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Cooling Water Intake Structure (Existing Facilities: Phase II)
Proposed Rule Comment Clerk – W-00-32
Water Docket, Mail Code 4101
U.S. Environmental Protection Agency
Ariel Rios Building
1200 Pennsylvania Avenue N.W.
Washington D.C. 20460

Re: Comments on Proposed Rule, RIN 2040-AD62
Clean Water Act §316(b) – National Pollutant Discharge Elimination System –
Proposed Regulations for Cooling Water Intake Structures at Phase II
Existing Facilities, EPA ICR no. 2060.01

Dear Sir/Madam:

I am pleased to have the opportunity to submit these comments on the above-captioned rulemaking. My comments address EPA's analysis of benefits for, and the role of cost-benefit analysis in, this rulemaking proceedings. Briefly stated, EPA's analysis of the benefits of reduced cooling water intake is seriously incomplete, and should be considered as no more than an extreme lower bound on the complete benefits. A simple quantitative adjustment, filling in just two of the many gaps in EPA's estimate of benefits and drawing on more recent economic literature than EPA has used, results in substantially greater benefits for every option EPA is considering, and show that EPA's proposed option does not maximize net social benefits. To be sure, my adjustments remain incomplete; they do not come close to capturing all of the benefits of regulating cooling water intake structures. Nevertheless, my estimates are sufficient to demonstrate that policy options involving greater reduction in water intake create greater net benefits than the proposed option.

These comments also examine the methodological problems of valuation of the environmental benefits involved in this case. Natural ecosystems, such as the aquatic ecosystems affected by cooling water intake, provide numerous interrelated services, some of which are clearly valuable but difficult to quantify. Assigning a zero value to these benefits would misstate society's preferences and values. Yet rigid insistence on applying a single, narrowly defined valuation methodology to every benefit would, in effect, dismiss (that is, value

¹ Research Director, Global Development and Environment Institute, and Research Assistant Professor, Department of Urban and Environmental Policy and Planning, Tufts University. These comments are not being submitted in my official capacity at Tufts University. My comments are being submitted on behalf of Riverkeeper.

at zero) all hard-to-quantify environmental values. For this reason, EPA's analysts should be commended for exploring valuation methodologies such as habitat-based replacement cost (HRC) and societal revealed preferences, which have the potential to address the full range of ecosystem services. The problems with these alternative methodologies are that they do not go far enough, and cannot be consistently applied across the board.

In addressing the methodological problems, I also respond to aspects of the comments on this rule by Dr. Robert Stavins. Commenting on behalf of PG&E National Energy Group, one of the major corporations that has a direct financial interest in the outcome of this rulemaking procedure, Dr. Stavins reaches conclusions opposite to mine, arguing that all methodological innovations in benefits valuation in this case are illegitimate and that many EPA benefit estimates are drastic overestimates. Throughout his comments, he inaccurately suggests that he speaks for all economists. However, he neglects to document the supposed unanimity of economists on these issues, repeatedly offering only his own personal authority as evidence for the views of the entire profession. In my comments I describe the ongoing differences among economists, including recent Nobel Prize winners, on the issues at stake in this case.

Here I will focus on three of the numerous points on which I disagree with Dr. Stavins: the treatment of non-use values, the basis for habitat replacement cost estimates, and the validity of societal revealed preferences. My conclusions on these issues, in short, are that

- Dr. Stavins ignores the extensive evidence that EPA's non-use values are conservative underestimates;
- Habitat replacement cost valuation is similar to standard approaches to asset valuation used through the economics literature, and provides a reasonable approach to valuation of large but uncertain ecosystem benefits; and
- Societal revealed preference is a reasonable approach to the problems of social choice, which are intrinsically different from the individual choice paradigm that is assumed in Dr. Stavins' preferred approach.

Finally, despite our differences, Dr. Stavins and I agree that there are enormous methodological difficulties in complete valuation of the benefits of reducing cooling water intake requirements, but we disagree about the implications of these challenges. Dr. Stavins urges EPA to wait to regulate until the valuation methodologies of economists catch up to the environmental aspirations of the Clean Water Act. I, in contrast, conclude that the difficulties in valuing environmental benefits illustrate the limits to the usefulness of cost-benefit analysis in the environmental setting. In contrast to the cost-benefit analysis EPA now appears to endorse, identification of the best available technology is a process in which costs are only one of many factors to be considered, and benefits need not be precisely quantified and monetized in order to be taken seriously. A recommendation based on the best available technology could be made, as

has been done for numerous regulations in the past, without entangling the agency in the massive web of methodological, technical, and even philosophical challenges to cost-benefit calculations.

My detailed comments are organized in the following sections:

1. Evidence of the incompleteness of EPA's benefit estimates
2. Adjustment of EPA benefit estimates to address selected problems of incompleteness
3. General comments on Dr. Stavins' arguments
4. Survey of non-use values and updated estimates of their magnitude
5. Rationale for use of habitat replacement cost
6. Problems of social choice and the use of societal revealed preference
7. Limitations of cost-benefit analysis and merits of the "best available technology" standard

1. The incompleteness of EPA's benefit estimates

Cost-benefit analysis is designed to weigh the relevant costs of a proposal against the corresponding benefits. This process cannot yield a meaningful result unless the calculations of costs and benefits are equally complete. In the private sector, a balance sheet that weighs all of a company's income against *some* of its expenditures does not provide a useful picture of the company's true financial condition, as recent corporate scandals have reminded us. Likewise, in the public sector, a comparison of complete costs and incomplete benefits does not provide an accurate picture of net benefits to society.

Yet a comparison of complete costs and incomplete benefits is exactly what EPA has produced in this case. The costs of reducing the impacts of cooling water intake are monetary costs for marketed goods and services, such as production and installation of screens, cooling towers, and other equipment. Such costs are backed up by detailed engineering analyses, and often by recent experience in buying and installing similar equipment. There are no categories of costs which are intrinsically difficult to express in monetary terms.

Contrast this with the calculation of the benefits of reducing cooling water intake. In general terms, the benefits consist of reduced damage to aquatic ecosystems. But how should those benefits be measured and monetized? EPA's analysis focuses on a more restricted question, namely valuing the benefits of killing fewer fish; this is already a complex problem with no simple answers. Market prices are available only for a few commercially valuable fish species; even when available, commercial prices do not necessarily capture all the value of

avoided fish mortality. And avoided fish kills are far from the only significant benefits of reduced ecosystem damages, since many other organisms and environmental services are also affected.

EPA's economic benefit analysis (EBA) explicitly describes the categories of benefits that have been omitted. EBA Chapter C1, particularly section C1-5, lists the following reasons why the environmental impacts of cooling water intake structures, and consequently the benefits of regulating them, are underestimated:

- Facility-provided monitoring data, the basis for EPA's analysis, typically focus on only a subset of the species impacted by impingement and entrainment (I&E), thus underestimating total losses.
- Monitoring data often pertain to conditions existing many years ago, before the Clean Water Act had improved aquatic conditions; if the numbers and diversity of fish were depressed by degraded water quality, estimates of I&E losses would be similarly low.
- Cumulative impacts of multiple facilities on the same fish population are often important, but have been considered only to a limited extent.
- Estimated recreational and commercial values include only the proportion of I&E losses that would have been caught, typically less than 20 percent of I&E mortality of recreationally and commercially valuable species.
- Secondary economic impacts such as effects on marinas, bait sales, and property values have not been included.
- Losses of invertebrate species such as lobsters, mussels, crabs, and shrimp were not included, even though these include commercially valuable species.
- Effects on fish-eating (piscivorous) birds were not included.
- Current fishing mortality rates often reflect already-depleted fisheries, as for example in the case of winter flounder near the Brayton Point facility, one of the EBA case studies.
- Forage species, accounting for the predominant share of I&E losses, are poorly documented, and their full ecological value to the food web is not considered.
- Non-use benefits are estimated only for recreational users, not for the population as a whole.

- Thermal impact reductions are not accounted for in some options, such as replacement of once-through cooling with cooling towers.

Another portion of the EBA, Case Study Chapter A11, re-examines the areas of incompleteness from a different perspective, focusing on the ecological services that are disrupted by I&E, but are not addressed by conventional valuation methods. Quoting directly from the EBA, those omitted or undervalued services include:

- decreased numbers of ecological keystone, rare, or sensitive species;
- decreased numbers of popular species that are not fished, perhaps because the fishery is closed;
- decreased numbers of special status (e.g., threatened or endangered) species;
- increased numbers of exotic or disruptive species that compete well in the absence of species lost to I&E;
- disruption of ecological niches and ecological strategies used by aquatic species;
- disruption of organic carbon and nutrient transfer through the food web;
- disruption of energy transfer through the food web;
- decreased local biodiversity;
- disruption of predator-prey relationships...
- disruption of age class structures of species;
- disruption of natural selection processes;
- disruption of public uses other than fishing, such as diving, boating, and birding; and
- disruption of public satisfaction with a healthy ecosystem.

(EBA Case Studies, p. A11-2.)

This second list is presented as part of the rationale for HRC valuation, a method that can encompass the full diversity of ecosystem values. My comments on HRC appear in section 5 below.

It would be impossible in practice to estimate all of these omitted values. However, benefit analyses for other proposed rules have estimated a broader set of values. For example, the economic and environmental benefits analysis for the metal products and machinery (MP&M) rule estimated separate recreational benefits for fishing, other boating, and wildlife viewing and near-water activities. Recreational fishing accounted for only one-fourth of all

recreational benefits from reduced MP&M discharges.² EPA has now issued a Notice of Data Availability for the MP&M rule; it suggests that the estimates of recreational benefits were increased in response to peer reviewers' comments.³ If similar relationships hold for the recreational benefits of reductions in cooling water intake, then EPA's estimates of recreational benefits in the 316(b) analysis should be multiplied by 4 or more. However, the data needed to determine the magnitude of other recreational benefits are not presented in the EBA. I recommend that EPA should explore the impacts of cooling water intake structures on the other recreational benefits considered in the MP&M analysis, and increase its estimates of recreational benefits of cooling water intake reduction whenever appropriate

The two lists of omissions and underestimates presented here – both taken directly from the EBA – are more than sufficient to demonstrate the incompleteness of the benefits analysis in this case. Complete costs are being compared to a restricted subset of benefits; the bottom line of such a lopsided comparison slants heavily in a predictable direction, toward “justifying” less regulation and weaker environmental protection than a complete analysis would support. All that can be concluded from this misleading, incomplete comparison is that true, complete benefits must be larger, and net social benefits larger as well, for each of the various options under consideration.

2. Summary account of adjustment of EPA benefit estimates

I have prepared an adjusted set of figures incorporating estimates of corrections to just two of EPA's omissions and underestimates. This section presents my calculations; the rationale for the first correction appears in section 4 below.

My first adjustment is for the underestimate of non-use benefits. As I discuss in section 4, a recent literature review finds that non-use benefits are on average 1.9 – 2.5 times all use values, rather than 0.5 times recreational benefits alone as EPA assumed. My reading of the recent literature suggests that 1.9 – 2.5 times use value is still a conservative estimate for existence values of many natural ecosystems. To correct for EPA's underestimate in this area, I have recalculated their estimates assuming that non-use values are 2 times estimated recreational, commercial, and forage values.

My second adjustment is for the unvalued fraction of the mortality of recreationally and commercially valuable species. EPA's methodology values only the fraction of those species that would have been caught in the absence of I&E mortality. That is, I&E mortality rates are adjusted downward in proportion to historical catch rates before any valuation occurs in the

² *Economic, Environmental and Benefits Analysis for the Proposed Metal Products and Machinery Rule* (EPA 821-B-00-0008, December 2000, available at www.epa.gov/waterscience/guide/mpm/rule.html), Chapter 15; the results in Table 15-13, p.15-17, show that recreational fishing accounts for 24% of the midpoint values for recreation benefits as a whole.

³ *Federal Register*, June 5, 2002, p. 38774.

EBA. Only the fraction of the fish that would have been caught are assigned any value; the rest are ignored. The catch rate, or "landed fraction," is below 20% in every case, and below 10% in some cases.⁴ Thus the great majority of I&E mortality of the most valuable species is never valued.

The nonlanded fraction of these species – the ones that survive uncaught – have an obvious ecological value. If nothing else, their reproduction is the source of the catch in future years; that is, they are essential to the creation of future recreational and commercial values. A catch rate of 100%, if it occurs, can only occur once. The available data do not allow calculation of the present value of future reproduction of nonlanded fish; the calculation would be complex and would likely vary by species. It seems reasonable to assume that nonlanded fish have a value that is significantly greater than zero, but not more than the value of the landed (caught) fish of the same species. I have conservatively assumed that nonlanded fish have a value equal to 0.25 times the value of landed fish of the same species. That is, I have created a new category of inferred recreational and commercial value in the case studies, as follows:

$$\text{Value of nonlanded recreational and commercial fish} = (\text{Value of landed recreational and commercial fish}) \times (\text{nonlanded fraction} / \text{landed fraction}) \times 0.25$$

To calculate the effects of these adjustments, it was first necessary to construct a spreadsheet system that reproduces EPA's estimates. This spreadsheet reproduces in detail the benefit categories for each of the EBA case studies, extrapolates to best estimates of national baseline losses using the relationships described in the EBA, and then adjusts for the percentage reduction in losses achieved by each EBA policy option.⁵ My spreadsheet calculates national baseline losses, and benefits of each policy option, replicating EPA's values when using EPA's assumptions.

I then recalculated the spreadsheet three times: in Scenario A, keeping all EPA assumptions and input data, except assuming that non-use value is 2 times recreational, commercial and forage value; in Scenario B, restoring EPA's non-use assumption but assuming that nonlanded recreational and commercial fish are valued according to the above equation; and

⁴ Data on the landed fraction of commercially and recreationally valuable species can be found in the EBA for every case study except Ohio. EPA's answers to Riverkeeper questions, received very late in the process of my analysis, imply a landed fraction of about 1-2% for Ohio; this appeared remarkably out of line with other case studies. My calculations conservatively assume a landed fraction of 10% for the Ohio case study. Use of EPA's Ohio data would lead to higher estimates of benefits in my Scenarios B and C in Table 1, below.

⁵ An additional stage of adjustments would have been necessary to convert to the policy options as presented in the Federal Register. EPA's explanation of these adjustments, in response to my questions, was received late in the process of my analysis. Therefore I did not develop calculations to match the Federal Register categories. In several of the key cases, EPA's estimates of Federal Register options benefits are about 95% of corresponding EBA benefits, suggesting that my conclusions apply almost equally to Federal Register options. The difference between Federal Register and EBA benefits includes both the distinction between estimates for 539 vs. 550 plants, and differences in the treatment of taxes.

in Scenario C, combining my two assumptions. The results, as shown in Table 1 (next page), are:

- Estimated benefits of each policy option are more than doubled in Scenario A, relative to the estimates in the EBA;
- Estimated benefits of each policy option are roughly doubled in Scenario B; and
- In Scenario C, combining my two adjustments, benefits of policy options are roughly 4-6 times the estimates in the EBA.

When compared to the costs of the policy options, as reported in the EBA, my three scenarios of course have much greater net social benefits. The order of policy options, ranked according to net social benefits, is changed: Option 5 – the dry cooling option – has the greatest net benefit in all three scenarios, as shown in Table 2. In Scenario C, combining the two adjustments, EPA's proposed option, i.e. EBA Option 3, is the one that fares worst. Options 1, 2, 3a, and 4 all have net benefits of \$4.1 – \$4.5 billion in Scenario C.

Because my rough estimates of these two changes have such a large effect on the outcome of the analysis, I recommend that EPA explore both issues in greater detail. Specifically,

1. EPA should develop approaches to non-use value more consistent with the recent economic literature, to replace the outmoded "50% rule" used in the EBA; and
2. EPA should develop plausible values for the nonlanded fraction of I&E fish mortality. The one thing we know for certain is that the current estimate of zero is *not* the correct value.

An enormous amount is at stake here: my two adjustments show that all options have large net benefits, and that EPA's incomplete valuation of benefits misleadingly favors the option that has the lowest net benefits on a corrected basis. Thus it is important that EPA explore these corrections in detail.

Table 1: Benefits of EBA Policy Options						
<i>(millions of dollars)</i>						
Option	EBA	Scenarios			C	
		A	B			
1	\$ 1,034	\$ 2,348	\$ 2,091	\$ 5,517		
2	\$ 890	\$ 2,043	\$ 1,814	\$ 4,815		
3	\$ 735	\$ 1,705	\$ 1,515	\$ 4,047		
3a	\$ 749	\$ 1,793	\$ 1,693	\$ 4,625		
4	\$ 1,223	\$ 2,933	\$ 2,775	\$ 7,589		
5	\$ 1,536	\$ 3,731	\$ 3,553	\$ 9,782		
6	\$ 1,159	\$ 2,666	\$ 2,362	\$ 6,274		

Scenario definitions: EPA data and assumptions used except
 A: Nonuse value = 2 * recreational, commercial & forage values
 B: Nonlanded recreational and commercial fish valued at
 0.25 * landed fish of same species
 C: Combines assumptions of A and B

Table 2: Net Benefits of EBA Policy Options						
<i>(millions of dollars)</i>						
Option	Costs	EBA	Net Benefits			C
			A	B		
1	\$969	\$ 65	\$ 1,379	\$ 1,122	\$ 4,548	
2	\$610	\$ 280	\$ 1,433	\$ 1,204	\$ 4,205	
3	\$283	\$ 452	\$ 1,422	\$ 1,232	\$ 3,764	
3a	\$300	\$ 449	\$ 1,493	\$ 1,393	\$ 4,325	
4	\$3,507	\$(2,284)	\$(574)	\$(732)	\$ 4,082	
5	\$2,054	\$(518)	\$ 1,677	\$ 1,499	\$ 7,728	

Costs for Option 6 were not calculated in the EBA.

3. *General comments on Dr. Stavins' arguments*

Dr. Stavins argues repeatedly that EPA's benefits analysis violates the canons of approved economic theory. As he says on page 1, "some of the methodologies employed are neither recommended nor endorsed by EPA's own *Guidelines for Preparing Economic Analysis...*" This is the first of at least 16 mentions of the *Guidelines* in his 43 pages of comments; it is by far his most frequent source, repeatedly cited as the final, definitive source on allowable methods.

However, when the *Guidelines* were first approved, Dr. Stavins had a more flexible view of the document. The *Guidelines* were reviewed by EPA's Science Advisory Board – Environmental Economics Advisory Committee (EEAC), chaired by Dr. Stavins. The EEAC review of the *Guidelines* said, in its Executive Summary,

Economics, like any scholarly discipline, is constantly changing. Environmental economics, a relatively young branch of the discipline, has experienced particularly rapid growth. New areas of the literature continue to emerge, and existing areas change and expand. Hence, despite the Committee's generally positive assessment of the revised *Guidelines*, we urge EPA to carry out new reviews every two to three years.⁶

The cover letter signed by Dr. Stavins, transmitting the EEAC review of the *Guidelines* to Carol Browner, the EPA Administrator at the time, likewise said,

The best analytical tools of environmental economics are constantly changing, as experience with applications of existing tools and as new theoretical and empirical techniques appear in the scholarly literature. As a result, it is important that EPA carry out new reviews of the *Guidelines* every two to three years to reflect these developments in environmental economics.⁷

Although the *Guidelines* were officially published in September 2000, the EEAC review occurred in 1998-99; the cover letter to Carol Browner is dated September 30, 1999. Thus it is now three years later, the time at which, according to the EEAC – and the Dr. Stavins of 1999 – a new review of the *Guidelines* would be called for. Dr. Stavins got it right the first time, in 1999: environmental economics is a fast-changing field, and it is important to take a fresh look at it, rather than being bound by scriptural references to a report from some years ago.

Looking more generally at the world of environmental economics and policy analysis, the choice of techniques for valuation of benefits, and the application of cost-benefit analysis to legal and regulatory issues, remain the subjects of active debate. Recent special issues of the *Journal*

⁶ Science Advisory Board Report on the EPA Guidelines for Preparing Economic Analysis, published as Appendix A to the *Guidelines*, p.1.

⁷ Letter to Carol Browner from Joan Daisey and Robert Stavins, September 30, 1999, included in Appendix A of the *Guidelines*.

of Legal Studies and the *University of Pennsylvania Law Review* have highlighted the ongoing differences of perspective on these issues among legal scholars and economists.⁸

The economics profession as a whole is exhibiting an increasing interest in alternative perspectives that question the conventional textbook wisdom. Two of the last four Nobel Prizes in economics have gone to scholars who are famous for their unorthodox views. Amartya Sen, the 1998 Nobel laureate, has raised fundamental questions about the nature of social choice, ethics, and equity in economics, including recent comments on cost-benefit analysis that I will discuss in section 6 below. The 2001 prize went to Joseph Stiglitz, George Akerlof, and Michael Spence, economists who have analyzed the problems of imperfect and asymmetric information – problems that require fundamental rethinking of the optimality of markets, and create a strong case for the benefits of regulation.

Several “heterodox” schools of economics have emerged in recent years, raising questions and developing methodologies that go beyond the conventional limits of economic theory. Ecological economics is one of the fastest-growing new perspectives, represented by the International Society for Ecological Economics and the journal *Ecological Economics*. Alternative approaches to ecosystem valuation, and studies of the role of “natural capital,” are frequent topics that have received insightful analysis by ecological economists, with direct relevance to the issues raised in the current rulemaking procedure.

In short, it is increasingly inaccurate to say that there is a single, narrowly defined approach to economic theory, environmental economics, or the evaluation of ecological benefits. If EPA's past guidelines for economic analysis were as rigidly defined as Dr. Stavins now suggests, perhaps EPA should begin the next review of those guidelines with a broader representation of the full range of contemporary views on environmental economics. As Dr. Stavins anticipated in 1999, it is now time for a fresh look at the progress of the field.

4. Survey of non-use values and updated estimates of their magnitudes

EPA's approach to non-use values is one of the least defensible aspects of the EBA. Environmental economics increasingly recognizes the importance of non-use values: people place a substantial value on the mere existence of animals, ecosystems, wildernesses, and unique natural locations, quite apart from any past, present, or planned future use of those aspects of nature. It is frequently the case that existence values dwarf use values: in the Exxon Valdez oil spill, a court awarded compensatory damages – compensating for lost use values – of less than \$300 million to those who lived and worked near Prince William Sound; economists using

⁸ *Journal of Legal Studies* 29 no. 2, part 2, June 2000, and *University of Pennsylvania Law Review* 150 no. 5, May 2002, are both devoted to discussion of cost-benefit analysis. For my own views on the discussion see Frank Ackerman and Lisa Heinzerling, “Pricing the Priceless: Cost-Benefit Analysis of Environmental Protection,” *University of Pennsylvania Law Review* 150 no. 5, 1553-1584.

contingent valuation techniques estimated the existence value of the pristine environment of Prince William Sound at \$9 billion, or 30 times use value.

The ratio of non-use value to use value is important here, because EPA uses an unfounded hypothesis about this ratio to estimate non-use value. Based on just a few, very dated citations, EPA suggests that non-use value can be estimated as 50% of the recreational component of use value. EPA notes that this is intended only as an estimate of non-use value to recreational users; there is no reason, however, to restrict the calculation of non-use value to this subset of the population. Here I am happy to agree with Dr. Stavins when he contends that the 50% rule is entirely inappropriate, since it fails to address any of the more recent literature on the subject. We differ, however, on the appropriate alternative.

A 1993 literature review by Thomas Brown – significantly newer and more comprehensive than the sources for the 50% rule – examines 31 contingent valuation studies published since 1980 that have estimated non-use values.⁹ Some of these studies contained multiple estimates, leading to 34 comparisons of non-use to use value for the same environmental benefit. The median ratio of non-use to use value was 1.92. After a thoughtful review of the varied methods used in the studies, Brown identifies 22 comparisons that appear to be more reliable than the others; these higher-quality comparisons have a median ratio of 2.56. It is on the basis of this study that I adopted the ratio of non-use to use value of 2 for the purpose of my recalculations presented in Tables 1 and 2 above. The Brown study contains a wealth of information about the effects of different methods of estimation on non-use value, and its relationship to use value, beyond the median ratio that I have used. I recommend that EPA explore additional uses of Brown's analysis, in devising more appropriate estimates of non-use value for the case studies.

Revised assumptions about non-use value have a large effect on net benefits. As shown in Table 1, moving from EBA estimates to my Scenario A, introducing the higher non-use value alone, adds \$1 – 2 billion to the benefits of the various policy options. Billion-dollar existence values, and more, for nationwide benefits are relatively common in the environmental economics literature.¹⁰ Studies have repeatedly found very large non-use values; these values are best understood as a quantitative expression of widespread public concern about environmental resources – even in the absence of personal use.

⁹ Thomas C. Brown, "Measuring Nonuse Value: A Comparison of Recent Contingent Valuation Studies," in J.C. Bergstrom, editor, *Benefits and Costs Transfer in Natural Resource Planning*, Sixth Interim Report, University of Georgia, Department of Agricultural and Applied Economics, Athens GA, 1993.

¹⁰ See, among many others, John B. Loomis and Douglas S. White, "Economic Benefits of Rare and Endangered Species: Summary and Meta-analysis", *Ecological Economics* 18 (1996), 197-206; and V. Kerry Smith and Laura L. Osborne, "Do Contingent Valuation Estimates Pass a 'Scope' Test? A Meta-analysis," *Journal of Environmental Economics and Management* 31 (1996), 287-301. The nationwide, per-household values in each of these articles, based on reviews of many other studies, imply multi-billion dollar national totals.

One of the studies cited by Brown found a nationwide non-user willingness to pay of \$111 per household for improving water quality in all U.S. rivers and lakes to a fishable level – implying a nationwide total value of more than \$11 billion in 1981 dollars, or closer to \$20 billion in today's dollars.¹¹ This remarkable figure emphasizes the great importance that people place on water quality, putting the benefit estimates for the current case in a broader perspective. Dr. Stavins' casual and undocumented suggestion that non-use values might be close to zero for this case appears to be quite at odds with the evidence of substantial non-user willingness to pay for improved water quality.

Other studies routinely find vast existence values for endangered species, for clean air in national parks, and other environmental resources and amenities. The surprising value, the figure that is out of line with the recent literature, is the very low estimate of non-use value found in the EBA. Revising this value up to a level more consistent with the literature, as shown in my Scenarios A and C, causes a fundamental change in the evaluation of the policy options considered by EPA.

5. *Rationale for use of habitat replacement cost*

In several of the case studies, the EBA uses calculations of habitat-based replacement cost (HRC) to value the damages due to impingement and entrainment. The rationale for this method is straightforward, although different from other approaches to valuation. Natural ecosystems produce numerous interrelated benefits, some of which are hard to quantify (see the lists of omitted benefit categories in section 2 above). Even if they all could be quantified, separate valuation of the entire list of ecosystem services is an impractical task. A simpler approach is to calculate the replacement cost of the ecosystem that provided the array of services.

Restoration cost is used as a measure of damages under CERCLA for Superfund sites, under the National Marine Sanctuaries Act, and under the oil spill provisions of the Clean Water Act. Use of restoration costs was explicitly upheld in the landmark *Ohio vs. Interior* court decision of 1989. I recommend that EPA revise and expand the EBA Case Studies Chapter A11, explaining and supporting HRC calculations, discussing the theoretical basis for HRC, and identifying categories of ecosystem value that are not measured by any other techniques.

Dr. Stavins finds HRC to be even more objectionable than other aspects of the EBA, describing it as “completely illegitimate” and “fatally flawed.” Yet again, we have only his word to go on, with little in the way of documentation. My reading of the literature is quite different; it appears to me that standard texts on environmental economics are *not* filled with warnings against the dire perils of the avoided cost method of benefits estimation.

¹¹ Robert C. Mitchell and Richard T. Carson, “An Experiment in Determining Willingness to Pay for National Water Quality Improvements,” preliminary draft of a report to EPA, Resources for the Future, 1981, as cited in Brown, *supra* note 9. My calculations in the text reflect the facts that there are more than 100 million households in the U.S. today, and average prices, as measured by the Consumer Price Index, have almost doubled since 1981.

Indeed, valuation of assets at replacement cost is a common practice in economics. In macroeconomics, depreciation is routinely valued at replacement cost; the difference between historical book value and market value (market value *is* current replacement cost, for a marketed asset) is essential in understanding investments. Any detailed analysis of capital costs focuses on “economic depreciation”, or the replacement cost of the capital that is consumed, and distinguishes it from accounting measures of depreciation based on book value or tax laws.¹²

Insurance companies frequently value damages to property at estimated replacement cost. If any of us should experience a loss, our home insurance provider might pay us on the basis of “household replacement cost” – unless we have explained to them that the calculation is fatally flawed and insisted on using a much lower value, as Dr. Stavins proposes to do for ecosystems.

Another important disagreement lurks behind these comments. Are the natural resources that are affected by cooling water intake best thought of as long-lived capital goods – or are they more like consumer goods that people, or power plants, might choose to consume when they are hungry? If you eat the last cookie and then throw out the box, you may not have to pay the full “cookie replacement cost.” Perhaps you are getting tired of cookies and don't plan to buy any more, so there is no need to worry about replacement cost. Something along these lines seems to be involved in the claim that HRC overstates the value of environmental resources: if we are planning to consume the ecosystem without replacement, then HRC might overestimate the values at stake.

A cookie box is not an appropriate analogy for the environmental resources protected by the Clean Water Act. Rather, the aquatic ecosystems under discussion in this case are long-lived assets, comparable to capital goods, which provide a wide range of valuable services. Society values and plans to keep these assets for the long run, and expects to receive their services year after year. The view of nature as “natural capital” is one of the foundations of ecological economics; but more conventional environmental economists have also argued that natural resources should be analyzed as assets, i.e. comparable to capital rather than consumer goods.¹³

HRC often looks more expensive than conventional approaches to valuation, as Dr. Stavins emphasizes. But this may simply reflect the incompleteness of conventional valuation, as discussed in section 2 above. Ecosystems provide numerous services simultaneously, using the same “capital equipment” to produce multiple benefits. Many of these benefits are not normally evaluated, but should be. As the list of separately evaluated benefits grows longer, the total benefit will of course increase. If we were able to achieve complete evaluation of ecosystem

¹² There are numerous examples, such as Frank C. Wykoff, “Economic Depreciation and the User Cost of Business-Leased Automobiles,” and other essays in Dale W. Jorgenson and Ralph Landau, editors, *Technology and Capital Formation* (MIT Press, 1989).

¹³ “Examples abound in the scientific literature supporting the asset interpretation of environmental resources.” V. Kerry Smith, *Estimating Economic Values for Nature: Methods for Non-Market Valuation* (Edward Elgar, 1996), p.7. See also Smith's subsequent discussion of the “asset interpretation.”

benefits, assuming that each benefit had to be produced and evaluated separately, we might well find that the totals exceeded HRC estimates. Nature has evolved efficient and parsimonious ways of producing many ecosystem services from limited resources; it would be surprising if artificial substitutes were routinely cheaper.

Although HRC is the only valuation method that even comes close to capturing the full range of ecosystem services, it, too, has shortcomings. In practical terms, it appears difficult and expensive to perform adequate HRC calculations; even more than with other valuation techniques, time and budget constraints may often limit the applications of HRC. Speaking more theoretically, HRC may at times be inappropriate because some ecosystems and natural services are not replaceable. If environmental damages involve risks of extinction of species, destruction of unique resources, or even disruption that allows unwanted invasive species to occupy vacated ecological niches, there may be no way to undo what has been done. Calculation of habitat replacement costs for regulatory purposes have often involved cost estimates for generic wetland restoration, an approach that captures only some of the ecosystem services that are at risk.

Despite these limitations, HRC remains a valuable contribution to the process of valuation whenever it can be used. I recommend that EPA explore HRC valuation of additional sites, to broaden the data and analysis used in the estimates of benefits in this case.

6. Problems of social choice and the use of societal revealed preference

To value the effects of cooling water intake on threatened and endangered species, EPA employs an innovative method described as “societal revealed preference” in the case study of the San Francisco Bay estuary plants. Essentially, the method assigns values based on the amounts that society has been willing to pay for protection of similar threatened and endangered species in other contexts. Economists have frequently deduced individual “revealed preference” for environmental amenities from individual behavior in other markets; here EPA simply extends the same reasoning to social behavior and social choices. Dr. Stavins again displays his hostility to theoretical innovation, describing this procedure as having “no foundation whatsoever in economic theory”; it is in his view “totally invalid... a complete corruption of the notion of a *revealed-preference* method... a complete sham...”

The revealed preference procedure employed by EPA would be entirely orthodox and familiar, even qualifying for endorsement by Dr. Stavins and the *Guidelines for Preparing Economic Analyses*, if it referred to individual rather than social choice. Thus the question at issue can be restated: is it totally invalid and a complete sham to consider issues of social choice, separately from individual choice? Both economic theory and political reality show that there is an irreducible, independent role for social choice.

In economic theory, Kenneth Arrow's impossibility theorem proved long ago that there is no universal “social welfare function” – that is, no mathematical function of individual choices

always produces meaningful social choices.¹⁴ Questions of public goods and public choice continue to challenge the standard model of individual choice; as textbooks often point out, there is no such thing as an individual demand curve for national defense. (Nor are there cost-benefit analyses to determine how much defense spending is “efficient” based on individual revealed preferences.) Any attempt to convert defense spending to a matter of individual purchases or private willingness to pay would be overwhelmed by the “free rider” problem: why pay for your individual share of defense, since your neighbors’ contributions will defend you as much as them?

Exactly analogous questions arise in environmental economics. Nobel laureate Amartya Sen, in recent comments on cost-benefit analysis, points out that individual willingness to pay for major environmental initiatives is not always meaningful: if the amount you would contribute to cleaning up an Exxon Valdez-sized oil spill does not depend on whether anyone else contributes anything, then you have not understood the nature of the problem. On the other hand, if the question is how much would you contribute if everyone else contributes the same amount, we are no longer discussing *individual* willingness to pay. As Sen puts it:

The very idea that I treat the prevention of an environmental damage just like buying a private good is itself quite absurd. The amount I am ready to pay for my toothpaste is typically not affected by the amount you pay for yours. But it would be amazing if the payment I am ready to make to save nature is totally independent of what others are ready to pay for it, since it is specifically a social concern.¹⁵

Dr. Stavins drifts out of economic theory and into political debate when he argues against societal revealed preference on the grounds that preferences must be “revealed by those individuals who are doing the paying, *not* by the judgment of others (in this case, legislatures, executive departments and agencies, and/or courts).” (Stavins comments, p. 27) Denouncing the supposed arbitrariness and unrepresentativeness of all government actions has become unfortunately fashionable; but in this case it is necessary to look beyond the rhetoric. Who exactly is paying for the actions of legislatures, executive agencies, and courts? Ultimately, the answer can only be the taxpayers, ratepayers (consumers), and shareholders – that is, society.

Do people feel that the decisions about environmental protection, made on their behalf by their elected representatives, are hopelessly inefficient and expensive? Is there a groundswell of popular demand to save money by eliminating the Clean Air Act, the Clean Water Act, protection for endangered species, and all the rest? Of course not. On the contrary, many successful politicians have figured out that people strongly prefer environmental protection, and are willing to have their money spent to back up that preference. That’s how democracy is

¹⁴ More precisely speaking, Arrow proved that there is in general no social welfare function that depends solely on individual preferences for relevant alternatives and avoids intransitivity, unless it is dictatorial (always agreeing with one individual no matter what others prefer).

¹⁵ Amartya Sen, “The Discipline of Cost-Benefit Analysis,” *Journal of Legal Studies* 29 no. 2 part 2 (June 2000), pp. 931-952; quote from 949.

supposed to work, with or without the blessing of conventional economic doctrine. Social choice is alive and well in environmental policy, and cannot always be deduced from isolated individual behavior. Dr. Stavins is able to “prove” that individual preferences are necessarily more legitimate than social preferences only by assuming that answer to begin with.

There is one more piece to the case against inferring social values from past regulation, as seen in the “societal revealed preference” approach; this final argument is implicit rather than explicit in Dr. Stavins’ comments. It is often said that past regulations, adopted without the benefit of careful economic analysis, have been disastrously expensive. Long lists of regulations, purporting to show wildly differing costs per life saved, are frequently cited as evidence of the need for cost-benefit analysis, rather than reliance on regulatory precedent. The lists, however, can almost always be traced back to just two original studies of the costs of regulation. Careful reading of those original studies reveals that they are routinely misquoted: they are studies of the costs of actual *and proposed* regulations, or in one case, actual, proposed, *and other possible* regulations that have never even been proposed by any agency.¹⁶ The ridiculously expensive regulations described in these studies are almost entirely the ones that were never adopted. In many cases, EPA and other agencies rejected the expensive proposed regulations, precisely because they were too expensive – evidence of the success, not failure, of past regulatory practice.

Since social choice cannot be reduced to individual choices, and past regulations are not nearly as expensive as is commonly believed, EPA’s “societal revealed preference” method is a promising new innovation in the methods of valuation, one that deserves further development and discussion.

7. Limitations of cost-benefit analysis and merits of the “best available technology” standard

To summarize briefly, I have demonstrated that EPA’s analysis of the benefits of reducing cooling water intake is incomplete, and underestimates true, complete benefits by an unknown but large amount. Just two corrections – accounting for the large “non-landed fraction” of I&E mortality of valuable species and increasing non-use values to levels more in line with the recent economics literature – add billions of dollars to the benefits of each regulatory option. These adjustments show that EPA’s proposed option does not maximize net social benefits. Dr. Stavins is not persuasive in his arguments for banning innovation in economics and lowering benefit estimates throughout the analysis. Two of the innovations adopted by EPA in this case, habitat-based replacement cost (HRC) and societal revealed preference, are useful contributions to the fast-changing field of environmental economics, and deserve to be analyzed in depth and applied more widely.

¹⁶ Lisa Heinzerling, “Regulatory Costs of Mythic Proportions,” *Yale Law Journal* 107 no. 7 (May 1998), pp. 1981-2070; Lisa Heinzerling and Frank Ackerman, “The Humbugs of the Anti-Regulatory Movement,” *Cornell Law Review* 87 no. 2 (January 2002), pp.648-670.

It is clear that there is no consensus on these issues. One of the few things that Dr. Stavins and I agree on is that EPA's published benefit estimates are an insufficient basis on which to make a decision in this case. The plain truth of the matter is that cost-benefit analysis has failed in its fundamental political ambition. Rather than providing an objective, transparent standard for cost-effective decision-making, cost-benefit analysis has become a partisan battleground where opposing parties fight over rival technical hypotheses about environmental valuation.

Fortunately, cost-benefit analysis is not required in this case. There is no reason to base the regulation of cooling water intake on an analysis that is neither required by law, nor close to complete representation of benefits, nor successful in achieving objectivity and transparency. My Scenario C (refer to Tables 1 and 2 above), combining my two revised estimates, makes it clear that every policy option under consideration has substantial net social benefits. Any choice of the "best available technology" from among these options will bring social benefits greater than its costs; options that achieve the greatest reduction in cooling water intake generally appear to have the greatest benefits.

In the end, only one question of "willingness to pay" matters for the politics of regulatory policy. It is a much broader, less technical question than the ones raised in the EBA. Any regulation will impose some costs; power plant operators will undoubtedly pass those costs on to their customers. So the question that ultimately matters is, are ratepayers willing to pay the increased costs imposed by regulation?¹⁷ As Synapse Energy Economics has estimated in their comments on this rule, if all costs were passed on to the consumer, an all cooling tower rule would cost each ratepayer 28 cents per month on their electric bills. If the public was asked, "Are you willing to pay 28 cents more per month on your electric bill to avoid massive fish mortality and other underwater environmental damages caused by power plants?", I feel confident the answer would be "yes." And if people are willing to pay the costs of environmental protection, there is no way for experts to prove that they are wrong.

Sincerely,

Frank Ackerman

¹⁷ One could also examine the impact on the plant owners. EPA did in fact discuss comparison of the costs of the rule to the revenues of the affected companies. But Dr. Stavins, commenting on behalf of PG&E, says, "The comparison [of regulatory costs to company revenues] is utterly irrelevant!... Although such a socially efficient technology [one endorsed by Dr. Stavins' analysis] maximizes net benefits to society, it may yield higher costs than benefits to an affected company." (Stavins comments, pp. 11, 12)