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**ELEVENTH ANNUAL LLOYD K. GARRISON
LECTURE ON ENVIRONMENTAL LAW**

**Irreversible and Catastrophic: Global
Warming, Terrorism, and Other Problems¹**

CASS R. SUNSTEIN*

Thank you very much. It's a pleasure to be here. I had a fantastic afternoon on the premises. I'm really grateful for the warmth and the substantive conversations.

What I'm going to be focusing these comments on is something called the precautionary principle. And if you haven't heard of the precautionary principle, you will before long. The precautionary principle is very popular in Europe. It is an idea for organizing environmental protection and regulation of risk in general. The United States in the last few years has fought hard against the precautionary principle on grounds that are occasionally obscure. But one thing that we can say is that the United States, in the last few years, has in one sense firmly endorsed the precautionary principle. In defending the Iraq War and many measures to fight against terrorism, the United States emphasized that you don't need certainty that harm will occur; you

1. This is a lightly edited transcript of the lecture Professor Sunstein delivered at Pace University School of Law on April 25, 2005. The lecture drew heavily on three works: Cass Sunstein, *Irreversible and Catastrophic*, CORNELL L. REV. (forthcoming 2006); CASS SUNSTEIN, *LAWS OF FEAR: BEYOND THE PRECAUTIONARY PRINCIPLE* (2005); and Cass Sunstein, *Beyond the Precautionary Principle*, 151 U. PA. L. REV. 1003 (2003) [hereinafter *Beyond the Precautionary Principle*].

* Karl N. Llewellyn Distinguished Service Professor of Jurisprudence, University of Chicago Law School and Department of Political Science.

should take preventive action because of the risk that harm will occur. The basic idea behind the precautionary principle is that we should build a margin of safety into our decisions—an idea that environmentalists in Europe emphasize in thinking about global warming, in thinking about destruction of the ozone layer, in thinking about clean air and clean water in general.² With respect to terrorism, the Iraq War was explicitly defended on the grounds that we need a margin of safety in all decision-making. The White House did not believe that Saddam Hussein definitely had weapons of mass destruction. It thought that there was some probability that he had weapons of mass destruction, and that that was enough to justify action.

I'm going to be making three suggestions here. The first is that the precautionary principle is incoherent. Risks are on all sides of social situations. It's just not possible to take precautions against all of them at the same time. So what Europe celebrates is an unfortunate basis for environmental and other decision-making, because it leads to paralysis and not to environmental protection.

My second claim is that the precautionary principle gives the misleading appearance of helpfulness just because of the way the human mind works. When we think about risks—and maybe this will resonate with your experience in the last six months and possibly in the next six months—when we think about risks, human minds tend to single out one or two from the background and fixate on them without thinking about the extent to which efforts to reduce the risks on which we're fixating may give rise to risks of their own. So if you think, I'm nervous about going into a bad neighborhood at night, I think I'll stay home, it may be that staying home introduces its own risks with respect to health or otherwise. So what I'm going to suggest is that the precautionary principle, which is incoherent, gives the appearance of coherence and usefulness because human minds select some of the universe of relevant risks.

Those are negative claims. Those are points against our friends in Europe. The third claim is an effort to rescue the pre-

2. See, e.g., INDOR GOKLANY, *THE PRECAUTIONARY PRINCIPLE: A CRITICAL APPRAISAL OF ENVIRONMENTAL RISK ASSESSMENT* 5 (2001) ("In order to protect the environment, the precautionary approach shall be widely applied by States according to their capabilities" (quoting U.N. Conference on Environment & Development (UNCED), June 3-14, 1992, *Rio Declaration on Environment and Development, Principle 15*, U.N. Doc. A/CONF.151/26 (Aug. 12, 1992) (hereinafter *Principle 15*))).

cautionary principle by suggesting that if we focus on a subset of risks, including environmental risks, we can make progress toward a more sensible way of orienting our laws and policies. And the subset that I'm going to identify includes those risks that are irreversible and catastrophic. Hence my title, *Irreversible and Catastrophic*—my cheerful title—the thought being that irreversible and catastrophic risks are ones against which we ought to take precautions, and those are the ones for which the precautionary principle is sensible. The rest is just going to be footnotes. But in law-professor fashion, there are going to be a lot of footnotes and they're going to be pretty long. So here goes.

Footnote one: What is the precautionary principle with which I started? There are some versions that are weak and there are some versions that are strong. The weak version suggests that a lack of decisive evidence of harm ought not to be a ground for refusing to regulate. Think for example about smoking and tobacco regulation in the 1960s. Then, we didn't have decisive evidence that smoking was going to cause cancer, but sensible people didn't smoke on the ground that they were going to build a margin of safety into their decision by saying, The fact that there isn't definitive evidence isn't a reason to refrain from precaution. So the 1992 Rio Declaration involving climate change says, "lack of full scientific certainty shall not be used as a reason for postponing cost-effective measures to prevent environmental degradation."³ Think for example about global warming or air pollution or water pollution, where we don't have a full sense of how large the harm is.

The ministerial declaration of an international conference on the protection of the North Sea is in the same weak vein: "[A] precautionary principle is necessary which may require action to control inputs of [dangerous] substances even before a causal link has been established by absolutely clear scientific evidence."⁴ Straightforward and sensible.

Here's a stronger version, from a group of environmentalists in the 1990s: "When an activity raises threats of harm to human

3. BJØRN LOMBORG, *THE SKEPTICAL ENVIRONMENTALIST: MEASURING THE REAL STATE OF THE WORLD* 348 (Hugh Matthews trans., Cambridge Univ. Press 2001) (quoting *Principle 15*, *supra* note 2).

4. Julian Morris, *Defining the Precautionary Principle*, in *RETHINKING RISK AND THE PRECAUTIONARY PRINCIPLE* 1, 3 (Julian Morris ed., 2000) (quoting Second International Conference on the Protection of the North Sea (SICPNS), *Ministerial Declaration* (1987)).

health or the environment, precautionary measures should be taken, even if some cause and effect relationships are not fully established scientifically. In this context, the proponent of the activity, rather than the public, should bear the burden of proof.”⁵ It should be clear that that’s a stronger version because it puts the burden of proof on those who want to expose people to risk. This version doesn’t merely say lack of certainty of harm is not a reason for refraining from regulation. So the proponent of an activity bears the burden of proof.

In Europe, it’s sometimes said that a margin of safety must be built into *all* decision-making.⁶ And think of that as the strong version of the precautionary principle—a margin of safety in *all* decision-making. So, in one European understanding, “[A]ction should be taken to correct a problem as soon as there is evidence that harm may occur”⁷ The possibility that harm may occur is a justification for corrective action.

And, “The precautionary principle mandates where there is a risk of significant damage to others or to future generations, then decisions should be made so as to prevent such activities from being conducted unless and until scientific evidence shows that the damage will not occur.”⁸ That doesn’t build a margin of safety. It doesn’t just shift the burden of proof. It says that it must be shown by a proponent of action that damage will not occur.

The weak version—that is the version that says lack of full scientific certainty isn’t a reason to refrain from action—is fine and good. I don’t have anything to say against that. What I’m going to try to criticize as incoherent is the strong version, that is, the version that requires a demonstration of absolute safety by the proponents of the activity.

Now, to get at the problem we need some examples. And let me just give four in which the precautionary principle has been invoked, both in the United States and in Europe, as a basis for thinking about environmental protection. One example, obvi-

5. *Id.* at 5 (citation omitted). A strong version is defended in Carolyn Raffensperger & Peter L. deFur, *Implementing the Precautionary Principle: Rigorous Science and Solid Ethics*, 5 HUM. & ECOLOGICAL RISK ASSESSMENT 933 (1999).

6. See LOMBORG, *supra* note 3, at 349.

7. *Beyond the Precautionary Principle*, *supra* note 1, at 1013 (quoting Paul McFedries, *Precautionary Principle*, *WordSpy*, Jan. 23, 2002, at <http://www.logophilia.com/WordSpy/precautionaryprinciple.asp>).

8. *The Cloning of Humans and Genetic Modifications: Hearing Before the S. Comm. on Appropriations*, 107th Cong. (2002) (statement of Dr. Brent Blackwelder, President, Friends of the Earth).

ously, is genetic engineering of organisms. Many people who like the precautionary principle (especially in Europe, and there's a movement to this effect in the United States), say that genetic modifications of organisms give rise to risks.⁹ We don't know their magnitude. In the view of some people, we should take a precautionary approach and not allow genetic engineering.¹⁰

Nuclear power is another one, where the halting of nuclear power plants in the United States in the last couple of decades has been driven in part by a precautionary idea that nuclear power gives rise to serious risks.¹¹

Global warming is an area where the United States' perceived intransigence has been criticized in Europe for failing to be precautionary. It's not clear that global warming will occur in a way that's extremely damaging, or at least some people so think. And that, Europeans say, is not a reason for refraining from action; the fact that it's a possible risk means that we should take very aggressive regulatory action.¹²

The Bush Administration's most controversial early decision, see if you remember this, involved arsenic in drinking water, in which the Bush Administration suspended the Clinton Administration's proposal, which was to reduce arsenic levels from fifty parts per billion to ten parts per billion.¹³

In all four of those areas, the precautionary principle is said to require aggressive protection. What I'm going to try to argue is that that's just not so, that for each of these problems the precautionary principle forbids the very steps that it requires. Let's go at it first by thinking about genetic engineering of food and arsenic. Genetic engineering of food, it's true, gives rise to risk; and the precautionary principle calls for precautions against risk. The problem is, if we don't allow genetic engineering of food, we will give rise to risks of starvation; because there's some hope, specula-

9. See Benoit Morel et al., *Pesticide Resistance, the Precautionary Principle, and the Regulation of Bt Corn: Real Option and Rational Option Approaches to Decision-making*, in *BATTLING RESISTANCE TO ANTIBIOTICS AND PESTICIDES* 184, 185 (Ramanan Laxminarayan ed., 2003).

10. See GOKLANY, *supra* note 2, at 55.

11. Energy Information Administration, Nuclear Power, http://www.eia.doe.gov/cneaf/nuclear/page/nuc_generation/newnuc2.html (last visited Sept. 29, 2005) ("No new commercial reactors have come on line in the United States since *Watts Bar 1* in 1996.").

12. See, e.g., Graciela Chichilnisky & Geoffrey Heal, *Global Environmental Risks*, 7 J. ECON. PERSPS. 65, 76 (1993).

13. See Cass R. Sunstein, *The Arithmetic of Arsenic*, 90 GEO. L. J. 2255, 2257, 2261, 2269, 2298 (2002).

tive to be sure, that genetic engineering of food can deliver safe and nutritious and inexpensive food to countries where this is literally lifesaving.¹⁴ A ban on genetic engineering of food is literally dangerous to people who have a great deal to gain from genetic modification. So my suggestion is that the precautionary principle forbids genetic modification of food because it gives rise to risk, but the precautionary principle also forbids forbidding of genetic engineering of food because forbidding genetic engineering of food gives rise to risk.

Let's explore another example: arsenic. The former head of the Environmental Protection Agency, Administrator Christine Whitman, said in the early days of trying to defend the suspension of regulation, that there's something we're worried about, which is the expense of the rule that costs \$210 million, and for some water systems that burden is going to be very hard.¹⁵ And for some users of water that's going to be very expensive—up to \$400 per year or more.¹⁶ And what we're worried about is they're going to stop relying on their water companies and they're going to start using wells, local wells.¹⁷ What worries us about those local wells is that they are contaminated.¹⁸ What Administrator Whitman argued, and it wasn't an implausible worry (it may have been wrong, but it wasn't implausible), was that the arsenic regulation would give rise to risks of its own in the form of increased use of highly contaminated, dirty well water.

Now, mind you, for the purposes of the precautionary principle, the mere fact that the Administrator has legitimate concerns should be decisive. Remember? The burden of proof switches—the possibility that harm may occur is the reason for the invoking of the principle. The arsenic regulation stands both mandated and condemned by the precautionary principle. Mandated, because there's a risk of cancer from levels of arsenic in drinking water that President Bush was thinking of allowing.¹⁹ But the

14. See Chantal Pohl Nielson & Kym Anderson, *Golden Rice and the Looming GMO Trade Debate: Implications for the Poor* 19 (Ctr. for Int'l Econ. Stud., Discussion Paper No. 0322, 2003), available at <http://adelaide.edu.au/cies/papers/0322.pdf>.

15. See Sunstein, *supra* note 13, at 2294-95.

16. See *id.* at 2294.

17. See *News Hour with Jim Lehrer: Interview with Christine Whitman* (PBS television broadcast Apr. 17, 2001), available at http://www.pbs.org/newshour/bb/white_house/jan-june01/whitman_4-17.html.

18. See *id.*

19. Cat Lazaroff, *Bush Administration Throws Out New Arsenic Standard*, ENV'T NEWS SERVICE, Mar. 20, 2001, <http://ens-newswire.com/ens/mar2001/2001-03-20-06.asp>.

precautionary principle also forbids the very regulation because it gives rise to substitute risks.

Think for a moment, if you would, about nuclear power and global warming, my other two examples. Nuclear power seems condemned by the precautionary principle. But its proponents say the following: If you're really worried about air pollution and global warming, you ought to rely on nuclear power, which is much better than fossil fuels which come from coal-fired power plants.²⁰ So they say that aggressive regulation of nuclear power runs afoul of the precautionary principle because it gives rise to risks in the form of increased reliance on coal-fired power plants, which make the air dirty and which contribute to global warming. Forbidding nuclear power seems required by the precautionary principle, and in a way it is. But forbidding nuclear power is also unacceptable under the precautionary principle because if you forbid nuclear power, you're going to increase reliance on coal-fired power plants.

What I'm saying with these examples—genetic modification, nuclear power, and arsenic—is that risks are on all sides of social situations. Not just one. If you push against one risk, it's inevitable that you'll be giving rise to another risk. This should be familiar in everyday life. Think, for example, of that risk-avoidance strategy called "staying at home all day." Probably not very good for your health. Or think, for example, of the strategy of driving, rather than flying, for those who fear the risks associated with airplanes. Driving is risky, too. There is no way of avoiding risks.

What about global warming? Well, the simple fact is that regulations, especially in poor countries, that cost a lot to reduce carbon dioxide emissions, will increase—significantly—expenditures.²¹ And if the expense is high enough, those expenditures will give rise to risks, for example in the form of dying of too much heat—if energy prices increase, you might not be able to afford fans or air-conditioning. That last point about global warming suggests that the very fact that risk regulation is often expensive creates risks of its own.²² And in fact, there are studies sug-

20. See Nuclear Energy Institute, Environmental Preservation, <http://www.nei.org/index.asp?catnum=2&catid=38> (last visited Sept. 29, 2005).

21. See Randall Lutter & John F. Morrall, III, *Health-Health Analysis: A New Way to Evaluate Health and Safety Regulation*, 8 J. RISK & UNCERTAINTY 43 (1994).

22. See Robert W. Hahn et al., *Do Federal Regulations Reduce Mortality?* (AEI-Brookings Joint Ctr. for Reg. Stud., 2000), available at <http://ssrn.com/abstract=259786>.

gesting that in the United States, every time the government requires industry to spend \$10 million to \$30 million, at least one person dies.²³ The mechanism by which the multi-million dollar expenditure produces death isn't agreed upon,²⁴ but think for example of the simple fact that a very expensive regulation will probably increase unemployment and therefore poverty, neither of which is good for your health. So my suggestion is that under the precautionary principle (which forbids government from allowing possible risk to occur), any regulation of an environmentally risky activity is both required by the precautionary principle and forbidden by the precautionary principle for the simple reason that it imposes a possible risk of death, against which we ought to take precautions.

So this is why I suggest that the precautionary principle, in its strong forms, is incoherent. It can be made sensible only if we single out some subset of the risks that social situations present. But it's impossible to be universally precautionary. We can be precautionary with respect to some risks, but not with respect to risks in general. And if this seems implausible, try it. Try to be precautionary in general in the next day or two. Chances are that precautions will give rise to the very risks that precautions induce.

Why then are Europeans and many others excited about the precautionary principle? I suggest that the precautionary principle becomes operational because of the way human minds work, and more particularly, because in assessing risks we tend to rely on something that has an elaborate name—but it's a pretty straightforward idea—called the “availability heuristic.” The availability heuristic says that we assess risks by thinking about the ease with which we can recall an example in which the risk came to fruition.²⁵ So if we don't know a lot about certain situations, we ask, Can we think of an example in which the risk occurred?

Here's a simple way of illustrating the use of the availability heuristic: Suppose that you ask people how many words on a page,

23. Michael Gough, Ph.D, “Environmental Cancer” Isn't What We Thought or Were Told (Mar. 6, 1997), <http://cato.org/testimony/ct-mg030697.html> (written testimony before Senate Cancer Coalition).

24. See Lutter & Morrall, *supra* note 21, at 49 tbl.1.

25. See Amos Tversky & Daniel Kahneman, *Judgment Under Uncertainty: Heuristics and Biases*, in *JUDGMENT UNDER UNCERTAINTY: HEURISTICS AND BIASES* 3, 11-14 (Daniel Kahneman et al. eds., 1982).

a random page, have as the last three letters “ing.” Most people tend to say twenty, twenty-five, fifteen. If you ask people how many words on this page have as the second-to-last letter “n,” people say four, five. The reason is that it’s easy to think of “ing” words, but not easy to think of words that have as the second-to-last letter “n.” So, too, in thinking about whether something gives rise to risks: Available instances often drive judgments.

An example is a recent cross-national study of risk from terrorism and risk from SARS, the illness that struck Canada, and China much worse, in the last few years.²⁶ The studies found that Americans believed that the terrorism risk is much higher than the SARS risk, and Canadians just the opposite.²⁷ The disparity was so large that it couldn’t easily be justified by reference to reality.²⁸ It’s just that Americans have an acute sense, because of the September 11th attacks, of the risk of terrorism, and the sense of the risk is probably wildly inflated. People tend to think that the chance that they, themselves, will die in a terrorist attack next year is about 8 percent—far too high²⁹—whereas we don’t have experiences with SARS. So the fact that terrorism is available cognitively and comes to our minds, and SARS doesn’t, helps to drive judgments.

A study of risk perceptions, in the sense of public concerns about risks in the United States for the past thirty years or so, showed—and this is a happy fact—that our concern about risks basically tracks fluctuations in real risks.³⁰ So as certain risks increase, people are more worried, and as other risks decrease, people are less worried. But there was one exception to this happy finding, which is panic bred by vivid illustrations in which harm came to fruition.³¹ So the mistakes, in which people had an unjustly inflated sense of risk, came from fear of suicide, fear of herpes, and fear of AIDS, in contexts in which the vivid new example made people far more scared than reality warranted.³² So the conclusion is when people got it wrong, it was because a particularly vivid case received considerable media attention.³³

26. See generally Neil Feigenson et al., *Perceptions of Terrorism and Disease Risk: A Cross-National Comparison*, 69 MO. L. REV. 991 (2004).

27. See *id.* at 996.

28. See *id.* at 1008.

29. See *id.* at 996.

30. *Id.*

31. *Id.*

32. See Feigenson et al., *supra* note 26, at 996.

33. *Id.*

A study of Kenya and Malawi tried to figure out when people are worried about and taking precautions against AIDS.³⁴ When do they use in their own behavior precautionary principles to guard against the AIDS risk? The answer was clear: Had they observed or heard about an illness or death?³⁵ The availability heuristic drove people's risk assessment.

My suggestion is, when the United States takes precautions against the risks posed by terrorism, we're not following the precautionary principle in the abstract; it's because that particular risk is available to our minds. When Europeans are especially concerned about mad-cow disease or other risks, it's because those are the risks that are cognitively available to them. I am suggesting that Europe does not in fact practice precaution in general—that it's not a possibility. It adopts a precautionary principle against a particular subcategory of risks that are readily available to European thinking, just because of their own recent experiences.

Okay, that's the end of that footnote, which ends with the claim that it is not possible to be precautionary in general—Europe isn't. The apparent workability of the precautionary principle rests on the fact that human minds naturally fixate on some sets of risks and not on others. When in the context of genetic modification of food, many people are nervous about the risks posed by genetic modification—and it does pose risks—they are fixating on those, and are ignoring the risks posed by refusing to use a technology that has a lot of promise.³⁶ I'm not suggesting that we go forward with genetic modification more than we already have, or that those who like it are right and those who don't like it are wrong. I'm only suggesting that the precautionary principle isn't a helpful entry into the debate.

Okay, now these footnotes have been destructive. Now we're going to try to get constructive. What I'm going to try to do is to figure out a way in which the precautionary principle can be made

34. See Jere R. Behrman et al., *Social Networks, HIV/AIDS, and Risk Perceptions* 1 (Penn. Inst. for Econ. Res., Working Paper No. 03-007, 2003), available at <http://ssrn.com/abstract=382844>.

35. See *id.* at 18-19.

36. See the discussion of risk-related tradeoffs in John D. Graham & Jonathan Baert Wiener, *Confronting Risk Tradeoffs*, in *RISK VS. RISK: TRADEOFFS IN PROTECTING HEALTH AND THE ENVIRONMENT* 1, 1-41 (John D. Graham & Jonathan Baert Wiener eds., 1995); Cass R. Sunstein, *Health-Health Tradeoffs*, in *RISK AND REASON: SAFETY, LAW, AND THE ENVIRONMENT* 133, 133-52 (2002); Nielson & Anderson, *supra* note 14.

workable for purposes of environmental law and environmental protection, possibly with regulation in general, conceivably even for human life.

A first way of trying to get at this might be to suggest that in the environmental context there's a distinctive argument for a precautionary principle. Meaning, there is an argument that would say that environmental risks in particular deserve precautionary thinking, even if risks in general don't and can't. The idea might be that environmental risks are frequently long-term risks and not short-term risks—which is to say incidents of their occurrence won't readily come to mind like the risks associated with workplace accidents—and also that the risks often are faced by a lot of people at once in the form of a statistical probability, rather than a concentrated group of people who are organized. In addition, environmental risks are often faced by wildlife and animals, which don't have a voice in environmental protection. You might say, for these reasons, there is a kind of a built-in problem, which is that environmental risks will receive less attention than they deserve. It's possible.

But I want to try to build up a coherent precautionary principle more narrowly by focusing on the problems of irreversibility and potential catastrophe. Let's notice that some subsets of the risks that the human species faces are irreversible if they come to fruition—meaning that if they happen, they happen permanently or they can't be stopped except at extraordinary cost. Extinction of species from which human beings benefit or not, or which are important to human beings for moral or other reasons—that's permanent. It's an irreversible risk. Genetic modification has three irreversible risks associated with it, one of which is its effect on pest resistance; that may be either literally irreversible or extremely costly to reverse.³⁷ The risks associated with global warming have an irreversible feature in that carbon dioxide is in the atmosphere for a long, long time—hundreds of years.³⁸ So what we're doing now will face future generations; unless technologies change, there's not much they can do about that.

37. See Justus Wesseler, *Resistance Economics of Transgenic Crops Under Uncertainty: A Real Option Approach*, in *BATTLING RESISTANCE TO ANTIBIOTICS AND PESTICIDES*, *supra* note 9, at 214, 215-16.

38. See ARIC Atmosphere, Climate & Environment Information Programme, Carbon Dioxide, http://www.ace.mmu.ac.uk/Resources/Teaching_Packs/Key_Stage_4/Climate_Change/02t.html (last visited Sept. 22, 2005).

It just so happens that some formulations of the precautionary principle are alert to this point. The United Nations Economic Conference for Europe in 1992 said, "Where there are threats of . . . irreversible damage, lack of full scientific certainty shall not be used as a reason for postponing . . . measures to prevent environmental degradation."³⁹ The final declaration of the first European Seas at Risk Conference says that "if the worst case scenario for a certain activity is serious enough, then even a small amount of doubt as to safety of that activity is sufficient to stop it taking place," with clear emphasis in context on the irreversible nature of the worst-case scenario.⁴⁰

One way to get at the problem of irreversibility is just to notice that when human beings are asked how much they value environmental goods, they tend to put their values into three separate categories: (1) How much would you value to use the good? Call it a pristine area or a beach. And then there's a dollar amount: (2) How much would you be willing to pay to have an *option* to use the good in the future? Then there's an amount that's separate and not identical to the amount that people would pay to use the good. And (3), there's also an amount that people would be willing to pay to maintain the existence of the good. What I want to emphasize here is that people are willing to pay something to have an option to prevent a harm that could prove to be irreversible in the future.

If we notice the existence of option value, we can just say that when a decision, a regulatory decision, involves uncertainty about what the future will bring, and when it's possible to resolve the uncertainty as time goes on, and when one or more alternatives is irreversible, it just makes a lot of sense to pay something extra to protect against the irreversible bad outcome. So my suggestion is, if there's an irreversible harm on the one side and a reversible one on the other, we should pay the extra amount to protect ourselves against the irreversible harm.

What might this mean concretely? Well, I've referred to global warming as a problem of irreversibility. People do dispute the nature of the threat from global warming. And so it's tempting to say what President Bush has said, which is that we should wait to regulate until we have more information. Often it does

39. GOKLANY, *supra* note 2, at 5 (quoting *Principle 15*, *supra* note 2).

40. See Richard B. Stewart, *Environmental Regulatory Decision Making Under Uncertainty*, in AN INTRODUCTION TO THE LAW AND ECONOMICS OF ENVIRONMENTAL POLICY: ISSUES IN INSTITUTIONAL DESIGN (2002).

make sense to say, if you don't know the magnitude of the problem, you should wait until you have clearer information about it before spending money to prevent it. But in the context of global warming, there's a big problem with waiting, which is the irreversible effect of greenhouse gas emissions on atmospheric concentrations of those gases.⁴¹ So if we make emission cuts now, we're essentially purchasing an option to enable global warming to be stopped or slowed in the future at a lower cost. The basic idea is that because of the irreversible nature of carbon dioxide emissions, to expend resources now serves to protect the future wealth by reducing their costs.

This is just to describe a narrow version of the precautionary principle. Let's call it the Irreversible Harm Precautionary Principle, which doesn't run afoul of the problem of incoherence, which doesn't depend on any selectivity in human minds, depending on whether examples are evident. It just draws attention to a distinctive feature of certain kinds of risks—environmental risks and some risks posed by terrorists.

Now let's shift from the problem of irreversible harm to the problem of catastrophic harm. Let's try to figure out how to make these go away, these harms, or to protect the human race against them. Let's have a little thought experiment. And if I had paper or a mind-reading machine, or had enough paper to pass out to you, we actually could find the answers. But think, if you will, about the following problem: Which do you think is a higher priority—a one-in-ten risk that 2000 people will die? Or a one-in-one-million chance that 200 million people will die? Suppose that the government is deciding between two programs: one that will eliminate a one-in-ten risk that 2000 people will die, and one that will eliminate the one-in-a-million risk that 200 million people will die. Which should the government choose? They cost the same.

One question you might ask yourself, if you're the President of the United States is, Which of those should you give higher priority to? Another question you might ask yourself is, What do you think most people would say in answering that question?

I've now asked hundreds of people that question, and the answer is clear. The vast majority of people think that the one-in-a-million chance of 200 million deaths is lower priority. Most people think the one-in-ten chance of 2000 deaths deserves more attention than the one-in-one-million chance of 200 million deaths.

41. See RICHARD A. POSNER, *CATASTROPHE* 161 (2004).

There are a couple of ways to think about this public judgment that the higher probability of that outcome is worth more than the very low probability catastrophe. The first thing to think of, if we're economists, involves expected value.⁴² And let's just notice that the two problems I gave have identical expected values: 200 lives. Each involves 200 lives. So if human beings consider the one-in-ten chance of 2000 deaths to be higher priority than the tiny chance of 200 million deaths, there's possibly something wrong there. On standard accounts of rationality, they should be treated the same. That's the first cut of the problem: that there seems to be something in human cognition that sometimes treats tiny probabilities, even of extreme disaster, as worth less than their expected value.⁴³ And maybe the United States' caution about global warming has something to do with the undervaluing of low risks of catastrophe.

But I think it's worse than that—that people's answers are even worse than they seem. Think for a moment what it would mean for 200 million people to die. Would that be a simple arithmetic multiplier of 2000 people dying—is it just a matter of adding the right number of zeroes? Probably it's a lot worse than that. If 200 million Americans die—and that's what I've given in the survey—then, our nation is devastated. What kind of institutions would we have if two-thirds of our country is lost? What kind of government could we have? How many generations would it take to replicate the system we now have? Two hundred million deaths is a lot worse than adding the relevant zeros to 2000. And human beings seem not easily to understand that fact.

This is just a suggestion that catastrophic risks deserve some kind of precautionary principle, if only to overcome the human tendency to treat them as worth less than their expected value, if you simply do the multiplication; and worth much less than their real expected value, if you consider the ancillary effects. In some domains we want to be risk averse. That is, we want to build in a big margin of safety. And for a risk of catastrophic harm, that makes a lot of sense.

I am attempting to sketch a distinctive precautionary principle. It has a name, which won't surprise you: the Catastrophic Harm Precautionary Principle. And the Catastrophic Harm Precautionary Principle is intended as a narrow replacement for the

42. See Tversky & Kahneman, *supra* note 25, at 14-18.

43. See Gary H. McClelland et al., *Insurance for Low-Probability Hazards: A Bimodal Response to Unlikely Events*, 7 J. RISK & UNCERTAINTY 95, 95, 102 (1993).

precautionary principle. We have to make a few qualifications. One is that if you make efforts to reduce catastrophic harm, you might give rise to catastrophic risk just by doing that. It's possible. And so the Catastrophic Harm Precautionary Principle sometimes does run into the incoherence problem.

Example: the Iraq War. Put to one side the question whether you're for it or against it. The Iraq War was best defended on the grounds that it averted a catastrophic harm, and best criticized on the grounds that it gave rise to a catastrophic harm in the form of increased hatred of the United States and better resources and manpower for terrorist activity. So, this is just to suggest that the Catastrophic Harm Precautionary Principle is coherent, but it can't work in a case in which its deployment gives rise to a catastrophic harm of its own.

Now turn to global warming. Those who think we ought *not* to be taking very expensive steps to avert global warming have, as the best arrow in their quiver, the suggestion that those very steps give rise to risk of catastrophic harm. This argument would be plausible if the cost of reducing global warming significantly were so high that it would produce mass unemployment and poverty. But in a context in which there is a catastrophic harm on one side and no catastrophic harm introduced by reducing it, then we have an argument for the Catastrophic Harm Precautionary Principle.

I want to be a little more concrete about all this by introducing a couple of suggestions for the use of the Catastrophic Harm Precautionary Principle. The first is that even for the Catastrophic Harm Precautionary Principle, the cost matters. If it costs a fortune to eliminate a catastrophic harm, that's different from if you can eliminate the catastrophic harm at essentially zero cost. The second thing to say about the Catastrophic Harm Precautionary Principle is, we want to know who is being protected from catastrophic harm and who is paying the cost of eliminating catastrophic harm. In the context of global warming, it's just the case that the United States has probably relatively little to fear from global warming. First, because our economy does not depend fundamentally on agriculture,⁴⁴ and second because we're rich and can adapt pretty well.⁴⁵ So even in the worst-case scenarios for global warming, the United States is probably not at severe risk. Poor countries, on the other hand, for which agriculture is

44. See WILLIAM D. NORDHAUS & JOSEPH BOYER, *WARMING THE WORLD: ECONOMIC MODELS OF GLOBAL WARMING* 69-98 (2000).

45. See *id.* at 96-98.

everything, are in very severe danger.⁴⁶ They have a risk of economic devastation, of very serious human health problems, and they don't have the wealth to respond to the risk.⁴⁷ Global warming is plausibly seen (it's not typically analyzed in these terms, but it's plausibly seen in these terms), as a kind of tort imposed by wealthy countries on poor ones through their global greenhouse gas emissions. And that has to bear on the analysis of what the obligations of wealthy countries are.

If we bear that in mind, we are well on the way to developing—to tie all bits of the argument together—an Irreversible and Catastrophic Harm Precautionary Principle. The principle could be used for the context of global warming—suggesting that while the Kyoto Protocol was imperfect, other approaches would make sense as a way of combating global warming. Consider an approach that would require general and broad participation by India and China, as well as by Germany and Russia and the United States. Such an approach might give a permit for greenhouse gas emissions to poor countries because they need them in order to have their economies grow. Poor countries would be allowed to sell their emissions rights to the United States, which has more money—and that would be good on distributional grounds, because it would help the poor. A sensible approach would have increasing intensity of reductions over time, so it doesn't cause massive poverty and unemployment in the short run, but allows reductions to occur with increasing severity as technology changes. In the United States, we might have a kind of cap-and-trade system, where we cap our carbon dioxide emissions, or greenhouse contributions generally, and allow trading internally.

Some system of this general kind would work; it wouldn't bankrupt us; it would be a response to the tort-like character of the current situation; and it would adopt not a general idea of precaution, but precaution in this particular context of catastrophic and irreversible risk.

I'm just about done. My first and negative submission has been that the precautionary principle is incoherent. It forbids the very steps that it requires. My second argument has been that the precautionary principle gives the illusion of coherence because human minds naturally fixate on a subset of risks that human beings encounter, and so the precautionary principle operates

46. *See id.* at 69-98.

47. *See id.* at 98.

with disregard for the other risks that are inevitably part of social situations and that are sometimes introduced by precautions themselves. The Irreversible Harm Precautionary Principle, which maybe underlies the Endangered Species Act,⁴⁸ is coherent. To evaluate it, we have to know the magnitude of the risk that the Irreversible Harm Precautionary Principle is combating. The Catastrophic Harm Precautionary Principle is coherent. The major qualification is that we have to make sure that our steps that are reducing catastrophic harm aren't themselves introducing catastrophic harm.

So my main suggestion has been that to operate sensibly, any counsel for precaution has to be attentive to the full range of consequences, not simply to a subset of them. But suitably modified, a precautionary principle focused on irreversibility and potential catastrophe deserves a prominent place not only in the law of environmental protection, but in the everyday life of human beings. Thank you.

48. Endangered Species Act of 1973, 16 U.S.C. §§ 1531-1543 (2000).

