www.ferc.gov/industries/hydropower/gen-info/licensing/hydrokinetics/pdf/white_paper.pdf [https://perma.cc/D7ZE-VYUW] [hereinafter WHITE PAPER].

153 18 C.F.R. § 4.30(b)(29).

allows for new, innovative hydropower methods to be categorized as small hydropower. It is worthwhile to briefly describe a few methods of small hydropower generation in order to understand the benefits, risks, and boundaries of possible reform to the current regulatory framework for small hydropower.

Conduit hydropower makes use of existing infrastructure that has a primary purpose other than electricity generation to produce hydropower.[154] This method can utilize "canals, pipelines, and other manmade structures," creating a synergetic process that produces power through water delivery or wastewater disposal systems.[155] Conduit hydropower requires little additional construction to begin generating electricity from common manmade structures such as tunnels, canals, aqueducts, and pipelines that would otherwise produce only a single benefit to society.[156] There are thousands of miles of existing conduits in the U.S. that could be put to the additional use of electricity generation if existing impediments were overcome. One way to unleash this power would be to lower overly stringent regulatory hurdles that are appropriate for higher-impact hydropower generation methods, such as large dam hydropower, but are needlessly burdensome for relatively low-impact small hydro development.[157]

Another small hydropower technology uses hydrokinetic turbines to "extract energy through horizontal- or vertical-axis rotors with blades moving rapidly through the water."[158]

---

[154] U.S. DEP'T OF ENERGY, PUMPED STORAGE AND POTENTIAL HYDROPOWER FROM CONDUITS: REPORT TO CONGRESS FEBRUARY 2015, at iii (Feb. 2015), http://energy.gov/sites/prod/files/2015/06/f22/pumped-storage-potential-hydropower-from-conduits-final.pdf [https://perma.cc/KBL4-XGSD] [hereinafter PUMPED STORAGE].

[155] *Conduit*, NAT'L HYDROPOWER ASS'N, http://www.hydro.org/policy/technology/conduit [https://perma.cc/YK9H-ULQG].

[156] PUMPED STORAGE, *supra* note 154, at 14.

[157] *Id.* at 22 ("Many types of small hydropower projects, including conduit projects that would have minimal impacts (e.g., those within existing pressure reduction vaults), still are required to go through regulatory steps that incur delays and additional costs.").

[158] Linus Hammar, et al., *Hydrokinetic Turbine Effects on Fish Swimming Behaviour*, 8(12) PLOS ONE, at 1 (Dec. 17, 2013), http://journals.plos.org/plosone/article?id=10.1371/journal.pone.0084141 [https://perma.cc/6XML-RK3K].

Hydrokinetic power is a true run-of-the-river generation method, producing all of its energy by utilizing the kinetic energy of flowing water or currents to produce electricity.[159] There are several potential sources of hydrokinetic energy, including ocean waves, tidal currents, and free-flowing rivers.[160] Hydrokinetic turbines in rivers can be installed by anchoring to either the riverbed or a structure such as a bridge.[161]

Hydropower can also be produced by the diversion of a small amount of water, often with the use of a weir, through a regulated-flow pipeline called a penstock, which channels the water through a turbine before emptying it back into the river below the generating facility.[162] Depending on the diversionary technique employed, this can have the greatest impact on the flow and structure of the river of all the small hydropower methods. That said, even if a width-of-the-river weir is used to divert water, this small-scale hydropower technology will have significantly lower impacts on the environment, fisheries, recreation, and natural beauty than the large-scale damming and impoundment of a river (albeit with a commensurately smaller generating capacity), because it is easier for fish to bypass, does not substantially change the natural flow of a river, and does not alter the existing geography by creating a reservoir.[163]

B. The Potential of Small Hydropower

Hydropower currently accounts for six percent of all U.S. electricity production, mostly through the use of big dam

---

159 *How Hydrokinetic Energy Works*, UNION OF CONCERNED SCIENTISTS (Apr. 28, 2008), http://www.ucsusa.org/clean-energy/renewable-energy/how-hydrokinetic-energy-works#.WbWYfrKGPIU [https://perma.cc/JMN2-RLP4].

160 *Id.*

161 COLO. ENERGY OFF., SMALL HYDROPOWER HANDBOOK (2015), http://extension.colostate.edu/docs/energy/hydro-handbook.pdf [https://perma.cc/6VB6-3TGU].

162 David K. Okot, *Review of small hydropower technology*, 26 RENEWABLE & SUSTAINABLE ENERGY REVIEWS 515, 516 (2013).

163 Michaël Ovidio & Jean-Claude Philippart, *The impact of small physical obstacles on upstream movements of six species of fish: Synthesis of a 5-year telemetry study in the River Meuse Basin*, 483 HYDROBIOLOGIA 55, 65–67 (2002).

hydropower technology.[164] Only sixteen percent of America's hydropower capacity is currently being tapped, however.[165] A large portion of the country's untapped hydro resources could feasibly be utilized through small hydropower technologies. The Department of Energy has concluded that 130,000 sites across the country are viable for immediate development of small hydropower, with the capacity to provide more than 100,000 MW of electricity production annually.[166] That is fourteen times the annual generating capacity of Grand Coulee Dam.[167] It has also been noted that if only 5,400 of the most reasonably feasible small hydropower sites were developed, hydropower generation in America would increase fifty percent on an annual basis,[168] and the new small hydropower facilities alone would be capable of powering sixteen million homes a year.[169]

C. The Impact of Small Hydropower

Hydropower has played second fiddle to wind and solar energy in the current popular conception of the future of U.S. renewable energy development. Under the Obama administration, the climate change issues page on the White House's website made no reference to hydropower in its explanation of a clean energy economy, while lauding expansions in wind and solar energy infrastructure.[170] Electricity

---

[164] *Electric Power Monthly, Table 1.1 Net Generation by Energy Source: Total (All Sectors), 2008–January 2018*, U.S. ENERGY INFO. ADMIN., http://www.eia.gov/electricity/monthly/epm_table_grapher.cfm?t=epmt_1_01 [https://perma.cc/UV9G-HDSL].

[165] INT'L ENERGY AGENCY, RENEWABLE ENERGY ESSENTIALS: HYDROPOWER (2010), http://www.iea.org/publications/freepublications/publication/hydropower_essentials.pdf [https://perma.cc/3FMJ-VX5T].

[166] WATER ENERGY RESOURCES OF THE UNITED STATES, *supra* note 34, at v.

[167] BUREAU OF RECLAMATION, U.S. DEP'T OF THE INTERIOR, GRAND COULEE DAM STATISTICS AND FACTS, https://www.usbr.gov/pn/grandcoulee/pubs/ factsheet.pdf [https://perma.cc/4Q5M-93DD].

[168] WATER ENERGY RESOURCES OF THE UNITED STATES, *supra* note 34, at v.

[169] Gina S. Warren, *Hydropower: Time for a Small Makeover*, 24 IND. INT'L & COMP. L. REV. 249, 251 (2014) [hereinafter *Time for a Small Makeover*].

[170] U.S. DEP'T OF ENERGY, PRESIDENT'S CLIMATE ACTION PLAN 4 (June 2013), https://obamawhitehouse.archives.gov/sites/default/files/image/president27sclimateactionplan.pdf [https://perma.cc/7L3F-TYFW].

generation from wind and solar energy in the U.S. increased 199,896 MW and 66,647 MW, respectively, between 2006 and 2016, while generation from hydropower decreased by 23,417 MW over the same period.[171] Until recently, the likeliest prediction for the future of hydropower development in the U.S. was a continuance of the status quo, "fluctuat[ing] between marginal increases in capacity . . . and the continued imposition of operating constraints and the removal of old dams."[172] Since 1999, nearly 850 dams have been removed nationwide.[173] As the sentiment driving river restoration and dam removal continues to gain traction, a further decline in the installed capacity of U.S. hydropower seems like a realistic possibility. These bleak forecasts overlook the potential of small hydropower methods that utilize relatively low-impact technologies when compared to big dam hydropower, however.

The disparate environmental, wildlife, and scenic impacts that helped bring about the end of the era of big dam hydropower development in the U.S., and that plague both wind and solar energy today (albeit to a lesser extent) do not emerge at the same magnitude or with the same frequency from small hydropower technology, giving small hydro an important role to play in the future of U.S. renewable energy generation.

1. Fisheries

In 1994, Floyd Dominy, former Commissioner of the Bureau of Reclamation (BOR), recounted the dam-building legacy of BOR under his leadership during the 1960s.[174] Lauding the virtues of the great BOR dams in the west, including the crown jewel, Glen Canyon Dam on the Colorado River, Dominy maintained that "the [salmon-blocking dams were] worth it. I think [there are] substitutes for eating salmon.

---

[171] U.S. DEP'T OF ENERGY, 2016 RENEWABLE ENERGY DATA BOOK 29 (Dec. 2017), https://www.nrel.gov/docs/fy18osti/70231.pdf.

[172] *Hydro Law*, *supra* note 59, at 1766–67.

[173] *72 Dams Removed to Restore Rivers in 2016*, AM. RIVERS (2017), https://s3.amazonaws.com/american-rivers-website/wp-content/uploads/2017/02/15104536/DamsRemoved_1999-2016.pdf.

[174] Marc Reisner, *The Fight for Reclamation*, HIGH COUNTRY NEWS (Mar. 20, 1995), http://www.hcn.org/issues/31/874 [https://perma.cc/E7EM-QQ62].

You can eat cake."[175] While Dominy was defending his hypothetical salmon-less, cake-infused world, the Commissioner at the time, Dan Beard, was ringing the death knell for dams in the U.S., due in large part to their outsized environmental impacts, including their immitigable effects on natural fisheries.[176]

The choice between fish and dams has long defined hydropower development. Some of the U.S.'s most robust salmon fisheries have been decimated by large dam hydropower.[177] In the American West, large hydroelectric dams on rivers, such as the Columbia and Snake, serve as insurmountable barriers for the eons-old upstream migrations of anadromous fish to their spawning grounds. Downstream migrations often fare no better, with migrating fish being entrained and blended in turbines.[178] Fish passage measures installed at large dams, such as fish ladders and elevators, have shown some limited success in helping fish safely bypass dams, but ultimately have done little to mitigate the catastrophic impact of large dams on fish populations.[179]

Small hydropower does not require the same stark choice between thriving fisheries and cheap electricity. The impact of

---

[175] Klein, *supra* note 95, at 695.
[176] *Id.* t 697.
[177] *See* Henry Lacey, *New Hope for Pacific Salmon? Northwest Resource Information Center v. Northwest Power Planning Council, Idaho Department of Fish & Game v. National Marine Fisheries Service, and the Aftermath of Judicial Impatience*, 3 HASTING W.-NW. J. ENVTL. L. & POL'Y 19, 20–21 (1995) (referencing the Columbia and Snake Rivers as two of the largest historic salmon fisheries in the United States); Alison Rieser, *Saving Salmo: Federalism and the Conservation of Maine's Atlantic Salmon*, 16 OCEAN & COASTAL L.J. 135, 139–40 (2010) (referencing the historic Atlantic Salmon fishery on the Penobscot River); Glen Spain, *Dams, Water Reforms, and Endangered Species in the Klamath Basin*, 22 J. ENVTL. L. & LITIG. 49, 51 (2007) (referencing the third largest historic salmon fishery as the Klamath River).
[178] Michael Blumm & Andy Simrin, *The Unraveling of the Parity Promise: Hydropower, Salmon, and Endangered Species in the Columbia Basin* 21 ENVTL. L. 657, 664 (1991).
[179] M.W. Chilcote, K.W. Goodson & M.R. Falcy, *Reduced recruitment performance in natural populations of anadromous salmonids associated with hatchery-reared fish*, 68 CAN. J. FISH. AQUAT. SCI. 511, 518–20 (2011); Michel Larinier, *Fish passage experience at small-scale hydro-electric power plants in France*, 609 HYDROBIOLOGIA 97, 99–100 (2008).

small hydropower on fisheries depends in large part on the technology being employed. A run-of-the-river hydropower facility that utilizes a large weir spanning the river's width could potentially have the same effect as a big dam project: effective blockage of fish migration to spawning areas. Numerous modifications to a small weir-and-penstock facility can keep it from functioning as such an absolute obstruction, however. It is conceivable that smaller fish passage methods, such as a Denil fish pass or a pool-type pass, could more effectively aide fish in bypassing a weir than the larger passage methods needed to bypass a large hydropower dam.[180] The smaller scale of these methods would mimic natural obstructions that fish are innately adept at surmounting, as opposed to larger methods, which require unnatural and sometimes life-threatening efforts by fish. But even without an installed fish pass, many fish species have the ability, in differing degrees, to successfully navigate diversion devices within a range of heights and slopes.[181] This method of small hydropower could employ an even lower-impact diversionary technique, however, by installing a weir that only partially dams a river and thus creates enough water depth to divert water through a penstock. This method would allow migrating fish to naturally pass on the opposite side of the river, but would also possibly result in a less consistent ability to divert the amount of water necessary to generate electricity through the facility.

Hydrokinetic technology, on the other hand, poses no river-wide barrier to fish migration, but rather involves the possible risks of collision, avoidance behavior, and delay as fish navigate up or downstream, all of which could lead to increased mortality or a reduction in population. Although the risk of hydrokinetic turbines to fish has not been thoroughly studied, the existing studies so far offer positive results for the feasibility of integrating hydrokinetic turbines into fish habitats.[182]

---

[180] Larinier, *supra* note 179.

[181] Ovidio & Philippart, *supra* note 163, at 65–67.

[182] Stephen V. Amaral et al., *Evaluation of Behavior and Survival of Fish Exposed to an Axial-Flow Hydrokinetic Turbine*, 35:1 N. AM. J. OF FISHERIES MGMT. 97, 108 (2015); Theodore Castro-Santos & Alex Haro, *Survival and Behavioral Effects of Exposure to a Hydrokinetic Turbine on Juvenile Atlantic Salmon and Adult American Shad*, 38 ESTUARIES & COASTS 203, 212–14 (2015);

Scientists have found that there is nearly no injury or mortality risk to entrained fish passing through a hydrokinetic turbine zone in high-velocity water conditions (i.e., the fish entering a spinning turbine and passing back through).[183] In fact, one study showed that "most fish will be able to escape or evade turbine entrainment, even when in close proximity to a turbine."[184] The use of high contrast colors, illumination, acoustic warning systems, electric deterrence, and passive alert systems have all been effective alerts to help fish avoid a hydrokinetic turbine in low-light conditions.[185] Furthermore, it has been observed that turbine avoidance is not appreciably different in light or dark conditions due to a fish's natural ability to navigate based on nonvisual cues.[186] Larger-scale hydrokinetic facilities with "many turbines deployed throughout a river system," and installed in close proximity to one another, could also have the effect of delayed migrations, however, and result in "reduced spawning viability, reduced access to habitat, and possibly increased risk of predation[and] disease transmission."[187]

2. Environment and Habitat

Glen Canyon, whose towering cliffs and river-hewn rock sculptures once inspired awe in those who traveled the Colorado River, now sits submerged below Lake Powell, which was created by the construction of Glen Canyon Dam in the early 1960s.[188] This story of a stolen landscape is not unique to Glen Canyon, and neither are the stories of natural flowing watersheds being replaced by reservoir-fed tailwaters. The development of big

---

Linus Hammar et al., *A Probabilistic Model for Hydrokinetic Turbine Collision Risks: Exploring Impacts on Fish*, 10(3) PLOS ONE, at 21 (Mar. 2, 2015), http://journals.plos.org/plosone/article?id=10.1371/journal.pone.0117756.

[183] Castro-Santos & Haro, *supra* note 182, at 212–14; Amaral et al., *supra* note 182, at 111.

[184] *Id.* at 108.

[185] Hammar et al., *supra* note 182, at 21.

[186] Amaral et al., *supra* note 182, at 109.

[187] Castro-Santos & Haro, *supra* note 182, at 213.

[188] Steven W. Carothers & Dorothy A. House, *Decommissioning Glen Canyon Dam: The Key to Colorado River Ecosystem Restoration and Recovery of Endangered Species?*, 42 ARIZ. L. REV. 215, 219 (2000).

dams and reservoirs over the last century has been the "cornerstone of growth" in the arid West, a region whose farmlands and cities would otherwise be unsustainable without the dams that have indelibly reshaped the American landscape.[189]

Dams transform the geography of the place where they are built and can also reshape entire river ecosystems.[190] Reservoirs that swallow up large swaths of wildlife and other habitats also alter downstream ecosystems. For example, the inundation of canyons creates deep reservoirs that then "act as thermal regulators," altering rivers' natural seasonal fluctuations in water temperature.[191] These massive water storage systems induce physical, chemical, and biological changes in both the water stored behind dams and the water being discharged.[192] Even flood control, one of the primary uses of dams in the twentieth century, can have damaging effects on downstream ecosystems, which rely on periodic floods for the exchange of water, energy, nutrients, sediments, and organisms.[193] Variations in water depth and flow patterns "are responsible for a diverse array of habitats and hence ecological diversity . . . all of which are maintained by flooding."[194] Additionally, changes to a river's sedimentation patterns from the addition of a dam impose significant environmental costs on the ecosystem below the dam site.[195] Dams can trap a drainage basin's entire sediment load, which can result in complex changes to habitat, river fauna, and the morphology of floodplains and coastal deltas, sometimes hundreds of miles from the dam site.[196] Dams can even contribute to global warming through "the decomposition by bacteria of submerged biomass,"

---

[189] Dudley, *supra* note 62, at 306.
[190] M.P. MCCARTNEY, ET. AL., INT'L UNION FOR CONSERVATION OF NATURE & NAT. RES. & THE U.N. ENVL. PROGRAMME, ECOSYSTEM IMPACTS OF LARGE DAMS 10, https://www.researchgate.net/profile/Matthew_Mccartney/publication/45165880_Ecosystem_Impacts_of_Large_Dams/links/0deec538c8d836760c000000/Ecosystem-Impacts-of-Large-Dams.pdf.
[191] *Id.*
[192] *Id.* at 20.
[193] *Id.* at 10.
[194] *Id.*
[195] *Id.* at 28.
[196] *Id.* at v.

resulting in the emission of greenhouse gases, primarily methane.[197]

Small hydropower offers a possible harmonization of the dueling objectives of environmental protection and hydropower generation. Low-impact, run-of-the-river hydropower technologies have negligible to unobservable impacts on a river's natural flow. These hydropower methods do not utilize reservoirs and do not divert a substantial amount of a river's overall water. As a result, a watershed's natural wildlife and aquatic habitat remain largely unchanged by the construction and operation of a low-impact, small hydropower facility.

IV. CURRENT REGULATIONS AND BARRIERS TO SMALL HYDROPOWER DEVELOPMENT

Like an ill-fitting hand-me-down winter coat from an older, larger sibling to his much younger and smaller brother, the current regulatory framework governing small hydropower development, based as it is on laws and regulations sized for large, environmentally burdensome dams, is overkill for much smaller, less impactful installations. It is the correct garment, but the poor fit overwhelms the wearer. These laws and regulations create a lengthy, complex, multi-party, and multifaceted process for developers to obtain authorization to construct and operate a small hydropower project. For large-scale hydropower facilities that dam rivers, inundate canyons, transform geography, and alter habitat, this intensive review process is arguably proportionate to the nature of the risks and impacts involved. But for potential developers seeking to generate nearly carbon-free electricity from small-scale facilities that will produce a fraction of the power of a dam-and-reservoir facility with a comparatively minimal effect on the environment, complying with this process is a regulatory albatross. To better understand why and how the regulations governing small hydropower development should be reformed, it is essential to understand the current regulatory maze that small hydropower developers must navigate to begin installing and operating a facility.

---

[197] *Id.* at 20.

A. FERC Licensing

With the exception of nuclear power, hydropower is the most heavily regulated traditional source of electricity in the United States, due to the extensive licensing procedures a developer must complete before constructing a facility as well as complex relicensing requirements should a dam owner wish to extend the life of the project.[198] In general, for a non-federal developer to begin operating a hydropower facility of any size (including traditional general small hydropower projects) that will affect interstate commerce or that is located on a waterway under federal jurisdiction or on federal land, it must first obtain a FERC license or an exemption from licensing.[199] A license will typically be for a term of thirty to fifty years,[200] and will carry with it mandatory and project-specific environmental, engineering, and administrative conditions.[201] A license also gives developers limited eminent domain powers to acquire the property sited for the project.[202]

Before applying for a license, a developer may apply for a preliminary permit.[203] Although not a prerequisite for obtaining a license, a preliminary permit grants a permittee priority over competing applicants for the project site and authorizes the permittee to conduct feasibility and environmental studies at the

---

[198] Kosnik, *supra* note 37, at 16 n.28.

[199] 16 U.S.C.A. § 797(e) (2012); 18 C.F.R. §§ 4.101–4.108 (2017). A license or licensing exemption from FERC "is required to construct, operate, and maintain a nonfederal hydroelectric project that is or would be (a) located on navigable waters of the United States; (b) occupy U.S. lands; (c) utilize surplus water or water power from a U.S. government dam; or (d) be located on a stream over which Congress has Commerce Clause jurisdiction, where project construction or expansion occurred on or after August 26, 1935, and the project affects the interests of interstate or foreign commerce." FED. ENERGY REG. COMM'N, HANDBOOK FOR HYDROELECTRIC PROJECT LICENSING AND 5 MW EXEMPTIONS FROM LICENSING 2–1 (Apr. 2004), https://www.ferc.gov/industries/hydropower/gen-info/handbooks/licensing_handbook.pdf [https://perma.cc/J9VA-U62C] [hereinafter HANDBOOK].

[200] 16 U.S.C. § 808(e).

[201] HANDBOOK, *supra* note 199, at 2–22.

[202] 16 U.S.C. § 814.

[203] *Id.* § 798.

project site.[204] If a developer decides to move forward with a project after the permit period or decides to bypass the preliminary permit altogether, it must undertake one of three FERC licensing processes to obtain a license, unless the proposed project qualifies for a licensing exemption.[205] The Integrated Licensing Process (ILP), touted as the most streamlined of the three, is the default process.[206] A developer wishing to use one of the two alternative processes, the Traditional Licensing Process (TLP)[207] or the Alternative Licensing Process (ALP),[208] must first apply for and obtain FERC approval to do so.[209]

Before filing an ILP application, a developer must initiate the ILP process by filing and distributing a Notice of Intent (NOI) and a Pre–Application Document (PAD) with FERC and all relevant resource agencies, Indian tribes, and interested members of the public.[210] A PAD must include all reasonably available engineering, economic, and environmental information that is relevant to the project to serve as the foundation for consultations, issue identification, study plan development, and FERC's environmental analysis.[211]

In this pre–application stage, a developer must consult with all relevant federal, state, and interstate resource agencies, Indian tribes, and members of the public regarding the project's design and impacts, as well as any required studies and reasonable alternatives.[212] The applicable parties that a developer is required to consult with include: the National Marine Fisheries Service; the U.S. Fish and Wildlife Service; the National Park Service; the U.S. Environmental Protection

---

[204] *Id.* § 798; FED. ENERGY REG. COMM'N, HYDROPOWER PRIMER: A HANDBOOK OF HYDROPOWER BASICS 29 (Feb. 2017), https://www.ferc.gov/legal/staff-reports/2017/hydropower-primer.pdf [hereinafter PRIMER] [https://perma.cc/E4RP-5DKL].

[205] HANDBOOK, *supra* note 199, at 2–3; PRIMER, *supra* note 204, at 32–33.

[206] PRIMER, *supra* note 204, at 32; 18 C.F.R. §§ 5.1–5.31 (2017).

[207] 18 C.F.R. §§ 4.38, 5.3, 5.5–5.6.

[208] *Id.* § 4.34(f).

[209] *Id.* § 5.8.

[210] *Id.* § 5.5 (NOI); *id.* § 5.6 (PAD); *see id.* § 16.6 (specifications for NOI contents).

[211] HANDBOOK, *supra* note 199, at 2–4.

[212] 18 C.F.R. § 5.1(d); *Id.* § 4.38; HANDBOOK, *supra* note 199, at 2–6.

Agency; the federal resource agencies that administer federal lands utilized or occupied by the proposed project; any state agency responsible for fish, wildlife, botanical resources, water quality, coastal zone management plan consistency certification, shoreline management, and water resources; the State Historic Preservation Officer and Tribal Historic Preservation Officer; local, state, and regional recreation agencies and planning commissions; local and state zoning agencies; any affected Indian tribe; and any interested member of the public.[213] The consulted parties have sixty days from the commencement of the process to comment on the project and request studies.[214] The developer must then respond to all reasonably requested studies by producing a draft study plan, which outlines each study's methodology, cost, scientific acceptability, schedule, and how the developer will communicate progress reports with all of the parties.[215] Although the composition of a study plan will depend on the specific project, studies will typically address engineering, design, and operation issues, facility safety, cost-benefit analyses, cost comparisons to alternative power sources, and environmental impacts and mitigation measures, including impacts on water quality, fisheries, and recreation.[216] The ILP provides a comment-and-meeting period for consulting parties to resolve any disputes as to the sufficiency of the proposed studies in the draft study plan.[217] Any party with authority to place conditions on a project may request a seventy-day formal dispute resolution process regarding the draft study plan.[218] Only after a draft study plan has satisfied all required comment periods and revisions can a developer submit a final study plan to FERC for approval, and if approved, begin conducting the studies required

---

[213] 18 C.F.R. §§ 4.38, 5.1(d)(1) (2017).
[214] *Id.* § 5.9(a).
[215] *Id.* § 5.11.
[216] *Id.* §§ 2.23, 4.41(e)(9), 4.51(e)(9), 4.61(c)(9); HANDBOOK, *supra* note 199, at 2–7 to 2–10.
[217] 18 C.F.R. §§ 5.11(e), 5.12.
[218] The FPA and section 401 of the CWA provide mandatory conditioning authority to federal and state agencies and Indian tribes involved in managing fish, wildlife, and water quality. *Id.* § 5.14; HANDBOOK, *supra* note 199, at 3–7 to 3–8.

by the final study plan.[219] Throughout the study process, any party may request, with good cause, that the developer conduct a new study or modify an existing study.[220]

At this point, sometimes several years into the pre–development process, a developer will file the project's licensing application with FERC. This application is the product of exhaustive scientific studies and numerous consultations with a multitude of parties with varying interests in the project.[221] Although the information that a licensing application must include will depend on the character, size, and risks of the project, all applications will describe a project's design, operations, financing, and construction schedule, record the results of the pre–filing studies, and provide an environmental report demonstrating how the project complies with all applicable environmental laws, which will form the foundation of FERC's environmental analysis of the project under NEPA.[222]

In the post–filing stage, FERC will conduct a preliminary review of the application to detect any deficiencies, and will inform the developer of all necessary corrections and requests for additional information.[223] Once FERC determines that the application meets all of the regulatory requirements, it will then prepare an environmental analysis of the project under NEPA,[224] Section 401 of the CWA,[225] and Section 10(j) of the FPA,[226] which requires fish and wildlife protection measures to be incorporated into a project license.[227] At this point, the project's environmental impact as determined through these analyses will be subject to an additional public comment period.[228]

If FERC authorizes the project, it will issue a license order containing all of the project's terms and conditions.[229] A

---

[219] 18 C.F.R. §§ 5.13–15.
[220] *Id.* § 5.15(c)(4).
[221] *Id.* §§ 5.16, 5.17.
[222] *Id.* § 5.18.
[223] *Id.* §§ 5.20, 5.21.
[224] *Id.* § 5.25.
[225] *Id.* § 5.23.
[226] *Id.* § 5.26.
[227] *Id.* § 5.22.
[228] *Id.* § 5.23.
[229] *Id.* § 16.18; HANDBOOK, *supra* note 199, at 2–21 to 2–22.

license is finalized and issued thirty days following this order unless requests for agency rehearing or judicial review are filed.[230] Even for the ILP, the most streamlined of the three FERC licensing processes, the time from commencement of the process to issuance of the project license can easily exceed five years.[231]

B. *The Small Hydropower Licensing Exemption*

There is a potential relief valve from this onerous, expensive, and time-consuming process for a small subset of hydropower projects that meet certain criteria qualifying them for an exemption from the licensing requirements under Part I of the FPA.[232] This exemption also includes an exemption from the FERC relicensing requirement, allowing qualifying small hydropower projects to enjoy perpetual authorization to operate subject to FERC oversight.[233] In reality, however, this so-called exemption is a misnomer because although a successful applicant is exempted from FERC licensing and relicensing, the process a small hydropower developer must follow to obtain the exemption can be nearly as onerous and time-consuming as the ILP licensing process itself.

Of the sixty-eight hydropower projects with generating capacities of ten MW or less that were approved for an exemption in the U.S. between 2003 and 2016, only a third were able to complete the exemption approval process in two years or less, and the vast majority of these had generating capacities no greater than a single MW and were sited at existing infrastructure, such as a dam or conduit.[234] This protracted

---

230 *Id.* at 2–22.

231 PRIMER, *supra* note 204, at 31; *see also* Shannon Morrissey, *FERC and USACE: The Necessity of Coordination in Implementation of the Hydropower Regulatory Efficiency Act*, 48 U.C. DAVIS L. REV. 1581, 1592 (2015).

232 Part I of the FPA entails 16 U.S.C.A. §§ 791–823d (2012); 18 C.F.R. § 4.103 (2017).

233 18 C.F.R. § 4.103.

234 FED. ENERGY REG. COMM'N, REPORT ON THE PILOT TWO-YEAR HYDROELECTRIC LICENSING PROCESS FOR NON-POWERED DAMS AND CLOSE-LOOP PUMPED STORAGE PROJECTS AND RECOMMENDATIONS PURSUANT TO SECTION 6 OF THE HYDROPOWER REGULATORY EFFICIENCY ACT OF 2013, at 34–

exemption process is regulatory overkill for small hydropower projects, which generally pose minimal risk of environmental harm, especially compared to the environmental risks of constructing and operating a large hydroelectric dam. It is also out of line with the comparably swift regulatory approval timelines for other sources of renewable energy, including wind and solar power projects, which can often be as short as eighteen to twenty-four months for projects of far greater overall size and generating capacity than a typical small hydropower project.[235]

To qualify for a licensing exemption, a small hydropower project must have a total generating capacity of ten MW or less and either be built on an existing non-federal dam or utilize a natural water feature without requiring construction of a dam, impoundment, or storage-and-release system.[236] To obtain an exemption, developers of qualifying small hydropower projects must conduct a three-stage consultation process that follows the same procedures necessary to obtain a license under the TLP,[237] and that largely mirrors the ILP consultation requirements described above, with a few exceptions.[238]

After initiating the exemption process with the filing and distribution of a NOI and PAD, a developer must organize and conduct a joint meeting and site visit with all relevant federal and state agencies, Indian tribes, and interested members of the public to discuss the proposed project, its potential environmental impact, additional information that needs to be obtained, and studies that need to be conducted.[239] As with all meetings and consultations, the developer must notify FERC of the joint meeting and provide the agency with a transcript

---

35 (May 2017), https://www.ferc.gov/legal/staff-reports/2017/final-2-year-process.pdf [https://perma.cc/4GN3-G2BV] [hereinafter REPORT].

[235] H.R. REP. NO. 113-6, at 4 (2013).

[236] 18 C.F.R. § 4.30(31) (2017).

[237] REPORT, *supra* note 234, at 4.

[238] 18 C.F.R. § 4.38(a)(6) ("The pre–filing consultation requirements of this section apply only to an application for: (i) Original license; (ii) Exemption. . . ."); PRIMER, *supra* note 204, at 35; HANDBOOK, *supra* note 199, at 6–3 ("The procedural steps for a[n] . . . exemption application are essentially the same as those that govern applications for license. . . . ").

[239] Members of the public must be invited to all joint meetings by public notice. 18 C.F.R. §§ 4.38(b)(3), (4), 5.3, 5.5, 5.6; PRIMER, *supra* note 204, at 35.

following its conclusion.[240] The participants then have four months to comment on the project and request information and studies.[241] Any disagreement among the parties, such as whether certain information is required or disputes about the appropriate methodology for a study, must be referred to and resolved by the Director of the Office of Energy Projects.[242] Additionally, if an agency, tribe, or member of the public fails to participate in the initial joint meeting or comment period, they are not precluded from participation in subsequent stages of consultation or from requesting information and studies.[243]

Similar to the ILP, a developer must respond to this comment period by putting together a study plan that incorporates all reasonably requested studies and their methodologies.[244] Along with this study plan, the developer must include detailed documentation of all agreements, dispute resolution efforts, and explanations for why a developer elected not to conduct a requested study.[245] Under the study plan, the developer must then conduct all agreed-upon studies and gather all information, including any information, studies, or study modifications that a party may request during the study process.[246]

Only after all required information has been gathered and all studies have been conducted can a developer distribute a draft application to all consulting parties.[247] The draft application must include a discussion of the results of conducted studies, any proposed protection, mitigation, and enhancement measures, and responses to all comments and recommendations made by consulting parties.[248] The draft application is then subject to a three-month public comment period,[249] and a

---

240 18 C.F.R. § 4.38(b)(4).
241 The regulations provide for a 60-day comment window with the option to extend by 60 days upon written notice by any consulting party. *Id.* § 4.38(b)(5), (7).
242 *Id.* § 4.38(b)(6)(i).
243 *Id.* § 4.38(e)(3).
244 *Id.* § 4.38(f), (g).
245 *Id.*; HANDBOOK, *supra* note 199, at 4–7.
246 18 C.F.R. § 4.38(c)(1), (2) (2017).
247 *Id.* § 4.38(c)(4).
248 *Id.* § 4.38(c)(4)(i)–(iii).
249 *Id.* § 4.38(c)(5).

developer must conduct dispute-resolution meetings to resolve all remaining disagreements regarding the draft application.[250]

Before filing a final exemption application with FERC, a developer must finalize the second consultation stage by producing documentation that records all dispute resolution agreements, and which demonstrates that the developer has considered "the full range of developmental and nondevelopmental values" and has justified a balancing of resources in best adapting the project to improving the affected waterway.[251] The general contents of a final exemption application are the same as those of a licensing application, including information regarding a project's design, operations, and construction schedule, a record of all pre–filing studies and consultations, and an environmental report sufficient to form a foundation for FERC's environmental analysis under NEPA.[252]

The post–filing process, much like the pre–filing process, follows the same procedures as any other hydropower project.[253] After filing the exemption application, FERC will inform the developer of any deficiencies and requests for additional studies or consultations, and the developer will have to inform all interested parties of corrections or additions made to the application.[254] FERC will also conduct an environmental review of the project under NEPA.[255] If FERC decides to authorize the project under the exemption process, it will issue an exemption order with all terms and conditions, including mandatory fish and wildlife protection conditions made by state and federal resource agencies under FPA 10(j).[256] Just like a licensing order, an exemption order goes into effect thirty days following issuance, unless an application for agency rehearing or judicial review is made.[257]

---

250 *Id.* § 4.38(c)(6)(i)–(iii).
251 *Id.* § 4.38(c)(8); HANDBOOK, *supra* note 199, at 4–10 (citing).
252 18 C.F.R. § 4.107 (2017).
253 PRIMER, *supra* note 204, at 36.
254 18 C.F.R. § 4.38(d)(2).
255 *Id.* §§ 4.34(g), 4.94, 4.105; HANDBOOK, *supra* note 199, at 6–2; PRIMER, *supra* note 204, at 36.
256 *Id.* at 36; 18 C.F.R. §§ 4.105–4.106.
257 PRIMER, *supra* note 204, at 36.

After conducting numerous consultation meetings, responding to lengthy public-comment periods, and completing extensive studies requested by a multitude of parties with competing policy goals, a developer of a qualifying small hydropower project has completed what is essentially the same process required to license a general small hydropower project or a large-scale hydroelectric dam operation. Once a developer of a qualifying small-scale project compiles all required information, including "explanatory text, diagrams, maps, letters, and appendices," which can take several months, an exemption application will ordinarily exceed one hundred pages.[258] To hire the consultants, engineers, lawyers, and other professionals needed to assist in the process of completing all required consultations and studies, a developer will typically spend tens of thousands of dollars, "a price tag that often outweighs the total hydro equipment installation cost" of a small hydropower project.[259] In all, the cost of completing the exemption process alone can easily double or triple the cost of construction.[260] What is more, despite the promise of a more expedited timeline, it could take a developer several years just to gain authorization to begin constructing a qualifying small-scale hydropower facility via this protracted exemption approval process.[261]

Requiring similar pre–filing obligations and consultations for both large-scale and small-scale hydropower developers has an outsized negative impact on the economics of small hydropower investment and development. Large, privately-funded hydroelectric dams typically generate and sell hundreds of megawatts of electricity each year and can take advantage of economies of scale in securing equipment at lower costs, meaning they can usually absorb the high costs of licensing without sacrificing long-term profitability.[262] The same

---

[258] H.R. REP. NO. 113-6, at 4 (2013).
[259] *Id.* at 3–4.
[260] *It's a Small World After All*, *supra* note 39, at 962–63.
[261] Jeffery Thaler, *Fiddling as the World Floods and Burns: How Climate Change Urgently Requires a Paradigm Shift in the Permitting of Renewable Energy Projects*, 42 ENVTL. L. 1101, 1145 (2012).
[262] Assuming a 10 percent cost of capital, the levelised cost of electricity for large dam projects ranges between .002 and 0.19 cents per kilowatt hour, making it one of the most cost competitive methods of electricity generation. *See* INT'L

cannot be said for small hydropower projects, which generate significantly less electricity and revenue and have much higher annual per-kilowatt-hour operation and maintenance costs than large hydropower dams.[263] Furthermore, due in large part to the high cost of procuring small-scale electromechanical equipment, the average cost per kilowatt of electrical generation capacity to construct a small hydropower dam is higher than for a large dam, further disadvantaging small hydro as an investment target.[264] For small hydropower projects, the costs associated with licensing the project and their impact on obtaining a desirable return on investment can be a significant impediment to obtaining financing.

C. Hydrokinetic Licensing Processes

There has also been little done to streamline the regulatory process for developers of hydrokinetic projects. Depending on the characteristics of a proposed hydrokinetic project, a developer has a choice between three regulatory pathways to obtain varying degrees of project authorization. Like any other hydropower project, a hydrokinetic project developer may obtain a thirty- to fifty-year operating license from FERC by completing one of the three standard licensing processes. Since most hydrokinetic projects are on a smaller scale, often generating much less than ten MW of electricity annually, a developer may also seek a small hydropower licensing exemption from FERC. However, as discussed above, similar to a general small hydropower project, obtaining an exemption from FERC licensing would likely do little to expedite approval and construction of a hydrokinetic project.

RENEWABLE ENERGY AGENCY, RENEWABLE ENERGY TECHNOLOGIES: COST ANALYSIS SERIES, Vol. 1, at i (June 2012), https://www.irena.org/documentdownloads/publications/re_technologies_cost_analysis-hydropower.pdf [https://perma.cc/8G3U-BGGB].

[263] *Id.* (noting that small hydroelectric projects often have annual per kilowatt operations and maintenance costs that are more than twice of those for large hydroelectric projects).

[264] *Id.* at 18, 23–24 (noting a strong relationship, driven by economies of scale, between the size of a dam and lower per kilowatt of electrical generation capacity construction costs).

Another option for the developer of a hydrokinetic project is to apply for a Hydrokinetic Pilot Project License (HPPL).[265] In 2007, FERC created the Hydrokinetic Pilot Project Policy to promote the burgeoning technology of hydrokinetics by reducing the regulatory hurdles of traditional licensing.[266] However, the purpose of the new HPPL was not to authorize the installation of long-term hydrokinetic facilities, but rather to provide developers with a streamlined licensing procedure to allow them to test new and emerging hydrokinetic technologies and gather information on the environmental effects of hydrokinetics.[267] What FERC came up with was a narrowly applicable, short-term license that imposes significant oversight and monitoring on qualifying projects. To qualify for an HPPL, a project must normally have a generating capacity of less than five MW, utilize a small number of generating units, and avoid siting at sensitive locations.[268] If FERC determines that a developer intends to site a project where there will be potential use conflicts, it will suggest that the developer pursue authorization for the project by obtaining a traditional hydropower license or a licensing exemption.[269] Even if a project meets the requirements for a pilot project license, it will only be authorized to operate for a five-year term.[270] Additionally, these short-term pilot project licenses carry with them strict conditions, which include public safety and environmental monitoring protocols that can lead to alteration, termination, or removal of the project, as well as site restoration obligations after license expiration.[271]

If a developer wishes to obtain an HPPL for a qualifying project, the process for obtaining a pilot project license mirrors the ILP licensing process, with specific procedural waivers

---

[265] *See Hydrokinetic Pilot Project Licensing Process*, FED. ENERGY REG. COMM'N, https://www.ferc.gov/industries/hydropower/gen-info/licensing/hydrokinetics/energy-pilot.asp [https://perma.cc/M6S2-XM2N].
[266] White Paper, *supra* note 152, at 2.
[267] *Id.* at 4.
[268] *Id.* at 13.
[269] *Id.*
[270] *Id.*
[271] *Id.* at 13–14.

granted on a case-by-case basis.[272] This includes the developer distributing a detailed draft application to all relevant agencies, Indian tribes, and other interested parties, and several successive consultation meetings and public-comment periods regarding the project, study plan, and information gathering.[273] A final HPPL application must meet all requirements of a license application under the ILP, with the additional documentation of application submissions for all concurrent regulatory processes, such as a Section 401 permit under the CWA, and a draft biological assessment to facilitate ESA consultations.[274] The pre–filing stage again mirrors that of a

---

[272] The process begins by filing and distributing an NOI and draft application to FERC and all relevant agencies, Indian tribes, and members of the public. *Id.* at 6.

[273] The draft application must include descriptions of the project's operations and facility, potential effects of the project and use conflicts, discussion of the environmental baseline of the siting location, monitoring plans, measures to safeguard public safety and the environment, and financial assurance for removal and restoration of the site. After distributing the draft application, a developer must conduct consultations pursuant to the ILP's study plan consultation requirements for all plans regarding monitoring, public safety and environment safeguards, and removal and restoration of facilities. Once all required consultations have been completed, a developer must include in its revised draft application documentation recording all consultations and distributions of materials. The developer will then submit its revised draft application with FERC, including a process-waiver request to use the Hydrokinetic Pilot Project License expedited review process. The request for waiver must demonstrate that the project meets the necessary criteria and propose a project-specific processing schedule. A developer must also request designation as the non-federal representative of FERC for ESA and National Historic Preservation Act consultations. Once a draft application has been filed, all interested parties are invited to participate in a 30- to 60-day comment period. FERC will also consult with all affected Indian tribes. At the end of the comment period, FERC will hold a joint meeting regarding the draft application with all relevant federal and state resource agencies, Indian tribes, nongovernmental organizations, and members of the public. FERC will then determine whether to allow the project to proceed with a final application for a pilot project license by using the expedited ILP process. *Id.* at 16–20.

[274] A final Hydrokinetic Pilot Project License application must meet all requirements of an application under the ILP. A developer must also reflect all public comments and additional information in the final application and include a "documentation of application submittals for concurrent regulatory processes," such as section 401 CWA permits. Additionally, a final application should include a draft biological assessment to facilitate ESA consultations. *Id.* at 20–21.

licensing or exemption process, with FERC providing a public-comment period on the final application, conducting an environmental assessment, and making a licensing determination.[275] From start to finish, FERC intended the HPPL process to take approximately six months to complete for a five-year authorization.[276]

Because of its limited authorization for testing of hydrokinetic projects only, the HPPL fails to provide hydrokinetic developers with a long-term option for a streamlined regulatory process to gain approval for the operation of a small hydrokinetic project. Instead, these developers are left with the same undesirable option as other general small hydropower developers between obtaining a thirty- to fifty-year license or a licensing exemption, both of which require processes that would take a developer several years and significant sums of money to complete just to gain approval to begin construction.[277]

D. Conduit Hydropower Exemption & Two-Year Licensing Pilot Process

To date, the only areas where either Congress or FERC has made any significant headway in reforming the cost-prohibitive regulatory hurdles to long-term, private small

---

[275] Following submission of a final application and any corrections of deficiencies, FERC will provide another 30-day public comment period. Then, FERC will initiate an environmental analysis of the project under NEPA. This environmental analysis will take into account all recommendations from federal and state fish and wildlife agencies for mandatory project conditions for the protection, mitigation, and enhancement of fish and wildlife species and habitat under section 10(j) of the FPA. Once the environmental analysis and accompanied public comment period is complete, FERC will make a licensing decision regarding the project. *Id.* at 22.

[276] *Id.* at 4.

[277] It is perhaps a testament to the limited utility of the HPPL process that a recent check of FERC's public database of approved licenses for hydrokinetic pilot projects lists only two such licenses nationwide. *See Hydrokinetic Pilot Project Licensing Process*, FED. ENERGY REG. COMM'N, https://www.ferc.gov/industries/hydropower/gen-info/licensing/hydrokinetics/energy-pilot.asp [https://perma.cc/M6S2-XM2N], https://www.ferc.gov/industries/hydropower/gen-info/licensing/hydrokinetics/permits-issued.xls [https://perma.cc/3B2E-8RUQ].

hydropower development are in conduit hydropower, which underwent a complete regulatory makeover in 2013, and, to a lesser degree, in hydropower development at non-powered dams and closed-loop pump storage projects.

1. Conduit Hydropower Exemption

Prior to 2013, a small conduit hydropower project would have to undergo the same three-stage consultation process as other general small hydropower projects to obtain an exemption from FERC licensing.[278] Recognizing that the existing licensing and exemption processes disincentivized the development of a significant amount of small conduit hydropower, Congress unanimously enacted the Hydropower Regulatory Efficiency Act of 2013 (HREA), a bill introduced by Representative Cathy McMorris Rogers, a Republican congresswoman from the hydro-rich state of Washington, and cosponsored by four Republican and five Democratic congressmen, most from western states.[279]

To address the problem, the HREA categorically excludes a qualifying conduit hydropower project from FERC's hydropower licensing and exemption requirements.[280] A conduit is defined by the HREA as "any tunnel, canal, pipeline, aqueduct, flume, ditch, or similar manmade water conveyance that is operated for the distribution of water for agricultural, municipal, or industrial consumption and not primarily for the generation of electricity."[281] A qualifying project is one that (i) uses only the hydroelectric potential of a non-federally owned conduit for generating electricity, (ii) has an installed electrical

[278] 18 C.F.R. § 4.90 (2017).
[279] *H.R.267-Hydropower Regulatory Efficiency Act of 2013*, LIBR. OF CONGRESS, https://www.congress.gov/bill/113th-congress/house-bill/267 [https://perma.cc/Q76C-8H3Q].
[280] 16 U.S.C. § 823a (Supp. IV 2017); 18 C.F.R. § 4.30(26); *Revisions and Technical Corrections to Conform the Commission's Regulations to the Hydropower Regulatory Efficiency Act of 2013*, 148 FERC P 61197, at 20 (Sept. 18, 2014), https://www.ferc.gov/whats-new/comm-meet/2014/091814/H-1.pdf [https://perma.cc/MD7G-2KZD]; *Soldier Canyon Filter Plant*, 151 FERC P 61228, at 2 (June 18, 2015), https://www.ferc.gov/whats-new/comm-meet/2015/061815/H-1.pdf [https://perma.cc/384C-8G88].
[281] 16 U.S.C. § 823a(3)(A) (Supp. IV).

generation capacity of five MW or less, and (3) is not currently licensed or exempted from license requirements.[282]

To obtain this categorical exclusion, a small conduit hydropower project developer must file a NOI that demonstrates that the proposed project meets the regulatory definition of a qualifying conduit hydropower facility.[283] Within fifteen days of receiving the NOI, FERC must make an initial determination on the project's status as a qualifying conduit hydropower facility and, if it finds that it so qualifies, publish notice of the NOI for a public comment period.[284] FERC must issue a written determination as to whether the facility meets the qualifying conduit hydropower facility criteria not later than forty-five days after publishing the public notice.[285]

A modest but instructive real-world example of the power of the HREA to spur small hydropower development occurred not long after its passage. The San Juan County Historical Society (Society) in San Juan County, Colorado owns and operates the historic Mayflower Mill overlooking the Animas River near Silverton, Colorado. The Mayflower Mill, the longest-operating mill in San Juan County, ceased operations in 1991. The Mayflower Mill's owner, Standard Metals, donated the Mill to the Society, which operates it as a tourist attraction.[286] The mill was named a National Historic Landmark in 2000.[287] Looking for a way to offset monthly electricity bills of $600, in 2010 the Society hit on the idea of installing an eleven-kilowatt microhydro system at the Mill, more than enough to meet its annual electricity needs with some generation left over to sell back to the local utility.[288] However, because the cost of

[282] *Id.* at § 823a(3)(C) (Supp. IV).

[283] *Soldier Canyon Filter Plant*, *supra* note 280, at 2 n.4; 18 C.F.R. § 4.30(26) (2017).

[284] 16 U.S.C. § 823a(B)(i) (Supp. IV).

[285] *Id.* at § 823a(C) (Supp. IV).

[286] *Mayflower Mill—1970s,* SAN JUAN CTY. HIST. SOC'Y, http://www.sanjuancountyhistoricalsociety.org/mayflower-mill.html [https://perma.cc/3NJB-67XW].

[287] *Id.*

[288] Samantha Wright, *Mayflower Mill Project First in Colo. to Benefit from Small Hydro Reform*, CHIEF DEPUTY WHIP DIANA DEGETTE: IN THE NEWS (Dec. 1, 2013), https://degette.house.gov/media-center/in-the-news/mayflower-mill-

complying with FERC's standard small hydropower licensing requirements made the project uneconomical, it did not move forward.[289] It was only after the passage of the HREA in 2013 that the Society was able to use its streamlined process to obtain a FERC exemption, becoming one of the first projects in the country to do so in November 2013.[290] The Mayflower Mill microhydro project went online in 2015.[291]

This relatively new process appears to be working. In 2017 alone, FERC made final qualifying determinations on all eighteen conduit hydropower facilities that filed an NOI.[292]

2. Two-Year Licensing Process

In addition to the licensing exemption for conduit hydropower provided for in Section 4 of the HREA, in Section 6 Congress directed FERC to investigate the feasibility of a two-year licensing process for hydropower development at non-powered dams and closed-loop pump storage projects to "improve the regulatory process and reduce delays and costs for [such] hydropower development."[293] This two-year timeframe includes

---

project-first-in-colo-to-benefit-from-small-hydro-reform [https://perma.cc/WV44-ALK8].

289 *Id.*

290 *Id.*; Notice of Preliminary Determination of a Qualifying Conduit Hydropower Facility and Soliciting Comments and Motions to Intervene, 78 Fed. Reg. 61958 (Oct. 8, 2013).

291 Beverly Rich, *Historical Society Inspires National Bipartisan Hydroelectric Legislation*, SAN JUAN COURIER (Summer 2015), http://www.sanjuancountyhistoricalsociety.org/2015Courier.pdf [https://perma.cc/35DX-W8YT].

292 *Qualifying Conduit Hydropower Facility Process*, FED. ENERGY REG. COMM'N (Nov. 6, 2014), https://www.ferc.gov/industries/hydropower/indus-act/efficiency-act/qua-conduit/process.asp [https://perma.cc/2H9T-ZBRG], https://www.ferc.gov/industries/hydropower/indus-act/efficiency-act/qua-conduit/soi.xls [https://perma.cc/PDL4-6ZEA].

293 Hydropower Regulatory Efficiency Act of 2013, Pub. L. 113-23, § 6, 127 Stat. 493 (2013). Pumped storage projects are used to store electricity by pumping water uphill from a lower reservoir to a higher reservoir using excess electricity at times when demand for electricity is low. The stored water is then released from the upper reservoir through a turbine to generate electricity at high-demand times. Unlike an open loop system, a closed loop pumped storage does not require a continuous connection to a natural water feature. *Pumped Storage Projects*, FED. ENERGY REG. COMM'N (Aug. 5, 2014),

FERC's pre–filing licensing processes.[294] FERC was instructed to develop criteria to identify projects that would be appropriate for the two-year licensing process and implement a test project within 180 days of the enactment of the HREA, which occurred on August 9, 2013.[295] Section 6 also instructed FERC to hold a final workshop (Final Workshop) soliciting public comment about the effectiveness of the two-year licensing process for the selected pilot project not later than three years after the implementation of the pilot project.[296] FERC was also required to submit a report (Two-Year Licensing Report) to the House of Representatives' Committee on Energy and Commerce and to the Senate's Committee on Energy and Natural Resources not later than sixty days after the completion of the Final Workshop. This Two-Year Licensing Report was to describe the outcomes of the tested pilot project and the public comment received at the Final Workshop, and either outline how FERC will implement policies and regulations that effectuate a two-year licensing process for appropriate projects or detail why implementation of the process is not practicable based on legal, environmental, economic, or other issues, with recommendation on how Congress may address these issues.[297]

On January 6, 2014, FERC issued a solicitation for pilot projects (Solicitation).[298] The Solicitation identified the following minimum criteria for projects that would be appropriate for the two-year licensing process:

- The project must cause little to no change to existing surface and groundwater flows and uses;

https://www.ferc.gov/industries/hydropower/gen-info/licensing/pump-storage.asp [https://perma.cc/22FT-35AH].

[294] Hydropower Regulatory Efficiency Act of 2013, Pub. L. 113-23, § 6, 127 Stat. 493 (2013).

[295] *Id.* at § 6(b)(3).

[296] *Id.* at § 6(b)(4).

[297] *Id.* at § 6(d)(2).

[298] FED. ENERGY REG. COMM'N, DOCKET NO. AD13-9-000 NOTICE SOLICITING PILOT PROJECTS TO TEST A TWO-YEAR LICENSING PROCESS, (Jan. 6, 2014), https://www.ferc.gov/media/news-releases/2014/2014-1/AD13-9-000.pdf [https://perma.cc/DKW4-6TNU] [hereinafter NOTICE SOLICITING PILOT PROJECTS].

- The project must be unlikely to adversely affect federally listed threatened and endangered species;
- If the project is proposed to be located at or to make use of a federal dam, the request to use the two-year process must include a letter from the dam owner that the applicant's plan of development is conceptually feasible;
- If the project is proposed to use any public park, recreation area, or wildlife refuge established under state or local law, the request to use the two-year process must include a letter from the managing entity indicating its approval of the site's use for hydropower development; and
- For a closed-loop pumped storage project, the project must not be continuously connected to a naturally flowing water feature.[299]

On August 5, 2014, FERC announced that it had selected Free Flow Power Project 92, LLC's Kentucky River Lock & Dam No. 11 Hydroelectric Project (Pilot Project) as the first hydropower project to test the two-year licensing process.[300] Free Flow Power Project 92, LLC was subsequently replaced by a successor entity, Rye Development, as the Pilot Project's developer.[301] The Pilot Project involved installing hydroelectric generating facilities with a capacity of five megawatts in the Kentucky River Authority's existing non-powered Lock & Dam No. 11 on the Kentucky River, and was proposed to be a run-of-the-river project that would maintain the water elevation at the existing dam reservoir by matching water outflow from the

---

[299] *Id.* at 2.
[300] *FERC Approves Pilot Project to Test Two-Year Hydropower Licensing Process*, FED. ENERGY REG. COMM'N (Aug. 5, 2014), https://www.ferc.gov/media/news-releases/2014/2014-3/08-05-14.asp#.WlfHka6nGUl [https://perma.cc/8X4K-L4NS].
[301] FFP Project 92, LLC, Project No. 14276-002, 155 FERC ¶ 62,089 (May 5, 2016) (order issuing original license), https://elibrary.ferc.gov/idmws/common/opennat.asp?fileID=14240499 [https://perma.cc/YB8S-FGVQ].

project with river inflow into the reservoir.[302] The approval letter from FERC to the project developer stated that the Pilot Project "meets the criteria outlined in the [Solicitation], including that the project would cause little to no change to existing surface and groundwater flows and uses, and that it would be unlikely to adversely affect federally listed threatened and endangered species."[303] The approval letter also set forth several studies, in addition to those already completed by the developer as part of the application process, that had to be completed to receive a license, including a project hydraulics study, an aquatic habitat assessment, and a fish entrainment and survival study.[304]

FERC issued a NEPA-required Environmental Assessment of the Pilot Project on February 12, 2016.[305] The Pilot Project Environmental Assessment concluded that the licensing of the Pilot Project would not constitute a major federal action significantly affecting the quality of the human environment.[306] On May 5, 2016, within the two-year licensing timeline, FERC issued an original license to Rye Development to construct, operate, and maintain the Pilot Project for a period of thirty-nine years and eight months.[307]

---

[302] *Id.* The additional facilities to be installed at the existing dam were "(1) a 275-foot-long, 75-foot-wide reinforced concrete intake located in the abandoned lock and partly within an existing esplanade; (2) a 260-foot-long, 47-foot-high intake channel guide wall to be installed along the esplanade to convey flows to be used for generation into a 30-foot-long, 47-foot-high, 64.5-foot-wide intake and headgate structure to be built within the existing lock structure and extending beyond the south lock wall into the riverbank; and (3) trash racks with 3-inch clear bar spacing to be installed on the project intake." *Id.*

[303] Letter from Jeff C. Wright, Director, Office of Energy Projects, Fed. Energy Regulatory Comm'n to Dan Lissner, Free Flow Power Corporation (Aug. 4, 2014), https://www.ferc.gov/media/news-releases/2014/2014-3/P-14276.pdf [https://perma.cc/2QMW-DD8Y].

[304] *Id.*

[305] FFP Project 92, LLC, Project No. 14276-002, Docket No. AD13-9-000 (Fed. Energy Reg. Comm'n Feb. 12, 2016) (notice of availability of environmental assessment), https://elibrary.ferc.gov/idmws/common/opennat.asp?fileID=14148780 [https://perma.cc/PA98-XBW5].

[306] *Id.*

[307] FFP Project 92, LLC, Project No. 14276-002, 155 FERC ¶ 62,089 (May 5, 2016) (order issuing original license), https://elibrary.ferc.gov/idmws/common/opennat.asp?fileID=14240499

The Final Workshop soliciting public comment on the effectiveness of the two-year licensing process was held on March 30, 2017.[308] As noted in the Two-Year Licensing Report, submitted by FERC to Congress on May 26, 2017, "the majority of the stakeholders and commenters [at the Final Workshop] felt that the pilot two-year licensing process was a success and that it is both feasible and practicable for [FERC] to implement a formal two-year licensing process."[309] Despite this sentiment, FERC's ultimate recommendation to Congress in the Two-Year Licensing Report is that formalizing a two-year licensing process for hydropower development at non-powered dams and closed-loop pumped storage projects is unnecessary.[310] As discussed in Part V below, this recommendation should be reconsidered.

The HREA's two-month approval process for conduit hydropower is a significant and noteworthy outlier in the otherwise lengthy and expensive hydropower licensing and exemption processes described in this Article. Likewise, FERC's pilot project to assess the feasibility of a two-year licensing process for hydropower additions to non-powered dams and closed-loop pumped storage projects ordered in Section 6 of the HREA appears to hold promise for the implementation of a more rational licensing timeline for these projects.

Keeping in mind the HREA's goal of reducing regulatory barriers to the development of certain types of small hydropower, as well as the environmental imperative to continue reducing U.S. reliance on carbon-intensive electricity generation, the pertinent questions—discussed in detail in Part V—are (i) whether the HREA should be expanded to exempt from federal licensing more types of low-impact small hydropower projects so

---

[https://perma.cc/YB8S-FGVQ]. The slightly less than 40-year term of the license reflects FERC's decision to sync the Pilot Project's license expiration date with 40-year licenses issued in 2015 for two upstream lock and dam structures on the Kentucky River.

[308] FED. ENERGY REG. COMM'N, PROJECT NO. 14276-002, DOCKET NO. AD13-9-000, NOTICE OF WORKSHOP (Jan. 30, 2017), https://elibrary.ferc.gov/idmws/common/opennat.asp?fileID=14476943 [https://perma.cc/T5ZR-HMJX].

[309] REPORT, *supra* note 234, at ii. Twelve organizations and individuals submitted written comments. *Id.* at 24.

[310] *Id.* at 46–48.

as to drive more investment in, and development of, these projects, and (ii) whether, based on the positive experience with the Pilot Project and despite FERC's recommendation to the contrary, Congress should compel FERC to formalize a two-year licensing process for small hydropower additions to non-powered dams and closed-loop pumped storage facilities.[311]

V. ROOM FOR REFORM

A. Background

In examining the disincentivizing influence of current small hydropower laws and regulations on investment in and development of small hydropower projects, and considering the potential of greater small hydropower development for reducing reliance on greenhouse gas-emitting electricity generation sources, it is evident that this legal and regulatory scheme is ripe for reform. The existing onerous regulations governing hydropower development resulted in part from broad disillusionment with the effects of shortsighted hydropower policies that provided inadequate protection for America's waterways, certain fish species, and natural landscapes. While the significant environmental and ecosystem impacts of big dam hydropower arguably merit this level of legal and regulatory oversight, and the costs of compliance are a manageable line

[311] Although beyond the scope of this Article, rethinking the current balance of authority over small hydropower development and the possible options for delegating more authority to motivated state governments may offer an additional pathway to easing the regulatory burden on small hydropower development. For a discussion of the auspicious Memorandum of Understanding between FERC and the State of Colorado, which placed the licensing exemption consultations and the application process for small hydropower and conduit projects under Colorado's authority. *See Memorandum of Understanding Between the Federal Energy Regulatory Commission and the State of Colorado Through the Governor's Energy Office to Streamline and Simplify the Authorization of Small Scale Hydropower Projects*, FED. ENERGY REG. COMM'N (Aug. 19, 2010), https://www.ferc.gov/legal/mou/mou-co.pdf [https://perma.cc/SE4B-F3XQ]; Courtney Krause, Edalin Koziol & Matthew Merrill, *Incorporating Small-Scale Hydropower Projects Into Our Energy Future* 30 NAT. RES. & ENV'T 3, 5 (2016); *It's a Small World After All*, *supra* note 39, at 972.

item in a large dam's development budget, applying the same or similar requirements to comparatively low-impact and financially marginal small hydropower facilities creates unnecessary and substantial barriers to investment in these projects, resulting in many fewer of them being built.

As the reams of scientific studies projecting potentially catastrophic impacts in the coming decades from ever-rising global temperatures continue to pile up in the offices of corporate CEOs and state and federal legislators, the imperative of quickly ramping up renewable energy development is (or at least should be) an unavoidable reality. A compromise must be made between environmental, recreational, cultural, and industrial interests in order to find significant low- or no-carbon alternatives to fossil fuel-generated electricity. It will not be easy, particularly since it would be a tremendous understatement to say that political compromise has seen better days. To borrow language from the modern tech sector, the ability and willingness to work across the political aisle to craft legislative solutions palatable to both sides, once a feature proudly touted by candidates for office, is today more often viewed as a bug that betrays a worrying weakness in party fidelity. For this reason, many of the possible legislative actions that could begin to address climate change, such as a federal carbon tax, are dead on arrival, victims of a no-compromise political culture.

That said, in the area of small hydropower generation, there is reason for cautious optimism that a legislative path exists to address current regulatory barriers to investment and development. This optimism is based both on a modest track record of such regulatory reform—evidenced by the bipartisan, unanimous support for the HREA and its success to date in bringing long-stalled projects online—and on the fact that lowering regulatory barriers to development of distributed methods of electricity generation is one of the few modern issues that cuts across political affiliations, holding appeal for environmentally conscious liberals and for small-government conservatives.[312] Given this, a window appears to be open for

---

312 *See* Carolyn Kormann, *Greening The Tea Party*, NEW YORKER (Feb. 17, 2015), https://www.newyorker.com/tech/elements/green-tea-party-solar

environmentally appropriate and politically feasible reform of federal hydropower laws and regulations.

B. Proposals for Reform

1. Expand Scope of HREA Conduit Hydropower Licensing Exemption

Congress should amend the HREA to extend its reach beyond qualifying conduit hydropower projects to include other types of low-impact small hydropower projects, regardless of the technology they use to generate electricity. The existing FERC licensing and relicensing processes for high-impact large hydropower development, such as large hydroelectric dams, while far from perfect, should remain in place as a necessary safeguard against the potential environmental degradation that can result from these projects. But for low-impact small hydropower projects, the likely benefits of the HREA's licensing exemption in spurring significant utilization of America's vast hydro resource potential through small-scale distributed generation of hydropower outweighs the real but limited environmental impact.

As a prefatory matter, it is important to establish what principles should undergird a new regulatory approach to small hydropower. First, "low impact" does not mean no impact. All hydroelectric projects, no matter how modest in scale, will have some impact on the waterways on which they are located. The key distinction that must be made (and that is generally not made in the United States' mostly one-size-fits-all hydropower regulatory scheme) is between hydropower projects that, for various reasons—including location on an ecologically sensitive waterway, proximity to other projects, or overall mass—pose significant risks to aquatic life and the environment and those that pose minimal risks, regardless of their total electricity generating capacity. Only the former warrant a robust licensing

[https://perma.cc/6WDC-FX5V] (describing Floridians for Solar Choice, a group supporting an initiative in Florida to ease restrictions of installing rooftop solar as "an inchoate alliance of libertarians, Christian Coalition conservatives, liberal environmentalists, and eighty-five Tea Party groups").

process that identifies and quantifies these risks through studies and consultations and imposes mitigation measures to alleviate them. The current federal hydropower regulatory licensing scheme arose in part from a justifiable concern that the balance between growth and regulation had tipped too far toward large dam development without appropriate environmental safeguards, and served as a necessary corrective to this imbalance. But a problem arises when this robust process of consultations, studies, experts, and hearings is applied in full to hydropower development that poses a much lower risk to the environment. In this approach, a new imbalance is created; one that erects a substantial barrier to investment in and development of low-impact small hydropower.

As discussed in Part III above, the FPA currently identifies three separate categories of small hydropower: conduit, hydrokinetic, and general. This third category is quite amorphous, and consequently, the regulations governing it are not adequately tailored to encourage low-impact small hydropower investment and development. A small hydropower facility is defined as one that generates no more than ten MW of electricity by utilizing either an existing dam or a "natural water feature" without the need for damming, impounding, or retaining water for storage and release.[313] This broad definition encompasses an array of methods for generating hydropower, and often leads to the lack of a meaningful distinction in the licensing process between the physical impacts these diverse methods have on the environment. As a result, a developer of a small run-of-the-river diversion hydropower facility that requires no man-made reservoir and that leaves a river open to natural fish migration will often be confronted by the same expensive and time-consuming licensing process that the developer of a large, river-blocking dam must navigate. To effectively and properly incentivize the development of small hydropower facilities while simultaneously promoting responsible stewardship of America's rivers and fisheries, it is imperative that the processes for hydropower licensing and exemptions be right-sized for low-environmental-impact small hydropower

---

[313] 18 C.F.R. § 4.30 (2017).

facilities, regardless of the technology they use to generate hydropower.

To expedite small hydropower development in the U.S., the licensing exemption created for conduit hydropower under the HREA should be extended to certain other low-impact methods of generating hydropower. As discussed in Part IV above, under the HREA, conduit hydropower is treated as a true exemption from FERC's licensing process.[314] To construct and operate a conduit hydropower facility, a developer must simply show that the objective benchmarks of a qualified conduit facility have been met.[315] FERC's role in the process is limited to assuring that the developer has met these qualifications; the agency has no discretionary power over the project's construction or operation.[316]

The HREA, among other things, enabled developers of small conduit hydropower projects to bypass FERC licensing and consultation requirements while "maintaining environmental protections and the opportunity for public input" as part of the process.[317] In lauding the job-creating and electricity-producing potential of private small hydropower development, the report on the HREA from the House Committee on Energy and Commerce emphasized that utilizing the untapped potential of hydropower in America could produce approximately 60,000 MW of new hydropower by 2025, while "creating as many as 700,000 jobs in the process."[318] The Committee found that this potential remained almost entirely untapped because the comprehensive regulatory approval process for these projects was typically too long and too costly for both potential investors and developers.[319] The licensing and exemption processes had created an approval process that ordinarily took five years to complete, striking in its regulatory proportions when compared to the eighteen- to twenty-four-month timeline typical for wind and solar

---

[314] Hydropower Regulatory Efficiency Act of 2013, Pub. L. 113-23, § 4, 127 Stat. 493 (2013) (to be codified at 16 U.S.C. § 823a).

[315] 18 C.F.R. § 4.30(26); Hydropower Regulatory Efficiency Act of 2013, Pub. L. 113-23, § 4, 127 Stat. 493 (2013) (to be codified at 16 U.S.C. § 823a).

[316] *Time for a Small Makeover*, *supra* note 167, at 262.

[317] S. REP. 113-38, at 2 (2013).

[318] H.R. REP. NO. 113-6, at 2 (2013).

[319] *Id.* at 3.

projects.[320] The Committee noted that the existing licensing and exemption processes served as a financial disincentive to investment in and development of small conduit hydropower projects, with the cost of complying with FERC's approval process often exceeding the cost of a project's electromechanical equipment.[321]

While Congress limited this exemption process in the HREA to qualifying conduit hydropower projects, the same rationale for shortening the approval process applies equally well to other types of small, low-impact hydropower projects that pose little risk to the environment and fisheries, and that suffer from a lack of investment because of the long FERC licensing timeline. Congress should expand this licensing exemption under the HREA to encompass all small (five MW or less), run-of-the-river hydropower projects that do not (i) require a man-made reservoir, (ii) materially alter the natural flow of the waterway, or (iii) unduly impede fish migration or recreational uses of the waterway (Qualifying Low Impact Hydropower Project). If a developer can show that it will construct such a project, it would then be exempted from any licensing or consultation requirements under the FPA. This change would substantially shorten the time needed to develop a small hydropower facility, making such projects a much more attractive investment target, and resulting in a small but meaningful increase in the amount of renewable energy generated in the U.S. It would also incentivize environmentally friendly forms of hydropower that generate electricity in harmony with aquatic species, wildlife habitat, and river recreation. Furthermore, the low-impact hydropower technologies, though generally producing less power than a dam-and-reservoir hydropower facility, would likely avoid many, if not all, of the legitimate concerns that plague traditional hydro, solar, and wind power projects, including concerns about detrimental impacts on wildlife and aquatic species, as well as viewshed and scenic alterations.

It is important to note that the proposed inclusion of Qualifying Low Impact Hydropower Projects in the HREA does

---

[320] *Id.*

[321] *Id.*

not mean that there will be no federal oversight of the potential environmental and aquatic species impacts of these projects. Congress would remain free to instruct FERC to develop criteria for identifying projects that are appropriate for this licensing exemption within a reasonable time of the legislation's passage, as it did with the two-year licensing process in Section 6 of the HREA, and it should again pursue this path. Assuming good faith on FERC's part in executing such a directive, these criteria would include requirements much like those developed by FERC for the two-year licensing process pilot projects: specifically, the requirements that a Qualifying Low Impact Hydropower Project "cause little to no change to existing surface and groundwater flows and uses" and "be unlikely to adversely affect federally listed threatened and endangered species."[322] As with the two-year licensing process, the burden of making such showings would be on the project developer, and they should serve to ensure that only truly low-impact hydropower projects enjoy the benefit of this exemption.

2. Formalize a Two-Year Licensing Process for Additions to Non-Powered Dams and Closed-Loop Pumped Storage Projects

As discussed in Part IV above, despite the success of the Pilot Project and overwhelming support for the two-year licensing process in the public comments at the Final Workshop, in the Two-Year Licensing Report to Congress, FERC recommended against formalizing that process in the HREA.[323] Rather, FERC concluded that "two-year license processing for new projects is feasible, and can occur within the existing legal and regulatory framework" through a combination of better site selection and pre–filing consultation practices by hydropower developers, as well as improved guidance from FERC to potential developers through, for example, updating the small/low-impact hydropower portion of its website.[324] Perhaps to assuage anticipated congressional concern about whether its

[322] NOTICE SOLICITING PILOT PROJECTS, *supra* note 298.
[323] REPORT, *supra* note 234, at ii–iii.
[324] *Id.* at iii, 45.

recommendation to maintain the status quo with only the relatively minor tweaks of better applicant hygiene and improved online guidance would effectively address the HREA's animating ambition (that being the promotion of more small hydropower development at existing dams and conduits through a streamlining of the regulatory approval process), the Two-Year Licensing Report also contained a vague commitment by FERC staff "to provid[e] more frequent processing updates, when appropriate, to provide additional clarity and certainty during the licensing process."[325]

In making this recommendation, FERC recognized that "the primary goal of section 6 of the HREA is to promote the development of new projects,"[326] but nevertheless found that formalizing a two-year licensing process was not necessary based on an analysis it conducted of eighty-three hydropower projects between 2003 and 2016 that were either licensed by FERC or granted a small hydropower exemption from licensing (Licensing Study).[327] The projects in the Licensing Study used a mix of FERC licensing processes.[328]

The median time from the filing of a NOI and PAD to the issuance of a license in the sample set of projects was 3.34 years.[329] FERC did not include the time between the issuance of a preliminary permit and the applicant filing an NOI and PAD in this median number because "(1) a preliminary permit is not a prerequisite to filing a NOI/PAD, and (2) [FERC] staff does not believe it is reasonable to count this time because it is the filing of the NOI/PAD that initiates the licensing process."[330] Whatever one thinks of the merits of this argument against counting the pre–filing period in the calculation of the median time to receive a license, it is indisputable that the days, months, and sometimes even years of the pre–filing period are no less

---

[325] *Id.* at iii.
[326] *Id.* at 33.
[327] *Id.*
[328] *Id.* at 33 & n.105. Of the 83 projects in the Licensing Study, 52 used the TLP, 7 used the ILP, 4 used the ALP, and 19 were granted exemptions from licensing under the small hydropower (10 MW or less) licensing exemption. The Pilot Project was the 83rd project considered in the Licensing Study.
[329] *Id.* at 33.
[330] *Id.*

real to a developer than those spent in the post–NOI/PAD filing period, and involve significant expense in preparing the NOI and PAD while lengthening the return on investment timeframe for potential investors. Additionally, while a preliminary permit is not a prerequisite to filing a NOI/PAD, it is nevertheless an attractive option for a developer, because it grants priority over competing applicants for the project site and allows for the conduction of feasibility and environmental studies at the site.[331] Arguably, FERC's decision to exclude this pre–filing period from its calculation of median licensing time for the projects included in the Licensing Study has the effect of understating the true time to license for many projects.

As a principal rationale for its recommendation to not formalize the two-year licensing process, FERC relied on the fact that while the median licensing time for the projects in the Licensing Study was nearly three-and-a-half years, twenty-two of the eighty-three projects (twenty-seven percent) were licensed or received a licensing exemption in two years or less using existing processes.[332] According to FERC, this is evidence that it is "feasible" for hydropower projects to be licensed in two years or less using the existing hydropower licensing processes, and therefore that no pressing need exists for a formal two-year licensing process under the HREA.[333] However, a closer look at the characteristics of the twenty-two licensed or exempted projects calls this rationale into serious question.

First, of the twenty-two projects, only twelve received a license, with the remaining ten receiving an exemption. By including the exempted projects in its calculation, FERC was able to claim that slightly more than a quarter (27 percent) of the eighty-three projects included in the Licensing Study were able to navigate FERC processes within two years. While not an overly impressive percentage, it is more compelling than the less than one in five ratio that results when the ten exempted projects are removed from the calculation.[334] Only twelve of the sixty-three non-exempted projects (18 percent) included in the

[331] 16 U.S.C.A. § 798 (Supp. IV 2017); PRIMER, *supra* note 204, at 29.
[332] REPORT, *supra* note 234, at 33–34.
[333] *Id.* at iii.
[334] *Id.* at 34 tbl.1.

Licensing Study were licensed within two years of filing a NOI and PAD.[335]

Second, it is significant that seventeen of the twenty-two projects (77 percent) that were licensed or received a licensing exemption within two years were one MW or smaller, and that none of the other five were larger than ten MW in installed capacity.[336] Conversely, only thirty percent of the sixty-one projects in the Licensing Study that took longer than two years to be licensed or receive an exemption were one MW or smaller, and a quarter of them were larger than ten MW.[337] The report acknowledged this clear correlation between the size of the project and its licensing time, noting "the increased complexity, scope of issues, and likelihood of the need for additional information that can arise as project size increases."[338] However, it failed to fully reckon with how tight this correlation is using existing processes. Based on the projects included in the Licensing Study, which covers a thirteen-year period, it is fair to conclude that using current FERC processes to receive a license or exemption for any hydropower project over one MW in two years or less is tremendously difficult. Of the projects in the Licensing Study greater than one MW, approximately one in ten (five projects total) were licensed or exempted from licensing in two years or less using current processes.[339] The report spends many pages describing in detail the factors other than project size that can influence licensing time, including site selection, project design, and application quality.[340] While those factors indisputably play a role, they are in large part driven by project size, which returns one to a basic conclusion: Namely, that under current licensing processes, only very small hydropower projects

---

[335] *Id.* It is noteworthy that none of these 12 licensed projects used the ILP, which is supposed to be the most streamlined of the FERC licensing processes and is the default process for obtaining a license. *Id.* at 34 & n.109.
[336] *Id.* at 35 tbl.2.
[337] *Id.*
[338] *Id.* at 37.
[339] *Id.* at 35 tbl.2. The report counts the 5 MW Pilot Project among the projects that were licensed within 2 years, but the authors have elected to remove it from the calculations included in this paper because it was licensed using the new process set forth in Section 6 of the HREA. To include it, as FERC has in its report, seems a case of having one's cake and eating it too.
[340] *Id.* at 37–45.

(one MW or less) have a meaningful chance at receiving a license or exemption in under two years, and even those projects represent only a fifty-fifty proposition of success within that timeframe.[341]

Finally, the initial test of the two-year licensing process for additions to non-powered dams and closed-loop pumped storage projects was a success, albeit one that required significant work from the applicant and FERC staff to achieve. The report notes that a number of additional and unanticipated filings by Rye Development during the licensing process to revise project design and environmental safeguards "caused significant delays in [FERC] staff's review of the application and in writing the [Environmental Assessment]" and caused staff to wonder "whether this level of post–filing coordination with other agencies and information gathering would be feasible with a large number of projects."[342] While this is a legitimate concern, it is unsurprising that the first run-through of a new process involving multiple stakeholders led to complications and opportunities for improvement. As with all new processes of this size, the lessons learned from the Pilot Project can and should be applied to the next project to go through the two-year licensing process, and the one after that, improving the process in an iterative fashion. In fact, many of the public comments at the Final Workshop from supporters of formalizing the two-year licensing process offered concrete suggestions for improving the process.[343] These suggestions for improvement, along with FERC's internal analysis of the pilot two-year licensing process, should be evaluated and, where appropriate, incorporated into the formalized two-year licensing process.

[341] Of the 35 projects of 1 MW or less in the Licensing Study, 17 received a license or exemption from licensing within 2 years or less. *Id.* at 35 tbl.2.

[342] *Id.* at 39.

[343] For example, in its comment at the Final Workshop, Rye Development suggested a revised process it called the "Existing Dam Process", which would be 26 months long and involve fewer eligibility criteria for a project to qualify for the expedited licensing process, shorter pre–filing response requirements for FERC and other stakeholders, and time for applicants to conduct studies, and "off-ramps" to allow developers time to deal with unexpected environmental issues. *Id.* at 29.

In passing the HREA, Congress was clear that its primary motivation was to promote the development of more hydropower in the U.S. The two-year licensing process outlined in Section 6 of the HREA represents a tangible path to do just that. FERC's first experience with this new process, while not without complications, demonstrated its effectiveness. Despite FERC's recommendation to the contrary, Congress should formalize this two-year licensing process in the HREA.

VI. CONCLUSION

In recent years, the portentous effects of global climate change have increasingly manifested through worsening droughts, increased coastal flooding, and destructive habitat loss.[344] If no change occurs in the current trend of human-induced carbon emissions, temperatures are projected to rise five to ten degrees Fahrenheit by the end of the twenty-first century.[345] If these projections were to be realized, the inevitable result would be significant impacts on ecosystems, "large-scale loss of biodiversity" on a scale "unknown in human experience," drastic displacement of populations due to coastal inundation, and considerable declines in agricultural production.[346] It is inescapable that the severe consequences of inaction on the issue of human-induced global climate change will have momentous effects on global populations and the world's natural resources.

Therefore, it is a pivotal moment for U.S. policymakers to facilitate drastic changes in the country's energy use and production. To do so, it is imperative that policymakers rethink the utility of America's hydro resource by reforming regulations

---

[344] FED. NAT'L CLIMATE ASSESSMENT & DEV. ADVISORY COMM., U.S. GLOB. CHANGE RESEARCH PROGRAM, CLIMATE CHANGE IMPACTS IN THE UNITED STATES: U.S. NATIONAL CLIMATE ASSESSMENT (Jerry M. Melillo et al. eds., 2014), http://s3.amazonaws.com/nca2014/low/NCA3_Climate_Change_Impacts_in_the_United%20States_LowRes.pdf?download=1 [https://perma.cc/PN8S-2VS6].

[345] *Id.* at 8.

[346] THE POTSDAM INST. FOR CLIMATE IMPACT RESEARCH & CLIMATE ANALYTICS, THE WORLD BANK, TURN DOWN THE HEAT: WHY A 4°C WARMER WORLD MUST BE AVOIDED, at xvi–xviii (2012), http://documents.worldbank.org/curated/en/865571468149107611/pdf/NonAsciiFileName0.pdf [https://perma.cc/7PYR-FZRY].

to incentivize low-impact small hydropower development. Concededly, it is likely that to successfully quell global climate change, new technological innovations that spark widespread modifications in social behavior will be required.[347] However, incremental progress toward greater dependence on carbon-free energy sources will help abate the catastrophic effects posed by climate change. Therefore, although the installation of small hydropower facilities across the country will not itself prevent rising global temperatures, electrifying small local communities throughout middle America with low-impact, sustainable hydropower will help move the country toward a working green economy.

[347] Ross Koningstein & David Fork, *What it Would Really Take to Reverse Climate Change*, IEEE SPECTRUM (Nov. 18, 2014, 20:00 GMT), http://spectrum.ieee.org/energy/renewables/what-it-would-really-take-to-reverse-climate-change [https://perma.cc/9KW2-3WAE].