

May 21, 1992

## A GUIDE TO THE GLOBAL WARMING THEORY

### INTRODUCTION

In the first week of June, an international "Earth summit" will convene in Rio de Janeiro, Brazil, to discuss environmental issues and their relationship to economic development.<sup>1</sup> The leaders of the majority of the world's countries are expected to attend. Last week, President Bush announced that he will attend.

This summit, formally called the United Nations Conference on Environment and Development, or UNCED, will discuss issues ranging from the distribution of wealth among nations and women's rights to deforestation. But the topic that will attract the most attention and controversy is the claim that the Earth is subject to steady and potentially damaging rise in temperature—a phenomenon known as "global warming"—and that this condition is in large part a byproduct of Western industrial growth.

While recent preparatory negotiations did not include binding agreements on targets and timetables for reducing emissions of carbon dioxide (CO<sub>2</sub>) and other so-called "greenhouse gases," the U.S. will come under enormous pressure at the conference, from other countries and many environmental groups, to sign a treaty curbing greenhouse gas emissions. These greenhouse gases occur in nature but also are caused by human activity, such as by burning fossil fuels. They are responsible for making the earth sufficiently warm to permit the existence of life, and are thus essential. The concern is that the build-up of these gases in the atmosphere could warm the planet more than would otherwise be the case, and that this global warming could lead to adverse changes in the world's ecology. At the extreme, some environmentalists say, parts of the Earth could become subject to flooding and tidal waves because of rising sea levels caused by melting polar ice caps, and drought-induced crop failures could trigger global famine.

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1 For an analysis of the circumstances leading up to the conference see Christopher M. Gacek and James Malone, "Guidelines for the U.N. Environmental Conference," Heritage Foundation *Background* No. 874, January 28, 1992.

In spite of these fears, the accumulated scientific data do not support such dire predictions, showing the cataclysmic results to be either highly improbable or simply wrong. Moreover, there is enormous uncertainty associated with the scientific methodology used to predict future climate changes. Among the difficulties:

- X Climate change computer models that predict warming often rely on assumptions and simplifications that raise questions about their reliability. Example: one model effectively moved the Earth's orbit 2 million miles closer to the sun.**
- X Models do not accurately account for the influence of important climate factors, such as the behavior and effect of clouds and oceans.**
- X There are shortcomings in the data. Example: temperature records over the last century may incorrectly suggest warming because many weather stations are close to growing cities.**
- X Temperature observations over the last century are inconsistent with the predictions of global warming theories.**
- X A competing theory, based on the hypothesis that solar activity may be the major factor in climate change, is more consistent with temperature observations in the northern hemisphere during the last century.**

Furthermore, even if most scientists and policy makers were convinced that some level of warming is occurring and will continue, three questions have to be answered.

**Question #1:** Is the Earth warming as a result of human-caused greenhouse gases or because of natural phenomena?

**Question #2:** If the planet is experiencing a major warming trend, in what way will this warming take place? Will the Earth warm up substantially at night with days cooling slightly? Will the warming occur in the tropical regions, or only in the high latitudes around the poles? Will the warming occur in the summer or the winter?

These questions are important because a single figure suggesting the average temperature of all regions of the world for all times of day and night during the entire year is a meaningless statistic. It ignores variations amid the warming trend that would have very different—and not necessarily harmful—effects in different regions.

**Question #3:** What will be the effect of any changes in the climate? Will the ocean levels rise, resulting in worldwide flooding? Or will they fall, expanding earth's landmass? Will worldwide agricultural production increase thanks to more crops in areas now too cold for major cultivation—helping to alleviate world hunger—or will it decrease, prompting famine in some regions?

The existing scientific evidence does not give clear answers to these questions. But the decisions made by policy makers at the United Nations conference and elsewhere could have enormous implications for the Earth's inhabitants. Moves to slow down

economic growth in the western industrialized countries, for instance, could have the unintended effect of slowing economic growth also in the poorest countries. Indeed, poor countries would be disproportionately affected.

The economic costs to Americans from enacting policies to address the perceived problem of global warming would be less dramatic, yet significant. Consider one proposal—imposing a “carbon tax” of \$100 per ton, designed to reduce industry’s carbon emissions to the 1990 level by the year 2000. The Congressional Budget Office estimates this tax would reduce the Gross National Product (GNP) of America by two percent. This would result in a loss to the economy of approximately \$100 billion per year, or about \$1,200 per household. Further, the increase in unemployment by the year 1997 would be an estimated 700,000 jobs.

<b>\$100 Carbon Tax Result: Skyrocketing Fuel Prices</b>	
<b>Fuel Type</b>	<b>Cost Increase</b>
<b>Electricity</b>	27%
<b>Gasoline</b>	27%
<b>Crude Oil</b>	73%
<b>Heating Oil, distillate</b>	33%
<b>Residential Natural Gas</b>	25%
<b>Wellhead Natural Gas</b>	82%
<b>Utility Coal</b>	165%
<b>Minemouth Coal</b>	240%
<b>Note:</b> 1989 constant dollars. Base year 1990.	
<b>Source:</b> U.S. Department of Energy, <i>Limiting Net Greenhouse Gas Emissions in the United States, 1991.</i>	

To be sure, if the economic, environmental, and health costs associated with global warming are as large as some fear, then the side-effects of reducing CO<sub>2</sub> might be smaller compared with the dangers of inaction. This leads to the question asked by many environmentalists and policy makers: “Isn’t it worth buying an insurance policy against global warming regardless of cost, since the consequences could be so severe?”

This is a reasonable question, but the answer is not necessarily “Yes.” The decision to buy an insurance policy depends not only on the possible consequences of not doing so, but on the probability of those consequences. With a high level of uncertainty, such as that associated with global warming, other measures might be more prudent.

To determine if the world should buy an expensive insurance policy against global warming, the probability of harm occurring must be multiplied by the likely magnitude of the harm. If the resulting expected harm is higher than the economic and social cost, then buying an insurance policy makes sense. If the expected harm is lower than the cost, it does not make sense to do so. Although it is difficult, if not impossible, precisely to quantify the expected harm from global warming, lawmakers must attempt this calculation if they are to develop sensible, cost-effective policies.

## WHAT IS GLOBAL WARMING?

One of the main subjects to be addressed at UNCED is global warming. While most Americans have heard of the phenomenon, few understand it, and there is widespread confusion between global warming and another term—the “greenhouse effect.”



**The greenhouse effect**, on the one hand, refers to the fact that the earth releases gases, called greenhouse gases, which enable the atmosphere to retain some of the heat received from the sun rather than reflecting all of it back out into space. These gases thus have the same effect as glass in a greenhouse, which is to keep the Earth at a higher average temperature, and a more even temperature, than would be the case without the gases. These gases include carbon dioxide, methane, nitrogen oxide, and water vapor. The greenhouse effect maintains the Earth at a temperature which allows plant and animal life to exist. Contrary to popular belief, all scientists agree that the greenhouse effect is desirable. Indeed, without it, life as we know it on Earth would cease because global temperatures would average  $-18^{\circ}\text{C}$ , or  $0^{\circ}\text{F}$ . Explains Patrick Michaels, State Climatologist for the Commonwealth of Virginia, the statement that all scientists agree that the greenhouse effect is real "is about as profound as a statement that all scientists agree that the Earth is round."<sup>2</sup>

**Global warming**, technically known as the "enhanced greenhouse effect," on the other hand, is a term used to describe temperature increases allegedly caused by humans over some period of time. This theory rests on the claim that certain gases released by human activity warm the planet significantly. These gases include carbon dioxide and other greenhouse gases that are released naturally into the atmosphere.<sup>3</sup> Chlorofluorocarbons (CFCs) are an exception. These are man-made gases, chiefly associated with refrigeration, which do not occur in nature.

## THE DEBATE AT UNCED

Many of the delegates at UNCED will demand action to reduce the levels of human-generated greenhouse gases on the grounds that a large rise in the Earth's temperature would be harmful. Among the studies generating these demands is a report to the United Nations Environment Programme (UNEP) by the Intergovernmental Panel on Climate Change (IPCC).<sup>4</sup> This summary concluded that global warming had already occurred, would continue to occur, and was causing a rise in the ocean levels.<sup>5</sup>

If an agreement to set targets and timetables for reducing man-made greenhouse emissions is reached at the conference, the most popular method to reduce emissions is likely to be a carbon tax. A carbon tax is a tax placed on every ton of carbon dioxide emitted by industry. This would encourage factory owners to reduce  $\text{CO}_2$  emissions—which is considered the leading human-caused greenhouse gas.

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- 2 Patrick Michaels, "Apocalypse Not Now: Science, Politics, and Global Warming (Part 1)," National Chamber Foundation, U.S. Chamber of Commerce, March, 1992.
  - 3 Water vapor, which is the primary greenhouse gas, is not increased by human activity. Water vapor and clouds account for about 98 percent of the greenhouse effect.
  - 4 "The Scientific Assessment of Climate Change," The Intergovernmental Panel on Climate Change, August 1990.
  - 5 The executive summary, however, was not representative of the body of the report, according to 40 percent of the scientists who worked on the document, and was termed "misleading" by half of those scientists. "Survey of U.S. Participants in the IPCC Report," The Science and Environmental Policy Project, August 1991.

The U.S. position throughout the discussions leading up to the conference has been that all greenhouse gases should be considered, not just CO<sub>2</sub>. Only half of the potential warming due to human activity would be caused by CO<sub>2</sub>, the rest would be due to the other greenhouse gases. The U.S. position has been that the other human-generated greenhouse gases also should be reduced if CO<sub>2</sub> is reduced. Putting the burden purely on CO<sub>2</sub> disproportionately affects the emerging poor countries and the U.S. economically.

Further, the U.S. has insisted throughout the preparatory negotiations that specific targets and timetable not be included in any treaty. On May 9, 1992, the U.S. position was formally adopted by the International Negotiating Committee (INC). Nevertheless, the negotiated language does state the general proposition that greenhouse gases should be cut.

One of the official concerns has been that the conference will turn into an effort aimed at redistributing the wealth from richer countries, such as the U.S., to poorer nations. Further, the U.S. and other industrialized countries may be pressed to change the foundations of their economic systems and lifestyles to help the less developed countries. Indeed, Maurice Stong, General Secretary of UNCED, claims that industrialized countries have developed and benefitted from unsustainable patterns of production and consumption which have produced the present dilemma, and thus, industrialized countries primarily have the means and responsibility to change these patterns.<sup>6</sup>

## THE ORIGINS OF GLOBAL WARMING CONCERNS

The theory of global warming was first put forward by Swedish chemist Svante Arrhenius in the late 19th century. Arrhenius theorized that the rise in CO<sub>2</sub> emissions caused by increased coal burning during industrialization would warm the Earth considerably. Arrhenius predicted that a doubling of CO<sub>2</sub> would increase the temperature by 5°C.<sup>7</sup> The enhanced greenhouse effect theory, or global warming, was given new life in the 1950s because the summers were hotter than usual, and was championed by Roger Revelle, then director of Scripps Institution of Oceanography.<sup>8</sup>

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- 6 Ironically, many environmental ills have not been brought on by industrialized countries. For instance, rainforest destruction is cited as one reason for this conference, but the policies of Brazil, the host country, and World Bank programs are largely responsible for the destruction. Brazil requires homesteaders to clear-cut the land in order to gain title. Likewise, the World Bank provided funds to build roads through the jungle to encourage agriculture. Thus, simple policy changes have the potential to curb much of the destruction.
  - 7 Svante Arrhenius, "Philosophical Transactions," 1896. Arrhenius further states that "[t]he influence is in general greater in the winter than in the summer, except in the case of the parts that lie between the maximum and the pole. The influence...is in general somewhat greater for land than ocean. On account of the nebulosity of the southern hemisphere, the effect will be less there than in the northern hemisphere. An increase in [CO<sub>2</sub>] will of course diminish the difference in temperature between day and night. A very important...secondary effect will probably remove the maximum effect from lower parallels to the neighborhood of the poles."
  - 8 Jonathan Laing, "Climate of Fear: The Greenhouse Effect May Be Mostly Hot Air," *Barron's*, February 27, 1989.

## The Ice Age Theory

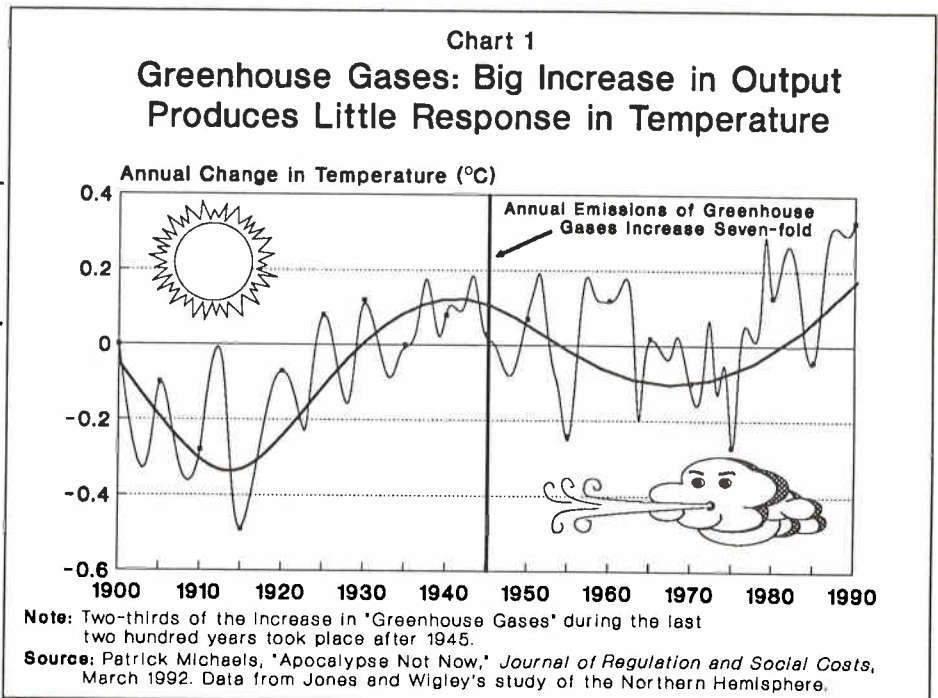
The 1960s and 1970s, however, were substantially cooler than previous decades in the northern hemisphere. The global warming theory lost favor and a new theory emerged to supplant it. Many scientists and environmentalists then believed that in fact global warming never had been a real threat and that the concern should be about global cooling. Just as many supporters of the global warming theory argue today, the culprit was said to be human economic activity—chiefly dust. And just as global warming predictions today are usually stated as fact, so the coming “Ice Age” was presented to the public as fact in the 1960s and 1970s. The only question, according to numerous nationally recognized proponents, was not whether an Ice Age would occur if man continued his destructive activities, but how soon it would come and how devastating the cold would be.<sup>9</sup>

## The Shift Back to Global Warming Theory

The international fear about an apocalyptic Ice Age waned as quickly as it had arisen as soon as the trend of temperatures turned upwards again in the late 1970s. The first computer-simulated climate model to gain attention by suggesting a warming trend, known technically as the General Circulation Model (GCM), was first published in 1975, and revised in 1980. This model predicted that the Earth would warm 4°C with a doubling of carbon dioxide (CO<sub>2</sub>) emissions.

The global warming theory gained enormous support after James Hansen, a physicist and the chief of NASA’s Goddard Institute for Space Studies, testified before the U.S. Senate in June 1988 that the full force of human-induced global warming had arrived.<sup>10</sup> Hansen stated that

“global warming is now sufficiently large that we can ascribe with a high degree of confidence a cause and effect relationship to the greenhouse effect.”<sup>11</sup> In support of



9 For examples of colorful and forceful quotes by nationally recognized proponents of global cooling, see Anna Bray, "The Ice Age Cometh," *Policy Review*, No. 58, Fall 1991.

10 Testimony before the Senate Committee on Energy and Natural Resources, June 23, 1988.

11 *Ibid.*

his conclusions, Hansen declared that 1988 would be the warmest year on record, barring any "remarkable and improbable" cooling. This statement was readily accepted by the press and the general population because the previous winter had been unusually warm and the spring and early summer were much hotter than normal. The remarkable and improbable cooling nevertheless occurred (even as Hansen was testifying) in the tropical Pacific Ocean. A cold front the size of the U.S. Great Plains also settled over Siberia later in the year, bringing average northern hemisphere temperatures downward. In fact, despite the unusual temperatures in the summer of 1988, one out of every six summers since 1895 has been hotter in the U.S., the most recent being 1963.<sup>12</sup>

Since his 1988 testimony, Hansen's vision of global warming has come under increasing attack.<sup>13</sup> Reid Bryson, a respected expert in climate research and Emeritus Professor of Geography, Meteorology, and Environmental Studies at the University of Wisconsin at Madison, dismissed the Hansen testimony as a "phenomenal snow job" and the global warming theory as "a triumph of sociology over science."<sup>14</sup> In fact, the theory that substantial global warming will occur is bitterly disputed by many highly respected scientists. Global warming is not a fact. It is a theory that is widely challenged. In a recent survey of atmospheric physicists and meteorologists, for instance, almost all of the scientists agreed that catastrophic global warming predictions are unsupported by scientific evidence and that climate models showing warming cannot be relied upon.<sup>15</sup> There are several reasons why so many scientists are uncertain about the theory.

#### **Reason #1: The science involved in the global warming theory is very complex.**

Scientists generally agree on many of the fundamental concepts behind the greenhouse theory, which is crucial to the catastrophic global warming theory. Where they part company is in making the jump between one theory and the other.

The reason why there can be deep disputes among scientists investigating climate change is that climatology is perhaps one of the most complex and uncertain of all scientific fields. It is not possible to run controlled experiments for the whole planet in a laboratory test tube. Climate conditions cannot be created and changed at will, and then studied. Thus scientists are forced to use models to predict the consequences of various influences, and to try to disentangle the effect of one factor from a myriad of others. Necessarily, such models attempt to include all significant variables and exclude the insignificant ones. The problem is to decide which is which, and if all the variables have in fact been considered.

Given the inherent difficulties in the science of climatology, it is crucial that models are continually tested against data being collected and that scientists accept that conflicts throw their models and theories into question. Unfortunately this does not always

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12 Jonathan Laing, "For 1989, a Drought Encore?" *Barron's*, February 27, 1989.

13 Hansen also testified that the observed warming in the past century was 0.6°C to 0.7°C. This is 20 to 40 percent higher than any objective trend analysis using the global records considered most reliable. See Michaels, *op. cit.*

14 Laing, "Climate of Fear," *op. cit.*

15 "Survey of U.S. Participants in the IPCC Report," *op. cit.*



happen. For example, Christopher Folland of the United Kingdom Meteorological Office, who was one of the senior authors of the 1990 Intergovernmental Panel on Climate Change report to the U.N. that predicted global warming of 2.5°C, recently was asked if the data collected to date (which showed substantially different results from those predicted by models) would alter recommendations for CO<sub>2</sub> emission reductions. Folland responded that “the data don’t matter,” adding that “[w]e’re not basing our recommendations on the data; we’re basing them upon the GCM [General Circulation Model] climate models.”<sup>16</sup>

Clinging to a model in the face of conflicting data is bad science, and generally leads to bad policy. But the data gathering and modeling problem is made even more difficult because of systematic warming biases of the data on which the models are based.

**“Heat Island” Effect.** For instance, past observations indicate a global temperature increase of 0.5°C over the last 100 years.<sup>17</sup> But questions have arisen over the reliability of even such a basic trend, because recording stations have been placed in areas, such as near cities, that have experienced growing populations over the decades. The buildings and roads which accompany an increasing urban population retain warmth from the sun. This may have exaggerated the long-term temperature rise—or even suggested one where none exists. This is known as the “heat island” effect.

Extremely accurate and more reliable temperature records do exist—but only since 1979. Satellite temperature readings, according to Roy Spencer of NASA, and John Christy of the University of Alabama, are accurate within 0.01°C, because the satellites use a different method to calculate temperature. Just as important, the satellites are not affected by the heat island effect and the readings cover the entire globe uniformly, unlike ground-based stations which are clustered and sporadic. Significantly, these satellite temperatures show that the ground-based stations records may not be very accurate. The ground-based records show a warming in the southern hemisphere of 0.3°C over the past decade, but the highly reliable satellite data contradict this warming trend. In fact, the satellites show that the southern hemisphere temperatures actually dropped 0.02°C. This calls into question the wisdom of relying on questionable data accumulated earlier this century as the basis for costly policy changes.

But even if the ground-station records were correct, the results would squarely contradict the global warming theory, which predicts that the northern hemisphere will warm much faster than the southern hemisphere. Northern hemisphere temperatures have not changed significantly. This means that global warming advocates are faced with the prospect of pursuing their theories although the data are suspect and do not support their assertions, or re-examining their theories in light of new satellite data, which show no warming trend where models predicted it should have occurred. Unfortunately they have chosen the first course.

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16 Presentation by Patrick Michaels at the National Chamber Foundation, U.S. Chamber of Commerce, April 10, 1992.

17 It should be noted that almost all of the warming occurred more than 50 years ago, prior to the emission of more than 67 percent of human-generated greenhouse gases. Since 1941, the temperature dropped and then rose about 0.1°C.



## Reason #2: Many models use questionable or incorrect parameters.

Some of the models predicting global warming have been discovered to have included incorrect parameters. Parameters are variables or arbitrary constants in mathematical expressions that generally try to reflect real world conditions which restrict or determine the outcome of the mathematical expression. Sometimes adjusting these parameters can have bizarre results. A prime example is the first influential GCM model, developed in 1975. This model, devised by Sukryo Manabe and Richard Wetherald of the Geophysical Fluid Dynamics Laboratory at the National Oceanic and Atmospheric Administration (NOAA), indicated that the Earth would warm by 4°C with a doubling of CO<sub>2</sub> in the atmosphere. Unfortunately for the model, it also predicted background temperatures (that is, the temperatures that would occur if there had been no CO<sub>2</sub> increase) that would have to be 5°C lower than today. It is interesting to note that since the last Ice Age was between 4°C and 6°C colder than today, an ice age would have occurred if the background model was correct. To correct for this problem, the researchers revised the level of the sun's radiation reaching the Earth's atmosphere upward by 6 percent. But this is equivalent to moving the earth's orbit 2 million miles closer to the sun.<sup>18</sup>

A study of Hansen's GCM computer model, which predicts catastrophic warming by the year 2100, found that a one percent difference in the initial conditions or parameters was enough to create totally different predictions of global temperatures over the last half of the period 1991-2100.<sup>19</sup>

Other examples of questionable or incorrect parameters include:

**Oceans.** The theory that oceans retard the warming caused by greenhouse gases is generally accepted, and incorporated into most newer models. Unfortunately, the magnitude of the ocean effect is poorly understood and roughly estimated. This could introduce significant errors into models. For instance, many researchers claim that it takes 50 years or more for carbon emissions to affect temperatures. Other researchers, however, concluded recently that 75 percent of the full effect of carbon dioxide emissions on sea temperatures is experienced within ten years.<sup>20</sup>

**Clouds.** The problem of determining the effect of clouds is even more complicated, and consequently climate models often contradict each other in the characteristics that they assign to clouds. One theory is that as the temperature increases, because of a rise in greenhouse gases, the relative humidity drops and fewer clouds form. Thus, sunlight reaching the earth increases, causing more warming, or "positive feedback." But another scientific school of thought maintains that clouds have a cooling effect, or "negative feedback." The cloud feedback problem is crucial to a full discussion of the global warming issue, since the models show a range of warming from less than 1°C to as

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18 The researchers also used incorrect parameters in another instance in the study. The original study predicted that the polar ice caps would melt at approximately today's temperatures. In the subsequent report, they corrected this error, but left the accelerated warming which is the direct result of ice cap melting in the model.

19 A. Tsonis, "Sensitivity of the Global Climate System to Initial Conditions," *Eos*, No. 30 (July 23, 1991), p. 313.

20 S. Manabe, K. Bryan, and M.J. Spelman, "Transient Response of Global Ocean Atmosphere Model to a Doubling of Atmospheric Carbon Dioxide," *Journal of Physical Oceanography*, Volume 20 (1990), pp. 722-749.

much as 5°C, depending on the extent and sign (positive or negative) of cloud feedback alone.<sup>21</sup>

Recent studies seem to support the view of scientists who theorize a negative feedback from clouds. James Angell, a research meteorologist at the NOAA Air Resources Laboratory, found that between 1950 and 1988, the number of cloudy days increased by 3.5 percent.<sup>22</sup> In addition, other research finds that human-generated sulfates, contributing to atmospheric pollution, also have the effect of enhancing the brightness of clouds. This increases the amount of sun radiation reflected back into space, thus cooling the earth.<sup>23</sup>

Many scientists have theorized that sulphate aerosols are primarily responsible for the increase in cloud cover, but this theory is challenged by new evidence. In the southern hemisphere, where there are virtually no sulphate aerosols, new evidence shows that cloudiness has increased.<sup>24</sup> Contends Patrick Michaels, State Climatologist for the Commonwealth of Virginia, this lends credence to another theory "that increased cloudiness is one of the natural responses to a greenhouse enhancement, and therefore, a disproportionate amount of warming occurs at night."<sup>25</sup>

**Cooling Effect.** Clouds are probably more important than greenhouse gases in their influence on global climate change by a factor of 4. A study by V. Ramanathan, a professor of geophysical sciences at the University of Chicago, has shown conclusively that clouds have a cooling net effect on the planet.<sup>26</sup> While clouds do create some warming effect as well as a cooling effect, the cooling effect is larger by 13.2 watts per square meter of planet surface.<sup>27</sup> This cooling effect is approximately four times the expected warming from enhanced greenhouse gases (almost 4 watts per square meter) predicted by catastrophic global warming models, according to the study. Moreover, "[t]his cooling effect is large over the mid- and high-latitude oceans, with values reach-

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21 George C. Marshall Institute, "Two Environmental Issues" (Washington, D.C. December 1991).

22 J.K. Angell, "Variations and Trends in Tropospheric and Stratospheric Global Temperatures, 1958-1987," *Journal of Climate*, Vol. 1, No. 12 (December 1988), pp. 1296-1313. The number of cloudy days increased 2 percentage points from approximately 56 percent to 58 percent of total days. This is a 3.5 percent increase in the number of cloudy days.

23 "When fossil fuel is burned, both carbon dioxide and sulphur dioxide are added to the atmosphere. The former should cause warming of the lower atmosphere by enhancing the greenhouse effect, whereas the latter, by producing sulphate aerosols, may cause a cooling effect. The possibility that these two processes could offset each other was suggested many years ago...but during most of the intervening period, attention has focused on the greenhouse effect...Over the next 10-30 years, it is conceivable that the increased radiative forcing due to SO<sub>2</sub> concentration changes could more than offset the reductions in radiative forcing due reduced CO<sub>2</sub> emissions." Virginia Climate Advisory, Volume 15, Number 1, Spring 1991, (quoting T.M.L. Wigley, "Could Reducing Fossil-Fuel Emissions Cause Global Warming?" *Nature*, Vol. 349 (1991), pp. 503-505.

24 Telephone interview with Patrick Michaels, State Climatologist for the Commonwealth of Virginia, May 13, 1992.

25 *Ibid.*

26 V. Ramanathan, R.D. Cess, E.F. Harrison, P. Minnis, B.R. Barkstrom, E. Ahmad, D. Hartmann, "Cloud-Radiative Forcing and Climate: Results from the Earth Radiation Budget Experiment," *Science*, Vol. 243, January 6, 1989.

27 *Ibid.* The heating effect of clouds, caused by longwave cloud forcing resulting from the greenhouse effect, is 31.3 watts per square meter. The cooling effect, caused by shortwave cloud forcing resulting from enhanced planetary albedo, is -44.5 watts per square meter.

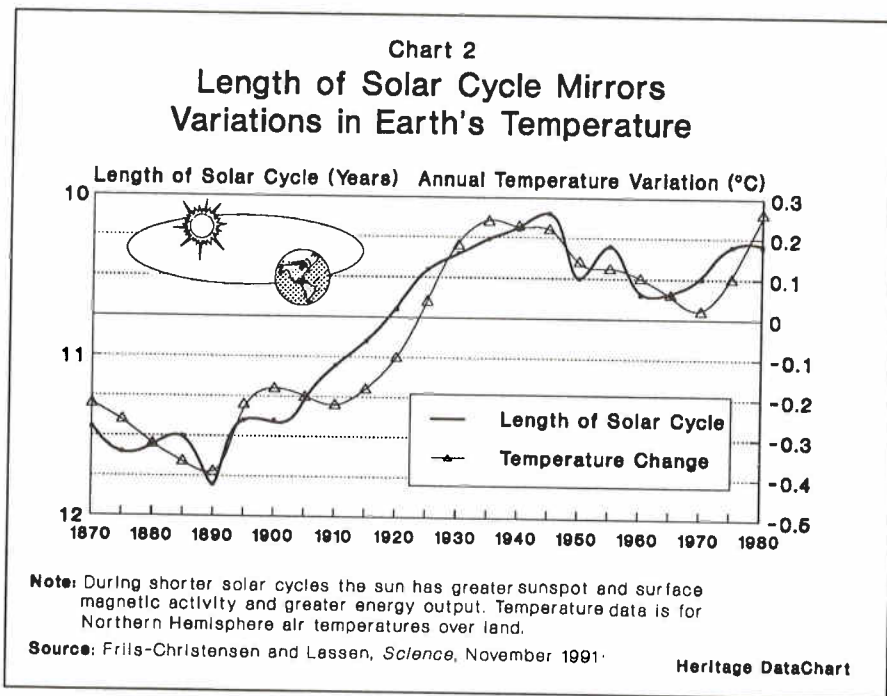
ing -100 watts/square meter."<sup>28</sup> Thus, a small increase in cloudiness could offset potential warming from enhanced greenhouse gases.

Perhaps even more important than the change in the effect of clouds on the overall change of temperature is the effect they may have on day-time and night-time temperatures. This is important because the dangers often cited by alarmists are generally predicated on the fears of rising day temperatures, which they claim will cause drought-induced crop failures, global flooding from the melting polar ice caps, and other catastrophes. If only night temperatures increase, then these dangers are extremely unlikely because rising night temperatures would not cause these problems. Alarmists rely on the 1990 IPCC report that states "there is no compelling evidence for general reduction in the amplitude of the diurnal cycle" from greenhouse gases. Yet this important assumption has been recently contradicted by government scientists. A 1991 study of the U.S., the former Soviet Union, and the People's Republic of China by Thomas Karl and other scientists of the National Climatic Data Center at NOAA have found that night temperatures over the time periods available in each country have increased, but day temperatures have not. This phenomenon is found to be directly related to increased cloud cover.<sup>29</sup>

This study concludes that either models have over-predicted day temperature (under-predicted night temperatures) or that the slight warming over the last century is due to "factors unrelated to an enhanced anthropogenically-induced greenhouse effect."<sup>30</sup>

### Solar Activity.

Cycle variations in solar activity may be a much bigger determinant of Earth temperature variations than previously had been assumed. While not without problems, this research is extremely promising as an alternative explanation of global temperature changes, and—if correct—means that variations in man-made greenhouse gas emissions may have little or no



28 *Ibid.*

29 T. Karl, G. Kukla, V. Razuvayev, M. Changery, R. Quayle, R. Heim, Jr., D. Easterling, Cong Bin Fu, "Global Warming: Evidence for Asymmetric Diurnal Temperature Change," *Geophysical Research Letters*, Volume 18, No. 12 (December 1991), pp. 2252-2256.

30 *Ibid.*



impact. A study by Danish scientists E. Friis-Christensen and K. Lassen of the Danish Meteorological Institute has gained enormous attention recently. This study, released in November 1991, found that variations in the sunspot cycle are correlated extremely closely with northern hemisphere temperature fluctuations.<sup>31</sup>

Some experts have even theorized that solar magnetic activity may account almost completely for the changes in the Earth's temperature in the last 130 years.<sup>32</sup> Indeed, the remarkably close relationship seems to suggest that other possible influences, such as greenhouse gases, could not influence temperatures beyond a few tenths of a degree over the period. There is further evidence that solar activity may be the dominant factor in climate change.<sup>33</sup> For example, carbon analysis of trees, which is a reliable indicator of levels of solar magnetic activity, indicates that solar activity has risen and fallen significantly every 200-300 years for the last 6,000 years. Geologic evidence of the size of past glaciers reveals that when solar activity increased in the past, as indicated by carbon analysis, the Earth's temperatures also increased. When solar activity decreased, temperatures decreased.

Needless to say, the solar theory, like the global warming theory, is still a theory and must be subjected to vigorous testing. Moreover, the theory also leaves several questions unanswered. Although the theory explains the northern hemisphere temperature changes extremely well, for example, it fails completely to explain temperature changes in the Southern Hemisphere. It also does not yet adequately explain how solar radiation warms night temperatures but not day temperatures. Nevertheless, the Danish study lends considerable weight to the argument that much more research on climate change is needed before fundamental changes in energy and economic policies should be enacted. If solar activity turns out to be the principal cause of climate change, the world would be needlessly throwing away its wealth and enduring hardship if it sought to control other minor factors.

## WHAT WOULD BE THE CONSEQUENCES OF GLOBAL WARMING?

Even if it appears likely that a significant increase in global temperatures will occur, and even if human activity is the principal cause, there is still the question of whether any changes in global temperature would be beneficial or detrimental. Again, the ability of science to predict with confidence the results of a climate change is very limited. Still, there are some indications of what might happen.

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- 31 E. Friis-Christensen and K. Lassen, "Length of Solar Cycle: An Indicator of Solar Activity Closely Associated with Climate," *Science* (Vol. 254), November 1, 1991. Sunspots are relatively dark spots that appear in groups on the surface of the sun. They have approximately eleven-year cycles and are associated with strong magnetic fields. The variations in the eleven-year cycle correlate to increasing and decreasing temperatures over the last 130 years, according to the Danish study.
- 32 See Marshall Institute, "Global Warming Update: Recent Scientific Findings" (Washington, D.C. 1992).
- 33 For a thorough explanation, see George C. Marshall Institute, *op. cit.*

## The Impact on Crops

Nights may become warmer without any major change in daytime temperatures. Historical data show that the temperature increases in the past 100 years have all been at night, and that day temperatures basically have remained constant.<sup>34</sup> This pattern has important implications. The crop-growing season is affected most by the timing of the last spring frost and the first fall frost. If night temperatures increased, these frosts would occur earlier in the spring and later in the fall, thereby extending the growing season and boosting food production in many regions.

It is widely believed that global warming would lead to droughts while increasing the water requirements of plants. But this theory does not stand up to scrutiny. First, droughts are not likely to increase with global warming if the primary effect is to raise only night-time temperatures.<sup>35</sup> Second, since water evaporation from plants mainly occurs during the day, plants would not experience greater heat stress simply from warmer nights.

The increased CO<sub>2</sub> associated with the global warming theory may also actually improve agricultural production. Studies conducted by the Department of Agriculture's Agricultural Research Service (ARS) show that doubling the CO<sub>2</sub> concentration in the atmosphere would improve cotton yields by 80 percent, wheat and rice by 36 percent, soybeans by 32 percent, and corn by 16 percent.<sup>36</sup> Increased CO<sub>2</sub> in the atmosphere also would significantly reduce the amount of water necessary for plants because plants could breathe easier, thus losing less moisture through their pores during the breathing process.

Another probable effect of global warming would be to expand the world's agricultural belt. More of Canada and the former Soviet Union, as well as the northern latitudes of Europe and the northern states of America, could become more abundant producers. But lower latitudes would not necessarily experience an equivalent fall in production. The enhanced greenhouse, or global warming, theory predicts that future warming will occur primarily in higher latitudes. Moreover, if warmer nights were the main effect of global warming, this would mean higher yields in lower latitudes that now experience frosts by extending the growing season.

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- 34 The large increase in warming that is often cited as having occurred in the last 100 years actually occurred between 50 to 100 years ago, before the large increases in CO<sub>2</sub> emissions. Obscuring this fact often leads to the false conclusion that the Earth has been steadily warming. In fact, it has oscillated. The last fifty years showed very little overall warming.
- 35 Part of the confusion stems from the improper use of a crude drought index, known as the Palmer Drought Index, to gauge not only the level of drought that has occurred, but to further predict the amount of drought that would occur in the future from increases in the mean temperature. Proponents of future drought base their predictions on the presumption that precipitation will decrease while mean temperatures will increase. The problems with this methodology are two-fold. There is no indication that precipitation will decrease (past records show no change). Further, using increased mean temperatures to estimate drought will systematically overstate the problem or find problems where they do not exist if the increase occurred at night. Simply stated, if precipitation and day temperatures remained constant while night temperatures increased, thereby raising the mean temperature, the evaporation rate would not change very much because evaporation is caused primarily by high day temperatures.
- 36 Laing, "Climate of Fear," *op. cit.*

### Flooding.

Some proponents of the global warming theory predict worldwide flooding. The theory is that as the earth warms, the polar ice caps will begin to melt and sea levels could rise to dangerous levels.

Some projections in the early 1980s

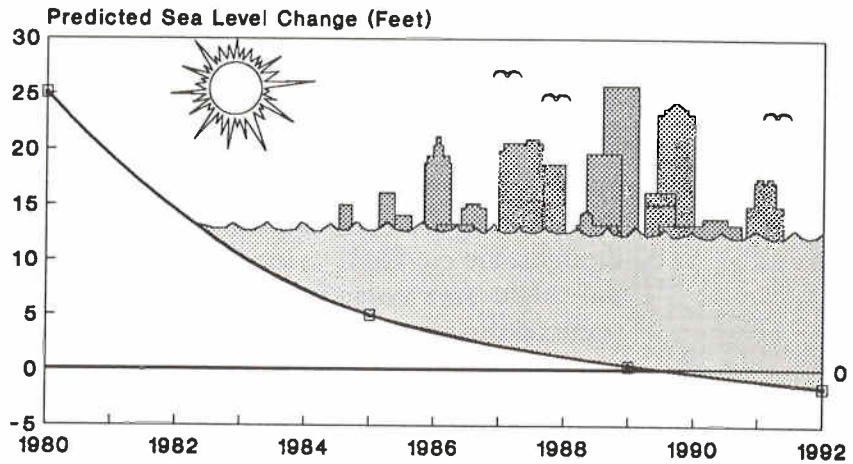
theorized huge tidal waves and a sea level rise of as much as 25 feet above the current sea level. Even the more conservative models suggested a rise of two to three feet. Projections have been revised down considerably in the last decade, however.<sup>37</sup>

Evidence released this year suggests that even these recent predictions may be wrong and that sea levels could even fall. A team of Canadian and American scientists studied the geological record of the ice caps over the last 130,000 years.<sup>38</sup> The team discovered that as global temperatures rose, the size of the ice caps became larger. The explanation? The Arctic and Antarctic air normally is too cold to hold much moisture.<sup>39</sup> Consequently, the poles experience very little snowfall. But as the temperature rises, the air becomes warm enough to hold moisture and snow falls—increasing the size of the polar caps and leading to a drop in the sea level.

## THE COST OF DOING SOMETHING

Many less developed countries are just beginning their slow ascent out of poverty, thanks to their adoption of free market economic policies favoring strong growth. These policies will bring material prosperity and improvements in the quality of life of their inhabitants. But rapid growth requires large amounts of inexpensive energy, and for underdeveloped countries, this generally means burning fossil fuels, such as oil and coal. If restrictions on the use of such fuels are enacted, these countries will have to

Chart 3  
Rising Oceans? Predictions of Global Warming Have Changed With the Times



Note: The most recent estimates indicate a net drop in sea level.

Source: George C. Marshall Institute, *Global Warming Update*, 1992.

Heritage DataChart

37 The 1990 IPCC report found that the "best estimate" predicted a sea level rise of 66cm, or just over 2 feet.

38 G. Miller, and A. deVernal, "Will Greenhouse Warming Lead to Northern Hemisphere Ice Sheet Growth," *Nature*, Volume 355 (1992), p. 245.

39 Marshall Institute, "Global Warming Update," *op. cit.*



forego some of the benefits of increased wealth and the associated improvements in health.

Some proponents of slower economic growth maintain that slower growth means better environmental protection. But a Princeton study of 42 countries, released late last year, shows that air pollution is inversely related to wealth above the \$4,000 to \$5,000 Gross Domestic Product (GDP) per capita level. In other words, as a country grows wealthier, its residents tend to be more prepared and can afford to devote financial resources to reducing air pollution.<sup>40</sup> Action to improve the environment is a characteristic of rich countries, not poor ones.

**Huge Costs.** Although the economic impact of curbing man-made greenhouse gas emissions would be greatest in less-developed countries, American families also would be hard hit. One proposal is to reduce CO<sub>2</sub> by 20 percent by the year 2000 by imposing a carbon tax. According to a 1991 Department of Energy report, this would cost approximately \$95 billion annually, or \$1,200 for every American household.<sup>41</sup> America currently spends approximately \$125 billion annually, or about \$1,500 per family, on environmental protection. The carbon tax proposal would almost double that cost, and might lead to demands from business and households to reduce other spending to protect the environment. In preparatory conference negotiations concluded this May 9, the U.S. and 142 other countries adopted non-binding vague language that urged greenhouse emissions to be returned to their 1990 levels by some unspecified date and to attempt unspecified reductions by the year 2000.

However, according to a 1990 study by the Congressional Budget Office (CBO), even if emissions were kept at 1990 levels, America would "risk several years of economic stagnation and high unemployment," depending on how a carbon tax was implemented.<sup>42</sup> Even if the tax were phased in gradually, an estimated 700,000 jobs would be lost as a direct result of the carbon tax by 1997, according to the CBO.

Another report, a Department of State memorandum issued last month, suggests the cost of reducing carbon emissions would be very small, but this report contains doubtful assumptions.<sup>43</sup> For instance, the State Department memorandum assumes that over one-quarter of all households and up to almost two-thirds of all U.S. businesses will replace their lighting fixtures with more energy efficient fixtures by the year 2000. This

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- 40 G.M. Grossman and A.B. Krueger, "Environmental Impacts of a North American Free Trade Agreement," Discussion Paper No. 158, Discussion Paper on Economics, Woodrow Wilson School, Princeton University, November 1991. It must be noted that between \$0 to \$4,000 GDP per capita, the amount of air pollution increases as GDP per capita rises. Since Lesser Developed Countries fall into this range, this provides an additional reason to allow these countries to break past the wealth barrier as quickly as possible, rather than slowly increasing in wealth or remaining economically flat.
- 41 "Limiting Net Greenhouse Gas Emissions in the United States," U.S. Department of Energy, Office of Environmental Analysis, Deputy Under Secretary for Policy, Planning and Analysis, September 1991.
- 42 Congressional Budget Office, "Carbon Charges as a Response to Global Warming: The Effects of Taxing Fossil Fuels," August 1990.
- 43 "U.S. Views on Global Climate Change," United States Department of State, Bureau of Oceans and International Environmental and Scientific Affairs, April 23, 1992.

unlikely assumption accounts for as much as 46 percent of the total voluntary carbon reductions the State Department predicts will occur.

## A PRUDENT POLICY AMID UNCERTAIN SCIENCE

When faced with uncertain science, as is the case with the theory of global warming, one of four basic strategies can be adopted.<sup>44</sup> These are:

- Option #1: Take no action, not even research.** This option has the advantage of being costless, since it requires nothing but waiting until the threat, if any, is clearer. But it introduces the danger of not dealing with a potential problem and not increasing knowledge concerning the threat and the consequences of inaction.
- Option #2: Conduct more research, but take no other action.** This option has the advantage of being relatively inexpensive compared with other possible actions, while increasing the knowledge of the scope and likelihood of a potential problem. It risks, of course, the consequences associated with having delayed action if the threat turns out to be real.
- Option #3: Take limited action to control greenhouse gas emissions, phased in over a period of time.** This option has the advantage of being less expensive than tackling the problem — if it exists — completely and immediately. But it suffers from being much more expensive than research, and the result may be huge expenditures on a problem that does not exist.
- Option #4: Undertake full control of emissions on an emergency timetable.** This option has the advantage of addressing potential harm as quickly and thoroughly as possible. But it is very expensive, and may address a mythical problem.

The threat posed by global warming, if it is real, is large enough to rule out the first option as the prudent policy. Policy makers then must consider the risk in delaying action while acquiring more scientific understanding on which to base a policy. Two studies completed last year strongly contradict the “must act now” view that maintains there is no time to delay, according to a scientific panel of the George C. Marshall Institute, which is a Washington, D.C.-based public policy institute focusing on scientific matters. According to the panel’s findings:

The calculations [of both studies] show that a five-year delay in limiting carbon emissions will make the world warmer in the next century by at most one tenth of a degree, compared to how warm it would be if there were no delay.<sup>45</sup>

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44 S. Fred Singer, "Environmental Strategies with Uncertain Science," *Regulation*, Winter 1990, p. 65.

45 Marshall Institute, "Global Warming Update," *op. cit.*

At the same time, the research data made possible by stepped-up global climate research means knowledge is increasing rapidly, so delay may significantly increase the chances of taking the right course of action without incurring serious damage to the Earth's environment if the global warming theory is found to be substantially correct.

Thus rather than agreeing to targets and timetables for controlling greenhouse gas emissions, which may not be needed and which would impose enormous costs on developed and less-developed countries, the U.S. would be wise to pursue an intensive program of research and urge other countries to do likewise.

The U.S. has set the pace in research on global change, and this has produced huge amounts of new data—much of it raising serious questions about the global warming theory. The U.S. has spent \$2.7 billion since the global change research project was initiated three years ago, and the Administration has proposed increasing the annual global change research budget next year by 24 percent to almost \$1.4 billion. The rest of the world combined spends about the same amount as the U.S. currently. The U.S. should commit to increases in the research budget of \$300 million, or 25 percent, annually for the next five years. To pay for this research, the federal government should sell the Naval Petroleum Reserve, which is no longer needed for the Navy's security.

**The Search for an Answer.** New climate change research could be supplemented by allowing scientists greater access to non-sensitive intelligence information accumulated in the past. This would be useful because surveillance satellites and aircraft, submarines, and oceanographic vessels have collected mountains of data that can be used to accelerate research on questions such as past contours and thaw rates of polar ice caps, ocean chemistry and temperatures, and scores of other issues. Subject to legitimate national security concerns, such as sources and methods of intelligence gathering and existing programs, President Bush should announce that he will authorize U.S. intelligence agencies to begin opening their relevant archived files.<sup>46</sup> Not only could this prove very beneficial to the search for an answer to the questions implicit in the global warming theory, but such an action would demonstrate that the President takes the potential threat of global warming seriously—without prematurely engaging in a potentially harmful and costly policy.<sup>47</sup>

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46 The authorization for opening the archives should be limited to global research only.

47 As Alton Frye, Vice President and Washington director of the Council on Foreign Relations, states: "Given the pressures on the President to join the commitments projected for the Rio conference, a program of cooperation between environmental and national security communities could be a political windfall for the Administration. The President should tell the world at the Earth Summit that he has sent a clear order to the national security community: 'subject only to safeguarding current programs, open the archives.' Few steps would do more to demonstrate commitment to vigorous action on the global warming issue...." Alton Frye, "How to 'Spy' on the Environment," *The Washington Post*, May 4, 1992, p. C4.



## CONCLUSION

Climate change is an extremely complicated field of scientific research. Although understanding of the probable effects of greenhouse gas emissions is rapidly improving, the level of uncertainty remains high and the predictive power of climate models is poor. The models now used vary in their predictions enormously.

Moreover, recent studies and analyses of past studies indicate that many of the underlying assumptions in the computer models showing warming are wrong and lead to erroneous predictions. Models of climate change also fail to explain the discrepancy between predicted climate change in the last 100 years and actual change.

In addition, even if the elements of the global warming theory are accepted, the forecasted effects are overblown and may in some cases be completely wrong. In particular, the evidence suggests strongly that widespread flooding from the melting of the ice caps will not occur. Further, agricultural production is likely to increase, not fall.

And while there is a plausible ring to the argument that it would be wise for countries to take action, "just in case," the costs of government-mandated reductions in CO<sub>2</sub> would be enormous. Such reductions would impose heavy costs on American families and raise unemployment. Less developed countries would be especially hard hit.

Thus, given the shaky science, the uncertain effects, and the enormous cost of taking precipitous action, the U.S. should not agree to binding targets and timetables on emissions at the Rio conference next month. Any agreement should be limited to a commitment to treat the threat seriously, with reductions in greenhouse gases voluntary for each country.

What the U.S. should do is emphasize the importance of research on global climate change. The U.S. should pledge to increase its climate research budget, which accounts for half the total spent by all countries, and challenge the other nations at the conference to step up their research. The U.S. also should open up the relevant archives of U.S. intelligence agencies, subject to legitimate national security concerns, to accelerate global climate research.

Global warming may pose a huge danger to the Earth. Or it may turn out to be just as much a false alarm as the "Ice Age" panic twenty years ago. If the science of climate change was more precise than it is, and all the evidence consistent with the dire predictions of some proponents of the global warming theory, then it could make sense for the U.S. and other countries to take urgent, expensive action in an effort to deal with the potential threat. But the science is uncertain. Rather than rush to "do something," the wiser course would be to find out what is actually happening to the Earth's climate.

John Shanahan  
Policy Analyst

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