

evaluating the kyoto **approach to climate change**

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about the author

Dr. Kenneth Green is Director of Environmental Studies at the Reason Public Policy Institute. Dr. Green has published six previous peer-reviewed policy studies on air quality and environmental risk including: *A Plain English Guide to the Science of Climate Change*, *Rethinking EPA's Proposed Ozone and Particulate Standards*, *Estimating Fatalities Induced by Economic Impacts of EPA's Proposed Ozone and Particulate Standards (co-authored)*, *Looking Beyond ECO*, *Defending Automobility*, and *Checking Up on Smog Check*. Green received his doctorate in environmental science and engineering (D.Env.) from UCLA in 1994, joined RPPI soon after, and now works from his home-office in Central Texas.



Executive Summary

Like most of the actions we take to improve our safety, actions intended to reduce environmental health risks are rarely pure in their effects. We know that choices have consequences, and it's a true Pollyanna who thinks that any significant action, risk-reducing or otherwise, can have purely positive consequences.

While some safety improvement may be gained through the impact of a given risk-reduction measure, we know that in many cases the unintended consequences of the measure can produce countervailing impacts which erase some or all of the perceived benefit. The recent debate over the countervailing impacts of automobile airbags is but one small example of such unintended consequences.

We also know that our available risk-reduction actions are not unlimited, but are constrained by the resources available to us as individuals and societies over a given span of time. We might like to pursue all risk-reduction measures at all possible speed at all times, but we know that such an approach is simply not possible for human beings, any more than it is possible for any other organism or society which exists in a constrained world. We must choose where to invest our risk-reduction resources, and we must do so wisely, or we will inevitably find ourselves living in a riskier world than we might otherwise.

Making sound public-policy decisions regarding risk-reduction measures requires a balanced net-benefit framework for portraying both the nature of environmentally conveyed health risks and the consequences of taking action – or choosing not to take action – to reduce them. It also requires an easily understood framework for choosing a strategy, whether that strategy is intended to head off a specific risk in a specific way, or is intended to help society and its members prepare for

suspected, but poorly defined risks looming in the distance. Such a net-benefit / sound-strategy framework can help decisionmakers make sensible choices regarding public policy. While some individuals may prefer simply to make choices based on sentiment rather than a careful weighing of risk information, decisions made in the public-sector regarding risk mitigation should be strategically sound and based on a net-benefit assessment of available measures that incorporates an evaluation of risk shifting and tradeoffs.

Environmental advocacy groups and agencies have long favored an anticipatory strategy to dealing with climate change, heading possible problems off at the pass through what might be called a “fast-drive / fixed-target” approach. They advocate the selection of a series of fixed targets for greenhouse gas reductions, and then a rapid drive toward those targets through aggressive use of industrial policy, taxation, marketable permit trading, regulations, or a combination of these approaches. The Kyoto protocol, announced in December 1997, exemplifies this anticipatory approach and gives us a concrete proposal to evaluate as a public policy option.

While portrayed as a “step in the right direction” by many environmental agencies and advocacy groups, scientists involved in climate-change research have characterized the potential impacts of the actual accord reached in Kyoto as negligible in terms of environmental benefit. Benefits, it is acknowledged, would result only if predicted harms are averted many years from now as the result of many future steps in the same direction.

But since future steps are highly speculative, and present-day impacts are more concrete, it is important to view the pros and cons of this first step on its own merits. When one considers a holistic view of potential benefits and liabilities of the anticipatory Kyoto-protocol approach to climate change policy, one finds

scientists characterize the kyoto accord as having negligible environmental benefit

ESTIMATED BENEFITS AND LIABILITIES OF THE KYOTO APPROACH

RISK-REDUCTION BENEFITS – NEARTERM^a

Reduced risk of harm from changing weather patterns:	NONE
Reduced risk of harm from extreme weather events:	NONE
Reduced risk of harm through famine avoidance:	NONE
Reduced risk of harm through disease prevention:	NONE
Reduction in other proposed climate change hazards:	NONE
Reduced risk of harm through avoided economic impacts of climate change:	NONE

RISK-REDUCTION BENEFITS – LONGTERM^b

Reduced risk of harm from changing weather patterns:	NONE – HIGH
Reduced risk of harm from extreme weather events:	NONE – HIGH
Reduced risk of harm through famine avoidance:	NONE – HIGH
Reduced risk of harm through disease prevention:	NONE – HIGH
Reduction in other proposed climate change hazards:	NONE – HIGH
Reduced risk of harm through avoided economic impacts of climate change:	NONE – HIGH

RISK-REDUCTION LIABILITIES – NEARTERM^c

Induced fatalities from income-risk relationship:	≈ 9,000 – 22,000/yr.
Lives not saved through other risk-reduction investments:	≈ 13,000 – 3.5 million/yr.

NET RISK-REDUCTION BENEFIT – NEARTERM NONE

NET RISK-REDUCTION BENEFIT – LONGTERM NONE - HIGH

NOTES:

- These values derive from the consensus scientific view that Kyoto compliance, of itself, will produce no environmental benefit, as discussed below.
- This range of values flows from the consideration that if the pessimistic scenarios of climate change as discussed in the IPCC reports on climate change are true, and if the anticipatory approach is effective, averted risks could be significant.
- Induced fatality values calculated by author using income-risk relationship as modeled in Keeney & Green, 1997. "Lives not saved" values calculated by author from values in Tengs, et al., 1994.

a tunnel-vision approach can become a potential public-health hazard

the near-term benefits are scant, and the liabilities significant:

The national debate over climate change policy illustrates the way that our current decision-making process takes a tunnel-vision view of important environmental health measures, and disregards the knowledge constraints that should guide our strategy selection.

This policy brief examines the way that a tunnel-vision approach can turn a public-safety measure into a potential public-health hazard. In a net-benefits framework, implementing the anticipatory Kyoto protocol may well do more harm than good in the near term and offer only uncertain benefits in the longer term.

The Policy Challenge

Like most of the actions we take to improve our safety, actions intended to reduce environmental health risks are rarely pure in their effects. We know that choices have consequences, and it is a true Pollyanna who thinks that any significant action, risk-reducing or otherwise, can have purely positive consequences. While some safety improvement may be gained through the impact of a given risk-reduction measure we know that in many cases, the unintended consequences of the measure can produce countervailing impacts which erase some or all of the perceived benefit.

A recent example of such countervailing impacts gained visibility in the debate over automobile air bag requirements put into place at the behest of the Congress.¹ We now know that rather than being “pure” in its risk-reducing impacts, the airbag requirement created new risks for a significant part of the population (smaller women) and posed a particular threat to children, the physically fragile, and the elderly. The additional risk posed by

airbags may not eradicate all of the safety gains stemming from their use, but logic dictates that this increased risk be taken off the bottom line of claims about increased safety stemming from airbag use to create, in effect, a “net-benefit” assessment of increased safety.

Part of the reason that risk-reducing measures are ambiguous is that risks themselves are often ambiguous. Even when we consider a simple risk scenario, we know that people don’t face risks in the same way, but rather, each person has a highly individualized portfolio of risks of various types: environmental, nutritional, hereditary, social, and so on. And largely, that’s how we address risk issues, by sectioning them off into risk-areas: environmental risk, transportation risk, food-safety, and so on.

But some personal characteristics, both physical and behavioral, transcend this categorization, and our tendency to artificially section off risks into easily manageable categories leaves us open to the risk of unintended consequences such as those exemplified by airbag regulations. In the most extreme cases, this tunnel-vision approach can lead us into actions that might ultimately cause more harm than good.

Making sound public-policy decisions regarding risk-reduction measures requires a balanced net-benefit framework for portraying both the nature of environmentally conveyed health risks and the consequences of taking action – or choosing not to take action – to reduce them. It also requires an easily understood framework for choosing a strategy, whether that strategy is intended to head off a specific risk in a specific way, or is intended to help society and its members prepare for suspected, but poorly defined risks looming in the distance. Such a net-benefit / sound-strategy framework can help decisionmakers make sensible choices regarding their lifestyle, actions, and favored public policy. While some

**risk-reducing measures are ambiguous
because risks themselves are often ambiguous**

individuals may prefer simply to make choices based on sentiment rather than a careful weighing of risk information, decisions made in the public-sector regarding risk mitigation should be strategically sound, and based on a net-benefit assessment of available measures that incorporates an evaluation of risk shifting and tradeoffs.

This policy brief first assesses the net-benefits available from the anticipatory, Kyoto-protocol approach to climate change risk reduction, then re-examines the choice of strategy in light of that net-benefit assessment and our state of knowledge regarding the specifics of climate-change risk.

A Net-Benefit Assessment of the Kyoto Protocol Approach

Environmental advocacy groups and agencies have long favored an anticipatory strategy for dealing with climate change, heading possible problems off at the pass through what might be called a “fast-drive / fixed-target” approach. They advocate the selection of a series of fixed targets for greenhouse gas reductions and then a rapid drive toward those targets through aggressive use of industrial policy, taxation, marketable permit trading, regulations, or a combination of these approaches. The Kyoto protocol, announced in December 1997, exemplifies this anticipatory approach and gives us a concrete proposal to evaluate as a public policy option.

While portrayed as a “step in the right direction” by many environmental agencies and advocacy groups, scientists involved in climate change research have characterized the impacts of the actual accord reached in Kyoto as negligible in terms of near-term environmental benefit. Yet, this 15-year step will span nearly a third of many people’s 47-year working lifetime. Given that longer-term benefits

from future steps are highly speculative, while present-day impacts are more concrete, we should view the pros and cons of this first step on its own merits.

A. Assessing Risk-Reduction Benefits

The belief that fully implementing the Kyoto protocol by itself is unlikely to provide meaningful risk-reduction benefits is widespread among those people cited as experts by proponents of the protocol at the 1997 Kyoto conference on climate change.

Jerry Mahlman, Director of the Geophysical Fluid Dynamics Laboratory at Princeton University, told the *Washington Post* that, “The best Kyoto can do is to produce a small decrease in the rate of increase.”² In a post-Kyoto *Science* news brief, Mahlman says that “it might take another 30 Kyotos over the next century” to cut global warming down to size.³

Bert Bolin, the outgoing chairman of the United Nations Intergovernmental Panel on Climate Change, assessed the impact of Kyoto as a 0.4 percent reduction in greenhouse gas emissions compared to a no-protocol alternative, and concluded: “The Kyoto conference did not achieve much with regard to limiting the buildup of greenhouse gases in the atmosphere.”⁴

Robert Repetto at World Resources Institute acknowledges that the Kyoto accord is little more than a tiny step toward a distant end, rather than a significant step in itself: “Nobody thought in their wildest dreams that Kyoto would solve the climate problem....If implemented, the achievement at Kyoto will be to get nations off a business-as-usual trajectory, and onto a path that peaks, and then starts going down.”⁵

And as Tom Wigley, a climate researcher at the National Center for Atmospheric Research in Colorado, puts it, “A short-term target and

it might take another 30 kyotos to cut global warming down to size

timetable, like that adopted at Kyoto, avoids the issue of stabilizing concentrations [of greenhouse gases] entirely.”⁶

In other words, benefits of the Kyoto protocol are described more in political terms – as initiating a shift in energy-use patterns – than in terms of tangible environmental or risk-reduction benefits.

B. Assessing Risk-Reduction Liabilities

1. Accounting for the income-risk relationship

Although regulatory costs and job losses are not often considered risk-relevant in themselves, they should be. The idea of a linkage between income and risk may be subtle, but in many ways, it is also intuitive. We know, for example, that people with large families face lower risks of suffering from severe depression or of becoming homeless due to economic dislocation. Having a large family seems to lessen one’s risk of serious depression or homelessness. We know that people with many friends are in less danger of becoming mentally ill than are “loners.” Thus, having a strong social network lessens one’s risk of mental illness. Likewise, we know that people’s safety is related to people’s income. Those with less income are proportionately less able to take the safety measures that higher-income earners can. Families with higher income levels can better withstand short-term health problems than those with less income. Families with higher incomes eat higher quality foods, drive safer cars, live in safer neighborhoods, train their children for safer jobs, and so on.

Peer-reviewed studies over two decades have examined the relationship between income and risk. The general conclusion of such studies is this: People use their disposable income to weave a personal safety net around themselves and their loved ones. The more dispos-

able income they have, the tighter the weave of their personal safety net. The less disposable income they have, the looser the weave.⁷

As systems engineer Ralph L. Keeney points out in *Estimating Fatalities Induced by the Economic Costs of Regulations*:

*Regulatory costs are paid by individuals, which leaves them with less disposable income. Since individuals on average use additional income to make their lives safer and healthier, the regulatory costs lead to higher mortality risks and fatalities. Based on data from the National Longitudinal Mortality Study relating income to the risk of dying, approximately each \$5 million of regulatory cost induces a fatality if costs are borne equally among the public. If costs are borne proportional to income, approximately \$11.5 million in regulatory costs induces a fatality.*⁸

Though environmental advocacy groups and agencies generally dismiss such ideas as being unconventional, the implications of this understanding are straightforward: less income, less safety. Nor is this relationship inherently unquantifiable. We can estimate the impact by determining how much a proposed action will cost an individual in terms of disposable income and then correlating that loss of disposable income with personal safety.

And one need not take extreme values in order to demonstrate that the impacts to people’s risk profiles as a result of the costs of the Kyoto protocol may be significant. Most moderate economic analyses with moderate assumptions show economic impacts of around a two percent reduction in U.S. GDP in order to bring U.S. greenhouse gas emissions to 1990 levels by the timeframe called for in the Kyoto protocol.⁹

But for the sake of this analysis, let us make a few more optimistic assumptions. Despite the fact that the Kyoto protocol actually obligates the United States to cut its greenhouse gas

regulatory costs are paid by individuals, which leaves them with less income

emissions 7 percent below that of 1990 and despite the fact that most studies showing a two percent reduction in GDP estimate dollar values above \$200 billion annually, let us assume that the full cost of compliance with the Kyoto Protocol might only cost \$100 billion annually.

Using a model of induced fatality developed by Ralph Keeney at the University of Southern California, we can model the impact of taking \$100 billion out of people's own risk-reduction budgets and spending it elsewhere. Depending on whether one assumes that regulatory costs are borne equally by all households (the high end of the range), or proportionally with household income (the low end of the range), \$100 billion (in 1990 dollars) spent each year to comply with the new standards will lead to induced fatality of 9,000–22,000 Americans each year.¹⁰

2. Accounting for missed opportunity to save lives through alternative risk-reduction investments

As Harvard risk-researcher Tammy Tengs demonstrated in her study of cost-effectiveness of

risk-reduction measures undertaken by various governmental agencies, all investments in risk-reduction do not yield equal results.¹¹

Table 2 shows the median cost of intervention for five regulatory agencies, each charged with reducing risk within its sphere of authority. To date, saving lives through environmental regulations has been, in the aggregate, more expensive than saving lives through other types of safety regulation, though some individual environmental measures may be highly cost-effective ways to reduce risk.

If, as discussed earlier, the costs of the Kyoto protocol amount to \$100 billion dollars per year, we can see that the same amount of money spent on some of the demonstrated, cost-effective health and safety risk-reduction measures could, hypothetically, save the lives of many people if we would get comparable return on our investment as we have through historically proven interventions. Of course, such high returns on risk-reduction investments are not likely to be maintained as the low-hanging fruit of risk-reduction is plucked, and as more marginal risk-reduction mea-

MEDIAN VALUE OF COST/LIFE-YEAR SAVED FOR FIVE REGULATORY AGENCIES

Regulatory Agency	Median cost/ life-year saved
Federal Aviation Administration	\$23,000
Consumer Product Safety Commission	\$68,000
National Highway Traffic Safety Administration	\$78,000
Occupational Safety and Health Administration	\$88,000
Environmental Protection Agency	\$7,629,000

Source: Tammy O. Tengs, et al., "Five-Hundred Life-Saving Interventions and Their Cost-Effectiveness," Draft, Harvard Center for Risk Analysis, Harvard University, Boston, MA, July 1994.

Table 2

the epa spends far more per life-year saved than other regulatory agencies

asures are pursued. Still, at \$23,000 per life-year saved, \$100 billion dollars could save 3,571,428 lives each year through further improvements in flight-safety (were there that many lives at risk!), while even with established environmental interventions, \$100 billion dollars could save 13,108 lives each year.

If policymakers are unwilling to allow people to retain all their earned resources to procure safety for themselves, they should consider whether we are getting better value for our governmentally administered safety investments than that which can be obtained by people on their own. Since risk-reduction resources are finite, policymakers should also consider whether we're getting the biggest risk-reduction available through established intervention pathways.

C. The Question of Long-Term Benefits

A short-term net-benefits assessment of the approach to climate change represented by the Kyoto protocol reveals a serious risk that a set of actions that are ostensibly risk-reducing might well turn out to be risk-increasing, or, colloquially, do more harm than good. But there is also the long term to consider.

Given that significant climate change might have the potential to cause great increases in risks to human health, a discussion of the long-term policy implications of the Kyoto protocol's "first step" is warranted.

Yet assessment of long-term impacts is precisely where things are the least certain, since the scaling up of the modest and validated greenhouse effect to the level of global climate effects, including effects on oceans, ecosystems, mountains, rivers, groundwater, solar variation, greenhouse gas emissions, clouds, aerosols, water vapor, and historical variation, then trying to scale the impacts back down to the local and regional level, leaves us with a view which is best characterized as "through a glass, darkly."

One need not look beyond the landmark 1995 IPCC reports themselves (the often-thumped but rarely read bible of climate change) for expressions of that uncertainty. Even a cursory review of the accepted uncertainties surrounding climate change show that we are clearly in a state of limited knowledge about what to do and a state of low predictability of the direction of change in risk.¹²

Tides, waves, and storm surges could be affected by regional climate changes, but future projections are, at present, highly uncertain.

— p. 41 of the 1995 IPCC Science volume

Confidence is higher in hemispheric to continental scale projections of climate change than at regional scales where confidence remains low.

— p. 41 of the 1995 IPCC Science volume

The global climate models used for future projections are run at fairly coarse resolution and do not adequately depict many geographic features (such as coastlines, lakes and mountains), surface vegetation, and the interactions between the atmosphere with the surface which becomes more important on regional scales.

— p. 44 of the 1995 IPCC Science volume

Impacts are difficult to quantify, and existing studies are limited in scope. While our knowledge has increased significantly during the last decade and qualitative estimates can be developed, quantitative projections of the impacts of climate change on any particular system at any particular location are difficult because regional scale climate change projections are uncertain; our current understanding of many critical processes is limited; and systems are subject to multiple climatic and non-climatic stresses, the interaction of which are not always linear or additive. Most impact studies have assessed how systems would respond to climate changes resulting from an arbitrary doubling of equivalent atmospheric carbon dioxide concentrations. Furthermore,

the kyoto protocol shows considerably higher liabilities than benefits

ESTIMATING THE BENEFITS AND LIABILITIES OF THE KYOTO APPROACH

RISK-REDUCTION BENEFITS – NEARTERM^a

Reduced risk of harm from changing weather patterns:	NONE
Reduced risk of harm from extreme weather events:	NONE
Reduced risk of harm through famine avoidance:	NONE
Reduced risk of harm through disease prevention:	NONE
Reduction in other proposed climate change hazards:	NONE
Reduced risk of harm through avoided economic impacts of climate change:	NONE

RISK-REDUCTION BENEFITS – LONGTERM^b

Reduced risk of harm from changing weather patterns:	NONE – HIGH
Reduced risk of harm from extreme weather events:	NONE – HIGH
Reduced risk of harm through famine avoidance:	NONE – HIGH
Reduced risk of harm through disease prevention:	NONE – HIGH
Reduction in other proposed climate change hazards:	NONE – HIGH
Reduced risk of harm through avoided economic impacts of climate change:	NONE – HIGH

RISK-REDUCTION LIABILITIES – NEARTERM^c

Induced fatalities from income-risk relationship:	≈ 9,000 – 22,000/yr.
Lives not saved through other risk-reduction investments:	≈ 13,000 – 3.5 million/yr.

NET RISK-REDUCTION BENEFIT – NEARTERM NONE

NET RISK-REDUCTION BENEFIT – LONGTERM NONE - HIGH

NOTES:

- These values derive from the consensus scientific view that Kyoto compliance, of itself, will produce no environmental benefit, as discussed above.
- This range of values flows from the consideration that if the pessimistic scenarios of climate change as discussed in the IPCC reports on climate change are true, and if the anticipatory approach is effective, averted risks could be significant.
- Induced fatality values calculated by author using income-risk relationship as modeled in Keeney & Green, 1997. "Lives not saved" values calculated by author from values in Tengs, et al., 1994.

Table 3

**our uncertainties not our knowledge
best indicate the choice of pathway**

very few studies have considered greenhouse gas concentrations; fewer still have examined the consequences of increases beyond a doubling of equivalent atmospheric carbon dioxide concentrations, or assessed the implications of multiple stress factors.

— p. 346 of the 1995 IPCC Impacts volume

Given these uncertainties, about the best that can be said regarding long-term risk reduction benefits of a given approach is that **if** the risks of climate change are actually as large as the more extreme predictions of some climate models, and **if** our actions are successful at somehow eliminating those risks over the long term, **then** we may achieve a high level of risk-reduction through those actions.

D. Balancing the Ledger

When we account for the lack of demonstrable near-term risk-reduction benefits from the Kyoto protocol approach to climate change policy, account for the risk-reduction liabilities of the income-risk relationship, and account for lost opportunities to use proven risk-reduction interventions, we find that a net-benefit assessment shows considerably higher liabilities than benefits for the near term. And given the long-term uncertainties involved, even putting the speculative benefits into the risk-ledger doesn't contribute much more information to facilitate evaluating whether we're on the right track (See Table 3 on page 8.)

Revisiting Strategy Options

Given the poor prognosis for the Kyoto protocol's approach to climate change risk-reduction, we may want to step back, and re-examine our choice of risk reduction strategy. We do, after all, have many available risk-reduction interventions available to us that let us move toward a bottom line goal

of decreased risk to ourselves and our children as conveyed through the environment, which is a far more holistic thing than tunnel-vision perspectives imply.

At the most generic level of classification, the options range from the resilient: "Maximize our ability to cope with risk by maintaining a dynamic, market-based, knowledge-building investment strategy;" to the anticipatory: "Let's make investments that require certain actions and prohibit or restrict others."¹³

But how do we decide, for any given risk, whether an anticipatory approach is more likely to provide us with a good return for our safety investment than a resilient approach? We can profitably use a framework developed by risk-policy analyst Aaron Wildavsky to answer that question, a framework which is a useful strategy selector based on levels of knowledge and predictability of change (for example, predictability of future harms) as shown in Figure 1.

What's apparent in this anticipation / resilience framework is that it is not our knowledge, but our **uncertainties** which most strongly indicate the choice of pathway. This is because:

- 1) the conditions needed to assure a reasonable chance of success for anticipatory actions are quite stringent; and
- 2) There are more ways to get things wrong than to get them right.

A. Why Resilience is the Default Strategy

There are several reasons why resilience should be considered the default strategy, and why it is very different from "do nothing." First, "do nothing" is really never an option. Research will simply not stop, because science doesn't stop. People will not stop tracking climate change, because people are now, and always have been concerned with the dangers of changing climate, and with building devices to help them anticipate change.

the resilient approach is a highly effective strategy for reducing risk

And as any number of researchers have demonstrated, there is an unmistakable linkage between a society's prosperity and its safety, and its environmental cleanliness. People instinctively seek out risk-reduction, however they view it with their own local knowledge of their own particular situation. We know that reducing their ability to do that is not without consequence, and that, therefore, wasting individual or societal risk-reduction resources poses a risk liability in itself.

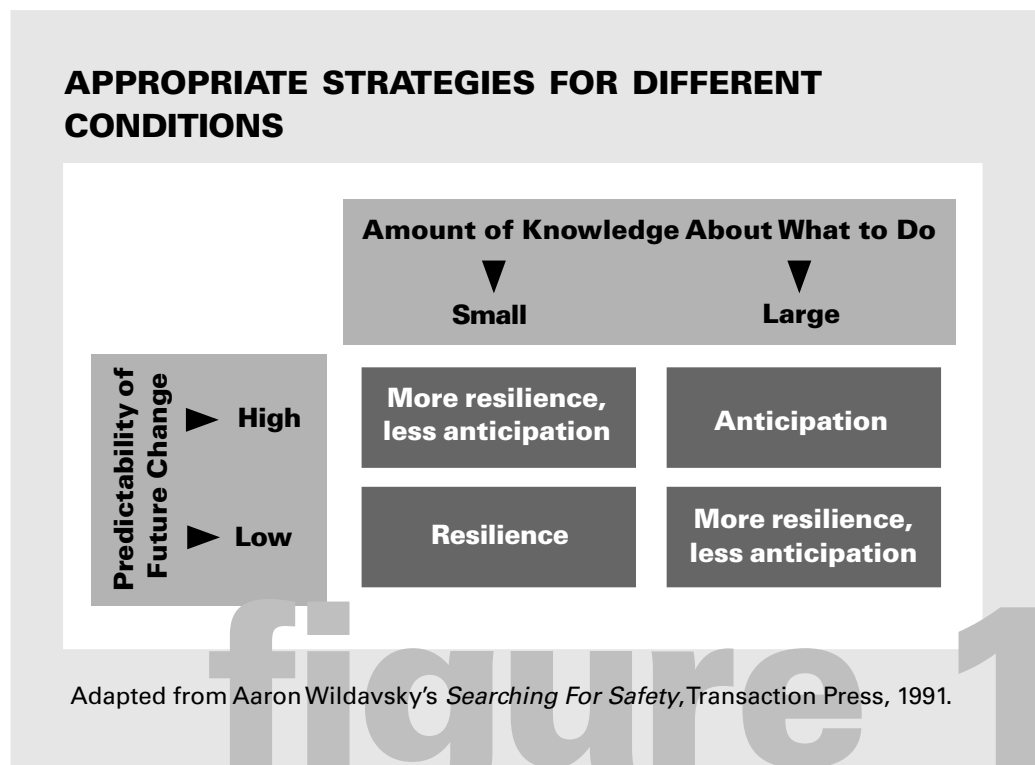
We have overwhelming evidence that resilient approaches that maintain a market-based, knowledge-building, and dynamic investment strategy are highly effective, enhancing our ability to respond over time to risks and to reduce risks. Therefore, departure from that default should require a demonstration, based on an assessment of evidence, that a proposed intervention reliably outperforms the default path of resilience sufficient to warrant overriding people's individual choices which we

not only revere from a basis of personal freedom, but which are maximally informed by the local knowledge which facilitates effectiveness.

B. Evaluating Anticipatory Approaches

In the cases where an anticipatory approach has been chosen (appropriately or not), we face another challenge: How do we evaluate these anticipatory approaches? How do we assess the likelihood that these approaches will achieve in practice what they are postulated to achieve in theory?

Unlike selecting a basic strategy, which depends largely on one's state of knowledge about a potential risk, evaluating specific tactics within a given strategy is a more complex question. There are, however, some guiding principles that should control the overall evaluation process:



there is a link between a society's prosperity and its environmental cleanliness

- 1) There must be a valid framework of risk / benefit evaluation that is:
 - a) Scientifically rigorous;
 - b) Holistic;
 - c) Aware of risk trading and shifting; and
- 2) There must be a valid framework for evaluating alternative interventions in terms of:
 - a) Their likelihood of providing real, quantifiable, net risk reduction benefits;
 - b) The information constraints that shape implementation of any anticipatory measure; and
 - c) The behavioral complexities that may result in a gap between the ideal and the actual performance.

Both of these principles, to a very large extent, are those put forward by various environmental agencies and advocacy groups as necessities in assessing not only environmental risks, but the efficacy of proposed compliance measures for dealing with various environmental policies.

Conclusions

People do not face risks in isolation of one another. Rather, at any given moment, each of us has a portfolio of risks and face a constant challenge in managing that portfolio and in selecting from the various risk-altering actions available to us as individuals, or through collective action. Man-made climate change may well be a risk in that portfolio, to ourselves, or to future generations.

But to empower individuals to make informed personal and public-policy risk management choices, we need a framework portraying risk, and the potential benefits of a risk-reduction

measure that retains the complexities that reality imposes, while providing an understandable basis for decision making. A net-benefits assessment offers a component of such a method. A strategy for selecting between resilience and anticipation offers another component of such a framework.

In a net-benefits framework, implementing the anticipatory Kyoto protocol may well do more harm than good in the near term, and offer only uncertain benefits in the longer term, where uncertainties cloud our abilities to model the risks and benefits of either acting or not acting to reduce greenhouse gas emissions, or of taking other actions intended to forestall climate change.

The lack of demonstrable benefits from an anticipatory approach given our presently available actions and uncertainties implies that, pending improved understanding of the probable impacts of climate change, policymakers should reconsider their selection of an anticipatory strategy. Instead, while keeping a wary eye out for more precise information about the risks posed by man-made climate change, this assessment suggests that decisionmakers should explore more proven, or more resilient risk-reduction strategies. □

Related Publications

A Plain English Guide to the Science of Climate Change, by Kenneth Green, D.Env., RPPI Policy Study No. 237, December 1997.

Estimating Fatalities Induced by Economic Impacts of EPA's Ozone and Particulate Standards, by Ralph Keeney and Kenneth Green, D.Env., RPPI Policy Study No. 225, June 1997.

Rethinking EPA's Proposed Ozone and Particulate Standards, by Kenneth Green, D.Env., RPPI Policy Study No. 224, June 1997.

decisionmakers should explore more proven, or more resilient risk-reduction strategies

- 1 National Motor Vehicle Safety Act, 15 USC 1381 *et seq*; Federal Motor Vehicle Safety Standard 208 as amended, 58 FR. 46551 (September 2, 1993). Standard 208 was recently revised in order to address this concern, allowing for the installation of an airbag deactivation switch.
- 2 Joby Warrick, "Reassessing Kyoto Agreement, Scientists See Little Environmental Advantage," *Washington Post*, February 13, 1998.
- 3 David Malakoff, "Thirty Kyotos Needed to Control Warming," *Science*, Vol. 278, December 19, 1997, p. 2048.
- 4 Bert Bolin, "The Kyoto Negotiations on Climate Change: A Science Perspective," *Science*, Vol. 279, January 16, 1998, p. 330.
- 5 Joby Warrick, "Reassessing Kyoto Agreement, Scientists See Little Environmental Advantage," *Washington Post*, February 13, 1998.
- 6 David Malakoff, "Thirty Kyotos needed to Control Warming," *Science*, Vol. 278, December 19, 1997, p. 2048.
- 7 Ralph L. Keeney, "Estimating Fatalities Induced by the Economic Costs of Regulations," *Journal of Risk and Uncertainty*, Vol. 14, pp. 5–23, 1997; Ralph L. Keeney and Kenneth Green, "Estimating Fatalities Induced by the Economic Impacts of EPA's Proposed Ozone and Particulate Standards," Policy Study No. 225, Reason Public Policy Institute, June 1997; Aaron Wildavsky, "Richer is Safer," *The Public Interest*, Vol. 60, 1980, pp. 23–29; William Kip Viscusi, "Mortality Effects of Regulatory Costs and Policy Evaluation Criteria," *Rand Journal of Economics*, Vol. 25, 1994, pp. 94–109.
- 8 Ralph L. Keeney, "Estimating Fatalities Induced by the Economic Costs of Regulations," *Journal of Risk and Uncertainty*, Vol. 14, 1997, pp. 5–23.
- 9 Ibid.
- 10 The lower value in the range represents the assumption that regulatory costs will be divided among the population proportionately with household income, while the higher value in the range represents the assumption that regulatory costs will be borne equally by households regardless of income.
- 11 Tammy O. Tengs, et al., "Five-Hundred Life-Saving Interventions and Their Cost-Effectiveness," Draft, Harvard Center for Risk Analysis (Boston, Mass: Harvard University, 1994).
- 12 Intergovernmental Panel on Climate Change (IPCC), *Climate Change 1995, The Science of Climate Change* (Cambridge, Mass: Cambridge University Press, 1996), p. 44 & 439 respectively.
- 13 Aaron Wildavsky, *Searching for Safety* (New Brunswick: Transaction Publishers, 1991).



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