

Adaptation Planning and Climate Impact Assessments: Learning From NEPA's Flaws

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Given past and current emission levels, the planet is already committed to significant climate change. Strong mitigation efforts can head off some of the most serious potential impacts but cannot prevent significant harm, particularly in vulnerable areas such as the arid western United States. Impacts on water supply are particularly worrisome, but a variety of other impacts are also forecast. Coping with these impacts will require retooling water systems, changing agricultural practices, reconsidering development patterns, creating conservation measures for endangered species, and other interventions into societal practices. Many of these impacts revolve around water: its supply, its uses, its flood risks.

We need to ensure that we evaluate adaptation needs through a sensible, well-designed process, and we can learn a lot from the shortcomings of existing processes for assessing environmental impacts. When we prepare Climate Adaptation Statements, we should benefit from our experience with environmental impact statements (EISs). We should take advantage of what we have learned from our experience with existing procedures rather than replicating their flaws.

As we will see, there are five major lessons to be learned from examining the shortcomings of current assessment procedures:

- The need for mainstreaming adaptation assessment into the normal decisionmaking process. In contrast, the EIS process has been isolated from government's primary decision processes.
- The need for better monitoring and follow-up. Unlike NEPA, which provides few learning mechanisms, adaptation assessment must include consistent follow-up and monitoring of adaptation predictions.

- Better access for adaptation assessment. Under NEPA, the government has not taken advantage of modern information technology to make all of the EIS documents easily available and connected with geographic information systems. Public access should be a priority for adaptation assessment.
- The inadequate treatment of uncertainty in impact statements. This is a key issue for adaptation because of the relative crudeness of regional downscaling of climate models. Fortunately, more sophisticated methodologies for analyzing risk are becoming available.
- The outdated triggering mechanism for EIS preparation. Existing environmental assessment mechanisms are triggered by agency *actions*—they do not require assessments of the status quo but only of proposed changes in the status quo. Adaptation assessment may be most needed in situations where no proposed action is pending, but the agency needs to be more proactive.

We now have almost 40 years of experience with EISs. We can learn from both the positive and negative aspects of that experience¹ how to best assess climate adaptation needs. Now is the time to establish the procedures that can guide climate impact assessment in the upcoming decades.

I. Background on Climate Change, Water-Related Impacts, and Adaptation

It is important to keep in mind the scope of the adaptation issue. Key concerns include the effect of sea-level rise on coastal areas, floods on coasts and inland waterways, droughts, and water quality.²

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1. The consensus among environmental law scholars seems to be that NEPA has been flawed but useful. For citations to the literature, see Alyson C. Flournoy et al., *Harnessing the Power of Information to Protect Our Public Natural Resource Legacy*, 86 TEX. L. REV. 1575, 1581 n.25 (2008).
2. For up-to-date information about potential climate impacts, see U.S. CLIMATE CHANGE SCI. PROGRAM & SUBCOMM. ON GLOBAL CHANGE RESEARCH, ABRUPT CLIMATE CHANGE (2008), available at <http://www.climate-science.gov/Library/sap/sap3-4/final-report/#finalreport>.

Floods are one serious threat. Summarizing the most recent data, the Intergovernmental Panel on Climate Change's (IPCC's) Fourth Assessment says:

Coasts are projected to be exposed to increasing risks, including coastal erosion, due to climate change and sea-level rise. The effect will be exacerbated by increasing human-induced pressures on coastal areas. . . . Many millions more people are projected to be flooded every year due to sea-level rise by the 2080s.³

The latest projections of sea-level rise are even higher. The IPCC assessment also notes that in North America:

Coastal communities and habitats will be increasingly stressed by climate change impacts interacting with development and pollution. Population growth and the rising value of infrastructure in coastal areas increase vulnerability to climate variability and future climate change, with losses projected to increase if the intensity of tropical storms increases. Current adaptation is uneven and readiness for increased exposure is low.⁴

Increased ocean temperatures not only lead to sea-level rise but to an increased risk of damage from storms. A large proportion of the financial losses fall in the developed world because of the high value and large amount of infrastructure at risk.⁵

The IPCC agrees that it "is *very likely* that hot extremes, heat waves, and heavy precipitation events will continue to become more frequent."⁶ There will be clear implications for water managers:

Heavier precipitation in tropical and inland storms will increase the risks of flooding, expand floodplains, increase the variability of streamflows (i.e., higher high flows and lower low flows), increase the velocity of water during high flow periods and increase erosion. These changes will have adverse effects on water quality and aquatic system health. For example, increases in intense rainfall result in more nutrients, pathogens, and toxins being washed into waterbodies.⁷

As a recent summary of the literature explains:

Uncertainty in predictions of anthropogenic climate change arises at all stages of the modeling process At each step, uncertainty in the true signal of climate change is introduced both by errors in the representation of Earth system processes in models and by internal climate variability.⁸

3. INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE (IPCC), *Summary for Policymakers*, in CLIMATE CHANGE 2007: IMPACTS, ADAPTATION, AND VULNERABILITY: CONTRIBUTION OF WORKING GROUP II TO THE FOURTH ASSESSMENT REPORT OF THE INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE 7, 12 (2007).

4. *Id.* at 15.

5. NICHOLAS STERN, THE ECONOMICS OF CLIMATE CHANGE: THE STERN REVIEW 92-93 (2007).

6. IPCC, *supra* note 3, at 15.

7. OFFICE OF WATER, U.S. ENVTL. PROT. AGENCY (EPA), NATIONAL WATER PROGRAM STRATEGY: RESPONSE TO CLIMATE CHANGE ii (2008).

8. IPCC, *Global Climate Projections*, in CLIMATE CHANGE 2007: THE PHYSICAL SCIENCE BASIS: CONTRIBUTION OF WORKING GROUP I TO THE FOURTH ASSESSMENT REPORT OF THE INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE 747, 797 (2007) (references omitted).

There seems to be a broad consensus among economists that uncertainty about climate change is not an excuse for inaction. As Thomas Schelling says, "this idea that costly actions are unwarranted if the dangers are uncertain is almost unique to climate."⁹ "In other areas of policy, such as terrorism, nuclear proliferation, inflation, or vaccination," he continues, "some 'insurance' principle seems to prevail: if there is a sufficient likelihood of sufficient damage[,] we take some measured anticipatory action."¹⁰ Nobel Laureate Kenneth Arrow suggests that we should take uncertainties into account by basing our policies on anticipated harm about 50% higher than the median expected harm, in order to account for the element of risk.¹¹ Innovative theoretical work by the eminent environmental economist Martin Weitzman suggests that uncertainty about possible catastrophic climate change should loom large as a justification for controlling climate change.¹²

The Pew Foundation collected much of the available information about adaptation strategies in a 2004 report.¹³ The Stern Report contains the most extensive discussion of adaptation costs. The report estimates that:

Infrastructure is particularly vulnerable to heavier floods and storms, in part because OECD [Organisation for Economic Co-Operation and Development] economies invest around 20% of GDP [gross domestic product] or roughly \$5.5 trillion in fixed capital each year, of which just over one-quarter typically goes into construction (\$1.5 trillion—mostly for infrastructure and buildings). The additional costs of adapting this investment to a higher-risk future could be \$15-150 billion each year (0.05-0.5% of GDP), with one-third of the costs borne by the US and one-fifth in Japan. This preliminary cost calculation assumes that adaptation requires extra investment of 1-10% to limit future damages from climate change.¹⁴

Another estimate, covering only the least developed countries and the short term, is over \$1 billion for the most urgently needed adaptation measures.¹⁵

The difficulty of adaptation varies directly with the pace of climate change and the potential increase in extreme events. "Extreme events such as floods and drought cause extensive damage to many parts of society, and thus a critical issue for adaptation is the degree to which frequency, intensity, and persistence of extreme events change."¹⁶

9. Thomas C. Schelling, *Climate Change: The Uncertainties, the Certainties, and What They Imply About Action*, 4 ECONOMISTS' VOICE 4 (2007), available at <http://www.bepress.com/ev/vol4/iss3/art3>.

10. *Id.*

11. Kenneth J. Arrow, *Global Climate Change: A Challenge to Policy*, 4 ECONOMISTS' VOICE 4 (2007), available at <http://www.bepress.com/ev/vol4/iss3/art2>.

12. Martin L. Weitzman, *Role of Uncertainty in the Economics of Catastrophic Climate Change* (AEI Brookings Joint Ctr., Working Paper No. 07-11, 2007), available at <http://ssrn.com/abstract=992873>. Weitzman shows that even a small degree of uncertainty about a single model parameter can become magnified into substantial economic risk.

13. See WILLIAM E. EASTERLING III ET AL., PEW CTR. ON GLOBAL CLIMATE CHANGE, COPING WITH GLOBAL CLIMATE CHANGE: THE ROLE OF ADAPTATION IN THE UNITED STATES 78-79 (2004).

14. NICHOLAS STERN, THE ECONOMICS OF CLIMATE CHANGE 417 (2007).

15. *Id.* at 443.

16. *Id.* at 17.

Flood risk and water supply issues can be intertwined, as in the California Delta, where potential levee collapses would drastically impair water supplies for much of the state.¹⁷ Meanwhile, in the Southwest, the future of the water supply is uncertain, with potentially major impacts on agriculture.¹⁸ Indeed, the most recent evidence regarding the Southwest is particularly worrisome:

Scientists also looked at the prospect of prolonged drought over the next 100 years. They said it is impossible to determine yet whether human activity is responsible for the drought the Southwestern United States has experienced over the past decade, but every indication suggests the region will become consistently drier in the next several decades. Richard Seager, a senior research scientist at Columbia University's Lamont-Doherty Earth Observatory, said that nearly all of the 24 computer models the group surveyed project the same climatic conditions for the North American Southwest, which includes Mexico.

"If the models are correct, it will transition in the coming years and decades to a more arid climate, and that transition is already underway," Seager said, adding that such conditions would probably include prolonged droughts lasting more than a decade.¹⁹

These new data also reflect an important theme discussed later: the need to make adaptation strategies robust given the uncertainty and changing evidence regarding the scale and timing of climate impacts.

Not only the timing, but also the average amounts of water available and the demand for water may be affected by climate change:

In some parts of the country, droughts, changing patterns of precipitation and snowmelt, and increased water loss due to evaporation as a result of warmer air temperatures will result in changes to the availability of water for drinking and for use for agriculture and industry. In other areas, sea level rise and salt water intrusion will have the same effect. Warmer air temperatures may also result in increased demands on community water supplies and the water needs for agriculture, industry, and energy production are likely to increase.²⁰

Much remains to be learned, however, about these impacts. There are still considerable uncertainties:

Studies of climate change impacts on U.S. water resources suggest that vulnerabilities are keenly tied to runoff changes and can vary greatly within and across regions. Estimates are

highly sensitive to assumptions about future demands and to the potential for adaptive responses to mitigate impacts.²¹

We can be sure that current water supply systems will need substantial modification in light of these projected changes. Not only the amount of water, but also its quality will be affected:

Changes in the timing of river flows and warming atmospheric temperatures may affect water quality and water uses in many different ways. At one extreme, flood peaks may cause more erosion, resulting in turbidity and concentrated pulses of pollutants. This will challenge water treatment plant operations to produce safe drinking water. . . . At the other extreme, lower summer and fall flows may result in greater concentration of contaminants. These changes in streamflow timing may require new approaches to discharge permitting and non-point source pollution. Warmer water will distress many fish species and could require additional cold water reservoir releases. Higher water temperatures can also accelerate some biological and chemical processes. . . .²²

Water quality and supply are related, because declining water quality may make it necessary to reserve more water for instream uses to maintain aquatic communities, decreasing the supply available for agriculture and other consumptive uses.

Although we can already see the outlines of the climate adaptation challenges relating to water, the details of the impact will only become clearer as we get more data and climate models develop. In the meantime, agencies that manage water supply, quality, or flood control will be faced with the need to develop adaptation plans.

II. NEPA's Flaws and Adaptation Impact Assessments

Adaptation planning requires an assessment of how climate will impact human activities and how to respond to those changes. These assessments flip current practices in environmental law around: instead of asking how human activities impact the environment, we instead begin by asking how environmental change will impact humans. A climate adaptation statement (CAS) would contain three key components: (1) identification of possible climate alterations; (2) analysis of how these climate changes would impact human society or natural ecosystems; and (3) an analysis of alternative methods of addressing the impacts.²³

17. LOUISE BEDSWORTH & ELLEN HANAK, PUB. POLICY INST. OF CAL., PREPARING CALIFORNIA FOR A CHANGING CLIMATE 8 (2008), available at <http://www.ppic.org/main/publication.asp?i=755>.
 18. See Jason Mark, *Climate Change Threatens to Dry Up the Southwest's Future*, ALTERNET, Oct. 16, 2008, www.alternet.org/story/103366/.
 19. Juliet Eilperin, *Faster Climate Change Feared: New Report Points to Accelerated Melting, Longer Drought*, WASH. POST (Dec. 25, 2008), available at http://www.washingtonpost.com/wp-dyn/content/article/2008/12/24/AR2008122402174_2.html?hpid=moreheadlines.
 20. OFFICE OF WATER, *supra* note 7, at ii.

21. EASTERLING ET AL., *supra* note 13, at 22.

22. CAL. DEP'T OF WATER RES., MANAGING AN UNCERTAIN FUTURE: CLIMATE CHANGE ADAPTATION STRATEGIES FOR CALIFORNIA'S WATER 6 (2008), available at <http://portal2.water.ca.gov/climatechange/docs/ClimateChangeWhitePaper.pdf>.

23. If the government proposes an action that has significant environmental impacts, major economic costs, or a potential effect on an endangered species, climate impacts might be considered through an EIS, cost-benefit analysis, or biological opinion under the Endangered Species Act. But these mechanisms may not directly apply for various reasons: the magnitude of the impact may not be enough in the relevant dimension that triggers the assessment (environment, cost, or biodiversity threat) or there may be no project proposal that

In designing institutional mechanisms to undertake these assessments and implement their results, we can learn a great deal from the shortcomings of current methods of assessment. This Article will focus primarily on EISs under NEPA as a point of comparison with climate impact assessments.

A. An Introduction to NEPA

Some background on NEPA may be helpful.²⁴ Implementation of NEPA has shifted over time. Section 101 of NEPA²⁵ proclaims the policy of the federal government to administer federal programs in the most environmentally sound fashion.²⁶ (Perhaps unfortunately, the courts have held that this policy is not judicially enforceable.) In practice, the most significant provision of NEPA is undoubtedly §102(2)(c). This section is designed to force agencies to take environmental factors into consideration when making significant decisions. The crucial language of this subsection reads as follows:

The Congress authorizes and directs that, to the fullest extent possible: . . . (2) all agencies of the Federal Government shall:

. . .

(c) include in every recommendation or report on proposals for legislation and other major Federal actions significantly affecting the quality of the human environment, a detailed statement by the responsible official on

(i) the environmental impact of the proposed action,

(ii) any adverse environmental effects which cannot be avoided should the proposal be implemented,

(iii) alternatives to the proposed action . . .²⁷

Section 102(2)(c) goes on to require the lead federal agency to consult other agencies with jurisdiction over or special expertise concerning the environmental problem involved. Copies of the EIS are to be circulated among relevant government agencies and to the public (though in practice access by the general public may be more of an aspiration than a reality). Other provisions of NEPA establish the Council on Environmental Quality (CEQ), which has been designated as the lead agency in implementing the EIS requirement.²⁸

The CEQ regulations now contain detailed procedural requirements for the entire EIS process. The process begins with an environmental assessment (EA), which is a brief analysis of the need for an EIS.²⁹ The EA must also consider

alternatives to the proposed action, as required by §102(2)(E) of NEPA. If the agency decides not to prepare an EIS, it must make a finding of no significant impact (FONSI) available to the public. Some agencies provide for public comment before the FONSI determination is made, but others do not.³⁰

If the agency does decide to prepare an EIS, the first step in the EIS process is called scoping. Scoping is intended to obtain early participation by other agencies and the public in planning the EIS, to determine the scope of the EIS, and to determine the significant issues to be discussed in the EIS. The actual preparation of the EIS itself involves a draft EIS, a comment period, and a final EIS. Agencies with jurisdiction or special expertise relating to the project are required to comment. Major interagency disagreements are to be referred to the CEQ for its recommendation. When an agency reaches a final decision on the project, it must prepare a record of decision summarizing its actions and explaining why it rejected environmentally preferable alternatives and mitigation measures.³¹

Mitigation measures have become an increasingly important part of the assessment process. When a formal EIS is required, it must include a discussion of the alternatives to the proposed action, including mitigation measures. The leading case on the issue of what alternatives must be included in the EIS is *NRDC v. Morton*.³² The impact statement must discuss all reasonable alternatives within the jurisdiction of any part of the federal government, even if a particular alternative is outside the authority of the specific agency in charge of the project. The court also held that the EIS must discuss the environmental effects of all the reasonable alternatives. The test for deciding these issues is whether a reasonable person would think that an alternative was sufficiently significant to warrant extended discussion.³³

If the EIS is to be more than a checklist of alternative actions, the consequences of each alternative must be discussed in detail. One frequently litigated issue is whether the discussion of the environmental impacts of the alternatives was adequate. In deciding which impacts must be discussed, the test once again is the “rule of reason.” Speculative impacts need not be discussed. Much the same is true for the

would trigger review. The need for adaptation rather than proposing a new project should trigger adaptation assessment.

24. National Environmental Policy Act (NEPA) of 1969, 42 U.S.C. §§4321-4370f, ELR STAT. NEPA §§2-209.

25. 42 U.S.C. §4331.

26. For an appraisal of the statute by its principal draftsman, see LYNTON KEITH CALDWELL, *THE NATIONAL ENVIRONMENTAL POLICY ACT: AN AGENDA FOR THE FUTURE* (1998). The legislative history of the statute is discussed in DANIEL R. MANDELKER, *NEPA LAW AND LITIGATION* §2.02 (2d ed. 1998).

27. 42 U.S.C. §4332(2)(c).

28. NEPA §§202-209, 42 U.S.C. §§4342-4347.

29. As noted earlier, when this specific form of environmental assessment is involved, the term will be capitalized or the abbreviation EA will be used, opposed to the use of the term as a generic description of project assessment.

30. NEPA TASK FORCE, *THE NEPA TASK FORCE REPORT TO THE COUNCIL ON ENVIRONMENTAL QUALITY: MODERNIZING NEPA IMPLEMENTATION* 19 (2003).

31. The CEQ has attempted to clarify both the timing and scope issues. The current regulation, 40 C.F.R. §1508.23 (West 2009), defines the term “proposal” as follows:

Proposal exists at that stage in the development of an action when an agency subject to the Act has a goal and is actively preparing to make a decision on one or more alternative means of accomplishing that goal and the effects can be meaningfully evaluated.

Other CEQ regulations make it clear that the EIS should be “prepared early enough so that it can serve practically as an important contribution to the decisionmaking process,” not simply “to rationalize or justify decisions already made.” 40 C.F.R. §1502.5 (West 2009). The CEQ regulations also require the EIS to consider: (a) connected actions which are closely related; (b) actions which may have a cumulative effect with the proposed action under consideration; and (c) similar actions that should be considered together in view of other “reasonably foreseeable or proposed agency action.” 40 C.F.R. §1508.25 (West 2009).

32. *NRDC v. Morton*, 458 F.2d 827, 2 ELR 20029 (D.C. Cir. 1972).

33. This test was endorsed by the U.S. Supreme Court in *Vermont Yankee Nuclear Power Corp. v. NRDC*, 435 U.S. 519, 8 ELR 20288 (1978).

EA in situations where the agency does not find a need for a full-scale EIS.

Agencies have also relied increasingly on promises of mitigation to avoid the need to prepare an EIS. “Mitigated FON-SIs” are increasingly common, meaning approval for projects that would otherwise have significant environmental impacts except for the use of mitigation measures.³⁴ This development can be seen in a positive light:

The use of the mitigated FONSI is the best evidence we have that NEPA is actually altering agency decision-making and improving environmental performance. Agencies are redefining projects to include mitigation measures that reduce adverse environmental impacts below the “significant” threshold. Moreover, through use of the mitigated FONSI, they are presumably achieving these environmentally beneficial results at a lower cost and in less time than would be required if they went through the full-blown EIS process. That is a positive outcome, not a negative one. It is evidence that NEPA works.³⁵

Compared to other environmental statutes, NEPA is strikingly simple and seemingly mild. It does not provide for elaborate penalties or enforcement mechanisms, nor for complex regulatory standards. Nevertheless, it became an important tool of environmentalists soon after it was passed. The statute is also thought to have had an important effect on decisionmaking by agencies, though rigorous empirical evidence on this question does not exist.³⁶

There has been a long-term decline in the number of EISs, with a corresponding expansion of less detailed EAs. In recent years, the number of full-scale EISs has declined, so that we are seeing only about 250 projects with EISs annually compared to about 50,000 EAs leading to FONSI.³⁷ The bulk of federal EISs (70%) have come from four agencies: the U.S. Department of Transportation, the U.S. Department of Agriculture, the U.S. Department of the Interior, and the U.S. Army Corps of Engineers.³⁸ The average cost of an EIS at the U.S. Department of Energy was \$6 million, whereas EAs cost around \$100,000.³⁹

In terms of information production, this means that a full-scale evaluation of environmental impacts is performed for approximately 250 projects a year. But in 200 times as many cases, only an EA is performed. In an unknown percentage of those EAs, the justification for a FONSI is based on projections about the effectiveness of mitigation measures. As we will see later, however, there is at best haphazard monitoring of the success of mitigation measures, and even if there were compulsory monitoring, the difficulty of obtaining access to

the EAs themselves by the public would prevent any systematic comparison of predictions with outcomes.

Although the NEPA EIS process has had its successes, time has also revealed significant weaknesses that should be addressed in designing the process for climate impact assessments. We turn to a discussion of those weaknesses and how climate impact planning can improve on NEPA.

B. The Need for Mainstreaming the Assessment Process

A key issue is that the EIS process has been isolated from agencies’ primary decision processes. U.S. Supreme Court decisions have allowed agencies to use the EIS as an end-of-process disclosure document rather than an integral part of the agency’s decisionmaking. In *Aberdeen & Rockfish RR v. Students Challenging Regulatory Procedures [SCRAP II]*,⁴⁰ the Supreme Court rebuffed the claim that NEPA requires agencies to integrate the EIS into their normal decisionmaking process; instead, according to the Supreme Court, the statute requires only that the statement be completed at the time the formal decision is announced.

“This approach is unacceptable in the adaptation context. We do not need simply better public disclosure of adaptation issues; we need better decision making. Mainstreaming adaptation means using or creating mechanisms that allow decisionmakers to integrate future climate risks into all relevant policy interventions, planning, and management.”⁴¹ Hence, we need to make sure that adaptation assessments are deeply embedded in agency decisionmaking rather than being considered an inconvenient form of paperwork required to help rationalize a decision that was already made.

C. The Need for Dynamic Learning in Adaptation Assessment

NEPA provides few learning mechanisms. Once an EIS is issued, the agency has no duty to follow up and confirm whether the statement’s predictions were valid. The relatively sparse studies that are available are not reassuring on this score. The one-shot nature of EA has been a frequent source of criticism.⁴² As a result, the assessment process ignores “unanticipated changes in environmental conditions, inaccurate predictions, or subsequent information that might affect the original environmental protections.”⁴³

Follow-up is particularly important in connection with adaptive management:

34. Bradley C. Karkkainen, *Whither NEPA?*, 12 N.Y.U. ENVTL. L.J. 333, 348 (2004).

35. *Id.* at 348-49.

36. See DANIEL A. FARBER ET AL., *CASES AND MATERIALS ON ENVIRONMENTAL LAW* 510-11 (7th ed. 2006).

37. Karkkainen, *supra* note 34, at 347-49.

38. NAT’L ACAD. OF PUB. ADMIN., *MANAGING NEPA AT THE DEPARTMENT OF ENERGY* 6 (1998), available at <http://71.4.192.38/NAPA/NAPAPubs.nsf?OpenDatabase>.

39. *Id.* at 26-27.

40. 422 U.S. 289, 5 ELR 20418 (1975). The Council on Environmental Quality does instruct agencies, however, to prepare the EIS “early enough so that it can serve practically as an important contribution to the decisionmaking process and will not be used to rationalize or justify decisions already made.” 40 C.F.R. §1502.5 (2008). The regulation does not, however, require the agency to actually consider the EIS in making its decision.

41. CAL. CLIMATE CHANGE CTR., *PREPARING FOR THE IMPACTS OF CLIMATE CHANGE IN CALIFORNIA: OPPORTUNITIES AND CONSTRAINTS FOR ADAPTATION* 24 (2006).

42. See Flournoy et al., *supra* note 1, at 1584-85.

43. NEPA TASK FORCE, *supra* note 30, at 44.

Adaptive management emphasizes formal experimentation with replicates, controls, and extensive monitoring. . . . Adaptive management is a knowledge driven system, and environmental impact statements can be a central supplier of the relevant data. . . . Because environmental impact statements continually revisit the environmental health of particular regions, environmental assessments build up the knowledge base as they accumulate over time.⁴⁴

Although the viability of adaptive management as an environmental tool is debated, there can be no doubt on one point: Without monitoring of outcomes, successful adaptive management is not even a possibility.

How can we encourage agencies to mainstream climate impact assessment? First, although consultants will often have valuable expertise, the preparation of climate assessments should not be outsourced to consultants. The agency needs to have in-house expertise and staff buy-in. Second, climate assessments should not await the proposal of particular projects. Instead, as discussed later, the agency needs to be proactive and consider climate impacts even before specific projects are on the table. Third, the agency's attention to climate issues should be monitored by a high-level official who reports directly to the agency head.

D. Monitoring and Dynamic Learning

One of NEPA's major flaws, which climate assessment needs to avoid at all costs, is the absence of dynamic learning. NEPA does not require agencies to perform later checks on their EIS predictions, and agencies do not generally do so.⁴⁵ Existing evidence is not reassuring. Studies find that the predictions are often too vague to be tested at all. Among those that can be verified, the results are no more reassuring, with fewer than one out of three being substantially accurate.⁴⁶

This is not a peculiarly American problem—studies from Canada and the United Kingdom produce similar results.⁴⁷ In contrast, however, the Netherlands does require systematic monitoring of project impacts, though compliance may be spotty.⁴⁸ Case studies indicate that “better prediction products arise more from the feedback between predictions and experience than from the introduction of more sophisticated predictive methodologies.”⁴⁹

Without the check provided by such feedback, overly optimistic predictions can result from the “economic and political pressures placed on the technical consultants and the government managers, which lead them to use inadequate

models and to misuse their predictive results.”⁵⁰ As one study puts it:

In the absence of any inducements linked to actual performance, a decisionmaker is likely to be averse to the substantial risk that an audit will prove embarrassing by documenting a project's shortcomings. Thus, with few positive incentives to self-evaluation and substantial risks, agency managers seem to live by the maxim that ignorance is bliss.⁵¹

The same study found that only one-third of predictions in EISs were “particularly accurate,” most of the remainder being “either accurate solely by virtue of the vagueness of the forecast or somewhat inaccurate in various complicated ways.”⁵² It should be noted that the unreliability of the predictions makes the use of mitigated FONSI's a bit suspect, since we cannot have any real confidence that the mitigation measures will actually reduce the impacts below the “significance” level.

The absence of follow-up under NEPA is a serious problem, in part because promised mitigation plans are not always implemented.⁵³ Most agencies seem to have no formal procedures for ensuring that mitigation measures are actually put in place, although the U.S. Army has recently taken the lead by imposing such a requirement.⁵⁴ Thus, the environmental impacts may be much more serious than predicted in an EA simply because mitigation commitments are not honored.

As others have observed, active learning is a key to adaptation. In this setting, “[k]nowledge is dynamic; it accumulates through observation, monitoring, and analysis.”⁵⁵ One solution to this problem is to impose formal monitoring requirements on agencies.⁵⁶ While this possible solution has appeal, it may be too expensive to institute across-the-board; after all, “[m]onitoring is not free.”⁵⁷ An emerging model of assessment is tied with adaptive management, which involves a cycle of planning, implementation, and reappraisal.⁵⁸ Of course, this process can only be effective if the proposals, predictions, and appraisals are all available for study. (As the next section discusses, availability is a real deficiency in NEPA implementation.) In any event, we do need to institutionalize follow-up mechanisms to check on the effectiveness of climate adaptation policies.

E. Use of Modern Information Technology

The government has not taken advantage of modern information technology to make all of the EIS documents easily

44. Joseph F.C. DiMento & Helen Ingram, *Science and Environmental Decision Making: The Potential Role of Environmental Impact Assessment in the Pursuit of Appropriate Information*, 45 NAT. RESOURCES J. 283, 299 (2005).

45. Bradley C. Karkkainen, *Toward a Smarter NEPA: Monitoring and Managing Government's Environmental Performance*, 102 COLUM. L. REV. 903, 927 (2002).

46. *Id.* at 928.

47. *Id.* at 928-29.

48. *Id.* at 951.

49. Daniel Sarewitz et al., *Conclusion*, in PREDICTION: SCIENCE, DECISION MAKING, AND THE FUTURE OF NATURE 359, 369 (Daniel Sarewitz et al. eds., 2000) [hereinafter PREDICTION].

50. Robert E. Moran, *Is This Number to Your Liking? Water Quality Predictions in Mining Impact Studies*, in PREDICTION, *supra* note 49, at 185, 187.

51. PAUL J. CULHANE ET AL., FORECASTS AND ENVIRONMENTAL DECISIONMAKING: THE CONTENT AND PREDICTIVE ACCURACY OF ENVIRONMENTAL IMPACT STATEMENTS 146 (1987).

52. *Id.* at 253.

53. ROBERT G. DREHER, NEPA UNDER SIEGE: THE POLITICAL ASSAULT ON THE NATIONAL ENVIRONMENTAL POLICY ACT 21 (2005).

54. *Id.* at 22.

55. EASTERLING ET AL., *supra* note 13, at 25.

56. Karkkainen, *supra* note 45, at 938.

57. *Id.* at 940.

58. See DAVID P. LAWRENCE, ENVIRONMENTAL IMPACT ASSESSMENT: PRACTICAL SOLUTIONS TO RECURRENT PROBLEMS 464-87 (2003).

available and connected with geographic information systems (GIS). A huge amount of money is invested in generating data and analysis that then disappears from view. In today's digital world, one would expect that EAs would be readily accessible. After all, it is practically a cliché that "wireless communications and the Internet portend the 'end of distance' and the 'collapse of time.' . . . Links to virtually anyone on the planet, or to data sets anywhere in the world, are now available at any time at very low cost."⁵⁹ This is undoubtedly true for many forms of information, but not for EAs. Not only is the information in the assessments hard to access, but there is not even a system for tracking what assessments have been performed, let alone their contents. Federal EAs and FONSI are not subject to any formal reporting requirement, and even the agencies themselves make little effort to track them:

Perhaps the most important reason that Environmental Assessments and FONSI have been so little explored in the legal and policy literature is that they are maddeningly difficult to ferret out. . . . [A]n EA (whether it results in a FONSI or a mitigated FONSI) need not be reported to CEQ, EPA, or any other central compiler, nor is Federal Register notice required. In most agencies, even the NEPA compliance officers at agency headquarters do not track or compile EAs and FONSI, devolving such duties to regional or subregional offices where record keeping may be lax or inconsistent across regions. Thus, in many cases it is difficult, if not impossible, for interested persons even to learn that an EA has been produced, much less to gain access to its contents.⁶⁰

In contrast to EAs, EISs are subject to *Federal Register* notice requirements and available to the public on request. Yet, access to the EIS itself is not always easy. A U.S. Environmental Protection Agency (EPA) website provides chronological listings of all draft and final impact statements.⁶¹ This itself compares favorably to the treatment of EAs, the less detailed preliminary documents used to determine if an EIS is required. But if users want to actually see the EIS, the site offers very little help. Users of the site are advised:

EPA does not have copies of Environmental Impact Statements (EISs) available for public distribution. Instead, we recommend that you request a copy directly from the agency that prepared the EIS. A good place to start is to telephone the agency "contact person" listed in EPA's weekly Notice of Availability of EISs. In addition, several agencies are publishing entire copies of EISs on the internet (check each agency's website to determine online availability).⁶²

Users are also referred to a Northwestern University site, which provides a link to the library's online book catalogue and instructions on how to obtain copies through interli-

brary loan.⁶³ The Northwestern site also cites a printed digest of EIS abstracts organized by broad subject headings.⁶⁴

In addition, it turns out that about one-third of current EISs (and some California EAs) are available at the Humboldt State University library.⁶⁵ Humboldt State also has an index and detailed abstract, but these are unfortunately available only to university users. EISs as well as a host of other environmental documents relating to southern Oregon have been digitized,⁶⁶ and there may be some other similar collections for specific regions.

The absence of an integrated database may be related to a perceived lack of consistency and learning for EISs. A recent study concludes that

[t]here appears to be very little learning from previous years of DEIS preparation in [ratings for] informational quality of environmental impact of the preferred alternative Documents are not of higher quality now than in the past. In fact, there were more top ratings of DEIS in the 1970s than today, even with standardizing for the large volume of documents in the 1970s vs. later years.⁶⁷

Integrating information between documents is made difficult by the idiosyncratic nature of EISs. EISs differ both within and between agencies, often making it impossible "to make meaningful comparisons, or to aggregate or synthesize information across multiple EISs, over time, or among agencies with disparate NEPA practices."⁶⁸ In addition, because agencies buy software and hardware independently of each other, interoperability can be a serious problem.⁶⁹

Climate adaptation assessments need to be available online. Preferably, they should be linked to GIS, so that assessments for particular geographic areas, ecosystems, or water basins can be easily identified.⁷⁰ None of this is particularly difficult technically, it merely requires organization and funding to establish the database, and a mandate that ensures submission of documents to be posted.

The potential benefits of making climate adaptation statements available online are obvious. First, online access would make it possible for the public to readily obtain copies of information about projects and climate impacts affecting them. In theory, this information can be obtained already, if only by making a formal request under the Freedom of Information Act. But there is a vast difference between making information available to the strongly motivated, legally

63. Northwestern University Library, How to Search for Environmental Impact Statements (EIS), <http://www.library.northwestern.edu/transportation/searcheis.html> (last visited Nov. 7, 2007).

64. *Id.*

65. Humboldt State University Library, Environmental Impact Assessment Reports, <http://library.humboldt.edu/infoservices/FEIRsandEISs.htm#fedreports> (last visited Sept. 2, 2008).

66. Southern Oregon Digital Archives, About Bioregion Collection, <http://soda.sou.edu/bioregion.html> (last visited May 27, 2009).

67. Kelly Tzoumis & Linda Finegold, *Looking at the Quality of Draft Environmental Impact Statements Over Time in the United States: Have Ratings Improved?*, 20 ENVTL. IMPACT ASSESSMENT REV. 557, 576 (2000).

68. Karkkainen, *supra* note 45, at 923.

69. NEPA TASK FORCE, *supra* note 30, at 20.

70. For observations on the utility and limitations of GIS in the climate change context, see Shalini P. Vajjhala & Janet Nackoney, *The New Cartography of Climate Change*, RESOURCES, Fall 2008, at 16.

59. Daniel C. Esty, *Environmental Protection in the Information Age*, 79 N.Y.U. L. REV. 115, 160 (2004).

60. Karkkainen, *supra* note 45, at 946.

61. U.S. EPA, Environmental Impact Statement (EIS) Database, <http://cfpub.epa.gov/compliance/nepa/current/> (last visited Jan. 2, 2009).

62. U.S. EPA, Obtaining Environmental Impact Statements, <http://www.epa.gov/compliance/nepa/obtaineis/index.html> (last visited Jan. 2, 2009).

informed observer and making it available to the average member of the public.

Second, online information would become immediately searchable. Even without being organized into a formal database, search engines such as Google would make it possible to access information via the Internet. This would likely be a somewhat inefficient process. The researcher seeking assessments concerning a particular species or ecosystem type might have to work through considerable extraneous information. Searches would be expedited by creating a database with its own search engine, designed to efficiently retrieve information from EAs.

Third, follow-up on adaptation measures would be much easier if the assessments themselves were readily available. This would make it possible to quickly determine what adaptation measures had been promised and what the predicted results were supposed to be. This is the necessary precondition for any effort at follow-up: you cannot follow up on predictions whose existence is unknown to you, or monitor mitigation promises that have vanished into the archives.

F. Sophisticated Methodologies for Analyzing Poor Quantifiable Risks

One aspect of climate change is increased uncertainty: “No longer can the historical record be relied on to guide the design, construction, and planning of water projects.”⁷¹ Although we can be confident in predicting global warming and increased climate change, the magnitude of climate change cannot be predicted accurately.

Government agencies are beginning to realize the importance of taking this uncertainty into account. For instance, California’s adaptation effort calls for the following:

An assessment of the region’s vulnerability to the long-term increased risk and uncertainty associated with climate change.

- An integrated flood management component.
- A drought component that assumes, until more accurate information is available, a 20 percent increase in the frequency and duration of future dry conditions.⁷²

The issue of uncertainty is central to environmental policy; indeed, the “obstacles that uncertainty creates for protecting natural resources, health, and safety under existing statutes are well documented.”⁷³ New methodologies developed by economists and decision theorists may be helpful in identifying robust strategies for dealing with nonquantifiable uncertainties, but these methodologies are not in general use.

One way to control for model uncertainty is called robust optimal control. Under this approach, to correct for uncertainty about the correctness of their preferred model, policymakers consider alternate models that are “close” to their baseline model, in the sense of being statistically

hard to distinguish from the baseline model. In the climate change context, the implication is that policymakers should react more aggressively and pursue more stringent mitigation strategies.⁷⁴

RAND researchers are developing methods to use computer assistance in scenario planning.⁷⁵ The key is a technique called Robust Decision Making (RDM):

RDM uses computer models to estimate the performance of policies for individually quantified futures, where futures are distinguished by unique sets of plausible input parameter values. Exploiting recent advances in computing power, RDM evaluates policy models once for each combination of candidate policy and plausible future state of the world to create large ensembles of futures. These ensembles may include a few hundred to hundreds of thousands of cases.⁷⁶

This technique provides a method for examining many potential scenarios in order to determine which characteristics of the scenarios are critical to the success or failure of particular strategies. The RAND technique has considerable potential:

For policy problems that have a large or unlimited number of possible policy approaches, RDM provides a systematic way of exploring these possible policies to efficiently identify and evaluate the policies that are likely to be robust. RDM first uses visualization and statistical analysis to identify policies (from the initial set) that perform well over many possible states. RDM then uses data-mining techniques to reveal under which future conditions such policies are vulnerable to poor performance. Examination of these key vulnerabilities (which can be considered “scenarios”) can suggest ways to craft new policies that hedge against the vulnerabilities. The analysis then identifies one or more new candidate robust policies and re-evaluates the performance of all policies against the different plausible future states. Through each iteration, the candidate policies become increasingly robust, and those key scenarios to which the policies are vulnerable are identified.⁷⁷

These methods may be especially useful when society must make large, long-term investments in infrastructure such as dams, water supply systems, or major power plants. Investments that fare well under some future scenarios may do badly in others, and a major purpose is to choose investments that are resilient across the most relevant risks. Computerized

74. Michael Funke & Michael Paetz, *Environmental Policy Under Model Uncertainty: A Robust Optimal Control Approach* (CESifo, Working Paper Series No. 1938, 2007), available at http://papers.ssrn.com/sol3/papers.cfm?abstract_id=971461. In essence, robust optimal control requires the policymaker to consider alternative models that are in some sense close to the preferred model but that produce more drastic predictions—thus, it could be considered as a way of considering plausible worst-case scenarios. *Id.* at 2.

75. David G. Groves, *New Methods for Identifying Robust Long-Term Water Resources Management Strategies for California* (Sept. 2005) (unpublished Ph.D. dissertation, Pardee RAND Graduate School), available at http://www.rand.org/pubs/rgs_dissertations/2006/RAND_RGSD196.pdf.

76. *Id.* at 125. See also David G. Groves & Robert J. Lempert, *A New Analytic Method for Finding Policy-Relevant Scenarios*, 17 GLOBAL ENVTL. CHANGE 73 (2007).

77. Groves, *supra* note 75, at 125.

71. EASTERLING ET AL., *supra* note 13, at 22.

72. CAL. DEP’T OF WATER RES., *supra* note 22, at 12.

73. Flournoy et al., *supra* note 1, at 1597.

scenario analysis can help determine the key areas in which investments vary in their resilience, so that policymakers can make informed choices between them.

Scenario analysis may also help determine what factual issues are critical for deciding between options. This makes it possible to focus research on policy-relevant issues. We should not consider the degree of uncertainty to be fixed forever. One role of modeling is to help us identify research priorities.

We have fairly good methods for analyzing situations in which risks can be quantified with reasonable confidence. We need improved methods for dealing with situations where such estimates do not exist or are subject to considerable uncertainty. The RAND methodology is a good start toward achieving such improved methodologies. Adaptation planners should aggressively utilize methodologies of this kind—and certainly should not rely on identifying the most likely or mean scenario as the sole basis for planning, without sensitivity analysis and consideration of the full range of possibilities.

G. Expanding the Agency's Agenda to Include "Overlooked" Adaptation Issues

Existing EA mechanisms are triggered by agency *actions*. They do not require assessments of the status quo but only of proposed changes in the status quo. There is nothing to prevent an agency from simply ignoring an emerging problem; NEPA kicks in only when the agency considers actually doing something rather than sitting still.⁷⁸

The reactive nature of the assessment process may be appropriate in contexts where the status quo is presumptively desirable, appropriate, and/or unchanging, but it is definitely not acceptable when dealing with climate adaptation, where the whole point is that the status quo will become unsustainable due to climate change. For example, "[p]roactive adaptation to climate change may necessitate periodic reassessment of the adequacy and preparedness of relief systems and programs, particularly in light of changing frequency and intensity of extreme events."⁷⁹ Yet, it is difficult to craft a general mandate that would require agencies to identify the key areas under their jurisdiction where assessment of adaptation needs is a priority.

A starting point would be to require agencies to produce reports on adaptation planning on a regular basis, such as every five years, just as water agencies in states like California are required to consider certain drought possibilities in their planning. But agencies may fail to produce adequate reports even under such a mandate.

There are a series of potential responses to this problem of policing agency failure to assess adaptation needs:

- (1) A petition process akin to that used under the Endangered Species Act⁸⁰ for listing species, where citizens could petition the agency to list a "critical adaptation need." For this to be effective, some specific metrics to determine the significance of an adaptation need would be required.
- (2) Investigative reports by independent bodies such as the Government Accountability Office (GAO) or the National Academy of Science.
- (3) A system of prizes for citizens who successfully identify high-priority needs for climate impact assessment. The prize would be awarded by an independent entity but would be funded out of the agency's operating budget, providing a small "stick" in addition to publicity impacts.
- (4) Adoption of legal rules making agencies liable for negligent failure to engage in climate adaptation. California law in effect provides a mechanism for this in the context of flood control.⁸¹ The use of risk markets (akin to the presidential prediction markets such as <http://www.biz.uiowa.edu/iem/>) trading long-term risk contracts for key climate impacts such as water supply impairments or flood frequency, with the parameters being set at levels that would indicate a failure of current systems.

Several of these techniques are promising. The use of outside reviewers such as GAO should be regularized as a way of checking for overlooked adaptation needs. A less conventional approach is the use of prizes, but this might provide a way of opening the process to broader public participation. In any event, we need to be attentive to the danger that agencies will take the status quo for granted and consider adaptation issues only when required to do so in the context of specific project proposals.

III. Conclusion

As we begin to design climate adaptation into our institutions, we should be careful to learn from past failures rather than repeating them. After almost four decades, we have had many opportunities to see NEPA's system of EA in action. We can do better in approaching climate adaptation assessment.

As discussed above, we can learn five valuable lessons for Climate Adaptation Statements from NEPA's shortcomings:

78. By its terms, NEPA requires an EA only when the agency is considering a proposal to take action, not when it is completely passive. For example, the government was not subject to NEPA when it failed to halt actions by private parties on public lands. See *Defenders of Wildlife v. Andrus*, 627 F.2d 1238, 10 ELR 20163 (D.C. Cir. 1980); *Inaction as Action Under NEPA: EIS Not Required for Interior's Failure to Halt Alaskan Wolf Hunt*, 10 ELR 10055 (Mar. 1980).

79. EASTERLING ET AL., *supra* note 13, at 25.

80. 16 U.S.C. §§1531-1544, ELR STAT. ESA §§2-18.

81. The modern development of flood liability in California began with *Belair v. Riverside County Flood Control Dist.*, 764 P.2d 1070 (Cal. 1988). In *Belair*, a flood control levee on the San Jacinto gave way, flooding parts of the city of San Jacinto. The California Supreme Court took this occasion to establish a new rule for determining the state's responsibility for flood damages, based firmly on the need to spread the risks created by unreasonably flawed flood control systems.

- Assessment of climate impacts and adaptation needs must be an integral part of the agency's decisionmaking process, not an afterthought, as is too often the case for EAs. Climate impact assessments should be available online and linked with GIS.
- Formal follow-up mechanisms must be institutionalized, and information about the effectiveness of adaptation measures must be readily available online.
- Planning should consider a range of potential adaptation scenarios to identify robust adaptation measures.
- To ensure that agencies adopt a proactive approach to adaptation, mechanisms such as a prize process should be used to ensure that adaptation needs are identified, rather than having adaptation considered only when specific projects are on the agency's agenda.

Climate impact analysis faces special challenges if it is to become an effective action-forcing technique, because of the long-term nature of climate change, the difficulty of separating current climate effects from statistical noise, and the limitations of climate modeling. Yet, if our society is to thrive in the next century, we need to implement climate impact analysis on a large scale and take seriously the results of the analysis. Developing effective methods of identifying relevant impacts and appropriate responses will not be done overnight, but the process needs to be begun, the sooner the better.