
Energy v. Water

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The role of economics in environmental regulation lies at the heart of the Supreme Court's 2009 decision in Entergy Corporation v. Riverkeeper. In Riverkeeper, the Supreme Court determined that the Environmental Protection Agency (EPA) has the authority to conduct cost-benefit analysis when promulgating technology standards for cooling water intake structures at existing power plants pursuant to the Clean Water Act. Like many environmental regulations, the Clean Water Act is silent on the use of such analysis. Writing for the majority, Justice Scalia interpreted the Act to permit the EPA's reliance on cost-benefit analysis. As Justice Breyer posits in his concurrence, in times of limited resources and dire environmental problems it is wasteful to force an industry to spend billions to save one more fish while those resources may be more wisely spent resolving other environmental woes. This Note argues that such an approach can only work when the environmental woes are properly defined. In the case at hand, the EPA grossly oversimplified the environmental problem and financial burdens and thus miscalculated the environmental and financial benefits of the best technology available. By ignoring the environmental harm caused by power plant water use and consumption, the EPA did not factor in the potentially huge environmental benefits of restoring instream flows and the financial and social benefit of averting a crisis in the energy-water nexus.

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INTRODUCTION

Quantification of the monetary value of any action's environmental costs and benefits is riddled with complexity. What is the value of an ecosystem, a stream reach, or a single fish? What financial savings may be achieved by averting future environmental disaster? To be intellectually honest, the quantification must account for every potential harm while discounting all advantages, both financial and environmental.

When the Environmental Protection Agency (EPA or "the Agency") promulgated regulations concerning the best cooling water intake technology available, the Agency conducted a rudimentary analysis of the costs and benefits of each available technology. The Agency considered only the most obvious environmental harm—the loss of aquatic species that are directly killed by the intake structures—and obvious financial costs—capital investment—of each technology option. This primitive cost-benefit analysis ("CBA") resulted in a technology standard that is environmentally destructive and may prove to be much

more expensive than EPA calculated. In *Entergy Corp. v. Riverkeeper*,¹ the Supreme Court endorsed the Agency's use of CBA despite the Justices' awareness of gaps in the calculations.²

This Note addresses the problematic nature of the CBA used in *Riverkeeper* in five parts. Part I gives background on other uses of CBA in the Clean Water Act (CWA or "the Act") and how those other contexts informed the decision in *Riverkeeper*. Part II describes the Agency's limited use of CBA in setting the standard at issue in this case, a CBA that overlooked substantial environmental impacts and other costs. Part III provides examples of the adverse environmental impacts the EPA overlooked in calculating environmental benefits, while Part IV describes costs beyond capital investment that the EPA did not include in CBA, with particular emphasis on the nexus between electricity generation and water use and consumption. Finally, Part V denounces the Agency's claim that interference with water allocation violates states' rights and suggests a legal venue for the EPA to address the environmental harm posed by cooling plant water use and consumption. This Note concludes that EPA's failure to conduct an intellectually honest CBA compromises the resulting rule, highlights the lack of scientific inquiry into broad environmental impacts, and arguably constitutes a missed opportunity to avert a looming crisis in the water and energy sectors.

I. BACKGROUND

A. *The Role of Cost-Benefit Analysis in the Clean Water Act*

The CWA is a technology-based statute; that is, it places rigorous demands on the regulated community to achieve higher and higher levels of pollution abatement under deadlines specified in the law.³ Through the CWA, Congress granted the EPA the authority to set technology standards that would restore the integrity of the nation's waters.⁴ To do

1. *Entergy Corp. v. Riverkeeper*, 129 S. Ct. 1498, 1504 (2009). Most legal literature refers to this case as *Riverkeeper II* because it is second in a line of related cases. However, this Note only cursorily mentions *Riverkeeper I*.

2. In his dissenting opinion, Justice Stevens points out that the EPA only considered the environmental benefit of saving 2 percent of the aquatic species that are killed by cooling water intake structures. *Id.* at 1516–17. This Note describes many more environmental factors that, for unknown reasons, were not addressed by EPA or the Court. *See infra* Part III.

3. 33 U.S.C. §§ 1311(b), 1314(b), 1326(b), 1331(b)(1)(A), 1361(b) (2006). This structure is in contrast to other types of environmental statutes, such as the National Environmental Policy Act of 1969, 42 U.S.C. § 4321–4347, which achieve their statutory goals by other means, such as creating incentives or gathering information.

4. 33 U.S.C. § 1251.

so, the EPA employs a variety of “best technology standards” to regulate effluent discharge.⁵ Three established technology-based standards—best practical control technology currently available, best conventional pollution control technology, and best available technology economically achievable—concern effluent limits meant to eliminate pollution discharges, while only section 316(b) of the Act concerns water intakes.⁶ These three effluent reducing standards for existing dischargers have been in place for decades, and the role of CBA in each has been judicially interpreted through rich case law.⁷ Intake technology standards, on the contrary, have received relatively little attention from the EPA, the regulated community, and environmental advocates.

Best practicable control technology currently available (BPT), the least stringent of the three effluent standards, was the interim minimum standard applied until 1987 to each class of industrial polluter.⁸ The EPA determined the BPT by assessing the total cost of applying the technology in relation to effluent reduction benefits to be achieved, along with other factors, such as facility age, process, or engineering aspects.⁹ The EPA had considerable latitude in weighing costs and benefits when determining BPT standards.¹⁰ Rather than requiring that the benefits outweigh the costs, the EPA applied only a limited CBA, in which it had to show only that the cost of achieving effluent reduction was not *wholly disproportionate* to the benefits. In setting this standard, Congress realized that some dischargers would be incapable of attainment and, thus, forced to close.¹¹

Best conventional pollution control technology (BCT) is the current standard in place for conventional pollutants, such as fecal coliform, pH, or suspended solids.¹² A two-part cost reasonableness test determines the appropriate BCT standard. First, costs and benefits must have a

5. *Id.* §§ 1311(b)(1)(A), 1361.

6. *Id.* §§ 1331(b)(1)(A), 1326(b), 1361.

7. *See, e.g.,* EPA v. Nat'l Crushed Stone Ass'n, 449 U.S. 64, 75 (1977); Nat'l Ass'n of Metal Finishers v. EPA, 719 F.2d 624, 657 (3d Cir. 1983); Am. Paper Inst. v. EPA, 660 F.2d 954 (4th Cir. 1981).

8. 33 U.S.C. § 1311(b)(1)(A)(i). The interim standards expired in 1977, after which facilities were to acquire the best available technology economically feasible by 1987. *Id.* § 1311(b)(2)(A). Similar to the Standard Industrial Classification system, the EPA regulates polluters by class, a highly specific designation based on facility parameters. Chemical Mnfrs. Ass'n v. EPA, 870 F.2d 177, 185 (5th Cir. 1989).

9. “Factors relating to the assessment of [BPT] . . . shall include consideration of the total cost of application of technology in relation to the effluent reduction benefits to be achieved.” 33 U.S.C. § 1314(b)(1)(B).

10. *Nat'l Ass'n of Metal Finishers*, 719 F.2d at 657.

11. *See Nat'l Crushed Stone Ass'n*, 449 U.S. at 75.

12. 33 U.S.C. §§ 1311(b)(2)(E), 1314(a)(4).

reasonable relationship.¹³ Second, the EPA must compare the costs and benefits of achieving the standard at industrial facilities with those of publicly owned treatment facilities, and sets the standard where the two are comparable.¹⁴ BCT is more stringent than BPT, but is less stringent than the third standard, best available technology economically achievable (BAT).

BAT standards regulate toxic and nonconventional pollution discharges, and are the most stringent of CWA pollution control.¹⁵ BAT is based on the performance of optimally operating plants.¹⁶ CBA is not required in setting the BAT standard¹⁷; indeed, costs are only considered as one factor of many.¹⁸ The cost consideration does not require that a particular technology be “economically achievable” for a particular plant. On the contrary, the technology must be “economically achievable” for the industry as a whole.¹⁹ Polluters must commit “the maximum resources economically possible” to achieve BAT.²⁰ The BAT standard is common throughout the CWA.²¹

Section 316(b) is the only section in the Act that governs water withdrawal. With only one sentence, Congress mandated that the “location, design, construction, and capacity of cooling water intake structures reflect the best technology available for minimizing adverse environmental impact.”²² The section does not describe or even mention the function of cost in the Agency’s determination of the “best technology available.” Despite their linguistic similarities, the process the EPA applied when promulgating the “best technology available” standard was not equivalent to the process used to set a “best available

13. “Factors relating to the assessment of [BCT] . . . shall include consideration of the reasonableness of the relationship between the costs of attaining a reduction in effluents and the effluent reduction benefits derived.” *Id.* § 1314(b)(4)(B).

14. *See* *Am. Paper Inst. v. EPA*, 660 F.2d 954, 962–63 (4th Cir. 1981).

15. 33 U.S.C. §1317(a)(2); CLAUDIA COPELAND, CONG. RESEARCH SERV., CLEAN WATER ACT: A SUMMARY OF THE LAW (2008).

16. *See* *Kennecott v. EPA*, 780 F.2d 445, 488 (4th Cir. 1986).

17. *EPA v. Nat’l Crushed Stone Ass’n*, 449 U.S. 64, 71 (1977); *Reynolds Metal Co. v. EPA*, 760 F.2d 549 (4th Cir. 1985); *Rybachek v. EPA*, 904 F.2d 1276, 1290–91 (9th Cir. 1990); *Am. Petroleum Inst. v. EPA*, 858 F.2d 261, 264 (5th Cir. 1988).

18. “Factors relating to the assessment of best available technology shall take into account . . . the cost of achieving such effluent reduction . . . and such other factors as the Administrator deems appropriate.” 33 U.S.C. §1314(b)(2)(B). Other factors include “age of equipment and facilities involved, the process employed, potential process changes, non-water quality environmental impacts, including energy requirements and other such factors as the EPA Administrator deems appropriate.” EPA, Effluent Limitation Guidelines, Frequently Asked Questions, <http://www.epa.gov/guide/questions/#bat> (last visited Mar. 28, 2010).

19. *Du Pont v. Train*, 430 U.S. 112, 126–27 (1977).

20. *Nat’l Crushed Stone*, 449 U.S. at 74.

21. *See, e.g.*, 33 U.S.C. §§ 1311(c), 1314(b)(2)(B), 1317(a)(2).

22. *Id.* § 1326 (1972).

technology” standard. Instead, the EPA relied on CBA to set national *performance* standards that approach but do not fully realize the environmental benefits of a certain technology.²³ The performance standards do not mandate a certain *technology*; instead, the standards require that a certain reduction in environmental harm be achieved and provide a suite of smaller scale technologies by which the standard could be achieved.²⁴

B. Technology of Cooling Water Intake Structures

Cooling water intake structures are regulated under the CWA because they are closely related to thermal water pollution, and the relevant regulations are found in the same section that limits thermal effluent.²⁵ Presumably, both cooling water intakes and discharges are regulated under the same provision because the goal of limiting thermal effluent is to “assure protection and propagation of balanced, indigenous population of shellfish, fish, and wildlife,” and such an objective is unattainable if the mechanism of withdrawing water is environmentally destructive.²⁶ One of the largest industrial uses of cooling water intake structures is thermoelectric power generation, the subject of the litigation in *Riverkeeper*.²⁷ In 2004, the EPA promulgated rules to implement section 316(b), including the rule at issue in *Riverkeeper*, concerning cooling water intake structures at existing thermoelectric power plants.²⁸ The amount of water required for cooling varies depending on the type of system and the type of electricity production, in both the fuel and the process used.²⁹ “Wet cooling” uses circulating water to dissipate heat, while “dry cooling” uses air to dissipate heat, much like an automobile radiator.³⁰ As the term implies, wet systems use vast amounts of water and often wreak havoc on the aquatic environment, but they require relatively cheap technology. While dry systems use no water, they are not

23. Final Regulations for Cooling Water Intake Structures at Phase II Existing Facilities, 69 Fed. Reg. 41,576, 41,590 (Jul. 9, 2004) (codified at 40 C.F.R. pts. 9, 122–25).

24. *Id.*

25. 33 U.S.C. § 1326(a)–(b) (2006).

26. *Id.* § 1326(a).

27. JOAN F. KENNY ET AL., U. S. GEOLOGICAL SURVEY, CIRCULAR 1344, ESTIMATED USE OF WATER IN THE UNITED STATES IN 2005, at 38 (2009), available at <http://pubs.usgs.gov/circ/1344/>.

28. Final Regulations for Cooling Water Intake Structures, 69 Fed. Reg. at 41,576.

29. ACQUIRING WATER FOR ENERGY: INSTITUTIONAL ASPECTS 2–3 (Gary Weatherford et al. eds., 1982).

30. *Id.* at 2.

without adverse environmental impacts and require “heavy capital investment costs.”³¹

Wet cooling systems break down into two major categories: “once-through systems” and “closed-cycle systems.” “Once-through,” or “open loop,” systems are those that operate by withdrawing water, cycling it through the cooling system once, and then discharging it.³² In sum, these systems use about 185 billion gallons of water each day across the United States.³³ Once-through systems account for approximately 91 percent of the water used for power plant cooling nationwide.³⁴ In contrast, “closed-cycle systems” recycle water through the cooling system multiple times, only withdrawing enough water to compensate for evaporative losses.³⁵ Closed-cycle cooling systems withdraw thirty to fifty times less water than once-through systems, but “more than 75% of the water is lost during plant operations.”³⁶ Thus, closed-cycle cooling consumes a relatively large amount of water, about 3 percent of the nation’s water consumption.³⁷ Once-through cooling requires greater withdrawals but ultimately consumes less water.³⁸

A variety of site-specific factors influence the choice of cooling systems, including the availability of water, environmental impacts, and financial considerations.³⁹ Where there is no dependable source of water, closed-cycle systems are more prevalent.⁴⁰ This method is most popular for groundwater sources and where “zero discharge” rules or thermal discharge restrictions are in place.⁴¹ Once-through cooling is suitable where abundant surface water sources are available and there are no thermal discharge restraints.⁴² In any type of wet cooling system, storage reservoirs may be required where water resources experience shortages or seasonal variation.⁴³ Dry cooling systems, on the other hand, have minimal water withdrawal and consumption, as they use either direct or

31. *Id.* Dry cooling reduces plant efficiency, thus requiring more raw fuel to produce an equivalent amount of energy. *Id.* at 4.

32. U.S. DEP’T OF ENERGY, ENERGY DEMANDS ON WATER RESOURCES: REPORT TO CONGRESS ON THE INTERDEPENDENCY OF ENERGY AND WATER 18 (2006), available at http://www.sandia.gov/energy-water/congress_report.htm.

33. KENNY ET AL., *supra* note 27, at 41.

34. See Benjamin K. Sovacool, *Running on Empty: The Electricity-Water Nexus and the U.S. Electric Utility Sector*, 30 ENERGY L.J. 11, 17 (2009).

35. U.S. DEP’T OF ENERGY, *supra* note 32, at 19.

36. Thomas J. Feeley III et al., *Water: A Critical Resource in the Thermoelectric Power Industry*, 33 ENERGY 1, 3 (2008).

37. ACQUIRING WATER FOR ENERGY: INSTITUTIONAL ASPECTS, *supra* note 29, at 3.

38. *Id.*

39. *Id.* at 2.

40. *Id.* at 3.

41. *Id.* 3–4.

42. *Id.* at 3.

43. *Id.*

indirect air-cooled steam condensers. “In the United States, existing thermoelectric power plants use each of these types of [cooling] systems,” with plants comprising approximately 42 percent of national generating capacity using once-through, 56 percent using closed-cycle, and just under 1 percent using dry systems.⁴⁴

Hybrid systems are also available. Hybrid system water use varies dependent on the proportion of wet to dry mechanisms in use at the facility. According to some industry experts, “[t]he optimal solution may prove to be a system combining wet/dry cooling towers [that] has the lower capital costs of water towers with the water savings of dry cooling.”⁴⁵

The technologies at issue not only entail myriad costs and benefits to plant efficiency, but also present the need to protect aquatic life from the water intakes of power plant cooling systems. Power plants using wet cooling systems withdraw large amounts of water from nearby rivers, lakes, and seas for use as a cooling agent.⁴⁶ Along with the water, intakes regularly suck up, or “entrain,” aquatic organisms.⁴⁷ The EPA requires screens on intakes to prevent entrainment, but smaller organisms slip through the mesh.⁴⁸ Another environmental consequence of intakes is “impingement,” where larger organisms get trapped and squashed against the screens.⁴⁹ The tension between these environmental considerations and financial costs gave rise to the *Riverkeeper* case, which will be considered in the next Part.

C. Entergy v. Riverkeeper

The controversy in *Riverkeeper* arose from an EPA rulemaking process that compared the financial costs to the environmental benefits of the aforementioned available technologies to determine how to implement CWA section 316(b). Under section 316(b), cooling water intake structures must reflect the “best technology available for minimizing adverse environmental impact.” The resulting standard did not require existing power plants to install the technology that would minimize environmental harm to the greatest degree. Instead, the rule

44. Feeley III et al., *supra* note 36, at 3.

45. ACQUIRING WATER FOR ENERGY: INSTITUTIONAL ASPECTS, *supra* note 29, at 4; Joe O’Hagan, Cal. Energy Comm’n, PIER PROGRAM Project Summary: Wet, Dry, Hybrid Wet/Dry, and Alternative Cooling Technologies, http://www.energy.ca.gov/research/environmental/project_fact_sheets/100-98-001-6.html (last visited Apr. 4, 2010).

46. See generally KENNY ET AL., *supra* note 27, at 38.

47. Final Regulations for Cooling Water Intake Structures at Phase II Existing Facilities, 69 Fed. Reg. 41,576, 41,586 (Jul. 9, 2004) (codified at 40 C.F.R. pts. 9, 122–25).

48. *Id.*

49. *Id.*

allows the use of a suite of technologies that approaches those results. The EPA cited “generally high costs” when it expressly declined to mandate the more environmentally beneficial technology.⁵⁰ The ambiguity contained in section 316(b)’s “best technology available” standard has not been much litigated, and thus was of central importance in *Riverkeeper*.⁵¹

For decades, the EPA neglected to issue rules regulating which intake system existing power plants were required to install. In 2004, however, the EPA promulgated rules concerning national performance standards for existing cooling water intakes, which permit site-specific variances if the cost of compliance “would be significantly higher than the benefits.”⁵² These rules—referred to as Phase II Rules⁵³— did not mandate the most environmentally beneficial technology. Instead of absolute eradication of impingement, plants affected by the Phase II rules must modify their existing cooling water intakes to reduce impingement mortality by 80 to 95 percent.⁵⁴ This reduction is based upon and measured against a baseline calculation defined as the amount of fish mortality that would occur at a plant with a shoreline intake absent any impingement and entrainment controls.⁵⁵ Had the EPA mandated industry-wide replacement of cooling technology, the new systems would have reduced impingement and entrainment harms by 98 percent, but the industry would have to spend \$3.5 billion annually—nine times more than if the EPA simply forced modifications to existing systems.⁵⁶ Because the environmental benefits were similar but the costs were much greater, the EPA adopted the lower national performance standards, which would “avoid extreme disparities between costs and benefits.”⁵⁷ In other words, the EPA applied a limited CBA to ensure that the modification costs were not “wholly disproportionate” to the projected environmental benefits.⁵⁸

Environmental groups challenged this use of CBA as contrary to the statutory language of CWA. In interpreting the Act’s technology standards, environmental groups argued that the best available demonstrated control technology (BAT) standard requires implementation of the most environmentally sound technology, no

50. *Entergy Corp. v. Riverkeeper*, 129 S. Ct. 1498, 1504 (2009).

51. *Id.*

52. Final Regulations for Cooling Water Intake Structures, 69 Fed. Reg. at 41,576.

53. *Id.*

54. *Id.*

55. *Id.*

56. *Id.*

57. *Entergy Corp. v. Riverkeeper*, 129 S. Ct. 1498, 1501 (2009).

58. Final Regulations for Cooling Water Intake Structures, 69 Fed. Reg. at 41,576.

matter the cost.⁵⁹ As evidence of congressional intent to limit the use of CBA, environmentalists offered the replacement of the term “practicable” with the term “available” in the statute.⁶⁰ In section 316, Congress used a linguistically similar term—“best technology available”—to set the standard for power plant cooling facilities.⁶¹ In this context, environmental groups argued, power plants’ use of CBA allowed them to ignore their environmental obligations.

The question in *Entergy v. Riverkeeper* was how the EPA should interpret the word “best” in “best technology available.”⁶² *Riverkeeper* argued that Congress provided no room for CBA in the plain language of section 316(b). In their view, the “best technology available for minimizing adverse environmental impact” standard requires the “EPA to mandate the most protective technology feasible.”⁶³ Because the environmental harm of cooling systems is clear, environmental groups advocated for strict, technology-forcing standards.⁶⁴ The Second Circuit agreed that the variance provision and standard unlawfully allow for CBA, and remanded to the EPA for further clarification of the promulgation process and reassessment of the best technology available standard.⁶⁵

On appeal to the Supreme Court, industrial representatives advocated that economic costs should be measured against environmental benefits before the agency could require implementation of expensive technologies.⁶⁶ They argued that the Second Circuit opinion would burden the industry with “a regime of potentially continuous retrofitting” that could cost billions of dollars annually, even in cases where environmental benefits could not be demonstrated.⁶⁷ Agreeing with the industry representatives, the Supreme Court in *Riverkeeper* reversed the Second Circuit by a vote of 5–1–3, holding that section 316(b) allows the EPA to compare costs to benefits in determining the

59. *Riverkeeper*, 129 S. Ct. at 1506.

60. *Id.* at 1508.

61. The 1972 amendments to CWA included section 316 and required that “the location, design, construction, and capacity of cooling water intake structures reflect the best technology available for minimizing adverse environmental impact.” 33 U.S.C. § 1326(b) (2006).

62. *Riverkeeper, Inc. v. EPA*, 475 F.3d 83 (2d Cir. 2007).

63. Petition for Writ of Certiorari, *Riverkeeper*, 129 S. Ct. 1498 (Nos. 07-588, 07-589 & 07-597).

64. See *Riverkeeper, Inc. v. EPA*, 358 F.3d 174, 181 (2d Cir. 2004) (“A single power plant might impinge a million adult fish in just a three-week period, or entrain some 3 to 4 billion smaller fish and shellfish in a year, destabilizing wildlife populations in the surrounding ecosystem.”).

65. *Id.* at 205.

66. Petition for Writ of Certiorari, *Riverkeeper*, 129 S. Ct. 1498 (No. 07-588, 07-589 & 07-597).

67. *Id.*

best technology available.⁶⁸ Writing for the *Riverkeeper* majority, Justice Scalia permitted this CBA-based interpretation, finding that the “best” technology available can reasonably be interpreted to mean the “most efficient,” and that efficiency determinations can reasonably rely on CBA.⁶⁹

II. THE EPA’S LIMITED CBA IN SETTING PHASE II STANDARDS

Simply put, CBA determines and compares the costs and benefits of an action or inaction.⁷⁰ When applied to environmental problems, CBA attempts to weigh the capital, social, and environmental costs and benefits of a proposed action or inaction. The difficulty lies in calculating unregulated externalities—noncommercial environmental benefits, intangible values, and potential impacts of inaction.⁷¹ For example, quantifying nonuse values, or the “existence value,” of a functioning riverine ecosystem may be difficult, but most economists agree that it is an important step in determining the value of environmental assets.⁷² This Part will elaborate the extent to which the EPA completed, or failed to complete, a thorough CBA in issuing the rule disputed in *Riverkeeper*.

A. Environmental Benefits Considered by the EPA

Full economic valuation of river system manipulation first predicts ecosystem impacts of the proposed change, then quantifies the direct and indirect effects of the ecosystem impacts on economic goods and services.⁷³ Because water resource management is vital to both ecosystems and socioeconomic systems, regulators must evaluate the effects of management decisions broadly to include nonmarket environmental values (such as noncommercial fishing and instream flows) and incidental socioeconomic consequences (such as the stable supply of

68. *Riverkeeper*, 129 S. Ct. at 1498.

69. *Id.* at 1506.

70. CBA is appropriate when an agency wishes to maximize net economic contribution to social welfare. See Partha Dasgupta & Karl-Goran Maler, *The Environment: The Environment and Emerging Development Issues*, in COST-BENEFIT ANALYSIS 319–35 (Richard Layard & Stephen Glaister, eds., 1994). Cost-effectiveness is appropriate when the agency is determined to take an action toward a predefined goal and must identify the most efficient means of reaching that goal. Charles M. Paulsen & Kris Wernstedt, *Cost-effectiveness Analysis for Complex Managed Hydrosystems: An Application to the Columbia River Basin*, 28 J. ENVTL. ECON. & MGMT 388, 388–400 (1995). Technically, they are different methods. Most non-economists, however, do not distinguish between them and refer to both tests as CBA.

71. Daniel Huppert & Sylvia Kantor, *Economic Perspectives*, in RIVER ECOLOGY AND MANAGEMENT: LESSONS FROM THE PACIFIC COASTAL ECOREGION 585 (Robert J. Naiman & Robert E. Bilby eds., 1998).

72. *Id.* at 579–80.

73. *Id.* at 577.

electricity).⁷⁴ Models that link river management decisions, economic consequences, and ecosystem vitality are rare and difficult to validate.⁷⁵ Nonetheless, in order to conduct a genuine, effective CBA, the EPA needed to evaluate the economic impacts of wet cooling systems on the energy sector especially in times of hydrologic variability.

Instead, the EPA only looked at the capital costs of retrofitting existing systems and the environmental benefit of saving the 1.8 percent of aquatic species that are commercially or recreationally valuable.⁷⁶ At a minimum, the EPA should have considered the value of the other 98 percent of aquatic species.⁷⁷ Moreover, the EPA arbitrarily limited its analysis to impingement and entrainment. The plain statutory text more broadly requires the EPA to minimize “adverse environmental impact.”⁷⁸ “Adverse environmental impact” is not defined in the CWA nor does the legislative history provide guidance. The Agency narrowly interprets the phrase such that “adverse aquatic environmental impacts occur whenever there will be entrainment or impingement damage as a result of the operation of a specific cooling water intake structure.”⁷⁹

The EPA’s Phase II Rules aimed to minimize mortality of aquatic species due to entrainment and impingement. The rule requires “technology that is technically available, economically practicable, and cost-effective while at the same time authorizing a range of technologies that achieve comparable reductions in adverse environmental impact.”⁸⁰ The costs and benefits of this rule were evaluated using facility-specific estimates of the costs and estimated benefits to commercial and recreational fisheries.⁸¹ The EPA did not require a single technology as best technology available for all existing power plants; instead, it designated a suite of technologies (such as screens, barrier systems, and return systems) to allow plants flexibility in compliance.⁸²

74. *Id.* at 572.

75. *Id.* at 572–73.

76. *Entergy Corp. v. Riverkeeper, Inc.*, 129 S. Ct. 1498, 1516–17 (2009) (Stevens, J., dissenting).

77. When EPA did calculate the environmental benefit of saving 100 percent of aquatic organisms, the environmental benefit increased by an order of magnitude. Final Regulations for Cooling Water Intake Structures at Phase II Existing Facilities, 69 Fed. Reg. 41,576, 41,666 (Jul. 9, 1994).

78. 33 U.S.C. § 1326(b) (2006).

79. Deborah G. Nagle & James T. Morgan Jr., *A Draft Regulatory Framework for Analyzing Potential Adverse Environmental Impact From Cooling Water Intake Structures*, 3 ENVTL. SCI. & POL ix–xiv, ix (2000) (citing EPA, DRAFT GUIDANCE FOR EVALUATING THE ADVERSE IMPACT OF COOLING WATER INTAKE STRUCTURES ON THE AQUATIC ENVIRONMENT (1977)).

80. Final Regulations for Cooling Water Intake Structures, 69 Fed. Reg. at 41,583.

81. *Id.*

82. *Id.*

Accordingly, the EPA set “national performance standards,” requiring most Phase II facilities to reduce “impingement mortality for [aquatic organisms] by 80 to 95 percent from the calculation baseline,” and requiring a subset of facilities to reduce entrainment of such organisms by “60 to 90 percent from [that] baseline.”⁸³ Phase II rules permit site-specific variances from the national performance standards, provided that the permit-issuing authority imposes remedial measures that yield results “as close as practicable to the applicable performance standards.”⁸⁴

In order to demonstrate compliance with the rules, a facility can go through a tiered analysis of impingement and entrainment, or bypass that analysis completely and simply adopt the best technology available.⁸⁵ The tiered analysis framework illustrates the Agency’s objective to expedite the permitting process for facilities that are unlikely to have adverse environmental impacts.⁸⁶ However, this expedited process eliminates layers of useful analysis of environmental harms. If a facility is sufficiently compliant to pass the first-tier evaluation, the framework does not even consider the aquatic life use designation of the facility’s water source, meaning that many facilities can pass environmental analysis without ever considering adverse impacts on other users, such as fisherman and recreational users.⁸⁷ This analysis favors facilities that are located in water bodies that do not support aquatic life, regardless of the power plant’s contribution to that factor; perversely, a power plant that operates in such a way that renders the source water completely unable to support aquatic life is more likely to pass the “adverse environmental impact” assessment because there are no fish to impinge or entrain.⁸⁸

With respect to section 316, the EPA has interpreted the CWA mandate to “minimize” adverse environmental impacts to mean “reducing to the smallest possible amount or degree.”⁸⁹ However, as discussed below, the environmental impacts and external cost of cooling water intake structures go well beyond sucking up fish. Section 316(a), which regulates thermal discharges, specifically mentions fish propagation and balanced indigenous populations, but the EPA and

83. 40 C.F.R. § 125.94(b)(1)–(2) (2009).

84. *Id.* § 125.94(a)(5)(i)–(ii).

85. Nagle & Morgan Jr., *supra* note 79, at xiv.

86. *Id.*

87. Tier 1 evaluates approach velocity, total intake flow, intake flow as a percentage of source body flow/volume, site environmental characteristics (such as species compilation and physical characteristics that may increase concentrations of fish at intakes), and other site and operational characteristics. If a facility passes this evaluation, it is deemed to be minimizing adverse environmental impacts. *Id.* at x.

88. *Id.* at xiii.

89. 40 C.F.R. § 402.

several courts have opted to treat sections 316(a) and 316(b) as separate requirements that address different environmental problems.⁹⁰ The EPA General Counsel notes that “[s]imply because cooling water could be discharged at a temperature which does not unduly disrupt the aquatic ecosystem does not mean that the withdrawal of the cooling water therefore will also not have an adverse environmental impact.”⁹¹ Section 316(b) should require the Secretary to minimize any adverse environmental impact, not just those disrupting the balance of indigenous populations.⁹²

B. Costs Considered by the EPA

The Agency’s first attempt at setting BTA standards in 1976 did not factor in the cost of each technology.⁹³ Despite protests from regulated utilities, the EPA rejected the CBA approach, stating that “[n]o comparison of monetary costs with the social benefits at minimizing adverse impacts, much less a formal, quantified ‘cost/benefit’ assessment is required.”⁹⁴ Congressman Donald H. Clausen construed section 316(b) to mean “the best available technology available commercially at an economically practicable cost.”⁹⁵ However, in 1979 these rules were pulled from the code after the Fourth Circuit remanded them back to the EPA on procedural grounds.⁹⁶ The Agency’s new interpretation arose from a controversial 1978 permitting decision, in which the EPA Administrator stated that section 316(b) did not contemplate formal CBA.⁹⁷ Instead, Administrator Douglas M. Costle declared: “I do not believe that it is reasonable to interpret section 316(b) as requiring use of technology whose cost is wholly disproportionate to the environmental benefit to be gained.”⁹⁸ Thus, the “wholly disproportionate” test was born.

90. The goal of section 316(a) limitations on thermal discharge pollution are to “assure the protection and propagation of a balanced, indigenous population of shellfish, fish, and wildlife.” 118 CONG. REC. 33,762 (daily ed. Oct. 4, 1972); James May & Maya van Rossum, *The Quick and the Dead: Fish Entrainment, Entrapment, and the Implementation and Application of Section 316(b) of the Clean Water Act*, 20 VT. L. REV. 373, 399 (1995–96).

91. *In re Central Hudson Gas & Elec. Corp.*, 2 Op. EPA GEN. COUNSEL 371, 381–82 (1977).

92. May & van Rossum, *supra* note 90, at 399–400.

93. 40 C.F.R. § 402.

94. *Id.*

95. 118 CONG. REC. 33,762 (daily ed. Oct. 4, 1972).

96. *Appalachian Power Co. v. Train*, 566 F.2d 451 (4th Cir. 1977); National Pollutant Discharge Elimination System Revision of Regulations, 44 Fed. Reg. 32,854, 32,956 (Jun. 7, 1979).

97. *In re Pub. Serv. Co. of N.H.*, 10 Env’t Rep. Cas. (BNA) 1257, 1261 (Env’tl. Prot. Agency June 17, 1977).

98. *Id.*

Since then, the Agency has applied the wholly disproportionate test in evaluating cooling water intake technologies. In setting the Phase II Rules, the EPA compared the initial capital cost of retrofitting existing once-through cooling systems to closed-cycle systems with the cost of mandating less effective modifications of once-through systems.⁹⁹ The EPA estimated that converting the entire industry to closed-cycle cooling would cost about \$3.5 billion annually, while mandating a suite of technologies that approached closed-cycle impingement and entrainment levels would cost about nine times less.¹⁰⁰ However, the EPA completely ignored the potential financial savings of reducing the energy sector's dependence on water, a figure that could reach into the billions if climate change projections are accurate.¹⁰¹

III. ADVERSE ENVIRONMENTAL IMPACTS IGNORED BY THE EPA

The Agency declined to define “adverse environmental impact” in its final rulemaking despite considering several possible definitions.¹⁰² In a 1976 permitting decision, the Office of General Counsel opined that cooling water intake structures “must reflect the best technology available for minimizing (i.e., ‘reducing to the smallest possible amount or degree’) adverse environmental impact—significant or otherwise. All environmental harm should be avoided”¹⁰³ In a 1977 permitting decision, the Regional Administrator defined “adverse” to mean “unfavorable, harmful, difficult, or detrimental.”¹⁰⁴ This definition suggests that the threshold for what is “adverse” in “adverse environmental impact” should be relatively low.¹⁰⁵ Unfortunately, the Agency's interpretations have ignored numerous categories of environmental harm that should have been evaluated as part of its analysis.

99. Final Regulations for Cooling Water Intake Structures at Phase II Existing Facilities, 69 Fed. Reg. 41,576, 415,84–415,86 (Jul. 9, 2004) (codified at 40 C.F.R. pt. 125, Subpart J (App. 122a-593a)).

100. Regulations Addressing Cooling Water Intake Structures for New Facilities, 66 Fed. Reg. 65,256, 65,256–65,345 (Dec. 18, 2001); Regulations Addressing Cooling Water Intake Structures for New Facilities, 65 Fed. Reg. 49,060, 49,060–49,121 (Aug. 10, 2000).

101. See *infra* Part IV.

102. Regulations Addressing Cooling Water Intake Structures, 66 Fed. Reg. at 65,256–345; Regulations Addressing Cooling Water Intake Structures, 65 Fed. Reg. at 49,060–121.

103. *In re* Brunswick Steam Electric Plant, 2 NPDES REGULATORY HEARING PROC. 172, 183 (Env'tl. Prot. Agency June 1, 1976) (decision of the general counsel) (citations omitted).

104. Carolina Power & Light Co., Permit No. NC007064, at 3, 28 (Env'tl. Prot. Agency Nov. 7, 1977) (citations omitted).

105. Cooling Water Intake Structures, 38 Fed. Reg. 34,410 (Dec. 13, 1973) (codified at 40 C.F.R. pts 401–02).

The factors the EPA used in determining the extent of adverse impact were limited only to fish killed via impingement and entrainment, despite multiple other forms of adverse environmental impacts caused by cooling water intake structures.¹⁰⁶ The EPA justified this simplification of environmental impact because “reductions in impingement and entrainment [are] a quick, certain, and consistent metric for determining performance at Phase II existing facilities.”¹⁰⁷

But Congress used the broad word “environmental,” not a more restrictive term such as entrainment, impingement, or even aquatic. Therefore, the technology standard should reflect the system that minimizes the full suite of environmental impacts of cooling water intake structures.¹⁰⁸ The Agency claims to have considered non-impingement and entrainment impacts on aquatic sources but only evaluated the indirect impacts of impingement and entrainment (such as a compromised food chain because small organisms were entrained, loss of endangered species due to impingement and entrainment, or reduced reproduction levels because 98 percent of aquatic organisms were killed via impingement and entrainment¹⁰⁹), not other direct and indirect effects. This Part will examine seven categories of adverse environmental impacts that EPA failed to consider and provide avenues to address three of the seven categories.

A. *Impingement and Entrainment*

Impingement and entrainment create the most obvious and direct environmental harm from thermoelectric power plants; their cooling water intake structures are the “single largest predator of our [n]ation’s waters.”¹¹⁰ Some intake structures are huge, with diameters of more than thirty feet and intake volumes of over a billion gallons per day.¹¹¹ Tons of aquatic life are sucked up along with the water.¹¹² Smaller organisms

106. EPA, OFFICE OF WASTE ENFORCEMENT, PERMITS DIV., DRAFT GUIDANCE FOR EVALUATING THE ADVERSE IMPACT OF COOLING WATER INTAKE STRUCTURES ON THE AQUATIC ENVIRONMENT: SECTION 316(B) P.L. 92-500, at 1 (1977), available at <http://www.epa.gov/waterscience/316b/files/1977AEIguid.pdf>.

107. Final Regulations for Cooling Water Intake Structures, 69 Fed. Reg. 41,576, 41,586 (Jul. 9, 2004) (codified at 40 C.F.R. pt. 125, Subpart J (App. 122a-593a)).

108. John A. Veil et al., *A Holistic Look at Minimizing Adverse Environmental Impact Under Section 316(b) of the Clean Water Act*, in DEFINING AND ASSESSING ADVERSE ENVIRONMENTAL IMPACT FROM POWER PLANT: IMPINGEMENT AND ENTRAINMENT OF AQUATIC ORGANISMS 40 (Douglas A. Dixon, John A. Veil & Joe Wisniewski eds., 2003).

109. Final Regulations for Cooling Water Intake Structures, 69 Fed. Reg. at 41,588–89.

110. May & van Rossum, *supra* note 90, at 376.

111. The intake structure at issue in Seabrook was 30.5 feet in diameter, had an intake velocity of one foot per second and withdrew 1.2 billion gallons per day. *In re Pub. Serv. Co. of N.H.*, 10 Env’t Rep. Cas. (BNA) 1257, 1258–59 (Env’tl. Prot. Agency June 17, 1977).

112. Final Regulations for Cooling Water Intake Structures, 69 Fed. Reg. at 41,586.

squeeze through protective screens only to be “entrained” or swept up in the cooling system.¹¹³ Larger organisms die by “impingement” as vast amounts of flowing water pin them to screens.¹¹⁴ Impingement and entrainment are the primary environmental effects of cooling water intake structures, and the scientific community has developed a suite of technologies to reduce the killing over the past three decades.¹¹⁵ The EPA estimates 3.4 billion aquatic species die from impingement and entrainment annually.¹¹⁶ Undoubtedly, EPA had to address these significant adverse environmental impacts.

Further, despite the CBA’s focus on reducing impingement and entrainment, it nevertheless ignored virtually all of the noneconomic effects these phenomena cause. The problem lies in the way the Agency calculated the environmental benefit of reducing entrainment- and impingement-related death. Instead of calculating the environmental benefit of saving 3.4 billion aquatic organisms annually, the EPA “took a shortcut” by only calculating the value of the 1.8 percent of species that are commercially or recreationally valuable.¹¹⁷

Libraries are filled with the literature on the economic benefit of the environment beyond what is commercially and recreationally valuable, and the aim of this Note is not to rehash those arguments.¹¹⁸ Simply put, the other 98.2 percent of aquatic life makes up almost the entire ecosystem, and that life has value—value that the EPA failed to analyze in its CBA.¹¹⁹ Justice Stevens points out this skewed “shortcut” in his dissent in *Riverkeeper*.¹²⁰ The Agency’s attempt to calculate the environmental benefit of 100 percent of the aquatic species determined a

113. *Id.*

114. *Id.*

115. E.P. Taft, *Fish Protection Technologies: a Status Report*, 3 ENVTL. SCI. & POL. 349, 349–59 (2000).

116. Final Regulations for Cooling Water Intake Structures, 69 Fed. Reg. at 41,586.

117. *Entergy Corp. v. Riverkeeper, Inc.*, 129 S. Ct. 1498, 1516–17 (2009) (Stevens, J., dissenting).

118. See, e.g., RICHARD REVESZ & MICHAEL LIVERMORE, *RETAKING RATIONALITY: HOW COST-BENEFIT ANALYSIS CAN BETTER PROTECT THE ENVIRONMENT AND OUR HEALTH* (2008); PER-OLOV JOHNANSSON, *COST-BENEFIT ANALYSIS OF ENVIRONMENTAL CHANGE* (1993); DANIEL SCHWARTZMAN ET AL., *COST-BENEFIT ANALYSIS AND ENVIRONMENTAL REGULATIONS: POLITICS, ETHICS, AND METHODS* (1982); A. MYRICK FREEMAN III, *THE BENEFITS OF ENVIRONMENTAL IMPROVEMENT: THEORY AND PRACTICE* (1979).

119. The small organisms susceptible to entrainment are vital links in the food chain of those species that are commercially and recreationally valuable. EPA cites to a study reporting that death of forage fish may result in losses of up to 25 percent of commercially and recreationally valuable fish. Final Regulations for Cooling Water Intake Structures, 69 Fed. Reg. at 41,586–41,587 (citing J. Kevin Summers, *Simulating the Indirect Effects of Power Plant Entrainment Losses on an Estuarine Ecosystem*, 49 ECOLOGICAL MODELING 31–47 (1989)).

120. *Riverkeeper*, 129 S. Ct. at 1516–17 (Stevens, J., dissenting).

value of \$735 million.¹²¹ When the EPA calculated the value of the commercially and recreationally desirable species alone, the economic benefits of reducing impingement and entrainment dropped dramatically to \$83 million.¹²² Even the EPA admits that this abandonment of nearly the entire ecosystem “could result in serious misallocation of resources.”¹²³ Considering the additional adverse environmental impacts that the EPA chose to ignore, this is a serious understatement.

B. *Reduced, Disrupted Flows*

In addition to impingement and entrainment, power plants’ enormous water intakes and discharges affect the environment by causing huge disruptions in natural water flows. Thermoelectric power plants withdraw 201.3 billion gallons of freshwater each day, beating out agriculture as the biggest water user in the country.¹²⁴ Once-through systems account for 185,000 million gallons per day withdrawn from fresh and saline sources, while closed-cycle systems withdraw 16,300 million gallons per day from fresh and saline sources, including groundwater.¹²⁵ Most of the water is returned to the source, but the disruption of the flow regime near power plants adversely impacts the aquatic ecosystem because intake structures can disrupt normal circulation patterns and prevent migration of organisms.¹²⁶

Cooling water for power generation also accounts for 3 percent of the total water *consumed* in the United States. Most of that water is lost through evaporation in closed-cycle cooling towers.¹²⁷ Three percent may not seem like a large chunk of the water withdrawal pie, but in the over-allocated West where many streams run dry, getting 3 percent of the river flowing again would benefit aquatic ecosystems tremendously. Energy industry critics may point out that agriculture consumes orders of magnitude more water than power plant cooling systems. While this is true, agriculture has no water-free equivalent like dry cooling systems.

121. *Id.* at 1516 (citing EPA, ECONOMIC AND BENEFITS ANALYSIS FOR THE PROPOSED SECTION 316(B) PHASE II EXISTING FACILITIES RULE, D1-4 (2002), available at <http://www.epa.gov/waterscience/316b/phase2/econbenefits>).

122. *Id.* at 1516–17 (citing Final Regulations for Cooling Water Intake Structures, 69 Fed. Reg. at 41,666).

123. *Id.* at 1517 (quoting Final Regulations for Cooling Water Intake Structures, 69 Fed. Reg. at 41,660).

124. See KENNY ET AL., *supra* note 27, at 23, 41 tbl.13.

125. *Id.* at 41 tbl.13.

126. *Hearing Before the Subcomm. on Air and Water Pollution of the Senate Comm. on Public Works*, 90th Cong., 2d Sess. 136 (1968).

127. See KELLY BIRKINSHAW ET. AL., ELEC. POWER RESEARCH INST., COMPARISON OF ALTERNATE COOLING TECHNOLOGIES FOR CALIFORNIA POWER PLANTS: ECONOMIC, ENVIRONMENTAL AND OTHER TRADEOFFS 6-3 (2002).

Technology has not advanced to the point of growing crops without water, whereas the power plant industry does have a dry alternative that should be promoted by environmental regulators.

Section 316(b) grants the EPA the authority to regulate intake velocity to a point that it only makes sense to use dry or closed-cycle cooling, but it “does not authorize [the agency] to impose a specific [dry or] closed-cycle cooling technology . . . [although] the use of a particular treatment system may be a predictable consequence of the limitation imposed on the discharge of specific pollutants.”¹²⁸ The interpretation of the term “capacity” in section 316(b) may be key to protecting instream flows from power plants. Capacity refers to the volume of water withdrawn from the source.¹²⁹ If the EPA reduces the permissible capacity of an intake structure to a point that is insufficient for cooling—which it can permissibly do, even to the point that intake is less than the discharge necessary to meet effluent limitations¹³⁰—the power plant will be forced to adapt by using a hybrid or completely dry system. Reducing capacity directly reduces entrainment. As EPA Office of General Counsel said, “the volume withdrawn is the principal determinant of entrainment damage which is *the* major adverse environmental effect associated with most cooling water intake structures.”¹³¹

The legislative history of the CWA supports the concept that volume should be restricted in order to protect entire aquatic ecosystems. Senator Edmund Muskie, Chairman of the Senate Conference Committee, stated that the “EPA had authority under the Act to regulate the *withdrawal* of cooling water so as to minimize adverse environmental aspects.”¹³² To minimize withdrawal and consumption to the greatest degree, cooling systems should run dry, which reduces water consumption by as much as 95 percent.¹³³

C. Thermal Discharge

Cooling water is returned warmer and dirtier than when it left the source, resulting in increased evaporation of the receiving body and harm

128. *In re Brunswick Steam Electric Plant*, 2 NPDES REGULATORY HEARING PROC. 172, 176, 181 (Env'tl. Prot. Agency June 1, 1976) (decision of the general counsel).

129. EPA, EFFLUENTS GUIDELINES DIV., DEVELOPMENT DOCUMENT FOR BEST TECHNOLOGY AVAILABLE FOR THE LOCATION, DESIGN, CONSTRUCTION AND CAPACITY OF COOLING WATER INTAKE STRUCTURES FOR MINIMIZING ADVERSE ENVIRONMENTAL IMPACT 149 (1976).

130. *Brunswick Steam*, 2 NPDES REGULATORY HEARING PROC. at 176, 181.

131. *Id.* at 179 (emphasis added).

132. *Id.* at 178–79.

133. Birkinshaw, *supra* note 127, at 6-3.

to aquatic species dependent on clean, cool water.¹³⁴ Closed-cycle tower systems require treatment and discharge of highly concentrated “blowdown,” the water and particulates that do not evaporate or condense and must be drained, while dry systems have no blowdown to discharge.¹³⁵ Treatment requires use of hazardous chemicals—such as bromine or chlorine—to control for biological contamination and pH, which are added to the water and eventually discharged into the receiving body.¹³⁶

Controlling thermal discharge may be difficult, since the Agency has determined that section 316(b) conditions may not take the form of effluent limitations, and thermal discharge is undoubtedly effluent.¹³⁷ However, section 316(b) conditions can be structured to restrict intake capacity so much that effluent limitations cannot be met.¹³⁸ Undoubtedly, thermal discharge is an adverse environmental impact that exists in once-through wet cooling systems and not in other systems. The Phase II national performance standards, while they aimed at mimicking the environmental benefits of those other systems on the intake end by reducing impingement and entrainment, ignore the environmental benefits of those same systems on the discharge end such as reduced thermal pollution. While, the EPA cannot impose effluent limits on section 316(b) conditions, it is not prevented from considering the environmental benefit of reducing thermal discharges when conducting CBA. Thus, the EPA should not have ignored thermal discharge impacts when conducting the Phase II CBA.

D. Sedimentation

Intake structures may interfere with sedimentation processes because the flow velocity is redirected toward the intake structure.¹³⁹ The EPA acknowledged that intake structures can have negative impacts on turbidity, but failed to factor in the cost of this adverse environmental impact in its CBA.¹⁴⁰ Instead, the EPA passes the turbidity ball to future analysis under different federal statutory provisions, such as CWA

134. For example, the change in temperature between withdrawal and discharge was 20.9 degrees F in Brunswick. Carolina Power & Light Co., Permit No. NC007064, at 3, 13–14 (Envtl. Prot. Agency Nov. 7, 1977).

135. Birkinshaw, *supra* note 127, at 6-4.

136. *Id.* at 6-5.

137. *In re* Central Hudson Gas & Elec. Corp., 2 Op. EPA GEN. COUNSEL 371, 379 (1977).

138. *Id.* at 380–81.

139. David R. Montgomery & John M. Buffington, *Channel Processes, Classification, and Response*, in RIVER ECOLOGY AND MANAGEMENT: LESSONS FROM THE PACIFIC COASTAL ECOREGION 17 (Robert J. Naiman & Robert E. Bilby eds., 1998).

140. Proposed Regulations for Cooling Water Intake Structures at Phase II Existing Facilities, 67 Fed. Reg. 17,122, 17,137 n.23 (Apr. 9, 2002).

section 401 regarding water quality, or the National Environmental Policy Act.¹⁴¹

E. Aesthetics

In addition to costs resulting directly from water flow, negative impacts on aesthetic and sound factors may also cause environmental harm, and EPA should have consider such impacts on surrounding neighborhoods and natural areas. Fans and flowing water are noisy, and their sound can negatively affect neighboring humans and animals. Excessive noise may impact surrounding organisms by interfering with mating and protection calls. Dry cooling systems eliminate the sound of flowing water but may produce increased noise from fans; ultra quiet fans are available but are expensive.¹⁴²

Tall cooling towers and steam plumes also scar the visual landscape. Once-through cooling—the most water-consumptive system—is the least visually disturbing cooling system, as it requires no tower.¹⁴³ Closed-cycle towers are the most visibly intrusive because of both the tall tower and the steam plume, which is especially visible on cool days. The plume may obscure visibility and make human transportation and animal migration difficult.¹⁴⁴ Dry cooling towers produce no steam plume but do obscure the horizon.

F. Public Health

Further, cooling technologies may have varying public health consequences. Closed-cycle cooling towers provide ideal conditions for the production of *Legionella pneumophila*, or Legionnaire's Disease.¹⁴⁵ Although it is still largely speculative, this small but significant environmental risk of cooling towers should have been factored into the Agency's CBA.

Beyond *Legionella*, many other hazardous substances may be released from cooling towers and contribute to poor air quality, such as chromium, zinc, and trihalomethalenes.¹⁴⁶ Asbestos may be released from older cooling towers.¹⁴⁷ Likewise, toxic biocides used in wet towers are

141. *Id.*

142. Birkinshaw, *supra* note 127, at 6-7.

143. *Id.* at 6-8.

144. *Id.*

145. *Id.*

146. *Id.* at 6-3.

147. *Id.*

eventually discharged into water bodies.¹⁴⁸ These public health threats should also be considered in the Agency's CBA.

G. Cumulative Impacts

Finally, where numerous power plants draw upon and discharge into the same water source, the abovementioned factors multiply. In addition to considering individual structures, the cumulative impacts of multiple intake structures should also be considered in evaluating adverse environmental impact.¹⁴⁹ Even if a single intake has little impact on aquatic life, cumulative impacts of multiple intakes "must eventually spell doom for important marine resources."¹⁵⁰

Almost a quarter of all existing facilities are located on a water body with another existing facility.¹⁵¹ The EPA expressed concern that the potential for aquatic species to be affected by cooling water withdrawals from multiple facility intakes is high.¹⁵² However, the environmental cumulative impacts of these facilities are still largely unknown, and the EPA has not adequately accounted for them in evaluating impacts.¹⁵³

In conclusion, the EPA ignored multiple environmental impacts of cooling water systems. Had the EPA given full consideration of the environmental benefits and harms of each system, perhaps its CBA would have produced a different result.

IV. COSTS BEYOND CAPITAL INVESTMENT IGNORED BY THE EPA

In addition to the EPA's failure to consider adverse environmental impacts, the EPA has also failed to consider financial costs beyond a facility's own investment. Electricity generation uses and consumes a large quantity of water, and in an age of increasing hydrologic vulnerability, this may not be the wisest use of a scarce resource. While the Act does not explicitly authorize the EPA to address this issue, an expanded CBA may permissibly include an evaluation of the financial savings of reduced water dependence as a factor. In this sense, the Agency's use of CBA may be a hidden blessing to environmentalists that

148. John Veil et al., *supra* note 108, at 41.

149. Carolina Power & Light Co., Permit No. NC007064, at 2-3 (Env'tl. Prot. Agency Nov. 7, 1977) (citations omitted).

150. May & van Rossum, *supra* note 90, at 463. (*quoting* Brunswick Memorandum from Howard D. Zeller Deputy Director, Enforcement Division, to Rebecca W. Hanmer, Region Administrator (Mar. 21, 1980), at 3).

151. See National Pollutant Discharge Elimination System—Final Regulations to Establish Requirements for Cooling Water Intake Structures at Phase II Existing Facilities, 69 Fed. Reg. 41,576, 41,589 (July 9, 2004).

152. *Id.*

153. *Id.*

advocate for drier power plants. This Part considers the costs beyond capital investment that the EPA did not include in its limited CBA, particularly costs at the nexus between electricity generation and water use and consumption, and illustrates the vulnerability of electricity generating facilities to projected population growth and climate-driven hydrologic fluctuations.

A. Energy-Water Interdependence

The energy sector depends on a stable supply of water, and the water sector depends on a stable supply of energy. Energy generation needs water for extraction, production, and emission control.¹⁵⁴ According to the National Renewable Energy Lab, electricity production from fossil fuels and nuclear energy requires 190 billion gallons of water per day, accounting for 39 percent of all freshwater withdrawals in the nation.¹⁵⁵ Further, water managers need electricity for treatment, monitoring, and distribution. Approximately 4 percent of power generation in the United States is used for water supply and treatment, and about 75 percent of the cost of municipal water processing and distribution is electricity, according to the Department of Energy.¹⁵⁶ As mutually dependent resources, a supply crisis in one immediately spurs a crisis in the other.¹⁵⁷ However, legislators and resource managers blindly treat them as separate issues.¹⁵⁸ Like the recent trend in surface water and groundwater commentary, policy makers are wising up to the growing need for integrated thinking and interdisciplinary approaches to managing the two most vital economic sectors: water and energy.¹⁵⁹

154. U.S. DEP'T OF ENERGY, *supra* note 32, at 9.

155. NAT'L RENEWABLE ENERGY LAB., EXPLORING THE ENERGY/WATER NEXUS: A STAKEHOLDER DIALOGUE FOR IDENTIFICATION OF CRITICAL ISSUES FORUM SUMMARY 2 (2005), available at http://www.nrel.gov/analysis/workshops/pdfs/water_nexus_summ_05.pdf.

156. U.S. DEP'T OF ENERGY, *supra* note 32, at 25.

157. Sovacool, *supra* note 34, at 11.

158. *Id.*

159. See, e.g., Press Release, H. Comm. on Sci. & Tech., Members, Witnesses Discuss Water, Energy Link (July 9, 2009), available at <http://science.house.gov/press/PRArticle.aspx?NewsID=2549> (quoting Subcommittee Chairman Brian Baird, D-WA) ("Too often these two essential resources are thought of independently However, the strong linkage between water and energy requires that we make a more concerted effort to ensure that water and energy technologies are being developed synergistically."). Several states have laws on the books acknowledging the need for integrated water and energy solutions. Cal. Pub. Utils. Code § 25008 promotes water and energy conservation and exploitation of alternative energy and water sources. Likewise, Colorado Revised Statutes § 40-2-123 promotes using solar energy in order to minimize water use for electric generation. Nevada Revised Statutes § 533.372 grants the State Engineer the authority to deny water transfers to generate electricity to be exported out of Nevada. South Dakota Codified Laws §46A- 1- 71 calls groundwater exploitation for energy development in Wyoming an "immediate threat" to ground and surface water supplies and many beneficial uses in western South Dakota. Washington has it backwards. Revised Code of

Water use for electricity increased five-fold from 1950 to 2000. “If new power plants continue to be built with today’s technologies, consumption of water for electrical energy production could more than double by 2030 from 3.3 billion gallons per day in 1995 to 7.3 billion gallons per day.”¹⁶⁰ This spells out a dire future considering the U.S. Department of Interior’s projections that water demands, especially in the arid West, will exceed available supply even in normal years by 2025.¹⁶¹ Dr. Benjamin Sovacool highlights how this crisis may play out in eight of America’s metropolitan areas if population and water and energy demands continue to grow as projected.¹⁶²

If a power plant cannot be cooled because of a lack of water, then it must be shut down.¹⁶³ Even if the plant has a senior water right, states often give low priority to industry in times of drought.¹⁶⁴ Shutting down a plant is extremely expensive, both financially and socially. A European heat wave in 2003 forced the state-owned Électricité de France to shut down or reduce the capacity of seventeen nuclear power generators, amounting to over 300 million in costs.¹⁶⁵

In conducting a limited CBA, the Agency arbitrarily restricted its cost analysis and ignored these potentially significant costs. However, the EPA has the authority to conduct broader cost analysis. In *Seacoast Anti-Pollution League v. Costle*, the court held that indirect costs such as the cost of delay and reengineering were an “acceptable consideration” in section 316(b) permitting.¹⁶⁶ Also, foreseeable external costs can be a factor in the cost analysis.¹⁶⁷ If a facility operator could have foreseen the cost of a retrofit when constructing the intake structure, those costs may

Washington § 90.82.070 promotes water conservation in order to supply enough water for power generation and does not promote water conservation in the energy sector.

160. *Technology Research and Development Efforts Related to the Energy and Water Linkage: Hearing Before the Subcomm. on Energy & Env’t of the H. Comm. on Sci. & Tech.*, 111th Cong. (2009) (statement of Brian Baird, Chairman, Subcomm. on Energy & Env’t), available at <http://science.house.gov/publications/OpeningStatement.aspx?OSID=2742>.

161. *Western Water Supply: Hearing Before the Senate Comm. on Energy and Natural Resources*, 108th Cong. 2d Sess. 5 (2004) (statement of Bennet Raley, Assistant Sec’y for Water and Science, Dep’t of Interior).

162. He argues that Atlanta, Charlotte, Chicago, Denver, Houston, Las Vegas, New York, and San Francisco will all face crises because of the energy-water nexus. It is important to note the geographic variety presented in this list; the problem extends beyond the arid West. Benjamin K. Sovacool, *supra* note 34, at 25–33.

163. ACQUIRING WATER FOR ENERGY: INSTITUTIONAL ASPECTS, *supra* note 29, at 4.

164. *Id.* at 7.

165. James Kanter, *Climate Change Puts Nuclear Energy Into Hot Water?*, N.Y. TIMES, May 20, 2007, available at <http://www.nytimes.com/2007/05/20/health/20iht-nuke.1.5788480.html>.

166. *Seacoast Anti-Pollution League v. Costle*, 597 F.2d 306, 311 (1st Cir. 1979).

167. May & van Rossum, *supra* note 90, at 475–76.

play into the cost equation.¹⁶⁸ This evaluation would ensure that ignoring foreseeable technology shifts is not rewarded.

B. Climate Change, Hydrologic Variability, Population Growth, and the Electricity Sector

Regardless of the particular rate of change, it is inevitable that climate change and population growth will greatly affect water resources.¹⁶⁹ Climate change threats will likely reveal “that the natural infrastructure on which we depend is sufficiently vulnerable, and already sufficiently stressed.”¹⁷⁰ The Intergovernmental Panel on Climate Change forecasts increases in the frequency of temperature extremes, heat waves, and heavy precipitation, changes in precipitation and temperature patterns, and increases and decreases in precipitation certain latitudes.¹⁷¹ As the global climate changes, hundreds of millions of people will be threatened by increased water stress. Likewise, ecosystems and agriculture production will suffer.¹⁷² The already water-stressed American West will likely experience reduced snow pack, increased winter floods, and reduced summer flows, “exacerbating competition for over-allocated water resources.”¹⁷³ Heat waves are also projected to increase in urban areas, increasing demand for water consumption.¹⁷⁴

Both water and energy demands will increase as population continues to grow. In 2005, irrigation accounted for about 37 percent of fresh water withdrawals in the United States, according to the U.S. Geological Survey,¹⁷⁵ and agricultural use will continue to grow to meet increased demand for food. According to the 2001 National Energy Policy, our growing population and economy will require an additional 393,000 megawatts of new generating capacity by 2020.¹⁷⁶ This generating

168. *Id.* at 477–78.

169. EPA, OFFICE OF WATER, NATIONAL WATER PROGRAM STRATEGY: RESPONSE TO CLIMATE CHANGE, 4–22 (2008), available at http://www.epa.gov/ow/climatechange/docs/3-27-08_ccdraftstrategy_final.pdf.

170. Holly Doremus & Michael Hanemann, *The Challenges of Dynamic Water Management in the American West*, 26 UCLA J. ENVTL. L. & POL’Y 55, 75 (2007–2008).

171. INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE, CLIMATE CHANGE 2007: SYNTHESIS REPORT SUMMARY FOR POLICYMAKERS 8 (2007).

¹⁷⁴ *Id.* at 10.

173. *Id.* at 11.

174. *Id.*

175. KENNY ET AL., *supra* note 27, at 1.

176. NAT’L ENERGY POLICY DEV. GROUP, NATIONAL ENERGY POLICY: RELIABLE, AFFORDABLE, AND ENVIRONMENTALLY SOUND ENERGY FOR AMERICA’S FUTURE ch. 1–4 (2001), available at <http://georgewbush-whitehouse.archives.gov/energy/2001/National-Energy-Policy.pdf>.

capacity equates to 1,300 to 1,900 new power plants by 2020, many of which will require additional water withdrawals.¹⁷⁷

Increased in energy and water demand amounts to a very expensive crisis in the water-energy nexus in the near future. Due to water restraints, power plants may be forced to reduce production, and reduced electricity production may cause brownouts during severe heat waves or summertime droughts. To avoid this debacle, some coal-burning power plants are voluntarily installing dry-cooling systems and switching to treated waste water in water-stressed areas.¹⁷⁸ Undoubtedly, companies conduct rigorous CBA before making such an expensive decision. Perhaps, if the EPA had factored in the foreseeable cost of water shortage in its own CBA, the resulting best technology available standard would be a bit drier.

V. EPA AUTHORITY TO REGULATE WATER WITHDRAWAL

The Agency may have refrained from considering water use and consumption in its CBA because the EPA typically does not interfere with water allocation issues for fear of intruding on states' rights that are explicitly protected in CWA section 101(g).¹⁷⁹ With respect to total maximum daily load, the EPA claims that flow impairment is not pollution, although it admittedly contributes to water quality impairment.¹⁸⁰ However, to fully enforce the CWA, the EPA cannot continue to make the "artificial distinction" between water quality and water quantity.¹⁸¹ The Supreme Court ruled in 1994 that section 101(g) does not give water allocations immunity from EPA jurisdiction.¹⁸²

As thoroughly examined by Maya van Rossum and Professor James May, EPA permit condition decisions concerning section 316(b) should only address intake structures as defined¹⁸³ to include all integral

177. *Id.* at ch. 1–5.

178. SCOTTISHPOWER, ENVIRONMENTAL PERFORMANCE REPORT 43 (2004–2005).

179. 33 U.S.C. § 1251(g) (2006).

180. Reed Benson, *Pollution Without Solution: Flow Impairment Problems Under Clean Water Act Section 303*, 24 STAN. ENVTL. L.J. 199 (2005).

181. Justice O'Connor, writing for the majority, opined

Petitioners' assertion that the Act is only concerned with water quality, not quantity, makes an artificial distinction, since a sufficient lowering of quantity could destroy all of a river's designated uses, and since the Act recognizes that reduced stream flow can constitute water pollution.

Pud No. 1 v. Wash. Dep't of Ecology, 511 U.S. 700, 701 (1994).

182. Reed Benson, *supra* note 180, at 210 (citing *Pud No. 1*, 511 U.S. at 719).

183. According to the EPA Effluents Guidelines Division,

A cooling water intake structure comprises the total structure used to direct cooling water from a water body into the components of the cooling system wherein the cooling function is designed to take place, provided that the intended use of the major

structures or components of the cooling water intake structure that either direct or draw cooling water into the cooling system.¹⁸⁴ But in reality, the EPA has employed a broader definition that includes intake canals, detention dams, and any other structure that the EPA deems necessary for moving water from the source to the cooling system.¹⁸⁵ Whether the cooling system is part of the intake structure is essential to this analysis. On one hand, the EPA stated that closed-cycle cooling systems do not fall under section 316(b) authority because they do not technically withdraw cooling water; rather, they facilitate condenser cooling.¹⁸⁶ However, on the other hand, the EPA has twice stated that flow restrictions that forced power plants to use closed-cycle systems were legitimate methods of minimizing adverse environmental impact to satisfy section 316(b).¹⁸⁷ May and van Rossum conclude that this makes closed-cycle cooling technologies integral components of cooling water intake structures.¹⁸⁸ In 1977 the Office of General Counsel issued Decision No. 63, ruling, *inter alia*, that a cooling tower is not an intake structure and that 316(b) conditions may not take the form of effluent limitations, but that section 316(b) conditions may restrict intake capacity to below the rate needed to achieve effluent limits.¹⁸⁹

portion of the water so directed is to absorb waste heat rejected from the process or processes employed or from auxiliary operations on its premises, including air conditioning. As defined above, the intake structure includes circulating and service water pumps where those pumps are located in the cooling system prior to the heat exchanger or condensers.

EPA, OFFICE OF WATER & HAZARDOUS MATERIALS, EFFLUENTS GUIDELINES DIV., DEVELOPMENT DOCUMENT FOR BEST TECHNOLOGY AVAILABLE FOR THE LOCATION, DESIGN, CONSTRUCTION AND CAPACITY OF COOLING WATER INTAKE STRUCTURES FOR MINIMIZING ADVERSE ENVIRONMENTAL IMPACT 2-3 (1976).

184. See *In re Brunswick Steam Electric Plant*, 2 NPDES REGULATORY HEARING PROC. 172, 183 (Envtl. Prot. Agency June 1, 1976) (decision of the general counsel); *In re Central Hudson Gas & Elec. Corp.*, 2 Op. EPA GEN. COUNSEL 371, 378 (1977); May & van Rossum, *supra* note 90, at 399.

185. Carolina Power & Light Co., Permit No. NC007064, at 3, 85 (Envtl. Prot. Agency Nov. 7, 1977) (citations omitted); EPA, REGION IV, APPLICATION FOR NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM PERMIT TO DISCHARGE TREATED WASTEWATER TO U.S. WATER, NO. TN 0005436, FACT SHEET 11(1986); see May & van Rossum, *supra* note 90, at 377.

186. *In re Central Hudson Gas & Elec. Corp.*, 2 Op. EPA GEN. COUNSEL 371, 378 (1977).

187. Best Technology Available for Cooling Water Intake Structures, 41 Fed. Reg. 17,387, 17,388 (Apr. 26, 1976) (codified at 40 C.F.R. pt. 402); *Brunswick Steam*, 2 NPDES REGULATORY HEARING PROC. at 181 (“[A]lthough §316(b) does not authorize the Agency to impose a specific closed-cycle cooling technology, it does authorize the restriction of the capacity of an intake structure. Such a restriction may necessitate a closed-cycle cooling system. This result is not inconsistent with Agency restrictions on the volume of pollutant discharge under §§ 301 and 306. That is, while the Agency cannot specify abatement technologies to be employed under those Sections, the use of a particular treatment system may be a predictable consequence of the limitation imposed on the discharge of specific pollutants.”).

188. May & van Rossum, *supra* note 90, 470-71.

189. *Central Hudson*, 2 Op. EPA GEN. COUNSEL at 378, 380-81.

Because “cooling towers or other closed-cycle cooling systems are not cooling water intake structures,” the EPA cannot directly mandate certain cooling technologies.¹⁹⁰ Instead, the EPA can limit the capacity of intake structures such that a “predictable consequence” is that a power plant is forced to switch to a less water intensive cooling system such as closed-cycle, dry cooling, or a hybrid.¹⁹¹ If the EPA can use this indirect approach to limit narrowly defined adverse environmental impacts, the Agency can also use this approach to limit broader adverse environmental impacts.

CONCLUSION

The scope of CBA cannot be infinite, but it should consider all direct impacts of each technology. If the EPA had factored in the cost of shutting down a power plant because of water supply issues and the environmental harm of using and consuming billions of gallons of freshwater each year, then its CBA would have been more legitimate; undoubtedly, it would have been more intellectually honest. Instead, EPA circumvented the true calculation of cost and benefits and missed an opportunity to avert crisis in the two most vital sectors of our economy: energy and water.

Just as the phrase “adverse environmental impact” should not be narrowly restricted to entrainment and impingement, the environmental impacts of cooling systems should not be limited to water quality.¹⁹² Cooling systems vary in energy demands, with dry systems demanding the most energy. Dry systems impose an energy “penalty” on power plant output because they require increased internal energy consumption.¹⁹³ These demands reduce the efficiency of the power plant and may require increased fuel consumption to produce the same amount of energy. The air quality and climate impacts of energy production are well-known and should be considered in the CBA along with broad water quality impacts.¹⁹⁴

After the Second Circuit decision, the EPA suspended the Phase II rule.¹⁹⁵ When the EPA revisits the Phase II rule, the Agency should

190. *Brunswick Steam*, 2 NPDES REGULATORY HEARING PROC. at 183.

191. *Id.* at 181; *Central Hudson*, 2 Op. EPA GEN. COUNSEL at 378; *In re Pub. Serv. Co. of N.H.*, 10 Env't Rep. Cas. (BNA) 1257 (Envtl. Prot. Agency June 17, 1977). Limiting capacity in order to reduce entrainment and impingement was upheld in *Brunswick II*, the appeal of Carolina Power & Light. Carolina Power & Light Co., Appeal No. 77-19, Permit No. NC007064, at 12, 33, 60, 91 (Envtl. Prot. Agency Feb. 20, 1978).

192. Veil et al., *supra* note 108, at 40.

193. ACQUIRING WATER FOR ENERGY: INSTITUTIONAL ASPECTS, *supra* note 29, at 4.

194. Veil et al., *supra* note 108, at 40.

195. *EPA Suspends Cooling Water Rule In Response to Second Circuit Decision*, 38 Env't Rep. (BNA) 1481 (2007).

conduct studies of the broader environmental impacts and value. However, calculating the value of reducing all adverse environmental impacts may prove to be impossible. The interrelationships in the hydrologic cycle and aquatic ecosystems may create such complexities in the equation that not even the most detailed, well-studied system can be quantified. If this is the case, then the EPA should abandon the calculation and reliance on CBA altogether instead of arbitrarily simplifying the equation.