GREENHOUSE POLICY WITHOUT REGRETS

A FREE MARKET APPROACH TO THE UNCERTAIN RISKS OF CLIMATE CHANGE

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EXECUTIVE SUMMARY

Due to uncertainty about climate change, and human contributions thereto, many policymakers call for "precautionary" measures to reduce the risk of global warming. Such policies are characterized as "insurance." Such insurance against the risks of climate change can be achieved by either lessening the likelihood of change by reducing atmospheric concentrations of greenhouse gases through a combination of emission controls and carbon sequestration strategies, or by enacting mitigation measures to reduce the possible economic and ecological impact of a potential climate change.

No insurance policy is worthwhile if the cost of the premiums exceeds the protection purchased. For greenhouse insurance to be worthwhile, it must either reduce the risks of anthropogenic climate change or reduce the costs of emission reductions designed to achieve the same goal, without imposing off-setting risks, such as those which would result from policies that slow economic growth and technological advance. Currently proposed precautionary measures, such as the Kyoto Protocol, call for government interventions to control greenhouse-gas emissions and suppress the use of carbon-based fuels. Such policies would impose substantial costs and yet do little, if anything, to reduce the risks of climate change. Such policies cannot be characterized as cost-effective greenhouse "insurance."

Rather than adopt costly regulatory measures that serve to suppress energy use and economic growth, policy makers should seek to eliminate government interventions in the marketplace that obstruct emission reductions and discourage the adoption of lower emission technologies. Such an approach is a "no regrets" strategy, as these policy recommendations will provide economic and environmental benefits by fostering innovation and economic efficiency *whether or not climate change is a serious threat*. While fear of global warming may prompt the enactment of these reforms, they merit implementation even if we have nothing to fear from climate change.

A "no regrets" approach to climate change would incorporate the following policy measures, among others:

1) **Remove Regulatory Barriers to Innovation:** Existing regulatory programs, and many environmental regulations in particular, create obstacles to the development and deployment of emission-reducing and energy-saving technologies. Such regulations retard market-driven enhancements in efficiency and environmental performance that reduce energy use and emissions per unit of output.

2) **Eliminate Energy Subsidies:** Government energy subsidies distort energy markets and energy-related investment decisions without producing off-setting returns. The elimination of energy subsidies, in the United States and abroad, would result in a more efficient energy sector.

3) **Deregulate Electricity Markets:** Local electricity monopolies and government utility regulation are significant barriers to innovation in the energy sector. Electricity deregulation and consumer choice will create market opportunities for alternative energy sources and create further pressure for greater efficiency and innovation in the energy sector.

4) **Deregulate Transportation Markets:** Airline travel is a rapidly increasing source of greenhouse gas emissions, yet air travel regulations prevent airlines from flying the most cost-effective and energy-efficient routes. Allowing "free flight" could reduce per-flight energy use by as much as 17 percent. Lowering regulatory barriers to improvements in other transportation sectors, such as road construction and management, could also produce substantial emission reductions.

The aforementioned policies may not significantly reduce total greenhouse-gas emissions, but they will reduce emissions per unit of output and spur greater technological innovation. Were it ever demonstrated that emission controls were merited, the adoption of "no regrets" strategies today would make it easier to meet those goals without compromising existing standards of living.

The broader choice in climate change policy is between measures which constrain economic choices and thereby hamper economic growth and innovation, and those measures which free up society's creative energies to spur innovation and enhance resiliency. The human impact on the global climate system will always be indeterminate to some degree. Unforeseen events, natural and human-induced, will occur. For these reasons, the best insurance policy is one that improves society's generalized ability to cope with disasters, environmental and otherwise. Freeing up key sectors of the economy, particularly those most reliant on energy, provides two forms of insurance: It spurs innovation in the energy sector, increasing energy efficiency and technological innovation, while also enhancing society's overall resiliency.

A true "no regrets" approach to climate change is not greater government controls on economic activity, but fewer. Economic growth, market institutions, and technological advance are often the most effective forms of insurance that a civilization can have. Policy efforts aimed at freeing up the energy sector, and those segments of the economy that are most energy intensive, will produce both economic and environmental gains. The economic gains will come from greater productivity and efficiency; the environmental gains from increased production per unit of energy expended or emissions released. Such an approach will reduce whatever threat of human-induced climate change might exist while spurring technological innovation and economic development. This strategy is the only approach to climate change that can be pursued with "no regrets."

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INTRODUCTION

Many climate scientists believe that human activity, in particular the consumption of carbon-based fuels, may be contributing to a gradual warming of the earth's climate. Yet whether the human contribution to global climate change is significant or cause for alarm is as of yet unclear. As one NASA scientist observed in 1999, "There remain substantial uncertainties in our understanding of how the climate system will respond to increasing concentrations of carbon dioxide and other greenhouse gases."[1] If there is one thing certain about global warming, it is that the nature and extent of humanity's impact on the global climate system is not yet known.

Whether or not industrial and personal emissions of carbon dioxide, methane, and other greenhouse gases will induce dangerous climatic disturbances is actively debated by scientists and policymakers. The human contribution to climate change may be dwarfed by natural phenomena. A modest warming, occurring largely during winter and at night, may be net beneficial. Some regions of the globe may benefit substantially from more benign climates. Yet because the possibility of a greenhouse threat cannot be excluded, many policymakers call for "precautionary" measures to serve as greenhouse "insurance."

"Insurance" against the risks of climate change can be achieved either by A) reducing the likelihood of climate change by stabilizing, and perhaps lowering, atmospheric concentrations of greenhouse gases through some combination of emission controls and carbon sequestration strategies, or B) enacting mitigation measures to reduce the possible economic and ecological impact of a potential climate change. The first option dominates global warming policy discussions. Most climate-change policy proposals seek to control emissions of carbon dioxide and other greenhouse gases, reducing atmospheric concentrations of these gases or, at the very least, slowing the rate at which greenhouse-gas concentrations increase. Such policies would impose substantial costs of their own, while doing little, if anything, to reduce the feared risks of climate change.

Vice President Al Gore, for example, calls for ratification of the Kyoto Protocol, signed by President Clinton in 1997. The Protocol requires

industrialized nations to cut greenhouse-gas emissions to 5 percent below 1990 levels by 2008-2012. The US obligation would be to cut emissions 7 percent below 1990 levels. Meeting this target would require the United States to reduce carbon energy use by about one-third from projected levels through the use of regulatory controls, energy taxes, or other government interventions. The Kyoto Protocol would impose substantial economic costs for little to no environmental benefit, even if the most apocalyptic climate scenarios are accepted as given. Adopting regulatory controls to achieve the Kyoto targets could cost as much as 2 percent of GDP, nearly doubling the annual cost of complying with current environmental regulations. Yet full global compliance would result in only a fraction of the emissions reduction necessary to stabilize atmospheric concentrations of greenhouse gases. Indeed, because the Kyoto Protocol does not impose any emission-control obligations on developing nations, it cannot reduce overall emissions of greenhouse gases, let alone achieve the stated goal of stabilizing atmospheric concentrations. Within a few years, developing nations alone will generate enough greenhouse gases to keep concentrations on their upward trajectory. In addition, the premature adoption of controls on energy use could actually increase the costs of providing for greenhouse "insurance." Current environmental regulations and government interventions in the economy suppress economic growth and slow technological innovation, forestalling developments that would ensure a healthier and cleaner world. Such policies, in the aggregate, have the perverse effect of increasing the costs of meeting the emission-reduction goals sought by global warming policy advocates.

The nature and extent of humanity's impact on the global climate system is not yet known.

Even assuming stabilization of atmospheric concentrations over the next century would reduce the risk of climatic disturbances, it is not at all clear that emission controls are wise policy. Stabilization of concentrations of greenhouse gases would require global emission reductions of 60 to 80 percent from current levels. Meeting such a target in the near- to medium-term is inconceivable without a wrenching transformation of societies around the globe that would sacrifice economic improvements and condemn much of the developing world to perpetual poverty. Such a climate-change policy would create risks that rival, if not surpass, the most horrific warming scenarios. Any "insurance" policy with such costly premiums is not worth buying.

For an "insurance" policy to be worthwhile, it must either reduce the risks of anthropogenic climate change or reduce the costs of later emission reductions designed to achieve the same goal. An emission-control policy is only wise if it can be implemented without imposing off-setting risks, such as those which would result from policies that slow economic growth and technological advance. Given the tremendous uncertainties in the climate forecast, and the fact that the Kyoto targets could not be met with existing technologies without imposing substantial economic disruptions, an alternative course is warranted. Instead of imposing caps or limits on greenhouse-gas emissions, near-term policies should aim at accelerating technological innovation and society's adaptive capacities.

To address the uncertainties of global warming, policymakers should seek to eliminate government interventions in the marketplace that obstruct emission reductions, discourage the adoption of lower-emission technologies, and undermine technological innovation. Such an approach would be a genuine "no regrets" strategy, as these policy recommendations will provide economic and environmental benefits by fostering innovation and economic efficiency *whether or not climate change is a serious threat*. While fear of global warming may prompt the enactment of these reforms, they merit implementation even if we have nothing to fear from climate change. Such policies may not significantly reduce total greenhouse-gas emissions, but they will reduce emissions per unit of output and spur greater technological innovation. Were it ever demonstrated that emission controls were merited, the adoption of a "no regrets" strategy today would make it easier to meet those goals without compromising existing standards of living. Whether or not the threat of global warming ever materializes, society would be better off having taken this course.

THE UNCERTAIN CLIMATE FORECAST

The 1995 report of the Intergovernmental Panel on Climate Change is generally accepted as the most comprehensive statement on the state of climate science. Yet this report, which purportedly represents the scientific "consensus" on climate change, equivocates on the nature and extent of human impact on the climate system. The strongest statement linking human emissions with observed climatic changes is simply, "The balance of evidence suggests a discernible human influence on global climate."[2] This heavily qualified statement hardly provides a basis for the imposition of new regulatory controls, energy taxes, or new subsidy programs. Indeed, the balance of the IPCC report further qualifies predictions of climate change and highlights uncertainties in a wide number of areas:

- **Modeling:** "Model validation is one of the most important components in our efforts to predict future global climate change. Although model performance has generally improved over the last decade, both coupled and uncoupled models still show systematic errors in their representation of the mean state and variability statistics of current climate. Such errors reduce our confidence in the capability of AOGCMs [Atmosphere-Ocean Global Circulation Models] to predict anthropogenic change."[3]

- **Sea Level Change:** "The current estimates of changes in surface water and ground water storage are very uncertain and speculative. There is no compelling recent evidence to alter the conclusion of IPCC [1990] that the most likely net contribution during the past one hundred years has been near zero or perhaps slightly positive."[4]

- **Weather Impacts:** "Overall, there is no evidence that extreme weather events, or climate variability, has increased, in a global sense, through the

20th century, although data and analyses are poor and not comprehensive. On regional scales there is clear evidence of changes in some extremes and climate variability indicators. Some of these changes have been toward greater variability; some have been toward lower variability."[5]

- **Attribution:** "Despite this consistency [in the pattern of change], it should be clear from the earlier parts of this chapter that current data and systems are inadequate for the complete description of climate change. . . . Although these global mean results suggest that there is some anthropogenic component in the observed temperature record, they cannot be considered as compelling evidence of a clear cause-and-effect link between anthropogenic forcing and changes in the Earth's surface temperature."[6]

Whether human-induced changes are themselves harmful or threatening is itself an unresolved question.

Completed in 1995, the IPCC report is not the last word on climate science. Since the report was issued, numerous studies have appeared in the peer-reviewed literature that further demonstrate the uncertainty of climate forecasts and the unlikelihood that human activity poses a serious threat of inducing a climate catastrophe. One such report, issued in early 2000 by the National Research Council of the National Academy of Sciences, attracted significant press attention for "confirming" that surface temperatures have increased over the past twenty years.[7] The study also found, however, that the troposphere, that level of the atmosphere predicted by computer models to be most sensitive to greenhouse-gas emissions, has scarcely warmed at all. This study concluded that the extent of human impact on global temperature trends is uncertain and further research is warranted. Other recent scientific studies reinforce this conclusion:

- A June, 1998, study in *Nature* found that "global annual methane emissions have remained nearly constant during the period 1984-96, and that the decreasing growth rate in atmospheric methane emissions reflects the approach to a steady state on a time-scale comparable to methane's atmospheric lifetime." That means that atmospheric methane levels are not likely to increase significantly for the next 100 years.[8]

- In October, 1998, James Hansen, the climatologist most associated with predictions of a greenhouse future, concluded, "The forcings that drive long-term climate change are not known with an accuracy sufficient to define future climate change." The reason it is so difficult to predict future climate change, says Hansen, is that "anthropogenic greenhouse gases (GHGs), which are well measured, cause a strong positive (warming) forcing. But other, poorly measured, anthropogenic forcings, especially changes of atmospheric aerosols, clouds, and land-use patterns, cause a negative forcing that tends to offset greenhouse warming."[9]

- In an October, 1998, study on carbon sinks in North America, researchers plugged data on carbon dioxide levels taken from 1988 to 1992 at 63 ocean-sampling stations into two computer models, one which estimates ocean

uptake and release of carbon dioxide, the other which estimates how carbon dioxide is distributed by wind currents.[10] What they found is that North America could be a far greater carbon sink than previously estimated, and that the North American continent may even absorb more carbon dioxide than is emitted by US industry.

- In March, 1999, researchers concluded that during three separate deglaciations temperature rises *preceded* increases in atmospheric concentrations of greenhouse gases. Using ice core samples from the Antarctic they found that increases in carbon dioxide concentrations occurred centuries "after the warming of each of the last three deglaciations."[11]

- Despite claims that industrial emissions are causing retreat of the West Antarctic Ice Sheet (WAIS), a November, 1999, study found that the WAIS was retreating long before modern industry began emitting greenhouse gases. Indeed, the grounding line of the WAIS has retreated approximately 120 meters per year for the last 7,500 years, and its rate of retreat has not increased. This led researchers to conclude that the "modern grounding-line retreat is part of ongoing recession that has been under way since early to mid-Holocene time. It is not a consequence of anthropogenic warming or recent sea level rise."[12]

- In September, 1999, the National Research Council concluded that more research into the fundamentals of climate science was necessary before developing mitigation strategies. Unanswered questions about the climate system's sensitivity to human activity "is seriously blocking progress in critical policy development," the report concluded.[13]

These and other studies counsel skepticism of environmentalist claims that increases in greenhouse-gas emissions will inevitably produce a climate apocalypse.

There is substantial historical evidence to suggest that a moderately warmer climate might actually be better.

THE IMPLICATIONS OF CLIMATE CHANGE

Determining whether human activity is impacting the climate is only the first step in assessing whether, and to what extent, the risk of global warming calls for a policy response. Whether human-induced changes are themselves harmful or threatening is an unresolved question. The earth's climate has fluctuated for millennia, and there is no basis upon which to presume that the present climatic conditions are optimal. There is, in fact, substantial historical evidence to suggest that a moderately warmer climate might actually be better for much of human civilization and the natural world.[14]

In the past decade there has been a "near revolution" in the scientific understanding of the likely impact of climate change on the natural environment, according to Robert Mendelsohn of the Yale School of Forestry and Environmental Studies.[15] "Ecologists have shifted from predicting ecosys-

tem collapse to predicting that net primary productivity will likely increase over the long run," says Mendelsohn, and economic forecasts no longer predict disaster.[16] While coastal regions could be impacted by rising sea levels or tropical storms, agricultural productivity and forest growth would increase significantly.[17]

The state of current research is such that there is significant "uncertainty as to whether the net impacts [of a predicted warming] by the end of the next century will be harmful or beneficial."[18] As climate scientists have tempered their warming forecasts, so too have the estimates of its impact fallen—so much so that some economic studies indicate that a modest warming would produce net gains. Even assuming the worst-case scenarios, for the foreseeable future "other environmental and public health problems plaguing the world will be substantially more urgent than climate change."[19] The bottom line, according to Mendelsohn, is, "There is no emergency that requires ill-considered crash programs."[20] Even if the predictions of greenhouse warming are correct, there is time to develop mitigation and adaptation strategies without imposing emission controls in the time-frame established by Kyoto.

ASSESSING THE VALUE OF GREENHOUSE INSURANCE

The arguments for dramatic greenhouse-gas reductions are all variants of the precautionary principle, which is essentially the argument that it is better to be safe than sorry. Typical of this approach is this statement from the President's Council on Sustainable Development: "Where public health may be adversely affected, or environmental damage may be serious or irreversible, prudent action is required even in the face of scientific uncertainty."[21] Similarly, the "Wingspread Consensus Statement," a document drafted by several dozen environmental activists and scholars, adopts the view that "when an activity raises threats of harm to human health or environment, precautionary measures should be taken even if some cause and effect relationships are not fully established."[22]

For the foreseeable future "other environmental and public health problems plaguing the world will be substantially more urgent than climate change."

Stanford University's Stephen Schneider is a prominent advocate of adopting a "precautionary" approach to climate change. Schneider compares the policy question to placing a high-stakes bet. Given the potential for dramatic global changes due to greenhouse warming, Schneider decries delaying action as the equivalent of betting one's whole life savings. Even if the odds are in your favor, Schneider claims, you should not make the bet if you cannot afford to lose. In the case of climate, therefore, one should not risk potentially catastrophic climatic changes, as the costs would be too much for human civilization and natural ecosystems to bear. Refusing to gamble, in Schneider's view, is accomplished by seeking to stabilize, if not reduce, atmospheric levels of greenhouse gases. This construction is compelling, but it fundamentally misstates the policy choices posed by global warming, specifically the notion of "insurance" in this context.

The analogy of a bet suggests that there are no risks or costs associated with seeking to curtail industrial emissions. In Schneider's example, one simply foregoes the wager by adopting emission-control policies, such as those contained in the Kyoto Protocol. This view presumes that there are risks from potential climate change, but no risks from climate policy. It focuses on the risks of further increases in carbon-based fuel use, but not on the risks from the imposition of strict limitations on energy availability. It also presumes, with little basis, that an international regime can be developed to enforce carbon-based fuel restrictions on a global scale. Yet there is reason to be skeptical that an international community that cannot control the proliferation of weapons of mass destruction can limit the use of carbon-based fuels. It is possible that the insurance Schneider seeks cannot be purchased at *any* price.

The precautionary principle is essentially the argument that it is better to be safe than sorry.

The scale of emission reductions necessary to achieve any level of greenhouse "insurance" through the prevention or mitigation of climate change is enormous. As noted above, even the most optimistic projections acknowledge that stabilizing concentrations will require global emission reductions on the order of 60 to 80 percent. This would require drastic reductions in greenhouse-gas emissions in the industrialized nations, and a limit on increases in the rest. At present, there is no serious policy proposal that would achieve this type of "insurance," and for good reason. Alternative energy sources, including wind and solar, are a long way from being able to meet current, much less projected, energy demands. On the whole, they are more expensive and less reliable than their carbon-based counterparts, and are incapable of providing for the bulk of modern society's needs.[23] Other low-emission alternatives—such as nuclear and hydropower—are no longer politically viable, at least in the short term. Nuclear power is plagued by high costs and political opposition, and more dams are on the path to decommissioning and removal than expansion or construction.

Near-term emission-control strategies fail as proposed "insurance" policies because they are not capable of reducing the risks of climate change at an acceptable cost, if they are capable of reducing the risks at all. If the IPCC draft projections are to be taken seriously, then one must accept that much of the potential warming over the next century is a *fait accompli*. Lowering greenhouse-gas emissions will not prevent warming; at most it will modestly reduce the predicted temperature rise over the next century. At the same time, however, the costs imposed by such emission-control strategies will reduce the inherent societal resiliency that results from increased wealth and economic advance (see below).

Indeed, by some estimates, the costs of seeking to prevent human-induced global warming rival the likely costs of climate change itself. For instance, a recent study co-authored by William Nordhaus of Yale University found that the Kyoto Protocol has a benefit-cost ratio of 1:7; in other words, the costs of Kyoto-style emission controls are approximately seven times higher than

the environmental costs averted by the emission controls.[24] Thus, even if one accepts the computer models as accurate projections of the world's future, it is not clear that preventing global warming is less costly than adapting to it.

Alternative energy sources, including wind and solar, are a long way from being able to meet current, much less projected, energy demands.

WARMING WITHOUT REGRETS

Eliminating government policies that distort energy markets, suppress technological innovation and deployment, and subsidize waste would be worthwhile for many reasons. Such policies can also form the basis for a true "no regrets" approach to the uncertainties of climate change by expanding energy choices, improving energy productivity, and increasing societal resiliency and adaptability. These policies are likely to reduce greenhouse-gas emissions per unit of output, and spur the technological innovation that would be necessary to meet emission-reduction targets should such measures ever prove necessary. As a result, these policies would make it easier to meet emission-reduction goals without sacrificing existing standards of living in developed nations and improvements in standards of living in the developing world, even if they do not reduce overall emission levels.[25] On the other hand, should further scientific research reveal that the threat from anthropogenic climate change is minimal, and there is little need for emission reductions, these policy measures would still be beneficial. Eliminating wasteful subsidies and technology-suppressing regulations will spur technological innovation and increase energy efficiency, improving economic performance and lowering costs for consumers. In other words, these polices are worth pursuing whether or not one fears global warming. They are policies that can be pursued with "no regrets."

The following section of this paper identifies several types of "no regrets" policies. In particular, it outlines measures that: 1) remove or reduce barriers to technological innovation, thereby making it easier to develop and adopt emission-reducing and energy-saving technologies; 2) eliminate subsidies for energy use, thereby reducing government-induced distortions in energy markets that inflate use and emissions; and 3) free up markets, particularly in the electricity and transportation sectors, to encourage and allow for market-driven improvements in efficiency and productivity. The specific policy measures below in no way represent an exhaustive list of "no regrets" measures. Rather, they serve as illustrative examples of the sorts of measures that should be pursued by those who fear a greenhouse apocalypse as well as those who do not. Nor do the following measures guarantee short-run reductions in aggregate emissions of greenhouse gases. What they have in common is that they would reduce inefficiencies within energy markets and energy-dependent sectors of the economy and spur greater technological innovation. Such steps are necessary if any serious emission-control strategy is to be undertaken, and yet make economic sense even if no emission-control regime is ever required. In other words, they are "no regrets" strategies because they are worth undertaking whether or not global warming is a serious threat.

REMOVE REGULATORY BARRIERS TO INNOVATION

Companies and entrepreneurs operating in competitive markets are constantly seeking to reduce their costs. Energy use is a cost of production. Therefore, companies are constantly seeking ways to achieve the same level of output while reducing their consumption of energy and other input factors. On the whole, this has the effect of reducing energy use—and greenhouse- gas emissions—*per unit of output*. It is for this reason that energy use per unit of output has been constantly declining in the US and other market-oriented economies for decades, despite declining energy prices.[26]

Eliminating wasteful subsidies and technology-suppressing regulations will spur technological innovation and increase energy efficiency.

Government regulations generally, and environmental regulations in particular, often pose a substantial barrier to emission-reducing innovations. Many efficiency gains are capital-embodied—that is, they can be realized only if existing equipment is rebuilt or replaced. A regulatory structure which increases the burden on such capital changes will reduce the rate at which such gains are realized by slowing the rate of equipment modernization. As a recent study by the Environmental Law Institute (ELI) concluded, "While our current environmental system has served us well, it has created significant barriers to innovation."[27] By increasing the costs of modifying and enhancing existing industrial facilities, and the costs of replacing older, dirtier facilities with newer, cleaner ones, the existing pollution-control regime often works at cross-purposes with the goal of developing less-polluting modes of production. As the ELI study noted, "Technology-based emission limits and discharge standards, which are embedded in most of our pollution laws, play a key role in discouraging innovation."[28] Other researchers have similarly concluded that "technology-based standards provide the weakest incentives for both abatement technology and output technology innovation."[29]

Once a technology is anointed as the preferred pollution control method, there is substantially less of an incentive to introduce newer technologies, even if they will improve environmental performance. As Adam Jaffe and Robert Stavins observe, "Once a performance standard has been satisfied, there may be little benefit to developing and/or adopting even cleaner technology."[30] As noted above, the regulatory process can, and indeed does, create barriers to the development and diffusion of even cleaner technologies. Indeed, "regulated firms may fear that if they do develop a cleaner technology, the performance standard will be tightened."[31] According to ELI:

> Emission limits or discharge standards based on a single best technology create practical barriers to innovation by limiting permissible technologies to available ones that meet the standard. This requirement precludes the normal development and refinement processes most technologies need to achieve their best performance and, in many cases, can limit permissible technologies to a single one.[32]

The Office of Technology Assessment (OTA) reached similar conclusions in a 1995 report. "Regulations that are overly prescriptive can lock in existing technologies to the detriment of other technologies that might meet or exceed requirements."[33] Moreover,

> even performance-based standards are frequently based on established reference technologies. In such cases, companies and regulators are likely to prefer reference technologies they are confident will meet standards, rather than innovative approaches that are less certain.[34]

Environmental laws such as the Clean Air Act explicitly target newer emission sources, effectively grandfathering older technologies and discouraging their replacement with newer, less-emitting, and more-efficient facilities. The result is that older, more-polluting facilities stay in operation for longer periods of time, increasing overall emissions. As Paul Portney of Resources for the Future observes, "The expected life of a plant . . . is not beyond the control of the firm . . . that owns it. By requiring strict, and therefore expensive, controls on all new sources, the [Environmental Protection Agency] has created a powerful incentive to keep old plants . . . in operation longer."[35] The OTA reached a similar conclusion in its study of technological innovation: "Regulatory systems that grandfather existing facilities may dissuade investments in new or upgraded technologies if such changes trigger more stringent standards or lengthy permitting processes."[36] In fact, approximately half of the power plants in operation in 1990 began before 1971, according to a 1990 General Accounting Office report.[37] That so many old facilities remain in use for so long is due, in part, to the existing regulatory regime.

These problems are compounded by the substantial paperwork, and uncertainty, that is inherent in the permitting processes mandated under various environmental statutes. "New technologies must overcome a two-step approval process, the first being acceptance by risk-averse business managers and the second approval by risk-averse government permit writers. These two steps greatly increase the cost and time required to innovate."[38] Title V of the Clean Air Act, for example, imposes substantial paperwork burdens on industrial facilities, in addition to numerous opportunities for government regulators and activists to intervene and delay facility upgrades or modifications.[39]

Lowering greenhouse-gas emissions will not prevent warming; at most it will modestly reduce the predicted temperature rise over the next century.

Title V adds no new substantive environmental protections, but simply adds more procedural requirements to existing ones. Beyond the paperwork costs and the possibility of a year-long (or longer) delay in obtaining a permit, Title V provides further opportunities for local, state, or federal officials, as well as environmental organizations, to stop a proposed project. "The permitting process can also discourage innovation by making the approval process for new technologies lengthier, more cumbersome, and less certain than for conventional approaches," according to ELI.[40] Barriers include "delays inherent in the permitting system, permit writers' lack of time,

expertise and experience, the lack of rewards for implementing innovative technologies, and the cautious approach inherent in a government bureaucracy."[41] Any serious attempts by industry to reduce greenhouse emissions by building new power plants or upgrading existing ones must face this permitting gauntlet and its attendant costs, delays, and possible project disapprovals. As with the rest of the Clean Air Act, Title V favors the status quo, a bias that works against greenhouse-gas reductions.

Even the manner by which emission levels are calculated under the Clean Air Act may create perverse incentives to operate facilities that do not minimize greenhouse emissions. The new source-performance standards set limits based on emissions of regulated pollutants per unit of energy *input*, not output.[42] This means that a less energy-efficient and higher carbon-emitting plant can more readily pass muster than a more efficient facility, because emissions are averaged over a larger energy input. The Environmental Protection Agency (EPA) proposed changing these standards to be based on emissions per unit of energy output, but it is unclear whether this change will occur.[43]

"Companies and regulators are likely to prefer reference technologies they are confident will meet standards, rather than innovative approaches that are less certain."

In addition to the added difficulties of obtaining a permit in the first place, firms attempting to reduce greenhouse emissions will suffer ongoing disincentives under the operating permits program. Even after a permit is obtained, certain subsequent operational changes will require a revision to that permit, adding further rounds of uncertainty, costs, and delays.[44] For this reason, fast-moving industries that frequently need to make such changes have been the most vocal critics of the operating permits program.[45] Likewise, any eventual need to reduce greenhouse emissions will spark a wave of technological innovations, the incorporation of which into existing facilities will be discouraged by the operating permits program. For example, a new process that reduces carbon dioxide emissions may nonetheless need to survive a public comment period, hearings, opportunities for EPA objections, and citizen group petitions.[46]

The Clean Air Act's New Source Review (NSR) program similarly discourages changes at industrial facilities that could reduce greenhouse-gas emissions.[47] NSR's permitting and other requirements impose substantial costs and delays on both new industrial facilities and existing ones that undergo modifications. Only routine maintenance at pre-existing facilities is exempted. The disincentives created by NSR have discouraged the replacement or upgrading of existing facilities, often at the expense of energy efficiency and greenhouse-gas emissions reductions.

Generally speaking, like-kind replacements of old components stand the best chance of falling under the "routine maintenance" exception, while technological improvements run the risk of being considered a modification. Thus, a change resulting in a substantial increase in energy efficiency would be more likely to invoke NSR than one that keeps a facility in line with past

performance. For example, one EPA region recently stated that utilities' periodic replacement of deteriorated turbine blades with modern, more efficient ones would likely trigger NSR.[48]

Existing Clean Air Act waiver provisions are insufficient to solve the problem due to "high transaction costs, delay and uncertainty in gaining an exemption."[49] Waiver provisions that are administratively complex suffer from the same problems that the underlying permitting program does: "They are administratively complex, in some ways ambiguous in their definition of innovation, and depend on timely consideration and approval by the same permitting body that administers other permits for conventional technologies."[50] For its part, the EPA's proposed approach to global warming is to keep the existing regime in place, and to tack on additional carbon dioxide reduction requirements.[51] But even the EPA admits that this approach would further strain an "already overburdened" regulatory process, with the likely result of creating further barriers to environmental innovation.[52]

The federal government continually spends tens of millions of dollars every year subsidizing the use of carbon-based fuels.

Regulations on industrial facilities are not the only potential regulatory barriers to lower greenhouse-gas emissions. All sorts of regulations, environmental and otherwise, prevent or delay the introduction of energy-saving technologies. Transgenic crops, for instance, can be engineered so as to require less fertilizer and pesticide use, as well as substantially less tilling, thereby saving the energy use—and consequent emissions—associated with the production, distribution, and application of these chemicals and the operation of tilling equipment. Corn, cotton, and potato crops have been modified to produce a natural pesticide generated by the *Bacillus thuringiensis* (Bt) bacterium. This modification makes the crops more pest-resistant. Recent studies have found that Bt-enhanced corn and cotton crop yields were 7 percent and 15-17 percent higher than unmodified crops, respectively.[53]

Such increases are likely only the beginning. A scientific panel convened by the World Bank and Consultative Group on International Agricultural Research concluded that genetic engineering could increase agricultural yields by as much as 25 percent.[54] Even delaying ripening in fruits and vegetables could substantially enhance food supplies, as post-harvest and end-use losses are estimated to be as high as 47 percent worldwide.[55] This would reduce energy use, and consequent emissions, in both food production and transport. Other innovations in the genetic engineering of crops could also increase the carbon-sequestration potential of agriculture.[56] Regulatory strictures that delay the introduction of such new transgenic crops are potentially as greenhouse-unfriendly as barriers to industrial innovation. Both artificially delay emission-reducing innovations.

ELIMINATE SUBSIDIES TO FUEL USE

While Vice President Gore and environmental activists rail against the use of carbon energy sources, the federal government continually spends tens

of millions of dollars every year subsidizing the use of carbon-based fuels. In other words, the federal government is subsidizing the expanded use of those fuel sources which some federal officials claim must be discouraged in order to combat climate change. Many foreign nations that have endorsed the Kyoto Protocol have even larger subsidies for carbon-based fuels.[57] Such subsidy programs also serve to "tilt the playing field" so as to discourage the development of alternative energy sources by reducing research expenditures made by private energy companies. This, in turn, spawns arguments for additional energy subsidy programs to "level the playing field" for other energy sources. The end result is significant distortions in energy markets due to government interventions. The Energy Information Administration estimates aggregate energy subsidies of between $5 billion and $10 billion per year, approximately $2 billion of which is devoted to research and development programs that benefit particular energy industries.[58]

While direct federal subsidies to carbon-based fuels are not large, they do distort energy choices. In Fiscal Year 1999, fossil energy research and development programs at the Department of Energy received just over $384 million; the Clinton Administration sought to reduce fossil fuel R&D to $364 million in FY 2000. These funds cover research on: the conversion of coal into petroleum; mine restoration; advanced coal power generation technologies; enhanced oil recovery; and offshore geological surveys used for private oil and gas exploration. In FY 1997, the Clean Coal Technology Program (CCTP) received only $12 million. However, since its inception in 1984, the CCTP has cost taxpayers approximately $1.5 billion. The CCTP program funds research into advanced emission-control technologies for coal facilities. These are two of the most prominent examples of subsidies to carbon-based fuels buried in the federal budget.

Since its inception in 1984, the Clean Coal Technology Program has cost taxpayers approximately $1.5 billion.

Federal subsidies for carbon-based fuels are typically justified as cost-effective federal support for research and development. Yet the Congressional Budget Office and other analysts note that federal R&D money rarely produces commercially-viable technologies. Economists Linda Cohen and Roger Noll assert, "An effective, coherent national commercial R&D program has never been put in place."[59] Federal investment R&D expenditures tend to be less productive than private sector investments. If the investments are worth making because of their potential to develop market-viable innovations, the private sector is fully capable of making those investments on its own. In addition, the allocation of government R&D funding is inevitably subject to political influence. As a result, notes one Department of Energy official, "Government R&D dollars will tend to flow to marginal ideas."[60] There may be an economic case for government support for basic scientific research, but fossil fuel R&D programs cannot be justified on those grounds.[61] However small fossil fuel research subsidies are in terms of the overall federal budget, or even the energy sector of the US economy, there is no economic or environmental basis for continuing these programs.

Other federal subsidy programs can also serve to inflate the use of carbon-based fuels in comparison to other fuel sources. For example, for years the Rural Electrification Administration, since renamed the Rural Utilities Service, has subsidized the electrification of rural and remote areas. In practice, this meant expending substantial resources to enable rural areas to receive electricity from central power plants. Yet due to the remoteness of these areas, and the tremendous cost of putting up power lines for a handful of users in a given location, alternative fuel sources, such as solar, may have been more cost-effective. These federal subsidies served to increase carbon-based fuel use and discourage the development of markets for alternative fuels that may have been viable. Other federal programs subsidize the provision of power through the Power Marketing Administrations, artificially increasing aggregate energy use in affected areas.

Before new regulatory controls or subsidy programs are even considered, the entire federal budget should be reviewed with an eye toward eliminating federal programs which inflate the use of energy, particularly those energy sources that are blamed for contributing to global warming. Instead of seeking to use fiscal instruments to accelerate or slow down the development of given energy technologies, energy policy should be shifted to neutral so as not to distort the energy marketplace. Even subsidies for alternative fuel sources, such as wind or solar, should be up for reconsideration, if for no other reason than federal research and development subsidies for such energy sources have tended to go toward politically attractive though economically foolhardy projects, such as the solar "tower of power"—an effort to create a solar-powered steam generator in the Mojave desert. As even alternative-energy advocates have been forced to recognize, alternative-energy subsidies tend to fund "technical sophistication rather than practicality," resulting in prototypes that are "neither reliable nor commercially viable."[62]

Subsidies to energy R&D cost taxpayers millions of dollars while producing minimal benefits.

Some analysts may question the impact of eliminating energy subsidies on energy markets. Several hundred million dollars in research funding is admittedly a drop in the bucket for the one-half trillion dollar energy sector of the US economy. From this standpoint, eliminating energy subsidies may be seen as little more than a symbolic gesture. Nonetheless, it is important. In many nations, government interventions in energy markets are extensive and produce substantial distortions. If for no other reason, the US should eliminate its subsidies to carbon-based-fuel energy sources so as to serve as an example to the rest of the world that energy production and consumption should not be subsidized by government policy.

Subsidies to energy R&D cost taxpayers millions of dollars while producing minimal benefits. While these programs may be relatively small given the size of domestic energy markets, they serve little, if any, useful purpose while subsidizing large corporations at taxpayer expense. The potential threat of global warming, whether it is real or not, is simply one more reason to eliminate these subsidy programs.

FREE UP MARKETS: ELECTRICITY

One of the most important elements of a "no regrets" strategy should be the deregulation of electricity markets by eliminating local and regional monopoly franchises for utilities. A deregulated electricity marketplace will spur greater innovation in the energy sector and accelerate the market penetration of natural gas and other reduced-carbon-dioxide-emission energy sources. Current market trends suggest that natural gas, which emits significantly lower levels of greenhouse gases than other carbon-based fuels, would make substantial inroads in a deregulated energy marketplace.[63] Moreover, environmental activist groups consistently maintain that alternative energy sources, such as wind or solar, are ready to compete in an open marketplace; deregulation will give them that chance. While solar, wind, and other alternative energy sources are still more expensive than carbon-based energy sources, they stand to benefit from the willingness of some consumers to pay a premium for "green" energy. That opportunity to compete with more traditional fuel sources will spur greater investment in the development and marketing of alternative energy sources that are currently constrained in their ability to compete.

The diffusion of technological innovations is approximately ten years faster in unregulated industries as compared with regulated industries.

Energy use is the primary industrial source of greenhouse gases. All else being equal, a dramatic increase in energy use will result in a dramatic increase in greenhouse-gas emissions, carbon dioxide emissions in particular. But all else does not have to be equal. Existing regulations that bar competition in the domestic energy sector represent substantial barriers to the innovation and development of less-emitting energy technologies. The present cost-recovery-plus-profit regulatory structure works against the goal of efficiency in fuel use, and indirectly in carbon emitted per unit of fuel burned. The reason is that today's regulatory structure allows utilities to pass on all costs, including those of fuel. There is less need for utilities to economize on fuel use: If one plant inefficiently burns far more coal than another for the same electricity yield, it still recovers costs plus a guaranteed profit. Introducing greater competition into electricity markets will change these incentives, creating pressure for greater efficiency and lower emissions. Moreover, as new innovations are developed, their adoption by the industry will be more rapid in a deregulated electricity market; historical evidence suggests that the diffusion of technological innovations is approximately ten years faster in unregulated industries as compared with regulated industries.[64]

The Environmental Protection Agency and some environmental groups fear the deregulation of energy markets will increase the consumption of coal, thereby increasing greenhouse-gas emissions. A recent EPA memo, fearful of the environmental impacts of restructuring, encourages integrating restructuring of the industry with efforts to combat global warming. The Energy Information Administration (EIA), in a report to Sen. James Jeffords (R-VT), concluded,

> Emissions are expected to increase between now and 2015, with or without open access. . . . Both the EIA and FERC [Federal Energy Regulatory Commission] analyses indicate that increases in emissions . . . are expected to be larger in the next five to ten years. Thereafter, the impacts in the EIA study were usually negligible, whereas the FERC cases typically resulted in declining, but observable, increases in emissions.[65]

Regulation makes us use power unwisely.

Despite these projections, there are good reasons to believe that the long-term result of deregulation would be a greater reliance on natural-gas-fired turbines and cogeneration systems. Natural gas is not only an increasingly cost-competitive source of energy, it generates less greenhouse gases than other carbon-based fuels. Cogeneration systems operate by burning the source fuel and recapturing the heat for other uses. In a sense, the same unit of energy is utilized for two or more purposes, which can cut costs and greenhouse-gas emissions. As former Trigen CEO Michael Casten notes, "When appropriately sized generating plants are built near users of heat, the normally wasted heat from electric generation can be recovered and sold, thus saving money and avoiding burning more fuel to make heat."[66]

The average generation efficiency of power plants in the US today is only 33 percent, but a gas turbine in combined cycle with cogeneration can reach a generation efficiency of close to 90 percent. Given existing trends in energy markets, natural-gas-fired electric plants are likely to replace coal-fired plants, so long as regulatory obstacles do not stand in the way.[67]

Arguments that electricity restructuring will inevitably increase emissions often neglect the culpability of today's regulatory barriers in inhibiting efficiency. In addition to the barriers to emission reductions identified above, regulation that allows utilities to cover all costs by simply passing them on to the ratepayer naturally promotes waste rather than stewardship in resource use. Regulation makes us use power unwisely. Deputy Treasury Secretary Lawrence Summers noted correctly, "Today, when utilities can pass through costs, there is no incentive for them to increase their use of cogeneration or reduce their fuel costs through heat-rate efficiency."[68]

Those fearful of deregulation focus on Midwestern coal-burning plants, arguing that deregulation will add significantly to emissions. But is this presumption necessarily right? Michael Banta, vice president and assistant general counsel at Indianapolis Power and Light Company, notes,

> "Cheap" and "dirty" are not synonymous. Indeed, many of today's older, higher emissions power plants are also relatively expensive to operate because they are inefficient. Older coal and oil-fired power plants with high heat rates in both the Midwest and the East Coast, much like high-operating-cost nuclear plants, will simply not be viable in a fully competitive market.[69]

Banta further notes that this condition is exacerbated when "the costs associated with either purchasing emission allowances or installing additional emission control technology on these aged plants are confronted."[70]

According to *The Economist*, "the environmental effect of liberalization will probably be benign. It will accelerate the transition from coal to cleaner gas. That is good, and as clean, emissions-free hydrogen-based systems become more practical, natural-gas systems can be converted."[71] Gas-fired plants on average emit 40 percent less carbon dioxide per unit of energy produced than coal plants.[72] Moreover, gas is less expensive to produce. Coal will continue to dominate for some time, but the rise of gas appears likely to continue. The EIA predicts that the "natural-gas-fired share of electricity generation (excluding cogenerators) more than triples, from 9 percent to 31 percent, between 1996 and 2020."[73]

Gas turbines, much like the engines of jet aircraft, are currently the most economical way to produce electricity. Fuel is burned to turn the turbine, generating power. Combined-cycle plants are those in which the heat from the combustion turbine is captured and used to generate steam, turning turbines to generate additional power. By this process, well over half the energy in the gas is converted into electricity; by contrast, a typical base-load coal plant converts just 35 percent of the source fuel's energy into electricity.[74] Burning less fuel for the same output means lower emissions.

Even electric utilities themselves are turning to smaller gas plants to serve peak load and to provide power on the fringes of the grid. Deploying such satellite facilities is referred to as distributed generation. Of revolutionary importance, perhaps, is the rise of desk-sized gas microturbines that can power homes and convenience stores, and the likelihood that they will be mass produced.[75] Micro-generation of power means more reliance on gas, potentially heralding a seismic shift away from coal, and delivering a corresponding decrease in emissions. Microturbines in a sense will operate on a grid already parallel to the network of transmission and distribution wires—the natural gas pipelines. As prices come down, units such as these could be tacked onto home mortgages.

Gas-fired plants on average emit 40 percent less carbon dioxide per unit of energy produced than coal plants.

As choice in electricity dissolves the role of the regulator in energy source selection, consumers can take charge. In anticipation of public environmental sentiments, companies like Green Mountain Energy Resources and Enron have stepped forth to offer "green energy" packages to consumers. Businesses enjoy being seen as caring for the planet, and some proportion of consumers are likely to respond. Environmental groups are seeking to facilitate consumer selection of low-carbon fuels by distributing information on the implications of different electricity choices.[76]

To date, "few green-power programs have enrolled more than 5 percent of ratepayers."[77] Nonetheless, there is evidence that a significant percentage

of consumers would purchase low-emitting energy if given the choice. For example, approximately 145 residential customers and 20 business customers of Transverse City, Michigan's municipal utility, signed up to switch from coal to wind power. About 3 percent of the City's 8,000 customers have signed up. Seventy-five customers are on a waiting list.[78]

While premiums are high, full deregulation would allow even greater options than exist today, and consumers will be better able to afford them thanks to deregulation. The Clinton Administration, for example, estimates household savings from restructuring of $232 per year.[79] Such price-cuts increase the willingness to purchase green power by making renewable energy more affordable. Falling electricity prices also have the effect of altering the relative price structure of fuels, potentially leading to increased electricity use in jobs that formerly required other, dirtier fuels. According to Resources for the Future,

> Falling prices for electricity—and therefore increased production of it—need not necessarily spell increases in air pollution. For example, lower electricity prices could lead individual, commercial, and industrial users to substitute electricity for other energy sources that contribute more significantly to air pollution and environmental degradation. This could happen if, say, cheaper electricity led to increased use of electric-powered lawnmowers and automobiles in lieu of those equipped with gasoline-powered, internal combustion engines. Electric motors also could substitute for coal- or oil-fired generation in industrial processes.[80]

Proposals to reduce airline emissions further will force a dramatic reduction in air travel.

Similarly, Karen Palmer notes, "If competition causes electricity prices to fall relative to the prices of other fuels, such as natural gas, it could spur increased use of electric technologies, resulting in emissions reductions." She continues, "For example, a decline in the relative price of electricity could induce some households to switch from natural gas heat to an electric heat pump that, in general, uses less primary energy per unit of heat output."[81] Given newfound efficiencies spurred by competition in electricity, it appears plausible that, in the service of greater energy-use efficiency, "in the long run, restructuring may lead to greater reliance on new plants with more benign environmental consequences."[82]

However, it is important to point out that today's changes in the electricity marketplace are properly described as "restructuring" rather than "deregulation." In fact, the press release announcing the Clinton Administration's electricity plan fails to mention the word "deregulate" or "deregulation" even once, although the *Washington Post* called the administration's offering a "Plan to Deregulate Power."[83] For the efficiencies cited to have both the best chance of occurring, as well as maximum impact when they do, it is essential that the industry be *deregulated*, not simply restructured.

FREE UP MARKETS: TRANSPORTATION

Energy markets are not the only place to look for "no regrets" deregulatory opportunities. Deregulation in other areas may also increase energy efficiency. Airline transportation, for example, is an increasing source of greenhouse-gas emissions. Greater demand for air travel means more flights, which means greater fuel use and increased emissions. Yet, the current government-operated system of air traffic control may hinder innovations that could reduce fuel use and emissions. For instance, allowing pilots to fly more direct routes between destinations—so-called "free flight"—could save substantial amounts of fuel and reduce emissions by as much as 17 percent.

Although one ordinarily does not think of airplanes as a prominent source of CO_2, aircraft are responsible for roughly 3 percent of the total global emissions of CO_2.[84] It is for this reason that some environmental organizations have proposed implementing some sort of international tax or regulatory control to reduce the volume of air travel. The combustion of carbon-based fuels releases CO_2 into the atmosphere. The emissions are greatest when the engine is hottest, such as when the plane takes off.

It is unlikely the CO_2 emissions from air travel will decline without a proportionate decrease in fuel use. Because fuel consumption is the second largest cost for airlines—an estimated $10 billion per year, or 15 percent of airlines' operating costs—airlines have already begun to seek means of reducing their fuel consumption, thereby increasing their competitiveness and profitability.[85] Indeed, the industry has already cut fuel consumption by nearly 50 percent since 1977.[86] This reduction has been a result of investments in newer, more efficient aircraft, as well as basic operational changes such as lowering cruising speeds, taxiing with only one engine, and shutting down engines when takeoff is delayed by inclement weather.

Proposals to reduce airline emissions further, such as to 1990 levels, will force a dramatic reduction in air travel. Consumers will be forced into other modes of travel that are often more expensive and substantially less safe per mile traveled. Barring changes in existing air travel regulations, the imposition of tax or regulatory controls to meet 1990 emission levels could make it virtually impossible for US airlines to meet the increasing demand for air travel. The Air Transport Association (ATA) estimates that reducing emissions to 1990 levels would result in a 25 to 35 percent reduction in air services.

Soaring costs will replace soaring planes. Airline fares and air cargo rates will skyrocket; service to smaller cities will be grounded; and industry employment will drop. The ATA projects that US airlines would be disproportionately impacted and placed at a competitive disadvantage, as airlines from third-world countries are exempt. The airline deregulation of

the late-1970s is estimated to have saved consumers close to $20 billion per year.[87] Greenhouse-gas emission controls now threaten to swallow those gains. As in other sectors of the economy, however, adopting deregulatory measures could enable airlines to reduce their per-trip fuel consumption.

As a general rule, the shorter the flight, the less fuel will be consumed. Yet neither airlines nor pilots have the freedom to choose the most direct and economical route. This is because of the manner in which the Federal Aviation Administration (FAA) regulates air traffic control. The FAA mandates that airlines fly indirect routes because existing regulations were put in place at a time during which it was deemed necessary to ensure vast amounts of space between planes in the air. At the time the regulations were developed, existing radar and computer systems were incapable of providing pilots with sufficient information about other air-borne planes to maintain safe distances and line-of-sight control procedures. This is no longer the case.

The inefficiencies created by this approach to air traffic control delay planes, waste fuel, and cost airlines over $3 billion a year, according to the FAA's own estimates.[88] Allowing planes to fly more direct routes by allowing pilots to engage in "free flight" would reduce both costs and greenhouse-gas emissions. The FAA defines "free flight" as a

> concept [which] moves the NAS from a centralized command-and-control system between pilots and air traffic controllers to a distributed system that allows pilots, whenever practical, to choose their own route and file a flight plan that follows the most efficient and economical route.[89]

"Free flight" would leave a pilot free to choose the most efficient flight path given existing atmospheric conditions, traffic patterns, and the like, rather than having each plane's flight pattern dictated by the FAA. As long as the aircraft maintains a protected zone of airspace that does not meet the protected zone of another aircraft, it can fly anywhere. Only in high-traffic areas such as John F. Kennedy Airport in New York would pilot flexibility be limited.[90] Free flight is possible only with the implementation of "new ground- and air-based communications, navigation, and surveillance equipment, avionics, and decision support systems (automation)."[91]

Giving pilots freedom to map their own course is an attractive and desirable change in the eyes of the industry, and the impact on the environment would be tremendous. Aircraft CO_2 emissions would be reduced by an estimated 17 percent domestically and 12 percent abroad.[92] Unfortunately, the FAA has proven itself incapable of moving to "free flight" in a cost-effective or expeditious fashion. Upgrading air traffic control equipment to allow "free flight" is behind schedule and substantially over budget.[93] The Gore Commission on Aviation recently reported that the problems "have

been traced to inadequate user input, poor management and contractor performance, and inadequate oversight . . . [and] capital needs of the future could well outstrip the ability to fund them through the traditional budget process."[94] The *Wall Street Journal* reports the program will not be possible until at least 2015.[95]

"Free flight" is likely to save consumers money and increase the efficiency of air travel. Yet the FAA may not be up to the job.[96] Taking responsibility for air traffic control out of the hands of the FAA and privatizing the system would increase the ability and incentive of the air traffic control system to adopt such reforms as this, increase overall efficiency within the air travel sector, and have the additional benefit of reducing greenhouse-gas emissions from air travel. As the successful experiences with private air traffic control by Canada and New Zealand indicate, a privatized system will be able to act more rapidly in making decisions and acquiring and implementing new technologies and procedures that increase the efficiency of air travel, thereby reducing the resulting greenhouse-gas emissions.

Removing regulatory obstacles to capacity expansion and improvement of highways is another potential transportation-related "no regrets" policy. Reducing congestion in and around many urban centers could also greatly reduce per-trip greenhouse-gas emissions from automobile use, if not absolute emissions, while increasing the efficiency of urban transportation systems. It is well known that cars stuck in slow-moving traffic get lower fuel efficiency—and emit more carbon dioxide per mile—than cars that are moving at a constant speed. Moreover, the more time it takes for a vehicle to make a certain trip, the more emissions will result. A report prepared by Cambridge Systematics for the American Highway Users Alliance suggests that reducing congestion at the 18 worst traffic bottlenecks in the nation—largely by enhancing capacity or creating more efficient travel corridors—could reduce carbon dioxide emissions at these sites by as much as 70 percent.[97] Such improvements are slowed by extensive regulatory obstacles, review procedures, and activist litigation. As with air travel, allowing drivers to take more direct and efficient routes improves the efficiency of auto travel and reduces the consequent emissions associated with their activity.

The best insurance policy is one that improves society's generalized ability to cope with disasters.

THE SAFETY OF RESILIENCY

The broader choice in climate-change policy is between measures which constrain economic choices and thereby hamper economic growth and innovation, and those measures which free up society's creative energies to spur innovation and enhance resiliency. The human impact on the global climate system will always be indeterminate to some degree. Unforeseen events, natural and human-induced, will occur. For these reasons, the best insurance policy is one that improves society's generalized ability to cope with disasters, environmental and otherwise, not simply to mitigate one potential disaster scenario that may or may not occur.

World Bank studies indicate that concentrations of key air pollutants generally peak when per capita incomes reach $3,000-$4,000, and decline thereafter.

The importance of economic institutions in generating societal resiliency can be readily observed in the disparate impacts that natural disasters have on different parts of the world. A hurricane in Bangladesh or the Dominican Republic has a far more devastating effect than an equally severe hurricane in Florida or North Carolina. Much the same can be said when comparing the effects of earthquakes in Nicaragua and India on the one hand, and California on the other. While the economic damage may be greater in the US—representing the greater accumulation of wealth that can be affected—there is greater loss of life in poorer nations. As environmental analyst Indur Goklany observes, "Wealth alone can explain much of the variability in the vulnerability of societies to environmental and natural stresses: Just as a person afflicted with AIDS is less immune to infectious diseases, so is a poorer society more susceptible to such stresses."[98] Insofar as poorer nations are more vulnerable to potential climatic changes, it is a function of their poverty and centralized economic institutions.

Moreover, in poorer nations the amount of time it takes to restore essential services and infrastructure is far greater. This is not only a function of disparities in wealth, but also a function of the added resiliency afforded by market economies which are more able to reallocate resources to distressed areas in times of need. Price signals and other market feedbacks send powerful signals to entrepreneurs, businesses, and merchants throughout the economy, leading to a greater provision of needed goods and services in those areas hit by a disaster. This response is far more rapid and efficient than that which can be provided through a centrally-planned system. Thus, the vulnerability due to the lack of wealth in developing nations is compounded by central control of their economies. Insofar as an emission-control regime restricts the dynamism of a market economy, it will also make that society more vulnerable to natural disturbances, regardless of whether they are man-made.

It is also important to consider that health is a function of standards of living; so too is environmental protection, though to a lesser extent. Wealthier *is* healthier, and richer *is* cleaner. Limiting economic activity therefore can have a dramatic impact on quality of life, not least by reducing life expectancy. Researchers have found a direct correlation between income and mortality, with a disproportionate impact on poorer communities.[99] Thus, policies that reduce societal wealth can be expected to induce premature mortalities, as well as to increase disease and injury rates. As one recent study concluded, "Any public policy that leads to declining disposable income, such as environmental regulations, is likely to have significant adverse health effects."[100] Studies indicate that aggregate economic losses as small as $4 million can induce a premature mortality. Even assuming a conservative estimate of one premature mortality per $10 million in costs, emission-control policies, such as those envisioned by the Kyoto treaty, can have a devastating effect—a death toll of as high as 25,000 per year.[101]

On the environmental side, national wealth also correlates with environmental protection. As already noted, wealthier economies tend to be more efficient, producing more output with fewer inputs and residuals. As countries develop, they reach a transition point at which they start getting cleaner. World Bank studies indicate that ambient concentrations of key air pollutants, such as particulate matter and sulfur dioxide, generally peak when per capita incomes reach $3,000-$4,000, and decline thereafter.[102] The transition point for fecal coliform in water is even lower, at less than $1,500 per capita. Thus, according to Goklany, "Anything that retards economic growth generally also retards environmental cleanup."[103]

Increasing wealth can also impact emissions of greenhouse gases. A study of developed nations conducted by the OECD, for example, found that between 1971 and 1988, each increase in per capita income of $1,000 correlated with a 3.5 percent decrease in carbon dioxide emissions per capita. The United States may be the greatest emitter of carbon dioxide, but it emits far less per unit of output than the comparatively poor and inefficient economies of India and China.[104]

It is true that economic growth and technological advance pose environmental risks, including the risk of climate change. But regulatory policies that constrict energy use—the lifeblood of the modern economy—hardly constitute a safer course. By limiting economic growth, such policies inhibit the technological innovation and adaptive forces of the marketplace which represent the most powerful forms of insurance against uncertain threats. Irrespective of whether the greatest environmental threat is anthropogenic greenhouse warming, a new ice age, or some other unforeseen natural calamity, society will be left best able to cope with these eventualities the less restricted its economic institutions. Freeing up key sectors of the economy, particularly those most reliant on energy, thus provides two forms of insurance: It spurs innovation in the energy sector, increasing energy efficiency and technological innovation, while also enhancing society's overall resiliency.

CONCLUSION: SEEKING THE SAFER COURSE

No set of policies can eliminate all potential risks from climate change. Given the uncertain climate forecast, and the relative contribution of humans to climate changes, there is no "safe" course of action. The task for policymakers is to determine which policy approach is "safest" in comparison with the remaining options. This does not necessarily entail increased government action. In some cases the "safest" course—even when the perceived threat is serious—is simply to maximize societal resiliency. The proper prescription in this instance is not greater government controls on economic activity, but fewer. Economic growth, market institutions, and technological advance are often the most effective forms of insurance that a civilization can have. Policy efforts aimed at freeing up the

Given the uncertain climate forecast, there is no "safe" course of action.

energy sector and those segments of the economy that are most energy intensive will produce both economic and environmental gains. The economic gains will come from greater productivity and efficiency; the environmental gains from increased production per unit of energy expended or emissions released. Whether global warming is a serious threat or not, the safest course is to reduce barriers to technological innovation and the adoption of cleaner technologies. A "no regrets" strategy will reduce the threat of human-induced climate change while spurring technological innovation and economic development. In other words, it provides the most overall insurance given the present climate forecast. In the debate over the proper global warming policy, the burden of proof still rests with those who would divert societal resources to guard against an uncertain future.

NOTES

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[4] Ibid., p. 381.
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[15] Robert Mendelsohn, *The Greening of Global Warming* (Washington, DC: American Enterprise Institute, 1999), p. 1.
[16] Ibid.
[17] See Indur Goklany, "Richer Is More Resilient: Dealing with Climate Change and More Urgent Environmental Problems," in *Earth Report 2000*, p. 161.
[18] Mendelsohn, *The Greening of Global Warming*, p. 24.
[19] Goklany, "Richer Is More Resilient," p. 177.
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[25] It should be noted, however, that expanding technology and wealth can, by expanding options, increase the value of opportunities foregone due to regulatory restrictions. In other words, as technology improves, the opportunity costs of Kyoto-style emission reductions will inevitably increase as well.
[26] As Lynn Scarlett observes, "Competitive markets have pushed entrepreneurs on farms and in factories to look for new ways to 'do more with less'—to use fewer resources and less energy in producing goods and services." Lynn Scarlett, "Doing More with Less," in *Earth Report 2000*, p. 45.
[27] *Barriers to Environmental Technology Innovation and Use* (Washington, DC: Environmental Law Institute, 1998), p. 5.
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