

Hydro Law and the Future of Hydroelectric Power Generation in the United States

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Hydroelectric energy (“hydro”) is the oldest major source of noncarbon, renewable energy in the United States. For three reasons, increased hydro generation should be a major element of any national climate change and energy-security policy designed to promote the greater use of renewables to help the country transition to the production of sustainable, i.e., noncarbon-based, energy. First, hydro is relatively clean because it does not cause air pollution or substantial greenhouse gas emissions.¹ Second, hydro is relatively reliable.² Third, hydro can help wean the United States from its dependence on imported and often politically unstable hydrocarbon sources of energy,³ because the resource is widely available, and substantial undeveloped capacity exists.⁴ In addition, many nations in Africa, Asia, and Latin America, and Canada are investing heavily in new

1. For a discussion of the release of methane from reservoirs, see *infra* notes 72–73 and accompanying text.

2. I describe hydro as *relatively* reliable because it experiences wild swings in production from year to year due to normal wet and dry climatic cycles. For example, drought dropped production by 21% between 2000 and 2001. U.S. DEPT OF HOMELAND SEC. & U.S. DEPT OF ENERGY, DAMS AND ENERGY SECTORS INTERDEPENDENCY STUDY 11 (2011).

3. *E.g.*, DANIEL YERGIN, THE QUEST: ENERGY, SECURITY, AND THE REMAKING OF THE MODERN WORLD 713–14 (2011) (discussing the transition from carbon to renewable sources, including hydro, or energy to generate electricity). The instability of hydrocarbon sources is demonstrated by the fact that there is some fluctuation in the companies who are exporting the most oil to the United States. For a list of the top ten countries exporting oil to the United States in 2011, as well as real time data, see *Crude Oil and Total Petroleum Imports Top 15 Countries*, U.S. ENERGY INFO. ADMIN., http://www.eia.gov/pub/oil_gas/petroleum/data_publications/company_level_imports/current/import.html (last visited Sept. 2, 2012). I would put all countries except Canada on an instability continuum. However, for a description of the conventional position that “U.S. policy makers have viewed its increased dependence on Western Hemisphere supplies and its decreased dependence on the Middle East as a welcome development,” see NAT’L CONFERENCE OF STATE LEGISLATURES, TRANSPORTATION ENERGY FOR THE FUTURE: A GUIDE FOR POLICYMAKERS 1 (2012), *available at* <http://www.ncsl.org/documents/energy/tranenergyfuture.pdf>. This said, U. S. oil imports are declining as domestic production increases. In 2012, the United States imported only 42% of its oil supply. Kasia Klimasinska, *U.S. Oil Imports Seen Hitting 20-Year Low 42% of Use*, BLOOMBERG (Aug. 23, 2012), <http://www.bloomberg.com/news/2012-08-23/u-s-oil-imports-to-seen-hitting-20-year-low-42-of-use.html>.

4. That said, hydro production is concentrated in ten states. Idaho, Washington, Oregon, Montana, and New York, respectively, derive the largest percentage of their power needs from hydro. U.S. DEPT OF HOMELAND SEC. & U.S. DEPT OF ENERGY, *supra* note 2, at 9 fig.1. They are followed by California, Tennessee, Alabama, Arizona, and North Carolina. *Id.* Only two of the twenty largest hydro dams are in the East, and both are in New York state on the Saint Lawrence River. *Id.* at 14.

hydro facilities.⁵ The Energy Information Administration (“EIA”) projects that worldwide hydro-generating capacity will grow at a rate of 2% from 2008 to 2035.⁶ However, in the United States, hydro is treated as the stepchild of renewable energy law and policy. Given hydro’s benefits, it is logical to ask: is the United States as out of step with world energy policy as it is with climate change policy? The current expert consensus answer is no: increased hydro generation will not be a major component of any carbon or noncarbon U.S. energy future. Hydro currently supplies 42% of the 7% of domestic energy production generated by renewable resources.⁷ Most “authoritative” energy scenarios suggest that, for the foreseeable future, hydro’s share will be flat or experience only modest increases.⁸

The EIA estimates that the United States’ hydro-generating capacity is projected to grow at a rate of only 0.1% per year. Initially, this conclusion is paradoxical because the International Energy Agency (“IEA”) estimates that the United States has tapped only 16% of its potential hydro production.⁹ The conventional answer to this paradox is that hydro is nonetheless a developed technology, has high environmental costs compared to wind and solar energy, and is both a climate change adaptation option and an energy source stressed by climate change. Therefore, the prevailing consensus is that there is no

5. *E.g.*, U.S. ENERGY INFO. ADMIN., ANNUAL ENERGY OUTLOOK 2012, WITH PROJECTIONS TO 2035 (2012). Under a reference case scenario, the projected growth rates of installed hydro-generating capacity from 2008–2035 for the following regions and countries are: Non-OECD Africa (2.7%), Non-OECD Asia (3.2%), Non-OECD Central and South America (2.6%), Canada (1.1%), and the United States (0.1%). *World Installed Hydroelectric Generating Capacity by Region and Country, Reference Case*, U.S. ENERGY INFO. ADMIN., http://www.eia.gov/oiad/aeo/tablebrowser/#release=IEO2011&subject=9-IEO2011&table=22-IEO2011®ion=0-0&cases=Reference-0504a_1630 (last visited Sept. 3, 2012).

6. U.S. ENERGY INFO. ADMIN., *supra* note 5. Under a reference case scenario, the projected growth rate of installed hydro-generating capacity from 2008–2035 for the United States is 0.1%. *World Installed Hydroelectric Generating Capacity, supra* note 5.

7. U.S. ENERGY INFO. ADMIN., RENEWABLE ENERGY CONSUMPTION AND ELECTRICITY PRELIMINARY 2006 STATISTICS 5 fig.1 (2007), *available at* http://www.eia.gov/cneaff/solar.renewables/page/prelim_trends/rea_prereport.html.

8. This is the conclusion reached by a comprehensive assessment of the nation’s energy future by the National Academies. NAT’L ACADS. OF SCI. ET AL., ELECTRICITY FROM RENEWABLE SOURCES: STATUS, PROSPECTS AND IMPEDIMENTS 56 (2010). Other studies reach similar conclusions. *E.g.*, CHRISTOPHER G. PERNIN ET AL., RAND SCI. & TECH., GENERATING ELECTRIC POWER IN THE PACIFIC NORTHWEST: IMPLICATIONS FOR ALTERNATIVE TECHNOLOGIES 8 (2002), *available at* <http://www.dtic.mil/cgi-bin/GetTRDoc?Location=U2&doc=GetTRDoc.pdf&AD=ADA407473> (“Current projections show that in the future, the majority of all new electricity generation in the Northwest—in fact, in the entire West—will come from natural-gas-fired plants.”).

9. INT’L ENERGY AGENCY, RENEWABLE ENERGY ESSENTIALS: HYDROPOWER 2 fig.3 (2010), *available at* http://www.iea.org/papers/2010/Hydropower_Essentials.pdf.

need to provide substantial incentives for its expansion, like those available for wind, solar, biomass, and other alternative renewables.¹⁰ To borrow from equilibrium ecology, hydro has reached its climax stage.¹¹ This assumption is reflected in state renewable portfolio standards legislation and federal tax incentives,¹² which exclude conventional hydro from definitions of renewable energy. However, there is some resistance to the exclusion of hydro from classification as a “contemporary” renewable energy source.¹³ To enable Vermont utilities to purchase power from large Quebec hydro projects, the state legislature removed the cap on renewable hydro.¹⁴

This Article asks whether there are valid reasons to question the conventional wisdom, and, if so, what steps should be taken to promote the expansion of hydro?¹⁵ First, the Article reviews the history of hydro in the United States, situating it in the big, multiple-purpose dam era. Second, it sets out the external costs of dams and hydro generation and briefly traces the mounting opposition to dams starting with John Muir’s campaign to block the inundation of Hetch Hetchy Valley (adjacent to Yosemite National Park). Third, the Article traces the development of a complex network of laws that constrain

10. For example, the 2011 Amendments to Illinois’s utility renewable portfolio standards define only “hydropower that does not involve new construction or significant expansion of hydropower dams” as a renewable source of hydro. 20 ILL. COMP. STAT. 3855/1-10 (2011). The purpose is to ensure that most existing hydropower does not count toward the portfolio standard. The failed 2009 Waxman-Markey energy bill, H.R. 2454, 111th Cong. § 610(a)(12) (2009), classified hydro as a renewable energy source for the purpose of carbon credits, but the credit calculation was limited to “qualified hydropower,” which was based on either energy efficiency improvements or capacity additions to pre-1992 hydroelectric facilities placed in service after January 1, 1992.

11. Early twentieth century ecology was premised on the theory that natural systems progressed to a relatively steady climax state. Fred P. Bosselman & A. Dan Tarlock, *The Influence of Ecological Science on American Law: An Introduction*, 69 CHI.-KENT L. REV. 847, 854–73 (1994) (explaining the origins of climax theory and its replacement by non-equilibrium theories).

12. For a discussion of federal tax incentives for new hydro, see *infra* notes 186–88 and accompanying text.

13. In 2010, the National Association of Regulatory Utility Commissions adopted a resolution recognizing hydro as a *potential* source of renewable energy. See David C. Coen & Robert J. Thormeyer, *Should Large Hydroelectric Projects Be Treated as Renewable Resources?*, 32 ENERGY L.J. 541, 541 (2011).

14. Compare VT. STAT. ANN. tit. 30, § 8002(2) (West 2012), with Mary C. Powell, *Treatment of Large Hydropower as a Renewable Resource*, 32 ENERGY L.J. 553, 553 (2011) (explaining the previous cap was two hundred megawatts). For an overview of the legislation’s background, see Powell, *supra*, at 553–56.

15. This Article is an extension of A. Dan Tarlock, *The Legal-Political Barriers to Ramping Up Hydro*, 86 CHICAGO-KENT L. REV. 259 (2011), which briefly explained the reasons for hydro’s steady-state future but did not explore the possibility of inducing greater hydro investment or the legal consequences of more aggressive hydro promotion. *Id.* at 275–76.

both new development and the operation of existing projects. Fourth, it examines the efforts underway to stimulate new “little” hydro projects and improve the operation of “big” projects. Fifth, it asks the heretical question: is it worth considering repealing or modifying the existing laws, primarily the environmental laws put in place in the 1970s that now constrain hydro, to increase hydro capacity? If so, which laws would be on the chopping block and what would be changed? The Article concludes by proposing two scenarios. The first maintains the status quo as an object lesson in externality control for nonhydro renewables. The second proposes a new river management regime premised on the maintenance of base flows for both aquatic ecosystem conservation and hydro production.

I. SETTING THE STAGE: HYDRO TRIUMPHS BUT ITS MARKET SHARE STEADILY DECLINES

Hydro is one of the great technological achievements of the twentieth century. It improved the lives of millions¹⁶ and supported defense production in World War II.¹⁷ Hydro developed in an era of almost absolute faith in the ability of technology to promote progress and the efficient use of natural resources. The dominant water ethic posited that the failure to develop the full multiple use potential of a river was waste. The major issue was not whether rivers should be dammed for multiple uses including hydro, but whether this resource should be developed by governments or by the private sector. If the latter, another issue was whether public utilities should have to pay for the privilege of access to and use of water. This ethic allowed the two major external costs of hydro—the loss of fish runs and the

16. See DUNCAN HAY, TASK FORCE ON CULTURAL RES. MGMT., EDISON ELEC. INST., HYDROELECTRIC DEVELOPMENT IN THE UNITED STATES 1880-1940 (1991).

17. See *The History of Hydropower Development in the United States*, BUREAU OF RECLAMATION, U.S. DEPT. OF INTERIOR, <http://www.usbr.gov/power/edu/history.html> (last revised Aug. 12, 2009) (“With the advent of World War II the Nation’s need for hydroelectric power soared. . . . To produce enough aluminum to meet the President’s goal of 60,000 new planes in 1942 alone required 8.5 billion kWh of electric power. . . . Hydropower provided one of the best ways for rapidly expanding the country’s energy output. Addition of more powerplant units at dams throughout the West made it possible to expand energy production, and construction pushed ahead to speed up the availability of power.”). Federal dams on the Columbia River supplied the power to develop the aluminum industry in the Northwest, which in turn fed new aircraft plants and shipyards on the West Coast. See MICHAEL P. MALONE & RICHARD W. ETULAIN, *THE AMERICAN WEST: A TWENTIETH CENTURY HISTORY* 98, 112 (1989) (detailing how the power supplied by the Bonneville and Grand Coulee Dams provided “federally subsidized cheap power” to the Northwest; explaining how that power fostered the aluminum industry’s Northwestern growth).

flooding of scenic areas—to be largely ignored. There were always political objections to dams and modest legal efforts to promote fish ladders and other protection devices, but serious legal constraints on hydro development did not emerge until the 1950s.

Water power has been used for millennia to turn wheels for milling and irrigation, but the modern hydro era began in the late nineteenth century. After Thomas Edison invented his steam-powered electric generator, a small group of progressive business leaders in Appleton, Wisconsin realized that falling and flowing water could also turn the turbines of a generator. In 1882, they built a 12.5 kilowatt plant on the Fox River.¹⁸ Two years later, Congress authorized the first private power development on a navigable stream.¹⁹ Because the technology for large dams was already in place,²⁰ large-scale production soon followed. Hydro fit nicely with the water agenda of the Progressive Conservation Era. Large multiple-purpose dams and reservoirs including hydroelectric generating capacity became a central feature of the Progressive Conservation Movement's (1890–1920) project of promoting the efficient, i.e. nonwasteful, development of public water resources.²¹ To promote hydro, public and private

18. THOMAS V. CECH, *PRINCIPLES OF WATER RESOURCES: HISTORY, DEVELOPMENT, MANAGEMENT, AND POLICY* 18 (2002). The Vulcan Street Plant was named a National Historical Engineering Landmark in 1977. A history of the plant prepared for its fiftieth anniversary can be found at *National Historic Engineering Landmark: Vulcan Street Plant*, AM. SOC'Y MECHANICAL ENGINEERS, <http://files.asme.org/ASMEORG/Communities/History/Landmarks/5657.pdf> (last visited Sept. 2, 2012). A small power plant was constructed to light the village of Niagara Falls in 1881, but it went bankrupt two years later. *The Historic Mill District: Niagara Falls, New York 1861-1918*, THUNDER ALLEY, <http://www.niagarafrontier.com/milldistrict.html> (last visited Sept. 2, 2012).

19. Act of July 5, 1884, ch. 230, 23 Stat. 154 (1884).

20. The first dam has been traced to Egypt in the third millennium BCE. Heloisa Yang et al., *The History of Dams*, UCDAVIS: CIVIL & ENVTL. ENGINEERING (1999), http://cee.engr.ucdavis.edu/faculty/lund/dams/Dam_History_Page/History.htm. In the last two decades of the nineteenth century, the technology for larger concrete and arch dams was developed and encouraged the construction of larger gravity storage dams. *Id.* DAVID P. BILLINGTON & DONALD C. JACKSON, *BIG DAMS OF THE NEW DEAL ERA: A CONFLUENCE OF ENGINEERING AND POLITICS 47–70* (2006), sets out the transfer of French dam building technology to the United States and the interagency debates about the merits of massive gravity and arch dams.

21. The leading history remains SAMUEL P. HAYS, *CONSERVATION AND THE GOSPEL OF EFFICIENCY: THE PROGRESSIVE CONSERVATION MOVEMENT, 1890-1920* (1959). Recent historians argue that the movement was not as directed by the scientific and political elite as Hays argues, e.g., JOHN F. REIGER, *AMERICAN SPORTSMEN AND THE ORIGINS OF CONSERVATION* (3d ed. 2000) and RICHARD W. JUDD, *COMMON LANDS, COMMON PEOPLE: THE ORIGINS OF CONSERVATION IN NORTHERN NEW ENGLAND* (1997), and that multiple-purpose water was the product of the interplay between regional politics and the vision of progressive, elite scientists, and engineers. DONALD J. PISANI, *WATER, LAND, AND LAW IN THE WEST: THE LIMITS OF PUBLIC POLICY, 1850-1920* (1996).

operators had to be able to obtain secure water rights to this new use of water, which often required the construction of reservoirs to change downstream flow patterns. Water law could have seriously impeded hydro development, but courts and voters removed the major barriers by the end of the 1920s. After several decades of experimentation, Congress authorized the free use of navigable waters in 1920.

The assignment of property rights to exploit a resource is generally thought to be a necessary condition for investment in any energy production.²² Initially, the law of water rights posed substantial barriers to the intensive development of hydro. The common law of riparian rights, which prevailed east of the Missouri River, in theory prohibited all dams on streams. The natural flow theory gave each riparian on a stream the right to the unobstructed flow until the river flowed to the sea. In practice, the law of riparian rights never in fact prohibited dams. Legislatures intervened to allow mill dams,²³ and courts adopted the reasonable use theory, which allowed dams.²⁴ But the common law still cast a chill over dam construction and operation, especially in 1926, when the California Supreme Court applied the natural flow theory to effectively bar upstream hydro development.²⁵ Voters quickly overturned the decision;²⁶ Article XIV § 3 of the state's constitution adopted the reasonable use theory, which opened the way for public and private dams. The amendment was quickly interpreted to limit injured downstream riparians' restitution to money damages.²⁷

22. Solar and wind energy are exceptions because the resource is so widely available, and, thus, no private property regime is necessary for development. Exploitation has been able to provide thorough universal access to these two commons.

23. MORTON J. HOROWITZ, *THE TRANSFORMATION OF AMERICAN LAW, 1780-1860* (1977) traces the rise of these acts, which allowed mill owners to erect dams that flooded upstream lands provided that the compensation was paid. The constitutionality of this early delegation of the power of eminent domain was upheld in *Fiske v. Framingham Mfg. Co.*, 29 Mass. (12 Pick.) 68 (1832).

24. See, e.g., *Mason v. Hoyle*, 14 A. 786, 788–89 (Conn. 1888) (explaining that under reasonable use theory water may be detained to secure fair proportion of beneficial use).

25. See *Herminghaus v. So. Cal. Edison Co.*, 252 P. 607, 618–21 (Cal. 1926) (ruling that dams and reservoirs for hydro could not be built because they would divert the usual and ordinary flow of the river to an extent that would essentially withdrawal the water from a large portion of lands downstream).

26. See NORRIS HUNDLEY, JR., *THE GREAT THIRST: CALIFORNIANS AND WATER* 245 (rev. ed. 2001) (stating that the *Herminghaus* decision upset the public and “culminated in 1928 with a popularly voted initiative amending the state constitution and prohibiting any ‘waste or unreasonable use’ of water”).

27. E.g., *Peabody v. City of Vallejo*, 40 P.2d 486, 495 (Cal. 1935).

Prior appropriation was better suited for hydro because an appropriator could directly divert water or construct a dam.²⁸ Impoundment itself is not a beneficial use of water, but power generation is.²⁹ The law, however, could have taken another turn. Early in the twentieth century, there was an attempt to sneak the natural flow rule into prior appropriation. A small Idaho appropriator claimed the entire current of the Snake River to power the water wheels he used to irrigate benchland in the Snake River canyon. A 1912 Supreme Court opinion unanimously rejected this attempt to reintroduce riparianism in the West as heresy; the Court held that an appropriator cannot claim a right to the current of a stream, but rather is limited to the amount of water he can actually put to beneficial use.³⁰ This decision removed the major legal barrier to private hydro development in the Mountain West, and public and private projects followed.

Federal law presented a more serious legal constraint because the right to use navigable waters without federal approval was not clear. The Commerce Clause gives the federal government plenary control of navigable waters,³¹ meaning that the federal government can exclude users or charge them to use this federal resource. Prior to hydro, this power had been primarily exercised to improve commercial navigation, so the exclusion issue did not arise. Congress showed no interest in exclusion and reacted swiftly to hydro's promise, but it was not until 1920 that it settled on a permanent legal regime for this resource. Congress first authorized the secretary of the Army to sell surplus power from U.S. Army Corps of Engineers navigation

28. Hydro generation is a nonconsumptive use, and, therefore, there have never been serious challenges to this use. However, users of all energy, including hydro, may face challenges that if hydro generation fails to use state-of-the-art water-saving technology, the use is not beneficial. See Katherine A. Abend, *Avoiding Water-Intensive Energy Production: How to Keep the Water Running and the Lights On*, 41 ENVTL. L. REP., NEWS & ANALYSIS 11020, 11028–29 (2011) (stating that water boards could adopt a policy in which water-intensive energy facilities could be too wasteful to qualify as a beneficial use).

29. See generally *Idaho Power Co. v. Idaho Dep't of Water Res.*, 255 P.3d 1152, 1154–56, 1160 (Idaho 2011) (describing the process required to receive a permit to divert water for hydro generation, which requires that a beneficial use of the water be shown before a license to appropriate the water is issued).

30. See *Schodde v. Twin Falls Land & Water Co.*, 224 U.S. 107, 117–26 (1912) (discussing and upholding prior precedent that “the extent of beneficial use [is] an inherent and necessary limitation on the right to appropriate”). See generally A. Dan Tarlock, *The Legacy of Schodde v. Twin Falls Land and Water Co.: The Evolving Reasonable Appropriation Principle*, 42 ENVTL. L. 37 (2012) (discussing the history of the *Schodde v. Twin Falls Land & Water Co.* litigation and its legacy).

31. *United States v. Appalachian Elec. Power Co.*, 311 U.S. 377, 404 (1940).

projects.³² In 1890, it authorized the secretary of the Army to approve individual dams on navigable rivers, but Congress did not adopt a general licensing scheme until 1910.³³ The major issues of the era were whether private developers should pay for the privilege of using navigable waters and whether there should be substantial public power development. The final report of President Roosevelt's Inland Waterways Commission recommended that the government assess "reasonable" charges for the use of power sites.³⁴ Congress refused to implement the recommendation, but President Roosevelt vetoed a number of authorized private developments, most notably at Muscle Shoals on the Tennessee River, to preserve the public power option.³⁵

In the end, President Roosevelt lost the battle for public power and federal charges. The Progressive Conservation dream of large-scale public power on comprehensively planned rivers ended in 1920 with the passage of the Federal Water Power Act, which was merged into the Federal Power Act ("FPA") in 1935.³⁶ Congress completely rejected the recommendations of Roosevelt's Inland Waterways Commission and opted for private development of hydro on navigable rivers. The Federal Power Commission (now the Federal Energy

32. See Rivers and Harbors Appropriations Act of 1888, ch. 860, 25 Stat. 400, 417 (authorizing the Secretary of War to grant leases and licenses for the use of water power). In 1906, Congress authorized the Bureau of Reclamation to lease surplus power. Town Sites, Under Reclamation Act, ch. 1631, § 5, 34 Stat. 116, 117 (1906) (codified as amended at 43 U.S.C. § 522 (2006)).

33. See The River and Harbor Appropriations Act of 1890, ch. 907, § 7, 26 Stat. 426, 454 (stating that the Secretary of the Army must approve any dam "outside established harbor-lines, or in any navigable waters of the United States where no harbor-lines are or may be established"); 3 THE PRESIDENT'S WATER RES. POLICY COMM'N, REPORT OF THE PRESIDENT'S WATER RESOURCES COMMISSION: WATER RESOURCES LAW 263-66 (1950) (discussing the federal legislative history of dams between 1890 and 1910). The General Dam Act of 1910 limited dam grants to 50 years. General Dam Act of 1910, ch. 360, § 4, 36 Stat. 593, 595.

34. S. DOC. NO. 62-469, app. 1 at 85 (1912).

35. See 3 THE PRESIDENT'S WATER RES. POLICY COMM'N, *supra* note 33, at 270 (describing how President Franklin D. Roosevelt did not believe private individuals should be given such an element of public value). Muscle Shoals Dam was subsequently authorized in 1916 and completed in 1925. There were various attempts to privatize the dam by sale or lease, but these plans remained in limbo until the election of President Roosevelt. BILLINGTON & JACKSON, *supra* note 20, at 81-85 (detailing the attempted sale of the dam to Henry Ford, the recommendation that it be leased to a private operator for fertilizer production, and Roosevelt's statement upon election that he was determined to put Muscle Shoals to work). PRESTON J. HUBBARD, ORIGINS OF THE TVA: THE MUSCLE SHOALS CONTROVERSY, 1920-1932 (1961), is the leading history of pre-New Deal efforts to preserve the Tennessee Valley for public power.

36. See 16 U.S.C. § 797(e) (2006) (describing Congress's authority under the FPA to issue licenses for the construction of dams).

Regulatory Commission) was authorized to issue licenses,³⁷ but there was no charge for the use of navigable waters.³⁸ The FPA essentially confirmed the status quo, as small dams on mountain streams were already generating 40% of the nation's energy.³⁹ The public power option was preserved by giving the Federal Energy Regulatory Commission ("FERC") the discretion to deny a private project if the site was better suited to public development.⁴⁰ Utilities responded by investing in hydro. In the next five decades, public and private reservoir storage capacity grew from about forty million acre feet to 450 million acre feet.⁴¹ Today, there are more than two thousand FERC-licensed projects.⁴²

Public power was initially limited to surplus power from Corps of Engineers and Bureau of Reclamation projects.⁴³ The Bureau of Reclamation built a few reservoirs with hydro capacity, such as the Theodore Roosevelt Dam, upstream from Phoenix, Arizona on the Gila River.⁴⁴ Public power advocates had to wait until the New Deal

37. To avoid confusion, the Article uses Federal Energy Regulatory Commission to refer to both pre-1973 FPC decisions and post-1973 Federal Energy Regulatory Commission decisions.

38. The dream of charging for access to navigable waters lives, but it is hard to achieve for legal and political reasons. Montana tried to charge Federal Energy Regulatory Commission licenses for the use of the beds of the headwaters of three rivers it claimed to own. Under the "equal footing" doctrine, states obtain title to the beds of waters if they were a link in an aquatic highway of commerce at the time of statehood. The Montana Supreme Court ruled that if a portion of a river historically supported commercial navigation, the state acquired title to beds beneath the entire river, and, thus, there was no need for historical proof that each reach of a river actually was a link in the chain of commerce. The U.S. Supreme Court found this approach inconsistent with prior law and unanimously reversed and remanded. A state must prove title to the beds in each segment of the river in question based on historical use and suitability for commercial navigation, a difficult standard for Western states to meet. *See PPL Montana, LLC v. Montana*, 132 S. Ct. 1215, 1227–29 (2012) ("To determine title to a riverbed under the equal-footing doctrine, this Court considers the river on a segment-by-segment basis to assess whether the segment of the river, under which the riverbed in dispute lies, is navigable or not.").

39. William Arthur Atkins, *Hydroelectric Power*, WATER ENCYCLOPEDIA, <http://www.waterencyclopedia.com/Ge-Hy/Hydroelectric-Power.html> (last visited Aug. 31, 2012).

40. 16 U.S.C. § 800(b).

41. *Hydroelectric Water Use*, U.S. GEOLOGICAL SURV., <http://ga.water.usgs.gov/edu/wuhy.html> (last visited Aug. 31, 2012).

42. *The Federal Power Act*, HYDROPOWER REFORM COALITION, <http://hydroreform.org/policy/fpa> (last visited Aug. 31, 2012).

43. The Corps did not embrace multiple-purpose dams until the 1920s, so most federal dams were built by the Bureau of Reclamation.

44. *See The History of Hydropower Development in the United States*, U.S. DEPT OF THE INTERIOR BUREAU OF RECLAMATION, <http://www.usbr.gov/power/edu/history.html> (last modified Aug. 12, 2009) (discussing how a hydro plant was first built to assist the construction of the Theodore Roosevelt Dam and how the power subsequently impacted the area's economy, enhancing the lives of both farmers and individuals in the city).

revived the idea of public river development.⁴⁵ The Tennessee Valley Authority's experiment to use dams to "re-engineer" a backward region has been described as "[a] turning point in the history of large dams . . . because for the first time . . . the idea of regulating the entire river basin through a series of multiple purpose dams had been put into practice."⁴⁶

From the 1930s to the 1960s, hydroelectric generation became an integral part of many of the large publically financed multiple-purpose dams in the West.⁴⁷ Hydro revenues helped to finance subsidized irrigation and free flood-control projects.⁴⁸ Today, dams operated by the Tennessee Valley Authority, the Corps of Engineers, and the Bureau of Reclamation primarily on the Colorado, in Columbia, Missouri, and in California generate 51% of the nation's hydro.⁴⁹ When other public dams are added, the figure jumps to 71%.⁵⁰ However, even as large federal dams were being built, hydro's share of energy supply progressively declined as coal, oil, and gas came to dominate the electricity energy market outside of the Pacific Northwest⁵¹ and California. As nuclear plants began to come online in the 1960s, hydro's share further declined. Nuclear plants now generate 70% of the nation's noncarbon energy.⁵²

The question is: does hydro fit the model of sustainable energy? Sustainable energy production has three criteria: (1) a shift from

45. Every major policy initiative has antecedents. In addition to the public power debates during the Progressive Conservation Era (1890-1920), in 1937, the U.S. Army Corps of Engineers was authorized to prepare river basin reports that included the potential for hydro at Corps dams. Thus, the "New Deal did not so much serve as the inspiration for the conception and planning of large federal dams, as it provided a compelling catalyst for their construction." BILLINGTON & JACKSON, *supra* note 20, at 4.

46. Ravi Baghel & Marcus Nuesser, *Discussing Large Dams in Asia After the World Commission on Dams: Is a Political Ecology Approach the Way Forward*, 3 WATER ALTERNATIVES 231, 231, 235-36 (2010).

47. JOHN R. FERRELL, *THE BIG DAM ERA: A LEGISLATIVE AND INSTITUTIONAL HISTORY OF THE PICK-SLOAN MISSOURI RIVER BASIN PROGRAM* 130 (1993).

48. See 3 THE PRESIDENT'S WATER RES. POLICY COMM'N, *supra* note 33, at 259 ("[T]he drive to economical use of capital investment has placed growing emphasis upon power as the principal and often feasible means of recovering project costs.").

49. DOUGLAS G. HALL & KELLY S. REEVES, IDAHO NAT'L LAB., *A STUDY OF UNITED STATES HYDROELECTRIC PLANT OWNERSHIP* (2006), available at http://hydropower.inel.gov/hydrofacts/pdfs/a_study_of_united_states_hydroelectric_plant_ownership.pdf.

50. "Hydroelectric plant ownership in the United States is predominately in hands of the private sector (69%). On the other hand, capacity is predominately owned by federal and non-federal public owners (75%)." *Id.* at 10.

51. Hydro provides about two-thirds of the power in this region. *Hydroelectricity*, U.S. ENVTL. PROTECTION AGENCY, <http://www.epa.gov/cleanenergy/energy-and-you/affect/hydro.html> (last updated Dec. 28, 2007). However, coal is a major source of energy in states such as Oregon.

52. Matthew L. Wald, *Edging Back to Nuclear Power*, N.Y. TIMES, Apr. 22, 2010, at F1.

nonrenewable to renewable energy sources, (2) user conservation, and (3) the reduction of the environmental external costs and risks of all sources of energy production.⁵³ Hydro stacks up well on the first criteria, not as well on the third, and is neutral on the second.⁵⁴ The question then becomes: is this deficiency fatal or correctable?

A. *The Pros*

The basic case for ramping up hydro production is (1) the technology is proven, reliable, and improving; (2) it is a climate-friendly resource; (3) it has unused potential; (4) flowing water is a “free” renewable resource; and (5) there is a range of increased capacity options short of building new dams. The United States currently generates over three hundred billion kilowatt hours of electricity from hydro plants.⁵⁵ The Department of Energy estimates that up to an additional thirty-five thousand megawatts of electricity could be generated from undeveloped sites.⁵⁶ This additional capacity could come from the construction of new dams and reservoirs, by increasing the generating capacity of existing facilities, by installing available new technologies, and by placing hydrokinetic devices in streams.⁵⁷ At existing dams, turbines could be upgraded, more water

53. See THE LAW OF ENERGY FOR SUSTAINABLE DEVELOPMENT 56 (Adrain J. Bradbrook et al. eds., 2005) (“Sustainable development, although a concept difficult to define precisely, seeks economic development that is ecologically sound, equitable as to both present and future generations, and promote social welfare.”).

54. Hydro’s external costs are more diffuse compared to the public health and climate risks from burning coal and automobile use. See COMM. ON HEALTH, ENVTL., & OTHER EXTERNAL BENEFITS & COSTS OF ENERGY PROD. & CONSUMPTION, NAT’L RESEARCH COUNCIL, HIDDEN COSTS OF ENERGY: UNPRICED CONSEQUENCES OF ENERGY PRODUCTION AND USE (2011).

55. For this Article, all statistics referring to electrical power measurements have been converted from the original units listed in the citations to megawatts. The purpose of the statistical conversion to megawatts in this Article is to provide the reader a simpler method to compare the statistics referred to throughout the Article. An electrical power unit converter can be found at *Power Converter*, UNITCONVERSION.ORG, http://www.unitconversion.org/unit_converter/power.html (last visited Aug. 31, 2012).

56. DOUGLAS G. HALL ET AL., FEASIBILITY ASSESSMENT OF THE WATER ENERGY RESOURCES OF THE UNITED STATES FOR NEW LOW POWER AND SMALL HYDRO CLASSES OF HYDROELECTRIC PLANTS 35 (2006), available at http://hydropower.inl.gov/resourceassessment/pdfs/main_report_appendix_a_final.pdf.

57. Hydrokinetic devices float on or below the surface of the river and generate electricity from the current. DANIEL B. BOTKIN, POWERING THE FUTURE: A SCIENTIST’S GUIDE TO ENERGY INDEPENDENCE 82 (2010). Substantial kinetic development is occurring on the Mississippi River, but even if all projects were built, they would only amount to 6% of the region’s energy capacity. Frank Jossi, *Surge in Mississippi Hydro Proposals Points to Coming Hydro Boom*, INSIDE CLIMATE NEWS (June 22, 2011), <http://insideclimatenews.org/news/20110622/hydroelectric-power-mississippi-river-ferc-coming-boom>.

could be put through the existing turbines to generate more power, or new pump storage facilities could be constructed at the facility.⁵⁸

For example, the Bonneville Power Authority has installed a new turbine at Chief Joseph Dam on the Columbia River, and the upgrade will generate enough power for thirty thousand homes in the Pacific Northwest.⁵⁹ The Electric Power Institute estimates that untapped hydro capacity could increase production by 24 to 27%.⁶⁰ The Energy Information Administration puts that total potential increase in hydro for new and upgraded plants at forty million megawatts.⁶¹

B. The Cons

The list of cons is long, and the conventional assumption is that the cons outweigh the pros. Hydro's fate is entwined with the opposition to large dams on economic, environmental, and social grounds. Dams have multiple adverse impacts.⁶² They change river flows and the fish runs that depend on them, alter river chemistry, change riverine landscapes, and inundate large areas including Indian reservations and scenic canyons and valleys. New dam construction is not on the political agenda. The Big Dam Era effectively ended in the 1960s⁶³ when large dam construction stopped. The net impact of many

58. See generally *Developers Pursue 22,459 MW of Pumped Storage in 11 States*, HYDROWORLD.COM, <http://www.hydroworld.com/articles/2009/03/developers-pursue-22459-mw-of-pumped-storage-in-11-states.html> (last visited Aug. 31, 2012) ("Interest in new pumped-storage hydroelectric projects is increasing across the United States, with developers proposing 22 projects in 11 states totaling 22,459 MW.").

59. The Bonneville Power Administration explained further:

The upgraded turbine runner is the first of 10 new and more efficient runners to be installed at Chief Joseph by 2014. The new runners and related refurbishment will increase the dam's power generation by more than 40 megawatts and boost the efficiency of the turbines to 95 percent or better. That is enough to power more than 30,000 additional Northwest homes compared to the 50-year-old runners being replaced.

More Powerful Hydro Turbine Heads for Washington, BONNEVILLE POWER ADMIN., <http://www.bpa.gov/corporate/BPANews/ArticleTemplate.cfm?ArticleId=article-20100510-01> (last visited Aug. 31, 2012).

60. BOTKIN, *supra* note 57, at 83.

61. COMM. ON AMERICA'S ENERGY FUTURE, NAT'L ACAD. OF ENG'G, *AMERICA'S ENERGY FUTURE: TECHNOLOGY AND TRANSFORMATION* 36 tbl.2.1.1 (2009).

62. See Deborah Moore, John Dore & Dipak Gyawali, *The World Commission on Dams + 10: Revisiting the Large Dam Controversy*, 3 WATER ALTERNATIVES 1, 3, 4–5 (2010) (stating that dams create both social and environmental costs); see also EDWARD GOLDSMITH & NICHOLAS HILDYARD, *THE SOCIAL AND ENVIRONMENTAL EFFECTS OF LARGE DAMS* 51–119 (1986) (discussing the negative effects of dams, such as loss of land and wildlife to flooding, the reduction of fertility downstream, and an increase in insects and diseases).

63. The water historian Donald Pisani has traced this development through the career of the legendary Commissioner of the Bureau of Reclamation, Floyd Dominy. During his tenure

environmental laws adopted after 1970 was to seriously constrain the operation of existing public and private projects. The two major federal water agencies, the Corps of Engineers and the Bureau of Reclamation, remain, but today they largely manage their legacy projects and try to undo the environmental harm that their dams did.⁶⁴ No coherent federal water policy has emerged to replace dam, levee, and canal building.⁶⁵ Climate change has added new concerns about the reliability of hydro, and the federal water agencies are struggling with how to factor climate change into existing operating regimes.⁶⁶

1. Fish Loss

Dams can damage fish runs in many ways by changing their habitats and migration patterns. Anadromous or catadromous species⁶⁷ are at the most risk, as both upstream and downstream migration can be impacted.

The construction of a dam on a river can block or delay upstream fish migration and thus contribute to the decline and even the extinction of species that depend on longitudinal movements along the stream continuum during certain phases of their life cycle. Additionally, the number of fish that die during downstream

(1959-69), Dominy presided over the construction of major dams on the Colorado River and in California. The passage of the Central Arizona Project in 1968 marked the effective end of the Big Dam Era, although the western states clung to the idea into the 1980s. See Donald J. Pisani, *Floyd E. Dominy*, WATERHISTORY.ORG, <http://www.waterhistory.org/histories/dominy> (last visited Aug. 31, 2012) (discussing Dominy's tenure and stating that "the last major project authorization came in 1968, a year before Dominy left office").

64. See NAT'L RESEARCH COUNCIL, U.S. ARMY CORPS OF ENGINEERS WATER RESOURCES PLANNING: A NEW OPPORTUNITY FOR SERVICE 49 (2004) (stating that a large amount of "construction dollars is allocated to structural rehabilitation of older projects, while another share is devoted to a relatively new and broadly defined ecological restoration mission").

65. This conclusion was first reached in NAT'L WATER COMM'N, WATER POLICIES FOR THE FUTURE: FINAL REPORT TO THE PRESIDENT AND CONGRESS OF THE UNITED STATES (1973), and echoed in several subsequent studies. See, e.g., NAT'L RESOURCE COUNCIL, *supra* note 64, at 45-47 (stating that federal water planning today focuses on construction of water resources projects, which doesn't assist current water problems; the federal government's role in addressing water resources planning and management will be important moving forward).

66. See, e.g., Omnibus Public Land Management Act of 2009 § 9503, 42 U.S.C. § 10363(c)(2) (2010) (stating that the Secretary of the Interior must assess climate change impacts on its project operation in eight river basins).

67. Anadromous fish, such as salmon or striped bass, are born in fresh water, spend most of their life at sea, but return to fresh water to spawn and die. Catadromous fish, such as eels, are the opposite. They live in fresh water, but enter salt water to spawn.

migration, either by passing through hydraulic turbines or over dam spillways, can be significant.⁶⁸

The best example is the struggle to preserve salmon runs on the Columbia River. To generate power, the optimal strategy is to store spring runoffs for use in the late summer and winter when power demand is high. But, as a result of the Endangered Species Act (“ESA”), water is released in the spring and early summer to benefit migrating juvenile salmon.⁶⁹

2. Land Loss and Scenic Impairment

Dams foreclose productive present and future alternative uses of land. Hydro facilities with large carryover storage reservoirs consume large amounts of land. A 2002 Cornell University study estimated that switching to the maximum amount of renewable energy through hydro, wind, solar, and biomass would reduce fossil-fuel use by only 50% and consume up to one-sixth of the country’s land mass. Hydro now occupies approximately sixty-four million acres, and increasing the acreage to its maximum potential would add another forty-two million acres dedicated to this resource.⁷⁰ The political fights over the loss of scenic canyons propelled the genteel Sierra Club into a national environmental advocacy organization. The inundation of the Fort Berthold Indian Reservation in South Dakota by the Pick-Sloan project still reverberates in the politics of the Missouri River.⁷¹

3. Pollution and Aquatic Ecosystem Modification

In addition to blocking fish runs, dams and stream channelization reduce flood plains, seasonal flood pulses, and the habitats and survival chances of many aquatic and terrestrial species. The chain of Missouri River dams from Montana to South Dakota constructed since the 1930s have had this effect to the point at which “[t]he ecosystem has been simplified and its production of goods and

68. Michel Larinier, *Environmental Issues, Dams and Fish Migration*, in DAMS, FISH, AND FISHERIES: OPPORTUNITIES, CHALLENGES, AND CONFLICT RESOLUTION 45 (Gerd Marmulla ed., 2001), available at <http://www.fao.org/DOCREP/004/Y2785E/y2785e03.htm>.

69. U.S. DEP’T OF HOMELAND SEC. & U.S. DEP’T OF ENERGY, *supra* note 2, at 16–17.

70. See David Pimentel et al., *Renewable Energy: Current and Potential Issues*, 52 BIOSCIENCE 1111, 1112 (2002).

71. BILLINGTON & JACKSON, *supra* note 20, at 240; JOHN E. THORSON, RIVER OF PROMISE, RIVER OF PERIL: THE POLITICS OF THE MISSOURI RIVER 80–83 (1994).

services has been greatly compromised.”⁷² The dams have also decreased downstream sediment transport to the detriment of endangered species along the Missouri River and contributed to the loss of wetlands in the Mississippi Delta.⁷³

4. Climate Change

One of the biggest unknowns in any strategy to increase hydro production is the impact of climate change on this resource, but the climate change literature provides no clear guidance on the net impact on production.⁷⁴ Hydro generation is a function of water flow and reservoir storage. Climate change will change water flows and reservoir levels throughout the world both positively and negatively through the alteration of temperature and precipitation schedules.⁷⁵ In addition, large reservoirs are a source of methane, which is released as decayed plants and animals pass through turbines,⁷⁶ but more recent research suggests that emission levels are lower than previously estimated.⁷⁷ The primary concern is that there will be less

72. DIV. ON EARTH & LIFE STUDIES OF THE COMM. ON MO. RIVER ECOSYSTEM SCI., NAT'L RESEARCH COUNCIL, THE MISSOURI RIVER ECOSYSTEM: EXPLORING THE PROSPECTS FOR RECOVERY 1, 3 (2002).

73. See M.D. Blum & H.H. Roberts, *Drowning of the Mississippi Delta Due to Insufficient Sediment Supply and Global Sea-Level Rise*, 2 NATURE GEOSCIENCE 488, 488 (2009) (stating that 25% of the wetlands associated with the Mississippi delta have been lost and that the reduction of sediment caused by the construction of dams could hinder efforts to protect and restore the coast).

74. See U.S. DEP'T OF HOMELAND SEC. & U.S. DEP'T OF ENERGY, *supra* note 2, at 22 (“Although certain temperature trends are evident, the projections of future precipitation remain unclear, leading to uncertainty in possible changes in future streamflow in the Colorado River.”).

75. See *Hydropower*, CENTER FOR CLIMATE & ENERGY SOLUTIONS, <http://www.pewclimate.org/technology/factsheet/hydropower> (last visited Aug. 31, 2012) (“Climate change and the alteration of rainfall and temperature regimes can affect hydropower generation. . . . Although hydropower systems may benefit from more storage and generation capacity, expansion of such capabilities may not be economically and environmentally justified.”).

76. See CLIMATE CHANGE AND DAMS: AN ANALYSIS OF THE LINKAGES BETWEEN THE UNFCCC LEGAL REGIME AND DAMS, UNITED NATIONS ENVIRONMENTAL PROGRAMME 26 (2000), available at <http://www.indiaenvironmentportal.org.in/files/DAMs%20and%20climate%20change.pdf> (“Methane is emitted from reservoirs that are stratified and where the bottom layers are anoxic, leading to degradation of biomass through anaerobic processes. Where the water is well oxygenated, degradation of biomass generates carbon dioxide, not methane.”); see also Kirsi Mäekinen & Shahbaz Kahn, *Policy Considerations for Greenhouse Gas Emissions from Freshwater Reservoirs*, 3 WATER ALTERNATIVES 91, 95–96 (2010) (summarizing research that confirms earlier concerns on methane emissions).

77. Compare Nathan Barros et al., *Carbon Emissions from Hydroelectric Reservoirs Linked to Reservoir Age and Latitude*, 4 NATURE GEOSCIENCE 593, 593 (2011) (stating that the estimates in the study “are smaller than previous estimates on the basis of limited data” and that they estimate hydroelectric reservoirs emit 3 TgC as CH₄), with Ivan B.T. Lima et al., *Methane*

water to turn turbines in hydro-dependent areas during times of high demand.⁷⁸

Reservoirs and river flows are fed by snow and rain. Climate change models forecast that higher temperatures can lead to both changes in snowfall and in the timing of snowmelt in watersheds.⁷⁹ These changes to snowfall and snowmelt could “include an increase in the ratio of rain to snow; a delayed onset of the snow season; a shortened overall snowfall season; an accelerated rate of spring snowmelt; and more rapid and earlier runoff.”⁸⁰ These changes will produce both winners and losers among electricity consumers. For example, a 2011 Intergovernmental Panel on Climate Change report concluded that the global impacts of climate change on hydro will be, “on balance,” positive.⁸¹

Further, based on research on the potential impact of climate change in Alpine Europe, most climate change scenarios indicate that alpine regions will experience a decrease in water runoff during the summer, which could reduce the ability to generate hydro during the season.⁸² However, during the winter, alpine regions will experience an increase in water runoff, which could increase the ability for generation. Rainy Norway is projected as a clear climate change winner, because increased precipitation will increase its generating capacity, although the benefits will vary from year to year.⁸³ The more

Emissions from Large Dams as Renewable Energy Resources: A Developing Nation Perspective, 13 MITIGATION & ADAPTATION STRATEGIES FOR GLOBAL CHANGE 193, 193 (2007) (estimating that “global large dams might annually release about 104 ± 7.2 Tg CH₄ to the atmosphere through reservoir surfaces, turbines and spillways”).

78. See Carl J. Bauer, *Dams and Markets: Rivers and Electric Power in Chile*, 49 NAT. RESOURCES J. 583, 589 (2009) (stating that power generation will be undermined by the scarcity and variability of water).

79. ASPEN ENVTL. GRP. & M. CUBED, POTENTIAL CHANGES IN HYDROPOWER PRODUCTION FROM GLOBAL CLIMATE CHANGE IN CALIFORNIA AND THE WESTERN UNITED STATES 3 (2005), available at <http://www.energy.ca.gov/2005publications/CEC-700-2005-010/CEC-700-2005-010.PDF>.

80. *Id.*

81. INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE, IPCC SPECIAL REPORT ON RENEWABLE ENERGY SOURCES AND CLIMATE CHANGE MITIGATION: SUMMARY FOR POLICYMAKERS 12 (Ottmar Edenhofer et al. eds., 2011) available at http://srren.ipcc-wg3.de/report/IPCC_SRREN_Full_Report.pdf (“For hydropower the overall impacts on the global technical potential is expected to be slightly positive.”).

82. OTTO PIRKER, CLIMATE CHANGE & HYDROPOWER CONSEQUENCES AND CHALLENGES (2007), available at <http://www.climate-water-adaptation-berlin2007.org/documents/pirker.pdf>.

83. See Kate Galbraith, *Hydropower's Resurgence and the Controversy Around It*, N.Y. TIMES, May 15, 2011, <http://www.nytimes.com/2011/05/16/business/global/16iht-green16.html?pagewanted=all> (citing a study that states that climate change will lead to more rain in Norway, causing better production in power plants; however, climate change will also cause

arid the area is, the greater the stress will be. In southern Europe, climate change is projected to decrease the amount of water runoff, and thus reduce the potential of hydro generation in the region. Also, projections indicate an increased likelihood of drought for the region, which would further stress the availability of water for hydro generation.⁸⁴

In the United States, the focus has been on the stresses in three major hydro-dependent regions—California, the Columbia Basin, and the Southwest—but the Southeast may also face increased risks of decreased hydro production. The biggest U.S. losers could be California and the arid western states. The region's water resources are already stressed by competing demands, and the projected temperature increases from the “wetter, warmer, less net water” scenarios for the region will further stress hydro. California is already experiencing a warming trend. The average runoff in California could increase by 77% according to the high wet forecast, but it could also decrease by 25% in the driest season.⁸⁵ It is possible that a seasonable increase-decrease pattern may result in no net change in current hydrographs. The rub is that the range of geographic and temporal variation still makes predictions difficult if not impossible.

The arid Colorado River Basin will be the most impacted region. There is a widespread consensus that Basin precipitation is likely to decrease; snowpack decreases are estimated to range around 30%. Decreased precipitation is expected to lead to about a 10% decrease in annual runoff, which will have major effects on hydro generation from the large mainstream and tributary reservoirs.⁸⁶ A study of future climate scenarios for the time periods 2010–2039, 2040–2069, and 2070–2098 showed decreased hydro generation by 56, 45, and 53%, respectively, compared to simulated historical hydro.⁸⁷

weather variations, which could produce dry years during which electricity production would decrease).

84. WORKING GROUP II, INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE, FOURTH ASSESSMENT REPORT OF THE INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE: SUMMARY FOR POLICYMAKERS 14 (M.L. Parry et al. eds., 2007), available at <http://www.ipcc.ch/pdf/assessment-report/ar4/wg2/ar4-wg2-spm.pdf>.

85. ASPEN ENVTL. GRP. & M. CUBED, *supra* note 79, at 3.

86. *Id.* at 23.

87. *Id.* In 2008, researchers at the Scripps Institute of Oceanography published a paper that concluded that the odds were fifty-fifty that Lake Mead could dry up by 2021 after factoring in both available information on inflows into and outflows from the Lake and various climate change scenarios. Tom P. Barnett & David W. Pierce, *When Will Lake Mead Go Dry?*, 44 WATER RESOURCES RES. (2008). Bureau of Reclamation officials responded that they omitted inflows below Lake Powell and the seven basin state agreement to coordinate the operation of Lake Powell and Lake Mead, which would require at most a five hundred thousand dollar cut back in

The expected reductions in the Basin's hydropower generation are due to the high sensitivity of the Colorado River system, where current demands are not much less than mean inflows.⁸⁸ Thus even slight decreases in the mean inflow could result in significant negative impacts on hydro.

In the Columbia River Basin, the interplay of water flows and energy demand is complex. There is more available water, but there are strong competing demands for uses that conflict with hydro generation. Studies forecast modest changes in winter precipitation over the twenty-first century, but warming temperatures are expected to dominate hydrologic effects in the Basin.⁸⁹ These effects include a gradual shift toward diminished snowpacks and earlier snowmelt runoff, accompanied by reduced summer and fall streamflows. Due to the expected reduction in streamflows during the summer and fall, the hydro-generation system would be most affected by its decreasing ability to maintain storage through the summer for late autumn drawdown. The result could be an increase of winter production by around 4% but a summer decrease by between 13 and 16%, with annual reductions estimated between 2 and 4%.⁹⁰ By 2080, hydro production is projected to increase by around 7 to 10% in winter and decrease by about 18 to 21% in summer, with annual reductions of about 3%.

The stresses on hydro are substantial, but the major stresses may come from the tension between adapting to decreased capacity

Lower Basin entitlements. WILLIAM DEBUYS, A GREAT ARIDNESS 139 (2011); Letter Concerning Development of Lower Basin Shortage Guidelines and Coordinated Management Strategies for the Operation of Lake Powell and Lake Mead Under Low Reservoir Conditions, *reprinted in* NAT'L RESEARCH COUNCIL, COLORADO RIVER BASIN MANAGEMENT: EVALUATING AND ADJUSTING TO HYDROCLIMATIC VARIABILITY 175 (2007). The researchers published a revised paper, which argued that the added inflows and other technical corrections only delayed the onset of serious problems by four to ten years. Tom P. Barnett & David W. Pierce, *Sustainable Water Deliveries from the Colorado River in a Changing Climate*, PROC. OF THE NAT'L ACAD. OF SCI. EARLY EDITION 106 (2009), available at <http://www.pnas.org/content/early/2009/04/17/0812762106.abstract>. See generally U.S. DEP'T OF THE INTERIOR, SECURE WATER ACT SECTION 9503(C) – RECLAMATION CLIMATE CHANGE AND WATER (2011), available at <http://www.usbr.gov/climate/SECURE/docs/SECUREWaterReport.pdf> (summarizing the existing state of current research).

88. Letter Concerning Development of Lower Basin Shortage Guidelines, *supra* note 87, at 151–54.

89. JEFFREY T. PAYNE ET AL., MITIGATING THE EFFECTS OF CLIMATE CHANGE ON THE WATER RESOURCES OF THE COLUMBIA RIVER BASIN 1–2 (2004), available at http://cses.washington.edu/cig/outreach/workshopfiles/Apr03_Scenarios_water/Payne_crb_v7_112502.pdf.

90. ALAN F. HAMLET ET AL., EFFECTS OF PROJECTED CLIMATE CHANGE ON ENERGY SUPPLY AND DEMAND IN THE PACIFIC NORTHWEST AND WASHINGTON STATE 187–88 (2010), available at <http://cses.washington.edu/db/pdf/wacciach4energy647.pdf>.

and meeting the demand for instream flows. In the Columbia Basin, hydrologic changes will increase the competition for reservoir storage between hydro and the instream flow targets developed pursuant to the ESA listing of Columbia River salmonids.⁹¹ The net effect is that people in the Pacific Northwest are likely to be warmer in both the summer and winter.⁹² Warmer winter temperatures will make adaptation easier, but come summer, peak electrical loads for air conditioning are likely to increase with the projected warming temperatures of the region.⁹³

5. Increased Competition for Water

Climate change aside, hydro production faces increasing competition for both nonconsumptive and consumptive uses of water. Hydro is a nonconsumptive use, but it competes with established consumptive uses. In addition, many federal dams and reservoirs are part of multiple-purpose projects, so hydro must compete with other uses, such as flood protection and irrigation, which can have a higher priority.⁹⁴ As discussed in the next Section, efforts to protect fish and restore aquatic ecosystems require that more water be left in the stream or that dam-release patterns be altered to mimic pre-dam conditions. This instream use can conflict with the demand for power and thus constrain generation. Population growth also creates new consumptive use demands. The best example is the conflict over the allocation of Lake Lanier, a major source of water supply for Atlanta, Georgia. Upstream uses impact hydro, navigation, and the integrity of productive oyster fisheries in Florida in two interconnected basins, the Apalachicola-Chattahoochee-Flint and Alabama-Coosa-Tallapoosa.

91. “In order to maintain performance of the [Colorado River Basin] reservoir system with respect to instream flow targets developed under the NMFS Biological Opinion associated with ESA listing of Columbia River salmonids, substantial (10–20%, depending on the future time period) reductions in firm hydropower would be required.” Jeffrey T. Payne et al., *Mitigating the Effects of Climate Change on the Water Resources of the Columbia River Basin*, 62 CLIMATIC CHANGE 233, 254 (2004). Therefore, even modest warming associated with climate change may cause significant shifts in Colorado River Basin runoff patterns because the hydrology of the region is dominated by the temperature-sensitive cycle of snow accumulation and melt. *See id.*

92. PAYNE ET AL., *supra* note 89, at 1–2.

93. HAMLET ET AL., *supra* note 90, at 188. Due to the expected reduction in hydro generation during the summer, the ability to transfer electrical energy from the Pacific Northwest to other regions is likely to decrease in May, June, July, and August.

94. The Colorado River Compact is an agreement signed by seven western states governing the water rights of the Colorado River. Article IV(b) of the Compact subordinates hydro to “the use and consumption of such water for agricultural and domestic purposes and shall not interfere with or prevent use for such dominant purposes.” The Bureau of Reclamation has made a copy of the Compact available at www.usbr.gov/lc/region/g1000/pdfiles/crcompact.pdf.

After the states of Alabama, Florida, and Georgia could not agree on a compact allocation, the federal government brokered a temporary solution. The Corps of Engineers unilaterally reallocated 248,858 acre-feet of water in Lake Lanier to Atlanta and planned to use the proceeds from the sale to compensate utilities that lost generating capacity. The D.C. Circuit invalidated the agreement on the theory that only Congress could reallocate the reservoir,⁹⁵ but the Eleventh Circuit has reached a different conclusion and remanded the decision for a determination of the Corps' reallocation authority.⁹⁶ The broader lesson of this litigation is that hydro is still a major purpose of multiple-use projects, but it is increasingly caught in tugs of war among a wide range of competing uses and cannot be assured that it will continue to prevail over other uses.

6. Aging Infrastructure

Many hydro plants, especially public ones, face the problem of an aging infrastructure due to years of underinvestment.⁹⁷ Technology is available to upgrade existing generators and dams; the problem is how to finance upgrades in an era of decreased federal spending for all water resource activities. For example, Corps projects contribute three to four billion dollars per year to the federal treasury,⁹⁸ but the agency cannot tap these revenues to repair and upgrade its facilities. Instead, federal power is marketed by four power marketing agencies and the money deposited in the federal treasury. The treatment of public power revenues can, however, differ from project to project, but with the exception of the Bonneville Power Authority and Hoover Dam, the

95. See *Se. Fed. Power Customers, Inc. v. Geren*, 514 F.3d 1316, 1325 (D.C. Cir. 2008) (holding that only Congress had authority to reallocate the water resources of the reservoir).

96. See *In re MDL-1824 Tri-State Water Rights Litig.*, 644 F.3d 1160, 1205 (11th Cir. 2011) (remanding the reallocation decision to the Army Corps of Engineers). The Eleventh Circuit held that water supply was an authorized purpose of Lake Lanier and that municipal supply could not be subordinated to hydro generation; it ordered the Corps of Engineers to consider Georgia's request for an allocation from the Lake after it reexamined its authority to operate the reservoir. Previously, the D.C. Circuit held that only Congress should reallocate the reservoir. See *Geren*, 514 F.3d at 1325. However, in *MDL-1824 Tri-State Water Rights*, the Eleventh Circuit held that the Corps was not bound by *Geren* since the *Geren* court did not have an opportunity to examine the Corps's full operational authority. See generally Victor Flatt & Jeremy Tarr, *Adaptation, Legal Resiliency, and the U.S. Army Corps of Engineers*, 89 N.C. L. REV. 1499 (2011) (detailing the Corps's authority).

97. MICHAEL J. SALE, U.S. ARMY CORPS OF ENGRS, OUTLOOK FOR THE CORPS OF ENGINEERS HYDROPOWER PROGRAM 9–12 (2011), available at www.iwr.usace.army.mil/docs/iwrreports/2011-WRO-P-02.pdf.

98. *Id.* at 4.

other agencies generally lack the authority to finance the operation and maintenance of the plants that they run.⁹⁹

II. THE ENVIRONMENTAL-RECREATIONAL-TRIBAL NETWORK OF CONSTRAINTS

The major story of hydro in the last fifty years is the effort of the federal and state governments to deal with the external costs of this resource by striking a new balance between hydro generation and releases for fishery conservation. There are two intertwined stories. The first is the opposition to dams for the aesthetic¹⁰⁰ and economic reasons that ended the Big Dam Era. Efforts to stop dams to preserve scenic canyons go back to the epic struggle to stop the construction of a dam in Hetch Hetchy Canyon north of Yosemite National Park.¹⁰¹ But, the opposition to two “cash register” dams at either end of Grand Canyon National Park helped to create the modern environmental protection movement.¹⁰² As a result, efforts to promote hydro have

99. *Id.* at 6.

100. *E.g.*, ELIOT PORTER, *THE PLACE THAT NO ONE KNEW: GLEN CANYON ON THE COLORADO RIVER* 6–7 (1963) (documenting of the loss of access to the floor of Glen Canyon damned by Glen Canyon Dam at Page, Arizona); Kim Murphy, *A Hydroelectric Future Faces A Fish Predicament*, L.A. TIMES, July 27, 2009, <http://articles.latimes.com/2009/jul/27/nation/na-hydro-power27> (explaining the opposition to dams for aesthetic and environmental reasons). Many developing nations are aggressively building dams and these dams generally have substantial adverse social and environmental impacts. *See generally* THAYER SCUDDER, *THE FUTURE OF LARGE DAMS: DEALING WITH SOCIAL, ENVIRONMENTAL, INSTITUTIONAL AND POLITICAL COSTS* (2005) (detailing the adverse social and environmental impacts of dam construction in developing nations).

101. In 1913, Congress allowed the construction of O'Shaughnessy Dam in the Hetch Hetchy Valley in Yosemite National Park, which supplies the city of San Francisco with water and power, by authorizing the necessary rights of way through Yosemite National Park. *See Raker Act*, 38 Stat. 242 (1913). The decision to build the dam was one of the great natural resource fights of the Conservation Era and played a major role in splitting the conservation movement into the utilitarian, multiuse, and preservation wings. *See* RICHARD WHITE, “IT'S YOUR MISFORTUNE AND NONE OF MY OWN”: A HISTORY OF THE AMERICAN WEST 413 (1993). California environmentalists have long dreamed of restoring the valley to John Muir's vision of it as the “flow of nature.” *See* MICHAEL COHEN, *THE PATHLESS WAY: JOHN MUIR AND THE AMERICAN WILDERNESS* 330 (1984).

102. In the 1960s, the Bureau of Reclamation proposed two dams, Marble and Bridge Canyons, solely for the generation of hydro at either end of the Canyon. The big-thinking Bureau proposed that the revenues be used for a massive interbasin transfer from the Columbia River to Arizona and California. After Senator Henry Jackson of Washington state blocked the proposed transfer, the case for the power revenue shifted to supplying the Central Arizona Project (“CAP”) and southern California. For the story of the history of the two dams and the political campaign to defeat them, see PHILIP L. FRADKIN, *A RIVER NO MORE: THE COLORADO AND THE WEST* 228–34 (2d ed. 1981). Ironically, to supply the CAP, large coal-burning plants were constructed near Page, Arizona, and set off a decades-long air pollution battle to preserve the clarity and vistas of the Four Corners area.

concentrated on smaller projects, often run of the river, and improvements at existing facilities. The second story is the effort to conserve and restore diminished fish runs. Efforts to preserve fish runs can be traced to the dawn of the hydro era, but fish conservation was almost always secondary to hydro development until the ESA in 1973. These two developments have produced an extensive, if fragmented and uncoordinated, network of major legal constraints that have been effectively used by environmental nongovernmental organizations (“NGOs”) and Native American tribes¹⁰³ to constrain hydro development and operation.¹⁰⁴ Public and private turbines continue to spin but often at less than maximum capacity.

A. Mitigation of Lost Fish Runs Pre-NEPA and ESA

The first efforts to deal with the external costs of hydro resulted in the construction of fish ladders and passages. As far back as 1888, the secretary of the Army was given the *discretion* to require fish passages for navigation improvements.¹⁰⁵

This idea was incorporated into the 1920 FPA, which required FERC to impose conditions in its licenses to construct and operate “such fishways as may be prescribed by the Secretary of Interior.”¹⁰⁶ Starting in 1934, Congress began to mandate the incorporation of fish protection facilities into federal dams and water-related projects.¹⁰⁷ The first Fish and Wildlife Coordination Act required any federal agency that directly impounds or licenses the impoundment of water to first consult with the Fish and Wildlife Service (“FWS”) of the Department of Interior and the head of the affected state wildlife agency about available fishery-conservation migration options.¹⁰⁸

103. See Mason Morisset et al., *Tribal Interests, Instream Flows & Hydropower Licensing*, 92 THE WATER REP., Oct. 15, 2011, at 1, 1–2 (discussing Native American tribes’ effective use of the system of fragmented rules and regulatory mechanisms).

104. See generally Michael C. Blumm & Viki A. Nadol, *The Decline of the Hydropower Czar and the Rise of Agency Pluralism in Hydroelectric Licensing*, 26 COLUM. J. ENVTL. L. 81 (2001).

105. Act of August 11, 1888, 25 Stat. 400, 425 (codified as amended at 33 U.S.C. § 608 (2006)).

106. Federal Power Act, 41 Stat. 1063 (1920) (codified as amended at 16 U.S.C. § 811 (2006)).

107. See Fish and Wildlife Coordination Act, 48 Stat. 401 (1934) (codified as amended at 16 U.S.C. § 662 (2006)) (requiring the Secretary of the Army to give “full consideration: to fish and wildlife needs in management of Upper Mississippi navigation system”).

108. *Id.* The modern FWS was created in 1939 when two bureaus dealing with fish, Fisheries and the Biological Survey, were moved from the Department of Agriculture to the Department of the Interior. See *Origins of the U.S. Fish and Wildlife Service*, U.S. FISH & WILDLIFE SERVICE, <http://training.fws.gov/History/TimelinesOrigins.html> (last updated May 21, 2009). Consultation was first mandated in 1946. Act of August 14, 1946, 60 Stat. 1080.

However, until the 1950s, there was no legal basis to force FERC or the federal government to reduce the broader external costs of hydro. In 1958, the Act was strengthened to require that federal agencies give wildlife conservation equal consideration “with other features of federal resource development programs.”¹⁰⁹ Under this amendment, fish ladders were installed on many dams; even after it was revealed that they would not be effective on large dams, the dams continued to be built.¹¹⁰ The FWS was a marginal agency within the Department of Interior during the Big Dam Era, and thus the Act never became a major constraint on hydro development because it was construed not to apply to pre-1970 projects.¹¹¹ In addition, pre-National Environmental Policy Act (“NEPA”) administrative law imposed almost insurmountable barriers to challenging agency actions applying the NEPA.

The story is different for FERC. The agency took the Fish and Wildlife Coordination Act seriously, consistently imposed fish flow releases in its licenses, and relied on the Act to reinforce its discretion to impose conditions over the objections from states. States often claimed that FERC conditions were insufficient, and water right holders argued that such conditions interfered with their state-created water rights.¹¹² In the 1950s, opposition to dams began to mount,¹¹³ and the opposition slowly worked its way into FERC license applications. Section 10 of the Act requires that “the project adopted . . . will be best adapted to a comprehensive plan . . . for the adequate protection, mitigation, and enhancement of fish and wildlife (including related spawning grounds and habitat).”¹¹⁴ FERC never implemented section 10, but in 1954, it denied a license on a Wisconsin river that eventually was incorporated into the Wild and Scenic Rivers

109. Fish and Wildlife Coordination Act § 661.

110. For example, the five hundred foot high Grand Coulee Dam was too high for fish to climb the ladders. “Having cut off the upper third of the Columbia’s spawning habitat, the salvage effort focused on transforming the fish runs above Grand Coulee into composite, hybridized stocks suitable for artificial propagation and transfer to tributaries below the dam.” *History*, SALMON FOR ALL, <http://www.salmonforall.org/history/> (last visited Sept. 7, 2012).

111. See *Upper Snake River Chapter of Trout Unlimited v. Hodel*, 921 F.2d 232, 235–36 (9th Cir. 1990) (holding that damage NEPA intended to prevent had already occurred).

112. See *California v. Fed. Power Comm’n*, 345 F.2d 917, 928 n.8 (9th Cir. 1965) (demonstrating typical arguments against FERC conditions); *Iowa v. Fed. Power Comm’n*, 178 F.2d 421, 423–25 (8th Cir. 1949) (same).

113. See ELMO RICHARDSON, DAMS, PARKS AND POLITICS: RESOURCE DEVELOPMENT AND PRESERVATION IN THE TRUMAN–EISENHOWER ERA 71–73 (1973) (explaining that opposition to dams began to mount in the 1950s).

114. 16 U.S.C. § 806(a)(1) (2006).

program.¹¹⁵ In a landmark decision, the Seventh Circuit upheld FERC's section 10 discretion to deny a hydro license for aesthetic reasons¹¹⁶ because no project or "conservation" alternative was an option in any comprehensive river plan.

The Act was given a boost by the Supreme Court in the last gasp of the public power debate after FERC rejected the secretary of Interior's recommendation that FERC deny a license for the High Mountain Sheep Dam on the Snake River in Idaho. Secretary Stuart Udall had urged FERC to recommend to Congress that the site be publically developed as part of a comprehensive plan of public power. Justice William O. Douglas—the most avid environmentalist to serve on the Court¹¹⁷—used the Act to bolster his almost unprecedented conclusion that FERC breached its section 7 duties to consider public development of the site. He found the record "relatively silent" on the merits of public versus private development and remanded the decision to FERC.

Modern environmental law has further eroded FERC's discretion. A well-financed challenge to a FERC decision gave birth to the new area of environmental law. FERC licensed a pump-storage plant on an iconic reach of the Hudson River at scenic Storm King Mountain. In 1965, a coalition of NGOs convinced the Court of Appeals for the Second Circuit to read the FPA, which had only been construed to confer discretion on the agency, to consider aesthetic values (a then much-contested idea).¹¹⁸ The coalition also convinced the Second Circuit to impose a mandatory duty on an agency to consider environmental values and to more fully justify decisions not to deny a license when the impacts were substantial.¹¹⁹ The Second Circuit remanded the case because FERC failed to consider the aesthetic and fish and wildlife impacts of the project. FERC reissued

115. 16 U.S.C. § 1274(a)(6).

116. See *Namekagon Hydro Co. v. Fed. Power Comm'n*, 216 F.2d 509, 511–13 (7th Cir. 1954) (holding FERC had discretion to deny a hydro license for aesthetic reasons).

117. See generally WILLIAM O. DOUGLAS, *A WILDERNESS BILL OF RIGHTS* (1964) (laying out Justice Douglas's avid environmentalism). The honor of the most effective environmental justice goes to Justice Thurgood Marshall who recognized marginalization when he saw it.

118. See *Scenic Hudson Pres. Conference v. Fed. Power Comm'n*, 354 F.2d 608, 623–25 (2d Cir. 1965); A. Dan Tarlock, Roger Tippy & Frances Ensey Francis, *Environmental Regulation of Power Plant Siting: Existing and Proposed Institutions*, 45 S. CAL. L. REV. 502, 514–23 (1972) (explaining the significance of the *Namekagon* decision).

119. See *Scenic Hudson Pres. Conference*, 354 F.2d at 624–25 (holding that an agency must consider environmental values and justify decisions not to deny licenses when there are substantial environmental impacts).

the license, and the Court upheld the decision,¹²⁰ but in *Scenic Hudson I*, the Court articulated the two core ideas—advance, detailed environmental assessment and substantial, if not equal, weight to fishery conservation—that have shaped both environmental law generally and the law of hydro in the past five decades.

Three years later Congress effectively ended the Big Dam Era by withdrawing many potential hydro sites from public and private development. After a decade of advocacy by wildlife conservation scientists such as John Craighead,¹²¹ Congress passed the Wild and Scenic Rivers Act.¹²² The Act applied the Wilderness Act preservation model to water by creating three classes of free-flowing rivers. Section 1 declares that

Certain selected rivers of the Nation which, in their immediate environments, possess outstandingly remarkable scenic, recreational, geologic, fish and wildlife, historic, cultural, or other similar values, shall be preserved in free-flowing condition . . . and their immediate environments shall be protected for the benefit and enjoyment of future generations.¹²³

The section went on to declare that the “established national policy of dam construction . . . needs to be complemented by a policy that would preserve other selected rivers or sections.” FERC is specifically prohibited from licensing any facility on a designated river, although the protection is not absolute. Dams are permitted above and below preserved reaches so long as the project will not “invade the area or unreasonably diminish the scenic, recreational, and fish or wildlife values present in the area on the date of the designation of the river.”¹²⁴

The afterglow of the Big Dam Era lived on for another decade as the dam-building agencies and their constituencies—especially in the West—did not initially appreciate that Congress was losing its appetite for subsidized large-scale water development. Large multiple-purpose projects continued to be proposed until Jimmy Carter issued

120. *Id.*

121. Joel K. Bourne, Jr., *America's Wild and Scenic Rivers*, NAT'L GEOGRAPHIC (Nov. 2011), <http://ngm.nationalgeographic.com/2011/11/americas-wild-rivers/bourne-text>.

122. Wild and Scenic Rivers Act, 16 U.S.C. §§ 1271–1287 (2006).

123. *Id.* § 1271.

124. *Id.* § 1278. It took a while for FERC to internalize the language. See *Swanson Mining Corp. v. Fed. Energy Regulatory Comm'n*, 790 F.2d 96, 101–03 (D.C. Cir. 1986). The Wild and Scenic River System protects 203 rivers in 39 states and Puerto Rico, but totals only 12,598 miles or one-fourth of 1% of the nation's rivers. *About the WSR Act*, NAT'L WILD & SCENIC RIVERS SYSTEM, <http://www.rivers.gov/rivers/wsr-act.php> (last visited Sept. 30, 2012).

his infamous 1977 “hit list.”¹²⁵ Hopes that the Reagan Administration would reverse this heresy were dashed when it turned out that the Reagan Administration’s cold-eyed economists wanted to end federal water development subsidies. Since the 1980s, the diminishing federal budget devoted to water has been increasingly spent on aquatic ecosystem restoration rather than dam construction.

B. NEPA and ESA Change the Game

Environmental law, specifically the NEPA,¹²⁶ turned the Fish and Wildlife Coordination Act from a shield into a sword, if a relatively dull one, and the Endangered Species Act (“ESA”)¹²⁷ transformed the marginalized FWS into a powerful agency within and outside of the Department of Interior. NEPA suits began to include an allegation that agencies were also violating the Fish and Wildlife Coordination Act,¹²⁸ and courts quickly merged the two—so compliance with the NEPA was presumed compliance with the Act.¹²⁹ Courts initially refused to require agencies such as the Corps of

125. See DAVID L. FELDMAN, WATER POLICY FOR SUSTAINABLE DEVELOPMENT 50–51 (2007) (explaining why President Carter tried to curb the power of Congress to distribute federal “pork” through inefficient water projects). For a discussion of the political firestorm that resulted, see MARC REISNER, CADILLAC DESERT: THE AMERICAN WEST AND ITS DISAPPEARING WATER 306–32 (1986).

126. National Environmental Policy Act, 42 U.S.C. §§ 4321–4370 (2006).

127. Endangered Species Act, 16 U.S.C. §§ 1531–1539 (2006).

128. The Act, unlike the later Clean Air Act and Clean Water Act, does not contain a citizen suit provision and, under the Supreme Court’s restrictive standards, does not create a private right of action. See *San Carlos Apache Tribe v. United States*, 272 F. Supp. 2d 860, 885 (D. Ariz. 2003) (explaining that “it is well settled that the FWCA provides no private right of action for citizen suits”), *aff’d*, 417 F.2d 1091 (9th Cir. 2005). However, some courts have found that the NEPA private right of action includes Fish and Wildlife Act violations. See *Profitt Found. v. U.S. Army Corps of Eng’rs*, 175 F. Supp. 2d 755, 770 (E.D. Pa. 2001) (noting that some courts find that the NEPA private right of action includes Fish and Wildlife Act violations), *aff’d on other grounds*, 343 F.3d 119 (2d Cir. 2003).

129. *Env’tl. Def. Fund, Inc. v. Froehkle*, 473 F.2d 346, 356 (8th Cir. 1972) (leading case holding that complying with NEPA in good faith necessarily involves taking into consideration all required factors under the FWA); *accord Env’tl. Def. Fund, Inc. v. Corps of Eng’rs of the U.S. Army*, 492 F.2d 1123, 1138 (5th Cir. 1974) (holding that the Corps complied by consulting with FWS in preparing EIS for Tennessee-Tombigbee navigation project and the Corps had no duty to obtain cabinet level approval); *Bergen County v. Dole*, 620 F. Supp. 1009 (D. N.J. 1985) (holding that complying with NEPA in good faith necessarily involves taking into consideration all required factors under the FWA), *aff’d*, 800 F.2d 1130 (3d Cir. 1986); *Missouri ex rel. Ashcroft v. Dep’t of Army, Corps of Eng’rs*, 526 F. Supp. 660, 673–75 (E.D. Mo. 1980) (finding that NEPA and FWA compliance are intertwined), *aff’d*, 672 F.2d 1297 (8th Cir. 1980).

Engineers to adopt FWS recommendations,¹³⁰ but agencies quickly learned that if they adopted some fish mitigation measures suggested by FWS, courts were likely to uphold their decision to proceed with a project.¹³¹

The initial environmental laws passed by Congress did not directly target hydro, but they eventually imposed serious constraints on the operation of existing facilities and made it more difficult to construct new ones, especially public projects. The ESA has become a basis for the imposition of mandatory flow release conditions to protect at-risk species. Hydro facilities on the Columbia¹³² and Colorado¹³³ Rivers have been impacted by the ESA. Courts have ordered releases from dams to protect listed species and have held that diversions can constitute an ESA section 9 taking.¹³⁴ In addition, Indian water-rights settlements are another source of minimum flows.¹³⁵ Indian Tribes have federally reserved water rights, which entitle them to the water necessary to support the purposes for which their reservation was established.¹³⁶ In the past twenty years, these rights have been quantified primarily through congressional settlement acts, and some impact dam operation. For example, in 2004, the state of Idaho, the federal government, and the Nez Perce tribe, entered into a creative settlement that provides for a more stable flow regime on lower Snake River, which can benefit both salmon restoration efforts and hydro generation.¹³⁷

130. See *Lake Erie Alliance for Prot. of Coastal Corridor v. U.S. Army Corps of Eng'rs*, 526 F. Supp. 1063, 1081 (W.D. Pa. 1981) (holding that the Corps need not follow the recommendations of FWS), *aff'd*, 707 F.2d 1392 (3d Cir. 1983).

131. *Missouri ex rel. Ashcroft*, 526 F. Supp. at 677 n.7 (“Defendants are making an effort to minimize adverse effects of the operation of the [] project upon fish and wildlife.”).

132. See *supra* note 91 and accompanying text (detailing the impact of the ESA on hydro facilities on the Columbia River).

133. See *infra* note 162 and accompanying text (detailing the impact of the ESA on hydro facilities on the Colorado River).

134. See A. DAN TARLOCK ET AL., *WATER RESOURCE MANAGEMENT* 737–47 (6th ed. 2009) (detailing court-ordered dam releases to protect list species).

135. *E.g.*, Notice of Lodgment of Stipulation of Settlement, *Natural Res. Def. Council v. Rodgers*, No. CIV S-88-1658 LKK/GGH (E.D. Cal. Sept. 23, 2006) (providing for instream flows and flows to support irrigation diversions).

136. *Winters v. United States*, 207 U.S. 564, 577 (1908) (establishing that Native American Tribes have federally reserved water rights).

137. The settlement essentially will release water that willing state water rights holders deposit into water banks. See Ann R. Klee & Duana Mecham, *The Nez Perce Indian Water Right Settlement—Federal Perspective*, 42 IDAHO L. REV. 595, 611–18 (2006) (explaining the settlement process). The broader question of the merits of salmon restoration efforts in the Columbia-Snake River Basin, including the breaching of the Snake River dams, is beyond the scope of this Article. See Michael C. Blumm, Erica J. Thorson & Joshua D. Smith, *The Failure of Columbia Basin*

Hydro initially got a pass from the Clean Water Act (“CWA”).¹³⁸ The CWA requires that all “point sources” of pollution acquire a discharge permit. In addition, a permitted charge cannot violate state water quality standards. For “institutional” reasons, an early influential D.C. Circuit Court of Appeals decision rejected the argument that dams were point sources.¹³⁹ FERC initially also assumed that it was immune from the CWA. Starting with the New Deal, the Supreme Court consistently held that FERC had the exclusive authority to regulate the operation of its licensed facilities on the fiction that the agency was conducting the unified river basin planning required by the FPA.¹⁴⁰ Not only were dams nonpoint sources, but power releases were not considered pollution discharges because nothing was added to the water.

Washington state ultimately found a way to subject dam releases to state regulation in a rare proenvironmental Supreme Court decision. Section 401 of the CWA¹⁴¹ requires that federal licensees obtain a state certification that the operation of the project will not violate state water quality standards. Section 401 certification applies to both public utilities and state-operated hydroelectric facilities. *PUD No. 1 of Jefferson County v. Washington Department of Ecology*¹⁴² was a challenge to fishery maintenance flow release conditions on a public utility. The Court held that section 401 allowed the state to impose minimum flows for fish protection and aesthetic enhancement. The utility argued that the conditions were water quantity, not quality, conditions, but Justice O’Connor dismissed the distinction as artificial. FERC had to accept the section 401 conditions

Salmon Recovery Under the Endangered Species Act, 36 ENVTL. L. 709 (2006) (addressing the broader question of salmon restoration efforts in the Columbia-Snake River Basin).

138. Clean Water Act, 33 U.S.C. §§ 1251–1387 (2006).

139. See *Nat’l Wildlife Fed’n v. Gorsuch*, 693 F.2d 156, 161 (D.C. Cir. 1982) (rejecting the argument that dams are point sources). Dams could be classified as point sources because they confine water and can be operated to control downstream adverse water quality impacts, but the court chose to exclude them in large part because other regulatory regimes were better suited to deal with the problem. See WILLIAM H. RODGERS, JR., ENVIRONMENTAL LAW 312 (2d ed. 1994) (arguing other regulatory schemes are better suited to deal with water quality problems).

140. See *California v. Fed. Energy Regulatory Comm’n*, 495 U.S. 490, 505–06 (1990) (holding that state instream flow conditions on FERC licensees were preempted); *First Iowa Hydro-Electric Coop. v. Fed. Power Comm’n*, 328 U.S. 152, 167–69 (1946) (holding that the Federal Power Commission had exclusive authority to regulate its licensed facilities).

141. 33 U.S.C. § 1341(a).

142. See *PUD No. 1 of Jefferson Cnty. v. Wash. Dep’t of Ecology*, 511 U.S. 700, 710–11 (1994) (explaining the challenge to fishery maintenance flow release conditions).

imposed by the state.¹⁴³ Thus, the section turned into a frequently used opportunity for environmental NGOs to impose minimum flow or environmental flow release conditions on FERC licensees.¹⁴⁴

C. Parity for Fish and White Water Rafters in FERC Licensing

In 1986, Congress both broadened FERC's power to consider the environmental impact of the operation of its licensed facilities and imposed new duties to exercise this power by limiting the agency's power to sacrifice the wellbeing of fish populations to gain power-generation benefits. The Federal Water Power Act of 1920 authorized fifty-year renewable licenses. In the mid-1980s, the issue changed from the licensing of new projects to the relicensing of existing projects. As the original licenses reached their golden anniversary, Congress enacted the Electric Consumers Protection Act of 1986 ("ECPA"),¹⁴⁵ which amends the FPA and mandates that FERC give equal weight to the benefits of relicensing the project and to "the protection, mitigation of damage to, and enhancement of, fish and wildlife (including related spawning grounds and habitat)." The ESA still applies to all FERC projects as well, but the ECPA applies whether or not the project will jeopardize a listed species. Hydro-rich states such as Oregon have a similar rigorous review process for new and relicensed non-FERC facilities.¹⁴⁶

143. FERC cannot make a determination that the conditions are outside the scope of section 401. If a utility objects, it must bring a judicial challenge. See *Am. Rivers v. Fed. Energy Regulatory Comm'n*, 129 F.3d 99, 107–09 (2d Cir. 1997). Subsequent cases have extended the reach of section 401. See *S.D. Warren Co. v. Me. Bd. of Env'tl. Prot.*, 547 U.S. 370, 375–77 (2006); Daniel Pollack, Note, *S.D. Warren and the Erosion of Federal Preemption in Hydropower Regulation*, 34 *ECOLOGY L.Q.* 763, 764–68 (2008) (arguing that federal hydro preemption is eroding). For an example of the power of section 401 certification, see *AES Sparrows Point LNG LLC v. Wilson*, 589 F.3d 721, 734, (4th Cir. 2009) (holding that Maryland can deny certification for a liquefied natural gas terminal).

144. *E.g.*, CAL. ENVTL. PROT. AGENCY, STATE WATER RES. CONTROL BD., ORDER WQ 2009-0007, IN THE MATTER OF PETITIONS FOR RECONSIDERATION OF WATER QUALITY CERTIFICATION FOR THE RE-OPERATION OF PYRAMID DAM FOR THE CALIFORNIA AQUEDUCT HYDROELECTRIC PROJECT FEDERAL ENERGY REGULATORY COMMISSION PROJECT NO 2426, ORDER PARTIALLY GRANTING PETITION FOR RECONSIDERATION AND AUTHORIZING ISSUANCE OF REVISED WATER QUALITY CERTIFICATION (2009), available at http://www.waterboards.ca.gov/board_decisions/adopted_orders/water_quality/wq09.shtml (requiring California to operate a project to stimulate natural flow conditions "to the extent operationally feasible" to protect the federally listed arroyo toad while rejecting NGO petition to increase summer minimum flows).

145. Electric Consumers Protection Act of 1986, 16 U.S.C. § 797(e) (2006).

146. See Adell Amos, *Freshwater Conservation in the Context of Energy and Climate Policy: Assessing Progress and Identifying Challenges in Oregon and the Western United States*, 12 *U. DENV. WATER L. REV.* 1, 122–31 (2008) (explaining that hydro-rich states such as Oregon have rigorous non-FERC facility review processes).

The ECPA has changed the way that FERC does business, but it has not prevented relicensing. The first case to consider the statute told FERC to stop marginalizing fish, but subsequent cases make it clear that the statute does not disturb FERC's discretion to make the final balancing among hydro, fish, and recreation. *National Wildlife Federation v. FERC*¹⁴⁷ remanded seven preliminary permits to develop license applications for hydro projects along the Salmon River in Idaho. The court held, *inter alia*, that the record did not support FERC's refusal to develop a comprehensive plan for hydroelectric development in the Salmon River Basin and not to collect baseline environmental data before granting the permits. FERC argued that its experience with these kinds of permits obviated the need for a plan, but the court found that this traditional deference to agency expertise arguments was inadequately justified and conflicted with the statements of FERC's own scientist who chaired the preliminary permit hearings. In language that echoed *Scenic Hudson I*, the court concluded that "the unique nature of the Salmon River Basin and the large number of applications filed made it imperative that a comprehensive plan be prepared before preliminary permits were issued." Because the Northwest Power Act also imposed new substantive requirements on FERC,¹⁴⁸ the court did not need to reach the issue of whether FERC violated the ECPA. Instead, on remand, it instructed FERC to "consider the evidence in the record, articulate reasons supported by the record for whatever decisions it makes, and consider the Council's Program to the fullest extent practicable." Thus, "if and when a future appeal is taken, whether the consideration [FERC] has given to fish and wildlife at this point satisfies the 'equitable treatment' requirement will no longer be an issue."¹⁴⁹

Subsequent cases have retreated from *National Wildlife Federation*, but FERC cannot ignore fish conservation. FERC's discretion to make the final balance between fish and hydro was first applied to a small project and then extended to larger ones. *National Wildlife Federation*¹⁵⁰ allowed FERC to trade off protection of a state-

147. See *Nat'l Wildlife Fed'n v. Fed. Energy Regulatory Comm'n*, 801 F.2d 1505, 1515–16 (9th Cir. 1986) (remanding the preliminary permits).

148. See *Confederated Tribes & Bands of the Yakima Indian Nation v. Fed. Energy Regulatory Comm'n*, 746 F.2d 466, 473 (9th Cir. 1984) (imposing new substantive requirements on FERC).

149. *Nat'l Wildlife Fed'n*, 801 F.2d at 1515.

150. See *Nat'l Wildlife Fed'n v. Fed. Energy Regulatory Comm'n*, 912 F.2d 1471, 1481–83 (D.C. Cir. 1990) (allowing FERC to have final discretion when weighing fish protection against hydro needs).

listed endangered fish against nonpower benefits, including water supply. FERC studied the benefits from development of the dam and concluded that those benefits justified the environmental costs. The court acknowledged that the ECPA requires FERC “to give equal consideration to environmental values and the need for development,” but concluded “it is not necessarily required to give these sets of competing values equal weight in every situation.”¹⁵¹ *U.S. Department of Interior v. FERC*¹⁵² extended the tradeoff discretion to the licensing of sixteen projects on the upper Ohio River. Specifically, it held that the ECPA does not require FERC to conduct studies that fish and wildlife agencies deemed necessary in order to give equal consideration to environmental concerns because it only required that the agency “address each recommendation.”¹⁵³ It also rewarded FERC for exercising its discretion to deal with the uncertain future impacts through extensive license conditions and reopeners.¹⁵⁴ *Conservation Law Foundation v. FERC* held that FERC may use existing dam conditions in deciding what protection should be given to fish runs.¹⁵⁵ In addition, the court stated:

[E]ven if the statute refers generally to all “fish and wildlife” it hardly follows that [FERC] must imagine the [channel] as it existed before 1899 and assess the effect of relicensing by pretending that [the] [d]am does not exist – at least when no one advocates decommissioning the . . . Project and tearing down the dam.¹⁵⁶

151. *Id.* at 1481.

152. *See* U.S. Dep’t of Interior v. Fed. Energy Regulatory Comm’n, 952 F.2d 538, 549 (D.C. Cir. 1992) (extending FERC’s takeoff discretion).

153. *Id.* at 545 (quoting Nat’l Wildlife Fed’n v. Fed. Energy Regulatory Comm’n, 912 F.2d at 1481).

154. *See* U.S. Dep’t of Interior, 952 F.2d at 547:

FERC liberally used license conditions to protect against unknown risks. Despite a finding on minimum flows necessary to maintain [dissolved oxygen] levels at the eleven dams rated fair-to-good aerators, FERC not only conditioned the licenses on flow maintenance but also conditioned them on maintaining the 6.5 mg/l level – thereby eliminating any uncertainty due to the flow prediction model. . . . FERC additionally required that licensees build their projects to accommodate the future addition of fish protective devices

The Court added:

[The Final EIS] examined several studies and concluded that mortality would not exceed 10 percent and that, even at that worst-case level, the projects licensed were in the public interest. The ten percent figure was based on substantial evidence: FERC pointed to studies conducted at several sites and noted that higher mortality levels in some experiments were not controlling because the turbines to be used in the licensed projects were substantially different.

Id. at 546.

155. *Conservation Law Found. v. Fed. Energy Regulatory Comm’n*, 216 F.3d 41, 45 (D.C. Cir. 2000).

156. *Id.* at 46.

III. FROM WORKING RIVERS TO RIVERS THAT WORK

The laws enacted since the Wild and Scenic Rivers Act have not only constrained individual hydro projects, but they have also laid the foundation for a paradigm shift in water resources management that is still working its way into the law of hydro. From the Conservation Era to the beginning of the modern environmental era, the ideal river was a working one.¹⁵⁷ For the first half of the twentieth century, rivers were viewed as imperfect examples of nature that could be improved by harnessing them with dams, levees, and ditches so that little water would be wasted through non-use.¹⁵⁸

We are now transitioning to the vision of a river that works for both humans and the environment. It is not a new vision. John Muir saw the mighty Columbia River as “gathering a glorious harvest of crystal water to be rolled through forest and plain in one majestic flood to the sea.”¹⁵⁹

There are two visions of the normative river: the rational and the wild. The first may mean the curtailment of generation options, and the second may mean the loss of existing facilities. The rational vision is grounded in the physical and social sciences. It seeks both to describe the pre-dam functions of the river and to quantify the value of such ecosystem services if some measure of the pre-dam hydrograph were to be restored. Ecosystem “services” include biodiversity enhancement, pollution filtering, and flood retention.¹⁶⁰ The best articulation of this vision of a river that works is the “normative river.”¹⁶¹ The normative river largely accepts the reality that a return to predevelopment (pre-dam) conditions is unrealistic on most large,

157. See W. WATER POLICY REVIEW COMM'N, WATER IN THE WEST: CHALLENGE FOR THE NEXT CENTURY 4-21 (1998). For the distinction between a working river, which is dammed and managed for flood control, irrigation, hydroelectric generation, and municipal water supply, and a river that works by providing a wide range of ecosystem services, see *id.* at 2-13; see also *id.* at 3-2, 3-3 (arguing rivers that work can accommodate sustainable, non-wasteful levels of consumptive use and non-consumptive uses such as hydro generation).

158. See NAT'L RESEARCH COUNCIL, *supra* note 64, at 34-41 (sketching the trends within the “pure doctrine of river management”).

159. BILLINGTON, *supra* note 20, at 153-54.

160. See James Salzman & J.B. Ruhl, *Currencies and Commodification of Environmental Law*, 53 STAN. L. REV. 607, 612 (2000); see also J.B. RUHL, STEVEN E. KRAFT & CHRISTOPHER L. LAND, THE LAW AND POLICY OF ECOSYSTEM SERVICES (2007).

161. See INDEP. SCI. GRP. OF NW. POWER PLANNING COUNCIL, RETURN TO THE RIVER: REPORT TO THE NORTHWEST POWER PLANNING COUNCIL 15 (1996) (introducing the concept in a report on Columbia River salmon restoration); see also Jack A. Stanford et al., *A General Protocol for Restoration of Regulated Rivers*, 12 REGULATED RIVERS 367 (1996) (articulating the principle fully).

regulated rivers such as the Columbia-Snake, Colorado, and Missouri. Instead, the objective is to manage dam releases to create a new, synthetic hydrograph that performs a reasonable range of pre-dam and predevelopment functions within constraints such as existing water rights and the legislative mandates that control reservoir operation. Hydro operations continue under this scenario, but will be subject to periodic revenue losses.¹⁶² Dams will remain because they can help improve aquatic ecosystems through reoperation that produces flow regimes closer to pre-dam conditions.

The normative river has not been legislatively codified, but it is no longer an abstract idea. A number of ad hoc river-restoration experiments implement the idea either de facto or de jure. The most ambitious de jure effort is the Comprehensive Everglades Restoration Plan, enacted as part of the omnibus Water Resources Development Act of 2000, which seeks to recreate a normative river of grass in the Everglades after decades of human alteration.¹⁶³ The ecosystem depends on seasonal sheet flows of water from the Kissimmee River in central Florida and Lake Okeechobee. To make South Beach and Miami what they are today, these flows were substantially diverted for agricultural and urban development and flood control. The objective of the legislation is no less than to replumb the Everglades to restore some measure of prediversion flows.¹⁶⁴

162. In 1982, the Bureau of Reclamation announced plans to rewind the eight generators at Glen Canyon Dam on the Colorado River. The decision triggered concerns about the dam's operations on endangered fish in the Colorado and Lower Colorado Rivers, rafting in the Grand Canyon, the Grand Canyon ecosystem, and Tribal interests. The Bureau responded by funding extensive studies of the dam's environmental impacts. As a result of review by the National Research Council, see NAT'L RESEARCH COUNCIL, RIVER AND DAM MANAGEMENT: A REVIEW OF THE BUREAU OF RECLAMATION'S GLEN CANYON ENVIRONMENTAL STUDIES (1987), the Western Area Power Administration was instructed to develop a minimum flow release pattern to replace the pattern of fluctuating discharges. Trevor C. Hughes, *Reservoir Operations*, in NAT'L RESEARCH COUNCIL, COLORADO RIVER ECOLOGY AND DAM MANAGEMENT: PROCEEDINGS OF A SYMPOSIUM 207, 214 (1991). Eventually, a permanent Glen Canyon Adaptive Management Program was established. Under this program, the Bureau has engaged in controlled flood releases to try and rebuild beaches on the Canyon floor by flushing sediment out of the tributaries to replace sediment flows arrested by the dam. The merits of the experiment remain contested, but the magnitude of the lost power revenues is clear. A 2008 controlled flood cost four million dollars in lost power revenues. Lawrence Susskind, Alejandro E. Camacho & Todd Schenk, *Collaborative Planning and Adaptive Management in Glen Canyon: A Cautionary Tale*, 35 COLUM. J. ENVTL. L. 1, 25–26 (2010).

163. 33 U.S.C. § 2201 (2006). See generally DAVID MCCALLY, THE EVERGLADES: AN ENVIRONMENTAL HISTORY (1999); EVERGLADES: THE ECOSYSTEM AND ITS RESTORATION (S.M. Davis & J.C. Ogden eds., 1994); C. Walters, Lance H. Gunderson & C.S. Holling, *Experimental Policies for Water Management in the Everglades*, 2 ECOLOGICAL APPLICATIONS 189 (1992).

164. U.S. ARMY CORPS OF ENG'RS & S. FLA. WATER MGMT. DIST., CENTRAL AND SOUTHERN FLORIDA COMPREHENSIVE REVIEW STUDY, FINAL INTEGRATED FEASIBILITY REPORT AND

Many argue that the ultimate conclusion of the normative river idea is to return a river to its wild, pre-dam state through dam removal.¹⁶⁵ Removal was first proposed for small dams that have exceeded their planned useful life or no longer perform their intended functions. Some small, marginal hydroelectric dams have been removed in Maine.¹⁶⁶ The largest ongoing removal is the 108-foot high Elwha Dam on the Elwha River in Washington state.¹⁶⁷ There have been proposals to take down large multipurpose dams such as Glen Canyon on the Colorado River¹⁶⁸ and O'Shaughnessy Dam north of Yosemite National Park.¹⁶⁹ Environmentalists have set their sights on

PROGRAMMATIC ENVIRONMENTAL IMPACT STATEMENT (1999), available at http://www.evergladesplan.org/docs/comp_plan_apr99/summary.pdf; see also Michael Voss, Note, *The Central and South Florida Comprehensive Review Study: Restoring the Everglades*, 27 *ECOLOGY L.Q.* 751 (2000) (presenting a plan for restoration of the Everglades using new technologies and interagency cooperation).

165. See generally STEVEN HAWLEY, *RECOVERING A LOST RIVER: REMOVING DAMS, REWILDING SALMON, REVITALIZING COMMUNITIES* (2011).

166. A Maine conservation organization, the Penobscot River Restoration Trust, raised twenty-five million dollars to supplement a fifteen million dollar federal grant to purchase and remove two hydroelectric dams at the lower end of the river and to build a fish run around a third. The hope is that fish will return to the watershed. The river was a major source of economic development as logs were floated from the headwater forests to downstream paper mills, but much of the resulting pollution has now been cleaned up. Katie Zezima, *Maine Conservationists Reach Milestone in Plan to Buy Three Dams*, N.Y. TIMES, Aug. 21, 2008, at A13.

167. See Elwha River Ecosystem and Fisheries Restoration Act, Pub. L. No. 102-495, 106 Stat. 3173 (1992) (authorizing removal following their purchase by the federal government in 2000); Kim Murphy, *Dam Removal Begins, and Soon the Fish Will Flow*, L.A. TIMES, Sept. 17, 2011, <http://articles.latimes.com/2011/sep/17/nation/la-na-0918-dam-20110918> (discussing how efforts to remove the dam were triggered by a major Supreme Court decision, *Washington v. Washington State Commercial Passenger Fishing Vessel Association*, 443 U.S. 658 (1979), which recognized on and off reservation tribal fishing rights for several reservations in Washington state including one downstream from two dams on the salmon-rich Elwha River); see also JEFF CRANE, *FINDING THE RIVER: AN ENVIRONMENTAL HISTORY OF THE ELWHA* (2012) (summarizing competing claims to the use of the river).

168. See Scott K. Miller, *Undamming Glen Canyon: Lunacy, Rationality, or Prophecy?*, 19 *STAN. ENVTL. L.J.* 121 (2000), for reviews of proposals to take down the Glen Canyon Dam. The issues raised by dam removal are beyond the subject of this Article. See generally DAM REMOVAL RESEARCH: STATUS AND PROSPECTS (William L. Graf ed., 2002); 52 *BIOSCIENCE* (2002) (featuring several articles discussing dam removal).

169. See *supra* note 101 and accompanying text (discussing the decision to build the O'Shaughnessy Dam). The issue of the dam still resonates in California. See WHITE, *supra* note 101, at 413; see also COHEN, *supra* note 101, at 330 (discussing California environmentalists' dreams of restoring the valley to John Muir's vision of it as the "flow of nature"); SPRECK ROSEKRANS ET AL., *ENVTL. DEF., PARADISE REGAINED: SOLUTIONS FOR RESTORING YOSEMITE HETCH HETCHY VALLEY* (2004) (giving a comprehensive effort to simulate a removal debate). In 1987, one of President Reagan's Secretaries of the Interior, Donald Hodel, was the first high-ranking official to suggest removal. Environmentalists viewed the suggestion as a ploy to split green northern California. In 2007, the Bush II Administration proposed a seven million dollar removal feasibility study, but Senator Dianne Feinstein, the former mayor of San Francisco and staunch Hetch Hetchy defender, was not amused. In 2012, the Senator was photographed in

the Snake River. To improve salmon runs on the Columbia-Snake River, proposals to breach four dams on the upper Snake River have been floated.¹⁷⁰ Major dam removal decisions must be made by Congress, but FERC has the power to order the removal of at least some licensed dams. Congressional approval is not required for the removal of FERC-licensed dams. Dam removal is now a relevant consideration in many relicensing applications because the FPA has been construed by the courts to give the agency the authority to deny a license-renewal application and order that a dam be decommissioned if the facility has become uneconomic.¹⁷¹

IV. HYDRO'S FUTURE

Energy law and policy are never static.¹⁷² Although hydro has been pronounced a retro-energy source and consigned to a steady-state future, it is currently enjoying a mini boom. Its fate remains tied, however, to the price and environmental policies regarding the big three hydrocarbons—oil, natural gas, and coal. To chart its future, it is useful to distinguish between big and little hydro. The distinction is not a hard and fast one, but it captures a crucial difference between small-scale projects and large power plants at dams. State and federal

front of a painting of pre-dam Hetch Hetchy Valley, which spurred the editorial board of the Sacramento Bee to speculate that it “might inspire a new Feinstein vision of what Hetch Hetchy Valley could be in the future.” *Feinstein Sees Hetch Hetchy in Its Natural State*, THE SACRAMENTO BEE (Mar. 28, 2012, 7:00 AM), http://blogs.sacbee.com/the_swarm/2012/03/feinstein-admires-a-natural-he.html.

170. The efforts to restore salmon runs on the Columbia River and its tributaries are an epic tale and illustrate the role that dam removal can play in the future resolution of such conflicts. After a court suggested that the federal government conduct a study to evaluate the removal of eleven dams on the Columbia and the Snake Rivers, the Clinton Administration began a study to assess the consequences of breaching four major dams on the Snake River. However, the Bush II Administration rejected the idea, although a 2002 Rand Corporation Report found that four Lower Snake River dams could be removed with no disruption to the regional economy. PERNIN ET AL., *supra* note 8, at 27–32; *see also* HAWLEY, *supra* note 165 (arguing that the dams should be removed). *See generally* MICHAEL C. BLUMM, SACRIFICING THE SALMON: A LEGAL AND POLICY HISTORY OF THE DECLINE OF COLUMBIA BASIN SALMON (2002).

171. *See City of Tacoma v. Fed. Energy Regulatory Comm'n*, 460 F.3d 53, 73 (D.C. Cir. 2006) (holding uneconomic licenses would be per se unreasonable); *see also Jackson Cnty. v. Fed. Energy Regulatory Comm'n*, 589 F.3d 1284, 1291 (D.C. Cir. 2009) (holding that FERC reasonably accepted the surrender of a license and plan to remove a dam and powerhouse and had no power to compel transfer of the license to the county).

172. *See, e.g.,* Jad Mouawad, *Fuel to Burn: Now What?*, N.Y. TIMES, Apr. 11, 2012, at F8 (arguing that years of concern in the United States about shortages of domestic sources oil, and to a lesser extent natural gas, and higher energy costs have led to extensive drilling in the United States, and that these new oil and gas reserves, along with Canadian tar sands, will ensure that oil and gas will be the major sources of the country's energy for the foreseeable future.)

alternative energy legislation extends various benefits, such as credit under state alternative energy portfolio standards and tax incentives to new, small-scale hydro projects. Thus, little hydro is trailing behind wind, solar, and biomass. In contrast, the previously discussed regulatory framework for big hydro, a federally funded, multiple-purpose project or a FERC license, remains in place. This said, small hydro must comply with applicable environmental laws. The current boom is primarily in little hydro, run-of-the-river, and kinetic projects.¹⁷³ However, some efforts to ramp up big hydro are emerging.

A. *Is the Capacity There?*

The first question that must be asked before any strategy to increase hydro production aggressively can be considered is whether the capacity is there. There is no simple answer to this question. Congress mandated a Department of Energy (“DOE”) study in 2005.¹⁷⁴ A 2011 study prepared for the Corps of Engineers summarized the results of this study and those of an earlier Electric Power Research Institute (“EPRI”) one.¹⁷⁵ The two studies are a classic case of trying to compare apples and oranges. The DOE’s study focused on technical feasibility and excluded constraints, such as environmental impact. It is a parody of the punch line of a joke in which an engineer, a scientist, and an economist are charged with opening a can on a desert island without any tools. The economist’s solution is “to first assume a can opener.” The EPRI’s study speculated in a different direction. It developed a series of incentive scenarios such as green portfolio purchases, tax incentives, and federal loans. The DOE came up with the figure of 467 megawatts of undeveloped power compared to the EPRI’s study. The DOE concludes that most of the increases will come from small, new dams or pumped storage.¹⁷⁶ It did not venture into the political landmine of large, new dams. The Corps of Engineers study concluded that “new hydropower development in the U.S. will

173. Kinetic hydro devices are placed in a body of water and generate electricity from running water without impoundment or diversion. For FERC’s kinetics policy and the location of pending permits, see *Hydrokinetic Projects*, FED. ENERGY REG. COMMISSION, <http://www.ferc.gov/industries/hydropower/gen-info/licensing/hydrokinetics.asp> (last updated Sept. 13, 2012).

174. Energy Policy Act of 2005, Pub. L. No. 109-58, § 1834, 119 Stat. 594, 1139–40.

175. SALE, *supra* note 97, at 28–30.

176. For a discussion of a variety of small, new hydro projects, many at existing dams, at various stages of licensing or construction, see *Adding Hydro at Existing Dams: Project Profiles*, HYDROWORLD.COM, <http://www.hydroworld.com/articles/hr/print/volume-27/issue-5/feature-articles/adding-hydro-at-existing-dams-project-profiles.html> (last visited Oct. 2, 2012).

most likely be accomplished by”¹⁷⁷ FERC-licensed projects. The EPRI did a similar study, but it came up with a figure of only 0.5 megawatts and agreed with the DOE that the future was in small dams and pumped storage.

B. The Small-Scale Upgrade Scenario

The current “action” is in little hydro. There are many untapped sources of falling water at low gradients.¹⁷⁸ Currently, the United States is using tax credits and efforts to speed up FERC licensing as the major inducements for small hydro. The United States’ first effort to do the latter did not end well. In 1978, Congress enacted legislation designed to bring new, smaller low-head plants online.¹⁷⁹ Studies projected that new, cost-effective facilities could produce one hundred thousand megawatts of clean power.¹⁸⁰ The carrot was the requirement that public utilities purchase the electricity generated from qualifying facilities.¹⁸¹ FERC interpreted this to be the utility’s avoided cost, and the Supreme Court upheld the standard.¹⁸² However, the increased generation produced by the act has been well below the initial expectations.¹⁸³ The reasons for the lack of increased generation include the multitude of regulatory approvals required for a plant¹⁸⁴ and avoided cost contracts that exceeded market rates.¹⁸⁵ FERC currently encourages small projects by exempting projects from licensing if they are located in existing conduits such as aquifers or produce less than five megawatts.¹⁸⁶

177. See SALE, *supra* note 97, at 29.

178. New York City is looking at its water system as a source of hydro. A New York City ordinance mandates a study of generating hydro as New York City’s water flows from the Catskill Mountains to the city, although major technical problems exist. Jim Dwyer, *Seeing Sources of Electricity in Water Pipes*, N.Y. TIMES, May 9, 2011, at A16.

179. The Public Utility Regulatory Policies Act of 1978, 16 U.S.C. §§ 824a–824w (2006).

180. DOUGLAS G. HALL ET AL., IDAHO NAT’L ENG’G & ENVTL. LAB., WATER ENERGY RESOURCES OF THE UNITED STATES WITH EMPHASIS ON LOW HEAD/LOW POWER RESOURCES 38–43 (2004), available at <http://www1.eere.energy.gov/water/pdfs/doewater-11111.pdf>.

181. 16 U.S.C. § 824a-3(a).

182. *Am. Paper Inst., Inc. v. Am. Elec. Power Serv. Corp.*, 461 U.S. 402, 423 (1983).

183. See STEVEN FERRY, LAW OF INDEPENDENT POWER § 3.4 (1989).

184. Lea-Rachel Kosnik, *River Basin Water Management in the U.S.: A Regulatory Anticommons*, 5 ENVTL. ENERGY L. & POL’Y J. 365, 371–72 (2010).

185. Jerry R. Bloom & Joseph M. Karp, *The Folly of PURPA Repeal*, PUB. UTIL. FORT., July 1, 1995, at 52.

186. See *Small/Low Impact Hydropower Projects*, FED. ENERGY REG. COMMISSION, <http://www.ferc.gov/industries/hydropower/gen-info/licensing/small-low-impact/get-started/exemp-licens.asp> (last updated May 4, 2012):

There is less need for “feed in tariffs,” as they are called in Europe, because today, there are many merchant power plants that do not sell to utilities.¹⁸⁷

In 2005, Congress focused on relicensing by speeding up the process and providing tax credits, which have been extended by the 2008–2009 stimulus bills. The Energy Policy Act of 2005 requires that FERC “take an adaptive approach for restoring anadromous fish to their historically accessible habitat” when relicensing hydroelectric projects.¹⁸⁸ However, the Act also weakened habitat protection. Section 241(b) created an expedited trial of ninety days on all material facts in dispute between any party and the applicant.¹⁸⁹ Section 33 of the Energy Policy Act of 2005 requires applicants and other parties to propose alternatives to conditions established by the Departments of Interior, Commerce, and Agriculture.¹⁹⁰ Specifically, section 33 requires that FERC must accept the project if (1) the secretary of any of the three agencies determines that it meets environmental conditions and is “no less protective than the fishway initially prescribed,” and (2) in comparison with the original proposal, the project will “cost significantly less to implement; or result in improved operation of the project works for electricity production.”¹⁹¹ Since both the applicant and any other interested party can propose these conditions, this standard would seem to allow the secretaries a way to

A small conduit hydroelectric facility up to 15 megawatt (MW) (up to 40 MW for certain municipal projects) using a man-made conduit operated primarily for non-hydroelectric purposes may be eligible for a conduit exemption. The applicant must have all the real property interests necessary to develop and operate the project or an option to obtain the interests (18 CFR 4.31(b)(2)). The facility cannot occupy federal lands. The conduit on which the project is located is not included as a project work. Applications for exemptions of small hydroelectric conduits are categorically exempt from the requirement for an Environmental Assessment (EA) or Environmental Impact Statement (EIS) to be prepared by the Commission. However, this does not mean that the Commission cannot require an EA or EIS to be prepared if your project appears to have adverse effects on the environment.

187. DOUGLAS G. HALL, A STUDY OF UNITED STATES HYDROELECTRIC POWER PLANT OWNERSHIP, at v (2006) (“Private owners that are not utilities own 38% of the plants corresponding to only 4% of the total capacity . . .”).

188. FED. ENERGY REGULATORY COMM’N, DRAFT ENVIRONMENTAL IMPACT STATEMENT FOR RELICENSING OF THE KLAMATH HYDROELECTRIC PROJECT NO. 2082-027, EXECUTIVE SUMMARY xxix (2006), available at <http://www.ferc.gov/industries/hydropower/enviro/eis/2006/09-25-06.asp>.

189. Energy Policy Act of 2005, Pub. L. No. 109-58, § 241(b), 119 Stat. 594, 674–75; see also § 241(a) (requiring a “determination on the record” invoking a formal hearing, consistent with the statute requiring parties to have the “opportunity to undertake discovery and the right to cross-examine witnesses”).

190. *Id.* § 33(a)–(b)(5) (amending section 4(e) of the Federal Power Act).

191. *Id.* § 33(b)(2)(a)–(b)(2)(b)(ii).

dismiss those alternatives that are not economically favorable to the dam operator.

Little hydro is the beneficiary of tax credits and other credits. The Energy Policy Act of 2005 gave a tax credit of 0.9 cents per kilowatt hour for efficiency increases at existing facilities put in place by 2009.¹⁹² New power generated from existing dams that does not require a project enlargement or new impoundment is eligible for incentive payments of 1.8 cents per kilowatt hour for ten years.¹⁹³ Under section 1301 of the Energy Policy Act of 2005, the Internal Revenue Code allowed plant operators to apply incremental production gains from efficiency improvements or capacity additions to existing hydroelectric facilities placed into service after August 8, 2005 and before January 1, 2014.¹⁹⁴ These incentives are sparking a mini boom in hydrokinetic projects. For example, in 2008, FERC approved the installation of two twenty-five-kilowatt hydrokinetic devices, projected to generate 364 megawatt hours per year, within the footprint of a municipal FERC-licensed dam on the Mississippi River at Hastings, Minnesota.¹⁹⁵

192. *Id.* § 1301.

193. *Id.* § 242.

194. See OFFICE OF ENERGY PROJECTS, FED. ENERGY REGULATORY COMM'N, RENEWABLE ENERGY PRODUCTION TAX CREDIT: INSTRUCTIONS FOR REQUESTING CERTIFICATION OF INCREMENTAL HYDROPOWER PRODUCTION PURSUANT TO THE ENERGY POLICY ACT OF 2005, at 3 (2011), available at <http://www.ferc.gov/industries/hydropower/gen-info/comp-admin/credit-cert.pdf> (providing guidance on definitions within section 1301 of the Energy Policy Act of 2005). The Act “does not define ‘efficiency improvements’ or ‘additions of capacity,’ except by excluding ‘operational changes . . . not directly associated with the efficiency improvements or additions of capacity.’” *Id.* The FERC report continued:

We construe ‘efficiency improvements’ to encompass additional generation from existing equipment in the form of upgrades to generators or turbines. Examples include rewinding generators, replacing turbines with more efficient units, and computerizing control of turbines and generators to optimize regulation of flows for generation. We construe ‘additions of capacity’ to mean any increase in generating capacity other than an addition resulting from an efficiency improvement or an addition resulting from an operational change. An example of addition of capacity is of installation of a minimum flow generating unit. Examples of operational changes not directly associated with efficiency improvements or additions to capacity include raising the pond level to increase head and reducing spill flows required for environmental protection.

Id.

195. Order Amending License, 125 FERC ¶ 61,287 (2008); see also *Hydro Green Energy’s 1st Project*, HYDRO GREEN ENERGY, <http://www.hgenergy.com/hastings.html> (last visited Oct. 3, 2012) (describing the project).

C. Big Hydro

1. Private Financing of Project Upgrades

Big hydro is in a steady state because the federal government is not building multiple-purpose dams, utilities are not investing in large hydro dams, and funding for upgrades is inconsistent.¹⁹⁶ Increased big hydro is likely to come from pumped-storage projects¹⁹⁷ and turbine upgrades.¹⁹⁸ This strategy assumes that only modest increases in hydro production should be tolerated in light of the environmental costs of dams and turbines. Nonetheless, recent developments in turbine design, runner configuration, and generator efficiency make it possible to modify existing dams and squeeze out 15 to 25% more power from the same water flows.¹⁹⁹ At the present time, the major effort to ramp up big hydro is a 2010 Memorandum of Understanding (“MOU”) among the Department of Energy, the Department of Interior, and the Corps of Engineers.²⁰⁰ The signatories are to assess federal facilities suitable for increased production and to select “low impact” pilot projects in identified basins. The hope is that the agencies can identify environmentally sustainable projects, especially pumped-storage projects at existing facilities, and get an early approval from likely objecting stakeholders. The MOU is a positive step, but it fails to address the real problem: lack of money for federal project upgrades.

The fundamental issue for federal hydro is how to upgrade the aging infrastructure. The major barrier is the general inability of the operating agencies to use power revenues to finance these upgrades. As discussed earlier, with the exception of the Tennessee Valley Authority, the major dam-owning agencies do not have access to the revenues that they generate. For example, most of the two to four

196. *See, e.g., id.* (discussing how only three of the nation’s twenty highest dams have been built since 1970; one, Seven Oaks Dam in southern California, is only for flood control and the hydro capacity at the other two, New Melones and Don Pedro, is relatively small).

197. *See, e.g.,* TURLOCK IRRIGATION DIST., RED MOUNTAIN BAR PUMPED STORAGE PROJECT (2009), available at http://www.tid.org/sites/default/files/documents/tidweb_content/tidweb_red_mountain_fact_sheet.pdf (discussing the proposed Red Mountain Project at Don Pedro Dam on the River in California).

198. SALE, *supra* note 97, at 9–12.

199. *Id.*

200. *See DOE, DOI and Army Corps of Engineers Sign Memorandum of Understanding on Hydropower*, ENERGY.GOV (Mar. 24, 2010), <http://energy.gov/articles/doe-doi-and-army-corps-engineers-sign-memorandum-understanding-hydropower>; *see also* MEMORANDUM OF UNDERSTANDING FOR HYDROPOWER: TWO-YEAR PROGRESS REPORT (2012), available at http://www1.eere.energy.gov/water/pdfs/hydropower_memorandum_of_understanding.pdf.

billion dollars in annual power revenues go into the Treasury's general fund. Any revenues that are partially recaptured are used to cover Power Marketing Administration operating costs; to repay the federal capital investment costs and interest of the construction of the hydroelectric facility; and to cover operations and maintenance costs incurred from the operation of the hydro facility, as well as costs such as environmental-mitigation costs incurred due to the operation of the hydro facility. One possible solution is to adapt the concept of Energy Savings Performance contracts adopted in the Energy Policy Act of 1992. The Act authorized contracts to finance energy-efficiency improvements and allowed the financing entity to recoup the costs avoided due to the improvements. For hydro, the entity would finance the upgrade and then receive the resulting incremental power revenues to recoup the costs of the improvements.²⁰¹

2. Integrating Hydro Production with the Environmental Protection Network

This Article has shown that hydro and environmental protection operate on two separate legal tracks. They intersect when a specific project threatens an endangered species or an environmental resource. Hydro might be better served by a tighter integration. The Conservation Era dream of the rational development of all major river basins needs to be rethought and adapted to the demands of sustainable energy and climate change adaptation. As discussed above, technological advances in generation could generate more power from the same amount of water, but they could also support environmental objectives such as ecosystem restoration. New technologies make it possible to generate the current output with 15 to 25% less water. The challenge is to make the idea of the normative river, discussed in Part V, compatible with hydro generation.²⁰²

The central question for future water and hydro policy is what magnitude of functions, from power generation to ecosystem protection, can a river that "works" be legitimately asked to perform as we adapt to climate change and try to move toward more

201. Kate Anderson, Steve Smith & Andrew Morton, Funding Federal Hydro Dam Refurbishment with Energy Savings Performance Contracts (Oct. 11, 2011) (unpublished manuscript).

202. See, e.g., Ximing Cai, Daene C. McKinney & Leon Lasdon, *Integrated Hydrologic-Agromomic-Economic Model for River Basin Management*, 129 J. WATER RESOURCES PLANNING & MGMT. 4 (2003) (presenting a model which permits irrigation, hydroelectric generation, and the release of environmental flows in the Syr Darya River Basin in Central Asia).

sustainable power generation? The first step in answering the question should be implementation of the core idea of the normative river and the establishment of artificial base ecosystem maintenance flows on major rivers. This is consistent with the rational view of the normative river that recognizes that it will not be possible to maintain the base flows under all conditions. Instead, any effort to more rationally integrate hydro and environmental protection must be seen as an ongoing experiment. Thus, species conservation and ecosystem restoration must be subject to continuing, rigorous assessment using adaptive management.²⁰³

Adaptive management is a response to static or deterministic environmental assessment using decision-tree analysis.²⁰⁴ It recognizes that most resource management decisions must be made under conditions of uncertainty and with what has come to be called nonequilibrium ecology. The central idea is that management decisions must be constantly monitored, *evaluated*, and modified or reversed when new information so counsels.²⁰⁵ Adaptive management must be seen as a rigorous science-based tool and must be supported, as it is not now, by a clear legislative framework.

FERC, the Corps of Engineers, the Bureau of Reclamation, and public utilities will not embrace adaptive management easily. The concept has usually meant that some production must be foregone at certain times of the year to serve environmental objectives.²⁰⁶ However, adaptive management offers at least two major benefits to public and private hydro. First, the concept can support heretical ideas such as assessing wild and scenic rivers to determine if there are delisting candidates with high hydro benefits and low environmental costs. It can also support the placement of performance and time constraints on all ecosystem restoration experiments, including those driven by the ESA, to determine if the actual benefits produced justify

203. See NAT'L RESEARCH COUNCIL, DOWNSTREAM: ADAPTIVE MANAGEMENT OF GLEN CANYON DAM AND THE COLORADO ECOSYSTEM 52–54 (1999) (discussing how the Columbia River provides a depressing example of ineffective adaptive management); see also John Volkman & Willis E. McConnaha, *Through a Glass Darkly: Columbia River Salmon, The Endangered Species Act, and Adaptive Management*, 25 ENVTL. L.J. 1249 (1993).

204. HOWARD RAIFFIA, DECISION ANALYSIS (1968).

205. DANIEL BOTKIN, DISCORDANT HARMONIES: A NEW ECOLOGY FOR THE 21ST CENTURY (1992); see also Alejandro E. Camacho, Lawrence Susskind & Todd Schenk, *Collaborative Planning and Adaptive Management in Glen Canyon: A Cautionary Tale*, 33 COLUM. J. ENVTL. L. 1 (2010); Milena Harms-Benson, *Adaptive Management Approaches by Resource Management Agencies in the United States: Implications for Energy Development*, 28 J. ENERGY & NAT. RESOURCES 87, 91 (2010).

206. See *infra* notes 207–11 and accompanying text.

foregone hydro production. Second, established flows would make it easier for generators to assess the longer-term risks of altered flows for a variety of reasons, from global climate change to aquatic ecosystem restoration. It might also provide inducements for more flexible operating regimes in cases where the long-term costs of hydro are small.²⁰⁷ No option should be off the table, from dam removal to eliminating or scaling back a fish conservation program.

Adaptive management has the potential to help strike a balance between hydro production and fish protection weighted toward increased production. At the present time, any efforts would be hampered by the lack of coherent U.S. water policy and a dysfunctional water management structure.²⁰⁸ Although the political and environmental costs of this strategy would be substantial, the project is worth undertaking given the stresses that U.S. water resources will undergo in the future.²⁰⁹ In 2010, the National Research Council called for a new adaptation paradigm.²¹⁰ However, the closest that Congress has come was in the Clean Energy and Security Act of 2009 which called for state climate change adaptation initiatives.²¹¹ Thus, federal water and climate adaptation policy remains in “silos,” leaving utilities and consumers to rely on FERC, the Corps of Engineers, and the Bureau of Reclamation to arbitrate competing demands and to set flow release patterns that do not seriously compromise hydro revenues.

V. CONCLUSION

Realistically, hydro's most probable future is the preservation of the status quo. The resource will continue to be subordinated to aquatic ecosystem conservation. It will therefore fluctuate between

207. See, e.g., Robert Haskell Abrams, *Water, Climate Change, and the Law: Integrated Eastern States Water Management Founded on a New Cooperative Federalism*, 42 ENVTL. L. REP. 10433, 10477 (2012); Daniel Pollack, *Adaptive Management in Hydropower Regulation*, 39 ENVTL. L. REP. 10979, 10933 (2009).

208. See NAT'L WATER COMM'N, *supra* note 65 (reaching this conclusion for the first time); see also, e.g., NAT'L RESEARCH COUNCIL, *supra* note 64, at 46.

209. See Abrams, *supra* note 207 (arguing states need more authority over water allocation and that both the U.S. Army Corps of Engineers and FERC's power should be curtailed).

210. See generally NAT'L RESEARCH COUNCIL, ADAPTING TO THE IMPACTS OF CLIMATE CHANGE I (2010).

211. See American Clean Energy and Security Act of 2009, H.R. 2454, 111th Cong., § 479(c)(1)(C) (2009) (requiring state plans which “prioritized” the particular risks that the state faces and detailing a list of cost-effective projects and strategies “to assist fish, wildlife, plant populations, habitats, ecosystems, and associated ecological processes in becoming more resilient, adapting to, and better withstanding” the impacts of climate change).

marginal increases in capacity, primarily from little hydro, and the continued imposition of operating constraints and the removal of old dams. As a 2010 National Academies study concluded, “[t]he future of hydropower will play out in the public policy debate, where the benefits of the electric power are weighed against its effects on the ecosystem.”²¹² However, if global climate change begins to impact hydro production, Congress may eventually be forced to deal with adaptation and to more directly address the question of where hydro generation fits in any environmental policy, such as it is, and energy strategy and to provide a more stable adaptation regime. Hydro is the oldest major source of noncarbon, renewable energy and is the only conventional renewable resource in the current energy mix. Increased hydro capacity would seem to be a key element of any U.S. energy policy designed to promote the greater use of renewable resources.

212. NAT'L ACADS. OF SCIS. ET AL., *supra* note 8, at 99.