

# EXHIBIT 40

# Environmental Effects of Increased Atmospheric Carbon Dioxide

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**ABSTRACT** A review of the research literature concerning the environmental consequences of increased levels of atmospheric carbon dioxide leads to the conclusion that increases during the 20th and early 21st centuries have produced no deleterious effects upon Earth's weather and climate. Increased carbon dioxide has, however, markedly increased plant growth. Predictions of harmful climatic effects due to future increases in hydrocarbon use and minor greenhouse gases like CO<sub>2</sub> do not conform to current experimental knowledge. The environmental effects of rapid expansion of the nuclear and hydrocarbon energy industries are discussed.

## SUMMARY

Political leaders gathered in Kyoto, Japan, in December 1997 to consider a world treaty restricting human production of "greenhouse gases," chiefly carbon dioxide (CO<sub>2</sub>). They feared that CO<sub>2</sub> would result in "human-caused global warming" – hypothetical severe increases in Earth's temperatures, with disastrous environmental consequences. During the past 10 years, many political efforts have been made to force worldwide agreement to the Kyoto treaty.

When we reviewed this subject in 1998 (1,2), existing satellite records were short and were centered on a period of changing intermediate temperature trends. Additional experimental data have now been obtained, so better answers to the questions raised by the hypothesis of "human-caused global warming" are now available.

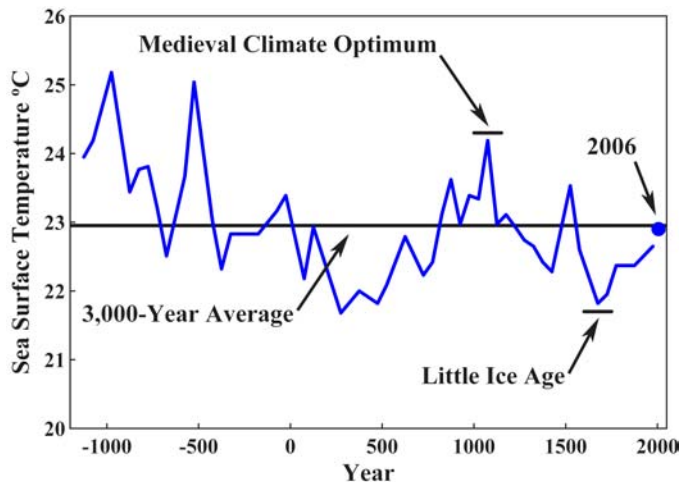


Figure 1: Surface temperatures in the Sargasso Sea, a 2 million square mile region of the Atlantic Ocean, with time resolution of 50 to 100 years and ending in 1975, as determined by isotope ratios of marine organism remains in sediment at the bottom of the sea (3). The horizontal line is the average temperature for this 3,000-year period. The Little Ice Age and Medieval Climate Optimum were naturally occurring, extended intervals of climate departures from the mean. A value of 0.25°C, which is the change in Sargasso Sea temperature between 1975 and 2006, has been added to the 1975 data in order to provide a 2006 temperature value.

The average temperature of the Earth has varied within a range of about 3°C during the past 3,000 years. It is currently increasing as the Earth recovers from a period that is known as the Little Ice Age, as shown in Figure 1. George Washington and his army were at Valley Forge during the coldest era in 1,500 years, but even then the temperature was only about 1° Centigrade below the 3,000-year average.

The most recent part of this warming period is reflected by short-

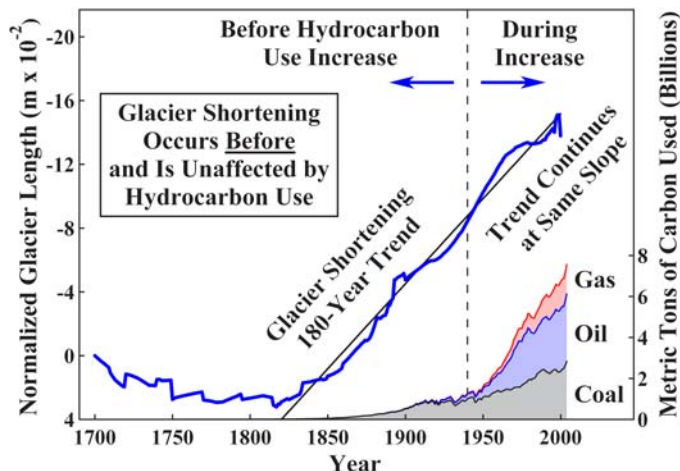


Figure 2: Average length of 169 glaciers from 1700 to 2000 (4). The principal source of melt energy is solar radiation. Variations in glacier mass and length are primarily due to temperature and precipitation (5,6). This melting trend lags the temperature increase by about 20 years, so it predates the 6-fold increase in hydrocarbon use (7) even more than shown in the figure. Hydrocarbon use could not have caused this shortening trend.

ening of world glaciers, as shown in Figure 2. Glaciers regularly lengthen and shorten in delayed correlation with cooling and warming trends. Shortening lags temperature by about 20 years, so the current warming trend began in about 1800.

Atmospheric temperature is regulated by the sun, which fluctuates in activity as shown in Figure 3; by the greenhouse effect, largely caused by atmospheric water vapor (H<sub>2</sub>O); and by other phenomena that are more poorly understood. While major greenhouse gas H<sub>2</sub>O substantially warms the Earth, minor greenhouse gases such as CO<sub>2</sub>

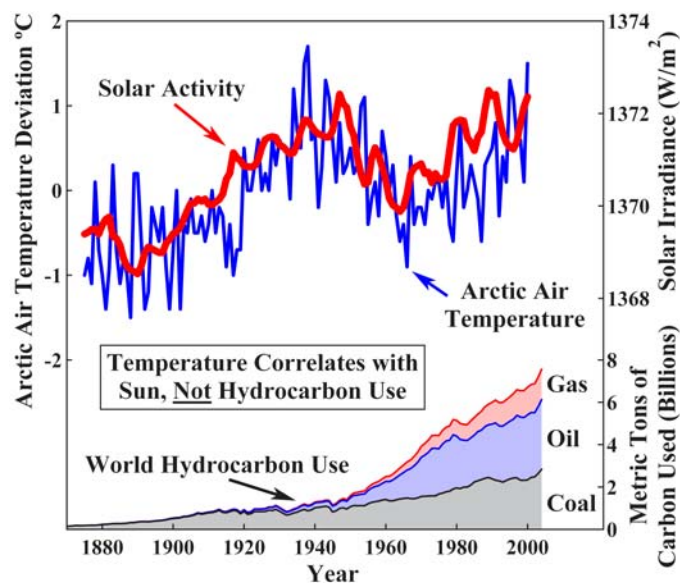


Figure 3: Arctic surface air temperature compared with total solar irradiance as measured by sunspot cycle amplitude, sunspot cycle length, solar equatorial rotation rate, fraction of penumbral spots, and decay rate of the 11-year sunspot cycle (8,9). Solar irradiance correlates well with Arctic temperature, while hydrocarbon use (7) does not correlate.

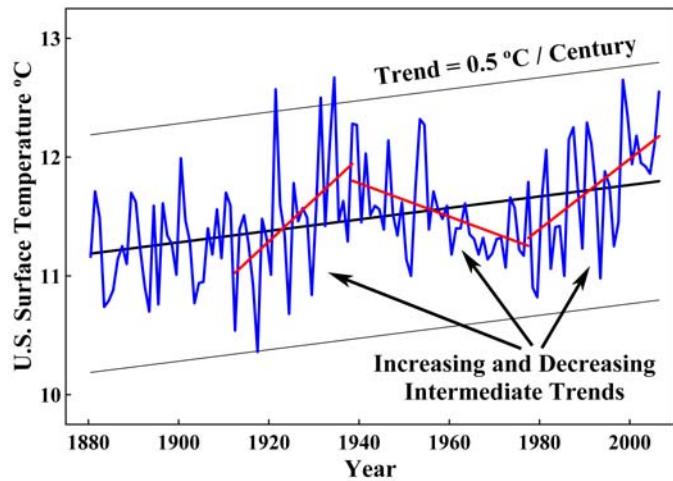


Figure 4: Annual mean surface temperatures in the contiguous United States between 1880 and 2006 (10). The slope of the least-squares trend line for this 127-year record is 0.5 °C per century.

have little effect, as shown in Figures 2 and 3. The 6-fold increase in hydrocarbon use since 1940 has had no noticeable effect on atmospheric temperature or on the trend in glacier length.

While Figure 1 is illustrative of most geographical locations, there is great variability of temperature records with location and regional climate. Comprehensive surveys of published temperature records confirm the principal features of Figure 1, including the fact that the current Earth temperature is approximately 1 °C lower than that during the Medieval Climate Optimum 1,000 years ago (11,12).

Surface temperatures in the United States during the past century reflect this natural warming trend and its correlation with solar activity, as shown in Figures 4 and 5. Compiled U.S. surface temperatures have increased about 0.5 °C per century, which is consistent with other historical values of 0.4 to 0.5 °C per century during the recovery from the Little Ice Age (13-17). This temperature change is slight as compared with other natural variations, as shown in Figure 6. Three intermediate trends are evident, including the decreasing trend used to justify fears of “global cooling” in the 1970s.

Between 1900 and 2000, on absolute scales of solar irradiance and degrees Kelvin, solar activity increased 0.19%, while a 0.5 °C temperature change is 0.21%. This is in good agreement with estimates that Earth’s temperature would be reduced by 0.6 °C through particulate blocking of the sun by 0.2% (18).

Solar activity and U.S. surface temperature are closely correlated, as shown in Figure 5, but U.S. surface temperature and world hydrocarbon use are not correlated, as shown in Figure 13.

The U.S. temperature trend is so slight that, were the temperature

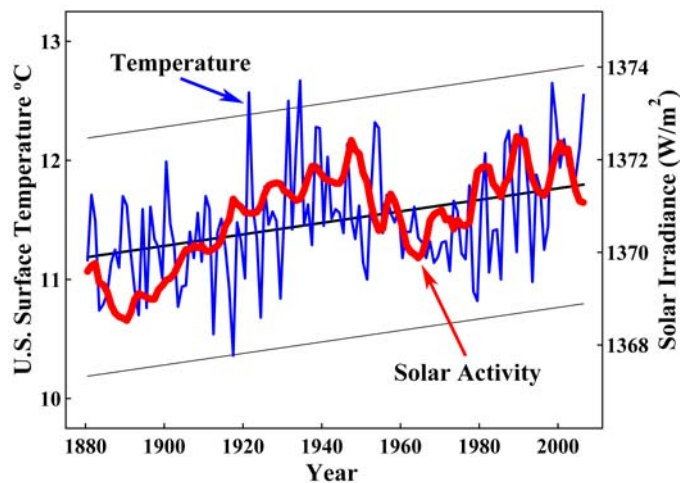


Figure 5: U.S. surface temperature from Figure 4 as compared with total solar irradiance (19) from Figure 3.

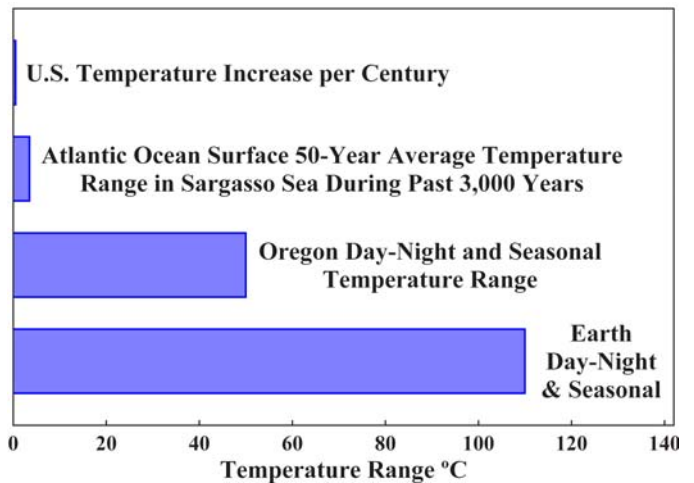


Figure 6: Comparison between the current U.S. temperature change per century, the 3,000-year temperature range in Figure 1, seasonal and diurnal range in Oregon, and seasonal and diurnal range throughout the Earth.

change which has taken place during the 20th and 21st centuries to occur in an ordinary room, most of the people in the room would be unaware of it.

During the current period of recovery from the Little Ice Age, the U.S. climate has improved somewhat, with more rainfall, fewer tornados, and no increase in hurricane activity, as illustrated in Figures 7 to 10. Sea level has trended upward for the past 150 years at a rate of 7 inches per century, with 3 intermediate uptrends and 2 periods of no increase as shown in Figure 11. These features are confirmed by the glacier record as shown in Figure 12. If this trend continues as

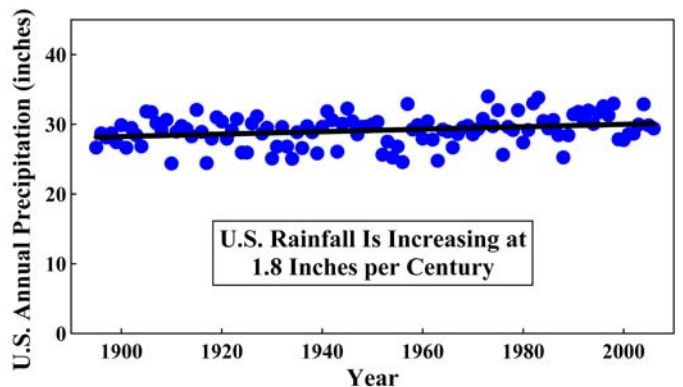


Figure 7: Annual precipitation in the contiguous 48 United States between 1895 and 2006. U.S. National Climatic Data Center, U.S. Department of Commerce 2006 Climate Review (20). The trend shows an increase in rainfall of 1.8 inches per century – approximately 6% per century.

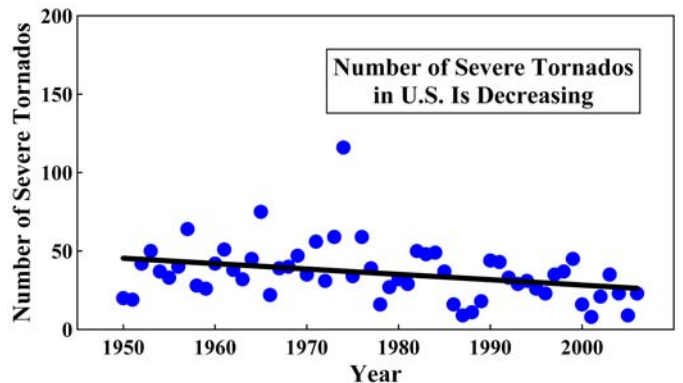


Figure 8: Annual number of strong-to-violent category F3 to F5 tornados during the March-to-August tornado season in the U.S. between 1950 and 2006. U.S. National Climatic Data Center, U.S. Department of Commerce 2006 Climate Review (20). During this period, world hydrocarbon use increased 6-fold, while violent tornado frequency decreased by 43%.

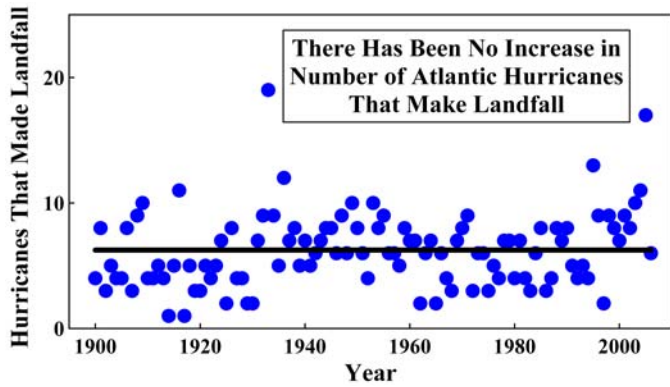


Figure 9: Annual number of Atlantic hurricanes that made landfall between 1900 and 2006 (21). Line is drawn at mean value.

did that prior to the Medieval Climate Optimum, sea level would be expected to rise about 1 foot during the next 200 years.

As shown in Figures 2, 11, and 12, the trends in glacier shortening and sea level rise began a century *before* the 60-year 6-fold increase in hydrocarbon use, and have not changed during that increase. Hydrocarbon use could not have caused these trends.

During the past 50 years, atmospheric CO<sub>2</sub> has increased by 22%. Much of that CO<sub>2</sub> increase is attributable to the 6-fold increase in human use of hydrocarbon energy. Figures 2, 3, 11, 12, and 13 show, however, that human use of hydrocarbons has not caused the observed increases in temperature.

The increase in atmospheric carbon dioxide has, however, had a substantial environmental effect. Atmospheric CO<sub>2</sub> fertilizes plants. Higher CO<sub>2</sub> enables plants to grow faster and larger and to live in drier climates. Plants provide food for animals, which are thereby also enhanced. The extent and diversity of plant and animal life have both increased substantially during the past half-century. Increased temperature has also mildly stimulated plant growth.

Does a catastrophic amplification of these trends with damaging climatological consequences lie ahead? There are no experimental data that suggest this. There is also no experimentally validated theoretical evidence of such an amplification.

Predictions of catastrophic global warming are based on computer climate modeling, a branch of science still in its infancy. The empirical evidence – actual measurements of Earth’s temperature and climate – shows no man-made warming trend. Indeed, during four of the seven decades since 1940 when average CO<sub>2</sub> levels steadily increased, U.S. average temperatures were actually decreasing.

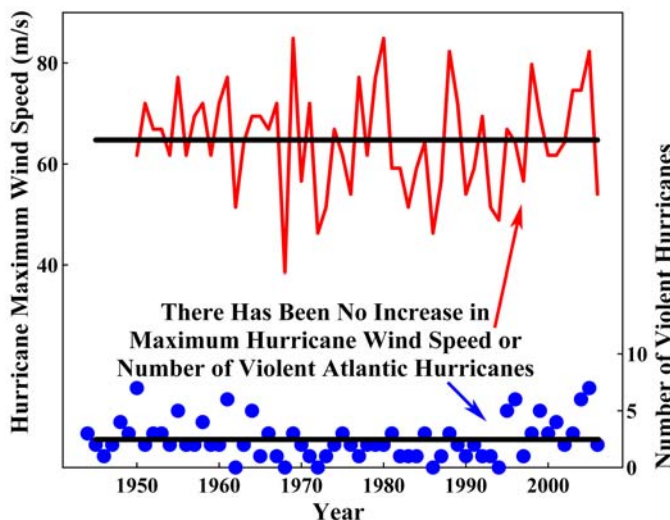


Figure 10: Annual number of violent hurricanes and maximum attained wind speed during those hurricanes in the Atlantic Ocean between 1944 and 2006 (22,23). There is no upward trend in either of these records. During this period, world hydrocarbon use increased 6-fold. Lines are mean values.

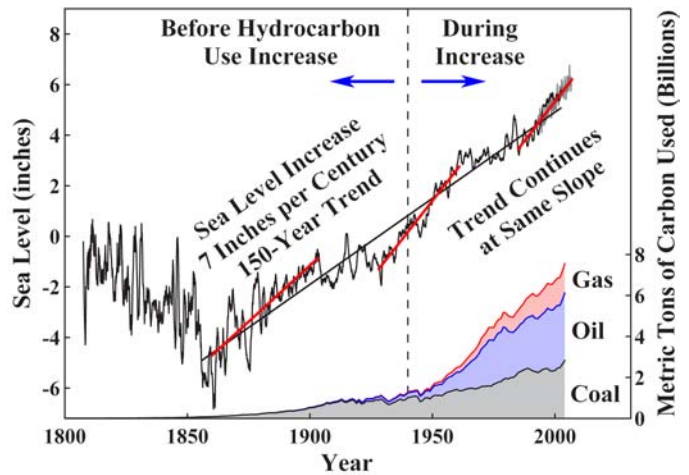


Figure 11: Global sea level measured by surface gauges between 1807 and 2002 (24) and by satellite between 1993 and 2006 (25). Satellite measurements are shown in gray and agree with tide gauge measurements. The overall trend is an increase of 7 inches per century. Intermediate trends are 9, 0, 12, 0, and 12 inches per century, respectively. This trend lags the temperature increase, so it predates the increase in hydrocarbon use even more than is shown. It is unaffected by the very large increase in hydrocarbon use.

While CO<sub>2</sub> levels have increased substantially and are expected to continue doing so and humans have been responsible for part of this increase, the effect on the environment has been benign.

There is, however, one very dangerous possibility.

Our industrial and technological civilization depends upon abundant, low-cost energy. This civilization has already brought unprecedented prosperity to the people of the more developed nations. Billions of people in the less developed nations are now lifting themselves from poverty by adopting this technology.

Hydrocarbons are essential sources of energy to sustain and extend prosperity. This is especially true of the developing nations, where available capital and technology are insufficient to meet rapidly increasing energy needs without extensive use of hydrocarbon fuels. If, through misunderstanding of the underlying science and through misguided public fear and hysteria, mankind significantly rations and restricts the use of hydrocarbons, the worldwide increase in prosperity will stop. The result would be vast human suffering and the loss of hundreds of millions of human lives. Moreover, the prosperity of those in the developed countries would be greatly reduced.

Mild ordinary natural increases in the Earth’s temperature have occurred during the past two to three centuries. These have resulted in some improvements in overall climate and also some changes in

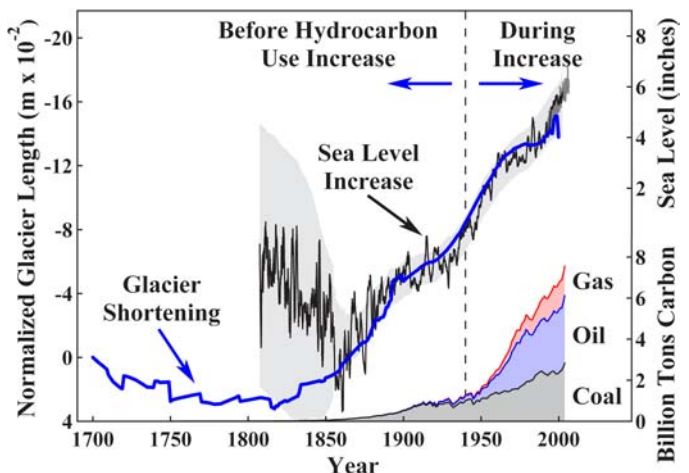


Figure 12: Glacier shortening (4) and sea level rise (24,25). Gray area designates estimated range of error in the sea level record. These measurements lag air temperature increases by about 20 years. So, the trends began more than a century before increases in hydrocarbon use.

the landscape, such as a reduction in glacier lengths and increased vegetation in colder areas. Far greater changes have occurred during the time that all current species of animals and plants have been on the Earth. The relative population sizes of the species and their geographical distributions vary as they adapt to changing conditions.

The temperature of the Earth is continuing its process of fluctuation in correlation with variations in natural phenomena. Mankind, meanwhile, is moving some of the carbon in coal, oil, and natural gas from below ground to the atmosphere and surface, where it is available for conversion into living things. We are living in an increasingly lush environment of plants and animals as a result. This is an unexpected and wonderful gift from the Industrial Revolution.

**ATMOSPHERIC AND SURFACE TEMPERATURES**

Atmospheric and surface temperatures have been recovering from an unusually cold period. During the time between 200 and 500 years ago, the Earth was experiencing the “Little Ice Age.” It had descended into this relatively cool period from a warm interval about 1,000 years ago known as the “Medieval Climate Optimum.” This is shown in Figure 1 for the Sargasso Sea.

During the Medieval Climate Optimum, temperatures were warm enough to allow the colonization of Greenland. These colonies were abandoned after the onset of colder temperatures. For the past 200 to 300 years, Earth temperatures have been gradually recovering (26). Sargasso Sea temperatures are now approximately equal to the average for the previous 3,000 years.

The historical record does not contain any report of “global warming” catastrophes, even though temperatures have been higher than they are now during much of the last three millennia.

The 3,000-year range of temperatures in the Sargasso Sea is typical of most places. Temperature records vary widely with geographical location as a result of climatological characteristics unique to those specific regions, so an “average” Earth temperature is less meaningful than individual records (27). So called “global” or “hemispheric” averages contain errors created by averaging systematically different aspects of unique geographical regions and by inclusion of regions where temperature records are unreliable.

Three key features of the temperature record – the Medieval Climate Optimum, the Little Ice Age, and the Not-Unusual-Temperature of the 20th century – have been verified by a review of local temperature and temperature-correlated records throughout the world (11), as summarized in Table 1. Each record was scored with respect to those queries to which it applied. The experimental and historical literature definitively confirms the primary features of Figure 1.

Most geographical locations experienced both the Medieval Climate Optimum and the Little Ice Age – and most locations did not

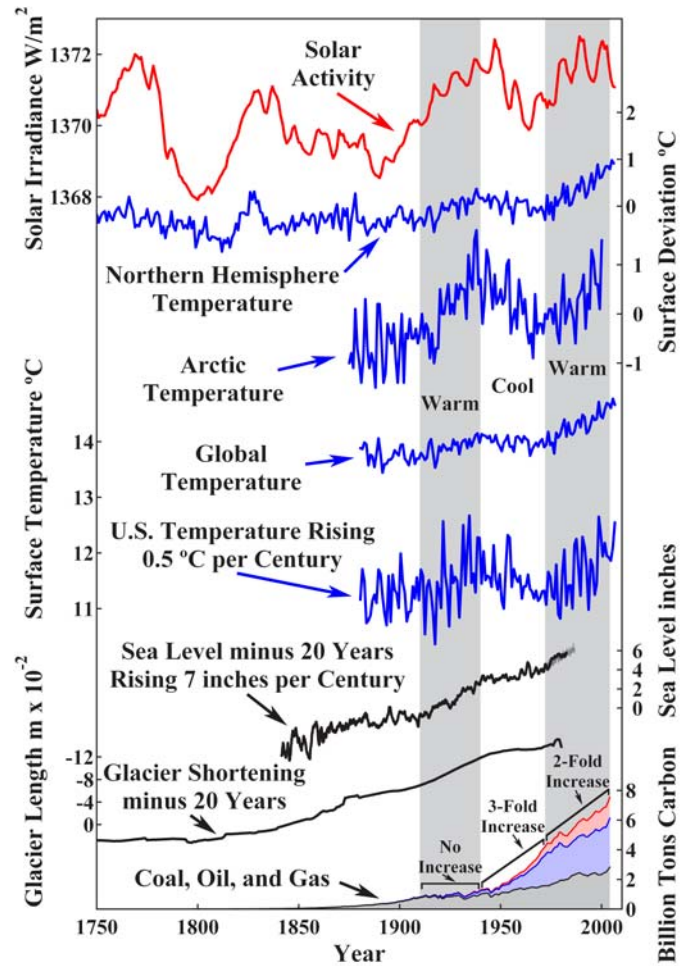


Figure 13: Seven independent records – solar activity (9); Northern Hemisphere, (13), Arctic (28), global (10), and U.S. (10) annual surface air temperatures; sea level (24,25); and glacier length (4) – all qualitatively confirm each other by exhibiting three intermediate trends – warmer, cooler, and warmer. Sea level and glacier length are shown minus 20 years, correcting for their 20-year lag of atmospheric temperature. Solar activity, Northern Hemisphere temperature, and glacier lengths show a low in about 1800.

Hydrocarbon use (7) is uncorrelated with temperature. Temperature rose for a century before significant hydrocarbon use. Temperature rose between 1910 and 1940, while hydrocarbon use was almost unchanged. Temperature then fell between 1940 and 1972, while hydrocarbon use rose by 330%. Also, the 150 to 200-year slopes of the sea level and glacier trends were unchanged by the very large increase in hydrocarbon use after 1940.

experience temperatures that were unusually warm during the 20th century. A review of 23 quantitative records has demonstrated that mean and median world temperatures in 2006 were, on average, approximately 1 °C or 2 °F cooler than in the Medieval Period (12).

World glacier length (4) and world sea level (24,25) measurements provide records of the recent cycle of recovery. Warmer temperatures diminish glaciers and cause sea level to rise because of decreased ocean water density and other factors.

These measurements show that the trend of 7 inches per century increase in sea level and the shortening trend in average glacier length both began a century before 1940, yet 84% of total human annual hydrocarbon use occurred only after 1940. Moreover, neither of these trends has accelerated during the period between 1940 and 2007, while hydrocarbon use increased 6-fold. Sea level and glacier records are offset by about 20 years because of the delay between temperature rise and glacier and sea level change.

If the natural trend in sea level increase continues for another two centuries as did the temperature rise in the Sargasso Sea as the Earth entered the Medieval Warm Period, sea level would be expected to rise about 1 foot between the years 2000 and 2200. Both the sea level and glacier trends – and the temperature trend that they reflect – are

Table 1: Query	Yes	No	Yes/No	Two-Tailed Probability
Warm Climatic Anomaly 800-1300 A.D.?	88	2	7	> 99.99
Cold Climatic Anomaly 1300-1900 A.D.?	105	2	2	> 99.99
20th Century Warmest in Individual Record?	7	64	14	< 0.0001

Table 1: Comprehensive review of all instances in which temperature or temperature-correlated records from localities throughout the world permit answers to queries concerning the existence of the Medieval Climate Optimum, the Little Ice Age, and an unusually warm anomaly in the 20th century (11). The compiled and tabulated answers confirm the three principal features of the Sargasso Sea record shown in Figure 1. The probability that the answer to the query in column 1 is “yes” is given in column 5.

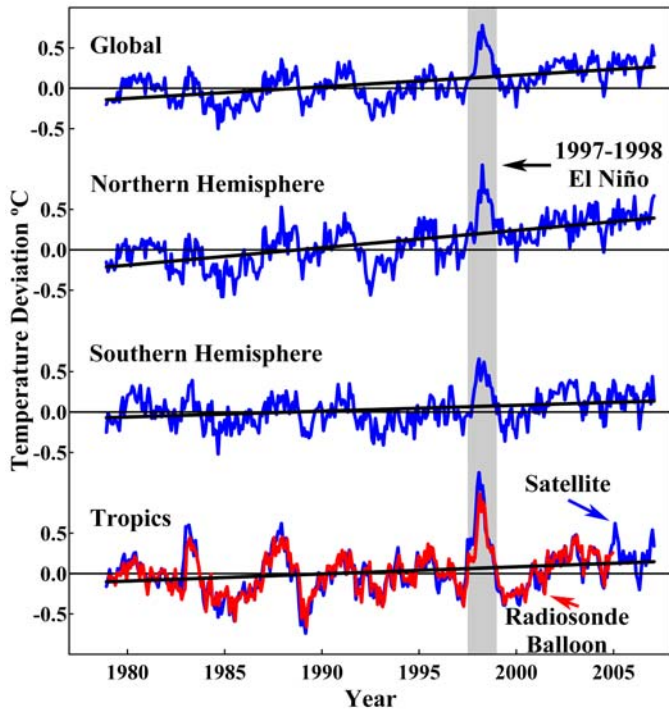


Figure 14: Satellite microwave sounding unit (blue) measurements of tropospheric temperatures in the Northern Hemisphere between 0 and 82.5 N, Southern Hemisphere between 0 and 82.5 S, tropics between 20S and 20N, and the globe between 82.5N and 82.5S between 1979 and 2007 (29), and radiosonde balloon (red) measurements in the tropics (29). The balloon measurements confirm the satellite technique (29-31). The warming anomaly in 1997-1998 (gray) was caused by El Niño, which, like the overall trends, is unrelated to CO<sub>2</sub> (32).

unrelated to hydrocarbon use. A further doubling of world hydrocarbon use would not change these trends.

Figure 12 shows the close correlation between the sea level and glacier records, which further validates both records and the duration and character of the temperature change that gave rise to them.

Figure 4 shows the annual temperature in the United States during the past 127 years. This record has an upward trend of 0.5 °C per century. Global and Northern Hemisphere surface temperature records shown in Figure 13 trend upward at 0.6 °C per century. These records are, however, biased toward higher temperatures in several ways. For example, they preferentially use data near populated areas (33), where heat island effects are prevalent, as illustrated in Figure 15. A trend of 0.5 °C per century is more representative (13-17).

The U.S. temperature record has two intermediate uptrends of comparable magnitude, one occurring before the 6-fold increase in hydrocarbon use and one during it. Between these two is an intermediate temperature downtrend, which led in the 1970s to fears of an impending new ice age. This decrease in temperature occurred during a period in which hydrocarbon use increased 3-fold.

Seven independent records – solar irradiance; Arctic, Northern Hemisphere, global, and U.S. annual average surface air temperatures; sea level; and glacier length – all exhibit these three intermediate trends, as shown in Figure 13. These trends confirm one another. Solar irradiance correlates with them. Hydrocarbon use does not.

The intermediate uptrend in temperature between 1980 and 2006 shown in Figure 13 is similar to that shown in Figure 14 for balloon and satellite tropospheric measurements. This trend is more pronounced in the Northern Hemisphere than in the Southern. Contrary to the CO<sub>2</sub> warming climate models, however, tropospheric temperatures are not rising faster than surface temperatures.

Figure 6 illustrates the magnitudes of these temperature changes by comparing the 0.5 °C per century temperature change as the Earth recovers from the Little Ice Age, the range of 50-year averaged Atlantic ocean surface temperatures in the Sargasso Sea over the past 3,000 years, the range of day-night and seasonal variation on average

in Oregon, and the range of day-night and seasonal variation over the whole Earth. The two-century-long temperature change is small.

Tropospheric temperatures measured by satellite give comprehensive geographic coverage. Even the satellite measurements, however, contain short and medium-term fluctuations greater than the slight warming trends calculated from them. The calculated trends vary significantly as a function of the most recent fluctuations and the lengths of the data sets, which are short.

Figure 3 shows the latter part of the period of warming from the Little Ice Age in greater detail by means of Arctic air temperature as compared with solar irradiance, as does Figure 5 for U.S. surface temperature. There is a close correlation between solar activity and temperature and none between hydrocarbon use and temperature. Several other studies over a wide variety of time intervals have found similar correlations between climate and solar activity (15, 34-39).

Figure 3 also illustrates the uncertainties introduced by limited time records. If the Arctic air temperature data before 1920 were not available, essentially no uptrend would be observed.

This observed variation in solar activity is typical of stars close in size and age to the sun (40). The current warming trends on Mars (41), Jupiter (42), Neptune (43,44), Neptune’s moon Triton (45), and Pluto (46-48) may result, in part, from similar relations to the sun and its activity – like those that are warming the Earth.

Hydrocarbon use and atmospheric CO<sub>2</sub> do not correlate with the observed temperatures. Solar activity correlates quite well. Correlation does not prove causality, but non-correlation proves non-causality. Human hydrocarbon use is not measurably warming the earth. Moreover, there is a robust theoretical and empirical model for solar warming and cooling of the Earth (8,19,49,50). The experimental data do not prove that solar activity is the only phenomenon responsible for substantial Earth temperature fluctuations, but they do show that human hydrocarbon use is not among those phenomena.

The overall experimental record is self-consistent. The Earth has been warming as it recovers from the Little Ice Age at an average rate of about 0.5 °C per century. Fluctuations within this temperature trend include periods of more rapid increase and also periods of temperature decrease. These fluctuations correlate well with concomitant fluctuations in the activity of the sun. Neither the trends nor the fluctuations within the trends correlate with hydrocarbon use. Sea level and glacier length reveal three intermediate uptrends and two downtrends since 1800, as does solar activity. These trends are climatically benign and result from natural processes.

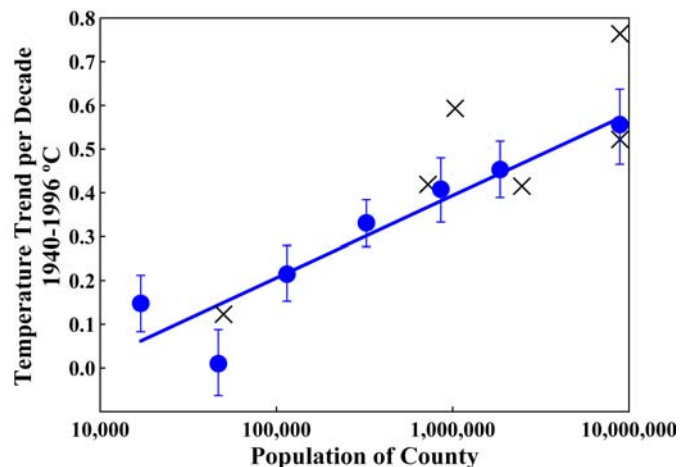


Figure 15: Surface temperature trends for 1940 to 1996 from 107 measuring stations in 49 California counties (51,52). The trends were combined for counties of similar population and plotted with the standard errors of their means. The six measuring stations in Los Angeles County were used to calculate the standard error of that county, which is plotted at a population of 8.9 million. The “urban heat island effect” on surface measurements is evident. The straight line is a least-squares fit to the closed circles. The points marked “X” are the six unadjusted station records selected by NASA GISS (53-55) for use in their estimate of global surface temperatures. Such selections make NASA GISS temperatures too high.

## ATMOSPHERIC CARBON DIOXIDE

The concentration of CO<sub>2</sub> in Earth's atmosphere has increased during the past century, as shown in Figure 17. The magnitude of this atmospheric increase is currently about 4 gigatons (Gt C) of carbon per year. Total human industrial CO<sub>2</sub> production, primarily from use of coal, oil, and natural gas and the production of cement, is currently about 8 Gt C per year (7,56,57). Humans also exhale about 0.6 Gt C per year, which has been sequestered by plants from atmospheric CO<sub>2</sub>. Office air concentrations often exceed 1,000 ppm CO<sub>2</sub>.

To put these figures in perspective, it is estimated that the atmosphere contains 780 Gt C; the surface ocean contains 1,000 Gt C; vegetation, soils, and detritus contain 2,000 Gt C; and the intermediate and deep oceans contain 38,000 Gt C, as CO<sub>2</sub> or CO<sub>2</sub> hydration products. Each year, the surface ocean and atmosphere exchange an estimated 90 Gt C; vegetation and the atmosphere, 100 Gt C; marine biota and the surface ocean, 50 Gt C; and the surface ocean and the intermediate and deep oceans, 40 Gt C (56,57).

So great are the magnitudes of these reservoirs, the rates of exchange between them, and the uncertainties of these estimated numbers that the sources of the recent rise in atmospheric CO<sub>2</sub> have not been determined with certainty (58,59). Atmospheric concentrations of CO<sub>2</sub> are reported to have varied widely over geological time, with peaks, according to some estimates, some 20-fold higher than at present and lows at approximately 200 ppm (60-62).

Ice-core records are reported to show seven extended periods during 650,000 years in which CO<sub>2</sub>, methane (CH<sub>4</sub>), and temperature increased and then decreased (63-65). Ice-core records contain substantial uncertainties (58), so these correlations are imprecise.

In all seven glacial and interglacial cycles, the reported changes in CO<sub>2</sub> and CH<sub>4</sub> lagged the temperature changes and could not, therefore, have caused them (66). These fluctuations probably involved temperature-caused changes in oceanic and terrestrial CO<sub>2</sub> and CH<sub>4</sub> content. More recent CO<sub>2</sub> fluctuations also lag temperature (67,68).

In 1957, Revelle and Seuss (69) estimated that temperature-caused out-gassing of ocean CO<sub>2</sub> would increase atmospheric

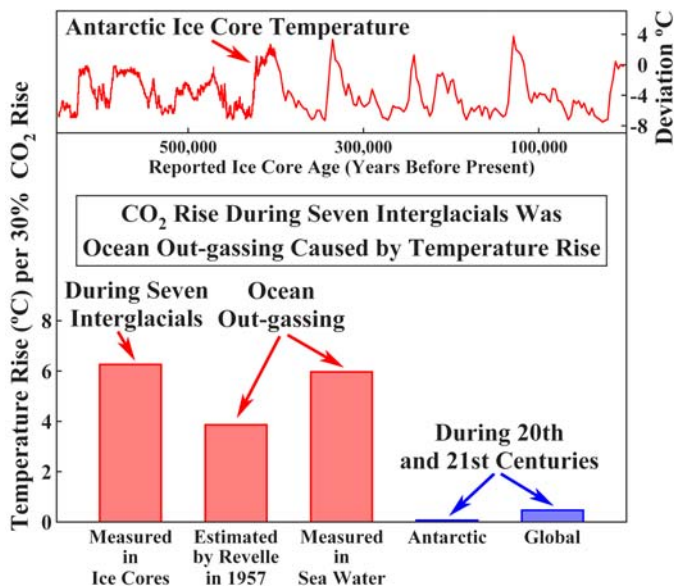


Figure 16: Temperature rise versus CO<sub>2</sub> rise from seven ice-core measured interglacial periods (63-65); from calculations (69) and measurements (70) of sea water out-gassing; and as measured during the 20th and 21st centuries (10,72). The interglacial temperature increases caused the CO<sub>2</sub> rises through release of ocean CO<sub>2</sub>. The CO<sub>2</sub> rises did not cause the temperature rises.

In addition to the agreement between the out-gassing estimates and measurements, this conclusion is also verified by the small temperature rise during the 20th and 21st centuries. If the CO<sub>2</sub> versus temperature correlation during the seven interglacials had been caused by CO<sub>2</sub> greenhouse warming, then the temperature rise per CO<sub>2</sub> rise would have been as high during the 20th and 21st centuries as it was during the seven interglacial periods.

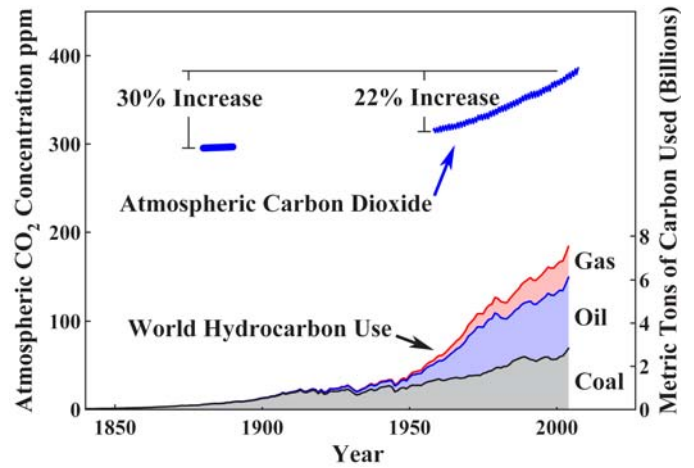


Figure 17: Atmospheric CO<sub>2</sub> concentrations in parts per million by volume, ppm, measured spectrophotometrically at Mauna Loa, Hawaii, between 1958 and 2007. These measurements agree well with those at other locations (71). Data before 1958 are from ice cores and chemical analyses, which have substantial experimental uncertainties. We have used 295 ppm for the period 1880 to 1890, which is an average of the available estimates. About 0.6 Gt C of CO<sub>2</sub> is produced annually by human respiration and often leads to concentrations exceeding 1,000 ppm in public buildings. Atmospheric CO<sub>2</sub> has increased 22% since 1958 and about 30% since 1880.

CO<sub>2</sub> by about 7% per °C temperature rise. The reported change during the seven interglacials of the 650,000-year ice core record is about 5% per °C (63), which agrees with the out-gassing calculation.

Between 1900 and 2006, Antarctic CO<sub>2</sub> increased 30% per 0.1 °C temperature change (72), and world CO<sub>2</sub> increased 30% per 0.5 °C. In addition to ocean out-gassing, CO<sub>2</sub> from human use of hydrocarbons is a new source. Neither this new source nor the older natural CO<sub>2</sub> sources are causing atmospheric temperature to change.

The hypothesis that the CO<sub>2</sub> rise during the interglacials caused the temperature to rise requires an increase of about 6 °C per 30% rise in CO<sub>2</sub> as seen in the ice core record. If this hypothesis were correct, Earth temperatures would have risen about 6 °C between 1900 and 2006, rather than the rise of between 0.1 °C and 0.5 °C, which actually occurred. This difference is illustrated in Figure 16.

The 650,000-year ice-core record does not, therefore, agree with the hypothesis of "human-caused global warming," and, in fact, provides empirical evidence that invalidates this hypothesis.

Carbon dioxide has a very short residence time in the atmosphere. Beginning with the 7 to 10-year half-time of CO<sub>2</sub> in the atmosphere estimated by Revelle and Seuss (69), there were 36 estimates of the atmospheric CO<sub>2</sub> half-time based upon experimental measurements published between 1957 and 1992 (59). These range between 2 and 25 years, with a mean of 7.5, a median of 7.6, and an upper range average of about 10. Of the 36 values, 33 are 10 years or less.

Many of these estimates are from the decrease in atmospheric carbon 14 after cessation of atmospheric nuclear weapons testing, which provides a reliable half-time. There is no experimental evidence to support computer model estimates (73) of a CO<sub>2</sub> atmospheric "lifetime" of 300 years or more.

Human production of 8 Gt C per year of CO<sub>2</sub> is negligible as compared with the 40,000 Gt C residing in the oceans and biosphere. At ultimate equilibrium, human-produced CO<sub>2</sub> will have an insignificant effect on the amounts in the various reservoirs. The rates of approach to equilibrium are, however, slow enough that human use creates a transient atmospheric increase.

In any case, the sources and amounts of CO<sub>2</sub> in the atmosphere are of secondary importance to the hypothesis of "human-caused global warming." It is human burning of coal, oil, and natural gas that is at issue. CO<sub>2</sub> is merely an intermediate in a hypothetical mechanism by which this "human-caused global warming" is said to take place. The amount of atmospheric CO<sub>2</sub> does have profound environmental effects on plant and animal populations (74) and diversity, as is discussed below.

## CLIMATE CHANGE

While the average temperature change taking place as the Earth recovers from the Little Ice Age is so slight that it is difficult to discern, its environmental effects are measurable. Glacier shortening and the 7 inches per century rise in sea level are examples. There are additional climate changes that are correlated with this rise in temperature and may be caused by it.

Greenland, for example, is beginning to turn green again, as it was 1,000 years ago during the Medieval Climate Optimum (11). Arctic sea ice is decreasing somewhat (75), but Antarctic ice is not decreasing and may be increasing, due to increased snow (76-79).

In the United States, rainfall is increasing at about 1.8 inches per century, and the number of severe tornados is decreasing, as shown in Figures 7 and 8. If world temperatures continue to rise at the current rate, they will reach those of the Medieval Climate Optimum about 2 centuries from now. Historical reports of that period record the growing of warm weather crops in localities too cold for that purpose today, so it is to be expected that the area of more temperate climate will expand as it did then. This is already being observed, as studies at higher altitudes have reported increases in amount and diversity of plant and animal life by more than 50% (12,80).

Atmospheric temperature is increasing more in the Northern Hemisphere than in the Southern, with intermediate periods of increase and decrease in the overall trends.

There has been no increase in frequency or severity of Atlantic hurricanes during the period of 6-fold increase in hydrocarbon use, as is illustrated in Figures 9 and 10. Numbers of violent hurricanes vary greatly from year to year and are no greater now than they were 50 years ago. Similarly, maximum wind speeds have not increased.

All of the observed climate changes are gradual, moderate, and entirely within the bounds of ordinary natural changes that have occurred during the benign period of the past few thousand years.

There is no indication whatever in the experimental data that an abrupt or remarkable change in any of the ordinary natural climate variables is beginning or will begin to take place.

## GLOBAL WARMING HYPOTHESIS

The greenhouse effect amplifies solar warming of the earth. Greenhouse gases such as H<sub>2</sub>O, CO<sub>2</sub>, and CH<sub>4</sub> in the Earth's atmosphere, through combined convective readjustments and the radiative blanketing effect, essentially decrease the net escape of terrestrial thermal infrared radiation. Increasing CO<sub>2</sub>, therefore, effectively increases radiative energy input to the Earth's atmosphere. The path of this radiative input is complex. It is redistributed, both vertically and horizontally, by various physical processes, including advection, convection, and diffusion in the atmosphere and ocean.

When an increase in CO<sub>2</sub> increases the radiative input to the atmosphere, how and in which direction does the atmosphere respond? Hypotheses about this response differ and are schematically shown in Figure 18. Without the water-vapor greenhouse effect, the Earth would be about 14 °C cooler (81). The radiative contribution of doubling atmospheric CO<sub>2</sub> is minor, but this radiative greenhouse effect is treated quite differently by different climate hypotheses. The hypotheses that the IPCC (82,83) has chosen to adopt predict that the effect of CO<sub>2</sub> is amplified by the atmosphere, especially by water vapor, to produce a large temperature increase. Other hypotheses, shown as hypothesis 2, predict the opposite – that the atmospheric response will counteract the CO<sub>2</sub> increase and result in insignificant changes in global temperature (81,84,85,91,92). The experimental evidence, as described above, favors hypothesis 2. While CO<sub>2</sub> has increased substantially, its effect on temperature has been so slight that it has not been experimentally detected.

The computer climate models upon which “human-caused global warming” is based have substantial uncertainties and are markedly unreliable. This is not surprising, since the climate is a coupled,

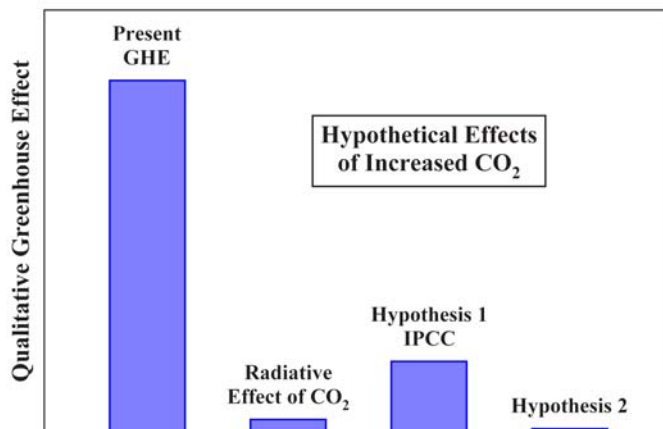


Figure 18: Qualitative illustration of greenhouse warming. “Present GHE” is the current greenhouse effect from all atmospheric phenomena. “Radiative effect of CO<sub>2</sub>” is the added greenhouse radiative effect from doubling CO<sub>2</sub> without consideration of other atmospheric components. “Hypothesis 1 IPCC” is the hypothetical amplification effect assumed by IPCC. “Hypothesis 2” is the hypothetical moderation effect.

non-linear dynamical system. It is very complex. Figure 19 illustrates the difficulties by comparing the radiative CO<sub>2</sub> greenhouse effect with correction factors and uncertainties in some of the parameters in the computer climate calculations. Other factors, too, such as the chemical and climatic influence of volcanoes, cannot now be reliably computer modeled.

In effect, an experiment has been performed on the Earth during the past half-century – an experiment that includes all of the complex factors and feedback effects that determine the Earth's temperature and climate. Since 1940, hydrocarbon use has risen 6-fold. Yet, this rise has had no effect on the temperature trends, which have continued their cycle of recovery from the Little Ice Age in close correlation with increasing solar activity.

Not only has the global warming hypothesis failed experimental tests, it is theoretically flawed as well. It can reasonably be argued that cooling from negative physical and biological feedbacks to greenhouse gases nullifies the slight initial temperature rise (84,86).

The reasons for this failure of the computer climate models are subjects of scientific debate (87). For example, water vapor is the largest contributor to the overall greenhouse effect (88). It has been suggested that the climate models treat feedbacks from clouds, water vapor, and related hydrology incorrectly (85,89-92).

The global warming hypothesis with respect to CO<sub>2</sub> is not based upon the radiative properties of CO<sub>2</sub> itself, which is a very weak greenhouse gas. It is based upon a small initial increase in temperature caused by CO<sub>2</sub> and a large theoretical amplification of that temperature increase, primarily through increased evaporation of H<sub>2</sub>O, a

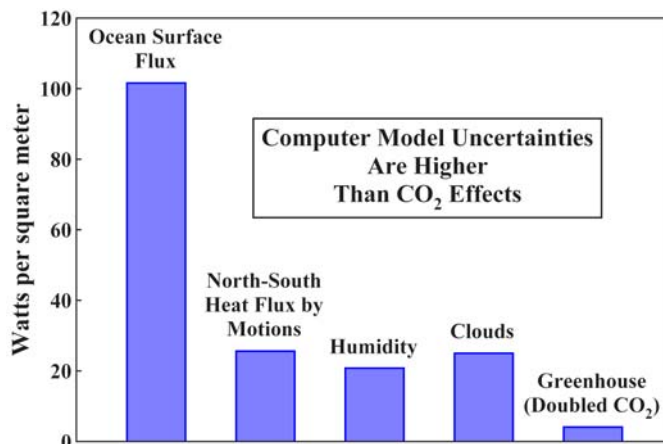


Figure 19: The radiative greenhouse effect of doubling the concentration of atmospheric CO<sub>2</sub> (right bar) as compared with four of the uncertainties in the computer climate models (87,93).



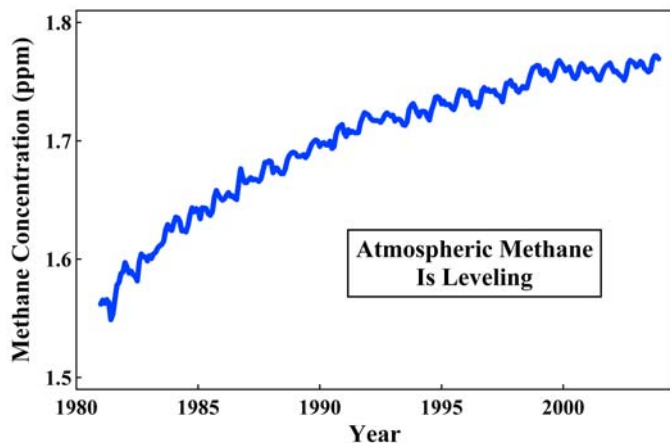


Figure 20: Global atmospheric methane concentration in parts per million between 1982 and 2004 (94).

strong greenhouse gas. Any comparable temperature increase from another cause would produce the same calculated outcome.

Thus, the 3,000-year temperature record illustrated in Figure 1 also provides a test of the computer models. The historical temperature record shows that the Earth has previously warmed far more than could be caused by CO<sub>2</sub> itself. Since these past warming cycles have not initiated water-vapor-mediated atmospheric warming catastrophes, it is evident that weaker effects from CO<sub>2</sub> cannot do so.

Methane is also a minor greenhouse gas. World CH<sub>4</sub> levels are, as shown in Figure 20, leveling off. In the U.S. in 2005, 42% of human-produced methane was from hydrocarbon energy production, 28% from waste management, and 30% from agriculture (95). The total amount of CH<sub>4</sub> produced from these U.S. sources decreased 7% between 1980 and 2005. Moreover, the record shows that, even while methane was increasing, temperature trends were benign.

The “human-caused global warming” – often called the “global warming” – hypothesis depends entirely upon computer model-generated scenarios of the future. There are no empirical records that verify either these models or their flawed predictions (96).

Claims (97) of an epidemic of insect-borne diseases, extensive species extinction, catastrophic flooding of Pacific islands, ocean acidification, increased numbers and severities of hurricanes and tornados, and increased human heat deaths from the 0.5 °C per century temperature rise are not consistent with actual observations. The “human-caused global warming” hypothesis and the computer calculations that support it are in error. They have no empirical support and are invalidated by numerous observations.

## WORLD TEMPERATURE CONTROL

World temperature is controlled by natural phenomena. What steps could mankind take if solar activity or other effects began to shift the Earth toward temperatures too cold or too warm for optimum human life?

First, it would be necessary to determine what temperature humans feel is optimum. It is unlikely that the chosen temperature would be exactly that which we have today. Second, we would be fortunate if natural forces were to make the Earth too warm rather than too cold because we can cool the Earth with relative ease. We have no means by which to warm it. Attempting to warm the Earth with addition of CO<sub>2</sub> or to cool the Earth by restrictions of CO<sub>2</sub> and hydrocarbon use would, however, be futile. Neither would work.

Inexpensively blocking the sun by means of particles in the upper atmosphere would be effective. S.S. Penner, A.M. Schneider, and E. M. Kennedy have proposed (98) that the exhaust systems of commercial airliners could be tuned in such a way as to eject particulate sun-blocking material into the upper atmosphere. Later, Edward Teller similarly suggested (18) that particles could be injected into

the atmosphere in order to reduce solar heating and cool the Earth. Teller estimated a cost of between \$500 million and \$1 billion per year for between 1 °C and 3 °C of cooling. Both methods use particles so small that they would be invisible from the Earth.

These methods would be effective and economical in blocking solar radiation and reducing atmospheric and surface temperatures. There are other similar proposals (99). World energy rationing, on the other hand, would not work.

The climate of the Earth is now benign. If temperatures become too warm, this can easily be corrected. If they become too cold, we have no means of response – except to maximize nuclear and hydrocarbon energy production and technological advance. This would help humanity adapt and might lead to new mitigation technology.

## FERTILIZATION OF PLANTS BY CO<sub>2</sub>

How high will the CO<sub>2</sub> concentration of the atmosphere ultimately rise if mankind continues to increase the use of coal, oil, and natural gas? At ultimate equilibrium with the ocean and other reservoirs there will probably be very little increase. The current rise is a non-equilibrium result of the rate of approach to equilibrium.

One reservoir that would moderate the increase is especially important. Plant life provides a large sink for CO<sub>2</sub>. Using current knowledge about the increased growth rates of plants and assuming increased CO<sub>2</sub> release as compared to current emissions, it has been estimated that atmospheric CO<sub>2</sub> levels may rise to about 600 ppm before leveling off. At that level, CO<sub>2</sub> absorption by increased Earth biomass is able to absorb about 10 Gt C per year (100). At present, this absorption is estimated to be about 3 Gt C per year (57).

About 30% of this projected rise from 295 to 600 ppm has already taken place, without causing unfavorable climate changes. Moreover, the radiative effects of CO<sub>2</sub> are logarithmic (101,102), so more than 40% of any climatic influences have already occurred.

As atmospheric CO<sub>2</sub> increases, plant growth rates increase. Also, leaves transpire less and lose less water as CO<sub>2</sub> increases, so that plants are able to grow under drier conditions. Animal life, which depends upon plant life for food, increases proportionally.

Figures 21 to 24 show examples of experimentally measured increases in the growth of plants. These examples are representative of a very large research literature on this subject (103-109). As Figure 21 shows, long-lived 1,000- to 2,000-year-old pine trees have shown a sharp increase in growth during the past half-century. Figure 22 shows the 40% increase in the forests of the United States that has

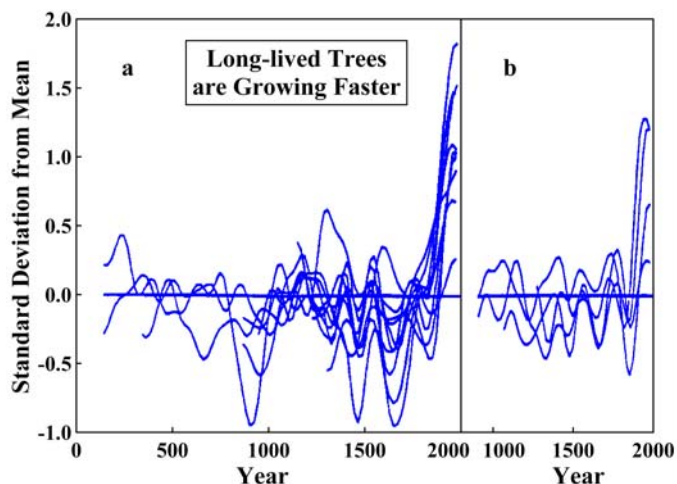


Figure 21: Standard deviation from the mean of tree ring widths for (a) bristlecone pine, limber pine, and fox tail pine in the Great Basin of California, Nevada, and Arizona and (b) bristlecone pine in Colorado (110). Tree ring widths were averaged in 20-year segments and then normalized so that the means of prior tree growth were zero. The deviations from the means are shown in units of standard deviations of those means.

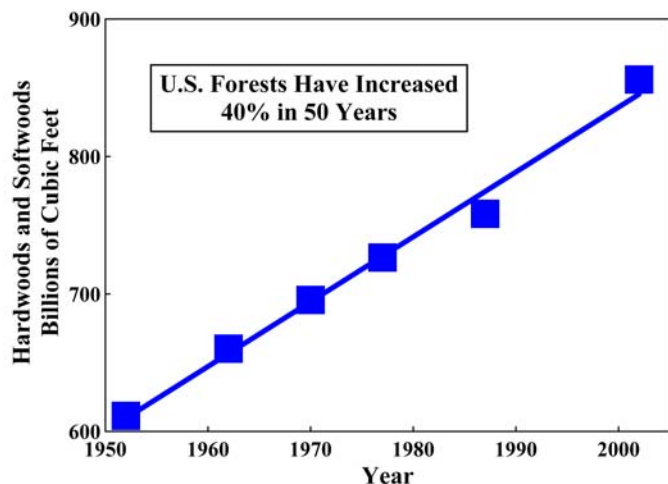


Figure 22: Inventories of standing hardwood and softwood timber in the United States compiled in *Forest Resources of the United States, 2002*, U.S. Department of Agriculture Forest Service (111,112). The linear trend cited in 1998 (1) with an increase of 30% has continued. The increase is now 40%. The amount of U.S. timber is rising almost 1% per year.

taken place since 1950. Much of this increase is due to the increase in atmospheric CO<sub>2</sub> that has already occurred. In addition, it has been reported that Amazonian rain forests are increasing their vegetation by about 900 pounds of carbon per acre per year (113), or approximately 2 tons of biomass per acre per year. Trees respond to CO<sub>2</sub> fertilization more strongly than do most other plants, but all plants respond to some extent.

Since plant response to CO<sub>2</sub> fertilization is nearly linear with respect to CO<sub>2</sub> concentration over the range from 300 to 600 ppm, as seen in Figure 23, experimental measurements at different levels of CO<sub>2</sub> enrichment can be extrapolated. This has been done in Figure 24 in order to illustrate CO<sub>2</sub> growth enhancements calculated for the atmospheric increase of about 88 ppm that has already taken place and those expected from a projected total increase of 305 ppm.

Wheat growth is accelerated by increased atmospheric CO<sub>2</sub>, especially under dry conditions. Figure 24 shows the response of wheat grown under wet conditions versus that of wheat stressed by lack of water. The underlying data is from open-field experiments. Wheat was grown in the usual way, but the atmospheric CO<sub>2</sub> concentrations of circular sections of the fields were increased by arrays of com-

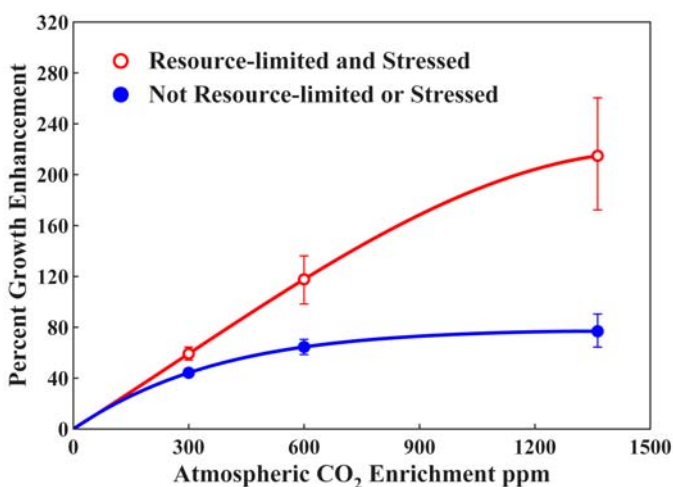


Figure 23: Summary data from 279 published experiments in which plants of all types were grown under paired stressed (open red circles) and unstressed (closed blue circles) conditions (114). There were 208, 50, and 21 sets at 300, 600, and an average of about 1350 ppm CO<sub>2</sub>, respectively. The plant mixture in the 279 studies was slightly biased toward plant types that respond less to CO<sub>2</sub> fertilization than does the actual global mixture. Therefore, the figure underestimates the expected global response. CO<sub>2</sub> enrichment also allows plants to grow in drier regions, further increasing the response.

puter-controlled equipment that released CO<sub>2</sub> into the air to hold the levels as specified (115,116). Orange and young pine tree growth enhancement (117-119) with two atmospheric CO<sub>2</sub> increases – that which has already occurred since 1885 and that projected for the next two centuries – is also shown. The relative growth enhancement of trees by CO<sub>2</sub> diminishes with age. Figure 24 shows young trees.

Figure 23 summarizes 279 experiments in which plants of various types were raised under CO<sub>2</sub>-enhanced conditions. Plants under stress from less-than-ideal conditions – a common occurrence in nature – respond more to CO<sub>2</sub> fertilization. The selections of species in Figure 23 were biased toward plants that respond less to CO<sub>2</sub> fertilization than does the mixture actually covering the Earth, so Figure 23 underestimates the effects of global CO<sub>2</sub> enhancement.

Clearly, the green revolution in agriculture has already benefitted from CO<sub>2</sub> fertilization, and benefits in the future will be even greater. Animal life is increasing proportionally, as shown by studies of 51 terrestrial (120) and 22 aquatic ecosystems (121). Moreover, as shown by a study of 94 terrestrial ecosystems on all continents ex-

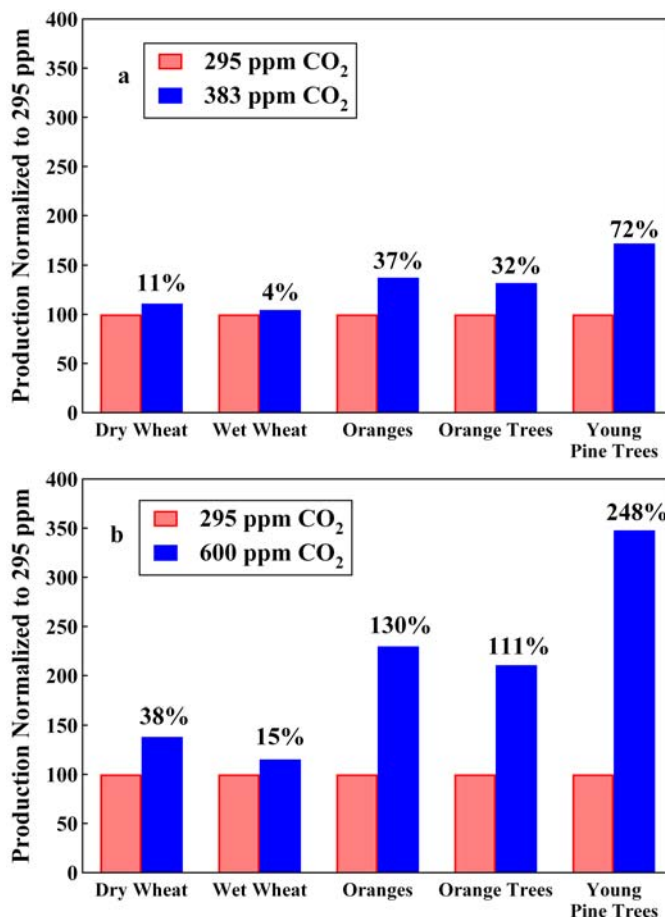


Figure 24: Calculated (1,2) growth rate enhancement of wheat, young orange trees, and very young pine trees already taking place as a result of atmospheric enrichment by CO<sub>2</sub> from 1885 to 2007 (a), and expected as a result of atmospheric enrichment by CO<sub>2</sub> to a level of 600 ppm (b).

cept Antarctica (122), species richness – biodiversity – is more positively correlated with productivity – the total quantity of plant life per acre – than with anything else.

Atmospheric CO<sub>2</sub> is required for life by both plants and animals. It is the sole source of carbon in all of the protein, carbohydrate, fat, and other organic molecules of which living things are constructed.

Plants extract carbon from atmospheric CO<sub>2</sub> and are thereby fertilized. Animals obtain their carbon from plants. Without atmospheric CO<sub>2</sub>, none of the life we see on Earth would exist.

Water, oxygen, and carbon dioxide are the three most important substances that make life possible.

They are surely not environmental pollutants.

## ENVIRONMENT AND ENERGY

The single most important human component in the preservation of the Earth's environment is energy. Industrial conversion of energy into forms that are useful for human activities is the most important aspect of technology. Abundant inexpensive energy is required for the prosperous maintenance of human life and the continued advance of life-enriching technology. People who are prosperous have the wealth required to protect and enhance their natural environment.

Currently, the United States is a net importer of energy as shown in Figure 25. Americans spend about \$300 billion per year for imported oil and gas – and an additional amount for military expenses related to those imports.

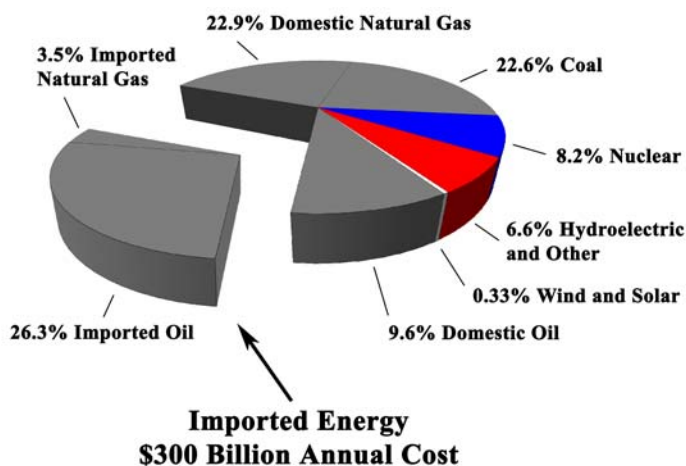


Figure 25: In 2006, the United States obtained 84.9% of its energy from hydrocarbons, 8.2% from nuclear fuels, 2.9% from hydroelectric dams, 2.1% from wood, 0.8% from biofuels, 0.4% from waste, 0.3% from geothermal, and 0.3% from wind and solar radiation. The U.S. uses 21 million barrels of oil per day – 27% from OPEC, 17% from Canada and Mexico, 16% from others, and 40% produced in the U.S. (95). The cost of imported oil and gas at \$60 per barrel and \$7 per 1,000 ft<sup>3</sup> in 2007 is about \$300 billion per year.

Political calls for a reduction of U.S. hydrocarbon use by 90% (123), thereby eliminating 75% of America's energy supply, are obviously impractical. Nor can this 75% of U.S. energy be replaced by alternative "green" sources. Despite enormous tax subsidies over the past 30 years, green sources still provide only 0.3% of U.S. energy.

Yet, the U.S. clearly cannot continue to be a large net importer of energy without losing its economic and industrial strength and its political independence. It should, instead, be a net exporter of energy.

There are three realistic technological paths to American energy independence – increased use of hydrocarbon energy, nuclear energy, or both. There are no climatological impediments to increased use of hydrocarbons, although local environmental effects can and must be accommodated. Nuclear energy is, in fact, less expensive and more environmentally benign than hydrocarbon energy, but it too has been the victim of the politics of fear and claimed disadvantages and dangers that are actually negligible.

For example, the "problem" of high-level "nuclear waste" has been given much attention, but this problem has been politically created by U.S. government barriers to American fuel breeding and reprocessing. Spent nuclear fuel can be recycled into new nuclear fuel. It need not be stored in expensive repositories.

Reactor accidents are also much publicized, but there has never been even one human death associated with an American nuclear reactor incident. By contrast, American dependence on automobiles results in more than 40,000 human deaths per year.

All forms of energy generation, including "green" methods, entail industrial deaths in the mining, manufacture, and transport of resources they require. Nuclear energy requires the smallest amount of such resources (124) and therefore has the lowest risk of deaths.

Estimated relative costs of electrical energy production vary with

geographical location and underlying assumptions. Figure 26 shows a recent British study, which is typical. At present, 43% of U.S. energy consumption is used for electricity production.

To be sure, future inventions in energy technology may alter the relative economics of nuclear, hydrocarbon, solar, wind, and other methods of energy generation. These inventions cannot, however, be forced by political fiat, nor can they be wished into existence. Alternatively, "conservation," if practiced so extensively as to be an alternative to hydrocarbon and nuclear power, is merely a politically correct word for "poverty."

The current untenable situation in which the United States is losing \$300 billion per year to pay for foreign oil and gas is not the result of failures of government energy production efforts. The U.S. government does not produce energy. Energy is produced by private industry. Why then has energy production thrived abroad while domestic production has stagnated?

This stagnation has been caused by United States government taxation, regulation, and sponsorship of litigation, which has made the U.S. a very unfavorable place to produce energy. In addition, the U.S. government has spent vast sums of tax money subsidizing inferior energy technologies for political purposes.

It is not necessary to discern in advance the best course to follow. Legislative repeal of taxation, regulation, incentives to litigation, and repeal of all subsidies of energy generation industries would stimulate industrial development, wherein competition could then automatically determine the best paths.

Nuclear power is safer, less expensive, and more environmentally benign than hydrocarbon power, so it is probably the better choice for increased energy production. Solid, liquid and gaseous hydrocarbon fuels provide, however, many conveniences, and a national infrastructure to use them is already in place. Oil from shale or coal liquefaction is less expensive than crude oil at current prices, but its ongoing production costs are higher than those for already developed oil fields. There is, therefore, an investment risk that crude oil prices could drop so low that liquefaction plants could not compete. Nuclear energy does not have this disadvantage, since the operating costs of nuclear power plants are very low.

Figure 27 illustrates, as an example, one practical and environmentally sound path to U.S. energy independence. At present 19% of U.S. electricity is produced by 104 nuclear power reactors with an average generating output in 2006 of 870 megawatts per reactor, for a total of about 90 GWe (gigawatts) (125). If this were increased by 560 GWe, nuclear power could fill all current U.S. electricity requirements and have 230 GWe left over for export as electricity or as hydrocarbon fuels replaced or manufactured.

Thus, rather than a \$300 billion trade loss, the U.S. would have a \$200 billion trade surplus – and installed capacity for future U.S. re-

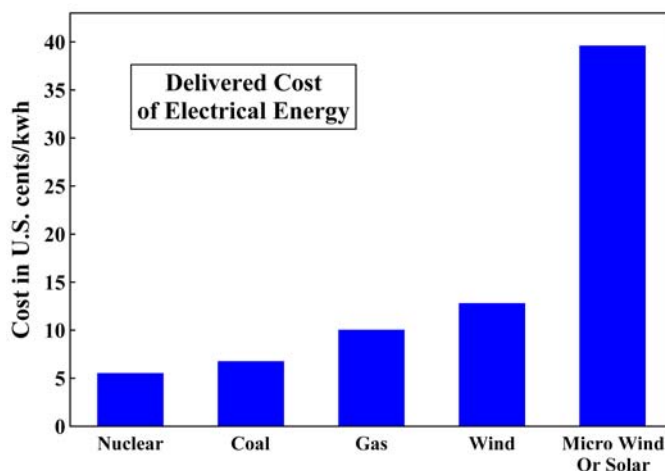


Figure 26: Delivered cost per kilowatt hour of electrical energy in Great Britain in 2006, without CO<sub>2</sub> controls (126). These estimates include all capital and operational expenses for a period of 50 years. Micro wind or solar are units installed for individual homes.

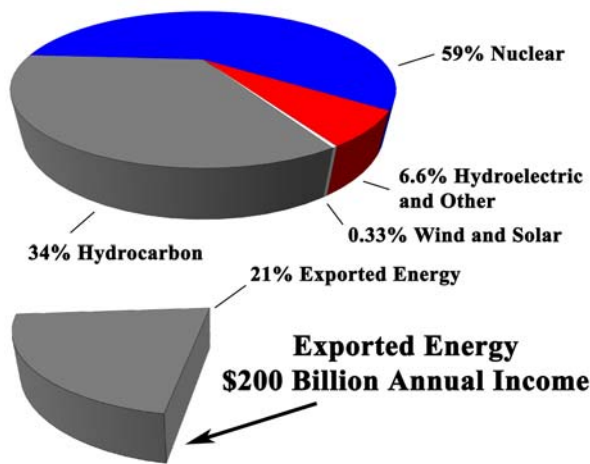


Figure 27: Construction of one Palo Verde installation with 10 reactors in each of the 50 states. Energy trade deficit is reversed by \$500 billion per year, resulting in a \$200 billion annual surplus. Currently, this solution is not possible owing to misguided government policies, regulations, and taxation and to legal maneuvers available to anti-nuclear activists. These impediments should be legislatively repealed.

quirements. Moreover, if heat from additional nuclear reactors were used for coal liquefaction and gasification, the U.S. would not even need to use its oil resources. The U.S. has about 25% of the world's coal reserves. This heat could also liquify biomass, trash, or other sources of hydrocarbons that might eventually prove practical.

The Palo Verde nuclear power station near Phoenix, Arizona, was originally intended to have 10 nuclear reactors with a generating capacity of 1,243 megawatts each. As a result of public hysteria caused by false information – very similar to the human-caused global warming hysteria being spread today, construction at Palo Verde was stopped with only three operating reactors completed. This installation is sited on 4,000 acres of land and is cooled by waste water from the city of Phoenix, which is a few miles away. An area of 4,000 acres is 6.25 square miles or 2.5 miles square. The power station itself occupies only a small part of this total area.

If just one station like Palo Verde were built in each of the 50 states and each installation included 10 reactors as originally planned for Palo Verde, these plants, operating at the current 90% of design capacity, would produce 560 GWe of electricity. Nuclear technology has advanced substantially since Palo Verde was built, so plants constructed today would be even more reliable and efficient.

Assuming a construction cost of \$2.3 billion per 1,200 MWe reactor (127) and 15% economies of scale, the total cost of this entire project would be \$1 trillion, or 4 months of the current U.S. federal budget. This is 8% of the annual U.S. gross domestic product. Construction costs could be repaid in just a few years by the capital now spent by the people of the United States for foreign oil and by the change from U.S. import to export of energy.

The 50 nuclear installations might be sited on a population basis. If so, California would have six, while Oregon and Idaho together would have one. In view of the great economic value of these facilities, there would be vigorous competition for them.

In addition to these power plants, the U.S. should build fuel reprocessing capability, so that spent nuclear fuel can be reused. This would lower fuel cost and eliminate the storage of high-level nuclear waste. Fuel for the reactors can be assured for 1,000 years (128) by using both ordinary reactors with high breeding ratios and specific breeder reactors, so that more fuel is produced than consumed.

About 33% of the thermal energy in an ordinary nuclear reactor is converted to electricity. Some new designs are as high as 48%. The heat from a 1,243 MWe reactor can produce 38,000 barrels of coal-derived oil per day (129). With one additional Palo Verde installation in each state for oil production, the yearly output would be at least 7 billion barrels per year with a value, at \$60 per barrel, of

more than \$400 billion per year. This is twice the oil production of Saudi Arabia. Current proven coal reserves of the United States are sufficient to sustain this production for 200 years (128). This liquified coal exceeds the proven oil reserves of the entire world. The reactors could produce gaseous hydrocarbons from coal, too.

The remaining heat from nuclear power plants could warm air or water for use in indoor climate control and other purposes.

Nuclear reactors can also be used to produce hydrogen, instead of oil and gas (130,131). The current cost of production and infrastructure is, however, much higher for hydrogen than for oil and gas. Technological advance reduces cost, but usually not abruptly. A prescient call in 1800 for the world to change from wood to methane would have been impracticably ahead of its time, as may be a call today for an abrupt change from oil and gas to hydrogen. In distinguishing the practical from the futuristic, a free market in energy is absolutely essential.

Surely these are better outcomes than are available through international rationing and taxation of energy as has been recently proposed (82,83,97,123). This nuclear energy example demonstrates that current technology can produce abundant inexpensive energy if it is not politically suppressed.

There need be no vast government program to achieve this goal. It could be reached simply by legislatively removing all taxation, most regulation and litigation, and all subsidies from all forms of energy production in the U.S., thereby allowing the free market to build the most practical mixture of methods of energy generation.

With abundant and inexpensive energy, American industry could be revitalized, and the capital and energy required for further industrial and technological advance could be assured. Also assured would be the continued and increased prosperity of all Americans.

The people of the United States need more low-cost energy, not less. If this energy is produced in the United States, it can not only become a very valuable export, but it can also ensure that American industry remains competitive in world markets and that hoped-for American prosperity continues and grows.

In this hope, Americans are not alone. Across the globe, billions of people in poorer nations are struggling to improve their lives. These people need abundant low-cost energy, which is the currency of technological progress.

In newly developing countries, that energy must come largely from the less technologically complicated hydrocarbon sources. It is a moral imperative that this energy be available. Otherwise, the efforts of these peoples will be in vain, and they will slip backwards into lives of poverty, suffering, and early death.

Energy is the foundation of wealth. Inexpensive energy allows people to do wonderful things. For example, there is concern that it may become difficult to grow sufficient food on the available land. Crops grow more abundantly in a warmer, higher CO<sub>2</sub> environment, so this can mitigate future problems that may arise (12).

Energy provides, however, an even better food insurance plan. Energy-intensive hydroponic greenhouses are 2,000 times more productive per unit land area than are modern American farming methods (132). Therefore, if energy is abundant and inexpensive, there is no practical limit to world food production.

Fresh water is also believed to be in short supply. With plentiful inexpensive energy, sea water desalination can provide essentially unlimited supplies of fresh water.

During the past 200 years, human ingenuity in the use of energy has produced many technological miracles. These advances have markedly increased the quality, quantity, and length of human life. Technologists of the 21st century need abundant, inexpensive energy with which to continue this advance.

Were this bright future to be prevented by world energy rationing, the result would be tragic indeed. In addition to human loss, the Earth's environment would be a major victim of such a mistake. Inexpensive energy is essential to environmental health. Prosperous people have the wealth to spare for environmental preservation and enhancement. Poor, impoverished people do not.

## CONCLUSIONS

There are no experimental data to support the hypothesis that increases in human hydrocarbon use or in atmospheric carbon dioxide and other greenhouse gases are causing or can be expected to cause unfavorable changes in global temperatures, weather, or landscape. There is no reason to limit human production of CO<sub>2</sub>, CH<sub>4</sub>, and other minor greenhouse gases as has been proposed (82,83,97,123).

We also need not worry about environmental calamities even if the current natural warming trend continues. The Earth has been much warmer during the past 3,000 years without catastrophic effects. Warmer weather extends growing seasons and generally improves the habitability of colder regions.

As coal, oil, and natural gas are used to feed and lift from poverty vast numbers of people across the globe, more CO<sub>2</sub> will be released into the atmosphere. This will help to maintain and improve the health, longevity, prosperity, and productivity of all people.

The United States and other countries need to produce more energy, not less. The most practical, economical, and environmentally sound methods available are hydrocarbon and nuclear technologies.

Human use of coal, oil, and natural gas has not harmfully warmed the Earth, and the extrapolation of current trends shows that it will not do so in the foreseeable future. The CO<sub>2</sub> produced does, however, accelerate the growth rates of plants and also permits plants to grow in drier regions. Animal life, which depends upon plants, also flourishes, and the diversity of plant and animal life is increased.

Human activities are producing part of the rise in CO<sub>2</sub> in the atmosphere. Mankind is moving the carbon in coal, oil, and natural gas from below ground to the atmosphere, where it is available for conversion into living things. We are living in an increasingly lush environment of plants and animals as a result of this CO<sub>2</sub> increase. Our children will therefore enjoy an Earth with far more plant and animal life than that with which we now are blessed.

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# EXHIBIT 41

**Joe Walker**

TO: Global Climate Science Team  
CC : Michelle Ross: Susan Moya  
Subject: Draft Global Climate Science Communications Plan

As promised attached is the draft global climate science Communication Plan that we developed during our workshop last Friday. Thanks especially to those of you who participated in the workshop, and in particular to join Adams for his very helpful though following up our meeting, and Alan Caurdill for tuning around the notes from our workshop so quickly

Please review the plan and get back to me with your comment as soon as possible.

As those of you who were at the workshop know we have scheduled a follow-up team meeting to review the plan in person on Friday, April 17, from 1 to 3 pm. at the API headquarters. After we hope to have a "Plan champion" help us move it forward to potential funding sources, perhaps starting with the global climate "Coordinating Council - that will be an item for discussion on April 17.

Again thanks for your hard work on this project. Please email, call or fax me with your comment. Thanks

Regards,  
Joe Walker

## **Global Climate Science Communications**

### **Action Plan**

#### **Project Goal**

A majority of the American public including industry leadership, recognizes that significant uncertainties exist in climate science, and therefore raises questions among those (e.g, Congress) who chart the future U. S. courts on global climate change.

Progress will be measured towards the goal. A measurement of the public's perspective on climate science will be taken, before the plan is launched, and the same measurement will be taken at one or more as yet-to-be-determined intervals as the plan is implemented

#### **Victory Will Be Achieved When**

- Average citizens “understand” (recognize) uncertainties in climate science; recognition of uncertainties becomes part of the “conventional wisdom”
- Media “understands” (recognizes) uncertainties in climate science
- Media coverage reflects balance on climate science and recognition of the validity viewpoints that challenge the current “conventional wisdom”
- Industry senior leadership understands uncertainties in climate science, making them stronger ambassadors to those who shape climate policy
- Those promoting the Kyoto treaty on the basis of extant science appear to be out of touch with reality.

#### **Current Reality**

Unless "climate change" becomes a non-issue, meaning that the Kyoto proposal is defeated and there are no further initiatives to thwart the threat of climate change, there may be no in comment when we can declare victory for our effort. It will be necessary to establish measurement for the science effort to track progress toward achieving the goal and strategic success



Because the science underpinning the global climate change theory has not been challenged effectively in the media or through other vehicles reaching the American public; there is widespread ignorance, which works in favor of the Kyoto treaty and against the best interests of the United States. Indeed, the public has been highly receptive to the Clinton Administration's plans. There has been little, if any, public resistance or pressure applied to Congress to reject the treaty, except by those "inside the Beltway" with vested interests.

Moreover, from the political viewpoint, it is difficult for the United States to oppose the treaty solely on economic grounds, valid as the economic issues are. It makes it too easy for others to portray the United States as putting preservation of its own lifestyle above the greater concerns of mankind. This argument in turn forces our negotiators to make concessions that have not been well thought through, and in the end may do far more harm than good. This is the process that unfolded at Kyoto, and is very likely to be repeated in Buenos Aires in November 1998.

The advocates of global warming have been successful on the basis of skillfully misrepresenting the science and the extent of agreement on the science, while industry and its partners ceded the science and fought on the economic issues. Yet if we can show that science does not support the Kyoto treaty — which most true climate scientists believe to be the case — this puts the United States in a stronger moral position and frees its negotiators from the need to make concessions as a defense against perceived selfish economic concerns.

Upon this tableau, the Global Climate Science Communications Team (GCSCT) developed an action plan to inform the American public that science does not support the precipitous actions Kyoto would dictate, thereby providing a climate for the right policy decisions to be made. The team considered results from a new public opinion survey in developing the plan.

Charlton Research's survey of 1,100 "informed Americans" suggests that while Americans currently perceive climate change to be a great threat, public opinion is open to change on climate science. When informed that "some scientists believe there is not enough evidence to suggest that [what is called global climate change] is a long-term change due to human behavior and activities," 58 percent of those surveyed said they were more likely to oppose the Kyoto treaty. Moreover, half the respondents harbored doubts about climate science.

GCSCT members who contributed to the development of the plan are A- John Adams, John Adams Associates; Candace Crandall, Science and Environmental Policy Project; David Rothbard, Committee For A Constructive Tomorrow; Jeffrey Salmon, The Marshall Institute; Lee Ganigaru Environmental Issues Council; Lynn Bouchev and Myron Ebell, Frontiers of Freedom; Peter Cleary, Americans for Tax Reform; Randy Randol, Exxon Corp.; Robert Gehrl, The Southern Company; Sharon Kneiss, Chevron Corp; Steve Milloy, The Advancement of Sound Science Coalition; and Joseph Walker, American Petroleum Institute.

The action plan is detailed on the following pages.

April 3, 1998

## Global Climate Science Communications

### Action Plan

#### Situation Analysis

In December 1997, the Clinton Administration agreed in Kyoto, Japan, to a treaty to reduce greenhouse gas emissions to prevent what it purports to be changes in the global climate caused by the continuing release of such emissions. The so-called greenhouse gases have many sources. For example, water vapor is a greenhouse gas. But the Clinton Administration's action, if eventually approved by the U.S. Senate, will mainly affect emissions from fossil fuel (gasoline, coal, natural gas, etc.) combustion.

As the climate change debate has evolved, those who oppose action have argued mainly that signing such a treaty will place the U.S. at a competitive disadvantage with most other nations, and will be extremely expensive to implement. Much of the cost will be borne by American consumers who will pay higher prices for most energy and Transportation.

The climate change theory being advanced by the treaty supporters is based primarily on forecasting models with a very high degree of uncertainty. In fact, it is not known for sure whether (a) climate change actually is occurring, or (b) if it is, whether humans really have any influence on it.

Despite these weaknesses in scientific understanding, those who oppose the treaty have done little to build a case against precipitous action on climate change based on the scientific uncertainty. As a result, the Clinton Administration and environmental groups essentially have had the field to themselves. They have conducted an effective public relations program to convince the American public that the climate is changing, we humans are at fault, and we must do something about it before calamity strikes.

The environmental groups know they have been successful. Commenting after the Kyoto negotiations about recent media coverage of climate change, Tom Wathen, executive vice president of the National Environmental Trust, wrote:

".. As important as the extent of the coverage was the tone and tenor of it- In a change from just six months ago, most media stories no longer presented global warming as just a theory over which reasonable scientists could differ. Most stories described predictions of global warming as the position of the overwhelming number of mainstream scientists. That the environmental community had, to a great extent, settled the scientific issue with the U.S. media is the other great success that began perhaps several months earlier but became apparent during Kyoto.

### Strategies and Tactics

- I. **National Media Relations Program: Develop and implement a national media relations program to inform the media about uncertainties in climate science; to generate national, regional and local media coverage on the scientific uncertainties, and thereby educate and inform the public, stimulating them to raise questions with policy makers.**

Tactics: These tactics will be undertaken between now and the next climate meeting in Buenos Aires, Argentina, in November 1998, and will be continued thereafter, as appropriate. Activities will be launched as soon as the plan is approved, funding obtained, and the necessary resources (e.g., public relations counsel) arranged and deployed. In all cases, tactical implementation will be fully integrated with other elements of this action plan, most especially Strategy II (National Climate Science Data Center).

- Identify, recruit and train a team of five independent scientists to participate in media outreach. These will be individuals who do not have a long history of visibility and/or participation in the climate change debate. Rather, this team will consist of new faces who will add their voices to those recognized scientists who already are vocal.
- Develop a global climate science information kit for media including peer-reviewed papers that undercut the "conventional wisdom" on climate science. This kit also will include understandable communications, including simple fact sheets that present scientific uncertainties in language that the media and public can understand.
- Conduct briefings by media-trained scientists for science writers in the top 20 media markets, using the information kits. Distribute the information kits to daily newspapers nationwide with offer of scientists to brief reporters at each paper. Develop, disseminate radio news releases featuring scientists nationwide, and offer scientists to appear on radio talk shows across the country.
- Produce, distribute a steady stream of climate science information via facsimile and e-mail to science writers around the country.
- Produce, distribute via syndicate and directly to newspapers nationwide a steady stream of op-ed columns and letters to the editor authored by scientists.
- Convince one of the major news national TV journalists (e.g., John Stossel) to produce a report examining the scientific underpinnings of the Kyoto treaty.
- Organize, promote and conduct through grassroots organizations a series of campus / community workshops/debates on climate science in 10 most important states during the period mid-August through October, 1998.

- Consider advertising the scientific uncertainties in select markets to support national, regional and local (e.g., workshops/debates), as appropriate.

National Media Program Budget — \$600,000 plus paid advertising

**II. Global Climate Science Information Source: Develop and Implement a program to inject credible science and scientific accountability into the global climate debate, thereby raising questions about and undercutting the "prevailing scientific wisdom." The strategy will have the added benefit of providing a platform for credible, constructive criticism of the opposition's position on the science.**

Tactics: As with the National Media Relations Program, these activities will be undertaken between now and the next climate meeting in Buenos Aires, Argentina, in November 1998, and will continue thereafter. Initiatives will be launched as soon as the plan is approved, funding obtained, and the necessary resources arranged and deployed.

- Establish a Global Climate Science Data Center. The GCSDC will be established in Washington as a non-profit educational foundation with an advisory board of respected climate scientists. It -will be staffed initially with professionals on loan from various companies and associations with a major interest in the climate issue. These executives will bring with them knowledge and experience in the following areas:
  - Overall history of climate research and the IPCC process;
  - Congressional relations and knowledge of where individual Senators stand on the climate issue;
  - Knowledge of key climate scientists and where they stand;
  - Ability to identify and recruit as many as 20 respected climate scientists to serve on the science advisory board;
  - Knowledge and expertise in media relations and with established relationships with science and energy writers, columnists and editorial writers;
  - Expertise in grassroots organization; and
  - Campaign organization and administration.

The GCSDC will be led by a dynamic senior executive with, a major personal . commitment to the goals of the campaign and easy access to business leaders at the CEO level. The Center will be run on a day-to-day basis by an executive director with responsibility for ensuring targets are met. The Center will be funded at a level that will permit it to succeed, including funding for research contracts that may be deemed appropriate to fill gaps in climate science (e-g., a complete scientific critique of the EPCC research and its conclusions).

- The GCSDC will become a one-stop resource on climate science for members of Congress, the media, industry and all others concerned. It will be in constant contact with the best climate scientists and ensure that their findings and views receive appropriate attention. It will provide them with the logistical and moral support they have been lacking. In short, it will be a sound scientific alternative to the IPCC. Its functions will include:
  - Providing as an easily accessible database (including a website) of all mainstream climate science information.
  - Identifying and establishing cooperative relationships with all major scientists whose research in this field supports our position.
  - Establishing cooperative relationships with other main stream scientific organizations (e.g. meteorologists, geophysicist) to bring their perspectives to bear on the debate, as appropriate.
  - Developing opportunities to maximize the impact of scientific views consistent with ours with Congress, the media and other key audiences.
  - Monitoring and serving as an early warning system for scientific developments with the potential to impact on the climate science debate, pro and con.
  - Responding to claims from the scientific alarmists and media.
  - Providing grants for advocacy on climate science, as deemed appropriate.

Global Climate Science Data Center Budget — \$5,000,000 (spread over two years minimum)

**III. National Direct Outreach and Education: Develop and implement a direct outreach program to inform and educate members of Congress, state officials, industry leadership, and school teachers/students about uncertainties in climate science. This strategy will enable Congress, state officials and industry leaders will be able to raise such serious questions about the Kyoto treaty's scientific underpinnings that American policy-makers not only will refuse to endorse it, they will seek to prevent progress toward implementation at the Buenos Aires meeting in November or through other way. Informing teachers/students about uncertainties in climate science will begin to erect a barrier against further efforts to impose Kyoto-like measures in the future.**

Tactics: Informing and educating members of Congress, state officials and industry leaders will be undertaken as soon as the plan is approved, funding is obtained, and the necessary resources are arrayed and will continue through Buenos Aires and for the foreseeable future. The teachers/students outreach program will be developed and launched in early 1999. In all cases, tactical implementation will be fully integrated with other elements of this action plan.

- Develop and conduct through the Global Climates Science Data Center science briefings for Congress, governors, state legislators, and Industry leaders by August 1998.
- Develop information kits on climate science targeted specifically at the needs of government officials and industry leaders, to be used in conjunction, with and "Separately from the in-person briefings to further disseminate information on climate science uncertainties and thereby arm these influentials to raise serious questions on the science issue.

- Organize under the GCSDC a "Science Education Task Group" that will serve as the point of outreach, to the National Science Teachers Association (NSTA) and other influential science education organizations. Work with NSTA to develop school materials that present a credible, balanced picture of climate science for use in classrooms nationwide.
- Distribute educational materials directly to schools and through grassroots organizations of climate science partners (companies, organizations that participate in -this effort).

National Direct Outreach Program Budget — \$300,000

**IV. Funding/Fund Allocation: Develop and implement program to obtain funding, and to allocate funds to ensure that the program it is carried out effectively.**

Tactics: This strategy will be implemented as soon as we have the go-ahead to proceed.

- Potential funding sources were identified as American Petroleum Institute (API) and its members; Business Round Table (BKT) and its members, Edison Electric Institute (EE3) and its members; Independent Petroleum Association of America (IPAA) and its members; and the National Mining Association (NMA) and its members.
- Potential fund allocators were identified as the American Legislative Exchange Council (ALEC), Committee For A Constructive Tomorrow (CFACT), Competitive Enterprise Institute, Frontiers of Freedom and The Marshall Institute.

Total Funds Required to Implement Program through November 1998 - \$2,000,000 (A significant portion of funding for the GCSDC will be deferred until 1999 and beyond)

**Measurements**

Various metrics will be used to track progress. These measurements will have to be determined in fleshing out the action plan and may include:

- Baseline public/government official opinion surveys and periodic follow-up surveys on the percentage of Americans and government officials who recognize significant uncertainties in climate science.
- Tracking the percent of media articles that raise questions about climate science.
- Number of Members of Congress exposed to our materials on climate science.
- Number of communications on climate science received by Members of Congress from their constituents.
- Number of radio talk show appearances by scientists questioning the "prevailing

- Number of school teachers/students reached with our information on climate science.
- Number of science writers briefed and who repeat upon climate science uncertainties.
- Total audience exposed to newspaper radio, television coverage of science uncertainties.

# EXHIBIT 42



LETTER • OPEN ACCESS

## Assessing ExxonMobil's climate change communications (1977–2014)

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## Environmental Research Letters



### LETTER

# Assessing ExxonMobil's climate change communications (1977–2014)

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### Abstract

This paper assesses whether ExxonMobil Corporation has in the past misled the general public about climate change. We present an empirical document-by-document textual content analysis and comparison of 187 climate change communications from ExxonMobil, including peer-reviewed and non-peer-reviewed publications, internal company documents, and paid, editorial-style advertisements ('advertorials') in *The New York Times*. We examine whether these communications sent consistent messages about the state of climate science and its implications—specifically, we compare their positions on climate change as real, human-caused, serious, and solvable. In all four cases, we find that as documents become more publicly accessible, they increasingly communicate doubt. This discrepancy is most pronounced between advertorials and all other documents. For example, accounting for expressions of reasonable doubt, 83% of peer-reviewed papers and 80% of internal documents acknowledge that climate change is real and human-caused, yet only 12% of advertorials do so, with 81% instead expressing doubt. We conclude that ExxonMobil contributed to advancing climate science—by way of its scientists' academic publications—but promoted doubt about it in advertorials. Given this discrepancy, we conclude that ExxonMobil misled the public. Our content analysis also examines ExxonMobil's discussion of the risks of stranded fossil fuel assets. We find the topic discussed and sometimes quantified in 24 documents of various types, but absent from advertorials. Finally, based on the available documents, we outline ExxonMobil's strategic approach to climate change research and communication, which helps to contextualize our findings.

### 1. Introduction

In 2016, Attorneys General (AGs) of 17 US states and territories announced that they 'are exploring working together on key climate change-related initiatives, such as ongoing and potential investigations' into whether ExxonMobil Corporation and other fossil fuel companies may have violated, variously, racketeering, consumer protection, or investor protection statutes through their communications regarding anthropogenic global warming (AGW) [1, 2]. (Unless specified otherwise, we refer to ExxonMobil Corporation, Exxon Corporation, and Mobil Oil Corporation as 'ExxonMobil'.) As part of a probe that began in 2015, New York Attorney General Eric Schneiderman has issued multiple subpoenas to ExxonMobil under the

state's Martin Act and alleged that the company's accounting of climate risk 'may be a sham' [3–6]. Massachusetts Attorney General Maura Healey is simultaneously investigating ExxonMobil, stating, 'Fossil fuel companies that deceived investors and consumers about the dangers of climate change should be held accountable' [7, 8]. US Virgin Islands Attorney General Claude Walker has said that he is investigating ExxonMobil for potentially violating the territory's anti-racketeering law [9]. Also in 2016, the US Securities and Exchange Commission (SEC) began a federal investigation into whether ExxonMobil appropriately discloses the business risks of AGW, and how it values its assets and reserves [10]. We offer no view on the legal issues raised by ongoing investigations.

ExxonMobil has responded stating, ‘We unequivocally reject allegations that ExxonMobil suppressed climate change research contained in media reports that are inaccurate distortions of ExxonMobil’s nearly 40 year history of climate research. We understand that climate risks are real. The company has continuously, publicly and openly researched and discussed the risks of climate change, carbon life cycle analysis and emissions reductions’ [11]. In particular, ExxonMobil’s website and statements offer a ‘10 page document listing the over 50 peer-reviewed articles on climate research and related policy analysis from ExxonMobil scientists from 1983 to the present’ [11–15]. ExxonMobil argues that this list, entitled ‘Exxon Mobil Contributed Publications’, ‘undercuts the allegation . . . that ExxonMobil sought to hide our research.’ The company has also published some of its internal company documents, originally made public by journalists at *InsideClimate News (ICN)* [16, 17] (and simultaneously reported by Columbia University’s Graduate School of Journalism and the *Los Angeles Times* [18]), to demonstrate that ‘allegations are based on deliberately cherry-picked statements’ [14]. ‘Read all of these documents and make up your own mind,’ ExxonMobil has challenged [14].

This paper takes up that challenge by analyzing the materials highlighted by the company, and comparing them with other publicly available ExxonMobil communications on AGW. The issue at stake is whether the corporation misled consumers, shareholders and/or the general public by making public statements that cast doubt on climate science and its implications, and which were at odds with available scientific information and with what the company knew. We stress that the question is not whether ExxonMobil ‘suppressed climate change research,’ but rather how they communicated about it [11].

Our analysis covers the publication period of the documents made available by ExxonMobil: 1977–2014. These documents include peer-reviewed and non-peer-reviewed publications (academic papers, conference proceedings, reports, company pamphlets, etc) and internal documents. Our analysis compares these documents with ExxonMobil’s public outreach in the form of paid, editorial-style advertisements—known as ‘advertorials’—published on the Op-Ed page of *The New York Times (NYT)* [19]. We focus on advertorials because they come directly from ExxonMobil and are an unequivocally public form of communication ‘designed to affect public opinion or official opinion’ [20]. Kollman has found that advertorializing is second only to mobilizing group members as the most commonly used outside lobbying technique [20, 21]. We examine whether these communications sent consistent messages about the state of climate science and its implications, or whether there is a discernable discrepancy between the company’s public and private communications.

Our study offers the first empirical assessment and intercomparison of ExxonMobil’s private and public statements on AGW<sup>2</sup>. By bringing to bear the quantitative methodologies of consensus measurement [22, 23] and content analysis [24–28], our results add to (i) earlier analyses of ExxonMobil’s communication practices [19, 20, 29–36], (ii) qualitative accounts of the company’s AGW communications [17, 18, 37–39], and (iii) the application of consensus measurement/content analysis to AGW communications [26–28, 40, 41]. In addition, this study contributes to the broader literature on climate change denial [42–48], corporate issue management [21, 35, 49, 50] and misinformation strategies [51–55], and the social construction of ignorance [56–58].

## 2. Method

We adapt and combine the methodologies used to quantify the consensus on AGW by Oreskes [23] and Cook *et al* [22] with the content analysis methodologies used to characterize media communications of AGW by Feldman *et al* and Elsasser and Dunlap [27, 28]. Developed to assess peer-reviewed scientific literature, cable news, and conservative newspapers, respectively, these offer generalizable approaches to quantifying the positions of an entity or community on a particular scientific question across multiple document classes.

Our study comprises 187 documents (see table 1): 32 internal documents (from *ICN* [16], ExxonMobil [59], and Climate Investigations Center [60]); 53 articles labeled ‘Peer-Reviewed Publications’ in ExxonMobil’s ‘Contributed Publications’ list [15]; 48 (unique and retrievable) documents labeled ‘Additional Publications’ in ExxonMobil’s ‘Contributed Publications’ list; 36 Mobil/ExxonMobil advertorials related to climate change in the *NYT*; and 18 ‘Other’ publicly available ExxonMobil communications—mostly non-peer-reviewed materials—obtained during our research. To our knowledge, these constitute the relevant, publicly available internal documents that have led to recent allegations against ExxonMobil, as well as all peer-reviewed and non-peer-reviewed documents offered by the company in response. They also include all discovered ExxonMobil advertorials in the *NYT* discussing AGW. Advertorials are sourced from a collection compiled by Polluter-Watch based on a search of the ProQuest archive [61].

<sup>2</sup> There are, of course, countless additional climate change communications from ExxonMobil that could be included in future work, including archived internal documents, advertorials published in newspapers beyond the *NYT*, and non-peer-reviewed materials such as speech transcripts, television adverts, patent documents, shareholder reports, and third-party communications (for example, from lobbyists, think-tanks, and politicians funded by ExxonMobil). These documents are potentially important, but are not the focus of the present study.

**Table 1.** Inventory of documents analyzed. Shown for each document category are the total number of documents, their date range, source(s), and assigned types. Among peer-reviewed and non-peer reviewed documents, eight publications were found to be redundant, with similar or identical wording to seven other (strictly unique) publications. All 15 are included in our analysis. Among non-peer-reviewed documents, there are two citations provided by ExxonMobil that are identical to two others. The identical two are not included in our analysis. Sources: ‘Peer-Reviewed’ and ‘Additional’ publications are cited in the ‘Exxon Mobil Contributed Publications’ list [15]; ‘Supporting Materials’ are internal documents offered by ExxonMobil [59]; ‘Other’ sources refers to documents discovered independently during our research; *ICN* = *InsideClimate News*; *NYT* = *The New York Times*. *NYT* advertorials were collated by Polluter Watch [61]. For details on document types, see section S2, supplementary information, available at [stacks.iop.org/ERL/12/084019/mmedia](https://stacks.iop.org/ERL/12/084019/mmedia). Miscellaneous Opinions include, for example, commentaries, opinion editorials, and speeches.

Category	No.	Dates	Sources						Document Types							
			Provided by ExxonMobil						Academic journal	Conference/workshop proceeding	Gov. report	Book	Industry white paper	Internal doc.	Ad	Misc. opinion
			‘Peer-reviewed’	‘Additional’	‘Supporting materials’	<i>ICN</i>	<i>NYT</i>	<i>Other</i>								
Internal Documents	32	1977–1995	0	0	22	28	0	1	0	0	0	0	0	32	0	0
Peer-Reviewed	72	1982–2014	50	19	0	0	0	3	53	2	13	4	0	0	0	0
Non-Peer-Reviewed	47	1980–2014	3	29	0	3	0	12	0	24	5	2	2	0	0	13
Advertorials	36	1989–2004	0	0	0	0	36	0	0	0	0	0	0	0	36	0

To characterize each document, we read its abstract, introduction, and conclusion, and either skim or read thoroughly the rest as necessary. In the case of long documents (over ~30 pages) in which executive summaries are provided, we rely on those summaries. The documents are binned into four categories as shown in table 1: *Internal*, *Peer-Reviewed*, *Non-Peer-Reviewed*, and *Advertorial*. This allows us to distinguish communications according to degree of accessibility—a key variable in assessing the consistency of ExxonMobil’s representations of AGW. Each document’s manifest content is then further characterized in four ways: type, topic, position with respect to AGW, and position with respect to risks of stranded assets. Details of document types and topics are discussed in sections S2–3, supplementary information.

## 2.1. Document position

Research has shown that four key points of understanding about AGW—that it is real, human-caused, serious, and solvable—are important predictors of the public’s perceived issue seriousness, affective issue involvement, support for climate policies, and political activism [62–66]. These four elements have also been found to underpin most narratives of AGW skepticism and denial (namely ‘it’s not happening’, ‘it’s not us’, ‘it’s not serious’, and ‘it’s too hard’) [28, 43, 67, 68]. We therefore use, *a priori*, these recognized elements as axes along which to characterize ExxonMobil’s positions on AGW in its communications; positions on each of these elements form the primary codes in our content analysis (table 2). Our coding scheme is summarized below (see section S1, supplementary information for further details).

One of the authors coded all of the documents, and ambiguities were resolved through discussion between authors. To verify intercoder reliability and intercoder agreement, both authors independently

coded a random subset of 36 documents (approximately 19% of the total number of documents in each category). Intracoder reliability was also calculated (see section S1.7, supplementary information).

### 2.1.1. ‘Real & human-caused’

Tailoring the approaches of Cook *et al*, Feldman *et al*, and Elsasser and Dunlap, each document is coded by assigning ‘Endorsement Points’ (EP1 to EP4b, defined in table 2) to pertinent text and figures based on whether each acknowledges or doubts the scientific evidence that AGW is real and human-caused (intercoder reliability of Endorsement Points: percentage agreement = 93%; Krippendorff’s (Kripp.)  $\alpha = 0.84$ ) [22, 27, 28]. We recognize that all science involves uncertainties, and therefore that doubt is not, *ipso facto*, an inappropriate response to complex scientific information. Uncertainties are an innate and important part of reasonable scientific discourse. However, it has also been shown that uncertainty may be amplified or exaggerated in ways that are misleading and unreasonable, sustaining doubt about claims that are scientifically established [42, 52, 57, 69]. Therefore, to distinguish reasonable and unreasonable doubt, we apply two first-order filters to our Endorsement Point codings. First, in documents published on or before 1990, we exempt expressions of doubt that AGW is *real* (i.e. we deem such expressions to be reasonable at that time). Second, in documents published on or before 1995, we exempt expressions of doubt that AGW is *human-caused*. 1990 and 1995 are when the Intergovernmental Panel on Climate Change (IPCC) first concluded that AGW is real and human-caused, respectively (these are conservative thresholds insofar as many scientists had arrived at these conclusions prior to the IPCC reports; indeed, IPCC reports are based only on already-completed work) [70, 71]. Finally, based on its individual Endorsement Points, each document is assigned one overall Endorsement

**Table 2.** Definitions of the Endorsement, Impact, and Solvable Points used to code levels of acknowledgment of AGW as real and human-caused, serious, and solvable, respectively. See section S1, supplementary information, for details on the content analysis and coding scheme.

<i>AGW as Real and Human-Caused</i>		
Endorsement points (EPs)		Description
'Acknowledge' (EP1)	Explicit endorsement with quantification	Explicitly supports position that humans are the primary cause of global warming (with quantification)
	(EP2) Explicit endorsement without quantification	Explicitly supports position that humans are the primary cause of global warming (without quantification) or refers to anthropogenic global warming as a known fact
	(EP3a) Implicit endorsement	Implicitly supports position that humans are the primary cause of global warming. e.g. research assumes greenhouse gas emissions cause warming without explicitly stating humans are the cause
	(EP3b) Implicit endorsement of consensus	Implicitly supports position that humans are the primary cause of global warming by referring to a consensus of the scientific community
'No position' (EP4a)	No position	Does not address the cause of global warming
'Doubt' (EP4b- 1)	Uncertain of reality of AGW	Expresses position that the <i>reality</i> of recent global warming is uncertain/undefined, namely 'it's not happening'
	2) Uncertain of human contribution to AGW	Expresses position that the <i>human contribution</i> to recent global warming is uncertain/undefined, namely 'it's not us'
<i>AGW as Serious</i>		
Impact points (IPs)		Description
'Acknowledge' (IP1)	Acknowledgment	Acknowledges and/or articulates known or predicted negative impacts of global warming e.g. geophysical, economic, socio-political
'No position' (IP2)	No position	Does not address the negative impacts of global warming (beyond generic references to climate change as a 'risk')
'Doubt' (IP3)	Uncertain	Expresses position that the reality of negative impacts of global warming is uncertain/undefined/exaggerated, namely 'it's not bad'
<i>AGW as Solvable</i>		
Solvable points (SPs)		Description
'Doubt' (SP1)	Uncertain	Expresses position that the difficulties of mitigating global warming are potentially insurmountable and/or exceed the benefits, namely 'it's too hard'

Level (EL) (intercoder reliability of Endorsement Levels: 89%; Kripp.  $\alpha = 0.85$ ): 'No Position' (all text and figures are EP4a only); 'Acknowledge' (EP1–3 only); 'Acknowledge and Doubt' (EP1–3 and EP4b); 'Reasonable Doubt' (EP4b only, deemed reasonable as defined above); or 'Doubt' (EP4b only, deemed unreasonable). 'Acknowledge and Doubt' reflects the fact that some communications acknowledge aspects of AGW yet emphasize other areas of doubt or uncertainty.

Our filtering of reasonable doubt (see also section S1.4.2, supplementary information) helps address the challenge of characterizing the positions of documents published during a period of rapidly evolving scientific opinion. Otherwise, however, our coding scheme is agnostic to each document's publication year.

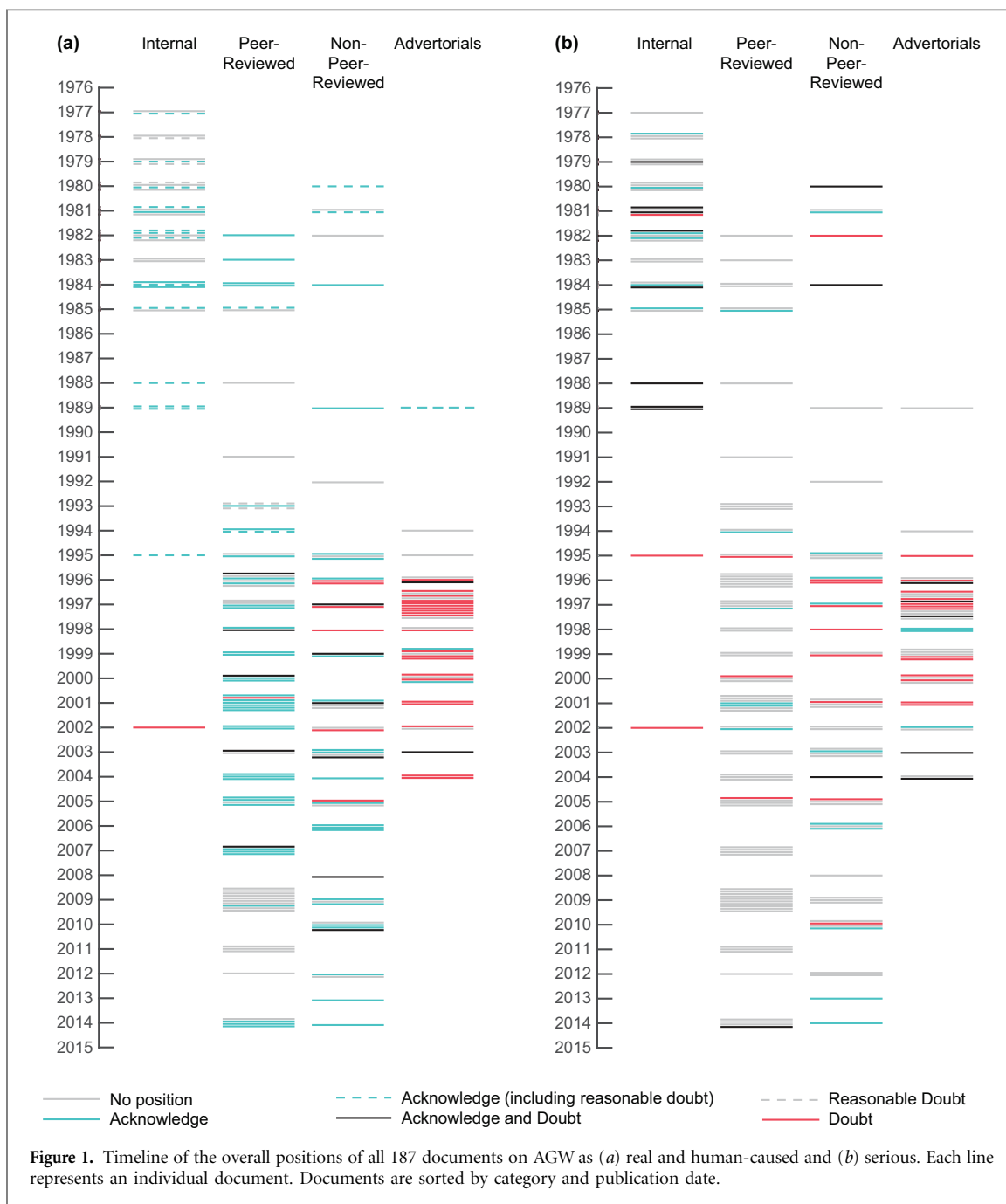
### 2.1.2. 'Serious'

We assign 'Impact Points' (IP1 to IP3, defined in table 2) throughout each document based on its

positions on AGW as having known or predicted negative impacts (for example, geophysical, economic, or sociopolitical) (intercoder reliability of Impact Points: 94%; Kripp.  $\alpha = 0.86$ ). Each document is then assigned one of four overall Impact Levels (ILs): 'No Position' (all text and figures are IP2 only); 'Acknowledge' (IP1 only); 'Acknowledge and Doubt' (IP1 and IP3); or 'Doubt' (IP3 only) (intercoder reliability of Impact Levels: 89%; Kripp.  $\alpha = 0.77$ ).

### 2.1.3. 'Solvable'

We identify documents that express 'Doubt' (SP1, defined in table 2) as to whether AGW can be mitigated or whether the costs of doing so exceed the benefits (intercoder reliability: 97%; Kripp.  $\alpha = 0.84$ ). While the question of AGW's solvability is not resolvable on purely technical grounds, the relative extent to which documents promote doubt on the matter remains relevant to the character of climate communications, insofar as assertions that AGW



cannot be stopped are a common component of contrarian claims [42, 72].

**2.2. Risks of stranded assets**

AGs and the SEC are investigating ExxonMobil’s understanding and disclosures of the financial risks related to either AGW or future climate policy, and shareholders have questioned the adequacy of ExxonMobil’s disclosures on this point. We examine what, if anything, has been stated on this subject in the documents examined [10, 73–75]. Across all documents, we collate and chronicle ExxonMobil’s communications regarding the risks of stranded assets (intercoder reliability: 100%; Kripp.  $\alpha = 1.0$ ). Financial documents from ExxonMobil, such as shareholder

reports, are beyond the scope of this study and a topic for future investigation.

**3. Results**

**3.1. Endorsement levels (ELs)—AGW as real and human-caused**

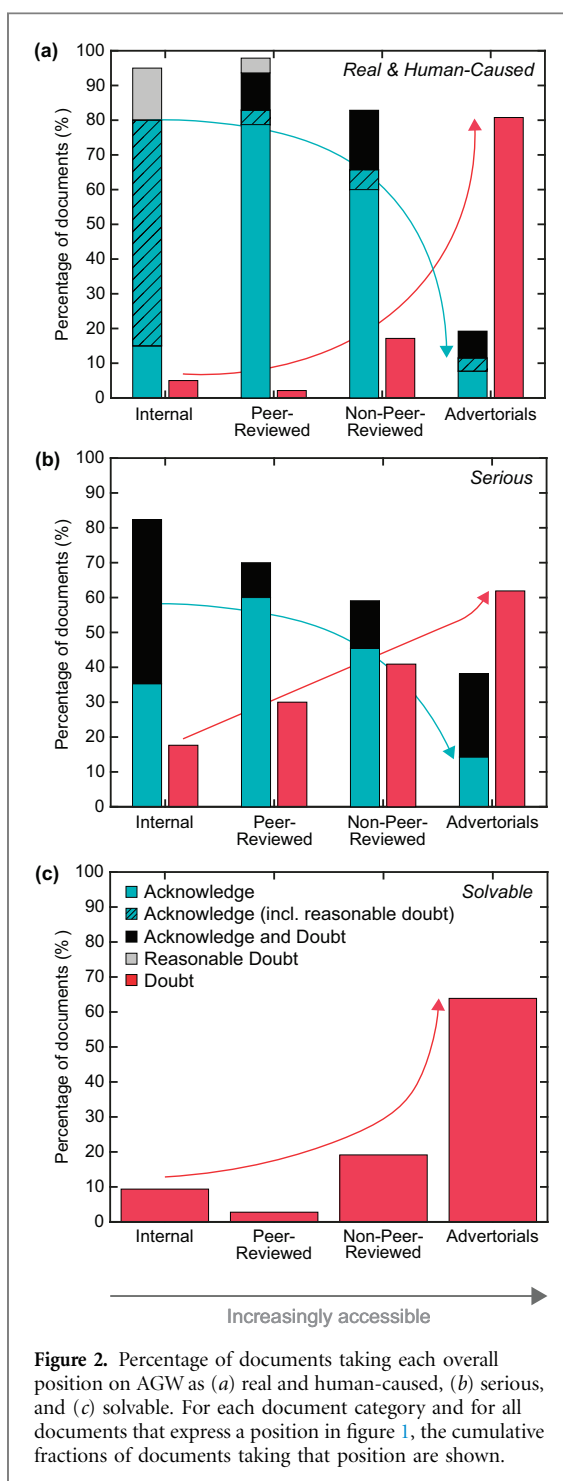
Figure 1(a) is a timeline of the overall positions of all 187 documents on AGW as real and human-caused, sorted by publication date and into four categories: *Internal Documents*, *Peer-Reviewed*, *Non-Peer-Reviewed*, and *Advertorials*. Each line represents an individual document and is color-coded: No position (grey); Acknowledge (blue); Acknowledge and Doubt (black); and Doubt (red). Dashed lines indicate documents that have

**Table 3.** Example quotations (coding units) expressing (left) acknowledgment and (right) doubt that AGW is real and human-caused. For each document category, two examples are given: the first typifies a relatively ‘strong’ quotation, the second a relatively ‘mild’ one. Substantiating quotations for all documents are provided in section S7, supplementary information.

	Acknowledge AGW is real and human-caused (EP1,2,3)	Doubt AGW is real and human-caused (EP4b-1,2)
INTERNAL	<p><b>1979</b> [82] ‘The most widely held theory is that:—The increase [in atmospheric CO<sub>2</sub>] is due to fossil fuel combustion;—Increasing CO<sub>2</sub> concentration will cause a warming of the earth’s surface;—The present trend of fossil fuel consumption will cause dramatic environmental effects before the year 2050.’</p> <p><b>1982</b> [83] ‘The question of which predictions and which models best simulate a carbon dioxide induced climate change is still being debated by the scientific community. Our best estimate is that doubling of the current concentration could increase average global temperature by about 1.3° to 3.1°C . . . .’</p>	<p><b>1982</b> [83] ‘There is currently no unambiguous scientific evidence that the earth is warming. If the earth is on a warming trend, we’re not likely to detect it before 1995.’<sup>a</sup></p> <p><b>2002</b> [84] ‘A major frustration to many is the all-too-apparent bias of IPCC to downplay the significance of scientific uncertainty and gaps . . . .’</p>
PEER-REVIEWED	<p><b>1996</b> [76] ‘The body of statistical evidence . . . now points towards a discernible human influence on global climate.’</p> <p><b>1995</b> [86] ‘We present a preliminary analysis of a geoengineering option based on the intentional increase of ocean alkalinity to enhance marine storage of atmospheric CO<sub>2</sub>. Like all geoengineering techniques to limit climate change . . . .’</p>	<p><b>2001</b> [85] ‘A general statistical methodology . . . is proposed as a method for deciding whether or not anthropogenic influences are causing climate change.’</p> <p><b>2003</b> [81] ‘Currently, our ability to forecast future climate is in question. Models are used to make projections of future climate, based on scenarios of future human activities and emissions, by simulating each link in the causal chain relating these scenarios to changes in climate. The estimation of the uncertainty of this causal chain remains an important scientific challenge.’</p>
NON-PEER-REVIEWED	<p><b>1981</b> [87] ‘The conviction in the scientific community that the observed trend of increasing carbon dioxide, if it continues, will cause a global warming is based on a variety of theoretical studies . . . the results are now fairly consistent. For a carbon dioxide doubling the calculated mean surface-air temperature increase is approximately 2°C to 3°C. The warming is 2 to 3 times larger in the northern polar regions . . . Other model-predicted features are shifts of precipitation and soil moisture, retreat of polar snow and sea ice, and changes of large-scale circulation patterns.’</p> <p><b>2003</b> [89] ‘. . . a 2°C warming target (which can still produce adverse climate impacts) requires non-CO<sub>2</sub>-emitting primary power in the 10 to 30 TW range by 2050.’</p>	<p><b>1996</b> [88] Title: ‘Global warming: who’s right? Facts about a debate that’s turned up more questions than answers.’ ‘. . . a multinational effort, under the auspices of the United Nations, is under way to cut the use of fossil fuels, based on the unproven theory that they affect the earth’s climate.’</p> <p><b>2008</b> [90] ‘Nor are [the <i>Oil and Natural Gas Industry Guidelines for Greenhouse Gas Reduction Projects</i>] intended to imply a direct connection between GHG emissions from the oil and natural gas industry and the phenomenon commonly referred to as climate change.’</p>
ADVERTORIALS	<p><b>1999</b> [91] ‘Reasonable concerns about the buildup of greenhouse gases in the atmosphere and their effect on earth’s climate have prompted policymakers to search for a response.’</p> <p><b>2003</b> [93] ‘We humans are interacting with the geo-chemical systems of our planet on a global scale. The concentration of carbon dioxide in the atmosphere has increased by a third from its preindustrial level, and the resulting change in the acidity of the upper ocean can be detected.’<sup>b</sup></p>	<p><b>1997</b> [92] ‘Let’s face it: The science of climate change is too uncertain to mandate a plan of action that could plunge economies into turmoil . . . Scientists cannot predict with certainty if temperatures will increase, by how much and where changes will occur. We still don’t know what role man-made greenhouse gases might play in warming the planet . . . Let’s not rush to a decision at Kyoto. Climate change is complex; the science is not conclusive; the economics could be devastating.’</p> <p><b>1997</b> [94] Title: ‘Climate change: a degree of uncertainty.’ ‘. . . there is a high degree of uncertainty over the timing and magnitude of the potential impacts that man-made emissions of greenhouse gases have on climate . . . To address the scientific uncertainty governments, universities and industry should form global research partnerships to fill in the knowledge gap, with the goal of achieving a consensus view on critical issues within a defined time frame . . . .’</p>

<sup>a</sup> Document filtered by our analysis as reasonable due to pre-1990 publication date.

<sup>b</sup> Advertorial is signed by Stanford University Professor Lynn Orr, then-director of Stanford’s Exxon-funded GCEP alliance, and bears the seal of Stanford University. See section S7, supplementary information, for details.



**Figure 2.** Percentage of documents taking each overall position on AGW as (a) real and human-caused, (b) serious, and (c) solvable. For each document category and for all documents that express a position in figure 1, the cumulative fractions of documents taking that position are shown.

been filtered for reasonable doubt. Table 3 presents exemplifying quotations (coding units) of varying ‘strength’ that illustrate the assigned positions for a selection of the documents. For each category and for all documents that express a position, figure 2(a) shows the cumulative fraction of documents that take that position. Positions on AGW as real and human-caused vary significantly across document categories ( $p < 3.7 \times 10^{-13}$ , Fisher’s exact test, FET; see table S3, supplementary information, for details and all probability values). Figure 2 is based on all documents in figure 1; the same trend is observed when only documents with an overlapping date range are considered (section S4, supplementary information).

### 3.1.1. Peer-reviewed publications

Figures 1(a) and 2(a) show that ExxonMobil’s peer-reviewed publications overwhelmingly acknowledge AGW as real and human-caused (‘Acknowledge’). Of the 65% (47/72) of peer-reviewed documents that express a position, more than three-quarters hold an ‘Acknowledge’ position (39/47 = 83%). Table 3 provides sample quotations (see section S7, supplementary information, for substantiating quotations for all documents). ExxonMobil’s listed publications include chapter 8 of the 1995 IPCC report (ExxonMobil’s principal climate scientist, Haroon Kheshgi, was a contributing author), which observed a ‘discernible human influence on global climate’ [15, 76]. Kheshgi also co-authored the Summary for Policymakers and several chapters of the next IPCC report in 2001, which found ‘there is new and stronger evidence that most of the warming observed over the last 50 years is attributable to human activities’ [77–80]. Of the minority of peer-reviewed documents holding a position of ‘Acknowledge and Doubt’ (5/47 = 11%), ‘Reasonable Doubt’ (2/47 = 4%), or ‘Doubt’ (1/47 = 2%), we judge that most of the expressed doubt constitutes normal scientific discussion about uncertainties; for example, ‘the estimation of the uncertainty of this causal chain [linking human activities to changes in climate]’ [81].

### 3.1.2. Non-peer-reviewed documents

The predominant stance taken in non-peer-reviewed communications is also ‘Acknowledge’, although compared to peer-reviewed work, it loses ground to the ‘Acknowledge and Doubt’ and ‘Doubt’ stances in roughly equal measure ( $p = 0.044$ , FET). Figures 1(a) and 2(a) show that, of the 74% (35/47) that take a position, 66% (23/35) ‘Acknowledge’, 17% (6/35) ‘Acknowledge and Doubt’, and 17% (6/35) ‘Doubt’ that AGW is real and human-caused. The more frequent expressions of doubt in non-peer-reviewed documents, compared with peer-reviewed ones, reflect the mixed nature of these documents. Some are technical, academic analyses, while others are industry-targeted speeches, reports, conference proceedings, company pamphlets, etc (see sections S2, S3, and S6, supplementary information).

### 3.1.3. Internal documents

The bulk of ExxonMobil’s internal documents also take the ‘Acknowledge’ stance. Figures 1(a) and 2(a) show that, of the 63% (20/32) that take a position, 80% (16/20) adopt ‘Acknowledge’, with most of the rest expressing ‘Reasonable Doubt’ (3/20 = 15%). Unlike other document categories, however, our characterization of internal documents shifts dramatically if we remove filters for reasonable doubt from our analysis (see section 2). Then, 61% (11/18) take the mixed position (‘Acknowledge and Doubt’), with the remainder split between ‘Acknowledge’ and ‘Doubt’ (3/18 = 17% and 4/18 = 22%, respectively).



These results are explained by the early publication period of internal documents: all but two were published before the 1990 IPCC report, and are therefore subject to our filters for reasonable doubt. These results also reflect the predominant nature of the internal documents: they acknowledge the likelihood of AGW based on internal and external research, while also highlighting uncertainties.

In 1979, for instance (table 3), an internal Exxon study concluded that:

The most widely held theory is that:

- The increase [in atmospheric CO<sub>2</sub>] is due to fossil fuel combustion
- Increasing CO<sub>2</sub> concentration will cause a warming of the earth's surface
- The present trend of fossil fuel consumption will cause dramatic environmental effects before the year 2050.

However, the memo notes: 'It must be realized that there is great uncertainty in the existing climatic models because of a poor understanding of the atmospheric/terrestrial/oceanic CO<sub>2</sub> balance' [82]. Likewise, an internal briefing on the 'CO<sub>2</sub> "Greenhouse" Effect' from 1982 states: 'There is currently no unambiguous scientific evidence that the earth is warming. If the earth is on a warming trend, we're not likely to detect it before 1995' (see table 3). Yet, the authors say, 'Our best estimate is that doubling of the current concentration could increase average global temperature by about 1.3°C to 3.1°C' [83]. Several internal documents make this distinction, acknowledging that increased CO<sub>2</sub> would likely cause warming, while expressing (reasonable) doubt that warming was already underway and large enough to be detected.

This cautious consensus is also evident in charts in internal ExxonMobil presentations and reports. (Due to copyright restrictions prohibiting the reproduction of figures owned by ExxonMobil, we instead provide hyperlinks to third-party websites at which relevant figures can be viewed.) For example, in a 1978 presentation to the Exxon Corporation Management Committee, Exxon scientist James Black showed a graph (see <https://perma.cc/PJ4N-T8SC>) of projected warming 'model[ed] with the assumption that the carbon dioxide levels will double by 2050 A.D.' [95]. Another case is the 1982 Exxon primer already mentioned, which includes a graph (see <https://perma.cc/PH4X-ZJBA>) showing 'an estimate of the average global temperature increase' under the 'Exxon 21st Century Study-High Growth scenario' [83]. A third example is a table (see <https://perma.cc/9DGQ-4TBW>) presented by Exxon scientist Henry Shaw at a 1984 Exxon/Esso environmental conference, which showed that Exxon's expected 'average temper-

ature rise' of 1.3°C–3.1°C was comparable to projections by leading research institutions (1.5°C–4.5°C) [96]. This shows that ExxonMobil scientists and managers were well informed of the state of the science at the time. But they also tended to focus on the prevailing uncertainties: Black stressed the alleged shortcomings of extant climate models before showing his results; Shaw emphasized the variable and 'unpredictable' character of some values.

We conclude that ExxonMobil's recent defense accurately characterizes the situation with respect to its peer-reviewed, non-peer-reviewed, and internal documents: 'Our researchers recognized the developing nature of climate science at the time . . . [and] mirrored global understanding' [14]. On several occasions during the early 1980s, the company's peer-reviewed and internal documents went as far as to refute 'calculations on a more limited scale by a number of climatologists' that projected much less global warming than the rest of the scientific community, including ExxonMobil [97–99]. 'In summary,' said a 1982 memo, 'the results of our research are in accord with the scientific consensus on the effect of increased atmospheric CO<sub>2</sub> on climate . . . and are subject to the same uncertainties' [99]. As a scientific consensus emerged in the early 1990s that AGW was underway, a 1995 'Primer on Climate Change Science' co-authored by Mobil as part of the Global Climate Coalition explicitly rejected contrarian claims that were beginning to circulate: 'Contrarian theories . . . do not offer convincing arguments against the conventional model of greenhouse gas emission-induced climate change' [100].

#### 3.1.4. Advertorials

The predominant stance taken in ExxonMobil's advertorials is 'Doubt'. In essence, these public statements reflect only the 'Doubt' side of ExxonMobil's mixed internal dialogue. Figures 1(a) and 2(a) show that of the 72% (26/36) of climate change advertorials that take a position, 81% (21/26) take the position of 'Doubt', with the remainder split between 'Acknowledge' (3/26 = 11.5%) and 'Acknowledge and Doubt' (2/26 = 7.5%). A characteristic example is a 1997 Mobil advertorial (table 3), which stated: 'Let's face it: The science of climate change is too uncertain to mandate a plan of action that could plunge economies into turmoil . . . Scientists cannot predict with certainty if temperatures will increase, by how much and where changes will occur. We still don't know what role man-made greenhouse gases might play in warming the planet' [92]. Another, also from 1997, referred to a 'high degree of uncertainty,' 'debate,' and a 'knowledge gap,' and the need for further 'fact-finding' and 'additional knowledge' before UN negotiators in Kyoto could make decisions [94]. The advertorial stressed the goal 'of achieving a consensus view,' two years after the IPCC had presented one.

Our analysis is limited to advertorials in the *NYT* because those pertaining to climate change have already been compiled and are readily available. Brown *et al* report that ExxonMobil also ran advertorials in eight other major newspapers [19]. Some of these appear to have been the same or similar to those in the *NYT*. For example, in an advertorial in *The Washington Post* in 2000, ExxonMobil criticized a US National Assessment report on climate change as putting the ‘political cart before a scientific horse’ and being based ‘on unreliable models’ [101]. The advertorial was condemned by the former director of the National Assessment Coordination Office: ‘To call ExxonMobil’s position out of the mainstream is . . . a gross understatement’ [102].

### 3.1.5. Contrast between advertorials and other documents

Our analysis shows that ExxonMobil’s scientists and executives were, for the most part, aware and accepting of the evolving climate science from the 1970s onwards, but they painted a different picture in advertorials. The majority of ExxonMobil’s peer-reviewed publications acknowledge that climate change is real and human-caused, and internal documents reflect this scientific framework. Uncertainties are mentioned or even highlighted, but usually in the context of broader scientific understandings and broadly consistent with the evolving science. In contrast, ExxonMobil’s advertorials overwhelmingly focus on the uncertainties, casting doubt on the growing scientific consensus (e.g. peer-reviewed publications versus advertorials:  $p = 4.1 \times 10^{-13}$ , FET).

The contrast between advertorials and other documents is particularly evident in their accompanying figures. For instance, in a chapter of a 1985 US Department of Energy report co-authored by Exxon scientist Brian Flannery [103], a graph (see <https://perma.cc/A5WN-LKLS>) presents the results of future warming modeled for different CO<sub>2</sub> scenarios. ‘The foregoing results, with all their caveats,’ the report summarizes, ‘can be construed as an approximate bracketing of the consensus of transient model predictions for the next century’s CO<sub>2</sub> greenhouse effect. In this restricted sense, they are consistent with the EPA’s estimate of a 2 °C warming from fossil fuel CO<sub>2</sub> and other greenhouse gases by the middle of the next century.’ Their conclusion is entitled ‘Consensus CO<sub>2</sub> Warming.’ Compare this with figures from ExxonMobil advertorials in 1997 and 2000 (see <https://perma.cc/39CC-JTES> and <https://perma.cc/74BL-KL8A>, respectively), which downplay the human contribution to AGW and emphasize natural variability instead [104, 105]. Featured in an advertorial entitled ‘Unsettled Science’ in the *NYT* and *The Wall Street Journal*, the latter figure was taken from an article in *Science*

by Lloyd Keigwin of the Woods Hole Oceanographic Institution [105–107]. Keigwin called the use of his data ‘very misleading’ [106]. They were a historical reconstruction of sea-surface temperatures in the Sargasso Sea and, in his words, ‘not representative of the planet as a whole [as the advertorial could be taken to imply]. To jump from the western North Atlantic Ocean to the globe is something no responsible scientist would do . . . There’s really no way those results bear on the question of human-induced climate warming . . .’

The contrast across document categories is also clear when analyzed at a year-to-year scale (figure 1 (a)). The majority of advertorials promoting doubt follow a decade of numerous acknowledgments in the other three document categories. Between 1977 and 1996, of all peer-reviewed, non-peer-reviewed, and internal documents that take a position, 83% fully or partly (81% and 2%, respectively) acknowledge that AGW is real and human-caused (if we remove our filter for reasonable doubt, still 83% fully or partly (43% and 40%, respectively) acknowledge this). Thereafter, in 1997 alone, we see nine advertorials promoting ‘Doubt’. Significantly, throughout the late 1990s and early 2000s, ExxonMobil peer-reviewed publications and advertorials *in the same years* contradict one another (figure 1(a)).

## 3.2. Impact levels (ILs)—AGW as serious

Figure 1(b) is a timeline of the overall positions of all 187 documents on AGW as serious. For each category of document and for all documents that express a position, figure 2(b) shows the cumulative fraction of documents that take that position. Positions on AGW as serious vary significantly across document categories ( $p = 0.11$ , FET).

### 3.2.1. Peer-reviewed publications

ExxonMobil’s 72 peer-reviewed publications focus almost exclusively on methods and mitigation (section S3, supplementary information). Only 10 discuss the potential impacts of AGW (figure 1(b)), of which 60% (6/10) take a position of ‘Acknowledge’, 30% (3/10) of ‘Doubt’, and 10% (1/10) of ‘Acknowledge and Doubt’ (figure 2(b)). Hoffert *et al* (2002), for example (see table 4), warned that unchecked greenhouse gas emissions ‘could eventually produce global warming comparable in magnitude but opposite in sign to the global cooling of the last Ice Age . . . Atmospheric CO<sub>2</sub> stabilization targets as low as 450 ppm could be needed to forestall coral reef bleaching, thermohaline circulation shutdown, and sea level rise from disintegration of the West Antarctic Ice Sheet’ [108]. A 1994 paper defined ‘mean global warming of 2 °C from preindustrial time to 2100 as *Illustrative Reference Values* for climate and ecosystem protection,’ two years before the EU adopted this limit [109, 110].

**Table 4.** Example quotations (coding units) expressing (left) acknowledgment and (right) doubt that AGW is serious. For each document category, two examples are given: the first typifies a relatively ‘strong’ quotation, the second a relatively ‘mild’ one. Substantiating quotations for all documents are provided in section S7, supplementary information.

	Acknowledge AGW is serious (IP1)	Doubt AGW is serious (IP3)
INTERNAL	<p><b>1982</b> [83] ‘. . . there are some potentially catastrophic events that must be considered. For example, if the Antarctic ice sheet[,] which is anchored on land should melt, then this could cause a rise in sea level on the order of 5 meters. Such a rise would cause flooding on much of the US East Coast, including the State of Florida and Washington, DC.’</p> <p><b>1982</b> [99] ‘There is unanimous agreement in the scientific community that a temperature increase of this magnitude [(3.0 ± 1.5)°C] would bring about significant changes in the earth’s climate, including rainfall distribution and alterations in the biosphere.’</p>	<p><b>1981</b> [111] ‘. . . it has not yet been proven that the increases in atmospheric CO<sub>2</sub> constitute a serious problem that requires immediate action.’</p> <p><b>1989</b> [113] ‘We also know that the modeled projections are far from certain: potential impacts could be small and manageable or they could be profound and irreversible.’</p>
PEER-REVIEWED	<p><b>2002</b> [108] ‘Atmospheric CO<sub>2</sub> has increased from ~275 to ~370 parts per million (ppm). Unchecked, it will pass 550 ppm this century. Climate models and paleoclimate data indicate that 550 ppm, if sustained, could eventually produce global warming comparable in magnitude but opposite in sign to the global cooling of the last Ice Age . . . Atmospheric CO<sub>2</sub> stabilization targets as low as 450 ppm could be needed to forestall coral reef bleaching, thermohaline circulation shutdown, and sea level rise from disintegration of the West Antarctic Ice Sheet.’</p> <p><b>1994</b> [109] ‘The rate of the climate change is thought to exert stress on ecosystems. While changes in, for example, precipitation or infrequent events such as droughts or storms may be more directly related to this stress, there remains great uncertainty in estimating these characteristics of climate.’</p>	<p><b>2000</b> [114] ‘. . . science cannot yet provide reliable guidance on what, if any, levels of greenhouse gas concentrations might be judged “dangerous,” . . .’</p> <p><b>1995</b> [86] ‘Among the options that might become necessary to deploy at some time in the future, should climate change prove to be serious, are those that involve geoengineering techniques to control greenhouse gas concentrations or to limit potential impacts.’</p>
NON-PEER-REVIEWED	<p><b>1984</b> [115] ‘Clearly, there is vast opportunity for [global] conflict. For example, it is more than a little disconcerting the few maps showing the likely effects of global warming seem to reveal the two superpowers losing much of the rainfall, with the rest of the world seemingly benefitting.’</p> <p><b>1980</b> [117] ‘Findings. 1. While CO<sub>2</sub>-induced changes in global climate may have certain beneficial effects, it is believed that the net consequences of these changes will be adverse to the stability of human and natural communities.’</p>	<p><b>1996</b> [116] ‘Is global warming good or bad? Let’s say human activity <i>does</i> contribute to warming the planet . . . warming that occurs mostly during the winter would reduce extreme cold, increase cloud cover and moderate temperature fluctuations. This sort of warming is more likely to raise soil moisture levels than to produce severe droughts . . . [T]he indications are that a warmer world would be far more benign than many imagine . . . [M]oderate warming would reduce mortality rates in the US, so a slightly warmer climate would be more healthful . . . We are faced with more questions than answers on almost every aspect of this issue, including whether possible changes could be both good and bad.’</p> <p><b>1998</b> [118] ‘Fortunately, all indications are that climate change is a very long-term phenomenon . . . Do we need an insurance policy? Some people argue that the world needs to take out an insurance policy against the possibility of global warming just in case . . . Because of the scientific uncertainties, we don’t have a clear understanding of the risks involved. The Kyoto agreement makes the cost of the policy high. No one can tell us with certainty what benefit we will gain. Thus, it doesn’t seem to be a good time to buy the policy.’</p>
ADVERTORIALS	<p><b>2002</b> [119] ‘The risk of climate change and its potential impacts on society and the ecosystem are widely recognized. Doing nothing is neither prudent nor responsible.’</p> <p><b>2004</b> [120] ‘. . . research has highlighted the risks to society and ecosystems resulting from the buildup of greenhouse gases.’</p>	<p><b>1995</b> [112] Title: ‘The sky is not falling.’ By-line: ‘The environment . . . better than you think.’</p> <p><b>2000</b> [121] ‘Good news: The end of the Earth as we know it is not imminent . . . [M]ore than 30 years have passed since the environmental movement began. They made their point. There is no longer a need for alarmists . . . [T]o those who think industry and nature cannot coexist, we say show a little respect for Mother Nature. She is one strong lady, resilient and capable of rejuvenation. The environment recovers well from both natural and man-made disasters . . . Does this justify or lessen the impact of industrial pollution? Of course not. Our point is that nature, over the millennia, has learned to cope. Mother Nature is pretty successful in taking on human nature.’</p>

### 3.2.2. Non-peer-reviewed publications

Non-peer-reviewed documents offer a mix of positions (figures 1(b) and 2(b)). Among the 47% (22/47) that take a position, 45% (10/22) ‘Acknowledge’, 41% (9/22) ‘Doubt’, and 14% (3/22) ‘Acknowledge and Doubt’. As with Endorsement Levels, several of the expressions of doubt in non-peer-reviewed documents reflect the industry-targeted communications included in this category (see sections S2, S3, and S6, supplementary information).

### 3.2.3. Internal documents

Internal documents typically acknowledge the potential for serious impacts but also highlight uncertainties. Of the 53% (17/32) of documents with a position, 35% (6/17) ‘Acknowledge’ and 47% (8/17) ‘Acknowledge and Doubt’ (figure 2(b)). A characteristic acknowledgement is found in a 1980 Exxon memo, which says, ‘There are some particularly dramatic questions that might cause serious global problems. For example, if the Antarctic ice sheet[,] which is anchored on land, should melt, then this could cause a rise in the sea level on the order of 5 meters. Such a rise would cause flooding in much of the US East Coast including the state of Florida and Washington D.C.’ [98] (see also [83]). An example of doubt is a 1981 report stating ‘that it has not yet been proven that the increases in atmospheric CO<sub>2</sub> constitute a serious problem that requires immediate action’ [111] (table 4).

### 3.2.4. Advertorials

In contrast, ExxonMobil advertorials overwhelmingly take the position of doubt (e.g. peer-reviewed publications versus advertorials:  $p = 0.045$ , FET). Of the 58% (21/36) of advertorials that take a position, 62% (13/21) express ‘Doubt’ (figure 2(b)). Most of the remainder express a mixed position (5/21 = 24%). Often, they express the opinion that concern over climate impacts is alarmist, such as a 1995 advertorial entitled ‘The sky is not falling,’ which asserted, ‘The environment recovers well from both natural and man-made disasters’ [112] (table 4).

## 3.3. Solvable Levels (SLs)—AGW as solvable

Positions on AGW as solvable vary significantly across document categories ( $p = 3.4 \times 10^{-12}$ , FET). Figure 2(c) shows that only 3% (2/72) of peer-reviewed papers express doubt that AGW is solvable. Internal and non-peer reviewed materials also express relatively low levels of doubt: 9% (3/32) and 19% (9/47), respectively. In contrast, 64% (23/36) of advertorials do so (e.g. peer-reviewed publications versus advertorials:  $p = 2.8 \times 10^{-12}$ , FET).

The ‘Doubt’ arguments are relatively consistent across document categories (table 5), typically suggesting that climate mitigation strategies will either fail or create bigger problems. The arguments point to one or more of: limitations of renewable energy and

other technologies such as carbon capture and storage; an (alleged) dichotomy between climate mitigation and poverty reduction; and potential adverse economic impacts of mitigation. However, there is a discernible difference in the prominence and emphasis that these concerns are given in advertorials compared to other documents. In particular, in advertorials, the remedies for AGW are presented as a grave threat, whereas climate change itself is not. For example, advertorials claimed that the Kyoto Protocol to the United Nations Framework Convention on Climate Change would be ‘financially crippling’ and ‘economy-wrecking’ [122, 123]. It, or strategies like it, would lead to ‘severe dislocations throughout the world economy,’ an ‘unprecedented transfer of wealth,’ and be a ‘blow to US prosperity’ [124–126]. One 1997 advertorial warns: ‘Flexibility will be constrained. Carpooling in; sport utility vehicles out. High fuel and electric bills. Factory closures. Job displacement. And could businesses and consumers cut their energy consumption by 30 percent without some form of tax or carbon rationing? Probably not’ [92]. A 2000 advertorial contrasts the unpredictability of AGW against the asserted ‘certainty that climate change policies, unless properly formulated, will restrict life itself’ [121] (table 5).

## 3.4. Stranded fossil fuel assets

The number of times the concept of stranded fossil fuel assets is mentioned varies significantly across document categories ( $p = 0.0042$ , FET). In total, 24 of the analyzed documents allude to the concept of stranded fossil fuel assets: seven peer-reviewed publications, ten non-peer-reviewed publications, and seven internal documents. No advertorials address the issue.

Stranded assets are discussed in two ways (see table 6 and section S5, supplementary information): (i) Implicit, qualitative connections between fossil fuel reserves/resources/use and either greenhouse gas limits or possible climate mitigation policies; and (ii) explicit quantifications of ‘cumulative emissions’ and/or ‘carbon budgets’ consistent with greenhouse gas stabilization.

### 3.4.1. Qualitative connections

These discussions imply limitations on fossil fuel use because of greenhouse gas limits or climate mitigation. ‘Mitigation of the “greenhouse effect,”’ says the 1982 internal Exxon primer, ‘would require major reductions in fossil fuel combustion’ [83]. Likewise, an internal 1979 Exxon study found that ‘should it be deemed necessary to maintain atmospheric CO<sub>2</sub> levels to prevent significant climatic changes . . . coal and possibly other fossil fuel resources could not be utilized to an appreciable extent’ [82].

### 3.4.2. Quantitative carbon budgets

These discussions introduce, with varying degrees of detail, ideas of ‘cumulative fossil fuel use,’ ‘cumulative

**Table 5.** Example quotations (coding units) expressing doubt that AGW is solvable. For each document category, two examples are given: the first typifies a relatively ‘strong’ quotation, the second a relatively ‘mild’ one. Substantiating quotations for all documents are provided in section S7, supplementary information.

Doubt AGW is solvable (SP1)		
INTERNAL	1989 [131]	‘Some key perceptions/misconceptions . . . Nuclear and/or renewable energy resources can solve the problem.’
	1982 [83]	‘Making significant changes in energy consumption patterns now to deal with this potential problem amid all the scientific uncertainties would be premature in view of the severe impact such moves could have on the world’s economies and societies.’
PEER-REVIEWED	2002 [108]	‘Even as evidence for global warming accumulates, the dependence of civilization on the oxidation of coal, oil, and gas for energy makes an appropriate response difficult.’
	2001 [132]	‘Even for the higher stabilization levels considered, the developing world would not be able to use fossil fuels for their development in the manner that the developed world has used them.’
NON-PEER-REVIEWED	1998 [118]	‘To get to the [Kyoto] target, we would have to stop all driving in the US or close all electric power plants or shut down every industry. Obviously, these are not realistic options . . . meeting the Kyoto target would clearly have a huge economic impact.’ ‘Independent economists project that to get the targeted reductions in fossil-fuel use, price increases like these would be required: 40 percent for gasoline, 50 percent for home heating oil, 25 percent for electricity and 50 percent for natural gas. These and other price hikes could cost the average American family of four about \$2,700 a year. At least some developed countries would probably have to impose significantly higher fossil fuel taxes, rationing or both.’
	2005 [133]	‘[E]missions will continue to grow to meet the demands of society for prosperity and to meet basic needs . . . Countries like India, China and Indonesia are going to rely on domestic coal to meet growing needs . . . and their emissions are going to grow rapidly . . . [F]ossil fuels will remain the dominant source of energy supply over this period and beyond. Even with rapid year-to-year growth, intermittent renewable energy from wind and solar will remain a small contributor to global energy needs.’
ADVERTORIALS	1997 [92]	‘What is not moderate is the call [by the US government and other countries in the run up to UN Kyoto negotiations] to lower emissions to 1990 levels. A cutback of that size would inflict considerable economic pain . . . Committing to binding targets and timetables now will alter today’s lifestyles and tomorrow’s living standards. Flexibility will be constrained. Carpooling in; sport utility vehicles out. High fuel and electric bills. Factory closures. Job displacement. And could businesses and consumers cut their energy consumption by 30 percent without some form of tax or carbon rationing? Probably not.’
	2002 [134]	‘On an overall basis, many of today’s suggested alternative energy approaches are not as energy efficient, environmentally beneficial or economic as competing fossil fuels. They are often sustained only through special advantages and government subsidies. This is not a desirable basis for public policy or the provision of energy.’

CO<sub>2</sub> emissions,’ and ‘carbon budgets . . . for CO<sub>2</sub> stabilization’ and/or climate mitigation [81, 127]. Five of these ExxonMobil studies—one internal, three peer-reviewed, and one non-peer-reviewed—include data (see, for example, <https://perma.cc/EJ5A-EAZ7>) that indicate 2015–2100 CO<sub>2</sub> budgets consistent with limiting warming to 2°C and/or stabilizing CO<sub>2</sub> concentrations below 550 ppm in the range of 251–716 GtC [81, 83, 127–129]. These budgets are within a factor of two of contemporary estimates of roughly 442–651 GtC [130] (see caption, table 6).

#### 4. Discussion

The question we have addressed in this study is not whether ExxonMobil ‘suppressed’ climate change research, ‘withheld’ it, or ‘sought to hide’ it, which is how ExxonMobil has glossed the allegations against it [11, 12, 135]. This is also how the allegations have occasionally been presented in the press [136]. Our assessment of ExxonMobil’s peer-reviewed publica-

tions and the role of its scientists supports the conclusion that the company did not ‘suppress’ climate science—indeed, it contributed to it.

However, on the question of whether ExxonMobil misled non-scientific audiences about climate science, our analysis supports the conclusion that it did. This conclusion is based on three factors: discrepancies in AGW communications between document categories; imbalance in impact of different document categories; and factual misrepresentations in some advertorials.

First, we have shown that there is a discrepancy between what different document categories say, and particularly what they emphasize, about AGW as real, human-caused, serious, and solvable. This discrepancy grows with the public accessibility of documents, and is greatest between advertorials and the other documents.

Second, in public, ExxonMobil contributed quietly to the science and loudly to raising doubts about it. ExxonMobil’s peer-reviewed and non-peer-reviewed publications have been cited an average (median (mean)) of 21(60) and 2(9) times, respectively,

**Table 6.** Example quotations (coding units) alluding to stranded fossil fuel assets. For each document category except advertorials, which do not discuss stranded assets, two examples are given: the first typifies an implicit, qualitative connection between fossil fuel reserves/resources/use and either greenhouse gas limits or possible climate mitigation policies; the second is characteristic of an explicit quantification of ‘cumulative emissions’ and/or ‘carbon budgets’ consistent with greenhouse gas stabilization. These quantitative examples are comparable to contemporary estimates; specifically, the IPCC indicates a carbon budget of 442 GtC (or 651 GtC) between 2015 and 2100 for limiting CO<sub>2</sub>-induced AGW to below 2 °C relative to 1861–1880 with a probability greater than 66% (or 50%) [130]. Quotations from all 24 documents that refer to stranded assets are provided in section S5, supplementary information.

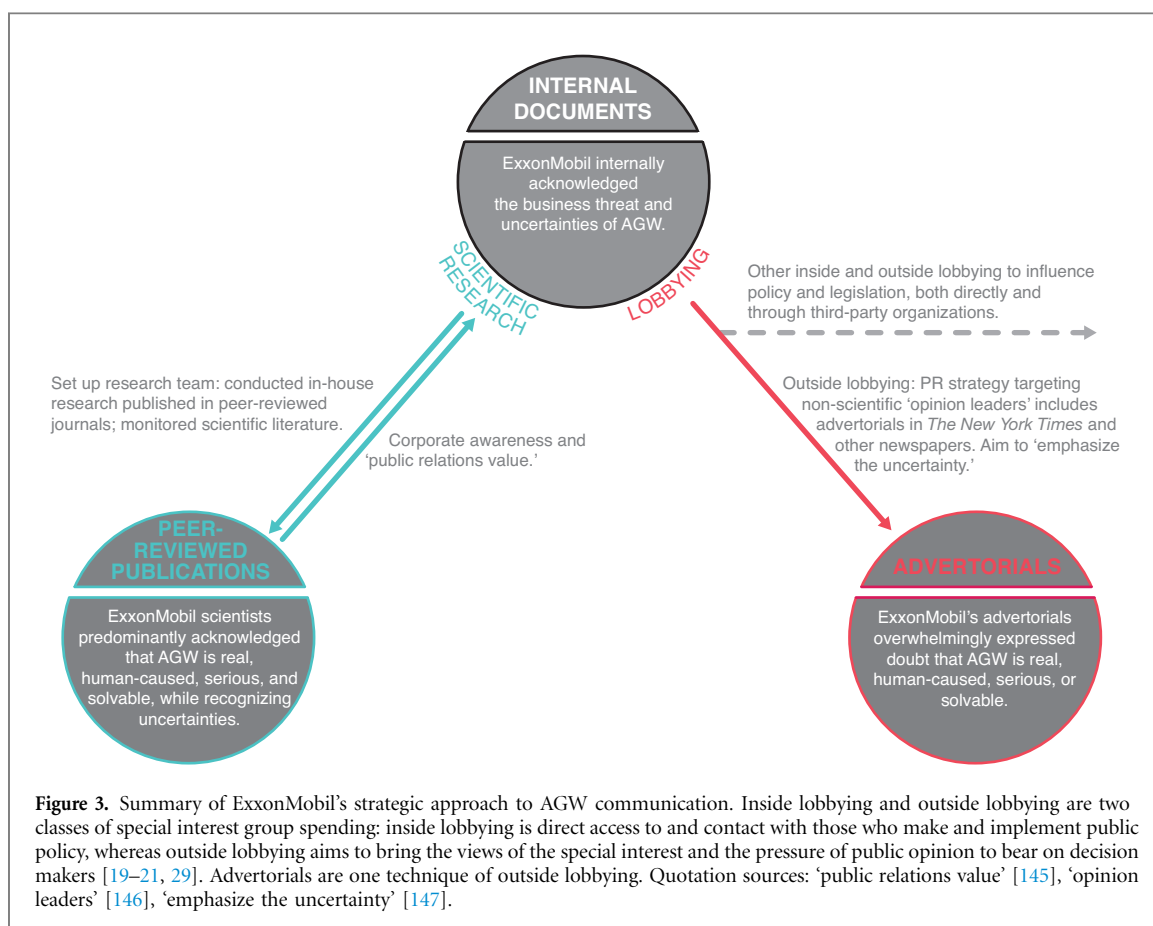
INTERNAL	1979 [82]	‘The major conclusion from this report is that, should it be deemed necessary to maintain atmospheric CO <sub>2</sub> levels to prevent significant climatic changes, dramatic changes in patterns of energy use would be required. World fossil fuel resources other than oil and gas could never be used to an appreciable extent . . . Removal of CO <sub>2</sub> from flue gases does not appear practical due to economics and lack of reasonable disposal methods. If it becomes necessary to limit future CO <sub>2</sub> emissions without practical removal/disposal methods, coal and possibly other fossil fuel resources could not be utilized to an appreciable extent.’
	1982 [83]	‘Table 4 presents the estimated total quantities of CO <sub>2</sub> emitted to the environment as GtC, the growth of CO <sub>2</sub> in the atmosphere in ppm (v), and average global temperature increase in °C over 1979 as the base year.’ (Note that temperature anomalies appear to be calculated based on equilibrium climate sensitivity.) It also shows ‘cumulative’ CO <sub>2</sub> ‘emitted, GtC’ as a function of time. Given roughly 0.3 °C warming by 1979 relative to 1861–1880, we read off (by interpolation) the cumulative emissions in table 4 (in [83]) corresponding to a further 1.7 °C warming, yielding a carbon budget for <2 °C of 624 GtC. Adjusting for emissions between 1979 and 2015, we obtain a carbon budget for <2 °C of 373 GtC between 2015 and 2100, which is comparable with contemporary estimates of roughly 442–651 GtC (see caption).
PEER-REVIEWED	1985 [103]	‘More complex scenarios . . . can be envisioned in which fossil fuel use is rapidly phased out by taxing or other policies, or in which fossil fuel use is decreased by societal feedbacks based on observations of global warming.’
	2003 [81]	Figure 9 (in [81]) shows that temperature anomalies of less than or equal to 2 °C (note that these appear to be calculated based on equilibrium climate sensitivity) are consistent with CO <sub>2</sub> stabilization at concentrations of 450 ppm or 550 ppm. Table 3 (in [81]) explicitly quantifies fossil fuel ‘carbon budgets . . . for CO <sub>2</sub> stabilization’ at these concentrations, with reference values of 485 GtC (450 ppm scenario) and 820 GtC (550 ppm scenario) between 2000 and 2099. Adjusting for emissions between 2000 and 2015, this yields carbon budgets for <2 °C of 357 GtC and 692 GtC, respectively, between 2015 and 2100, which are comparable with contemporary estimates of roughly 442–651 GtC (see caption).
NON-PEER-REVIEWED	2005 [133]	‘Without obligations by developing countries, stabilizing at 550 ppm would require a phase out in the use of fossil fuels by the middle of the century in the annex 1 countries. That’s a huge step.’
	2003 [129]	Author introduces the idea of ‘cumulative fossil fuel use’ and ‘cumulative CO <sub>2</sub> emissions.’ Figure 3 (in [129]) shows that a ‘550 ppm stabilization trajectory’ requires a rapid decline in annual CO <sub>2</sub> emissions, with cumulative emissions between 2015 and 2100 (integrating area beneath curve) of roughly 490 GtC. This is comparable to contemporary carbon budget estimates for <2 °C of roughly 442–651 GtC (see caption). Author also notes that ‘cumulative fossil fuel use of 2000 GtC might not exhaust global fossil fuel reserves, but limits to fossil fuel use might be driven by better alternatives that emerge over the next century.’ He refers to ‘notional scenarios for a fossil fuel era of limited duration.’

suggesting an average readership of tens to hundreds<sup>3</sup>. Most texts are highly technical, intellectually inaccessible for laypersons, and of little interest to the general public or policymakers. Most scientific journals and conference proceedings are only circulated to academic libraries and require a paid subscription, making them physically inaccessible for the general public, too. Obtaining academic documents for this study, for example, required access to libraries at Harvard University and Massachusetts Institute of Technology and international interlibrary loans. By contrast, Mobil/ExxonMobil bought AGW advertorials in the *NYT* specifically to allow ‘the public to know where we stand’ [137]. Readerships were in the millions [29]. The company took out an advertorial

every Thursday between 1972 and 2001 [29]. They paid a discounted price of roughly \$31 000 (2016 USD) per advertorial and bought one-quarter of all advertorials on the Op-Ed page, ‘towering over the other sponsors’ according to reviews of Mobil’s advertorials by Brown, Waltzer, and Waltzer [19, 29]. ‘After [experimentally] examining the effects of an actual ExxonMobil advertorial that appeared on the pages of *The New York Times*,’ Cooper and Nownes observed ‘that advertorials substantially affect levels of individual issue salience . . .’ [20]

Third, ExxonMobil’s advertorials included several instances of explicit factual misrepresentation. As discussed in section 3.1.5, an ExxonMobil advertorial in 2000 directly contradicted the IPCC and presented ‘very misleading’ data, according to the scientist who produced the data [105, 106]. Another advertorial, in 1996, claimed that ‘greenhouse-gas emissions, which have a warming effect, are offset by another

<sup>3</sup> Citation counts were sourced predominantly from Google Scholar and, when occasionally not available there, from Web of Science. IPCC reports and a handful of non-applicable documents, such as drafts, were excluded.



combustion product–particulates—which leads to cooling' [138]. In 1985, ExxonMobil scientists had reported being 'not very convinc[ed]' by the argument that 'aerosol particulates . . . compensat[e] for, and may even overwhelm, the fossil-fuel CO<sub>2</sub> greenhouse warming' [103]. By 1995, the IPCC had rejected it [71].

We acknowledge that textual analysis is inherently subjective: words have meaning in context. Particular coding assignments may therefore be debatable, depending on how the meaning and context of individual quotations and figures are interpreted. However, the intercoder reliability and agreement of our content analyses are consistently high (section S1.7, supplementary information). While one might disagree about the interpretation of specific words, the overall trends between document categories are clear (table S3, supplementary information).

In figure 3, we summarize ExxonMobil's strategic approach to AGW research and communication. Internal documents show that by the early 1980s, ExxonMobil scientists and managers were sufficiently informed about climate science and its prevailing uncertainties to identify AGW as a potential threat to its business interests. This awareness apparently came from a combination of prior research and expert advice. For example, in 1979 and 1980, university researcher Andrew Callegari co-authored two peer-reviewed articles acknowledging that 'the climatic implications of fossil fuel carbon dioxide emissions have been recognized for some time' [139, 140]. The

authors articulated the 'climatically huge' temperature increases and ecological impacts that would result 'if a significant fraction of the fossil fuel reserve is burned' (section S5, supplementary information). In 1980, Callegari joined Exxon, and the next year took over its CO<sub>2</sub> research efforts [141]. His papers were frequently cited in company publications [97, 142–144].

Around this time, ExxonMobil set up two parallel initiatives: climate science research, and a complementary public relations campaign (left and right branches of figure 3). According to a 1978 'Request for a credible scientific team,' these initiatives targeted four audiences: the scientific community, government, Exxon management, and the general public and policymakers [145].

#### 4.1. Scientific community

From approximately 1979 to 1982, the Exxon Research and Engineering (ER&E) Company pursued three major AGW research projects. ExxonMobil's 2015 statement that two of the projects 'had nothing to do with CO<sub>2</sub> emissions' [148] is contradicted by internal documents [111, 149, 150]. In the early 1980s, these major research initiatives were discontinued amidst budget cuts [111, 151]. In 1984, ER&E characterized its approaches: 'Establish a scientific presence through research program in climate modeling; selective support of outside activities; maintain awareness of new scientific developments' [152]. In 1986, scientist Haroon Khesghi joined ER&E [153], and was

henceforth ExxonMobil's principal (and only consistent) academic author, co-authoring 72% (52/72) of all analyzed peer-reviewed work (79% since his hiring). Indeed, the metadata title of the 'Exxon Mobil Contributed Publications' file is 'Haroon's CV' [15].

#### 4.2. Government

As a 1980 'CO<sub>2</sub> Greenhouse Communications Plan' explained, 'The research is . . . significant to Exxon since future public decisions aimed at controlling the buildup of atmospheric CO<sub>2</sub> could impose limits on fossil fuel combustion' [146]. The scientific research, a 1982 letter described, helped 'to provide Exxon with the credentials required to speak with authority in this area' [99]. ExxonMobil appealed to its research credentials in communications with government officials [84].

#### 4.3. Exxon management

A 1981 'Review of Exxon climate research' observes that 'projects underway and planned on CO<sub>2</sub> . . . are providing an opportunity for us to develop a detailed understanding of the total Federal atmospheric CO<sub>2</sub> program which the Corporation needs for its own planning . . .' [111].

#### 4.4. Public and policymakers

The company's climate science research offered 'great public relations value,' observed a 1978 memo [145]. In 1980, with input from outside public relations counsel, Exxon developed a 'CO<sub>2</sub> Greenhouse Communications Plan,' including advertorials, to target 'opinion leaders who are not scientists' [146, 147]. By 1988–9, this plan explicitly aimed to 'extend the science' and 'emphasize the uncertainty in scientific conclusions regarding the potential enhanced Greenhouse effect' [131, 147]. That year, 1989, they ran their first AGW advertorial. ExxonMobil's interest in influencing the non-scientific public and policymakers helps explain our key observation: the discrepancy between internal and academic documents versus advertorials concerning AGW as real, human-caused, serious, and solvable.

### 5. Conclusion

Available documents show a discrepancy between what ExxonMobil's scientists and executives discussed about climate change privately and in academic circles and what it presented to the general public. The company's peer-reviewed, non-peer-reviewed, and internal communications consistently tracked evolving climate science: broadly acknowledging that AGW is real, human-caused, serious, and solvable, while identifying reasonable uncertainties that most climate scientists readily acknowledged at that time. In contrast, ExxonMobil's advertorials in the NYT

overwhelmingly emphasized only the uncertainties, promoting a narrative inconsistent with the views of most climate scientists, including ExxonMobil's own. This is characteristic of what Freudenberg *et al* term the *Scientific Certainty Argumentation Method* (SCAM)—a tactic for undermining public understanding of scientific knowledge [57, 58]. Likewise, the company's peer-reviewed, non-peer-reviewed, and internal documents acknowledge the risks of stranded assets, whereas their advertorials do not. In light of these findings, we judge that ExxonMobil's AGW communications were misleading; we are not in a position to judge whether they violated any laws.

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# EXHIBIT 43

## RESEARCH ARTICLE

# The Scientific Consensus on Climate Change as a Gateway Belief: Experimental Evidence

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## Abstract

There is currently widespread public misunderstanding about the degree of scientific consensus on human-caused climate change, both in the US as well as internationally. Moreover, previous research has identified important associations between public perceptions of the scientific consensus, belief in climate change and support for climate policy. This paper extends this line of research by advancing and providing experimental evidence for a “gateway belief model” (GBM). Using national data (N = 1104) from a consensus-message experiment, we find that increasing public perceptions of the scientific consensus is significantly and causally associated with an increase in the belief that climate change is happening, human-caused and a worrisome threat. In turn, changes in these key beliefs are predictive of increased support for public action. In short, we find that perceived scientific agreement is an important gateway belief, ultimately influencing public responses to climate change.

## OPEN ACCESS

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## INTRODUCTION

The scientific consensus that human activities are the primary driver of global climate change is now unequivocal. This consensus is found not only in the latest Intergovernmental Panel on Climate Change (IPCC) report [1], but also by several different studies, including surveys of experts [2] and comprehensive reviews of the peer-reviewed literature on climate change [3] [4] [5]. All of these methods converge on the same basic conclusion: at least 97% of climate scientists have concluded that human-caused climate change is happening [6].

Yet, although a scientific consensus on this basic fact has been reached, much of the public remains largely unaware of this, both in the US as well as internationally [7, 8]. For example, only one in ten Americans (12%) correctly estimate scientific agreement at 90% or higher [7]. Moreover, influential ideological and politically-motivated actors, also known as “manufacturers of doubt”, publicly dispute the existence of the scientific consensus [9, 10], including recent media articles such as the “Myth of the Climate Change 97%” [11]. These efforts to undermine public understanding of the scientific consensus have arguably been quite successful, with cascading

effects on public understanding that climate change is happening, human caused, a serious threat, and in turn, support for climate change mitigation and adaptation policies.

In light of the growing ideological divide on the issue [12] (paired with people's tendency to selectively process information), some scholars have argued that merely educating the public about the scientific consensus is unlikely to be a helpful approach [13, 14]. To better understand how people think, process and respond to the scientific consensus message, this study investigates a "gateway belief model" (GBM) of public responses to climate change.

## The Gateway Belief Model (GBM)

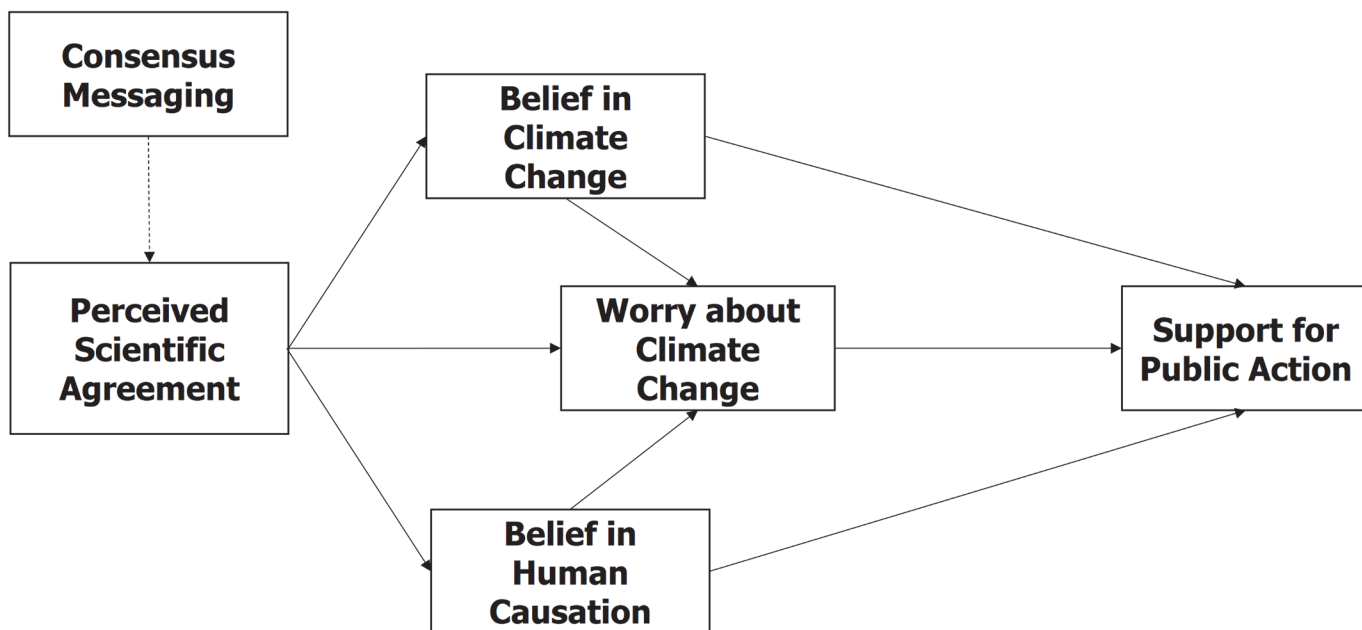
Perceived expert consensus plays an important role in the formation of public attitudes towards and the acceptance of general scientific principles, including climate change [15, 16]. In fact, misperceptions of the scientific consensus can be highly consequential, as even a small amount of perceived scientific dissent can undermine public support [17]. For example, a recent nationally representative study [18] found that the degree of perceived scientific agreement influences key beliefs about global warming, which in turn, drive public support for climate change policies. McCright, Dunlap & Xiao [19] successfully replicated these results in a recent independent study and similarly point to the robust role of perceived scientific agreement in generating public support for climate change policies.

Yet, past research in this area suffers from one major short-coming: the bulk of these findings are based on cross-sectional survey data and thus correlational in nature. To date, there have been no controlled representative experiments (or longitudinal studies) investigating the proposed causal relationship between public perceptions of the scientific consensus on climate change and support for public action. This study builds upon and extends prior research in a novel direction by directly testing the "gateway belief" model experimentally. We posit that belief or disbelief in the scientific consensus on human-caused climate change plays an important role in the formation of public opinion on the issue. This is consistent with prior research, which has found that highlighting scientific consensus increases belief in human-caused climate change [15]. More specifically, we posit perceived scientific agreement as a "gateway belief" that either supports or undermines other key beliefs about climate change, which in turn, influence support for public action. A schematic overview of the "gateway belief model" is presented in Fig. 1. Specifically, we hypothesize that an experimentally induced *change* in the level of perceived consensus is causally associated with a subsequent *change* in the belief that climate change is (a) happening, (b) human-caused, and (c) how much people worry about the issue (*H1*). In turn, a change in these key beliefs is subsequently expected to lead to a *change* in respondents' support for societal action on climate change (*H2*). Thus, while the model predicts that the perceived level of scientific agreement acts as a key psychological motivator, its effect on support for action is assumed to be fully mediated by key beliefs about climate change (*H3*).

## Method

### Sample and Participants

This analysis draws upon results from a recent experiment that investigated how to effectively communicate the scientific consensus on climate change (full details of the experiment, sample and materials are available and described in van der Linden et al. [20]). The purpose of the experiment was to test the efficacy of different ways to communicate the consensus-message (e.g., descriptive text, a pie chart, metaphors etc.). In total, 11 different treatment conditions were administered. The experiment was conducted using an online national quota sample (N = 1104) obtained from a major vendor (Survey Sampling International). The study was approved by the



**Fig 1. The Gateway Belief Model (GBM).**

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Yale Institutional Review Boards for ethical research (Human Research Protection Program) and participants signed a consent form with the sampling company (SSI) through which they chose to participate. A descriptive overview of the sample characteristics is provided in [Table 1](#).

**Table 1. Overview of sample characteristics and key belief measures.**

Sample	(N = 1,104)		
<b>Demographic characteristics</b>			
Gender (female %)	52		
Age (modal bracket, 18, 75+)	35–44		
Education (bachelor's degree or higher %)	36		
Party Affiliation (% Democrat)	38		
<b>Key climate change beliefs (0–100)</b>	<b>Pre-Test Mean</b>	<b>Post-Test Mean</b>	<b>Difference (S.E.)</b>
Estimate of Scientific Consensus	66.98	79.72	12.74 (0.71)
Belief in Climate Change	73.08	77.01	3.93 (0.55)
Human Causation	63.98	68.02	4.04 (0.47)
Worry about Climate Change	62.84	67.32	4.48 (0.39)
Support for Public Action	75.19	76.88	1.69(0.41)

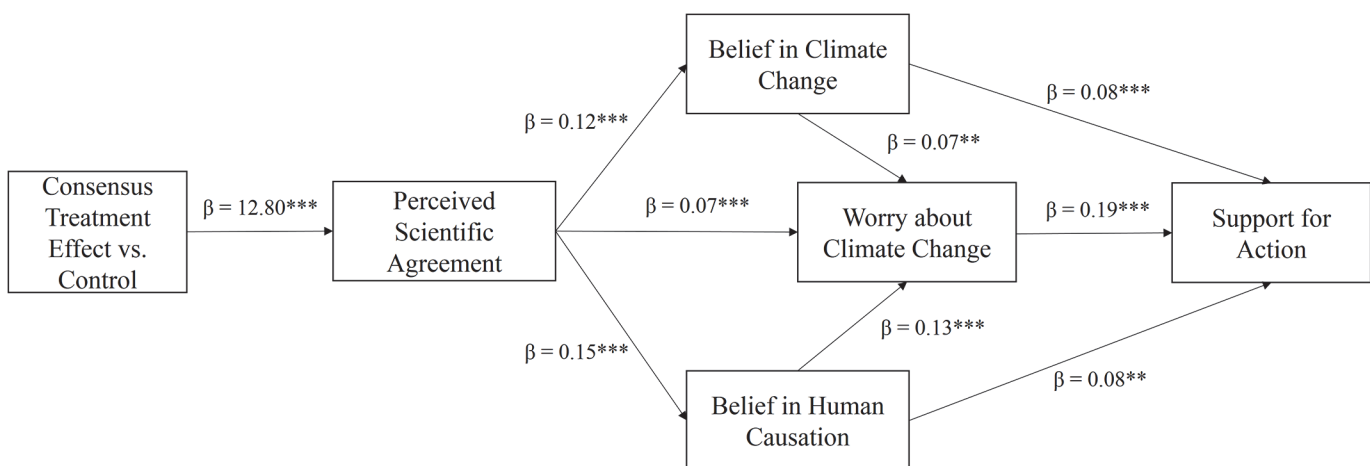
doi:10.1371/journal.pone.0118489.t001

## Procedure and Materials

Subjects were asked to provide an estimate (0%–100%) of the perceived level of scientific consensus on human-caused climate change at both the beginning (pre-test) and at the end of the survey (post-test). Respondents also answered a number of questions about whether they think climate change is happening, human-caused, how worried they are about climate change and whether they think people should be doing more or less about the issue. An overview of the key belief measures used in this study is also provided in [Table 1](#). All the consensus messages tested led to significant gains in public understanding of the scientific consensus compared to the control group. The current study, however, analyzes the data for an entirely different purpose. This study investigates whether the effect-size of the treatment messages (i.e., the *change* in respondents' estimates of the scientific consensus) is causally associated with a pre-post *change* in the belief that climate change is happening, human-caused and a worrisome problem that requires greater societal support. To test our hypotheses, all experimental consensus-message interventions were collapsed into a single “treatment” category and subsequently compared to the “control” group. The conceptual structure of the GBM ([Fig. 1](#)) is assessed using a structural equation modeling (SEM) approach.

## Results

The path (mediation) model was estimated using STATA's (StataCorp) SEM software. As recommended by Preacher and Hayes [21], significance of effects and model parameters was assessed using bias-corrected and accelerated bootstrap confidence intervals (the data were re-sampled 1,000 times). Furthermore, according to Little's MCAR test, part of the data (approx. 8% of the sample) was missing, but not completely at random. As a result, the model was estimated using a Full Information Maximum Likelihood (FIML) procedure [22] and adjusted for important covariates, including gender, education, age and political party. Using commonly



### Model Fit:

$\chi^2(6) = 27.38, p < 0.001$   
 $\chi^2 / df = 4.56$   
 RMSEA = 0.06  
 (90% CI: 0.04 – 0.08)  
 CFI = 0.92

\* $p < 0.05$ , \*\* $p < 0.01$ , \*\*\* $p < 0.001$ .  $N = 1104$ . Coefficients are unstandardized and adjusted for covariates; gender, age, education and political party.

**Fig 2. Visual depiction of the Gateway Belief Model (GBM) results.**

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accepted criteria for model evaluation [23], the fit of the overall model structure is considered acceptable;  $\chi^2(6) = 27.38, p < 0.01, \chi^2 / df = 4.56, CFI = 0.92, RMSEA = 0.06$  (90% CI: 0.04–0.08). On average, being in one of the treatment groups (vs. the control group) significantly increases respondents' estimate of the scientific consensus (by 12.80%). Moreover, a change in a respondent's estimate of the scientific consensus significantly influences the belief that climate change is happening, human-caused, and the extent to which they worry about the issue (note that belief in climate change and human causation also directly influence level of "worry"). Changes in these factors, in turn, significantly predict support for public action on climate change. As hypothesized, the effect of the treatment (i.e. increased belief in the scientific consensus) on the expressed need for public action is fully mediated by the intervening variables (i.e., key beliefs about climate change). Similarly, the effect of the treatment on the key-belief measures is fully mediated by perceived scientific agreement.

While the model "controls" for the effect of political party, we also explicitly tested an alternative model specification that included an interaction-effect between the consensus-treatments and political party identification. Because the interaction term did not significantly improve model fit (nor change the significance of the coefficients), it was not represented in the final model (to preserve parsimony). Yet, it is important to note that the interaction itself was positive and significant ( $\beta = 3.25, SE = 0.88, t = 3.68, p < 0.001$ ); suggesting that compared to Democrats, Republican subjects responded particularly well to the scientific consensus message. A visual depiction of the results is provided in Fig. 2 and a detailed overview of the effect sizes and model parameters is provided in Table 2.

**Table 2. SEM model parameters.**

Model path relationships	B	S.E.	95% C.I. <sub>bca</sub>
Treatment → PSA	12.8	2.13	8.60, 17.0
PSA → Belief in CC	0.12	0.03	0.06, 0.16
PSA → Belief in HC	0.15	0.02	0.11, 0.19
PSA → Worry	0.07	0.02	0.03, 0.10
Belief in CC → Worry	0.07	0.02	0.02, 0.11
Belief in HC → Worry	0.13	0.03	0.07, 0.19
Belief in CC → Public Action	0.08	0.02	0.04, 0.12
Belief in HC → Public Action	0.08	0.03	0.02, 0.14
Worry → Public Action	0.19	0.03	0.13, 0.25

*Note:* Numbers are rounded.  $N = 1104$ . Covariates; age, gender, education and political party. PSA = Perceived Scientific Agreement; CC = Climate Change; HC = Human Causation; B; unstandardized regression coefficient, SE: standard error, 95%CI<sub>bca</sub>: Bias-corrected and accelerated bootstrap confidence interval (based on 1,000 bootstrap samples).

doi:10.1371/journal.pone.0118489.t002

## Discussion

Previous research has suggested that perceptions of the scientific consensus play an important role in the formation of public beliefs and attitudes towards climate change and, moreover, that (mis)perceptions of the scientific consensus potentially decrease public support for climate change policies [15–19]. This study constructively builds upon and extends this research by providing direct experimental evidence for the “gateway belief model” (GBM). Using pre and post measures from a national message test experiment, we found that all stated hypotheses were confirmed; *increasing* public perceptions of the scientific consensus causes a significant increase in the belief that climate change is (a) happening, (b) human-caused and (c) a worrisome problem. In turn, changes in these key beliefs lead to increased support for public action. In sum, these findings provide the strongest evidence to date that public understanding of the scientific consensus is consequential.

It is important to note that the gateway belief model (GBM) describes a two-step cascading effect. First, the effect of consensus messaging on key beliefs about climate change is fully mediated by the perceived level of scientific agreement. Second, the effect of the induced increase in perceived scientific consensus is fully mediated onto support for public action via the key beliefs about climate change. In other words, belief in the scientific consensus functions as an initial “gateway” to changes in key beliefs about climate change, which in turn, influence support for public action. Thus, consistent with other recent research, this study found that when in doubt about scientific facts, people are likely to use consensus among domain experts as a heuristic to guide their beliefs and behavior [15].

These findings have important practical implications for science communication and stand in direct juxtaposition to the claim that “consensus-messaging” is not effective as a communication strategy [13, 14]. In particular, it is sometimes argued that (a) despite past public communication efforts, public understanding of the scientific consensus has not changed much in the last decade and hence the approach must not be very effective (i.e., “the stasis argument”) [13] and (b) because people are predisposed to engage in protective motivated reasoning (i.e., people process information consistent with their ideological worldviews), consensus-messaging is likely to be unsuccessful or could even backfire [12, 14].

The present study finds no support for these claims. On the contrary, results of this study show that perceived scientific consensus acts as a key gateway belief for both Democrats and Republicans. In fact, the consensus message had a larger influence on Republican respondents. It should be noted that this interaction might, to some extent, be attributable to a ceiling effect (i.e., there is relatively less upward adjustment potential in perceived scientific consensus for Democrats, although a significant gap in understanding persists even among Democrats). We do not dispute, however, that some people—especially those with strong ideological responses to the issue—selectively process information or engage in motivated reasoning [9, 14]. Yet, we find that consensus-messaging does not increase political polarization on the issue (perhaps partly due to the neutral scientific character of the message) and shifts the opinions of both Democrats and Republicans in directions consistent with the conclusions of climate science.

Furthermore, other recent research [24] has suggested that past campaigns have been unsuccessful (in both their reach and exposure), given that a substantial lack of awareness of the scientific consensus still persists (“information deficit”) while at the same time, the spread of misinformation has vastly increased (“misinformation surplus”). Because people often encounter multiple and conflicting informational cues, the criticism might be raised that as a controlled experiment, this study may overstate the actual effect that consensus messaging would have in the real-world. While we agree with this view and see this as an important and open area for future research, this shortcoming does not, however, negate the structural validity of

the GBM's causal mechanisms. It is also important to note that this study only used a single treatment, yet found that even a single, simple description of the scientific consensus significantly shifted public perceptions of the consensus and subsequent climate change beliefs and desire for action. A concerted campaign to inform the public about the scientific consensus would ideally involve numerous exposures to the key message, conveyed by a variety of trusted messengers [6, 20].

This is important because by strategically sowing seeds of doubt, organized opponents of climate change action have continually tried to undermine the validity of the scientific consensus argument [11]. As this research shows, such attempts could potentially decrease public engagement with climate change. Nonetheless, the present research also indicates the potential efficacy of consensus-messaging campaigns in mitigating such skepticism, as well as in generating support for public action on climate change. Particularly, repeated exposure to simple messages that correctly state the actual scientific consensus on human-caused climate change is a strategy likely to help counter the concerted efforts to misinform the public. Effectively communicating the scientific consensus can also help move the issue of climate change forward on the public policy agenda [6] [15] [20] [24–25].

## Supporting Information

**S1 File.**  
(PDF)

## Author Contributions

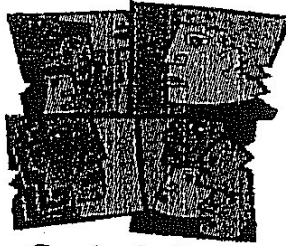
Conceived and designed the experiments: SLV AAL GDF EWM. Performed the experiments: SLV AAL GDF. Analyzed the data: SLV. Wrote the paper: SLV AAL GDF EWM.

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# EXHIBIT 44



**Creciendo Juntos**

**111 Monticello Avenue – Suite 104 – Charlottesville, VA 22902**

June 16, 2009

The Honorable Congressman Tom Perriello  
1520 Longworth HOB  
Washington, DC 20515

Dear Congressman Perriello:

My organization Creciendo Juntos, represents minorities in your district. Creciendo Juntos has worked on behalf of the Latino and Hispanic Community in Charlottesville since 2005.

You are about to vote on important environmental legislation (the Waxman-Markey bill). We support making the environment cleaner, but the reason we are writing is that we are concerned about our electric bills. Many of our members are on tight budgets and the sizes of their monthly utility bills are important expense items. The cost to heat and cool our homes, run hot water and use other appliances is very important to those on a budget.

Our state gets 56% of its electricity from coal. We urge you to pass legislation that reduces greenhouse gases but at the same time protects consumers from unaffordable increases in the basic necessity of electricity.

We ask you to use your important position to help protect minorities and other consumers in your district from higher electricity bills. Please don't vote to force cost increases on us, especially in this volatile economy. We urge you to make pro-consumer changes in the Waxman-Markey bill to protect minorities and all of your constituents from unaffordable energy cost increases.

Respectfully,

A handwritten signature in dark ink, appearing to read "Marisse K. Acevado". The signature is somewhat stylized and overlaps with the typed name below it.

Marisse K. Acevado, Asst Member Coordinator  
Creciendo Juntos



703 - C Concord Avenue - Charlottesville, VA 22902

June 12, 2009

1520 Longworth HOB  
Washington, DC 20515

Dear Congressman Perriello:

My organization, the NAACP- Charlottesville, represents minorities in your district. The NAACP has a long history of advocacy on behalf of all American citizens.

You are about to vote on important environmental legislation (the Waxman-Markey bill). We support making the environment cleaner, but the reason we are writing is that we are concerned about our electric bills. Many of our members are on tight budgets and the sizes of their monthly utility bills are important expense items. The cost to heat and cool our homes, run hot water and use other appliances is very important to those on a budget.

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Respectfully,

A handwritten signature in black ink, appearing to read "William Ernst".

William Ernst - Pro Temp  
NAACP - Charlottesville



709 - C Concord Avenue - Charlottesville, VA 22902

June 12, 2009

1520 Longworth HOB  
Washington, DC 20515

Dear Congressman Perriello:

My organization, the NAACP- Charlottesville, represents minorities in your district. The NAACP has a long history of advocacy on behalf of all American citizens.

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Respectfully,

Sheila Dowe  
NAACP - Charlottesville





703 - C Concord Avenue - Charlottesville, VA 22902

June 12, 2009

1520 Longworth H.C.B.  
Washington, DC 20515

Dear Congressman Ferriello:

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Respectfully,

T.J. Hudson  
NAACP - Charlottesville



705 - C Concord Avenue - Charlottesville, VA 22902

June 12, 2009

1520 Longworth HCB  
Washington, DC 20515

Dear Congressman Perriello:

My organization, the NAACP- Charlottesville, represents minorities in your district. The NAACP has a long history of advocacy on behalf of all American citizens.

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Respectfully,

A handwritten signature in cursive script that reads "Marilyn Williams".

Marilyn Williams  
NAACP -Charlottesville



703 - C Concord Avenue - Charlottesville, VA 22902

June 12, 2009

1520 Longworth HCB  
Washington, DC 20515

Dear Congressman Perriello:

My organization, the NAACP- Charlottesville, represents minorities in your district. The NAACP has a long history of advocacy on behalf of all American citizens.

You are about to vote on important environmental legislation (the Waxman-Markey bill). We support making the environment cleaner, but the reason we are writing is that we are concerned about our electric bills. Many of our members are on tight budgets and the sizes of their monthly utility bills are important expense items. The cost to heat and cool our homes, run hot water and use other appliances is very important to those on a budget.

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Respectfully,

Rebecka Shields  
NAACP - Charlottesville

# EXHIBIT 45



# CLIMATE TRUTH FILE 2016



Committee For A Constructive Tomorrow  
By Marc Morano

**The scientific reality is that on virtually every claim – from A to Z – the promoters of manmade climate fears are falling short or going in the opposite direction.**

- Global temperatures have been virtually flat for about 18 years according to satellite data, and peer-reviewed literature is now scaling back predictions of future warming.
- The U.S. has had no Category 3 or larger hurricane make landfall since 2005 – the longest spell since the Civil War.
- Strong F3 or larger tornadoes have been in decline since the 1970s.
- Despite claims of snow being 'a thing of the past,' cold season snowfall has been rising.
- Sea level rise rates have been steady for over a century, with recent deceleration.
- Droughts and floods are neither historically unusual nor caused by mankind, and there is no evidence we are currently having any unusual weather.
- So-called hottest year claims are based on year-to-year temperature data that differs by only a few HUNDREDTHS of a degree to tenths of a degree Fahrenheit – differences that are within the margin of error in the data. In other words, global temperatures have essentially held very steady with no sign of acceleration.
- A 2015 NASA study found Antarctica was NOT losing ice mass and 'not currently contributing to sea level rise.'
- 2016 Arctic sea ice was 22% greater than the recent low point of 2012. The Arctic sea ice is now in a 10-year 'pause' with 'no significant change in the past decade'
- 
- Deaths due to extreme weather have declined dramatically.
- Polar bears are doing fine, with their numbers way up since the 1960s.

**Have climate change skeptics lost the climate debate?**

No! Climate skepticism enjoys huge popularity in polling data, and every time a climate bill has come before the U.S. Congress it has failed to pass. There never was any real climate debate! One of the key reasons climate fear proponents don't want to debate is what happened during a pivotal high-profile debate in 2007 in New York City, where [skeptics were voted the clear winners against global warming proponents](#).

NASA's Gavin Schmidt appeared so demoralized at losing that debate that he announced debates equally split between believers in a climate 'crisis' and scientific skeptics are probably not "worthwhile" to ever agree to again. And climate change promoters listened, with debates becoming rarer and rarer.

In fact, instead of engaging in debates, prominent climate activists now call for jailing skeptics. [Robert F. Kennedy, Jr., declared he wanted to jail his climate skeptics. "They ought to be serving time for it," Kennedy said in 2014.](#) And [Bill Nye -- 'The Jail-The-Skeptics Guy!' -- entertained the idea of jailing climate skeptics for "affecting my quality of life" in 2016, while](#)

[U.S. Senators and top UN scientists called for RICO-style charges against skeptics.](#)

### **Will the UN Paris climate change agreement save the planet from 'global warming'?**

No! Even if you accept the UN's and Al Gore's version of climate change claims, the UN Paris agreement would not 'save' the planet. [Prominent scientists from MIT and Princeton have declared the basis for the UN agreement to be "irrational" and "based on nonsense."](#)

University of Pennsylvania Geologist Dr. Robert Giegengack noted in 2014, "None of the strategies that have been offered by the U.S. government or by the EPA or by anybody else has the remotest chance of altering climate if in fact climate is controlled by carbon dioxide."

In layman's terms: All of the so-called 'solutions' to global warming are purely symbolic when it comes to climate. So, even if we actually faced a climate catastrophe and we had to rely on a UN climate agreement, we would all be doomed!

### **Will the UN Paris agreement keep Earth's average temperature to within the 2-degree Celsius limit that climate activists have set as a goal?**

Even top UN scientists have mocked the notion that a 2-degree Celsius temperature limit is meaningful. Dr. Phil Jones revealed that the 2 deg C limit was "plucked out of thin air" with no scientific basis. "The 2 deg C limit is talked about by a lot within Europe. It is never defined though what it means. Is it 2 deg C for the globe or for Europe? Also when is/was the base against which the 2 deg C is calculated from? I know you don't know the answer, but I don't either! I think it is plucked out of thin air," Jones wrote in the leaked Climategate emails.

Princeton Physicist Dr. Will Happer rejects the whole notion of reducing emissions to control temperature. "Policies to slow CO<sub>2</sub> emissions are really based on nonsense. We are being led down a false path," Happer said in 2015.

### **Why would the UN and other organizations push manmade 'global warming' fears if the science is not there to support their claims? What possible reason could they have to hype science?**

The United Nations has publicly stated its goal is not to 'solve' climate change, but to seek to redistribute wealth and expand its authority through more central planning.

UN official Ottmar Edenhofer, co-chair of the IPCC Working Group III, admitted what's behind the climate issue: "One must say clearly that we redistribute *de facto* the world's wealth by climate policy ... One has to free oneself from the illusion that international climate policy is environmental policy. This has almost nothing to do with environmental policy anymore."

EU climate commissioner Connie Hedegaard revealed: *Global Warming Policy Is Right Even If Science Is Wrong*. Hedegaard said in 2013, "Let's say that science, some decades from now, said 'we were wrong, it was not about climate,' would it not in any case have been good to do many of things you have to do in order to combat climate change?"

The UN is seeking central planning. UN climate chief Christiana Figueres declared in 2012 that she is seeking a "centralized transformation" that is "going to make the life of everyone on the planet very different." She added: "This is a centralized transformation that is taking place because governments have decided that they need to listen to science."

The UN and EPA regulations are pure climate symbolism in exchange for a more centrally planned energy economy. The UN and EPA regulations are simply a vehicle to put politicians and bureaucrats in charge of our energy economy and 'save' us from bad weather and 'climate change.'

### **Is the UN IPCC the gold standard for science?**

It is fool's gold. The UN IPCC is a political organization masquerading as a scientific body. Many UN lead authors have now resigned from the IPCC or had their names removed due to the politicization of science to fit the climate change narrative. The former chief of the UN IPCC, Rajendra Pachauri, declared global warming "is my religion." The UN IPCC is a lobbying organization that seeks to enrich the UN by putting it in charge of 'solving' climate change.

### **Will stopping global warming help poor nations?**

Quite the opposite. Attempting to control weather and climate will have no impact on climate, but a huge impact on economic development of poor nations due to so-called 'solutions' of global warming that would limit development and ban many forms of life-saving carbon based energy.

### **Penn State Prof. Michael Mann has called the UN Paris agreement the "last chance" to battle global warming. Is it the last opportunity?**

The fact is that every UN Climate Summit is hailed as the "last chance" to stop 'global warming' before it's too late. Previous "last chance" deadlines turned out to be - well - not the "last chance," after all.

In 2001, and at almost every annual UN climate summit after that, every deadline has been heralded as the "last chance" to stop 'global warming.' It seems the earth is serially doomed. The UN issued environmental "Tipping Points" in 1982 and another 10-year climate "Tipping Point" in 1989. There have even been tipping points of Hours, Days, Months, Years, and even on Millennial time scales.

### **The 2015 UN Paris climate agreement was hailed as historic. Did it solve climate change?**

If climate activists at the UN and in the media actually believed the UN agreement 'solved' global warming, shouldn't that mean we never have to hear



about 'solving' global warming ever again? If it really 'solved' climate change, does this mean we can halt the endless supply of federal tax dollars funding 'climate change' studies? Does this mean we can stop worrying about the ability of 'global warming' to end civilization and cause wars, and increase [prostitution](#), [bar room brawls](#), [rape](#), [airline turbulence](#), etc.? If activists truly believed a UN treaty could 'solve' global warming, they would move on to a new issue.

### **Will EPA climate regulations impact the Earth's climate?**

NO! President Obama's own [EPA Chief Gina McCarthy admitted that the EPA regulations are symbolic and will have no measurable climate impact - even if you believe in the climate activist version of science](#). "The value of this rule is not measured in that way [temperature impact]," McCarthy said in 2015. "I am not disagreeing that this action in and of itself will not make all the difference we need to address climate action, but what I'm saying is that if we don't take action domestically we will never get started," she added. Obama's former EPA Administrator Lisa Jackson had previously noted that ["U.S. action alone will not impact world CO<sub>2</sub> levels."](#)

Climatologist Dr. Patrick Michaels' analysis says any potential impact on climate from EPA regulations would be "so small as to be undetectable, less than two one-hundredths of a degree C." "We're not even sure how to put such a small number into practical terms, because, basically, the number is so small as to be undetectable."

Even NASA's former lead global warming scientist James Hansen has called Obama's EPA climate regulations "practically worthless," and added, "You've got to be kidding me."

Yet, despite the fact that EPA regulations would have no impact on global CO<sub>2</sub> levels, Obama advisor John Podesta claimed in 2014 that the EPA CO<sub>2</sub> regulations are needed to combat extreme weather: "The risk on the downside you're seeing every day in the weather."

### **Why would skeptics seek to overturn Obama's EPA climate executive orders?**

Obama's EPA regulations (including the Clean Power Act) bypassed Congress and imposed domestic climate regulations on America without a single vote of Congress. Obama's Harvard Law School Professor Laurence Tribe said the EPA climate regulations are akin to "burning the Constitution."

Tribe, a liberal constitutional scholar at Harvard University, declared that Obama's executive orders "raised serious questions under the separation of powers" because "the EPA is attempting to exercise lawmaking power that belongs to Congress and judicial power that belongs to the federal courts." Tribe added, "Burning the Constitution cannot be part of our national energy policy."

Climate activists seem to think we need more taxes and regulation to somehow stop bad weather.

**Shouldn't all Americans want to reduce 'carbon pollution' for our health?**

CO<sub>2</sub> is not 'pollution.' The term 'carbon pollution' is unscientific and misleading. As James Agresti wrote: "The phrase conflates carbon dioxide with noxious chemicals like carbon monoxide and black carbon." "The phrase 'carbon pollution' is scientifically inaccurate because there are more than ten million different carbon compounds, and the word 'carbon' could refer to any of them. Some of the more notorious of these compounds are highly poisonous, such as carbon monoxide (a deadly gas) and black carbon (the primary ingredient of cancerous and mutagenic soot). Using a phrase that does not distinguish between such drastically different substances is a sure way to misinform people."

Carbon Dioxide - CO<sub>2</sub> - is a harmless trace essential gas in the atmosphere that humans exhale from their mouth (after inhaling oxygen).

Princeton Physicist Dr. Will Happer has said: "To call carbon dioxide a pollutant is really Orwellian. You are calling something a pollutant that we all produce. Where does that lead us eventually?"

**CO<sub>2</sub> is a greenhouse gas and it has been rising steadily. How can you deny global warming?**

CO<sub>2</sub> is not the tail that wags the dog. CO<sub>2</sub> is a trace essential gas, but without it life on earth would be impossible. Carbon dioxide fertilizes algae, trees, and crops to provide food for humans and animals. We inhale oxygen and exhale CO<sub>2</sub>. Slightly higher atmospheric CO<sub>2</sub> levels cannot possibly supplant the numerous complex and inter-connected forces that have always determined Earth's climate.

As University of London professor emeritus Philip Stott has noted: "The fundamental point has always been this. Climate change is governed by hundreds of factors, or variables, and the very idea that we can manage climate change predictably by understanding and manipulating at the margins one politically selected factor (CO<sub>2</sub>), is as misguided as it gets." "It's scientific nonsense," Stott added.

Even the global warming activists at RealClimate.org acknowledged this [in a September 20, 2008 article](#), stating, "The actual temperature rise is an emergent property resulting from interactions among hundreds of factors."

**Haven't the past few years shown global warming is worse than we thought?**

As the real world evidence mounts that global warming claims are failing, climate activists have ramped up predictions of future climate change impacts, declaring that it is 'worse than we thought.' But a prediction or projection 50 to 100 years into the future is not 'evidence.'

**Climate activists have said every storm is now influenced by 'global warming.'**

These types of unscientific claims have a long history. In Australia in 1846, Aborigines blamed the bad climate on the introduction of the white man in

Australia. During World War II, some blamed the war for causing unusual weather patterns. In 1933, Syria banned the Yo-Yo because they thought it caused drought. In the 1970s, extreme weather was blamed on manmade global cooling.

**If CO<sub>2</sub> is not the main driver of global temperatures, what is? The sun?**

When global temperatures are the question, the answer is not the sun or CO<sub>2</sub>. It is the sun, volcanoes, tilt of the Earth's axis, water vapor, methane, clouds, ocean cycles, plate tectonics, shifting ocean currents, albedo (Earth's changing reflective properties), atmospheric dust, atmospheric circulation, cosmic rays, particulates like carbon soot and volcanic dust, forests and grasslands, and urban and other land use changes. Climate change is governed by hundreds of factors, not just CO<sub>2</sub>.

**Hasn't the Earth overheated in the past when CO<sub>2</sub> rose?**

The geologic history of the earth undercuts rising carbon dioxide fears. CO<sub>2</sub> levels were higher in the past and there was no climate apocalypse. Greenpeace co-founder Dr. Patrick Moore has testified to Congress: "The fact that we had both higher temperatures and an ice age at a time when CO<sub>2</sub> emissions were 10 times higher than they are today, fundamentally contradicts the certainty that human-caused CO<sub>2</sub> emissions are the main cause of global warming. An Ice Age occurred when CO<sub>2</sub> was 10 times higher than today."

**Are there just a handful of skeptical scientists who dissent from the UN IPCC claims?**

Scientists who are skeptical about "dangerous manmade climate change" have been speaking out for years. Many former prominent former believers in manmade global warming announced they were reconsidering the science.

Scientists like Dr. Leonard Bengtsson, Dr. Judith Curry, and UN IPCC Lead Author Dr. Richard Tol are growing more skeptical of climate claims.

The 2016 film *Climate Hustle* documented many of the politically left scientists (who voted for Gore and endorsed Obama) who have reexamined the evidence and are now skeptical.

Climate scientist Mike Hulme [dismantled the "thousands of scientists agree" claim](#) put forth by the United Nations and news media. Claims that "2,500 of the world's leading scientists have reached a consensus that human activities are having a significant influence on the climate" are disingenuous, Hulme noted. The key scientific case for CO<sub>2</sub> driving global warming, like many others in the IPCC reports, "is reached by only a few dozen experts in the specific field of detection and attribution studies; other IPCC authors are experts in other fields." Other scientists are excluded or not consulted.

Dr. William Schlesinger agrees with the UN climate view but has admitted that [only 20% of UN IPCC scientists deal with climate](#). In other words, 80% of the UN's IPCC membership are experts in other fields and have no dealing with or expertise in climate change as part of their academic studies.

**How can you reject the National Academy of Sciences and other science organization that all agree manmade global warming is a threat?**

Proponents of manmade global warming often point out the National Academy of Sciences (NAS) and American Meteorological Society (AMS) have issued statements endorsing the so-called 'consensus' view that human emissions drive climate change. However, neither the NAS nor the AMS has ever allowed member scientists to vote directly on these statements. A couple of dozen members of the institutions' governing boards produced the statements - and then issued press releases.

The governing boards are steeped in politics and seek more funding for 'research' that promotes currently accepted viewpoints. The full membership of actual scientists never gets to vote on the activist statements and in many cases is completely unaware until too late that the boards have issued them. Many such organizations have faced [open rebellion](#) by their skeptical member scientists for such actions, including the American Chemical Society, American Physical Society, and International Geological Congress.

**But don't 97% of scientists say manmade climate change is real?**

The claim that "97% of scientists agree" is in part based on 77 anonymous scientists who responded to a survey. The survey started by seeking opinions from 10,257 scientists. However, [only 77 responded](#). So the 97% "consensus" claim is not based on *thousands* of scientists or even *hundreds* of scientists - but only on 77 scientists. Out of those 77 scientists, 75 answered the survey to form the mythical 97% 'consensus.'

In 2013 and 2014, other claims of an alleged 97% climate 'consensus' emerged, prompting UN IPCC lead author Dr. Richard Tol to publish a critique and declare: "The 97% is essentially pulled from thin air, it is not based on any credible research whatsoever."

The new 97% claim by climate activist John Cook was so ["so broad that it incorporates the views of most prominent climate skeptics."](#)

Another researcher, Andrew Montford, commented: "The [97%] consensus as described by the survey is virtually meaningless and tells us nothing about the current state of scientific opinion beyond the trivial observation that carbon dioxide is a greenhouse gas and that human activities have warmed the planet to some unspecified extent."

Lord Christopher Monckton's analysis found that "only 41 papers - 0.3% of all 11,944 abstracts or 1.0% of the 4,014 expressing an opinion, and not 97.1%" actually endorsed the claim that "more than half of recent global warming was anthropogenic."

Bjorn Lomborg wrote: "Do you remember the '97% consensus,' which even Obama tweeted? Turns out the authors don't want to reveal their data. It has always been a dodgy paper. Virtually everyone I know in the debate would automatically be included in the 97%."

**The Associated Press reported in 2015 that, "In the worst case scenario, Antarctica's melt could push sea levels up 10 feet worldwide in a century or two, recurving heavily populated coastlines." Don't we owe it to millions of people to stop this?**

A 2015 NASA study found that Antarctica was NOT losing ice mass and "not currently contributing to sea level rise," but actually *reducing* sea level rise. The NASA study found that the ice mass gains of the Antarctic ice sheet are greater than their losses.

The Associated Press was not the first one to hype these same Antarctica melt fears. Virtually the exact same claims and hype were reported in 2014, 1990, 1979, 1922, and 1901! In 1990, NBC's Today Show featured Paul Ehrlich warning of impacts of Antarctic ice melt: 'You Could Tie Your Boat to the Washington Monument.'

1979 New York Times: "Boats could be launched from the bottom of the steps of the Capitol' in DC."

1922: "Mountain after mountain of [Antarctic] ice will fall into the sea, be swept northwards by the currents, and melt, thus bringing about, but at a much more rapid rate, the threatened inundation of the land by the rising of the sea to its ancient level."

1901: "Geologists believe that this great ice sucker has reached the stage of perfection when it [Antarctica] will, break up again, letting loose all the waters of its auction over the two hemispheres, and completely flooding the low-lying lands of Europe, Asia, and North America."

**NOAA reported that manmade climate change has doubled the chances for the type of heavy downpours that caused devastating Louisiana floods in August 2016. Is climate change increasing rain and floods?**

NOAA chose media hype over science. Climatologist Dr. Roger Pielke, Sr., slammed the NOAA modeling study as "manipulation of science for political reasons," adding "NOAA should be embarrassed" and labeling the study "a dismaying example of manipulation of science for political reasons."

Real Climate Science's Tony Heller noted the NOAA claim "has no scientific basis, and ignores all available actual data." "Software models can be written to produce any result the author wants to produce. They are not evidence of anything. There has been no increase in heavy rains in Louisiana."

Climate models can be twisted to make it appear the invisible hand of 'global warming' has a role in almost every weather event. Ironically, heavy rains used to be caused by 'global cooling' in the 1970s. *Time Magazine* noted in a 1974 article titled "Another Ice Age" that "record rains" were accompanying a cooling climate trend.

Any attempt to link manmade global warming to [rainfall events](#) in any specific region is the stuff of pure politics - not science. As a result of this and similar realities, global warming activists are desperately seeking to tie any and all weather events to global warming.

In Australia, climate activists were caught blaming too little rain on manmade global warming, and then - when there was too much rain - they blamed *that* on manmade global warming, too. Other studies have found both temperatures and precipitation were higher 1,000 years ago during the Medieval Warm Period.

### **Did 'climate change' cause Hurricane Hermine that hit Florida in 2016?**

No. Hurricane Hermine was a Category 1 storm that finally broke the record 11-year span of no land-falling hurricanes hitting Florida. Meteorologist Joe Bastardi noted "portraying Hermine as some kind of climate change demon is either ignorance as to the history of hurricanes or deceit." They are "warning us about something [Florida hurricanes] that occurred much more frequently in the past, yet trying to blame it on an agenda-driven issue," Bastardi added.

### **Does global warming cause wars? Is it a national security threat?**

Ironically, the data and studies reveal that warm periods coincide with less conflict. This same argument was used by the CIA in 1974 to claim that 'global cooling' would cause conflict and terrorism. To believe that rising CO<sub>2</sub> is a key cause for the creation of ISIS is akin to believing that the Middle East was a peaceful region until modern 'global warming' set upon it. The Center for Strategic and International Studies report noted the opposite of recent claims regarding 'global warming' and war. "Since the dawn of civilization, warmer eras have meant *fewer* wars."

Another study published in the Proceedings of the National Academy of Sciences found that "Cooler periods coincided with conflicts and disease outbreaks."

### **The 'hottest year' on record occurred in recent years.**

Actually, global temperatures have been holding nearly steady for almost two decades (nearly 18 years according to RSS satellite data). While 2005, 2010, and 2015 were declared the 'hottest years' by global warming proponents, a closer examination revealed that the claims were "based on year-to-year temperature data that differs by only a few HUNDREDTHS of a degree to tenths of a degree Fahrenheit - differences that were within the margin of error in the data." In other words, global temperatures have essentially held very steady with no sign of acceleration.

The media and climate activists hype 'record' temperatures that are not even outside the margin of error of the dataset as somehow meaningful. Even former NASA climatologist James Hansen admitted 'hottest year' declarations are "not particularly important."

MIT climate scientist Dr. Richard Lindzen ridiculed 'hottest year' claims in 2015. "The uncertainty here is tenths of a degree. When someone points to this and says this is the warmest temperature on record, what are they talking about? It's just nonsense. This is a very tiny change period," Lindzen said. "If you can adjust temperatures to 2/10ths of a degree, it means it wasn't certain to 2/10ths of a degree."

So-called 'hottest year' claims are just a fancy way of saying that the 'global warming pause' has essentially continued.

### **Isn't the U.S. experiencing unprecedented heat waves?**

Climatologist Dr. John Christy: "About 75% of the states recorded their hottest temperature prior to 1955, and over 50% of the states experienced their record cold temperatures after 1940." In 2014, the U.S. experienced a brutally cold winter and a cool summer.

### **Arctic ice melted to record lows in 2012. Isn't that due to manmade global warming?**

In 2016, Arctic ice made was 22% greater than the satellite era low point of 2012. The 2016 Arctic sea ice minimum is now in a 10-year 'pause' with 'no significant change in the past decade'

According to climate analyst Dr. David Whitehouse of the UK Global Warming Policy Forum, "There is no general decrease in minimal ice area, by this measure, between 2007 - 2016 - ten years! The case can be made that the behavior of the Arctic ice cover has changed from the declining years of 1998 - 2007."

Arctic ice changes are not 'proof' of manmade global warming, nor are they unprecedented, unusual, or cause for alarm, according to experts and multiple peer-reviewed studies. After weeks of media hype blaming global warming, NASA finally admitted in September 2012 that an August Arctic cyclone "broke up" and "wreaked havoc" on sea ice. According to NASA: "The cyclone remained stalled over the arctic for several days ... pushing [sea ice] south to warmer waters, where it melted."

In 2013, the Arctic ice cap grew by 29% over 2012 in the summer with 533,000 more square miles of ocean covered with ice than in 2012.

Global warming activists have long hyped satellite era data, which begin in 1979, to claim [record low Arctic sea ice](#) - while ignoring the satellite data that showed record or near record sea ice expansion in the Antarctic in previous years. Moreover, satellite monitoring of Arctic ice began at the end of a 40-year cold cycle (remember [the 1970s fears of a coming ice age?](#)), when ice was most likely at its highest extent in the modern era.

We have had similar Arctic ice panics in the past. A November 2, 1922 [Washington Post article](#) was headlined, "Arctic Ocean getting warm: Seals vanish and icebergs melt." The Arctic Ocean is warming, icebergs are growing scarcer, and in places the seals are finding the water too hot, it claimed.

### **Isn't manmade global warming causing extreme weather?**

"There is a lack of evidence to blame humans for an increase in extreme events. One cannot convict CO<sub>2</sub> of causing any of these events, because they've happened in the past before CO<sub>2</sub> levels rose," climatologist John Christy [testified before Congress](#) in 2012. "There are innumerable types of events that can be defined as extreme events - so for the enterprising individual (unencumbered by the scientific method), weather statistics can supply an unlimited, target-rich environment in which to discover a 'useful' extreme event."

"There is no evidence that disasters are getting worse because of climate change," [notes Professor Roger Pielke, Jr.](#) "There's really no evidence that we're in the midst of an extreme weather era - whether man has influenced climate or not."

### **Aren't hurricanes getting bigger, stronger, and more frequent due to manmade global warming?**

As of 2016, the U.S. has gone 11 years (since Hurricane Wilma in 2005) with no Category 3 or larger hurricanes making landfall, the longest spell since at least 1900.

Even with the recent Hurricane Matthew which skirted the Florida coast as a category 3 hurricane, the U.S. is still currently in a record-breaking hurricane drought of no Category 3 or larger storms making landfall. In fact, the last Category 4-5 hurricane that made landfall in the US was 24 years ago in 1992 [Andrew]. For the United States, during the past four decades, "The fewest number of major hurricanes struck during any 40-year period since at least the 1800s."

The worst decade for major (Category 3, 4, and 5) hurricanes was the 1940s, according to the website Real Science which analyzed National Oceanic and Atmospheric Administration data. In 2011, a new study found that "overall global tropical cyclone activity has decreased to historically low levels during the past five years."

### **Isn't global warming causing bigger, more dangerous tornadoes?**

No. In fact, big tornadoes have seen a drop in frequency since the 1950s. "There has been a downward trend in strong (F3) to violent (F5) tornadoes in U.S. since 1950s." "Warming causes fewer strong tornadoes, not more," [climatologist Dr. Roy Spencer explained.](#)

The years 2012, 2013, and 2014 all saw at or near record low tornado counts in the U.S.

In 2015, the number of major tornadoes was "one of the lowest on record," according to NOAA.

And 2016 has so far been another below-normal tornado season, according to NOAA.

There is "no scientific consensus or connection between global warming and tornadic activity," [emphasized Greg Carbin](#), tornado warning coordination meteorologist at NOAA's Storm Prediction Center in Norman, Oklahoma. "NOAA statistics show that the last 60 years have seen a dramatic increase in the reporting of weak tornadoes, but no change in the number of severe to violent ones," Corbin commented.

In 1975, tornado outbreaks were blamed on 'global cooling.'



### **Don't we need to stop global warming to keep cities from being inundated by rising seas?**

Sea levels have been rising since the last ice age ended more than 10,000 years ago. There is currently no acceleration in sea level rise.

Global sea levels have been naturally [rising for ~20,000 years and have decelerated over the past 8,000 years](#), [decelerated over the 20th century](#), [decelerated 31% since 2002](#), and [decelerated 44% since 2004](#) to less than 7 inches per century. There is [no evidence of an acceleration of sea level rise](#), and therefore no evidence of any effect of mankind on sea levels.

According to tide gauges, sea levels are rising LESS than the thickness of one nickel (1.95 mm thick) per year or about the thickness of one penny (1.52 mm thick) a year. According to satellite info, it is rising slightly more than two pennies a year (3.04 mm)

### **Aren't the recent droughts in the U.S. due to manmade global warming?**

Across time scales required for any meaningful analysis, "Droughts have, for the most part, become shorter, less frequent, and cover a smaller portion of the U. S. over the last century," [Professor Roger Pielke, Jr. observes](#). "U.S. Midwestern drought has decreased in past 50+ years? That is not skepticism; that's according to the UN Intergovernmental Panel on Climate Change," he adds.

Even U.S. government scientists have admitted that recent droughts are not due to climate change. "This is not a climate change drought," [said Dr. Robert Hoerling](#), a NOAA research meteorologist, who served as the lead author of the U.S. Climate Change Science Plan Synthesis and Assessment Report. "The good news," he emphasized, "is that this isn't global warming. This is not the new normal in terms of drought."

For scientists who take the long view of history, the U.S. drought of 2012 is "merely a climatological blip," [E&E News reported](#), in an article titled "Dust Bowl and 1988 both eclipse 2012 drought, scientists say."

### **What about California's record drought?**

California's current drought is not related to climate change. Much more severe California droughts occurred with lower allegedly 'safe' CO<sub>2</sub> levels. [According to the data, "past dry periods have lasted more than 200 years."](#) "Researchers have documented multiple droughts in California that lasted 10 or 20 years in a row during the past 1,000 years - compared to the mere 3-year duration of the current dry spell. The two most severe mega-droughts make the Dust Bowl of the 1930s look tame: a 240-year-long drought that started in 850 and, 50 years after the conclusion of that one, another that stretched at least 180 years."

### **Isn't climate change making floods more severe?**

Peer-reviewed studies reject these claims, too. "Are US floods increasing? The answer is still 'No,'" says a new scientific paper by Roger Pielke, Jr. The evidence demonstrates that "flooding has not increased in U.S. over records of 85 to 127 years. This adds to a pile of research that shows similar results around the world," Pielke said. It is also worth noting that

"the world's ten deadliest floods all occurred before 1976." [In other words,](#) "All of the world's deadliest floods occurred with CO<sub>2</sub> well below 350 ppm."

In addition, a recent study by the U.S. government found no evidence that climate change caused more severe flooding during last century. In fact, the U.S. Geological Survey found that in some regions "floods become *less severe* as greenhouse gas emissions increased." Moreover, at this time, "We do not see a clear pattern that enables us to understand how climate change will alter flood conditions in the future," USGS scientist Robert Hirsch explained.

### **Aren't wildfires getting worse?**

No. "Data from both the U.S. and Canada show [the number of wildfires has declined](#) over the past 40 to 50 years and that the number of wildfires was higher during the global cooling scare of the 1970s." In fact, the number of U.S. wildfires has dropped 10% per decade. The U.S. government's National Interagency Fire Center has reported that U.S. wildfires now occur "half as often as they did 50 years ago."

Spanish researchers confirmed [climate change is not to blame for increased forest fires](#). "The change in the occurrence of fires that are recorded in the historical research cannot be explained by the gradual change in climate," they reported. Instead, it "corresponds to changes in the availability of fuel, the use of sources of energy, and the continuity of the landscape." In the United States, wildfires are also due to a failure to thin forests or remove dead and diseased trees - due largely to environmentalist protests and lawsuits.

### **Aren't polar bears dying, threatened with extinction by receding Arctic ice?**

No. Polar bears are at or near historic population highs. The only threats they face are from virtual world computer model predictions that do not reflect reality or account for the adaptability of these animals.

"The only reason the service listed them was based on speculation from fairly untested models, based on what the fate of polar bears may be in the future," like *if* global warming ever dramatically alters the bears' habitat, [Alaska's coordinator for endangered species explained](#).

"The polar bear population is very, very healthy," [Canadian Inuit have emphasized](#). "We live in polar bear country. We understand the polar bears. We are unanimous in our belief that polar bears have not declined."

Evolutionary biologist and paleozoologist Dr. Susan Crockford of the University of Victoria agrees. "Polar bears have survived several episodes of much warmer climate over the last 10,000 years than exists today," she wrote. "There is no evidence to suggest that the polar bear or its food supply is in danger of disappearing entirely with increased Arctic warming, regardless of the dire fairy-tale scenarios predicted by computer models."

Crockford added: "The annual minimum reached in late summer has little impact on polar bear health and survival. What matters most to polar bears is the presence of ample ice in spring and early summer (March-June), which is their critical feeding period."

University of Iceland professor and award-winning quaternary geologist Dr. Olafur Ingolfsson notes that a fossil specimen "confirms that the polar bear was a morphologically distinct species at least 100,000 years ago, and this basically means that the polar bear has already survived one interglacial period." This tells us that, "Despite the on-going warming in the Arctic today, maybe we don't have to be quite so worried about the polar bear."

Professor J. Scott Armstrong, a forecasting expert at the Wharton School, says [polar bear models are critically flawed](#). "To list a species that is currently in good health as an endangered species requires valid forecasts that its population would decline to levels that threaten its viability." In fact, the polar bear populations have been increasing rapidly in recent decades, due to hunting restrictions.

Biologist Josef Reichholf heads the Vertebrates Department at the National Zoological Collection in Munich. "In warmer regions, it takes far less effort to ensure survival," he points out. "How did the polar bear survive the last warm period? Whether bears survive will depend on human beings, not the climate."

### **Don't graphs show that current temperatures are the highest in 1,000 years?**

Penn State professor and UN IPCC modeler Michael Mann did publish a hockey stick-shaped graph that purportedly showed an unprecedented sudden increase in average global temperatures, following ten centuries of supposedly stable climate. However, Dr. Mann was at the center of the Climategate scandal. His graph and the data and methodology behind it have been scrutinized and debunked in peer-reviewed studies by numerous climate scientists, statisticians, and other experts.

The latest research clearly reveals that the Medieval Warm Period (also called the Medieval Climate Optimum) has been verified and was in fact global, not just confined to the Northern Hemisphere. The [Center for the Study of Carbon Dioxide and Global Change](#) reported in 2009 that "the [Medieval Warm Period](#) was: (1) global in extent, (2) at least as warm as, but likely even warmer than, the Current Warm Period, and (3) of a duration significantly longer than that of the Current Warm Period to date."

The Science and Public Policy Institute [reported in May 2009](#): "More than 700 scientists from 400 institutions in 40 countries have contributed peer-reviewed papers providing evidence that the Medieval Warm Period (MWP) was real, global, and warmer than the present. And the numbers grow larger daily."

### **Weren't the Climategate scientists exonerated - meaning there was no scandal?**

Many in the media repeatedly cite the various Climategate investigations as an 'exoneration' of the UN global warming scientists. But a closer look reveals that the investigations were nothing more than the global warming industry pretending to investigate itself, and of course finding no wrongdoing.

Penn State's investigation of Michael Mann is a prime example of what a mockery the process became. Clive Crook of the *Atlantic Monthly* [summed it up this way](#): "The Penn State inquiry exonerating Michael Mann would be difficult to parody. Three of four allegations were dismissed out of hand at the outset."

**Why do you oppose government taking steps to solve the climate crisis?**

Despite all the evidence and studies presented in this fact sheet, many people continue to say that Congress and the United Nations need to take immediate action to prevent more extreme weather, rising sea levels, and planetary 'overheating.' The reality is that politicians who say government "can do something about" droughts, floods, sea levels, hurricanes, and tornadoes are practicing the equivalent of medieval witchcraft.

Laws, treaties, and regulations - whether from the United Nations, the U.S. Congress, or the Environmental Protection Agency - cannot control the weather. CO<sub>2</sub> does not control global temperatures, and current global temperatures are well within natural variability, as demonstrated by surface and satellite data and extensive historic records. Scientific studies and data also show that droughts, floods, wildfires, and other extreme weather are not unusual, unprecedented, or related to CO<sub>2</sub> emissions or climate change.

# EXHIBIT 46

**Second  
Edition**

# Why Scientists Disagree About Global Warming

The NIPCC Report on Scientific Consensus

**Craig D. Idso · Robert M. Carter · S. Fred Singer**  
**Foreword by Marita Noon**



**Praise for past reports by the  
Nongovernmental International Panel on Climate Change**

*Climate Change Reconsidered* is a comprehensive, multidisciplinary compilation of technical papers covering a very large variety of important topics that will be appreciated by all who desire reliable, up-to-date information.

— Larry Bell, endowed professor and director  
Sasakawa International Center for Space  
Architecture at the University of Houston

Many will treat *Climate Change Reconsidered* as a highly authoritative source of reference. It is in particular a standing rebuke to all those alarmists who deny the existence of hard science supporting the sceptical case. ... Given the increasing realisation that climate mitigation efforts are creating an economic crisis, and increasing popular scepticism about the alarmist scenario, this is a timely publication, and a key resource for all of us who are arguing for common sense.

— Roger Helmer  
Member of the European Parliament

The 2011 edition of *Climate Change Reconsidered* is a quite extraordinary achievement. It should put to rest once and for all any notion that “the science is settled” on the subject of global warming, or that humanity and our planet face an imminent manmade climate change disaster.

— Paul Driessen  
Author, *Eco-Imperialism*

I fully support the efforts of the Nongovernmental International Panel on Climate Change (NIPCC) and publication of its latest report, *Climate Change Reconsidered II: Physical Science*, to help the general public to understand the reality of global climate change.

— Kumar Raina  
Former Deputy Director General  
Geological Survey of India



I've been waiting for this book for twenty years. It was a long wait, but I'm not disappointed. *Climate Change Reconsidered* is a *tour de force*.

— E. Calvin Beisner, Ph.D.  
National Spokesman, Cornwall Alliance for the  
Stewardship of Creation

Highly informative, *Climate Change Reconsidered* ought to be required reading for scientists, journalists, policymakers, teachers, and students. It is an eye-opening read for everyone else (concerned citizens, taxpayers, etc.).

— William Mellberg  
Author, *Moon Missions*

[T]here are several chapters in the NIPCC report that are substantially more thorough and comprehensive than the IPCC treatment, including 5 (Solar variability and climate cycles), 7 (Biological effects of carbon dioxide enrichment), 8 (Species extinction) and 9 (Human health effects). Further, the NIPCC's regional approach to analyzing extreme events and historical and paleo records of temperature, rainfall, streamflow, glaciers, sea ice, and sea-level rise is commendable and frankly more informative than the global analyses provided by the IPCC.

— Dr. Judith Curry, professor and chair  
School of Earth and Atmospheric Sciences  
Georgia Institute of Technology

NIPCC's CCR-II report should open the eyes of world leaders who have fallen prey to the scandalous climate dictates by the IPCC. People are already suffering the consequences of sub-prime financial instruments. Let them not suffer more from IPCC's sub-prime climate science and models. That is the stark message of the NIPCC's CCR-II report.

— M.I. Bhat, formerly professor and head  
Department of Geology and Geophysics  
University of Kashmir, India

*Climate Change Reconsidered* is a comprehensive, authoritative, and definitive reply to the IPCC reports.

— Dr. Gerrit van der Lingen  
Christchurch, New Zealand

I was glad to see that a new report was coming from the NIPCC. The work of this group of scientists to present the evidence for natural climate warming and climate change is an essential counter-balance to the biased reporting of the IPCC. They have brought to focus a range of peer-reviewed publications showing that natural forces have in the past and continue today to dominate the climate signal. Considering the recent evidence that climate models have failed to predict the flattening of the global temperature curve, and that global warming seems to have ended some 15 years ago, the work of the NIPCC is particularly important.

— Ian Clark, professor, Department of Earth Sciences  
University of Ottawa, Canada

Library shelves are cluttered with books on global warming. The problem is identifying which ones are worth reading. The NIPCC's CCR-II report is one of these. Its coverage of the topic is comprehensive without being superficial. It sorts through conflicting claims made by scientists and highlights mounting evidence that climate sensitivity to carbon dioxide increase is lower than climate models have until now assumed.

— Chris de Freitas, School of Environment  
The University of Auckland, New Zealand

The CCR-II report correctly explains that most of the reports on global warming and its impacts on sea-level rise, ice melts, glacial retreats, impact on crop production, extreme weather events, rainfall changes, etc. have not properly considered factors such as physical impacts of human activities, natural variability in climate, lopsided models used in the prediction of production estimates, etc. There is a need to look into these phenomena at local and regional scales before sensationalization of global warming-related studies.

— S. Jeevananda Reddy  
Former Chief Technical Advisor  
United Nations World Meteorological Organization

The claim by the UN IPCC that “global sea level is rising at an enhanced rate and swamping tropical coral atolls” does NOT agree with observational facts, and must hence be discarded as a serious disinformation. This is well taken in the CCR-II report.

— Nils-Axel Mörner, emeritus professor  
Paleogeophysics & Geodynamics  
Stockholm University, Sweden

*Climate Change Reconsidered* is simply the most comprehensive documentation of the case against climate alarmism ever produced. Basing policy on the scientifically incomplete and internally inconsistent reports of the UN's Intergovernmental Panel on Climate Change is no longer controversial – *Climate Change Reconsidered* shows that it is absolutely foolhardy, and anyone doing so is risking humiliation. It is a must-read for anyone who is accountable to the public, and it needs to be taken very, very seriously.

— Patrick J. Michaels, Director  
Center for the Study of Science, Cato Institute

CCR-II provides scientists, policy makers and other interested parties information related to the current state of knowledge in atmospheric studies. Rather than coming from a pre-determined politicized position that is typical of the IPCC, the NIPCC constrains itself to the scientific process so as to provide objective information. If we (scientists) are honest, we understand that the study of atmospheric processes/dynamics is in its infancy. Consequently, the work of the NIPCC and its most recent report is very important. It is time to move away from politicized science back to science – this is what NIPCC is demonstrating by example.

— Bruce Borders, professor of Forest Biometrics  
Warnell School of Forestry and Natural Resources  
University of Georgia

# **Why Scientists Disagree About Global Warming**

The NIPCC Report  
on Scientific Consensus

Craig D. Idso, Robert M. Carter, S. Fred Singer

**NIPCC**

NONGOVERNMENTAL INTERNATIONAL PANEL  
ON CLIMATE CHANGE

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Dedicated to the memory of our good friend, Robert Carter, who contributed so much to the writing of this book, and who passed away shortly after the first edition was released.





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## ***Foreword***

President Barack Obama and his followers have repeatedly declared that climate change is “the greatest threat facing mankind.” This, while ISIS is beheading innocent people, displacing millions from their homeland, and engaging in global acts of mass murder.

If it weren’t so scary, it would be laughable. These statements should ring alarm bells in the minds of all Americans. They show how out of touch this president and the movement he leads are with reality and the American public.

The global warming movement is the most extensive and most expensive public relations campaign in the history of the world. Nearly every government agency in the United States and many more around the world are promoting the manmade-climate-change-scare scenario. An entire generation has been brought up hearing and reading about it. Yet public concern about it peaked in 2000 and today, people are no more worried about it than they were 26 years ago when Gallup began polling this issue. They’ve seen through the rhetoric and exaggerations. They remember, even if journalists and politicians seem not to, that past sky-is-falling predictions failed to come true, and forecasts of a dire climate catastrophe are just as unlikely to come true.

Surveys show the American people put climate change at the very



**Marita Noon**, executive director, Citizen’s Alliance for Responsible Energy

bottom of lists of problems they want the government to address. But it is a very important issue nonetheless for anyone concerned about individual freedom and protecting our way of life. The alarmist view, advocated by the Obama administration and environmental extremists, influences virtually every public policy, including the kind of light bulbs we may purchase, the type of cars we may be able to drive, where we live, and the types of jobs we may create or are available for us or our children to perform.

The most consequential policy decisions coming out of Washington today are predicated on the narrative that climate change is a crisis of catastrophic proportion, that it is caused by humans using fossil fuels, and that ending the use of hydrocarbons will save us from this pending disaster. It is imperative that the topic gets a full debate. Instead, those who want to “fundamentally transform America,” as Obama promised, are seeking to silence and discredit anyone who dares to speak up and question their assertions. They claim the science is “settled.”

But true science is never “settled,” and true scientists are always eager to ask and answer questions. This is plainly the case regarding climate change, as this book, *Why Scientists Disagree About Global Warming*, makes clear.

Sweeping regulations like the Environmental Protection Agency’s Clean Power Plan – which will totally transform the way electricity is generated, distributed, and used, and will dramatically increase costs for industry and individuals – are justified by their supporters because they are purported to mitigate climate change. Yet even their proponents admit such laws will have a minuscule impact on global greenhouse gas emissions and an imperceptible impact on the world’s climate, well below the range of natural variability and the margin of error of our methods of measuring the planet’s temperature.

This begs the question: “Why bother?” Why impose regulations that will cost hundreds of billions of dollars a year, destroy millions of jobs, and condemn millions of people to lives of grinding poverty, if there is virtually no beneficial impact on Earth’s climate? Many people support the regulations out of pure naivete: They’ve been told over and over again that “97 percent of scientists” believe global warming is a crisis and so sacrifices, even huge sacrifices, are necessary to stop it. The leaders of the global warming movement surely know better. They know most scientists do not endorse their simplistic and alarmist narrative of a complex scientific question. They back the regulations despite, not because of, what scientists

believe. They support the Clean Power Plan because it will give them more power, more control, and more profit.

The alarmist view of global warming is at the core of renewable energy mandates and massive subsidies for solar and wind companies. Strangely, as more and more of these boondoggles have been exposed for what they are – massive transfers of wealth from the general public to a small politically connected cabal of climate profiteers – the “act now!” cries have become louder and more insistent, perhaps hoping to drown out the news of the failures. Like Dorothy in *The Wizard of Oz*, we are told not to look behind the curtain, lest we discover what a total fraud the global warming movement truly is.

Today, in 2016, those who dare to look behind the curtain are being threatened by the U.S. Department of Justice and a group of attorneys general with legal action under a law passed in 1970 to combat organized crime. Sadly, such threats are taking a toll as some who’ve spoken freely now have fallen silent, fearing for their livelihoods and even their safety and that of their families. Yes, this is happening in America, where freedom of speech once was considered a sacred right.

This is why scientific debate over the causes and consequences of climate change is so vitally important and must not be stifled. The fact of the matter is, despite the oft-stated claim that “97 percent of scientists agree,” scientists actually disagree, profoundly and on many points. Their disagreements are on display in almost countless articles in scientific journals and books. Before public policy is set in cement, irreversibly charting our course for decades, the voices of real scientists need to be heard.

Thankfully, *Why Scientists Disagree About Global Warming* presents the side in the global warming debate that has been demonized by environmental advocacy groups, censored by the mainstream media, and threatened by politicians and their allies in government agencies. The authors carefully document the shortcomings of studies claiming to find a “scientific consensus” and present evidence pointing to the opposite conclusion, that a full-throated debate is continuing over the human role in climate change and whether anything can or should be done to reduce our role.

*Why Scientists Disagree About Global Warming* is written by three highly regarded climate scientists, is carefully documented, and offers an easy-to-read format featuring summary points for the casual reader and

thorough explanations for the more inquisitive. All this, plus the importance of the subject it addresses, makes it a must-read for concerned citizens, truth-seeking policymakers, and educators. Energy is a pivotal issue of utmost priority, and it is tightly woven into the debate underway over global warming. Before you decide where you stand, be sure you understand the issue, not just believe what you've been told is true. Read *Why Scientists Disagree About Global Warming*.

– Marita Noon, executive director,  
*Citizen's Alliance for Responsible Energy*  
May 2016

### **About Marita Noon**

Marita Noon is executive director for Energy Makes America Great Inc. and its companion educational organization, the Citizens' Alliance for Responsible Energy (CARE). Together they work to educate the public and influence policymakers regarding energy, its role in freedom, and the American way of life.

Noon is also a columnist for Breitbart.com and a regular contributor to many online commentary sites including *The American Spectator*, RedState.com, *Canada Free Press*, and *NetRight Daily*.

Noon's twentieth book, *Energy Freedom*, is her first in the current affairs genre. Readers of her previous books, including best sellers *Wired That Way* and *Communication Plus*, know her as Marita Littauer. Prior to her work in energy, Noon was known as a motivational speaker and author.

## ***Preface to the Second Edition***

Just a few weeks after the release of the first edition of this book, which took place in December 2015 in Paris during the 21st session of the Conference of the Parties to the United Nations Framework Convention on Climate Change (UNFCCC), one of the coauthors, Robert M. Carter, passed away unexpectedly. He was 74 years old.

The authors and editors of this book are still, in May 2016, in shock over the loss of a friend, mentor, and source of inspiration. Dr. Carter attended the Paris release of the first edition of this book, and upon his arrival back home in Australia was hard at work on the third and final volume in the *Climate Change Reconsidered II* series. We could hardly believe the news when it arrived, in a series of late-night emails from his friends and family. We still can hardly believe he is gone.

This small book is based on Chapter 2 of the larger work Dr. Carter and others were working to finish. It focuses, as its title suggests, on the question of whether a “scientific consensus” exists on the causes and consequences of climate change. It discusses the role of consensus in science and reviews surveys and other evidence showing agreement and lack of agreement among climate scientists. It explains why scientists often disagree (not just on climate change) and summarizes the physical and biological sciences findings of the first two volumes of the *Climate Change Reconsidered II* series, released in 2013 and 2014. The summary relies significantly on the summaries for policymakers of those two volumes written mainly by Dr. Carter.

The first edition was quite a success. More than 50,000 copies of the

book were sold or given away in only five months to elected officials, civic and business leaders, scientists, and other opinion leaders. The response from the science community and experts on climate change has been overwhelmingly positive.

To meet demand for more copies, we are proud to produce this second revised edition. Changes in this edition include the new foreword by Marita Noon, an extremely talented and highly respected voice in the debate over energy policy and climate change. Some of the discussion in Chapter 1 has been revised and expanded thanks to feedback from readers. Some graphs have been added, mostly taken from testimony presented by Dr. John Christy, distinguished professor of atmospheric science, Alabama's state climatologist, and director of the Earth System Science Center at The University of Alabama in Huntsville, on February 2, 2016 to the U.S. House Committee on Science, Space & Technology.

Donors to The Heartland Institute are making it possible for this new edition to be sent to large numbers of teachers, university professors, and the CEOs of major companies in the United States. We greatly appreciate their financial support. This book stands on its own merits, but the political climate of the day requires that we report no corporate funds were raised or used to support the writing, editing, or publication of this book or the larger volumes from which it was derived. For more information about the publisher, The Heartland Institute, please visit its website at [www.heartland.org](http://www.heartland.org), and be sure to read the "reply to critics" page linked on the homepage.



**Joseph L. Bast**  
President  
The Heartland Institute



**Diane Carol Bast**  
Executive Editor  
The Heartland Institute

## ***Preface to the First Edition***

The global warming debate is one of the most consequential public policy debates taking place in the world today. Billions of dollars have been spent in the name of preventing global warming or mitigating the human impact on Earth's climate. Governments are negotiating treaties that would require trillions of dollars more to be spent in the years ahead.

A frequent claim in the debate is that a "consensus" or even "overwhelming consensus" of scientists embrace the more alarming end of the spectrum of scientific projections of future climate change. Politicians including President Barack Obama and government agencies including the National Aeronautics and Space Administration (NASA) claim "97 percent of scientists agree" that climate change is both man-made and dangerous.

As the authors of this book explain, the claim of "scientific consensus" on the causes and consequences of climate change is without merit. There is no survey or study showing "consensus" on any of the most important scientific issues in the climate change debate. On the contrary, there is extensive evidence of scientific disagreement about many of the most important issues that must be resolved before the hypothesis of dangerous man-made global warming can be validated.

Other authors have refuted the claim of a "scientific consensus" about global warming. This book is different in that it comprehensively and specifically rebuts the surveys and studies used to support claims of a consensus. It then summarizes evidence showing disagreement, identifies four reasons why scientists disagree about global warming, and then provides a detailed survey of the physical science of global warming based



on the authors' previous work.

This book is based on a chapter in a forthcoming much larger examination of the climate change debate to be titled *Climate Change Reconsidered II: Benefits and Costs of Fossil Fuels*. That volume will finish the three-volume *Climate Change Reconsidered II* series, totaling some 3,000 pages and reporting the findings of more than 4,000 peer-reviewed articles on climate change.

This book and the larger volume that will follow it are produced by the Nongovernmental International Panel on Climate Change (NIPCC), an international panel of scientists and scholars who came together to understand the causes and consequences of climate change. NIPCC has no formal attachment to or sponsorship from any government or government agency. It also receives no corporate funding for its activities.

NIPCC seeks to objectively analyze and interpret data and facts without conforming to any specific agenda. This organizational structure and purpose stand in contrast to those of the United Nations' Intergovernmental Panel on Climate Change (IPCC), which is government-sponsored, politically motivated, and predisposed to believing that dangerous human-related global warming is a problem in need of a UN solution.

This volume, like past NIPCC reports, is edited and published by the staff of The Heartland Institute, a national nonprofit research and educational organization newly relocated from Chicago to suburban Arlington Heights, Illinois. The authors wish to acknowledge and thank Joseph L. Bast and Diane C. Bast, Heartland's seemingly tireless editing duo, for their help in getting this chapter ready for release before the rest of the volume in which it will eventually appear.



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## ***Key Findings***

Key findings of this book include the following:

### **No Consensus**

- The most important fact about climate science, often overlooked, is that scientists disagree about the environmental impacts of the combustion of fossil fuels on the global climate.
- The articles and surveys most commonly cited as showing support for a “scientific consensus” in favor of the catastrophic man-made global warming hypothesis are without exception methodologically flawed and often deliberately misleading.
- There is no survey or study showing “consensus” on the most important scientific issues in the climate change debate.
- Extensive survey data show deep disagreement among scientists on scientific issues that must be resolved before the man-made global warming hypothesis can be validated. Many prominent experts and probably most working scientists disagree with the claims made by the United Nations’ Intergovernmental Panel on Climate Change (IPCC).

### **Why Scientists Disagree**

- Climate is an interdisciplinary subject requiring insights from many fields of study. Very few scholars have mastery of more than one or two of these disciplines.
- Fundamental uncertainties arise from insufficient observational evidence, disagreements over how to interpret data, and how to set the parameters of models.

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## WHY SCIENTISTS DISAGREE ABOUT GLOBAL WARMING

- IPCC, created to find and disseminate research finding a human impact on global climate, is not a credible source. It is agenda-driven, a political rather than scientific body, and some allege it is corrupt.
- Climate scientists, like all humans, can be biased. Origins of bias include careerism, grant-seeking, political views, and confirmation bias.

**Scientific Method vs. Political Science**

- The hypothesis implicit in all IPCC writings, though rarely explicitly stated, is that dangerous global warming is resulting, or will result, from human-related greenhouse gas emissions.
- The null hypothesis is that currently observed changes in global climate indices and the physical environment, as well as current changes in animal and plant characteristics, are the result of natural variability.
- In contradiction of the scientific method, IPCC assumes its implicit hypothesis is correct and that its only duty is to collect evidence and make plausible arguments in the hypothesis's favor.

**Flawed Projections**

- IPCC and virtually all the governments of the world depend on global climate models (GCMs) to forecast the effects of human-related greenhouse gas emissions on the climate.
- GCMs systematically over-estimate the sensitivity of climate to carbon dioxide (CO<sub>2</sub>), many known forcings and feedbacks are poorly modeled, and modelers exclude forcings and feedbacks that run counter to their mission to find a human influence on climate.
- NIPCC estimates a doubling of CO<sub>2</sub> from pre-industrial levels (from 280 to 560 ppm) would likely produce a temperature forcing of 3.7 Wm<sup>-2</sup> in the lower atmosphere, for about ~1°C of *prima facie* warming.
- Four specific forecasts made by GCMs have been falsified by real-world data from a wide variety of sources. In particular, there has been no global warming for some 18 years.

**False Postulates**

- Neither the rate nor the magnitude of the reported late twentieth century surface warming (1979–2000) lay outside normal natural variability.
- The late twentieth century warm peak was of no greater magnitude than previous peaks caused entirely by natural forcings and feedbacks.
- Historically, increases in atmospheric CO<sub>2</sub> followed increases in temperature, they did not precede them. Therefore, CO<sub>2</sub> levels could not have forced temperatures to rise.
- Solar forcings are not too small to explain twentieth century warming. In fact, their effect could be equal to or greater than the effect of CO<sub>2</sub> in the atmosphere.
- A warming of 2°C or more during the twenty-first century would probably not be harmful, on balance, because many areas of the world would benefit from or adjust to climate change.

**Unreliable Circumstantial Evidence**

- Melting of Arctic sea ice and polar icecaps is not occurring at “unnatural” rates and does not constitute evidence of a human impact on the climate.
- Best available data show sea-level rise is not accelerating. Local and regional sea levels continue to exhibit typical natural variability – in some places rising and in others falling.
- The link between warming and drought is weak, and by some measures drought decreased over the twentieth century. Changes in the hydrosphere of this type are regionally highly variable and show a closer correlation with multidecadal climate rhythmicity than they do with global temperature.
- No convincing relationship has been established between warming over the past 100 years and increases in extreme weather events.

Meteorological science suggests just the opposite: A warmer world will see milder weather patterns.

- No evidence exists that current changes in Arctic permafrost are other than natural or are likely to cause a climate catastrophe by releasing methane into the atmosphere.

### **Policy Implications**

- Rather than rely exclusively on IPCC for scientific advice, policymakers should seek out advice from independent, nongovernment organizations and scientists who are free of financial and political conflicts of interest.
- Individual nations should take charge of setting their own climate policies based upon the hazards that apply to their particular geography, geology, weather, and culture.
- Rather than invest scarce world resources in a quixotic campaign based on politicized and unreliable science, world leaders would do well to turn their attention to the real problems their people and their planet face.

## ***Introduction***

Probably the most widely repeated claim in the debate over global warming is that “97 percent of scientists agree” that climate change is man-made and dangerous. This claim is not only false, but its presence in the debate is an insult to science.

As the size of recent reports by the alarmist Intergovernmental Panel on Climate Change (IPCC) and its skeptical counterpart, the Nongovernmental International Panel on Climate (NIPCC) suggest, climate science is a complex and highly technical subject, making simplistic claims about what “all” or “most” scientists believe necessarily misleading. Regrettably, this hasn’t prevented various politicians and activists from proclaiming a “scientific consensus” or even “overwhelming scientific consensus” that human activities are responsible for observed climate changes in recent decades and could have “catastrophic” effects in the future.

The claim that “97 percent of scientists agree” appears on the websites of government agencies such as the U.S. National Aeronautics and Space Administration (NASA, 2015) and even respected scientific organizations such as the American Association for the Advancement of Science (AAAS, n.d.), yet such claims are either false or meaningless.

Chapter 1 debunks surveys and abstract-counting exercises that allege to have found a “scientific consensus” in favor of the man-made global warming hypothesis and reports surveys that found no consensus on the most important issues in the debate. Chapter 2 explains why scientists disagree, finding the sources of disagreement in the interdisciplinary character of the issue, fundamental uncertainties concerning climate

science, the failure of IPCC to be an independent and reliable source of research on the subject, and bias among researchers.

Chapter 3 explains the scientific method and contrasts it with the methodology used by IPCC and appeals to the “precautionary principle.” Chapter 4 describes flaws in how IPCC uses global climate models to make projections about present and future climate changes and reports the findings of superior models that foresee much less global warming and even cooling. Chapter 5 critiques five postulates or assumptions that underlie IPCC’s work, and Chapter 6 critiques five key pieces of circumstantial evidence relied on by IPCC. Chapter 7 reports the policy implications of these findings, and a brief summary and conclusion end this book.

Chapters 1 and 2 are based on previously published work by Joseph Bast (Bast, 2010, 2012, 2013; Bast and Spencer, 2014) that has been revised for this publication. Chapters 3 to 7 are based on the *Summary for Policymakers of Climate Change Reconsidered II: Physical Science*, an earlier volume in the same series as the present book produced by the Nongovernmental International Panel on Climate Change (NIPCC) (Idso, Carter, and Singer, 2014). Although brief, this summary of climate science is based on an exhaustive review of the scientific literature. Lead authors Craig D. Idso, Robert M. Carter, and S. Fred Singer worked with a team of some 50 scientists to produce a 1,200-page report that is comprehensive, objective, and faithful to the scientific method. It mirrors and rebuts IPCC’s Working Group 1 and Working Group 2 contributions to IPCC’s 2014 *Fifth Assessment Report*, or AR5 (IPCC, 2014). Like IPCC reports, NIPCC reports cite thousands of articles appearing in peer-reviewed science journals relevant to the subject of human-induced climate change.

NIPCC authors paid special attention to research that was either overlooked by IPCC or contains data, discussion, or implications arguing against IPCC’s claim that dangerous global warming is resulting, or will result, from human-related greenhouse gas emissions. Most notably, NIPCC’s authors say IPCC has exaggerated the amount of warming likely to occur if the concentration of atmospheric CO<sub>2</sub> were to double, and such warming as occurs is likely to be modest and cause no net harm to the global environment or to human well-being. The principal findings from *CCR-II: Physical Science* are summarized in Figure 1.

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**Figure 1**  
**Summary of NIPCC's Findings on Physical Science**

- Atmospheric carbon dioxide (CO<sub>2</sub>) is a mild greenhouse gas that exerts a diminishing warming effect as its concentration increases.
- Doubling the concentration of atmospheric CO<sub>2</sub> from its pre-industrial level, in the absence of other forcings and feedbacks, would likely cause a warming of ~0.3°C to 1.1°C, almost 50 percent of which must already have occurred.
- A few tenths of a degree of additional warming, should it occur, would not represent a climate crisis.
- Model outputs published in successive IPCC reports since 1990 project a doubling of CO<sub>2</sub> could cause warming of up to 6°C by 2100. Instead, global warming ceased around the end of the twentieth century and was followed (since 1997) by 19 years of stable temperature.
- Over recent geological time, Earth's temperature has fluctuated naturally between about +4°C and -6°C with respect to twentieth century temperature. A warming of 2°C above today, should it occur, falls within the bounds of natural variability.
- Though a future warming of 2°C would cause geographically varied ecological responses, no evidence exists that those changes would be net harmful to the global environment or to human well-being.
- At the current level of ~400 ppm we still live in a CO<sub>2</sub>-starved world. Atmospheric levels 15 times greater existed during the Cambrian Period (about 550 million years ago) without known adverse effects.
- The overall warming since about 1860 corresponds to a recovery from the Little Ice Age modulated by natural multidecadal cycles driven by ocean-atmosphere oscillations, or by solar variations at the de Vries (~208 year) and Gleissberg (~80 year) and shorter periodicities.



## 4 WHY SCIENTISTS DISAGREE ABOUT GLOBAL WARMING

- Earth has not warmed significantly for the past 18 years despite an 8 percent increase in atmospheric CO<sub>2</sub>, which represents 34 percent of all extra CO<sub>2</sub> added to the atmosphere since the start of the industrial revolution.
- No close correlation exists between temperature variation over the past 150 years and human-related CO<sub>2</sub> emissions. The parallelism of temperature and CO<sub>2</sub> increase between about 1980 and 2000 AD could be due to chance and does not necessarily indicate causation.
- The causes of historic global warming remain uncertain, but significant correlations exist between climate patterning and multidecadal variation and solar activity over the past few hundred years.
- Forward projections of solar cyclicality imply the next few decades may be marked by global cooling rather than warming, despite continuing CO<sub>2</sub> emissions.

Source: Idso, C.D., Carter, R.M., Singer, S.F. 2013. Executive Summary, *Climate Change Reconsidered II: Physical Science*. Chicago, IL: The Heartland Institute.

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# 1

## ***No Consensus***

Key findings of this chapter include the following:

- The most important fact about climate science, often overlooked, is that scientists disagree about the environmental impacts of the combustion of fossil fuels on the global climate.
- The articles and surveys most commonly cited as showing support for a “scientific consensus” in favor of the catastrophic man-made global warming hypothesis are without exception methodologically flawed and often deliberately misleading.
- There is no survey or study showing “consensus” on the most important scientific issues in the climate change debate.
- Extensive survey data show deep disagreement among scientists on scientific issues that must be resolved before the man-made global warming hypothesis can be validated. Many prominent experts and probably most working scientists disagree with the claims made by the United Nations’ Intergovernmental Panel on Climate Change (IPCC).

### **Why Debate Consensus?**

Environmental activists and their allies in the media often characterize climate science as an “overwhelming consensus” in favor of a single view

that is sometimes challenged by a tiny minority of scientists funded by the fossil fuel industry to “sow doubt” or otherwise emphasize the absence of certainty on key aspects of the debate (Hoggan and Littlemore, 2009; Oreskes and Conway, 2010; Mann, 2012; Prothero, 2013). This popular narrative grossly over-simplifies the issue while libeling scientists who question the alleged consensus (Cook, 2014). This chapter reveals scientists do, in fact, disagree on the causes and consequences of climate change.

In May 2014, Secretary of State John Kerry warned graduating students at Boston College of the “crippling consequences” of climate change. “Ninety-seven percent of the world’s scientists tell us this is urgent,” he added (Kerry, 2014). Three days earlier, President Obama tweeted that “Ninety-seven percent of scientists agree: #climate change is real, man-made and dangerous” (Obama, 2014). What is the basis of these claims?

The most influential statement of this alleged consensus appears in the *Summary for Policymakers* of the *Fifth Assessment Report (AR5)* from the Intergovernmental Panel on Climate Change (IPCC): “It is extremely likely (95%+ certainty) that more than half of the observed increase in global average surface temperature from 1951 to 2010 was caused by the anthropogenic increase in greenhouse gas concentrations and other anthropogenic forcings together. The best estimate of the human-induced contribution to warming is similar to the observed warming over this period” (IPCC, 2013, p. 17).

In a “synthesis report” produced the following year, IPCC went further, claiming “Continued emission of greenhouse gases will cause further warming and long-lasting changes in all components of the climate system, increasing the likelihood of severe, pervasive and irreversible impacts for people and ecosystems. Limiting climate change would require substantial and sustained reductions in greenhouse gas emissions which, together with adaptation, can limit climate change risks” (IPCC, 2014, p. 8). In that same report, IPCC expresses skepticism that even reducing emissions will make a difference: “Many aspects of climate change and associated impacts will continue for centuries, even if anthropogenic emissions of greenhouse gases are stopped. The risks of abrupt or irreversible changes increase as the magnitude of the warming increases” (p. 16).

The media uncritically reported IPCC’s claims with headlines such as “New Climate Change Report Warns of Dire Consequences” (Howard, 2014) and “Panel’s Warning on Climate Risk: Worst Is Yet to Come”

(Gillis, 2014).

What evidence is there for a “scientific consensus” on the causes and consequences of climate change? What do scientists really say? Any inquiry along these lines must begin by questioning the legitimacy of the question. Science does not advance by consensus or a show of hands. Disagreement is the rule and consensus is the exception in most academic disciplines. This is because science is a process leading to ever-greater certainty, necessarily implying that what is accepted as true today will likely not be accepted as true tomorrow. As Albert Einstein famously once said, “No amount of experimentation can ever prove me right; a single experiment can prove me wrong” (Einstein, 1996).

Still, claims of a “scientific consensus” cloud the current debate on climate change. Many people, scientists included, refuse to believe scientists and other experts, even scholars eminent in the field, simply because they are said to represent minority views in the science community. So what do the surveys and studies reveal?

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## Flawed Surveys

Claims of a “scientific consensus” on the causes and consequences of climate change rely on a handful of essays reporting the results of surveys or efforts to count the number of articles published in peer-reviewed journals that appear to endorse or reject the positions of IPCC. NASA on its website cites four sources supporting its claim that “Multiple studies published in peer-reviewed scientific journals show that 97 percent or more of actively publishing climate scientists agree: Climate-warming trends over the past century are extremely likely due to human activities” (NASA, 2015). As this section reveals, these surveys and abstract-counting exercises are deeply flawed and do not support the claims of those who cite them.

### Oreskes, 2004

The most frequently cited source for a “consensus of scientists” is a 2004 essay for the journal *Science* written by a socialist historian named Naomi Oreskes (Oreskes, 2004). Oreskes reported examining abstracts from 928 papers reported by the Institute for Scientific Information database published in scientific journals from 1993 and 2003, using the keywords

“global climate change.” Although not a scientist, she concluded 75 percent of the abstracts either implicitly or explicitly supported IPCC’s view that human activities were responsible for most of the observed warming over the previous 50 years while none directly dissented.

Oreskes’ essay appeared in a “peer-reviewed scientific journal,” as NASA reported, but the essay itself was not peer-reviewed. It was an opinion essay and the editors hadn’t bothered asking to see her database. This opinion essay became the basis of a book, *Merchants of Doubt* (Oreskes and Conway, 2010), and then an academic career built on claiming that global warming “deniers” are a tiny minority within the scientific community, and then even a movie based on her book released in 2015. Her 2004 claims were repeated in former Vice President Al Gore’s movie, *An Inconvenient Truth*, and in his book with the same title (Gore, 2006).

It is now widely agreed Oreskes did not distinguish between articles that acknowledged or assumed some human impact on climate, however small, and articles that supported IPCC’s more specific claim that human emissions are responsible for more than 50 percent of the global warming observed during the past 50 years. The abstracts often are silent on the matter, and Oreskes apparently made no effort to go beyond those abstracts. Her definition of consensus also is silent on whether man-made climate change is dangerous or benign, a rather important point in the debate.

Oreskes’ literature review inexplicably overlooked hundreds of articles by prominent global warming skeptics including John Christy, Sherwood Idso, Richard Lindzen, and Patrick Michaels. More than 1,350 such articles (including articles published after Oreskes’ study was completed) are now identified in an online bibliography (Popular Technology.net, 2014).

Oreskes’ methodology was flawed by assuming a nonscientist could determine the findings of scientific research by quickly reading abstracts of published papers. Indeed, even trained climate scientists are unable to do so because abstracts routinely do not accurately reflect their articles’ findings. According to In-Uck Park *et al.* in research published in *Nature* in 2014 (Park *et al.*, 2014), abstracts routinely overstate or exaggerate research findings and contain claims that are irrelevant to the underlying research. The authors found “a mismatch between the claims made in the abstracts, and the strength of evidence for those claims based on a neutral analysis of the data, consistent with the occurrence of herding.” They note abstracts often are loaded with “keywords” to ensure they are picked up by search engines and thus cited by other researchers.



Oreskes' methodology is further flawed, as are all the other surveys and abstract-counting exercises discussed in this chapter, by surveying the opinions and writings of scientists and often nonscientists who may write about climate but are by no means experts on or even casually familiar with the science dealing with attribution – that is, attributing a specific climate effect (such as a temperature increase) to a specific cause (such as rising CO<sub>2</sub> levels). Most articles simply reference or assume to be true the claims of IPCC and then go on to address a different topic, such as the effect of ambient temperature on the life-cycle of frogs, say, or correlations between temperature and outbreaks of influenza. Attribution is the issue the surveys ask about, but they ask people who have never studied the issue. The number of scientists actually knowledgeable about this aspect of the debate may be fewer than 100 in the world. Several are prominent skeptics (John Christy, Richard Lindzen, Patrick Michaels, and Roy Spencer, to name only four) and many others may be.

Monckton (2007) finds numerous other errors in Oreskes' essay including her use of the search term “global climate change” instead of “climate change,” which resulted in her finding fewer than one-thirteenth of the estimated corpus of scientific papers on climate change over the stated period. Monckton also points out Oreskes never stated how many of the 928 abstracts she reviewed actually endorsed her limited definition of “consensus.”

Medical researcher Klaus-Martin Schulte used the same database and search terms as Oreskes to examine papers published from 2004 to February 2007 and found fewer than half endorsed the “consensus” and only 7 percent did so explicitly (Schulte, 2008). His study is described in more detail below.

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### **Doran and Zimmerman, 2009**

In 2009, a paper by Maggie Kendall Zimmerman, at the time a student at the University of Illinois, and her master's thesis advisor Peter Doran was published in *EOS*. They claimed “97 percent of climate scientists agree” that mean global temperatures have risen since before the 1800s and that humans are a significant contributing factor (Doran and Zimmerman, 2009). This study, too, has been debunked.

The researchers sent a two-minute online survey to 10,257 Earth scientists working for universities and government research agencies, generating responses from 3,146 people. Solomon (2010) observed, “The two researchers started by altogether excluding from their survey the thousands of scientists most likely to think that the Sun, or planetary movements, might have something to do with climate on Earth – out were the solar scientists, space scientists, cosmologists, physicists, meteorologists and astronomers. That left the 10,257 scientists in disciplines like geology, oceanography, paleontology, and geochemistry that were somehow deemed more worthy of being included in the consensus. The two researchers also decided that scientific accomplishment should not be a factor in who could answer – those surveyed were determined by their place of employment (an academic or a governmental institution). Neither was academic qualification

a factor – about 1,000 of those surveyed did not have a Ph.D., some didn't even have a master's diploma." Only 5 percent of respondents self-identified as climate scientists.

Even worse than the sample size, the bias shown in its selection, and the low response rate, though, is the irrelevance of the questions asked in the survey to the debate taking place about climate change. The survey asked two questions:

"Q1. When compared with pre-1800s levels, do you think that mean global temperatures have generally risen, fallen, or remained relatively constant?"

Q2. Do you think human activity is a significant contributing factor in changing mean global temperatures?"

Overall, 90 percent of respondents answered "risen" to question 1 and 82 percent answered "yes" to question 2. The authors get their fraudulent "97 percent of climate scientists believe" sound bite by focusing on only 79 scientists who responded and "listed climate science as their area of expertise and who also have published more than 50 percent of their recent peer-reviewed papers on the subject of climate change."

Most skeptics of man-made global warming would answer those two questions the same way as alarmists would. At issue is not whether the climate warmed since the Little Ice Age or whether there is a human impact on climate, but whether the warming is unusual in rate or magnitude; whether that part of it attributable to human causes is likely to be beneficial or harmful on net and by how much; and whether the benefits of reducing human carbon dioxide emissions – i.e., reducing the use of fossil fuels – would outweigh the costs, so as to justify public policies aimed at reducing those emissions. The survey is silent on these questions.

The survey by Doran and Zimmerman fails to produce evidence that would back up claims of a "scientific consensus" about the causes or consequences of climate change. They simply asked the wrong people the wrong questions. The "98 percent" figure so often attributed to their survey refers to the opinions of only 79 scientists, hardly a representative sample of scientific opinion.

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### **Anderegg et al., 2010**

The third source cited by NASA as proof of a “scientific consensus” is another paper written by a college student. William R. Love Anderegg, then a student at Stanford University, used Google Scholar to identify the views of the most prolific writers on climate change. He claimed to find “(i) 97–98% of the climate researchers most actively publishing in the field support the tenets of ACC [anthropogenic climate change] outlined by the Intergovernmental Panel on Climate Change, and (ii) the relative climate expertise and scientific prominence of the researchers unconvinced of ACC are substantially below that of the convinced researchers” (Anderegg *et al.*, 2010). This college paper was published in *Proceedings of the National Academy of Sciences*, thanks to the addition of three academics as coauthors.

This is not a survey of scientists, whether “all scientists” or specifically climate scientists. Instead, Anderegg simply counted the number of articles he found on the Internet published in academic journals by 908 scientists. This counting exercise is the same flawed methodology utilized by Oreskes, falsely assuming abstracts of papers accurately reflect their findings. Further, Anderegg did not determine how many of these authors believe global warming is harmful or that the science is sufficiently established to be the basis for public policy. Anyone who cites this study in defense of these views is mistaken.

Anderegg *et al.* also didn’t count as “skeptics” the scientists whose work exposes gaps in the man-made global warming theory or contradicts claims that climate change will be catastrophic. Avery (2007) identified several hundred scientists who fall into this category, even though some profess to “believe” in global warming.

Looking past the flashy “97–98%” claim, Anderegg *et al.* found the average skeptic has been published about half as frequently as the average

alarmist (60 versus 119 articles). Most of this difference was driven by the hyper-productivity of a handful of alarmist climate scientists: The 50 most prolific alarmists were published an average of 408 times, versus only 89 times for the skeptics. The extraordinary publication rate of alarmists should raise a red flag. It is unlikely these scientists actually participated in most of the experiments or research contained in articles bearing their names.

The difference in productivity between alarmists and skeptics can be explained by several factors other than merit:

- Publication bias – articles that “find something,” such as a statistically significant correlation that might suggest causation, are much more likely to get published than those that do not;
- Heavy government funding of the search for one result but little or no funding for other results – the U.S. government alone paid \$64 billion to climate researchers during the four years from 2010 to 2013, virtually all of it explicitly assuming or intended to find a human impact on climate and virtually nothing on the possibility of natural causes of climate change (Butos and McQuade, 2015, Table 2, p. 178);
- Resumé padding – it is increasingly common for academic articles on climate change to have multiple and even a dozen or more authors, inflating the number of times a researcher can claim to have been published (Hotz, 2015). Adding a previously published researcher’s name to the work of more junior researchers helps ensure approval by peer reviewers (as was the case, ironically, with Anderegg *et al.*);
- Differences in the age and academic status of global warming alarmists versus skeptics – climate scientists who are skeptics tend to be older and more are emeritus than their counterparts on the alarmist side; skeptics are under less pressure and often are simply less eager to publish.

So what, exactly, did Anderegg *et al.* discover? That a small clique of climate alarmists had their names added to hundreds of articles published in academic journals, something that probably would have been impossible or judged unethical just a decade or two ago. Anderegg *et al.* simply assert those “top 50” are more credible than scientists who publish less, but they

make no effort to prove this and there is ample evidence they are not (Solomon, 2008). Once again, Anderegg *et al.* did not ask if authors believe global warming is a serious problem or if science is sufficiently established to be the basis for public policy. Anyone who cites this study as evidence of scientific support for such views is misrepresenting the paper.

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## Cook *et al.*, 2013

NASA's fourth source proving a "scientific consensus" is an abstract-counting exercise by a wacky Australian blogger named John Cook. Cook makes no effort to disguise his bias: His blog, misleadingly called "Skeptical Science," is mostly a collection of talking points for environmental activists and attacks on realists. He's also the author of a book titled *Climate Change Denial: Heads in the Sand*. When he's not writing about global warming, he's a professional cartoonist (PopularTechnology.net, 2012). Why does NASA consider him to be a credible source of evidence of scientific consensus?

In 2013, Cook and some of his friends persuaded *Environmental*

*Research Letters* to publish their claim that a review of the abstracts of peer-reviewed papers from 1991 to 2011 found 97 percent of those that stated a position explicitly or implicitly suggested human activity is responsible for some warming (Cook *et al.*, 2013). This exercise in abstract-counting doesn't support the alarmist claim that climate change is both man-made and dangerous, and it doesn't even support IPCC's claim that a majority of global warming in the twentieth century was man-made.

This study was quickly debunked by Legates *et al.* (2015) in a paper published in *Science & Education*. Legates *et al.* found "just 0.03 percent endorsement of the standard definition of consensus: that most warming since 1950 is anthropogenic." They found "only 41 papers – 0.3 percent of all 11,944 abstracts or 1.0 percent of the 4,014 expressing an opinion, and not 97.1 percent – had been found to endorse the standard or quantitative hypothesis."

Scientists whose work questions the consensus, including Craig Idso, Nils-Axel Mörner, Nicola Scafetta, and Nir J. Shaviv, protested that Cook misrepresented their work (Popular Technology.net, 2013).

Richard Tol, a lead author of the United Nations' IPCC reports, said of the Cook report, "the sample of papers does not represent the literature. That is, the main finding of the paper is incorrect, invalid and unrepresentative" (Tol, 2013). On a blog of *The Guardian*, a British newspaper that had reported on the Cook report, Tol explained: "Cook's sample is not representative. Any conclusion they draw is not about 'the literature' but rather about the papers they happened to find. Most of the papers they studied are not about climate change and its causes, but many were taken as evidence nonetheless. Papers on carbon taxes naturally assume that carbon dioxide emissions cause global warming – but assumptions are not conclusions. Cook's claim of an increasing consensus over time is entirely due to an increase of the number of irrelevant papers that Cook and Co. mistook for evidence" (Tol, 2014).

Montford (2013) produced a blistering critique of Cook *et al.* in a report for the Global Warming Policy Foundation. He reveals the authors were marketing the expected results of the paper before the research itself was conducted; changed the definition of an endorsement of the global warming hypothesis mid-stream when it became apparent the abstracts they were reviewing did not support their original (IPCC-based) definition; and gave guidance to the volunteers recruited to read and score abstracts "suggest[ing] that an abstract containing the words 'Emissions of a broad

range of greenhouse gases of varying lifetimes contribute to global climate change' should be taken as explicit but unquantified endorsement of the consensus. Clearly the phrase quoted could imply any level of human contribution to warming." Montford concludes "the consensus referred to is trivial" since the paper "said nothing about global warming being dangerous" and that "the project was not a scientific investigation to determine the extent of agreement on global warming, but a public relations exercise."

A group of Canadian retired Earth and atmospheric scientists called Friends of Science produced a report in 2014 that reviewed the four surveys and abstract-counting exercises summarized above (Friends of Science, 2014). The scientists searched the papers for the percentage of respondents or abstracts that explicitly agree with IPCC's declaration that human activity is responsible for more than half of observed warming. They found Oreskes found only 1.2 percent agreement; Doran and Zimmerman, 3.4 percent; Anderegg *et al.*, 66 percent; and Cook *et al.*, 0.54 percent. They conclude, "The purpose of the 97% claim lies in the psychological sciences, not in climate science. A 97% consensus claim is merely a 'social proof' – a powerful psychological motivator intended to make the public comply with the herd; to not be the 'odd man out.' Friends of Science deconstruction of these surveys shows there is no 97% consensus on human-caused global warming as claimed in these studies. None of these studies indicate any agreement with a catastrophic view of human-caused global warming" (p. 4).

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## Evidence of Lack of Consensus

In contrast to the studies described above, which try but fail to find a consensus in support of the claim that global warming is man-made and dangerous, many authors and surveys have found widespread disagreement or even that a majority of scientists oppose the alleged consensus. These surveys and studies generally suffer the same methodological errors as afflict the ones described above, but they suggest that even playing by the alarmists' rules, the results demonstrate disagreement rather than consensus.

### **Klaus-Martin Schulte, 2008**

Schulte (2008), a practicing physician, observed, "Recently, patients alarmed by the tone of media reports and political speeches on climate change have been voicing distress, for fear of the imagined consequences of anthropogenic 'global warming.'" Concern that his patients were experiencing unnecessary stress "prompted me to review the literature available on 'climate change and health' via PubMed

(<http://www.ncbi.nlm.nih.gov/sites/entrez>)” and then to attempt to replicate Oreskes’ 2004 report.

“In the present study,” Schulte wrote, “Oreskes’ research was brought up to date by using the same search term on the same database to identify abstracts of 539 scientific papers published between 2004 and mid-February 2007.” According to Schulte, “The results show a tripling of the mean annual publication rate for papers using the search term ‘global climate change’, and, at the same time, a significant movement of scientific opinion away from the apparently unanimous consensus which Oreskes had found in the learned journals from 1993 to 2003. Remarkably, the proportion of papers explicitly or implicitly rejecting the consensus has risen from zero in the period 1993–2003 to almost 6% since 2004. Six papers reject the consensus outright.”

Schulte also found “Though Oreskes did not state how many of the papers she reviewed explicitly endorsed the consensus that human greenhouse-gas emissions are responsible for more than half of the past 50 years’ warming, only 7% of the more recent papers reviewed here were explicit in endorsing the consensus even in the strictly limited sense she had defined. The proportion of papers that now explicitly or implicitly endorse the consensus has fallen from 75% to 45%.”

Schulte’s findings demonstrate that if Oreskes’ methodology were correct and her findings for the period 1993 to 2003 accurate, then scientific publications in the more recent period of 2004–2007 show a strong tendency away from the consensus Oreskes claimed to have found. We can doubt the utility of the methodology used by both Oreskes and Schulte but recognize that the same methodology applied during two time periods reveals a significant shift from consensus to open debate on the causes of climate change.

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## **Dennis Bray and Hans von Storch, 1996, 2003, 2008, 2010**

Surveys by German scientists Dennis Bray and Hans von Storch conducted

in 1996, 2003, 2008, and 2010 consistently found climate scientists have deep doubts about the reliability of the science underlying claims of man-made climate change (Bray and von Storch, 2007; Bray and von Storch, 2008; Bray and von Storch, 2010). This finding is seldom reported because the authors repeatedly portray their findings as supporting, as Bray wrote in 2010, “three dimensions of consensus, as it pertains to climate change science: 1. manifestation, 2. attribution, and 3. legitimation” (Bray, 2010). They do not.

One question in Bray and von Storch’s latest survey (2010) asked scientists to grade, on a scale from 1 = “very inadequate” to 7 = “very adequate,” the “data availability for climate change analysis.” On this very important question, more respondents said “very inadequate” (1 or 2) than “very adequate” (6 or 7), with most responses ranging between 3 and 5.

Bray and von Storch summarized their survey results using a series of graphs plotting responses to each question. In their latest survey, 54 graphs show responses to questions addressing scientific issues as opposed to opinions about IPCC, where journalists tend to get their information, personal identification with environmental causes, etc. About a third show more skepticism than confidence, a third show more confidence than skepticism, and a third suggest equal amounts of skepticism and confidence.

For example, more scientists said “very inadequate” (1 or 2) than “very adequate” (6 or 7) when asked “How well do atmospheric models deal with the influence of clouds?” and “How well do atmospheric models deal with precipitation?” and “How well do atmospheric models deal with atmospheric convection?” and “The ability of global climate models to model sea-level rise for the next 50 years” and “The ability of global climate models to model extreme events for the next 10 years.” These are not arcane or trivial matters in the climate debate.

Unfortunately, the Bray and von Storch surveys also show disagreement and outright skepticism about the underlying science of climate change don’t prevent most scientists from expressing their opinion that man-made global warming is occurring and is a serious problem. On those questions, the distribution skews away from uncertainty and toward confidence. Observing this contradiction in their 1996 survey, Bray and von Storch described it as “an empirical example of ‘postnormal science,’” the willingness to endorse a perceived consensus despite knowledge of contradictory scientific knowledge when the risks are perceived as being great (Bray and von Storch, 1999). Others might refer to this as cognitive

dissonance, holding two contradictory opinions at the same time, or “herding,” the well-documented tendency of academics facing uncertainty to ignore research that questions a perceived consensus position in order to advance their careers (Baddeleya, 2013).

On their face, Bray and von Storch’s results should be easy to interpret. For at least a third of the questions asked, more scientists aren’t satisfied than are with the quality of data, reliability of models, or predictions about future climate conditions. For another third, there is as much skepticism as there is strong confidence. Most scientists are somewhere in the middle, somewhat convinced that man-made climate change is occurring but concerned about lack of data and other fundamental uncertainties, far from the “95%+ certainty” claimed by IPCC.

Bray and von Storch are very coy in reporting and admitting the amount of disagreement their surveys find on the basic science of global warming, suggesting they have succumbed to the very cognitive dissonance they once described. But their data clearly reveal a truth: There is no scientific consensus.

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### **Verheggen *et al.*, 2014, 2015**

Verheggen *et al.* (2014) and Strengers, Verheggen, and Vringer (2015) reported the results of a survey they conducted in 2012 of contributors to IPCC reports, authors of articles appearing in scientific literature, and signers of petitions on global warming (but apparently not the Global Warming Petition Project, described below). By the authors' own admission, "signatories of public statements disapproving of mainstream climate science ... amounts to less than 5% of the total number of respondents," suggesting the sample is heavily biased toward pro-"consensus" views. Nevertheless, this survey found fewer than half of respondents agreed with IPCC's most recent claims.

A total of 7,555 authors were contacted and 1,868 questionnaires were returned, for a response rate of 29 percent. Verheggen *et al.* asked specifically about agreement or disagreement with IPCC's claim in its *Fifth Assessment Report* (AR5) that it is "virtually certain" or "extremely likely" that net anthropogenic activities are responsible for more than half of the observed increase in global average temperatures in the past 50 years.

When asked "What fraction of global warming since the mid 20th century can be attributed to human induced increases in atmospheric greenhouse gas (GHG) concentrations?," 64 percent chose fractions of 51 percent or more, indicating agreement with IPCC AR5. (Strengers, Verheggen, and Vringer, 2015, Figure 1a.1) When those who chose fractions of 51 percent or more were asked, "What confidence level would you ascribe to your estimate that the anthropogenic GHG warming is more than 50%?," 65 percent said it was "virtually certain" or "extremely likely," the language used by IPCC to characterize its level of confidence (*Ibid.*, Figure 1b).

The math is pretty simple: Two-thirds of the authors in this survey – a sample heavily biased toward IPCC's point of view by including virtually all its editors and contributors – agreed with IPCC on the impact of human emissions on the climate, and two-thirds of those who agreed were as confident as IPCC in that finding. Sixty-five percent of 64 percent is 41.6 percent, so fewer than half of the survey's respondents support IPCC. More precisely – since some responses were difficult to interpret – 42.6 percent

(797 of 1,868) of respondents were highly confident that more than 50 percent of the warming is human-caused.

This survey shows IPCC's position on global warming is the minority perspective in this part of the science community. Since the sample was heavily biased toward contributors to IPCC reports and academics most likely to publish, one can assume a survey of a larger universe of scientists would reveal even less support for IPCC's position.

Like Bray and von Storch (2010) discussed above, and Stenhouse *et al.*, (2014) discussed below, Verheggen *et al.* seem embarrassed by their findings and hide them in tables in a report issued a year after their original publication rather than explain them in the text of their peer-reviewed article. It took the efforts of a blogger to call attention to the real data (Fabius Maximus, 2015). Once again, the data reveal no scientific consensus.

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## Surveys of Meteorologists and Environmental Professionals

The American Meteorological Society (AMS) reported in 2013 that only 52 percent of AMS members who responded to its survey reported believing the warming of the past 150 years was man-made (Stenhouse *et al.*, 2014). The finding was reported in a table on the last page of the pre-publication version of the paper and was not even mentioned in the body of the peer-reviewed article.

From an earlier publication of the survey's results (Maibach *et al.*, 2012) it appears 76 percent of those who believe in man-made global warming also believe it is "very harmful" or "somewhat harmful," so it appears 39.5 percent of AMS members responding to the survey say they believe man-made global warming could be dangerous. Once again, this finding doesn't appear in the peer-reviewed article.

Questions asked in the AMS survey reveal political ideology is the strongest or second strongest factor in determining a scientist's position on global warming. But the published report doesn't reveal whether all or just nearly all of the AMS members who believe man-made global warming is dangerous self-identify as being liberals. In light of the numbers presented above, this appears likely.

Other surveys of meteorologists also found a majority oppose the alleged consensus (Taylor, 2010a, 2010b). A 2006 survey of scientists in the U.S. conducted by the National Registry of Environmental Professionals, for example, found 41 percent disagreed the planet's recent warmth "can be, in large part, attributed to human activity," and 71 percent disagreed recent hurricane activity is significantly attributable to human activity (Taylor, 2007).

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## **Global Warming Petition Project**

The Global Warming Petition Project (2015) is a statement about the causes and consequences of climate change signed by 31,478 American scientists, including 9,021 with Ph.D.s. The full statement reads:

We urge the United States government to reject the global warming agreement that was written in Kyoto, Japan in December, 1997, and any other similar proposals. The proposed limits on greenhouse gases would harm the environment, hinder the advance of science and technology, and damage the health and welfare of mankind.

There is no convincing scientific evidence that human release of carbon dioxide, methane, or other greenhouse gases is causing or will, in the foreseeable future, cause catastrophic heating of the Earth's atmosphere and disruption of the Earth's climate. Moreover, there is substantial scientific evidence that increases in atmospheric carbon dioxide produce many beneficial effects upon the natural plant and animal environments of the Earth.

This is a remarkably strong statement of dissent from the perspective advanced by IPCC. The fact that more than ten times as many scientists have signed it as are alleged to have “participated” in some way or another in the research, writing, and review of IPCC's *Fourth Assessment Report* is very significant. These scientists actually endorse the statement that appears above. By contrast, fewer than 100 of the scientists (and nonscientists) who are listed in the appendices to IPCC reports actually participated in the writing of the all-important *Summary for Policymakers*



or the editing of the final report to comply with the summary, and therefore could be said to endorse the main findings of that report.

The Global Warming Petition Project has been criticized for including names of suspected nonscientists, including names submitted by environmental activists for the purpose of discrediting the petition. But the organizers of the project painstakingly reconfirmed the authenticity of the names in 2007, and a complete directory of those names appeared as an appendix to *Climate Change Reconsidered: Report of the Nongovernmental International Panel on Climate Change (NIPCC)*, published in 2009 (Idso and Singer, 2009). For more information about The Petition Project, including the text of the letter endorsing it written by the late Dr. Frederick Seitz, past president of the National Academy of Sciences and president emeritus of Rockefeller University, visit the project's website at [www.petitionproject.org](http://www.petitionproject.org).

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## Admissions of Lack of Consensus

Even prominent “alarmists” in the climate change debate admit there is no consensus. Phil Jones, director of the Climatic Research Unit at the University of East Anglia, when asked if the debate on climate change is over, told the BBC, “I don’t believe the vast majority of climate scientists think this. This is not my view” (BBC News, 2010). When asked, “Do you agree that according to the global temperature record used by IPCC, the rates of global warming from 1860–1880, 1910–1940 and 1975–1998 were identical?” Jones replied,

Temperature data for the period 1860–1880 are more uncertain, because of sparser coverage, than for later periods in the 20th Century. The 1860–1880 period is also only 21 years in length. As

NO CONSENSUS

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for the two periods 1910–40 and 1975–1998 the warming rates are not statistically significantly different (see numbers below).

I have also included the trend over the period 1975 to 2009, which has a very similar trend to the period 1975–1998.

So, in answer to the question, the warming rates for all 4 periods are similar and not statistically significantly different from each other.

Finally, when asked “Do you agree that from 1995 to the present there has been no statistically significant global warming” Jones answered “yes.” His replies contradict claims made by IPCC.

Mike Hulme, also a professor at the University of East Anglia and a contributor to IPCC reports, wrote in 2009: “What is causing climate change? By how much is warming likely to accelerate? What level of warming is dangerous? – represent just three of a number of contested or uncertain areas of knowledge about climate change” (Hulme, 2009, p. 75). He admits “Uncertainty pervades scientific predictions about the future performance of global and regional climates. And uncertainties multiply when considering all the consequences that might follow from such changes in climate” (p. 83). On the subject of IPCC’s credibility, he admits it is “governed by a Bureau consisting of selected governmental representatives, thus ensuring that the Panel’s work was clearly seen to be serving the needs of government and policy. The Panel was not to be a self-governing body of independent scientists” (p. 95). All this is exactly what IPCC critics have been saying for years.

\* \* \*

As this summary makes apparent, there is no survey or study that supports the claim of a scientific consensus that global warming is both man-made and a problem, and ample evidence to the contrary. There is no scientific consensus on global warming.

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# 2

## ***Why Scientists Disagree***

Key findings in this section include the following:

- Climate is an interdisciplinary subject requiring insights from many fields. Very few scholars have mastery of more than one or two of these disciplines.
- Fundamental uncertainties arise from insufficient observational evidence, disagreements over how to interpret data, and how to set the parameters of models.
- The United Nations' Intergovernmental International Panel on Climate Change (IPCC), created to find and disseminate research finding a human impact on global climate, is not a credible source. It is agenda-driven, a political rather than scientific body, and some allege it is corrupt.
- Climate scientists, like all humans, can be biased. Origins of bias include careerism, grant-seeking, political views, and confirmation bias.

### **Conflict of Disciplines**

One reason disagreement among those participating in the climate change debate may be sharper and sometimes more personal than is observed in debates on other topics is because climate is an interdisciplinary subject

requiring insights from astronomy, biology, botany, cosmology, economics, geochemistry, geology, history, oceanography, paleontology, physics, and scientific forecasting and statistics, among other disciplines. Very few scholars in the field have mastery of more than one or two of these disciplines.

Richard S. Lindzen, an atmospheric physicist at MIT, observed, “Outside any given specialty, there are few – including scientists – who can distinguish one scientist from another, and this leaves a great deal of latitude for advocates and politicians to invent their own ‘experts.’ ... In effect, once political action is anticipated, the supporting scientific position is given a certain status whereby objections are reckoned to represent mere uncertainty, while scientific expertise is strongly discounted” (Lindzen, 1996, p. 98).

When an expert in one field, say physics, presents an estimate of the climate’s sensitivity to rising carbon dioxide levels, an expert in another field, say biology, can quickly challenge his understanding of the carbon cycle, whereby huge volumes of carbon dioxide are added to and removed from the atmosphere. Unless the physicist is intimately familiar with the literature on the impact of rising levels of CO<sub>2</sub> on photosynthesis, plant growth, and carbon sequestration by plants and aquatic creatures, he or she is missing the bigger picture and is likely to be wrong. But so too will the biologist miss the “big picture” if he or she doesn’t understand the transfer of energy at the top of the atmosphere and how the effects of CO<sub>2</sub> change logarithmically as its concentration rises.

Geologists view time in millennia and eons and are aware of huge fluctuations in both global temperatures and carbon dioxide concentrations in the atmosphere, with the two often moving in different directions. They scoff at physicists and botanists who express concern over a historically tiny increase in carbon dioxide concentrations of 100 parts per million and a half-degree C increase in temperature over the course of a century. But how many geologists understand the impact of even relatively small changes in temperature or humidity on the range and health of some plants and animals?

Economists are likely to ask if the benefits of trying to “stop” global warming outweigh the benefits of providing clean water or electricity to billions of people living in terrible poverty. Wouldn’t it be wiser – better for humanity and perhaps even wildlife – to focus on helping people today become more prosperous and consequently more concerned about

protecting the environment and able to afford to adapt to changes in weather regardless of their causes? But do economists properly value the contribution of ecological systems to human welfare, or apply properly the discount rates they use to measure costs and benefits that occur far in the future?

Simon (1999) observed another consequence of this tunnel vision. Scientists are often optimistic about the safety of the environment when it relates to subjects encompassing their own area of research and expertise, but are pessimistic about risks outside their range of expertise. Simon wrote:

This phenomenon is apparent everywhere. Physicians know about the extraordinary progress in medicine that they fully expect to continue, but they can't believe in the same sort of progress in natural resources. Geologists know about the progress in natural resources that pushes down their prices, but they worry about food. Even worse, some of those who are most optimistic about their own areas point with alarm to other issues to promote their own initiatives. The motive is sometimes self-interest (pp. 47–8).

The climate change debate resembles the famous tale of a group of blind men touching various parts of an elephant, each arriving at a very different idea of what it is like: to one it is like a tree, to another, a snake, and to a third, a wall. A wise man tells the group, "You are all right. An elephant has all the features you mentioned." But how many physicists, geologists, biologists, and economists want to be told they are missing "the big picture" or that their earnest concern and good research aren't enough to describe a complex phenomenon, and therefore not a reliable guide to making decisions about what mankind should do? Few indeed.

This source of disagreement seems obvious but is seldom discussed. Scientists (both physical scientists and social scientists) make assertions and predictions claiming high degrees of confidence, a term with precise meaning in science but turned into an empty tool of rhetoric by IPCC and its allies, that are wholly unjustified given their training and ignorance of large parts of the vast literature regarding climate.

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## Scientific Uncertainties

Fundamental uncertainties arise from insufficient observational evidence, disagreements over how to interpret data, and how to set the parameters of models.

The claim that human activities are causing or will cause catastrophic global warming or climate change is a rebuttable hypothesis, not a scientific theory and certainly not the “consensus” view of the science community. The human impact on climate remains a puzzle. As Bony *et al.* wrote in 2015, “Fundamental puzzles of climate science remain unsolved because of our limited understanding of how clouds, circulation and climate interact” (abstract).

Reporting in *Nature* on Bony’s study, Quirin Schiermeier wrote, “There is a misconception that the major challenges in physical climate science are settled. ‘That’s absolutely not true,’ says Sandrine Bony, a climate researcher at the Laboratory of Dynamic Meteorology in Paris. ‘In fact, essential physical aspects of climate change are poorly understood’” (Schiermeier, 2015, p. 140). Schiermeier goes on to write, “large uncertainties persist in ‘climate sensitivity,’ the increase in average global temperature caused by a given rise in the concentration of carbon dioxide,” citing Bjorn Stevens, a director at the Max Planck Institute for Meteorology in Hamburg, Germany (*Ibid.*). Bony has also identified uncertainty in climate science in the journal *Science* (Stevens and Bony, 2013).

The first volume in the *Climate Change Reconsidered II* series cited thousands of peer-reviewed articles and studies revealing the extensive uncertainty acknowledged by Bony *et al.* Since the *Summary for Policymakers* of that volume appears below (Chapters 3 to 7), there is no need to summarize its findings here. Instead, it is useful to ponder the views of two prominent climate scientists whose scientific contributions to the

debate are widely acknowledged.

Richard S. Lindzen, quoted earlier, is one of the world's most distinguished atmospheric physicists. According to the biography on MIT's website, "he has developed models for the Earth's climate with specific concern for the stability of the ice caps, the sensitivity to increases in CO<sub>2</sub>, the origin of the 100,000 year cycle in glaciation, and the maintenance of regional variations in climate. Prof. Lindzen is a recipient of the AMS's Meisinger, and Charney Awards, the AGU's Macelwane Medal, and the Leo Huss Walin Prize. He is a member of the National Academy of Sciences, and the Norwegian Academy of Sciences and Letters, and a fellow of the American Academy of Arts and Sciences, the American Association for the Advancement of Sciences, the American Geophysical Union and the American Meteorological Society.

"Lindzen is a corresponding member of the NAS Committee on Human Rights, and has been a member of the NRC Board on Atmospheric Sciences and Climate and the Council of the AMS. He has also been a consultant to the Global Modeling and Simulation Group at NASA's Goddard Space Flight Center, and a Distinguished Visiting Scientist at California Institute of Technology's Jet Propulsion Laboratory." He received his Ph.D. from Harvard University in 1964.

According to Lindzen (1996), there are three principal areas of uncertainty in climate science:

- "First, the basic greenhouse process is not simple. In particular, it is not merely a matter of the bases that absorb heat radiation – greenhouse gases – keeping the earth warm. If it were, the natural greenhouse would be about four times more effective than it actually is. ...
- "Second, the most important greenhouse gas in the atmosphere is water vapor. ... Roughly speaking, changes in relative humidity on the order of 1.3 to 4 percent are equivalent to the effect of doubling carbon dioxide. Our measurement uncertainty for trends in water vapor is in excess of 10 percent, and once again, model errors are known to substantially exceed measurement errors in a very systematic way.
- "Third, the direct impact of doubling carbon dioxide on the earth's temperature is rather small: on the order of .3 degrees C. Larger predictions depend on positive feedbacks. ... [T]hose factors arise from models with errors in those factors."



“[T]here is very little argument about the above points,” Lindzen wrote. “They are, for the most part, textbook material showing that there are errors and uncertainties in physical processes central to model predictions that are an order of magnitude greater than the climate forcing due to a putative doubling of carbon dioxide. There is, nonetheless, argument over whether the above points mean that the predicted significant response to increased carbon dioxide is without meaningful basis. Here there is disagreement” (pp. 86–7). For Lindzen’s more recent views (which are similar) see Lindzen (2012).

A second recognized authority is Judith Curry, a professor and former chair of the School of Earth and Atmospheric Sciences at the Georgia Institute of Technology. Her Ph.D. in geophysical sciences is from the University of Chicago, and she served for three decades on the faculties of the University of Wisconsin-Madison, Purdue, Penn State, University of Colorado-Boulder, and since 2002 at the Georgia Institute of Technology. She is an elected fellow of the American Geophysical Union and councilor and fellow of the American Meteorological Society.

Curry delivered a speech on June 15, 2015 to the British House of Lords. Titled “State of the climate debate in the U.S.,” the prepared text of her remarks is available online (Curry, 2015). Curry wrote, “there is widespread agreement” on three basic tenets: “Surface temperatures have increased since 1880, humans are adding carbon dioxide to the atmosphere, [and] carbon dioxide and other greenhouse gases have a warming effect on the planet.” However, she wrote, “there is disagreement about the most consequential issues,” which she lists as the following:

- “Whether the warming since 1950 has been dominated by human causes
- “How much the planet will warm in the 21st century
- “Whether warming is ‘dangerous’
- “Whether we can afford to radically reduce CO<sub>2</sub> emissions, and whether reduction will improve the climate”

Observing the “growing divergence between models and observations,” she poses three questions:

- “Are climate models too sensitive to greenhouse forcing?”

- “Is the modeled treatment of natural climate variability inadequate?”
- “Are climate model projections of 21st century warming too high?”

After observing surveys show most scientists seem to accept IPCC’s claims, she wrote, “Nevertheless, a great deal of uncertainty remains, and there is plenty of room for disagreement. So why do scientists disagree?” She gives five possible reasons:

- “Insufficient observational evidence
- “Disagreement about the value of different classes of evidence
- “Disagreement about the appropriate logical framework for linking and assessing the evidence
- “Assessments of areas of ambiguity & ignorance
- “And finally, the politicization of the science can torque the science in politically desired directions.”

“None of the most consequential scientific uncertainties are going to be resolved any time soon,” Curry wrote. “[T]here is a great deal of work still to do to understand climate change. And there is a growing realization that unpredictable natural climate variability is important.”

All of this concurs with the findings of NIPCC and was documented at great length in *Climate Change Reconsidered II: Physical Science* and *Climate Change Reconsidered II: Biological Impacts* (Idso *et al.*, 2013; Idso *et al.*, 2014).

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## Failure of IPCC

The Intergovernmental Panel on Climate Change (IPCC), created to find and disseminate research finding a human impact on global climate, is not a credible source. It is agenda-driven, a political rather than scientific body, and some allege it is corrupt.

According to Bray (2010), “In terms of providing future projection[s] of the global climate, the most significant player in setting the agenda is the Intergovernmental Panel on Climate Change (IPCC). It is typically assumed that IPCC, consisting of some 2500 climate scientists, after weighing the evidence, arrived at a consensus that global temperatures are rising and the most plausible cause is anthropogenic in nature.” As this section will explain, that assumption is wrong.

Prior to the mid-1980s very few climate scientists believed man-made climate change was a problem. This non-alarmist “consensus” on the causes and consequences of climate change included nearly all the leading climate scientists in the world, including Roger Revelle, often identified as one of the first scientists to “sound the alarm” over man-made global warming (Solomon, 2008; Singer, Revelle and Starr, 1992).

Most of the reports purporting to show a “consensus” beginning in the 1980s came from and continue to come from committees funded by

government agencies tasked with finding a new problem to address or by liberal foundations with little or no scientific expertise (Darwall, 2013; Carlin, 2015; Moore *et al.*, 2014). These committees, one of which was IPCC, often produced reports making increasingly bold and confident assertions about future climate impacts, but they invariably included statements admitting deep scientific uncertainty (Weart, 2015). Reports of IPCC, including drafts of the latest *Fifth Assessment Report*, are replete with examples of this pattern.

It is common for committees seeking consensus reports to include qualifications and admissions of uncertainty and even publish dissenting reports by committee members. This common practice had an unintended result in the climate debate. Politicians, environmental activists, and rent-seeking corporations in the renewable energy industry began to routinely quote IPCC's alarming claims and predictions shorn of the important qualifying statements expressing deep doubts and reservations. Rather than protest this mishandling of its work, IPCC encouraged it by producing *Summaries for Policymakers* that edit away or attempt to hide qualifying statements. IPCC news releases have become more and more alarmist over time until they are indistinguishable from the news releases and newsletters of environmental groups. In fact, many of those IPCC news releases were written or strongly influenced by professional environmental activists who had effectively taken over the organization.

Some climate scientists spoke out early and forcefully against this corruption of science (Idso, 1982; Landsberg, 1984; Idso, 1989; Singer, 1989; Jastrow, Nierenberg, and Seitz, 1990; Balling, 1992; Michaels, 1992), but their voices were difficult to hear amid a steady drumbeat of doomsday forecasts produced by environmentalists and their allies in the mainstream media.

Perhaps the most conspicuous and consequential example of this practice occurred in 2006 in the form of a movie titled *An Inconvenient Truth*, produced by former Vice President Al Gore, and Gore's book with the same title (Gore, 2006). The movie earned Gore a Nobel Peace Prize (shared with IPCC), yet it made so many unsubstantiated claims and over-the-top predictions it was declared "propaganda" by a UK judge, and schools there were ordered to give students a study guide identifying and correcting its errors before showing the movie (*Dimmock v. Secretary of State for Education and Skills*, 2007).

The principal source cited in Gore's movie and book, and arguably the

reason it was well-received by much of the science community, was IPCC. There is no evidence IPCC ever complained about the misrepresentation of its report in the film or asked for corrections. Despite documentation of the film's and book's many flaws (e.g., Lewis, 2007), Gore has never revised the book or even acknowledged the errors.

IPCC's reliability was crippled at birth, mandated by the UN Framework Convention on Climate Change (UNFCCC) to define climate change as human-caused climate change and to disregard naturally caused climate change. Since natural climate change is at the very center of the debate over whether human activity is influencing the climate and by how much, this essentially predetermined IPCC's conclusions. Tasked with finding a human impact on climate and calling on the nations of the world to do something about it, IPCC pursued its mission with fierce dedication.

IPCC's reports have been subjected to withering criticism by scientists and authors almost too numerous to count, including even high-profile editors and contributors to its reports (Seitz, 1996; Lindzen, 2012; Tol, 2014; Stavins, 2014) and no fewer than six rigorously researched books by one climate scientist, Patrick Michaels, former president of the American Association of State Climatologists, former program chair for the Committee on Applied Climatology of the American Meteorological Society, and a research professor of Environmental Sciences at the University of Virginia for 30 years (Michaels, 1992, 2000, 2005a, 2005b, 2009, 2011). Michaels also was a contributing author and is a reviewer of IPCC's reports. Besides Michaels, see Singer (1997); Essex and McKittrick (2003); McIntyre and McKittrick (2005); Green and Armstrong (2007); Green, Armstrong, and Soon (2009); Pielke Jr. (2010); Carter (2010); Bell (2011); and Vahrenholt and Lüning (2015).

Others have pointed out IPCC's heavy reliance on environmental advocacy groups in the compilation of its official reports, using their personnel as lead authors and incorporating their publications – even newsletters – as source material (Laframboise, 2011). Scientists who participated in the latest IPCC report (AR5) described the process of producing the *Summary for Policymakers* as “exceptionally frustrating” and “one of the most extraordinary experiences of my academic life” (*Economist*, 2014).

Criticism hasn't come only from individual scientists. *Nature*, a prominent science journal, editorialized in 2013: “[I]t is time to rethink the IPCC. The organization deserves thanks and respect from all who care

about the principle of evidence-based policy-making, but the current report should be its last mega-assessment.” (*Nature*, 2013) After describing the “exponential” growth of its reports and “truly breathtaking array of data” IPCC reports offer, the editors wrote, “Unfortunately, one thing that has not changed is that scientists cannot say with any certainty what rate of warming might be expected, or what effects humanity might want to prepare for, hedge against or avoid at all costs. In particular, the temperature range of the warming that would result from a doubling of atmospheric carbon dioxide levels is expected to be judged as 1.5–4.5°C in next week’s report – wider than in the last assessment and exactly what it was in the report of 1990. ... Absent from next week’s report, for instance, is recent and ongoing research on the rate of warming and what is – or is not – behind the plateau in average global temperatures that the world has experienced during the past 15 years. These questions have important policy implications, and the IPCC is the right body to answer them. But it need not wait six years to do so” (*Ibid.*).

In 2014, a reporter for *Science*, published by the American Association for the Advancement of Science (AAAS), reported on political interference with IPCC’s *Fifth Assessment Report*: “Although the underlying technical report from WGIII was accepted by the IPCC, final, heated negotiations among scientific authors and diplomats led to a substantial deletion of figures and text from the influential ‘Summary for Policymakers’ (SPM). ... [S]ome fear that this redaction of content marks an overstepping of political interests, raising questions about division of labor between scientists and policy-makers and the need for new strategies in assessing complex science. Others argue that SPM should explicitly be coproduced with governments” (Wible, 2014). The subtitle of the article is “Did the ‘Summary for Policymakers’ become a summary by policy-makers?”

Later in 2014, after release of the Working Group III contribution to the *Fifth Assessment Report*, *Nature* reported critics “find the key conclusions unsurprising and short of detail. They say that the document sidesteps any hint of what specific countries, or groups of countries, should do to move towards clean energy systems. ... Some researchers have long argued for a more pragmatic and diversified approach to climate change” (Schiermeier, 2014, p. 298).

Particularly harsh criticism of IPCC has come from the Amsterdam-based InterAcademy Council (IAC), which is made up of the presidents of many of the world’s national science academies, the very

academies defenders of IPCC often say endorse IPCC's findings. IAC conducted a thorough audit of IPCC in 2010 (IAC, 2010). Among its findings:

*Fake confidence intervals:* IAC was highly critical of IPCC's method of assigning "confidence" levels to its forecasts, singling out "... the many statements in the Working Group II Summary for Policymakers that are assigned high confidence but are based on little evidence. Moreover, the apparent need to include statements of 'high confidence' (i.e., an 8 out of 10 chance of being correct) in the Summary for Policymakers led authors to make many vaguely defined statements that are difficult to refute, therefore making them of 'high confidence.' Such statements have little value" (p. 61).

*Use of gray-sources:* Too much reliance on unpublished and non-peer-reviewed sources (p. 63). Three sections of IPCC's 2001 climate assessment cited peer-reviewed material only 36 percent, 59 percent, and 84 percent of the time.

*Political interference:* Line-by-line editing of the summaries for policymakers during "grueling Plenary session that lasts several days, usually culminating in an all-night meeting. Scientists and government representatives who responded to the Committee's questionnaire suggested changes to reduce opportunities for political interference with the scientific results ..." (p. 64).

*The use of secret data:* "An unwillingness to share data with critics and enquirers and poor procedures to respond to freedom-of-information requests were the main problems uncovered in some of the controversies surrounding IPCC (Russell *et al.*, 2010; PBL, 2010). Poor access to data inhibits users' ability to check the quality of the data used and to verify the conclusions drawn ..." (p. 68).

*Selection of contributors is politicized:* Politicians decide which scientists are allowed to participate in the writing and review process: "political considerations are given more weight than scientific qualifications" (p. 14).

*Chapter authors exclude opposing views:* “Equally important is combating confirmation bias—the tendency of authors to place too much weight on their own views relative to other views (Jonas *et al.*, 2001). As pointed out to the Committee by a presenter and some questionnaire respondents, alternative views are not always cited in a chapter if the Lead Authors do not agree with them ...” (p. 18).

*Need for independent review:* “Although implementing the above recommendations would greatly strengthen the review process, it would not make the review process truly independent because the Working Group Co-chairs, who have overall responsibility for the preparation of the reports, are also responsible for selecting Review Editors. To be independent, the selection of Review Editors would have to be made by an individual or group not engaged in writing the report, and Review Editors would report directly to that individual or group (NRC, 1998, 2002)” (p. 21).

This is a damning critique. IPCC misrepresents its findings and does not properly peer review its reports. The selection of scientists who participate is politicized, the summary for policymakers is the product of late-night negotiations among governments and is not written by scientists, and more. The quotations above and the reference below are to a publicly circulated draft of IAC’s final report, still available online (see reference). The final report was heavily edited to water down and perhaps hide the extent of problems uncovered by the investigators, itself evidence of still more misconduct. The report received virtually no press attention in the United States.

In 2012, IPCC issued a news release saying in part, “IPCC’s 32nd session in Busan, Republic of Korea, in October 2010, adopted most of the IAC recommendations, and set up Task Groups to work on their implementation” (IPCC, 2012). One key recommendation, that a new Executive Committee be created that would include “three independent members,” was almost comically disregarded: the committee was created, but all three slots were filled with IPCC employees (Laframboise, 2013). It is doubtful whether any other changes made at that time would have meaningfully affected the *Fifth Assessment Report*, which was already largely written. Media accounts of the release of AR5 once again told of late-night sessions with politicians and advocacy group representatives



rewriting the *Summary for Policymakers*.

In conclusion, it is difficult to understand why IPCC reports still command the respect of anyone in the climate debate. They are political documents, not balanced or accurate summaries of the current state of climate science. They cannot provide reliable guidance to policymakers, economists, and climate scientists who put their trust in them.

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## Bias

Climate scientists, like all humans, can be biased. Origins of bias include careerism, grant-seeking, political views, and confirmation bias.

Bias is another reason for disagreement among scientists and other writers on climate change. Scientists, no less than other human beings, bring their personal beliefs and interests to their work and sometimes make decisions based on them that direct their attention away from research findings that would contradict their opinions. Bias is often unconscious or overcome by professional ethics, but sometimes it leads to outright corruption.

Park *et al.* (2014), in a paper published in *Nature*, summarized research on publication bias, careerism, data fabrication, and fraud to explain how scientists converge on false conclusions. They write, “Here we show that even when scientists are motivated to promote the truth, their behaviour may be influenced, and even dominated, by information gleaned from their peers’ behaviour, rather than by their personal dispositions. This phenomenon, known as herding, subjects the scientific community to an inherent risk of converging on an incorrect answer and raises the possibility that, under certain conditions, science may not be self-correcting.”

Freedman (2010) identified a long list of reasons why experts are often wrong, including pandering to audiences or clients, lack of oversight, reliance on flawed evidence provided by others, and failure to take into account important confounding variables.

John P.A. Ioannidis, professor of medicine and of health research and policy at Stanford University School of Medicine and a professor of statistics at Stanford University School of Humanities and Sciences, in a series of articles published in journals including the *Journal of the American Medical Association* (JAMA), revealed most published research in the health care field cannot be replicated or is likely to be contradicted by later publications (Ioannidis, 2005a, 2005b; Ioannidis and Trikalinos, 2005; Ioannidis, 2012). His most frequently cited work is titled “Why most published research findings are false.”

Ioannidis’s work generated widespread awareness that peer review is no guarantee of the accuracy or value of a research paper. In fact, he found that the likelihood of research being contradicted was highest with the most prestigious journals, including *Nature*, *Science*, and *JAMA*. Springer, a major publisher of science journals, recently announced it was removing 16

papers it had published that were generated by a computer program called SCIgen that were simply gibberish (*Nature*, 2014). Much to their credit, these journals and academic institutions claim to be engaged in considerable soul-searching and efforts to reform a peer-review process that is plainly broken.

This controversy has particular relevance to the climate change debate due to “Climategate,” the release of emails exchanged by prominent climate scientists discussing efforts to exclude global warming skeptics from journals, punish editors who allowed skeptics’ articles to appear, stonewall requests for original data, manipulate data, and rush into publication articles refuting or attempting to discredit scientists who disagree with IPCC’s findings (Montford, 2010; Sussman, 2010; Michaels, 2011, Chapter 2). The scandal received little press attention in the United States. Journals such as *Nature* take the scandal over peer-review corruption seriously when it involves other topics (Ferguson *et al.*, 2014), but are curiously silent about its occurrence in the climate change literature.

Scientists, especially those in charge of large research projects and laboratories, have a financial incentive to seek more funding for their programs. They are not immune to having tunnel vision regarding the importance of their work and employment. Each believes his or her mission is more significant and essential relative to other budget priorities.

To obtain funding (and more funding), it helps scientists immensely to have the public – and thus Congress and potentially private funders – worried about the critical nature of the problems they study. This incentive makes it less likely researchers will interpret existing knowledge or present their findings in a way that reduces public concern (Lichter and Rothman, 1999; Kellow, 2007; Kabat, 2008). As a result, scientists often gravitate toward emphasizing worst-case scenarios, though there may be ample evidence to the contrary. This bias of alarmism knows no political bounds, affecting both liberal Democrats and conservative Republicans (Berezow and Campbell, 2012; Lindzen, 2012).

Alarmists in the climate debate seem to recognize only one possible source of bias, and that is funding from “the fossil fuel industry.” The accusation permeates any conversation of the subject, perhaps second only to the “consensus” claim, and the two are often paired, as in “only scientists paid by the fossil fuel industry dispute the overwhelming scientific consensus.” The accusation doesn’t work for many reasons:

- There has never been any evidence of a climate scientist accepting money from industry to take a position or change his or her position in the climate debate (Cook, 2014);
- Vanishingly few global warming skeptics have ever been paid by the fossil fuel industry. Certainly not more than a tiny fraction of the 31,478 American scientists who signed the Global Warming Petition or the thousands of meteorologists and climate scientists reported in Chapter 1 who tell survey-takers they do not agree with IPCC;
- Funding of alarmists by government agencies, liberal foundations, environmental advocacy groups, and the alternative energy industry exceeds funding from the fossil fuel industry by two, three, or even four orders of magnitude (Butos and McQuade, 2015). Does government and interest-group funding of alarmists not also have a “corrupting” influence on its recipients?
- The most prominent organizations supporting global warming skepticism get little if any money from the fossil fuel industry. Their support comes overwhelmingly from individuals (and their foundations) motivated by concern over the apparent corruption of science taking place and the enormous costs it is imposing on the public.

In the text of her speech to the British House of Lords cited earlier, climate scientist Judith Curry wrote, “I am very concerned that climate science is becoming biased owing to biases in federal funding priorities and the institutionalization by professional societies of a particular ideology related to climate change. Many scientists, and institutions that support science, are becoming advocates for UN climate policies, which is leading scientists into overconfidence in their assessments and public statements and into failures to respond to genuine criticisms of the scientific consensus. In short, the climate science establishment has become intolerant to disagreement and debate, and is attempting to marginalize and de-legitimize dissent as corrupt or ignorant” (Curry, 2015).

Money probably isn’t what motivates Mike Hulme, now professor of climate and culture in the Department of Geography at King’s College

London. He was professor of climate change in the School of Environmental Sciences at the University of East Anglia and a contributor to IPCC reports, and he is author of *Why We Disagree About Climate Change* (Hulme, 2009). Hulme was cited in Chapter 1 admitting to great uncertainties in climate science, yet he eagerly endorses and promotes IPCC's claims. Why does he do that?

In his book, Hulme calls climate change “a classic example of ... ‘post-normal science,’” which he defines (quoting Silvio Funtowicz and Jerry Ravetz) as “the application of science to public issues where ‘facts are uncertain, values in dispute, stakes high and decisions urgent.’” Issues that fall into this category, he says, are no longer subject to the cardinal requirements of true science: skepticism, universalism, communalism, and disinterestedness. Instead of experimentation and open debate, post-normal science says “consensus” brought about by deliberation among experts determines what is true, or at least true enough for the time being to direct public policy decisions.

The merits and demerits of post-normal science can be debated, but it undoubtedly has one consequence of significance in the climate change debate: Scientists are no longer responsible for actually doing science themselves, such as testing hypotheses, studying data, and confronting data or theories that contradict the “consensus” position. Scientists simply “sign onto” IPCC's latest report and are free to indulge their political biases. Hulme is quite open about his. He wrote, “The idea of climate change should be seen as an intellectual resource around which our collective and personal identities and projects can form and take shape. We need to ask not what we can do for climate change, but to ask what climate change can do for us” (p. 326).

In his book, Hulme says “because the idea of climate change is so plastic, it can be deployed across many of our human projects and can serve many of our psychological, ethical, and spiritual needs.” Hulme describes himself as a social-democrat so his needs include sustainable development, income redistribution, population control, and social justice. By focusing on these “needs,” how can Hulme objectively evaluate the anthropogenic global warming hypothesis?

Like the late Stephen Schneider, who once said “to reduce the risk of potentially disastrous climate change ... we need to get some broad based support, to capture the public's imagination. That, of course, means getting loads of media coverage. So we have to offer up scary scenarios, make



simplified, dramatic statements, and make little mention of any doubts we might have” (Schneider, 1989), Hulme wrote, “We will continue to create and tell new stories about climate change and mobilise them in support of our projects.” He suggests his fellow global warming alarmists promote four “myths,” which he labels Lamenting Eden, Presaging Apocalypse, Constructing Babel, and Celebrating Jubilee.

This is unusual behavior for a scientist and disturbing for one working at high levels in IPCC. When Hulme talks about climate science, is he telling us the truth or one of his “myths”?

\* \* \*

While it would be ideal if scientists could be relied upon to deliver the unvarnished truth about complex scientific matters to governments and voters, the truth is they almost always fall short. Ignorance of research outside their area of specialization, reliance on flawed authorities, bias, and outright corruption all contribute to unwarranted alarmism in the climate change debate.

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# 3

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## ***Scientific Method vs. Political Science***

Key findings of this section include the following:

- The hypothesis implicit in all IPCC writings, though rarely explicitly stated, is that dangerous global warming is resulting, or will result, from human-related greenhouse gas emissions.
- The null hypothesis is that currently observed changes in global climate indices and the physical environment, as well as current changes in animal and plant characteristics, are the result of natural variability.
- In contradiction of the scientific method, IPCC assumes its implicit hypothesis is correct and that its only duty is to collect evidence and make plausible arguments in the hypothesis's favor.

### **The Missing Null Hypothesis**

Although IPCC's reports are voluminous and their arguments impressively persistent, it is legitimate to ask whether that makes them good science. In order to conduct an investigation, scientists must first formulate a falsifiable hypothesis to test. The hypothesis implicit in all IPCC writings, though rarely explicitly stated, is that dangerous global warming is resulting, or will result, from human-related greenhouse gas emissions.

In considering any such hypothesis, an alternative and null hypothesis must be entertained, which is the simplest hypothesis consistent with the known facts. Regarding global warming, the null hypothesis is that currently observed changes in global climate indices and the physical environment are the result of natural variability. To invalidate this null hypothesis requires, at a minimum, direct evidence of human causation of specified changes that lie outside usual, natural variability. Unless and until such evidence is adduced, the null hypothesis is assumed to be correct.

In contradiction of the scientific method, IPCC assumes its implicit hypothesis is correct and that its only duty is to collect evidence and make plausible arguments in the hypothesis's favor. One probable reason for this behavior is that the United Nations protocol under which IPCC operates defines climate change as "a change of climate which is attributed directly or indirectly to human activity that alters the composition of the global atmosphere and which is in addition to natural climate variability observed over comparable time periods" (United Nations, 1994, Article 1.2). Not surprisingly, directing attention to only the effects of human greenhouse gas emissions has resulted in IPCC failing to provide a thorough analysis of climate change.

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<http://unfccc.int/resource/docs/convkp/conveng.pdf>.

## Models, Postulates, and Circumstantial Evidence

IPCC offers three lines of reasoning in defense of its hypothesis: global climate model projections, a series of postulates or assumptions, and appeals to circumstantial evidence. The specific arguments are summarized in Figure 2.

All three lines of reasoning depart from proper scientific methodology. Global climate models produce meaningful results only if we assume we already know perfectly how the global climate works, and most climate scientists say we do not (Bray and von Storch, 2010; Strengers, Verheggen, and Vringer, 2015). Moreover, it is widely recognized that climate models

are not designed to produce predictions of future climate but rather what-if projections of many alternative possible futures (Trenberth, 2009).

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## **Figure 2** **IPCC's Three Lines of Argument**

### **Global Climate Model Projections**

IPCC modelers assume Global Climate Models (GCMs) are based on a perfect knowledge of all climate forcings and feedbacks. They then assert:

- A doubling of atmospheric CO<sub>2</sub> would cause warming of up to 6°C.
- Human-related CO<sub>2</sub> emissions caused an atmospheric warming of at least 0.3°C over the past 15 years.
- Enhanced warming (a “hot spot”) should exist in the upper troposphere in tropical regions.
- Both poles should have warmed faster than the rest of Earth during the late twentieth century.

### **Postulates**

Postulates are statements that assume the truth of an underlying fact that has not been independently confirmed or proven. IPCC postulates:

- The warming of the twentieth century cannot be explained by natural variability.
- The late twentieth century warm peak was of greater magnitude than previous natural peaks.
- Increases in atmospheric CO<sub>2</sub> precede, and then force, parallel increases in temperature.
- Solar forcings are too small to explain twentieth century warming.
- A future warming of 2°C or more would be net harmful to the biosphere and human well-being.

**Circumstantial Evidence**

Circumstantial evidence does not bear directly on the matter in dispute but refers to circumstances from which the occurrence of the fact might be inferred. IPCC cites the following circumstantial evidence:

- Unusual melting is occurring in mountain glaciers, Arctic sea ice, and polar icecaps.
- Global sea level is rising at an enhanced rate and swamping tropical coral atolls.
- Droughts, floods, and monsoon variability and intensity are increasing.
- Global warming is leading to more, or more intense, wildfires, rainfall, storms, hurricanes, and other extreme weather events.
- Unusual melting of Boreal permafrost or sub-seabed gas hydrates is causing warming due to methane release.

*Source: Summary for Policymakers, Climate Change Reconsidered II: Physical Science (Chicago, IL: The Heartland Institute, 2013).*

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Postulates, commonly defined as “something suggested or assumed as true as the basis for reasoning, discussion, or belief,” can stimulate relevant observations or experiments but more often are merely assertions that are difficult or impossible to test (Kahneman, 2011). IPCC expresses “great confidence” and even “extreme confidence” in its assumptions, but it cannot apply a statistical confidence level because they are statements of opinion and not of fact. This is not the scientific method.

Circumstantial evidence, or observations, in science are useful primarily to falsify hypotheses and cannot prove one is correct (Popper, 1965, p. vii). It is relatively easy to assemble reams of “evidence” in favor of a point of view or opinion while ignoring inconvenient facts that would contradict it, a phenomenon called “confirmation bias.” The only way to avoid confirmation bias is independent review of a scientist’s work by other scientists who do not have a professional, reputational, or financial stake in whether the hypothesis is confirmed or disproven. As documented in Chapter 2, this sort of review is conspicuously absent in the climate change

debate. Those who attempt to exercise it find themselves demonized, their work summarily rejected by academic journals, and worse.

Facing such criticism of its methodology and a lack of compelling evidence of dangerous warming, IPCC's defenders often invoke the precautionary principle. The principle states: "Where there are threats of serious or irreversible damage, lack of full scientific certainty shall not be used as a reason for postponing cost-effective measures to prevent environmental degradation" (United Nations, 1992, Principle 15). This is a sociological precept rather than a scientific one and lacks the intellectual rigor necessary for use in policy formulation (Goklany, 2001).

The hypothesis of human-caused global warming comes up short not merely of "full scientific certainty" but of reasonable certainty or even plausibility. The weight of evidence now leans heavily against the theory. Invoking the precautionary principle does not lower the required threshold for evidence to be regarded as valid, nor does it answer the most important questions about the causes and consequences of climate change. Scientific principles acknowledge the supremacy of experiment and observation and do not bow to instinctive feelings of alarm or claims of a supposed scientific "consensus" (Legates *et al.*, 2015). The formulation of effective public environmental policy must be rooted in evidence-based science, not an over-abundance of precaution (More and Vita-More, 2013; U.K. House of Commons Science and Technology Committee, 2006).

Contradictions about methodology and the verity of claimed facts make it difficult for unprejudiced lay persons to judge for themselves where the truth actually lies in the global warming debate. This is one of the primary reasons why politicians and commentators rely so heavily on supposedly authoritative statements issued by one side or another in the public discussion. Arguing from authority, however, is the antithesis of the scientific method. Attempting to stifle debate by appealing to authority hinders rather than helps scientific progress and understanding.

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# 4

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## ***Flawed Projections***

Key findings in this section include the following:

- The United Nations' Intergovernmental Panel on Climate Change (IPCC) and virtually all the governments of the world depend on global climate models (GCMs) to forecast the effects of human-related greenhouse gas emissions on the climate.
- GCMs systematically over-estimate the sensitivity of climate to carbon dioxide (CO<sub>2</sub>), many known forcings and feedbacks are poorly modeled, and modelers exclude forcings and feedbacks that run counter to their mission to find a human influence on climate.
- The Nongovernmental International Panel on Climate Change (NIPCC) estimates a doubling of CO<sub>2</sub> from pre-industrial levels (from 280 to 560 ppm) would likely produce a temperature forcing of 3.7 Wm<sup>-2</sup> in the lower atmosphere, for about ~1°C of *prima facie* warming.
- Four specific forecasts made by GCMs have been falsified by real-world data from a wide variety of sources. In particular, there has been no global warming for some 18 years.

### **Why Computer Models Are Flawed**

In contrast to the scientific method, IPCC and virtually all national

governments in the world rely on computer models, called global climate models or GCMs, to represent speculative thought experiments by modelers who often lack a detailed understanding of underlying processes. The results of GCMs are only as reliable as the data and theories “fed” into them, which scientists widely recognize as being seriously deficient. If natural climate forcings and feedbacks are not perfectly understood, then GCMs become little more than an exercise in curve-fitting, or changing parameters until the outcomes match the modeler’s expectations. As John von Neumann is reported to have once said, “with four parameters I can fit an elephant, and with five I can make him wiggle his trunk” (Dyson, 2004).

The science literature is replete with admissions by leading climate modelers that forcings and feedbacks are not sufficiently well understood, that data are insufficient or too unreliable, and that computer power is insufficient to resolve important climate processes. Many important elements of the climate system, including atmospheric pressure, wind, clouds, temperature, precipitation, ocean currents, sea ice, and permafrost, cannot be properly simulated by the current generation of models.

The major known deficiencies include model calibration, non-linear model behavior, and the omission of important natural climate-related variability. Model calibration is faulty as it assumes all temperature rise since the start of the industrial revolution has resulted from human CO<sub>2</sub> emissions. In reality, major human-related emissions commenced only in the mid-twentieth century.

More facts about climate models and their limitations reported in Chapter 1 of *Climate Change Reconsidered II: Physical Science* are reported in Figure 3.

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**Figure 3**  
**Key Facts about Global Climate Models**

- Climate models generally assume a climate sensitivity of 3°C for a doubling of CO<sub>2</sub> above preindustrial values, whereas meteorological observations are consistent with a sensitivity of 1°C or less.
- Climate models underestimate surface evaporation caused by increased temperature by a factor of 3, resulting in a consequential underestimation of global precipitation.

- Climate models inadequately represent aerosol-induced changes in infrared (IR) radiation, despite studies showing different mineral aerosols (for equal loadings) can cause differences in surface IR flux between 7 and 25 Wm<sup>2</sup>.
- Deterministic climate models have inherent properties that make dynamic predictability impossible; introduction of techniques to deal with this (notably parameterization) introduces bias into model projections.
- Limitations in computing power restrict climate models from resolving important climate processes; low-resolution models fail to capture many important regional and lesser-scale phenomena such as clouds.
- Model calibration is faulty, as it assumes all temperature rise since the start of the industrial revolution has resulted from human CO<sub>2</sub> emissions; in reality, major human-related emissions commenced only in the mid-twentieth century.
- Non-linear climate models exhibit chaotic behavior. As a result, individual simulations (“runs”) may show differing trend values.
- Internal climate oscillations (AMO, PDO, etc.) are major features of the historic temperature record; climate models do not even attempt to simulate them.
- Climate models fail to incorporate the effects of variations in solar magnetic field or in the flux of cosmic rays, both of which are known to significantly affect climate.

*Source:* “Chapter 1. Global Climate Models and Their Limitations,” *Climate Change Reconsidered II: Physical Science* (Chicago, IL: The Heartland Institute, 2013).

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## Forcings and Feedbacks

The discussion in the previous section of why global climate models are flawed included references to some of the forcings and feedbacks that are poorly modeled and likely to make models unreliable. In many of these cases, climate scientists are substituting opinions or best guesses for data. As serious as that problem is, it is made worse by the exclusion of forcings and feedbacks that are well documented in the scientific literature. Many of these run counter to the goal of many modelers to find a human influence on climate and so are ignored.

Among the forcings and feedbacks IPCC has failed to take into account are increases in low-level clouds in response to enhanced atmospheric water vapor, ocean emissions of dimethyl sulfide (DMS), and the presence and total cooling effect of both natural and industrial aerosols. These processes and others are likely to offset most or even all of any warming caused by rising CO<sub>2</sub> concentrations. Figure 4 summarizes these and other findings about forcings and feedbacks appearing in Chapter 2 of *Climate Change Reconsidered II: Physical Science*.

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### Figure 4 Key Facts about Temperature Forcings and Feedbacks

- A doubling of CO<sub>2</sub> from pre-industrial levels (from 280 to 560 ppm) would likely produce a temperature forcing of 3.7 Wm<sup>-2</sup> in the lower atmosphere, for about ~1°C of *prima facie* warming.
- IPCC models stress the importance of positive feedback from increasing water vapor and thereby project warming of ~3–6°C, whereas empirical data indicate an order of magnitude less warming of ~0.3–1.0°C.
- In ice core samples, changes in temperature precede parallel changes in atmospheric CO<sub>2</sub> by several hundred years; also, temperature and CO<sub>2</sub> are uncoupled through lengthy portions of the historical and geological records; therefore CO<sub>2</sub> cannot be the primary forcing agent for most temperature changes.

- Atmospheric methane (CH<sub>4</sub>) levels for the past two decades fall well below the values projected by IPCC in its assessment reports. IPCC's temperature projections incorporate these inflated CH<sub>4</sub> estimates and need downward revision accordingly.
- The thawing of permafrost or submarine gas hydrates is not likely to emit dangerous amounts of methane at current rates of warming.
- Nitrous oxide (N<sub>2</sub>O) emissions are expected to fall as CO<sub>2</sub> concentrations and temperatures rise, indicating it acts as a negative climate feedback.
- Other negative feedbacks on climate sensitivity that are either discounted or underestimated by IPCC include increases in low-level clouds in response to enhanced atmospheric water vapor, increases in ocean emissions of dimethyl sulfide (DMS), and the presence and total cooling effect of both natural and industrial aerosols.

*Source: "Chapter 2. Forcings and Feedbacks," Climate Change Reconsidered II: Physical Science (Chicago, IL: The Heartland Institute, 2013).*

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Yet another deficiency in GCMs is that non-linear climate models exhibit chaotic behavior. As a result, individual simulations ("runs") may show differing trend values (Singer, 2013b). Internal climate oscillations (Atlantic Multidecadal Oscillation (AMO), Pacific Decadal Oscillation (PDO), etc.) are major features of the historic temperature record, yet GCMs do not even attempt to simulate them. Similarly, the models fail to incorporate the effects of variations in the solar magnetic field or in the flux of cosmic rays, both phenomena known to significantly affect climate.

We conclude the current generation of GCMs is unable to make accurate projections of climate even 10 years ahead, let alone the 100-year period that has been adopted by policy planners. The output of such models should therefore not be used to guide public policy formulation until they have been validated and shown to have predictive value.

## Failed Forecasts

Four specific forecasts made by GCMs have been falsified by real-world data from a wide variety of sources:

### **Failed Forecast #1: A doubling of atmospheric CO<sub>2</sub> would cause warming between 3°C and 6°C.**

The increase in radiative forcing produced by a doubling of atmospheric CO<sub>2</sub> is generally agreed to be 3.7 Wm<sup>-2</sup>. Equating this forcing to temperature requires taking account of both positive and negative feedbacks. IPCC models incorporate a strong positive feedback from increasing water vapor but exclude negative feedbacks such as a concomitant increase in low-level clouds – hence they project a warming effect of 3°C or more.

IPCC ignores mounting evidence that climate sensitivity to CO<sub>2</sub> is much lower than its models assume (Spencer and Braswell, 2008; Lindzen and Choi, 2011). Monckton *et al.* cited 27 peer-reviewed articles “that report climate sensitivity to be below current central estimates” (Monckton *et al.*, 2015). Their list of sources appears in Figure 5.

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### **Figure 5 Research Finding Climate Sensitivity Is Less than Assumed by IPCC**

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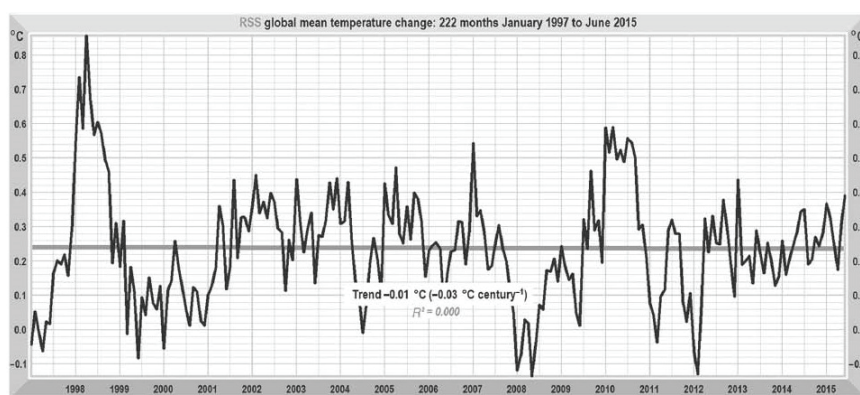
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 Source: Monckton, C., Soon, W. W-H., Legates, D.R., and Briggs, W.M. 2015. Keeping it simple: the value of an irreducibly simple climate model. *Science Bulletin* **60** (15): 1378–1390, footnotes 7 to 33.

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**Failed Forecast #2: CO<sub>2</sub> caused an atmospheric warming of at least 0.3°C over the past 15 years.**

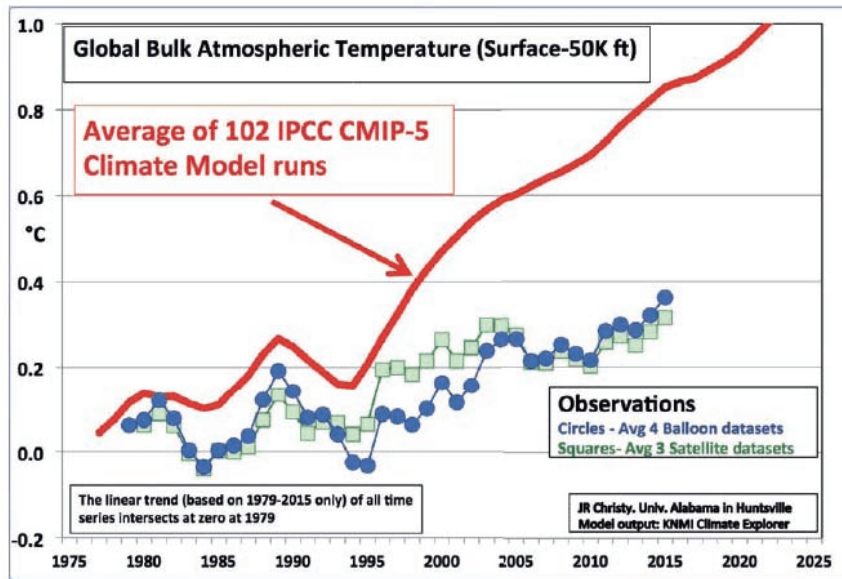
The global climate models relied on by IPCC predicted an atmospheric warming of at least 0.3°C during the first 15 years of the twenty-first century, but temperatures did not rise at all during that period. Figure 6 shows global temperatures from 1997 to 2015, based on satellite data compiled and reported by Remote Sensing Systems and interpreted by Monckton *et al.* (2015). They show a trend of -0.01°C from January 1997 to June 2015. Figure 7, from Dr. John Christy's 2016 Congressional testimony, vividly portrays the failure of GCMs to hindcast this trend.

**Figure 6**  
**RSS Monthly Global Mean Lower-troposphere Temperature Anomalies, January 1997 to June 2015**



Source: Monckton *et al.*, 2015.

**Figure 7. Failure of Climate Models to Hindcast Global Temperatures, 1979–2015**



*Notes:* Five-year averaged values of annual mean (1979–2015) global bulk (termed “midtropospheric” or “MT”) temperature as depicted by the average of 102 IPCC CMIP5 climate models (red), the average of 3 satellite datasets – UAH, RSS, NOAA (green), and 4 balloon datasets – NOAA, UKMet, RICH, RAOBCORE (blue). *Source:* Christy, 2016.

The absence of a warming trend for more than 15 years invalidates GCMs based on IPCC’s assumptions regarding climate sensitivity to carbon dioxide. In its 2008 *State of the Climate* report, the National Oceanic and Atmospheric Administration (NOAA) reported, “Near zero and even negative trends are common for intervals of a decade or less in the simulations, due to the models internal climate variability. The simulations rule out (at the 95% level) zero trends for intervals of 15 yr or more, suggesting that an observed absence of warming of this duration is needed to create a discrepancy with the expected present-day warming rate” (Knight *et al.*, 2009). This “discrepancy” now exists, indeed now extends to 18 years without warming, and the models have been invalidated.

IPCC’s authors compare the output of unforced (and incomplete)

models with a dataset that represents twentieth century global temperature (HadCRUT, British Meteorological Office). Finding a greater warming trend in the dataset than in model projections, the false conclusion is then drawn that this “excess” warming must be caused by human-related greenhouse forcing. In reality, no excess warming has been demonstrated, first because this line of argument assumes models have perfect knowledge, information, and power, which they do not, and second, because a wide variety of datasets other than the HadCRUT global air temperature curve favored by IPCC do not exhibit a warming trend during the second half of the twentieth century. See Figure 8.

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**Figure 8**  
**Lack of Evidence for Rising Temperatures**

The difference in surface temperatures between 1942–1995 and 1979–1997, as registered by datasets that represent land, oceanic, and atmospheric locations.

LAND SURFACE	Global (IPCC, HadCRUT)	+0.5° C
	United States (GISS)	~zero
OCEAN	Sea surface temperature (SST) <sup>1</sup>	~zero
	SST Hadley NMAT	~zero
ATMOSPHERE	Satellite MSU (1979–1997)	~zero
	Hadley radiosondes (1979–1997)	~zero
PROXIES	Mostly land surface temperature <sup>2</sup>	~zero

Unless otherwise indicated, data are drawn from the nominated government agencies.

Source: <sup>1</sup>Gouretski *et al.*, 2012; <sup>2</sup>Anderson *et al.*, 2013.

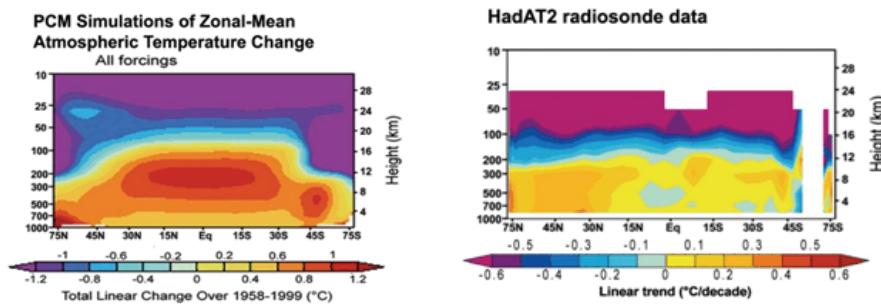
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### Failed Forecast #3: A Thermal Hot Spot Should Exist in the Upper Troposphere in Tropical Regions

Observations from both weather balloon radiosondes and satellite MSU sensors show the opposite, with either flat or decreasing warming trends with increasing height in the troposphere (Douglass *et al.*, 2007; Singer, 2011; Singer, 2013a). In Figure 9, the image on the left is model simulations of temperature trends in the tropical mid-troposphere, as shown in figure 1.3F from a report by the U.S. Climate Change Science Program (Karl *et al.*, 2006). The image shows a “hot spot” should occur in the upper troposphere in tropical regions. The image on the right is figure 5.7E from the same source. It shows observed temperatures based on radiosonde data by the Hadley Centre, which are in good agreement with the corresponding U.S. analyses. The observed data do not show the temperature rise in the tropical mid-troposphere forecast by the model.

**Figure 9**

### Greenhouse-model-predicted Temperature Trends Versus Latitude and Altitude Versus Observed Temperature Trends



Source: Karl *et al.*, 2006, pp. 25, 116.

### **Failed Forecast #4: Both Polar Regions Should Have Warmed Faster than the Rest of Earth During the Late Twentieth Century**

Late-twentieth century warming occurred in many Arctic locations and also over a limited area of the West Antarctic Peninsula, but the large polar East Antarctic Ice Sheet has been cooling since at least the 1950s (O'Donnell *et al.*, 2010). More data and commentary on this appears in Chapter 6.

\* \* \*

In general, GCMs perform poorly when their projections are assessed against empirical data. In their comprehensive report of an extensive test of contemporary climate models, Idso and Idso write, “we find (and document) a total of 2,418 failures of today’s top-tier climate models to accurately hindcast a whole host of climatological phenomena. And with this extremely poor record of success, one must greatly wonder how it is that anyone would believe what the climate models of today project about earth’s climate of tomorrow, i.e., a few decades to a century or more from now” (Idso and Idso, 2015).

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# 5

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## ***False Postulates***

Key findings in this section include the following:

- Neither the rate nor the magnitude of the reported late twentieth century surface warming (1979–2000) lay outside normal natural variability.
- The late twentieth century warm peak was of no greater magnitude than previous peaks caused entirely by natural forcings and feedbacks.
- Historically, increases in atmospheric CO<sub>2</sub> followed increases in temperature, they did not precede them. Therefore, CO<sub>2</sub> levels could not have forced temperatures to rise.
- Solar forcings are not too small to explain twentieth century warming. In fact, their effect could be equal to or greater than the effect of CO<sub>2</sub> in the atmosphere.
- A warming of 2°C or more during the twenty-first century would probably not be harmful, on balance, because many areas of the world would benefit from or adjust to climate change.

Figure 2 in Chapter 3 identified five postulates at the base of IPCC's claim that global warming has resulted, or will result, from anthropogenic greenhouse gas emissions. All five are readily refuted by real-world observations.

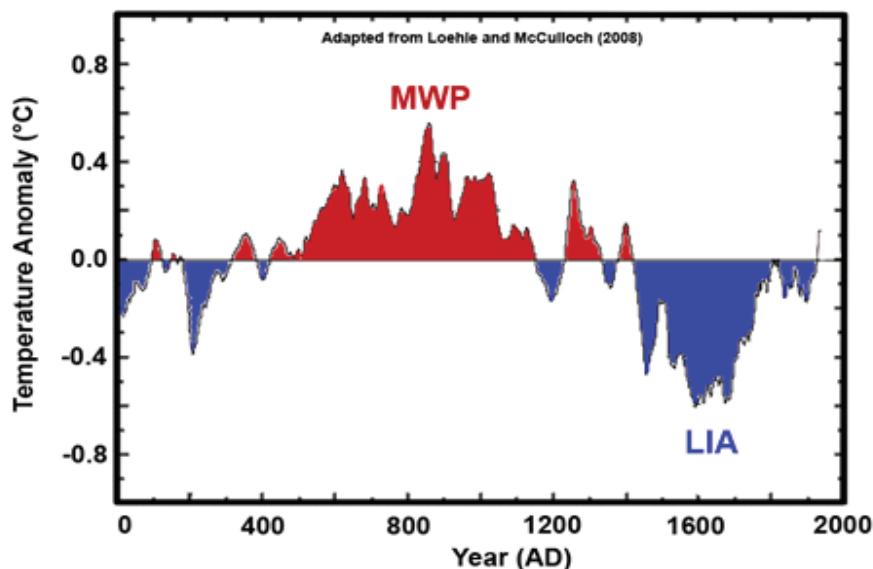


## Modern Warming Is Not Unnatural

IPCC's first false postulate is that the warming of the twentieth century cannot be explained by natural variability. But temperature records contain natural climate rhythms that are not well summarized or defined by fitting straight lines through arbitrary portions of a fundamentally rhythmic, non-stationary data plot. In particular, linear fitting fails to take account of meteorological-oceanographical-solar variations that are well established to occur at multidecadal and millennial time scales.

Even assuming, wrongly, that global temperatures would have been unchanging in the absence of man-made greenhouse gas emissions, the correctness of IPCC's assertion depends upon the period of time considered (Davis and Bohling, 2001). For example, temperatures have been cooling since 8,000 and 2,000 years ago; warming since 20,000 years ago, and also since 1850; and static (no net warming or cooling) between 700 BC and 150 AD and since 1997 AD. Figures 10 and 11 illustrate the variability of global temperatures during the past 2,000 and 10,000 years, respectively.

**Figure 10**  
**Mean Relative Temperature History of the Globe**

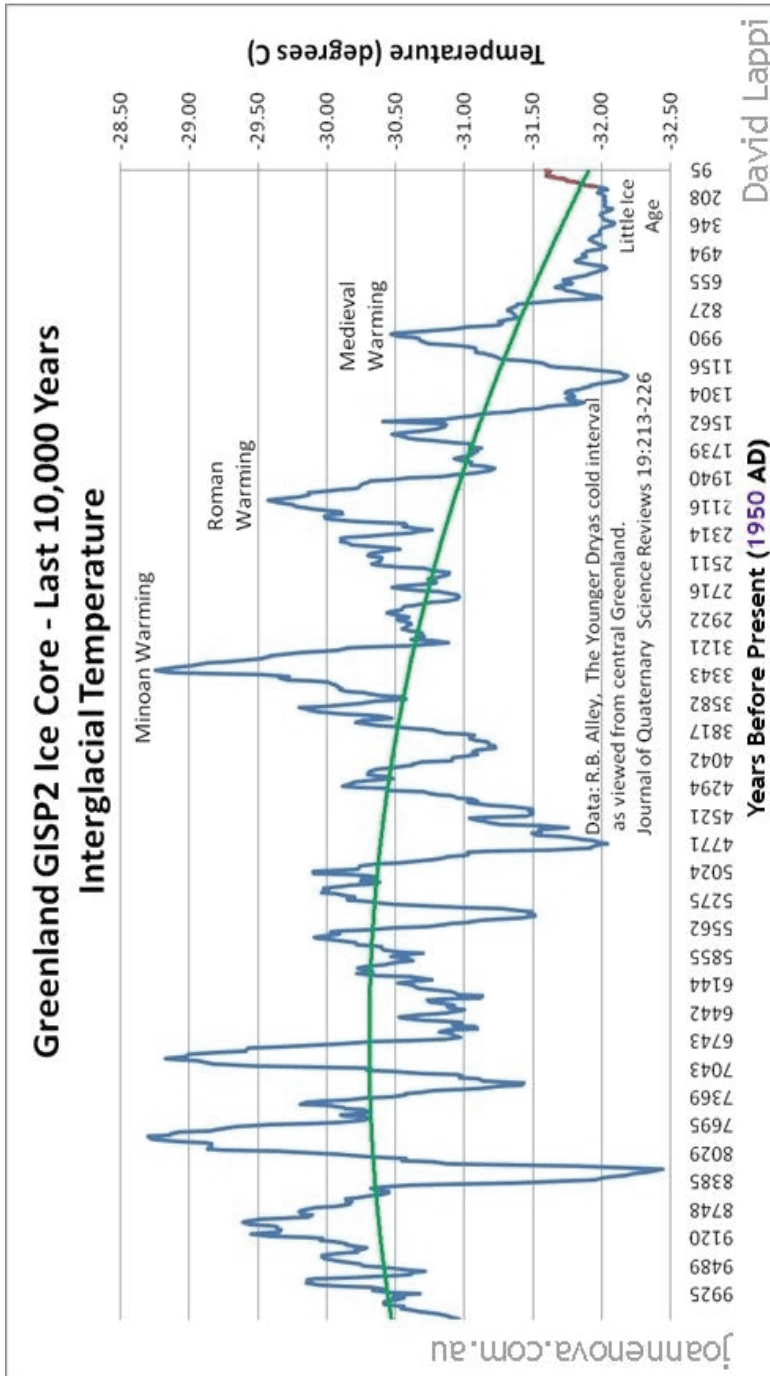


Source: Loehle and McCulloch, 2008.

FALSE POSTULATES

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Figure 11



Global warming during the twentieth century occurred in two pulses, between 1910–1940 and 1975–2000, at gentle rates of a little more than 1.5°C/century (British Meteorological Office, 2013). In contrast, natural warming at some individual meteorological stations during the 1920s proceeded at rates of up to 4°C/decade or more (Chylek *et al.*, 2004). The first period (1910–1940), having occurred prior to the build-up of greenhouse gases in the atmosphere, must represent natural variability. Measurements made during the late twentieth century warming are likely exaggerated by inadequate correction for the urban heat island effect (DeLaat and Maurellis, 2004; McKittrick and Michaels, 2004, 2007).

### **Modern Warming Is Not Unprecedented**

IPCC's second false postulate is that the late twentieth century warm peak was of greater magnitude than previous natural peaks. Comparison of modern and ancient rates of natural temperature change is difficult because of the lack of direct measurements available prior to 1850. However, high-quality proxy temperature records from the Greenland ice core for the past 10,000 years demonstrate a natural range of warming and cooling rates between +2.5 and -2.5 °C/century (Alley, 2000; Carter, 2010, p. 46, Figure 7), significantly greater than rates measured for Greenland or the globe during the twentieth century.

Glaciological and recent geological records contain numerous examples of ancient temperatures up to 3°C or more warmer than the peak reported at the end of the twentieth century. During the Holocene, such warmer peaks included the Egyptian, Minoan, Roman, and Medieval warm periods (Alley, 2000). During the Pleistocene, warmer peaks were associated with interglacial oxygen isotope stages 5, 9, 11, and 31 (Lisiecki and Raymo, 2005). During the Late Miocene and Early Pliocene (6–3 million years ago) temperature consistently attained values 2–3°C above twentieth century values (Zachos *et al.*, 2001).

Figure 12 summarizes these and other findings about surface temperatures that appear in Chapter 4 of *Climate Change Reconsidered II: Physical Science*.

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**Figure 12**  
**Key Facts about Surface Temperature**

- Whether today's global surface temperature is seen to be part of a warming trend depends upon the time period considered.
- Over (climatic) time scales of many thousand years, temperature is cooling; over the historical (meteorological) time scale of the past century temperature has warmed. Over the past 18 years, there has been no net warming despite an increase in atmospheric CO<sub>2</sub> of 8 percent – which represents 34 percent of all human-related CO<sub>2</sub> emissions released to the atmosphere since the industrial revolution.
- Given an atmospheric mixing time of ~1 year, the facts just related represent a test of the dangerous warming hypothesis, which test it fails.
- Based upon the HadCRUT dataset favored by IPCC, two phases of warming occurred during the twentieth century, between 1910–1940 and 1979–2000, at similar rates of a little more than 1.5°C/century. The early twentieth century warming preceded major industrial carbon dioxide emissions and must be natural; warming during the second (*prima facie*, similar) period might incorporate a small human-related carbon dioxide effect, but warming might also be inflated by urban heat island effects.
- Other temperature datasets fail to record the late twentieth century warming seen in the HadCRUT dataset.
- There was nothing unusual about either the magnitude or rate of the late twentieth century warming pulses represented on the HadCRUT record, both falling well within the envelope of known, previous natural variations.
- No empirical evidence exists to support the assertion that a planetary warming of 2°C would be net ecologically or economically damaging.

*Source:* “Chapter 4. Observations: Temperatures,” *Climate Change Reconsidered II: Physical Science* (Chicago, IL: The Heartland Institute, 2013).

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## **CO<sub>2</sub> Does Not Lead Temperature**

IPCC’s third false postulate is that increases in atmospheric CO<sub>2</sub> precede, and then force, parallel increases in temperature. The remarkable (and at first blush, synchronous) parallelism that exists between rhythmic fluctuations in ancient atmospheric temperature and atmospheric CO<sub>2</sub> levels was first detected in polar ice core samples analyzed during the 1980s. From the early 1990s onward, however, higher-resolution sampling has repeatedly shown these historic temperature changes precede the parallel changes in CO<sub>2</sub> by several hundred years or more (Mudelsee, 2001; Monnin *et al.*, 2001; Caillon *et al.*, 2003; Siegenthaler *et al.*, 2005).

Ice core records show seven periods during which CO<sub>2</sub>, methane (CH<sub>4</sub>) and temperature increased and then decreased. In all seven cycles, the reported changes in CO<sub>2</sub> and CH<sub>4</sub> lagged the temperature changes and could not, therefore, have caused them (Soon, 2007). Early estimates (Revelle and Seuss, 1957) found temperature-caused out-gassing of ocean CO<sub>2</sub> increases atmospheric CO<sub>2</sub> concentrations by about 7% per °C of temperature rise; later laboratory testing placed it at about 5% (Petit *et al.*, 1999). The relationship calculated from lab data and found in the ice core data is quantitatively perfect, meaning there is precisely the amount of CO<sub>2</sub> in the atmosphere as a function of temperature over the 800,000-year ice core record that there should be – in accordance with the ratio measured experimentally (Robinson, Robinson, and Soon, 2007).

The only departure in the relationship between temperature and atmospheric CO<sub>2</sub> in the historical record is in the recent values, with CO<sub>2</sub> rising far beyond the temperature-dependent equilibrium value. This is because so much CO<sub>2</sub> is being put into the atmosphere from non-ocean sources. It will eventually revert to the equilibrium values, with the reversion occurring with a half life of about seven years, as has been determined by several investigators (Segalstad, 1998).

## Solar Influence Is Not Minimal

IPCC's fourth false postulate is that solar forcings are too small to explain twentieth century warming. Having concluded solar forcing alone is inadequate to account for twentieth century warming, IPCC authors infer CO<sub>2</sub> must be responsible for the remainder. Nonetheless, observations indicate variations occur in total ocean-atmospheric meridional heat transport and that these variations are driven by changes in solar radiation rooted in the intrinsic variability of the Sun's magnetic activity (Soon and Legates, 2013).

Incoming solar radiation is most often expressed as Total Solar Insolation (TSI), a measure derived from multi-proxy measures of solar activity (Hoyt and Schatten, 1993; Willson, 2011; Scafetta and Willson, 2013). The newest estimates, from satellite-borne ACRIM-3 measurements, indicate TSI ranged between 1360 and 1363 Wm<sup>-2</sup> between 1979 and 2011, the variability of ~3 Wm<sup>-2</sup> occurring in parallel with the 11-year sunspot cycle. Larger changes in TSI are also known to occur in parallel with climatic change over longer time scales. For instance, Shapiro *et al.* (2011) estimated the TSI change between the Maunder Minimum and current conditions may have been as large as 6 Wm<sup>-2</sup>.

Temperature records from circum-Arctic regions of the Northern Hemisphere show a close correlation with TSI over the past 150 years, with both measures conforming to the ~60–70-year multidecadal cycle. In contrast, the measured steady rise of CO<sub>2</sub> emissions over the same period shows little correlation with the strong multidecadal (and shorter) ups and downs of surface temperature around the world.

Finally, IPCC ignores x-ray, ultraviolet, and magnetic flux variation, the latter having particularly important implications for the modulation of galactic cosmic ray influx and low cloud formation (Kirkby, *et al.*, 2011). Figure 13 summarizes these and other findings about solar forcings from Chapter 3 of *Climate Change Reconsidered II: Physical Science*.

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### Figure 13 Key Facts about Solar Forcing

- Evidence is accruing that changes in Earth's surface temperature are largely driven by variations in solar activity. Examples of

solar-controlled climate change epochs include the Medieval Warm Period, Little Ice Age, and Early Twentieth Century (1910–1940) Warm Period.

- The Sun may have contributed as much as 66 percent of the observed twentieth century warming, and perhaps more.
- Strong empirical correlations have been reported from around the world between solar variability and climate indices including temperature, precipitation, droughts, floods, streamflow, and monsoons.
- IPCC models do not incorporate important solar factors such as fluctuations in magnetic intensity and overestimate the role of human-related CO<sub>2</sub> forcing.
- IPCC fails to consider the importance of the demonstrated empirical relationship between solar activity, the ingress of galactic cosmic rays, and the formation of low clouds.
- The respective importance of the Sun and CO<sub>2</sub> in forcing Earth's climate remains unresolved; current climate models fail to account for a plethora of known Sun-climate connections.
- The recently quiet Sun and extrapolation of solar cycle patterns into the future suggest a planetary cooling may occur over the next few decades.

*Source:* “Chapter 3. Solar Forcing of Climate,” *Climate Change Reconsidered II: Physical Science* (Chicago, IL: The Heartland Institute, 2013).

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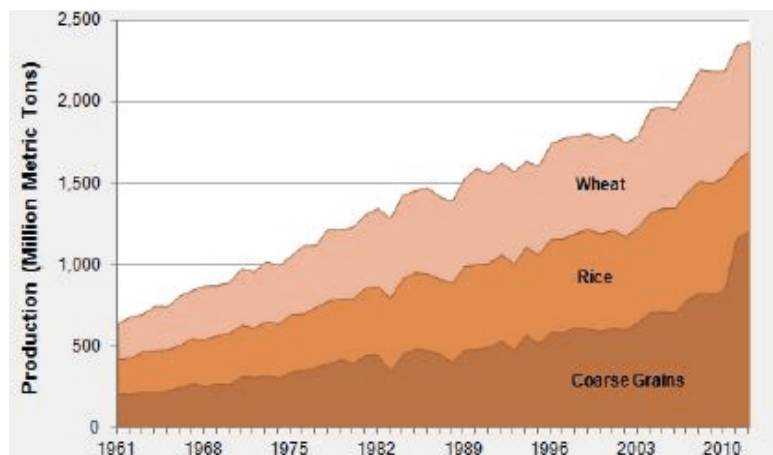
## **Warming Would Not Be Harmful**

IPCC's fifth false postulate is that warming of 2°C above today's temperature would be harmful. This claim was coined at a conference organized by the British Meteorological Office in 2005 (DEFRA, 2005).

The particular value of 2°C is entirely arbitrary and was proposed by the World Wildlife Fund, an environmental advocacy group, as a political expediency rather than as an informed scientific opinion. The target was set in response to concern that politicians would not initiate policy actions to reduce CO<sub>2</sub> emissions unless they were given a specific (and low) quantitative temperature target to aim for.

Multiple lines of evidence suggest a 2°C rise in temperature would not be harmful to the biosphere. The period termed the Holocene Climatic Optimum (c. 8,000 ybp) was 2–3°C warmer than today (Alley, 2000), and the planet attained similar temperatures for several million years during the Miocene and Pliocene (Zachos *et al.*, 2001). Biodiversity is encouraged by warmer rather than colder temperatures (Idso and Idso, 2009), and higher temperatures and elevated CO<sub>2</sub> greatly stimulate the growth of most plants (Idso and Idso, 2011). Figure 14 shows the substantial rise in world grain production since 1961, a trend that would seem unlikely if rising CO<sub>2</sub> levels produced more harms than benefits to the biosphere.

**Figure 14**  
**World Grain Production, 1961–2012**



Source: Christy, 2016, citing U.N. Food and Agriculture Organization.

Despite its widespread adoption by environmental NGOs, lobbyists, and governments, no empirical evidence exists to substantiate the claim that 2°C of warming presents a threat to planetary ecologies or human well-being. Nor can any convincing case be made that a warming will be more



economically costly than an equivalent cooling (either of which could occur for natural reasons), since any planetary change of 2°C magnitude in temperature would result in complex local and regional changes, some being of economic or environmental benefit and others being harmful.

\* \* \*

We conclude neither the rate nor the magnitude of the reported late twentieth century surface warming (1979–2000) lay outside normal natural variability, nor was it in any way unusual compared to earlier episodes in Earth’s climatic history. Furthermore, solar forcings of temperature change are likely more important than is currently recognized, and evidence is lacking that a 2°C increase in temperature (of whatever cause) would be globally harmful.

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# 6

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## ***Unreliable Circumstantial Evidence***

Key points in this chapter include the following:

- Melting of Arctic sea ice and polar icecaps is not occurring at “unnatural” rates and does not constitute evidence of a human impact on climate.
- Best available data show sea-level rise is not accelerating. Local and regional sea levels continue to exhibit typical natural variability – in some places rising and in others falling.
- The link between warming and drought is weak, and by some measures drought has decreased over the twentieth century. Changes in the hydrosphere of this type are regionally highly variable and show a closer correlation with multidecadal climate rhythmicity than they do with global temperature.
- No convincing relationship has been established between warming over the past 100 years and increases in extreme weather events. Meteorological science suggests just the opposite: A warmer world will see more mild weather patterns.
- No evidence exists that current changes in Arctic permafrost are other than natural or are likely to cause a climate catastrophe by releasing

methane into the atmosphere.

## Introduction

IPCC's third line of reasoning, summarized in Figure 2 in Chapter 3, consists of circumstantial evidence regarding natural phenomena known to vary with temperature. The examples IPCC chooses to report invariably point to a negative impact on plant and animal life and human well-being. When claims are made that such phenomena are the result of anthropogenic global warming, almost invariably at least one of the following three requirements of scientific confidence is lacking:

(1) *Correlation does not establish causation.* Correlation of, say, a declining number of polar bears and a rising temperature does not establish causation between one and the other, for it is not at all unusual for two things to co-vary in parallel with other forcing factors.

(2) *Control for natural variability.* We live on a dynamic planet in which all aspects of the physical and biological environment are in a constant state of flux for reasons that are entirely natural (including, of course, temperature change). It is wrong to assume no changes would occur in the absence of the human presence. Climate, for example, will be different in 100 years regardless of what humans do or don't do.

(3) *Local temperature records that confirm warming.* Many studies of the impact of climate change on wildlife simply assume temperatures have risen, extreme weather events are more frequent, etc., without establishing that the relevant local temperature records conform to the postulated simple long-term warming trend.

All five of IPCC's claims relying on circumstantial evidence listed in Figure 2 in Chapter 3 are refutable.

## Melting Ice

IPCC claims unusual melting is occurring in mountain glaciers, Arctic sea

ice, and polar icecaps. But what melting is occurring in mountain glaciers, Arctic sea ice, and polar icecaps is not occurring at “unnatural” rates and does not constitute evidence of a human impact on the climate. Both the Greenland (Johannessen *et al.*, 2005; Zwally *et al.*, 2005) and Antarctic (Zwally and Giovinetto, 2011) icecaps are close to balance. The global area of sea ice today is similar to that first measured by satellite observation in 1979 (Humlum, 2013) and significantly exceeds the ice cover present in former, warmer times.

Valley glaciers wax and wane on multidecadal, centennial, and millennial time-scales, and no evidence exists that their present, varied behavior falls outside long-term norms or is related to human-related CO<sub>2</sub> emissions (Easterbrook, 2011). Figure 15 summarizes the findings of Chapter 5 of *Climate Change Reconsidered II: Physical Science* regarding glaciers, sea ice, and polar icecaps.

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### **Figure 15** **Key Facts about the Cryosphere**

- Satellite and airborne geophysical datasets used to quantify the global ice budget are short and the methods involved in their infancy, but results to date suggest both the Greenland and Antarctic Ice Caps are close to balance.
- Deep ice cores from Antarctica and Greenland show climate change occurs as both major glacial-interglacial cycles and as shorter decadal and centennial events with high rates of warming and cooling, including abrupt temperature steps.
- Observed changes in temperature, snowfall, ice flow speed, glacial extent, and iceberg calving in both Greenland and Antarctica appear to lie within the limits of natural climate variation.
- Global sea-ice cover remains similar in area to that at the start of satellite observations in 1979, with ice shrinkage in the Arctic Ocean since then being offset by growth around Antarctica.
- During the past 25,000 years (late Pleistocene and Holocene) glaciers

around the world have fluctuated broadly in concert with changing climate, at times shrinking to positions and volumes smaller than today.

- This fact notwithstanding, mountain glaciers around the world show a wide variety of responses to local climate variation and do not respond to global temperature change in a simple, uniform way.
- Tropical mountain glaciers in both South America and Africa have retreated in the past 100 years because of reduced precipitation and increased solar radiation; some glaciers elsewhere also have retreated since the end of the Little Ice Age.
- The data on global glacial history and ice mass balance do not support the claims made by IPCC that CO<sub>2</sub> emissions are causing most glaciers today to retreat and melt.

*Source: “Chapter 5. Observations: The Cryosphere,”* *Climate Change Reconsidered II: Physical Science* (Chicago, IL: The Heartland Institute, 2013).

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## **Sea-Level Rise**

IPCC claims global sea level is rising at an enhanced rate and swamping tropical coral atolls. But the best available data show sea-level rise is not accelerating (Houston and Dean, 2011). The global average sea level continues to increase at its long-term rate of 1–2 mm/year globally (Wöppelmann *et al.*, 2009). Local and regional sea levels continue to exhibit typical natural variability – in some places rising and in others falling. Unusual sea-level rise is therefore not drowning Pacific coral islands, nor are the islands being abandoned by “climate refugees.”

The best available data show dynamic variations in Pacific sea level vary in accord with El Niño-La Niña cycles, superimposed on a natural long-term eustatic rise (Australian Bureau of Meteorology, 2011). Island coastal flooding results not from sea-level rise, but from spring tides or storm surges in combination with development pressures such as borrow pit digging or groundwater withdrawal. Persons emigrating from the islands are

doing so for social and economic reasons rather than in response to environmental threat.

Another claim concerning the effect of climate change on oceans is that increases in freshwater runoff into the oceans will disrupt the global thermohaline circulation system. But the range of natural fluctuation in the global ocean circulation system has yet to be fully delineated (Srokosz *et al.*, 2012). Research to date shows no evidence for changes that lie outside previous natural variability, nor for any malign influence from increases in human-related CO<sub>2</sub> emissions. See Figure 16 for more findings about climate change and oceans from Chapter 6 of *Climate Change Reconsidered II: Physical Science*.

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### **Figure 16 Key Facts about Oceans**

- Knowledge of local sea-level change is vital for coastal management; such change occurs at widely variable rates around the world, typically between about +5 and -5 mm/year.
- Global (eustatic) sea level, knowledge of which has only limited use for coastal management, rose at an average rate of between 1 and 2 mm/year over the past century.
- Satellite altimeter studies of sea-level change indicate rates of global rise since 1993 of more than 3 mm/year, but complexities of processing and the infancy of the method preclude viewing this result as secure.
- Rates of global sea-level change vary in decadal and multidecadal ways and show neither recent acceleration nor any simple relationship with increasing CO<sub>2</sub> emissions.
- Pacific coral atolls are not being drowned by extra sea-level rise; rather, atoll shorelines are affected by direct weather and infrequent high tide events, ENSO sea-level variations, and impacts of increasing human populations.



- Extra sea-level rise due to heat expansion (thermosteric rise) is also unlikely given that the Argo buoy network shows no significant ocean warming over the past nine years (Knox and Douglass, 2010).
- Though the range of natural variation has yet to be fully described, evidence is lacking for any recent changes in global ocean circulation that lie outside natural variation or were forced by human CO<sub>2</sub> emissions.

Source: “Chapter 6. Observations: The Hydrosphere,” *Climate Change Reconsidered II: Physical Science* (Chicago, IL: The Heartland Institute, 2013).

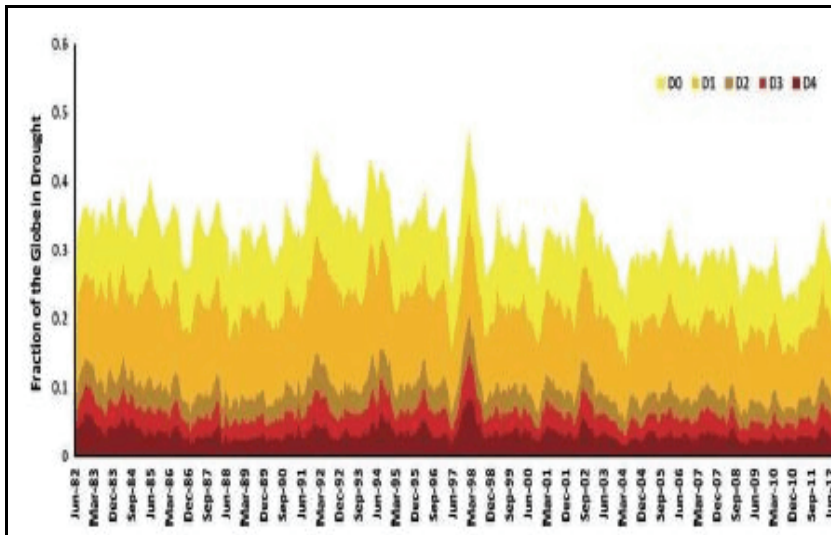
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## Droughts, Floods, and Monsoons

IPCC claims droughts, floods, and monsoon variability and intensity are increasing. But the link between warming and drought is weak, and pan evaporation (a measurement that responds to the effects of several climate elements) decreased over the twentieth century (Roderick *et al.*, 2009). Huntington (2008) concluded on a globally averaged basis precipitation over land increased by about 2 percent over the period 1900–1998. However, changes in the hydrosphere of this type are regionally highly variable and show a closer correlation with multidecadal climate rhythmicity than they do with global temperature (Zanchettin *et al.*, 2008). Figure 17 shows the absence of a trend toward more drought conditions between 1982 and 2012.

Monsoon intensity correlates with variations in solar activity rather than increases in atmospheric CO<sub>2</sub>, and both the South American and Asian monsoons became more active during the cold Little Ice Age and less active during the Medieval Warm Period (Vuille *et al.*, 2012), suggesting there would be less volatility if the world becomes warmer. See Figure 18 for more facts about monsoons, droughts, and floods presented in Chapter 6 of *Climate Change Reconsidered II: Physical Science*.

**Figure 17**  
**Global Areal Extent of Five Levels of Drought for 1982–2012**



*Notes:* Dryness is indicated in percentile rankings with D0 < 30, D1 < 20, D2 < 10, D3 < 5 and D4 < 2 percentile of average moisture availability. *Source:* Christy, 2016, citing Hao *et al.*, 2014.

**Figure 18**  
**Key Facts about Monsoons, Droughts, and Floods**

- Little evidence exists for an overall increase in global precipitation during the twentieth century independent of natural multidecadal climate rhythmicity.
- Monsoon precipitation did not become more variable or intense during late twentieth century warming; instead, precipitation responded mostly to variations in solar activity.
- South American and Asian monsoons were more active during the cold Little Ice Age and less active during the Medieval Warm Period. Neither global nor local changes in streamflow have been linked to CO<sub>2</sub> emissions.

- The relationship between drought and global warming is weak, since severe droughts occurred during both the Medieval Warm Period and the Little Ice Age.

*Source:* “Chapter 6. Observations: The Hydrosphere,” *Climate Change Reconsidered II: Physical Science* (Chicago, IL: The Heartland Institute, 2013).

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## **Extreme Weather**

IPCC does not object when persons, such as former U.S. Vice President Al Gore, cite its reports in support of claims that global warming is leading to more, or more intense, wildfires, rainfall, storms, hurricanes, and other extreme weather events. IPCC’s latest *Summary for Policymakers* is filled with vivid warnings of this kind, even though in 2012 an IPCC report acknowledged that a relationship between global warming and wildfires, rainfall, storms, hurricanes, and other extreme weather events has not been demonstrated (IPCC, 2012).

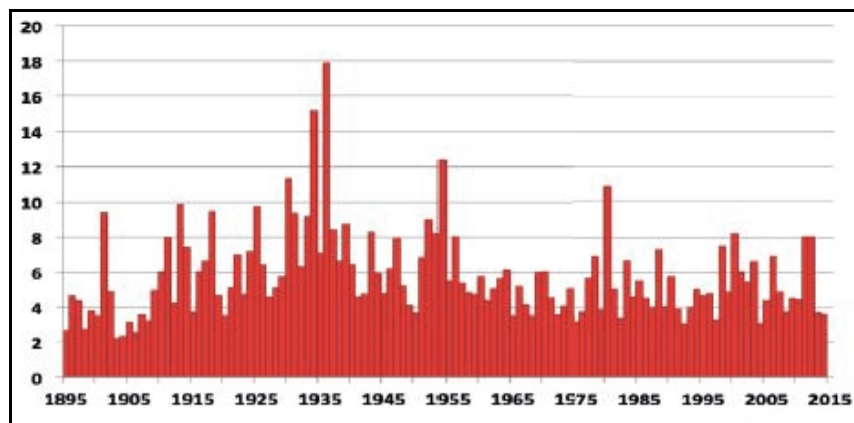
In no case has a convincing relationship been established between warming over the past 100 years and increases in any of these extreme weather events (Alexander *et al.*, 2006; Khandekar, 2013; Pielke Jr., 2014). Instead, the number and intensity of extreme events vary, and they wax and wane from one place to another and often in parallel with natural decadal or multidecadal climate oscillations. Basic meteorological science suggests a warmer world would experience fewer storms and weather extremes, as indeed has been the case in recent years.

Figure 19 shows there has been no trend toward more days of extreme heat in the U.S. since 1895. Figure 20 summarizes key facts on this subject presented in Chapter 7 of *Climate Change Reconsidered II: Physical Science*.

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**Figure 19**  
**Average Number of Daily High Temperatures in the U.S.**  
**Exceeding 100°F per year 1895–2014**



*Notes:* Average from 982 stations of the USHCN database (NOAA/NCEI, prepared by JRChristy). *Source:* Christy, 2016.

**Figure 20**  
**Key Facts about Extreme Weather Events**

- Air temperature variability decreases as mean air temperature rises, on all time scales.
- Therefore the claim that global warming will lead to more extremes of climate and weather, including of temperature itself, seems theoretically unsound; the claim is also unsupported by empirical evidence.
- Although specific regions have experienced significant changes in the intensity or number of extreme events over the twentieth century, for the globe as a whole no relationship exists between such events and global warming over the past 100 years.
- Observations from across the planet demonstrate that droughts have not become more extreme or erratic in response to global warming. In most

cases, the worst droughts in recorded meteorological history were much milder than droughts that occurred periodically during much colder times.

- There is little to no evidence that precipitation will become more variable and intense in a warming world; indeed some observations show just the opposite.
- There has been no significant increase in either the frequency or intensity of stormy weather in the modern era.
- Despite the supposedly “unprecedented” warming of the twentieth century, there has been no increase in the intensity or frequency of tropical cyclones globally or in any of the specific ocean basins.
- The commonly held perception that twentieth century warming was accompanied by an increase in extreme weather events is a misconception fostered by excessive media attention and has no basis in facts.

*Source: “Chapter 7. Observations: Extreme Weather,”* *Climate Change Reconsidered II: Physical Science* (Chicago, IL: The Heartland Institute, 2013).

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## **Thawing Permafrost**

IPCC claims unusual thawing of Boreal permafrost or sub-seabed gas hydrates is causing warming due to methane release. It is true that over historic time, atmospheric methane concentration has increased from about 700 ppb in the eighteenth century to the current level of near 1,800 ppb. However, the increase in methane concentration levelled off between 1998 and 2006 at around 1,750 ppb, which may reflect measures taken at that time to stem leakage from wells, pipelines, and distribution facilities (Quirk, 2010). More recently, since about 2007, methane concentrations have started to increase again, possibly due to a combination of leaks from new

shale gas drilling and Arctic permafrost decline.

The contribution of increased methane to radiative forcing since the eighteenth century is estimated to be only  $0.7 \text{ Wm}^{-2}$ , which is small. And in any case, no evidence exists that current changes in Arctic permafrost are other than natural. Most of Earth's gas hydrates occur at low saturations and in sediments at such great depths below the seafloor or onshore permafrost that they will barely be affected by warming over even one thousand years.

\* \* \*

We conclude no unambiguous evidence exists for adverse changes to the global environment caused by human-related  $\text{CO}_2$  emissions. In particular, the cryosphere is not melting at an enhanced rate; sea-level rise is not accelerating; no systematic changes have been documented in evaporation or rainfall or in the magnitude or intensity of extreme meteorological events; and an increased release of methane into the atmosphere from permafrost or sub-seabed gas hydrates is unlikely.

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# 7

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## ***Policy Implications***

Key findings in this section include the following:

- Rather than rely exclusively on IPCC for scientific advice, policymakers should seek out advice from independent, nongovernment organizations and scientists who are free of financial and political conflicts of interest.
- Individual nations should take charge of setting their own climate policies based upon the hazards that apply to their particular geography, geology, weather, and culture.
- Rather than invest scarce world resources in a quixotic campaign based on politicized and unreliable science, world leaders would do well to turn their attention to the real problems their people and their planet face.

To date, most government signatories to the UN's Framework Convention on Climate Change have deferred to the monopoly advice of IPCC in setting their national climate change policies. Nearly 30 years since IPCC began its work in 1988, it is now evident this approach has been mistaken. One result has been the expenditure of hundreds of billions of dollars implementing energy policies that now appear to have been unnecessary, or at least ill-timed and ineffective.

Rather than rely exclusively on IPCC for scientific advice,

policymakers should seek out advice from independent, nongovernment organizations and scientists who are free of financial and political conflicts of interest. The Chinese Academy of Sciences took an important step in this direction by translating and publishing an abridged edition of the first two volumes in NIPCC's *Climate Change Reconsidered* series (CAS, 2013).

Climate change, whether man-made or not, is a global phenomenon with very different effects on different parts of the world (Tol, 2011). Individual nations should take charge of setting their own climate policies based upon the hazards that apply to their particular geography, geology, weather, and culture – as India has started to do by setting up an advisory Indian Network on Comprehensive Climate Change Assessment (INCCCA) (Nelson, 2010).

The theoretical hazard of dangerous human-caused global warming is but one small part of a much wider climate hazard – extreme natural weather and climatic events that Nature intermittently presents us with, and always will (Carter, 2010). The 2005 Hurricane Katrina disaster in the United States, the 2007 floods in the United Kingdom, and the tragic bushfires in Australia in 2009 demonstrate the governments of even advanced, wealthy countries are often inadequately prepared for climate-related disasters of natural origin.

Climate change as a natural hazard is as much a geological as a meteorological issue. Geological hazards are mostly dealt with by providing civil defense authorities and the public with accurate, evidence-based information regarding events such as earthquakes, volcanic eruptions, tsunamis, storms, and floods (which represent climatic as well as weather events), and then planning to mitigate and adapt to the effects when such events occur.

The idea that there can be a one-size-fits-all global solution to address future climate change, such as recommended by the United Nations in the past, fails to deal with real climate and climate-related hazards. It also turned climate change into a political issue long before the science was sufficiently advanced to inform policymakers. A better path forward was suggested by Ronald Brunner and Amanda Lynch: “We need to use adaptive governance to produce response programs that cope with hazardous climate events as they happen, and that encourage diversity and innovation in the search for solutions. In such a fashion, the highly contentious ‘global warming’ problem can be recast into an issue in which every culture and community around the world has an inherent interest”

(Brunner and Lynch, 2010).

There is some evidence world leaders are reconsidering past decisions. China, India, Russia, and other countries are making it clear they will not blindly follow the path of reducing the use of fossil fuels in the vain hope of having an almost indiscernible effect on climate some time in the twenty-second or twenty-third centuries. A writer for *Nature*, commenting before the December 2015 Conference of the Parties (COP-21) of the UN Framework Convention on Climate Change, reported in May 2015,

The negotiations' goal has become what is politically possible, not what is environmentally desirable. Gone is a focus on establishing a global, "top down" target for stabilizing emissions of a carbon budget that is legally binding. The Paris meeting will focus on voluntary 'bottom up' commitments by individual states to reduce emissions. The global climate target is being watered down in the hope of getting any agreement in Paris. The 2°C warming limit need only be kept "within reach." The possibility of using "ratcheting mechanisms" keeps hopes alive of more ambitious policies, but such systems are unlikely to achieve the desired outcomes. Strict measuring, reporting and verification mechanisms are yet to be agreed (Geden, 2015, p. 27).

Michael Levi, a senior fellow for the Council on Foreign Relations, wrote in June 2015 about the changing expectations of world leaders. His points in brief: (1) Developed countries are no longer pushing for binding emissions reduction commitments, whether for themselves or developing countries; (2) the emphasis has shifted from reducing emissions in order to mitigate future climate change to helping nations adapt to whatever the future climate might look like; (3) the goals declared at the UN's next meeting (in Paris in December 2015) will be too far in the future to matter to anyone; and (4) the widely discussed pledge of giving developing countries \$100 billion a year is going to consist largely of relabeling foreign aid and private funding already going to those countries (Levi, 2015).

If Geden's and Levi's observations are true, this is all very good news indeed. The world appears to be backing away from a disaster of its own making, caused by lobbyists and campaigners and interest groups steering public policy in the wrong direction.

Policymakers should recognize that the human impact on the global

climate remains a scientific puzzle, perhaps the most difficult one science has ever faced. The scientific debate is far from over. Despite appeals to a “scientific consensus” and claims from even the president of the United States that “climate change is real, man-made, and dangerous,” the truth is we simply don’t know if climate change is a problem that needs to be addressed. The best available evidence points in a different direction: The human impact on climate is small relative to natural variability, perhaps too small to be measured. Rather than invest scarce world resources in a quixotic campaign based on politicized and unreliable science, world leaders would do well to turn their attention to the real problems their people and their planet face.

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## ***Conclusion***

The most important fact about climate science, often overlooked, is that scientists disagree about the environmental impacts of the combustion of fossil fuels on the global climate. There is no survey or study showing “consensus” on the most important scientific issues, despite frequent claims by advocates to the contrary.

Scientists disagree about the causes and consequences of climate for several reasons. Climate is an interdisciplinary subject requiring insights from many fields. Very few scholars have mastery of more than one or two of these disciplines. Fundamental uncertainties arise from insufficient observational evidence and disagreements over how to interpret data and how to set the parameters of models. The Intergovernmental Panel on Climate Change (IPCC), created to find and disseminate research finding a human impact on global climate, is not a credible source. It is agenda-driven, a political rather than scientific body, and some allege it is corrupt. Finally, climate scientists, like all humans, can be biased. Origins of bias include careerism, grant-seeking, political views, and confirmation bias.

Probably the only “consensus” among climate scientists is that human activities can have an effect on local climate and that the sum of such local effects could hypothetically rise to the level of an observable global signal. The key questions to be answered, however, are whether the human global signal is large enough to be measured and if it is, does it represent, or is it likely to become, a dangerous change outside the range of natural variability? On these questions, an energetic scientific debate is taking place on the pages of peer-reviewed science journals.

In contradiction of the scientific method, IPCC assumes its implicit hypothesis – that dangerous global warming is resulting, or will result, from human-related greenhouse gas emissions – is correct and that its only duty is to collect evidence and make plausible arguments in the hypothesis’s favor. It simply ignores the alternative and null hypothesis, amply supported by empirical research, that currently observed changes in global climate

indices and the physical environment are the result of natural variability.

The results of the global climate models (GCMs) relied on by IPCC are only as reliable as the data and theories “fed” into them. Most climate scientists agree those data are seriously deficient and IPCC’s estimate for climate sensitivity to CO<sub>2</sub> is too high. We estimate a doubling of CO<sub>2</sub> from pre-industrial levels (from 280 to 560 ppm) would likely produce a temperature forcing of 3.7 Wm<sup>-2</sup> in the lower atmosphere, for about ~1°C of *prima facie* warming. The recently quiet Sun and extrapolation of solar cycle patterns into the future suggest a planetary cooling may occur over the next few decades.

In a similar fashion, all five of IPCC’s postulates, or assumptions, are readily refuted by real-world observations, and all five of IPCC’s claims relying on circumstantial evidence are refutable. For example, in contrast to IPCC’s alarmism, we find neither the rate nor the magnitude of the reported late twentieth century surface warming (1979–2000) lay outside normal natural variability, nor was it in any way unusual compared to earlier episodes in Earth’s climatic history. In any case, such evidence cannot be invoked to “prove” a hypothesis, but only to disprove one. IPCC has failed to refute the null hypothesis that currently observed changes in global climate indices and the physical environment are the result of natural variability.

Rather than rely exclusively on IPCC for scientific advice, policymakers should seek out advice from independent, nongovernment organizations and scientists who are free of financial and political conflicts of interest. NIPCC’s conclusion, drawn from its extensive review of the scientific evidence, is that any human global climate impact is within the background variability of the natural climate system and is not dangerous.

In the face of such facts, the most prudent climate policy is to prepare for and adapt to extreme climate events and changes regardless of their origin. Adaptive planning for future hazardous climate events and change should be tailored to provide responses to the known rates, magnitudes, and risks of natural change. Once in place, these same plans will provide an adequate response to any human-caused change that may or may not emerge.

Policymakers should resist pressure from lobby groups to silence scientists who question the authority of IPCC to claim to speak for “climate science.” The distinguished British biologist Conrad Waddington wrote in 1941,

It is ... important that scientists must be ready for their pet theories to turn out to be wrong. Science as a whole certainly cannot allow its judgment about facts to be distorted by ideas of what ought to be true, or what one may hope to be true (Waddington, 1941).

This prescient statement merits careful examination by those who continue to assert the fashionable belief, in the face of strong empirical evidence to the contrary, that human CO<sub>2</sub> emissions are going to cause dangerous global warming.

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## ***About the Authors***

**Dr. Craig D. Idso** is founder and chairman of the Center for the Study of Carbon Dioxide and Global Change. Since 1998, he has been the editor and chief contributor to the online magazine *CO2 Science*. He is the author of several books, including *The Many Benefits of Atmospheric CO2 Enrichment* (2011) and *CO2, Global Warming and Coral Reefs* (2009). He earned a Ph.D. in geography from Arizona State University, where he lectured in meteorology and was a faculty researcher in the Office of Climatology.

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**Dr. S. Fred Singer** is one of the most distinguished atmospheric physicists in the United States. He established and served as the first director of the U.S. Weather Satellite Service, now part of the National Oceanic and Atmospheric Administration (NOAA), and earned a U.S. Department of Commerce Gold Medal Award for his technical leadership. He is coauthor, with Dennis T. Avery, of *Unstoppable Global Warming Every 1,500 Years* (2007, second ed. 2008) and many other books. Dr. Singer served as professor of environmental sciences at the University of Virginia, Charlottesville from 1971 to 1994 and is founder and chairman of the nonprofit Science and Environmental Policy Project. He earned a Ph.D. in physics from Princeton University.

## ***About NIPCC***

The Nongovernmental International Panel on Climate Change (NIPCC) is what its name suggests: an international panel of nongovernment scientists and scholars who have come together to understand the causes and consequences of climate change. Because we are not predisposed to believe climate change is caused by human greenhouse gas emissions, we are able to look at evidence the Intergovernmental Panel on Climate Change (IPCC) ignores. Because we do not work for any governments, we are not biased toward the assumption that greater government activity is necessary.

NIPCC traces its roots to a meeting in Milan in 2003 organized by the Science and Environmental Policy Project (SEPP), a nonprofit research and education organization based in Arlington, Virginia. SEPP, in turn, was founded in 1990 by Dr. S. Fred Singer, an atmospheric physicist, and incorporated in 1992 following Dr. Singer's retirement from the University of Virginia. NIPCC is currently a joint project of SEPP, The Heartland Institute, and the Center for the Study of Carbon Dioxide and Global Change.

NIPCC has produced eight reports to date:

*Nature, Not Human Activity, Rules the Climate*  
*Climate Change Reconsidered: The 2009 Report of the Nongovernmental International Panel on Climate Change (NIPCC)*  
*Climate Change Reconsidered: 2011 Interim Report*  
*Climate Change Reconsidered II: Physical Science*  
*Climate Change Reconsidered II: Biological Impacts*  
*Scientific Critique of IPCC's 2013 'Summary for Policymakers'*  
*Commentary and Analysis on the Whitehead & Associates 2014 NSW Sea-Level Report*  
*Why Scientists Disagree About Global Warming*

These publications and more information about NIPCC are available at [www.climatechangereconsidered.org](http://www.climatechangereconsidered.org).

## ***About The Heartland Institute***

The Heartland Institute is a national nonprofit research and education organization based in Arlington Heights, Illinois. We are a publicly supported charitable organization and tax exempt under Section 501(c)(3) of the Internal Revenue Code.

Heartland is approximately 5,500 men and women funding a nonprofit research and education organization devoted to discovering, developing, and promoting free-market solutions to social and economic problems. We believe ideas matter, and the most important idea in human history is freedom.

Heartland has a full-time staff of 39. Joseph Bast is cofounder, president, and CEO. Dr. Herbert Walberg is chairman of the 10-member Board of Directors. Approximately 250 academics participate in the peer review of its publications and more than 200 elected officials pay annual dues to serve on its Legislative Forum.

Heartland has a long and distinguished history of defending freedom. We are widely regarded as a leading voice in national and international debates over budgets and taxes, environmental protection, health care, school reform, and constitutional reform. Five centers at The Heartland Institute conduct original research to find new ways to solve problems, turn good ideas into practical proposals for policy change, and then effectively promote those proposals to policymakers and the public.

For more information, visit our website at [www.heartland.org](http://www.heartland.org), call 312/377-4000, or visit us at 3939 North Wilke Road, Arlington Heights, Illinois.

**“Probably the most widely repeated claim in the debate over global warming is that ‘97% of scientists agree’ that climate change is man-made and dangerous. This claim is not only false, but its presence in the debate is an insult to science.”**

With these words, the distinguished authors of *Why Scientists Disagree About Global Warming: The NIPCC Report on Scientific Consensus* begin a detailed analysis of one of the most controversial topics of the day. Do most scientists agree on the causes and consequences of climate change? Is it really only a small fringe of the scientific community that believes global warming is not a crisis?

The authors make a compelling case against claims of a scientific consensus. The purported proof of such a consensus consists of sloppy research by nonscientists, college students, and a highly partisan Australian blogger. Surveys of climate scientists, even those heavily biased in favor of climate alarmism, find extensive disagreement on the underlying science and doubts about its reliability.

Why do scientists disagree? The authors point to four reasons: a conflict among scientists in different and often competing disciplines; fundamental scientific uncertainties concerning how the global climate responds to the human presence; failure of the United Nations’ Intergovernmental Panel on Climate Change (IPCC) to provide objective guidance to the complex science; and bias among researchers.

What does the science actually say about global warming? The authors offer a succinct summary of the real science of climate change based on their previously published comprehensive review of climate science in a volume titled *Climate Change Reconsidered II: Physical Science*. They recommend policymakers resist pressure from lobby groups to silence scientists who question the authority of IPCC to claim to speak for “climate science.” They conclude with a quotation from the distinguished British biologist Conrad Waddington:

*It is ... important that scientists must be ready for their pet theories to turn out to be wrong. Science as a whole certainly cannot allow its judgment about facts to be distorted by ideas of what ought to be true, or what one may hope to be true.*

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# EXHIBIT 47

AMERICAN LEGISLATIVE EXCHANGE COUNCIL

# The State Factor

*Jeffersonian Principles in Action*

## *Global Warming and the Kyoto Protocol: Paper Tiger, Economic Dragon*

by Patrick J. Michaels

### Foreword

The summer of 1988 was excruciatingly hot and dry in the eastern United States. Vast farm acreage in the Midwest lay bare, lacking water even for germination. Civil War relics buried in the mud of the Mississippi since 1864 were unearthed to historians. Temperatures skyrocketed.

On June 23, a NASA astrophysicist, James Hansen, stunned a joint Congressional hearing with his statement that there was a "strong cause and effect relationship between the current climate and human alteration of the atmosphere." Strictly, he merely meant that a slight warming of planetary mean temperature was consistent with small changes in the earth's natural greenhouse effect, brought on largely by the combustion of fossil fuels.

NASA employs rocket scientists. As surely as they can track a projectile through space, they can project the downstream trajectory of a press release. Hansen and NASA knew that his testimony would unleash a bonfire of global warming hysteria, tremendous amounts of taxpayer money for research, and create an international treaty and protocol, with enormous economic implications for the United States.

Hansen's testimony was not as well received by many scientists, as compared to the press. In response, a school of "skeptical" scientists (a strange moniker given to those who thought Hansen's view was irrationally pessimistic) arose, who argued for much more benign and limited climate change based upon observed climate and emission trends. This view largely (but not completely) prevails in the present Administration, and

is what is mainly responsible for President Bush's outright rejection of the Kyoto Protocol. Global warming turns out to be a paper tiger, and the Kyoto protocol a dangerous economic dragon.

This paper details the evolution of that argument, and the economic and scientific poverty of the Kyoto Protocol on global warming.

### I. Introduction

Recently, global warming celebrated its 100th birthday. After nine centuries of decline, global surface temperatures began to rise around the year 1900. In 1896, Svante Arrhenius published a paper in the journal *Philosophical Transactions* that predicted that if human beings doubled the concentration of atmospheric carbon dioxide (mainly from burning of fossil fuels) they would increase the surface average temperature around 9°F. This forecast differs very little from one published by NASA's Hansen nearly 100 years later. Arrhenius also argued that if we increased the concentration by 50 percent, the surface temperature would rise 5° Fahrenheit. Thanks to the addition of several other "greenhouse" gases besides carbon dioxide, Homo Sapiens accomplished this change in the greenhouse effect in the 20th century, but the large temperature rise did not occur.

Arrhenius was wrong.

Instead, there was a modest rise in surface temperature of about 1°F. While he missed the magnitude, Arrhenius correctly predicted its distribution. In 1896, he wrote:

“The [warming] influence is in general greater in the winter than in the summer... is in general somewhat greater for land than for ocean... the effect will be less there [in the southern] than in the northern hemisphere... [it] will of course diminish the difference in temperature between day and night.”

All of these things accompanied the warming of the last half of this century, and it is this constellation of climate change that serves as the basis for the benign synthesis of climate change, rather than the apocalyptic vision championed by extremists who are long on rhetoric but devoid of data. The way the planet warms is much more important than whether it warms, and the patterns, seasonality, and timing of observed warming paint a rather benign, if not beneficial picture.

No credible argument counters the notion that the measured planetary average surface temperature is warmer than it was 100 years ago. But what does that warming mean? If that warming were in the coldest air of winter, rather than in the heat of summer, the overall effect is hardly bad. Although most mathematical simulations of climate predict an overall increase in precipitation, is more precipitation really a bad thing? If there were a sudden and dramatic increase in the frequency of severe floods with no concomitant positive effects, then obviously the answer is yes. But what if gentle spring rains increase while the severity of hurricanes declines?

This paper examines the history of how climate changed over the 20th century and what that change portends. It is very difficult to demonstrate a large negative net effect of these changes, at least in free societies: life span has doubled, crop yields have quintupled, and average wealth has increased to levels beyond the imagination of someone alive in 1900. All of that occurred as the planet warmed. Global warming may not have created all those benefits (although there is some evidence for a positive agricultural impact), but it surely did not prevent them.

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## II. Overall History

Figure 1, on page 7, details the surface temperature history of the Northern Hemisphere where data is available for the last 100 years. (Southern Hemisphere records are not as reliable because of paucity of coverage over the vast Southern Ocean and Antarctica). There are two distinct warmings of similar magnitude. The first occurred from 1910 to 1940, and likely has little if anything to do with changes in the earth's greenhouse effect, as three-quarters of the greenhouse emissions are in the postwar era. NASA scientists Judith Lean and David Rind and Harvard astrophysicist Sallie Baliunas have argued persuasively that this early warming is largely a result of solar changes.

The second warming, which began about 35 years ago, is much more interesting. Greenhouse-effect physics predicts that increasing concentrations of carbon dioxide will warm very dry air much more than moist air. In general, the driest air masses in the planet are very cold high pressure systems that dominate continental interiors during the winter.

The propensity for greenhouse warming to heat dry air has enormous implications that have largely been ignored in the raucous debate about climate change. This is because a warming of dry air is largely a warming of very cold air. At  $-40^{\circ}\text{F}$ , the amount of water in the atmosphere averages about one one-thousandth of what resides at  $+105^{\circ}\text{F}$  (this encompasses the earth's natural temperature range), so the effect of adding carbon dioxide to frigid air is to produce a stong warming.

Figure 2, on page 7, details the observed difference between winter and summer warming. The darker the shaded area (where data is available), the more the planet has warmed in the winter vs. the summer. It is quite obvious that the lion's share of warming is taking place in Siberia and northwestern North America in the winter.

Note the large areas of the map that are colored black. These are regions where there isn't enough reliable data to estimate a temperature trend since World War II. The expanse of the Southern Hemisphere that is not covered is truly astounding—it is

virtually everywhere south of 40°. For a comparative perspective in the Northern Hemisphere, this would mean there would be no data for every location north of Chicago.

Siberia and western North America are home to the great Northern Hemisphere cold “anticyclones,” or high-pressure regions. The high barometric pressure simply means that there is a more air present in these regions. Occasionally the jet stream kicks one of these air masses southeastward toward the eastern United States. In the Christmas 1983 anticyclone, about 40 perished in South Carolina alone.

Summer warming has been, as predicted by greenhouse theory, much less than in the winter. In fact, less than one-third of the observed warming of the second half of the 20th century occurs in the warm half-year, while two-thirds occurs in the cold half-year.

I recently demonstrated in a technical article in the journal *Climate Research*, that the amount of warming is indeed directly related to the amount of cold air available. In dry environments, such as Siberia or North-western North America, the colder it is, the more it warms.

These cold airmasses are usually responsible for the last freeze in the spring and the first freeze in the fall over temperate latitudes. Reducing their inherent coldness lengthens the growing season, and there are several lines of evidence indicating that this is occurring. A study by David Thompson of Bell Laboratories, published in *Science* in 1995, found that the spring warm-up has progressed about three days forward in our latitude. In 1997, R.B. Myneni et al. found, using satellite data, that the high latitudes were “greening up” a week earlier in the 1990s than they were in the 1980s.

### III. Warming and Temperature Variability

Along with the spectre of global warming comes the notion that “extreme weather” is getting worse. Our research team tested this notion and found it dead wrong. The results can be found in another article in the technical journal *Climate Research*.

We examined the U.S. temperature history because it is one of the best-maintained networks in the world. As

is apparent from Figure 3 (on page 8), there is no strong overall warming trend. But there are three “epochs” of American climate in the last 100 years:

- ♦ A period of warming in the first third of the 20th century. In this epoch, the hottest days of the year warmed the most, making the climate more extreme.
- ♦ A period of cooling in the middle third of the 20th century. In this epoch, the coldest days of the year cooled the most, which is also a tendency towards a more extreme climate.

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**The apocalyptic argument on global warming—that increased temperatures will increase drought by evaporating more moisture—is simply wrong.**

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- ♦ Another period of warming in the last third of the 20th century. In this epoch, the largest warming was in the coldest winter temperatures. This period, which coincides most with greenhouse effect changes in the atmosphere, therefore exhibits a tendency towards less extreme climate.

In another study, we found that warmer years tend to display less season-to-season differences. This is because, as noted above, changing the greenhouse effect tends to warm the coldest air of winter much more than it warms the summer. The result is an annual climate of greater equanimity.

What about U.S. precipitation? Over the last 100 years, American rainfall has increased by about 10%. Because there has been no important warming, this increase in rainfall has not evaporated away; instead it has been beneficial for agriculture and water supplies. The apocalyptic argument on global warming—that increased temperatures will increase drought by evaporating more moisture—is simply wrong.

There are many different measures of drought. One of the standard indices known as the Palmer Index, takes into consideration precipitation, evaporation, runoff into rivers and streams, and storage in the soil. As shown in figure 4, on page 8, there is simply no trend towards increasing drought in the United States.

### IV. Heat-Related Deaths

Almost every summer, climate alarmists point to urban death statistics during heat waves. The popular perception is that heat-related deaths will increase with global warming. Here are two disparate sources touting this common assumption:



“On a warmer planet, intense heat waves alone are by 2050 likely to result in increases in death by cardiac and respiratory illness of several thousand a year—especially in urban areas and among the elderly and very young...” (Wall Street Journal, October 19, 1999)

“[Based upon data from several North American cities], the annual number of heat-related deaths would approximately double by 2020 and would increase several fold by 2050.” (United Nations Intergovernmental Panel on Climate Change, 1996)

Our research shows that this perception is dead wrong. After standardizing U.S. mortality data for age distribution, we first plotted death rates against “apparent temperature”—a combination of temperature and humidity that accounts for the multiplicative impact of moisture on heat stress at a given temperature. In general, heat-related deaths decline with apparent temperature, although there are a few days that show remarkable death excursions at high temperature (Figure 5)—events such as July 1995’s Chicago heat wave, which was responsible for what in the final analysis appears to be about 200 excess deaths.

There are no excessive heat deaths in cities in the southern United States, which means that people adapt to their climatic expectations. Perhaps more interesting is that deaths at high effective temperatures have been declining in northern cities such as Philadelphia to the point that they are now near zero (Figure 6).

People clearly adapt to changing climate conditions by adopting technologies, such as insulation and air conditioning, which ameliorate heat-related discomfort and death. It would be the height of folly to artificially raise energy prices in this situation. The result would clearly be more heat-related death.

## V. What Does The Future Hold?

By now, climate modelers have run dozens of different computer simulations to estimate future warming.

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**It is clearly politically untenable to impose grave economic damage in return for no detectable environmental change — even if one assumed that global warming was a terrible threat.**

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How do you decide which, if any, is likely to be correct?

The key to the future lies in the rather extended period for which humans have already altered the natural greenhouse effect—roughly from the start of the Industrial Revolution in the late 19th century to the present. The concentration of atmospheric carbon dioxide—the main greenhouse emission resulting from human activity—varied from between 260 and 320 parts per million (ppm) between the end of the glacial stage, 10,800 years ago, and the Industrial Revolution. The average value during that period has been near the low end of that range, about 280ppm. The current concentration is 365ppm, about a 30 percent increase.

Nearly 20 years ago, a few climate scientists (including this author) noted that the planet had not warmed as much as would be expected from early computer simulations of greenhouse warming. By 1996, United Nations Intergovernmental Panel on Climate Change (IPCC) acknowledged that this observation had become the consensus of the broad scientific constituency. Yet at the same time, the IPCC concluded “the balance of evidence suggests a discernible human influence on global climate.”

As we have seen, that influence is largely on the coldest temperatures of the winter and has been rather modest. It also tells us much about future warming.

Figure 7, on page 10, is a representative sample of so-called general circulation climate models for human warming in the atmosphere. Note that the rates of warming that they project are different, but that they are all straight lines—in other words, once human warming starts, it takes place at a constant rate for the foreseeable future. It is worth noting that climate alarmists argue for an exponential (increasing rate) of warming, which is clearly counter to the consensus of the scientific models.

In fact, the warming of the last third of the 20th century in the surface average temperatures has been a straight line, and its concentration in very cold, dry air argues that it is from greenhouse changes. This allows us to determine which (if any) of the model projections are likely to be correct, simply by superimposing the observed trend on the various modeled trends (Figure 8). This must be adjusted for the fact that a small portion of the recent warming (about 15%) is thought to be from solar changes.

Assuming that the sun reverts to its long-term average behavior, we can expect about 1.6°C of warming, averaged over the surface, in the next 100 years or 0.8°C in the next fifty years. This is a very modest amount, and will be distributed roughly 2:1 between the winter and the summer. It is similar to what has been witnessed over much of the second half of the 20th century, a period of unprecedented economic expansion, longevity increases, and technological development. It is difficult to understand the alarmist logic that suddenly, somehow, this will all change if conditions continue to warm as they have been for most of our lifetimes.

In 1900, life expectancy at birth in the United States was 42 years. After 100 years of global warming it was twice that number. Urban infrastructure in the United States has adapted so well to both average and warmed climates that heat-related deaths are disappearing. After a warming of 0.6°C, U.S. crop yields quintupled. World food production per capita has increased by nearly 50 percent in the last half-century. An as yet untold story is that carbon dioxide itself makes most crops grow better: by the year 2050, that direct stimulation of planetary greening will feed an increment of 1.5 billion people the equivalent of today's diet.

## VI. Can It Be Stopped?

No known mechanism can stop global warming.

Upon the return of the U.S. negotiating team from Kyoto, Japan, in 1997, Vice President Gore asked federal scientists how much warming the Kyoto Protocol would save. The answer, which was published by T.M.L. Wigley in the journal *Geophysical Research Letters*, was stunning: a mere 0.07°C by 2050 and, owing to the linear nature of the warming models, 0.14°C, or twice that figure, by 2100. This assumes that all nations of the world comply with their Kyoto agreements. In the case of the United States, that would mean reducing our emissions of carbon dioxide to 7% below 1990 levels by the period 2008-2012. We are currently about 15% above 1990 levels, and meeting this target is simply impossible.

Ironically it was Wigley's calculation that, more than anything else, provided the scientific logic for President

Bush's withdrawal from the Kyoto Protocol in spring of 2001. Because of the intransigence of European environment ministers, mainly Germany's Jurgen Trittin and Frances Dominique Voynet, at subsequent international negotiations designed to implement the Kyoto Protocol, the mechanism imposed on the U.S. would have been disastrously expensive. As shown recently by economist William Nordhaus, after all is said and done, the U.S. assumes virtually all of the costs for Kyoto.

It is clearly politically untenable to impose grave economic damage in return for no detectable environmental change—even if one assumed that global warming was a terrible threat.

Once the Clinton Administration scientists had revealed that Kyoto would have no detectable effect on the earth's temperature, there was no choice to any president but a graceful withdrawal.

Bush's withdrawal threatened the entire Protocol because it does not take force until a collection of nations responsible for 55% of the industrialized world's carbon dioxide emissions agrees to participate. In

fact, this level could only be achieved in the absence of the U.S. if the Japanese became a party, and they were reluctant because they, too, perceived major economic damage. As an inducement, the Kyoto signatories further weakened the prospective Japanese and Russian commitments so substantially that the net warming that would now be "saved" by the Kyoto Protocol is a mere 0.02°C by 2050. There is no measurement system that could ever isolate this small factor from year-to-year variations in the earth's temperature, which are approximately ten times as great.

Thus Kyoto is scientifically and politically dead in the United States. In fact, while European ministers posture that the U.S. is an environmental "rogue nation" because of its view on Kyoto, in fact it is the Europeans that are out of step with the world. There is no Kyoto commitment from India, China, all of South America, all of Africa, and much of the former Soviet Union. Europe is isolated in its adherence to the environmentally irrelevant Kyoto Protocol, not the United States, and the U.S. demonstrated science-based leadership when it finally rejected Kyoto.

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**Europe is isolated in its adherence to the environmentally irrelevant Kyoto Protocol, not the United States, and the U.S. demonstrated science-based leadership when it finally rejected Kyoto.**

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## VII. Policy Leadership

Having established that the Kyoto Protocol will have no detectable effect on average temperature within any reasonable policy time frame of 50 years or so, what constructive policies can engage global climate issues?

In a simple phrase: private investment. We cannot envision the energy technology that will power the world 100 years from now, but one thing seems certain: it will produce power much more efficiently than we do today. That is because market forces inevitably reward production efficiency. Today, we produce a constant-dollar of GDP for 40% less energy than we used a mere thirty years ago. These increases in efficiency did not result because of fears about global warming. Instead, they came about because of investment in energy efficiencies that are dictated by a competitive economy. It seems doubtless that these trends will continue, as long as our elected officials do not confiscate investable income, tilting it at the windmill of disastrous global warming. This is a problem that will fix itself if we are wise enough to leave it alone.

## Conclusion

The scientific argument in this paper is fairly straightforward. In essence, it says that because human activity has been slightly changing the atmosphere's natural greenhouse effect for nearly 100 years, nature has had plenty of time to display its response. Using that logic, the amount of prospective warming for the next 100 years becomes relatively inconsequential, compared to the boisterous projections made over a decade ago. This projection is for 0.8°C in the next fifty years, or 1.6°C in the next hundred.

In December 2001, NASA's James Hansen, whose testimony was instrumental in igniting the global warming issue, published a new paper in the *Proceedings of the National Academy of Sciences*. The paper argued that observed changes in the concentrations of global warming gases were much less than had been previously anticipated, and that a continuation of these trends, which have included increased efficiency, would yield an "additional warming in the 50 years of  $3/4 \pm 1/4^\circ\text{C}$ ".

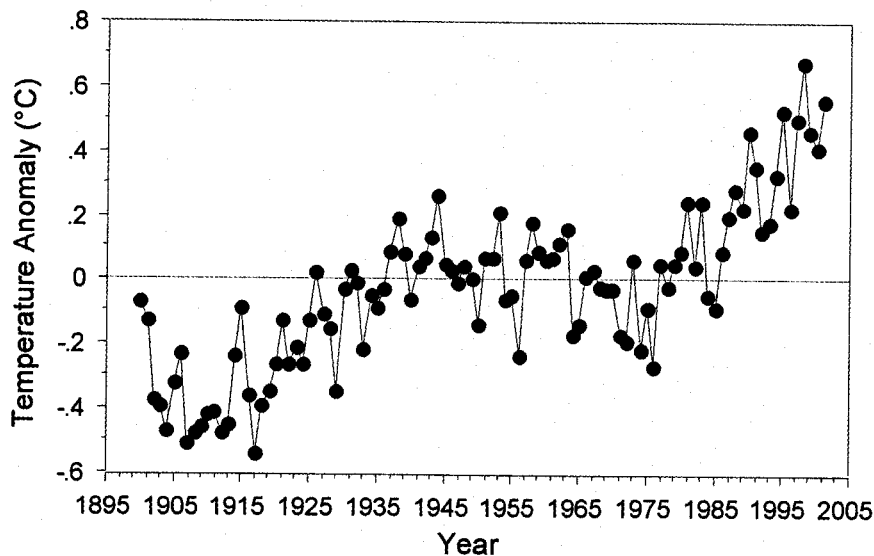
It appears that the "skeptics" have prevailed. Over the period in which this issue has been politically active, they have argued that observed trends in human activity and global temperatures would presage only a modest warming. They were right. Global warming is a paper tiger.

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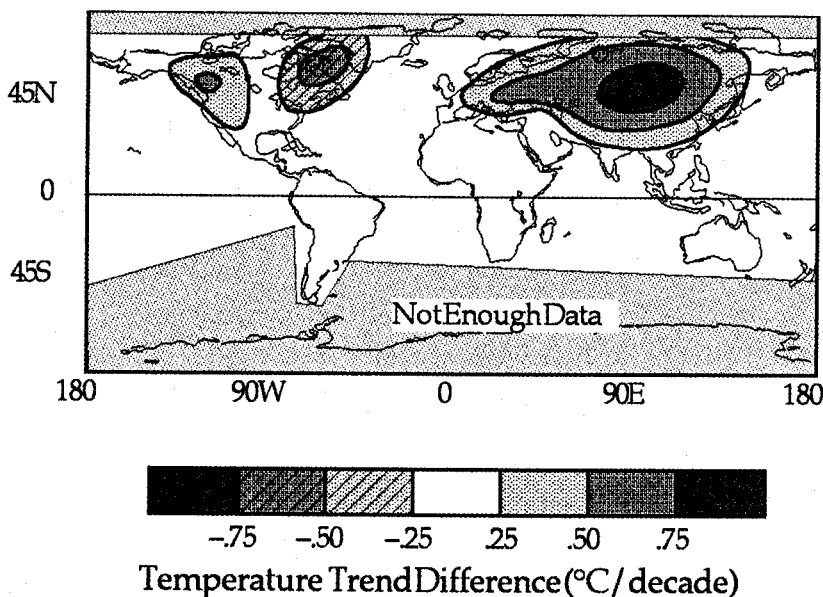
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## ABOUT THE AUTHOR

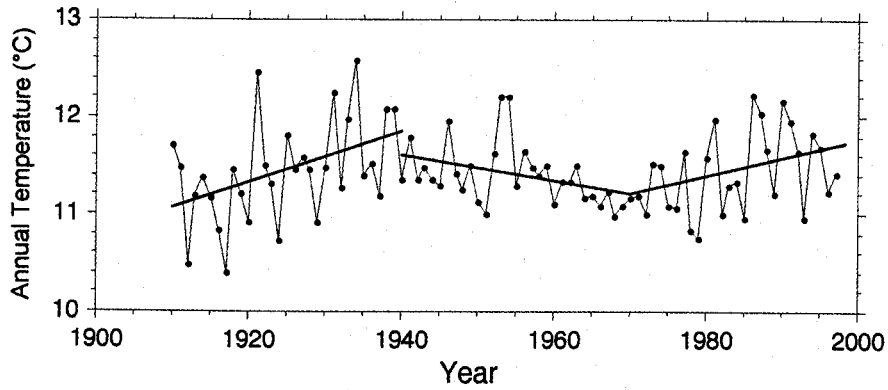
**Patrick J. Michaels** is a Professor of Environmental Sciences at the University of Virginia.



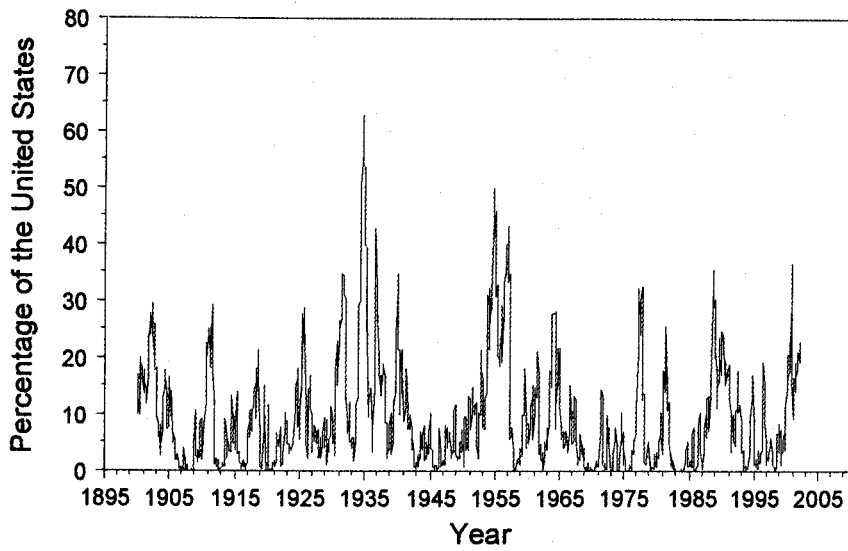
**Figure 1. Northern Hemisphere annual temperature history, 1900–2001.**



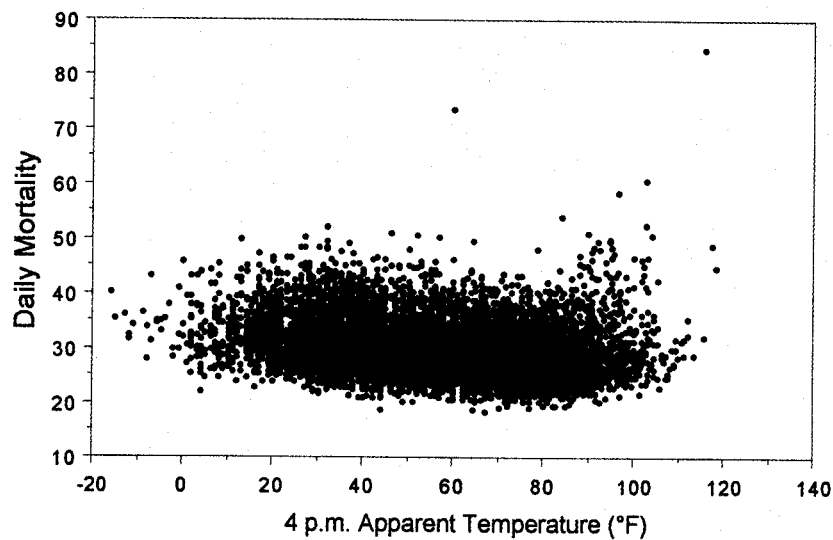
**Figure 2. Surface temperature trends (°C per decade) during the cold half-year (October–March in the Northern Hemisphere, April–September in the Southern Hemisphere) from 1946–1995.**



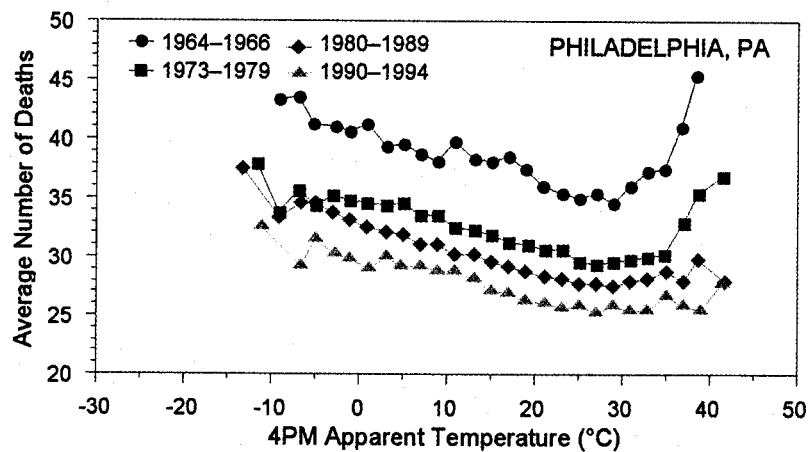
**Figure 3. Annual average temperature history from the United States, 1910-1997, showing three distinct epochs of change.**



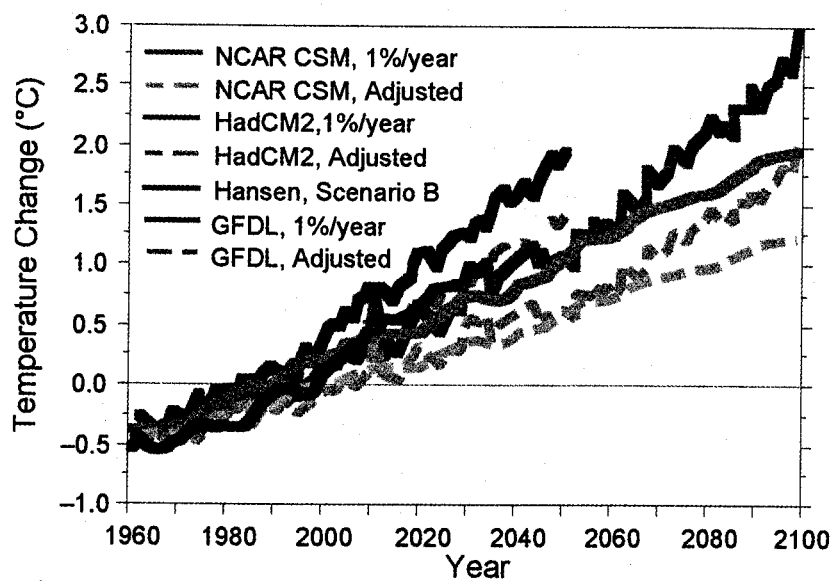
**Figure 4. Percentage of the United States experiencing severe or extreme drought conditions.**



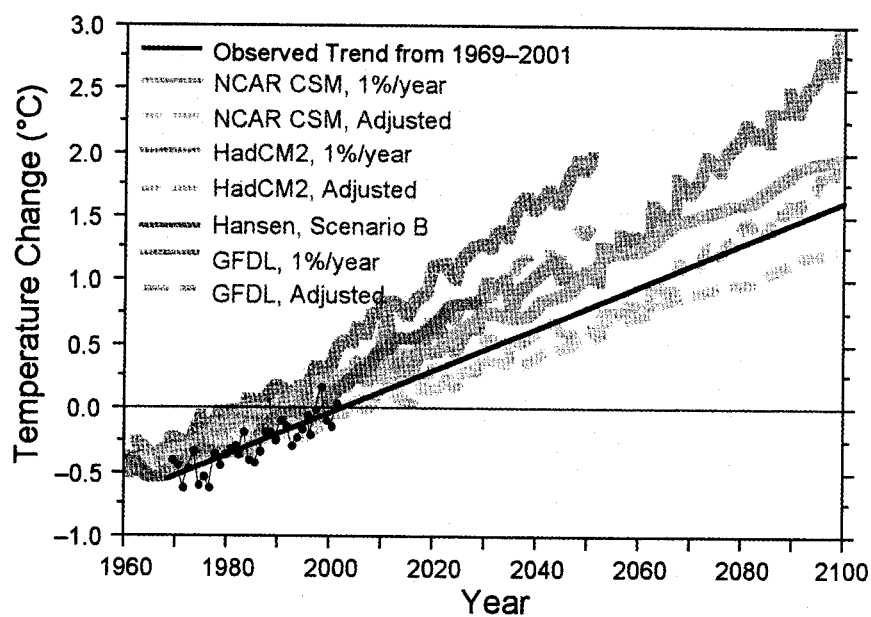
**Figure 5. Daily mortality versus 4p.m. apparent temperature in Chicago, IL. There is a negative relationship between temperature and daily mortality throughout most of the temperature range. However, on the very hottest days, daily mortality can become greatly elevated.**



**Figure 6. Average Daily mortality versus 4 p.m. apparent temperature in Philadelphia, broken down into decades. The population's sensitivity to extremely high temperatures has declined in more recent decades.**



**Figure 7. Typical climate model projections of future temperatures. Notice that the temperature rise is nearly linear in all cases, and that only the slope varies from model to model.**



**Figure 8. Observed warming of the last three decades superimposed on typical climate model projections. The observed linear trend is near the lowest value that the climate models predict and considerably below the mean projected warming.**



**AMERICAN LEGISLATIVE EXCHANGE COUNCIL**

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# EXHIBIT 48



## Sons of Kyoto: Greenhouse Gas Regulation in the States

*By Alexandra Liddy Bourne, EENRA Task Force Director ALEC*

### Synopsis

Although the United Nations agreement, known as the Kyoto Protocol, was rejected by the U.S. Senate, greenhouse gas regulation has proliferated in the states at an alarming rate. In the 2001-2002 general sessions, 66 bills were introduced in 24 states. During the 2003 general session, over 90 bills were introduced in 27 states. Regardless of the scientific uncertainty and the economic costs, there is an orchestrated movement to force the American public to bear the costs of implementing Kyoto-like regulation and develop a cap and trade carbon emission system. Ultimately, this system will create a national energy tax in the short term and has implications that may significantly harm free trade in the future. The legacy that we may hand over to future generations is not one of individual choices in a free market system, but one of lost opportunities in a global market controlled by a carbon cartel.

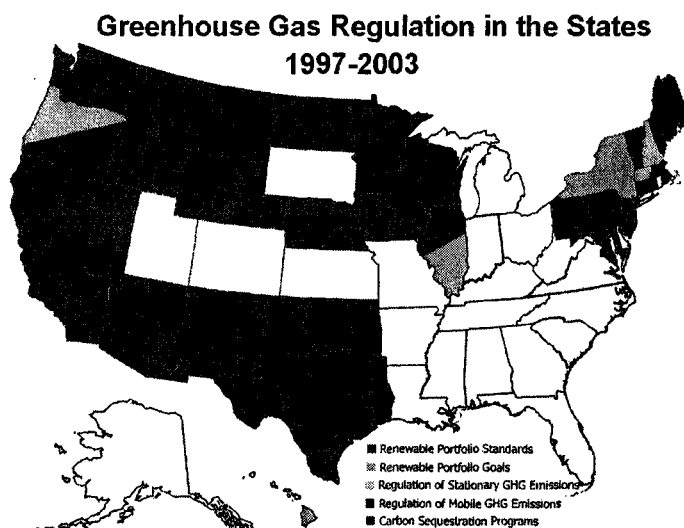
### Introduction

Climate change policy and global warming became the new mantra for environmentalists and non-governmental organizations in their quest to redistribute international and domestic wealth. Combine this dynamic with rent-seeking industries attempting to gain a short-sighted competitive edge in the emissions trading scheme, a recipe for economic disaster has been set up in the states: a carbon cap and trade system.

Rallying around the concept of global warming during the 1992 UN Conference on Environment and Development in Rio de Janeiro, global environmentalists gained momentum to lay the foundation for international greenhouse gas reduction treaties. Subsequently, in 1997 an international agreement to limit “greenhouse gases” and effectively reduce hydrocarbon fuel consumption was conceived under the auspices of concern about increased temperatures due to global warming. This agreement, known as the Kyoto Protocol, did not have a scientific standing nor did it reflect economic realities. Instead, the agreement was driven by public advocacy and supported by foreign governments seeking a competitive edge in the global market place. As one observer noted, “The driving force behind this movement is not any theoretical harm associated with carbon dioxide; it is the real economic value associated with carbon-containing fuels.”<sup>1</sup>

ALEC Issue Analysis

After the U. S. Senate rejected the Kyoto Protocol, an effort to implement the treaty through the back door of state governments was initiated. At first appearance, the regulatory actions were implemented in the states where the environmental movement is strong. Voluntary greenhouse gas registries were introduced as a compromise in states where industry and manufacturers provide economic stability or policymakers were inclined to view voluntary programs as a benign regulatory tool to improve the environment. Mobile and stationary sources of emissions were regulated along the east and west coasts of the nation. Carbon sequestration programs were implemented in the rural states. Since 1997, there has been an orchestrated attempt to establish a carbon dioxide cap and trade program as a “market mechanism” to reduce greenhouse gases in the atmosphere (Figure 1).



### Greenhouse Gas Action in the States

In 1997, Oregon was one of the first states to legislate greenhouse gas reductions. An emissions standard was established that required new or expanded power plants to decrease emissions of carbon dioxide. This legislation also required that if a plant could not meet the standard of its own accord, it could meet the reduction target by paying funds to a “qualified non-profit organization.” That non-profit was required to use the funds to finance projects that avoid, sequester, or displace excess carbon dioxide produced by the plant.

This is one of the first examples of legislated environmental coercion under the climate change agenda that seeks to remove monies from tax-paying, private sector profit centers, to finance a new industry that will not serve as a revenue source for the state general fund. A non-governmental organization, known as the Oregon Climate Trust was designated to oversee the projects. An interesting aspect of this law is that it does not produce an increase in energy efficiency as Oregon’s renewable energy sources already provide 79% of its electricity primarily through hydroelectric dams.<sup>2</sup>

Subsequently, in 1998 New Jersey’s governor imposed an initially voluntary program on utilities to reduce carbon dioxide emissions. To help reach New Jersey’s emissions goals the state also passed egregious regulation to create one of the nation’s first “societal benefits charges” on retail energy sales. The state collected approximately \$358 million

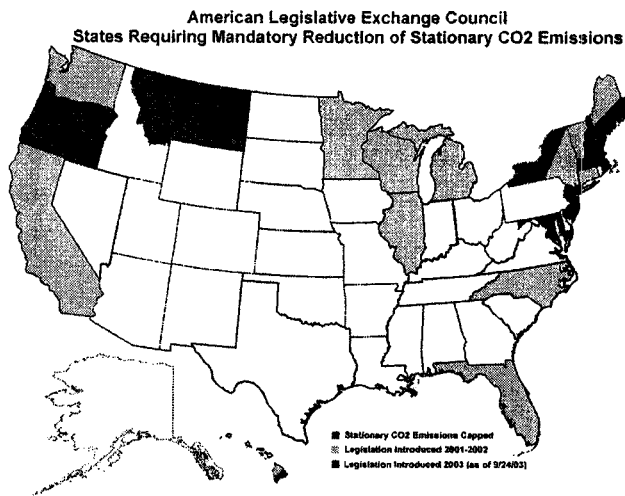
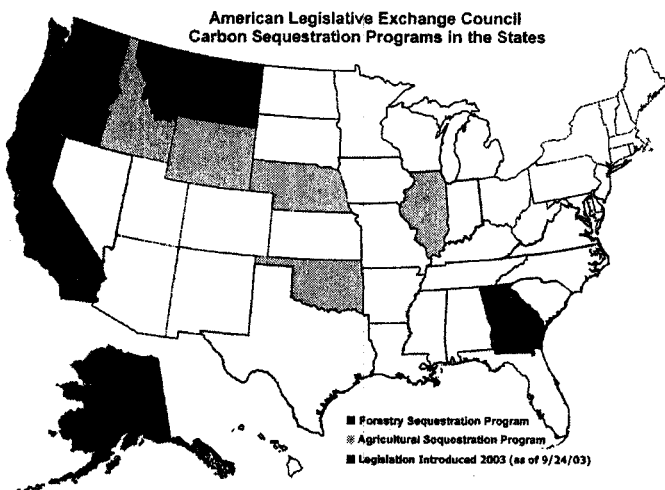
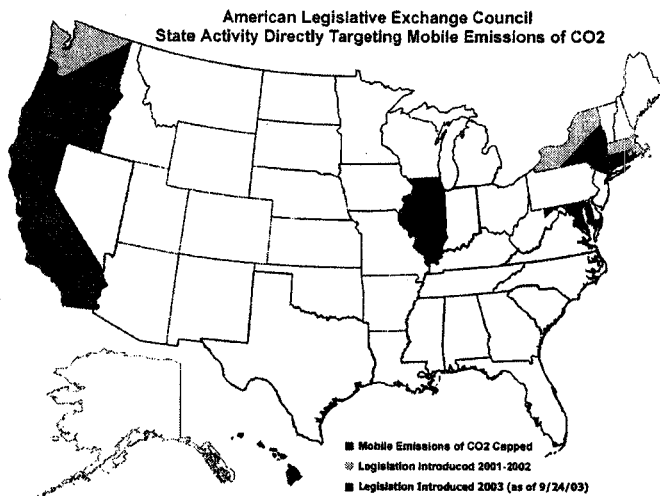
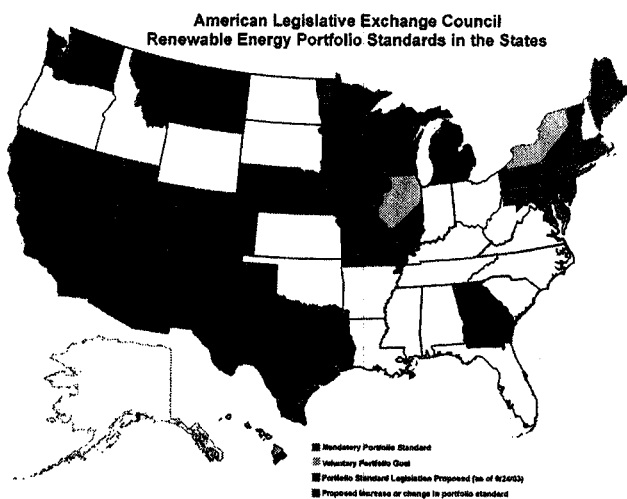
for the first three years to fund energy efficiency and renewable energy programs to reduce carbon dioxide emissions. If the program succeeds in its goals, the states' taxpayers would have paid \$55/ton over three years for every ton of carbon emissions avoided.<sup>3</sup> The voluntary reduction program was discontinued in late 2002, because of accounting and verification problems. However, not before the state forced its largest utility, the Public Service Enterprise Group, to convert its voluntary pledge to a legally binding commitment under mitigation for other Clean Air Act violations in January of that year.

This is an excellent example of the evolution of well intentioned, voluntary initiatives undertaken by industry that are converted into mandatory requirements by coercion at a huge cost to consumers. Like Oregon, New Jersey will not achieve its carbon dioxide reductions because of the regulations, but by default because of its reliance upon nuclear energy, a non-carbon dioxide emitter.<sup>4</sup>

After the Bush Administration entered government in 2000, greenhouse gas legislation was introduced at the state level at a rapid pace. During the 2001-2002 general session, 66 bills were introduced in 24 states. In 2003, there were over 90 legislative bills introduced in 27 states. Carbon dioxide was the key term in the legislative language that has been skillfully inserted to target all fossil fuels used in energy production.

Carbon sequestration programs were targeted toward rural states or states with heavy agriculture and forestry services. Carbon dioxide emission reductions were targeted toward urban states with key national transportation routes or, as in the state of California, with a large market share of the national economy. An example of this strategy is demonstrated by the enactment of a mobile emissions (vehicles) reduction bill in California – which holds 1/8 of the national market share in automobile sales – in an effort to force manufacturers to retool factories and change vehicle choices for all consumers.

The maps below depict the variety of greenhouse gas regulatory programs and carbon dioxide emission and sequestrations programs introduced during the 2003 general sessions in the states.



## **Regional Regulation**

New York's Governor Pataki announced a regional program to curb emissions of carbon dioxide from power plants. Eight of ten invited states have agreed to the plan (CT, VT, NH, DE, ME, NJ, MA, and RI). Maryland and Pennsylvania have not agreed to the concept. The group is to issue rules for a "flexible, market-based cap and trade program" by April 2005. California, Oregon, and Washington are considering a similar program.

There is a serious flaw to this approach. It does not take into consideration the differences in electric generation profiles. New York and the other New England states rely heavily on nuclear, hydropower, and natural gas generation. Pennsylvania, Maryland, and Delaware rely primarily upon coal for electricity generation. The Mid-Atlantic states would have to fuel switch to natural gas or other forms of renewable energy with a significant increase in utility rates.<sup>5</sup> Electricity generated from coal generation prices is approximately \$1.27 per million BTU in the first half of 2003, as opposed to natural gas prices of \$5.81 per million BTU.<sup>6</sup>

The New York proposal is a bit disingenuous; if New York sets the carbon dioxide emission rate to match its emissions in a credit trading program, the state stands to gain economically from the mid-Atlantic states in the region. Pennsylvania alone would lose 50,000 jobs in this regulatory scheme.<sup>7</sup>

## **State Revenue Impact**

Energy taxes bring in large amounts of revenue for state governments. For all states, state motor fuel taxes have increased 3.1% from 1991-2001 to bring in \$32.1 billion in revenue. State public utilities taxes have increased 1.8% in that same period to bring in \$9.9 billion in state revenues. Motor fuel taxes make up 5.6% of total revenues generated by state taxes. Public utilities taxes make up 1.7% of total revenues.<sup>8</sup>

General sales tax is the largest proportion of total state revenues. Seven states charge sales tax on gasoline in addition to other fuel taxes.<sup>9</sup> Almost all states charge some form of sales tax in addition to utility taxes on energy sales. However, the formula differs by states. Some states charge industrial users, but exempt residences. Others charge sales tax on only a portion of the bill (e.g., on the transmission charge). Corporate income taxes imposed upon energy providers also have a variety of mechanisms to provide revenue to the states. To put these numbers into perspective, corporate income taxes provide approximately \$30 billion in revenue, while utility taxes bring in \$86 billion in revenue to the states.<sup>10</sup>

Bast, et al., estimate in their study of the Kyoto Protocol impacts upon 37 states, that consumers would pay a minimum of \$104 billion per year for greenhouse gas emission reductions in these states. To put this number in perspective, this is an average of 25% of the total legislative budget for each state. State implementation of this type of greenhouse reduction policy could cost each household as much as \$10,000 per year.<sup>11</sup>

Increasing regulation or increasing taxes has a detrimental effect on the daily cost of living for state residents, and causes businesses to flee to a more palatable economic climate. Collectively, state legislatures recognizing the high risk of increased regulation upon the state revenues – at a time when 47 states were in budget deficit – and passed only 8 of the 96 greenhouse gas bills introduced in the 2003 general session. Of those eight bills, four were resolutions, one created voluntary reduction goals, two added onto programs already in existence, and the last created a mandatory renewable portfolio standard for electricity generation.

A back of the envelope approach to this state tax dynamic is to compare the states with the highest and lowest electricity prices to the states with the highest and lowest level per capita tax collection (see Tables 1-4). States are heavily reliant upon energy taxes as a revenue source. In states with the highest tax burdens, consumers pay more for energy. Implementing a carbon based cap and trade system founded on the principles of the Kyoto Protocol will plunge our sputtering economy into a tailspin.

**Figure 1: Top Ten Highest State Electricity Prices**

State	Cents/Kilowatt-hour
Hawaii	14.05
California	11.78
New York	11.63
Massachusetts	11.51
New Hampshire	10.95
Vermont	10.80
Rhode Island	10.79
Maine	10.73
Alaska	10.53
Connecticut	9.62

Source: Energy Information Administration. 2001 Electric Power Annual.

**Figure 2: Top Ten Lowest State Electricity Prices**

State	Cents/Kilowatt-hour
Kentucky	4.24
Wyoming	4.46
Idaho	4.92
West Virginia	5.07
Utah	5.21
Washington	5.26
Indiana	5.30
Nebraska	5.39
Oregon	5.44
North Dakota	5.48

Source: Energy Information Administration. 2001 Electric Power Annual.



**Figure 3: Top 10 Highest Per Capita State Tax Collections**

State	Per Capita State Tax Collections
Connecticut	\$3,091.99
Hawaii	\$2,864.89
Delaware	\$2,731.14
Minnesota	\$2,722.00
Massachusetts	\$2,700.18
California	\$2,621.76
Vermont	\$2,532.64
New York	\$2,359.41
Wyoming	\$2,273.96
New Jersey	\$2,269.25

Source: Census Bureau, 2001 State Taxes

**Figure 4: Top Ten Lowest Per Capita State Tax Collections**

State	Per Capita State Tax Collections
South Dakota	\$1,291.92
Tennessee	\$1,362.71
Texas	\$1,379.74
New Hampshire	\$1,410.29
Alabama	\$1,426.42
South Carolina	\$1,513.06
Florida	\$1,520.98
Missouri	\$1,569.74
Arizona	\$1,593.41
Louisiana	\$1,611.04

Source: Census Bureau, 2001 State Taxes.

**Maine: A Case Study**

In looking at the fuel sources for electricity production in Maine, the biggest source for energy is petroleum. Sixty-seven percent of Maine's electric summer generating capacity (summer generating capacity is a common measurement used by energy economists) is fossil fuel based.<sup>12</sup> Renewables make up about 33 percent, although it is important to note the more than half of the renewable generation - 17 percent - is hydropower. The remaining 16 percent is biomass incineration.<sup>13</sup> Maine's remarkable utilization of renewable energy sources is among the highest in the country.

But there is a catch.

Maine's renewable portfolio standard requires that 30 percent of generation sold in the state be generated from renewable resources. The portfolio requirement was enacted as part of Maine's restructuring law. Maine's Public Utilities Commission 2000 restructuring report estimates that approximately half of the portfolio requirement was met by out-of-state generation. This means that Maine's RPS standard, though the highest in the country, is unlikely to spur the development of new renewables. Furthermore, the higher price of renewable energy means that the extra cost will pass from Maine residents to out-of-state renewable energy providers.

Maine presents an interesting picture. According to the Energy Information Administration, Maine residents have the lowest electricity consumption rate in the entire United States. They use almost half as much as the national average. However, Maine residents pay the eighth highest electricity prices. An average household's monthly bill is 52 percent higher than the average U.S. household.<sup>14</sup>

Placing further regulatory requirements upon the energy marketplace in Maine will only serve to increase the cost of electricity with little impact upon improving the environment. Because Maine is already so energy efficient, residents will be unable to decrease energy consumption sufficiently to compensate for the higher prices.

Maine's transportation sector would also be hard hit by efforts to cap mobile greenhouse gas emissions. Residents currently enjoy gasoline pump prices only slightly above the national average. However, gasoline taxes already contribute to 24% to the state's pump price. Gasoline prices, which have increased during the winter of 2003 to the second highest level on record, would increase even more in the face of additional energy taxes.

### **Impact of Greenhouse Gas Reduction Policy at the National Level**

The Heartland Institute found that a national program to reduce greenhouse gas emissions 7% below the 1990 levels by 2010 would increase gasoline prices at least 65 cents/gallon, double the price of electricity, eliminate 2.4 million jobs, and cause the average household income to fall approximately \$3,372 annually.<sup>15</sup> An Energy Information Administration analysis of the Kyoto Protocol in 1998 estimated that the national Gross Domestic Product would be reduced by almost \$400 billion in 2010.<sup>16</sup>

Analysis of multi-pollutant legislation by the Energy Information Administration reveals that the cost of capping carbon dioxide is almost 13 times as expensive as regulating nitrogen oxides and sulfur dioxides. The effort will cost tens of billions in direct costs and many urban centers will still be in violation of national ambient air quality standards.<sup>17</sup>

According to economic models noted by Margo Thorning of the American Council for Capital Formation, when carbon emissions are capped or constrained, economic growth slows due to lost output as new energy taxes are imposed and prices rise for carbon intensive goods. Thorning recommends avoiding caps on carbon dioxide emissions as such a "policy will have a negative impact on the willingness of industry to invest (in the

U.S.) in the new technologies because of the concern that “voluntary” emissions cuts will become mandatory.”<sup>18</sup>

There is significant debate amongst scientific and economic scholars about the merit of the Kyoto Protocol and the effect it would have on global climate change. State legislators should remain skeptical about policies that provide a “market mechanism” for carbon dioxide emissions reduction.

## Conclusion

Regardless of the scientific uncertainty and the economic costs, there is an orchestrated movement to force the federal government and the American public to implement Kyoto-like regulation and develop a cap and trade carbon emission system. Ultimately, this system will create a national energy tax in the short term and has implications that may significantly harm free trade in the future. The legacy that we may hand over to future generations is not one of individual choices in a free market system, but one of lost opportunities in a global market controlled by a carbon cartel.

## Endnotes:

<sup>1</sup> Mannix, Brian. Climate Change Policy Could create the Mother of All Cartels. Heartland Institute, Environment and Climate News. June 2001

<sup>2</sup> Energy Information Administration, Renewable Energy Annual 2001, Nov. 2002, Table C15.

<sup>3</sup> 2002 Annual Report. New Jersey Board of Public Utilities. Available online:

<http://www.bpu.state.nj.us/reports/NJCEP2002AnnualReport-9-22.pdf>. Last Accessed 11/14/03. And Bast, Taylor, Lehr. *State Greenhouse Gas Programs: An Economic and Scientific Analysis*. Heartland Institute, Feb. 2003 p.7. The state of New Jersey designated \$358 million in revenues for 2001-2003 to fund its program. The Bast, et al. report says that it cost the state \$55/ton per year for every ton of carbon avoided. This should read \$55/ton for the first three years of the program.

<sup>4</sup> *ibid.* p.8

<sup>5</sup> Trisko, Eugene; New York’s Proposal for a Regional CO2 Control Plan, American Legislative Exchange Council; July 2003.

<sup>6</sup> Annual Energy Report. *Table 4.1 Receipts, Average Cost, and Quality of Fossil Fuels: Total (All Sectors), 2001 through June 2003*. Energy Information Administration. Available online: [http://www.eia.doe.gov/cneaf/electricity/epm/table4\\_1.html#\\_ftnref4](http://www.eia.doe.gov/cneaf/electricity/epm/table4_1.html#_ftnref4). Last Accessed 11/14/03.

<sup>7</sup> Rose, PhD; Adam; Economic Impacts of Coal Utilization in the Continental United States., Pennsylvania State University, 2001.

<sup>8</sup> “State Government Tax Collections by Type of Tax Fiscal Years 1991– 2001.” *Facts and Figures on Government Finance, 36<sup>th</sup> Edition*. Tax Foundation. Available online: <http://www.taxfoundation.org/collectionsbytype10years.html>. Last accessed 11/14/03.

<sup>9</sup> (API. "Nationwide and State-by-State Motor Fuel Taxes" July 2002).

<sup>10</sup> “State Government Tax Collections by Type of Tax Fiscal Years 1991– 2001.” *Facts and Figures on Government Finance, 36<sup>th</sup> Edition*. Tax Foundation. Available online: <http://www.taxfoundation.org/collectionsbytype10years.html>. Last accessed 11/14/03.

<sup>11</sup> Bast, Taylor, Lehr. *State Greenhouse Gas Programs: An Economic and Scientific Analysis*. Heartland Institute, Feb. 2003. Pg., 33-35. Estimates have been adjusted to reflect current New Jersey figures of \$18.4/ton of avoided carbon per year.

<sup>12</sup> *Existing Capacity by State 1990-2001*. Energy Information Administration. Available online: [http://www.eia.doe.gov/cneaf/electricity/epa/existing\\_capacity\\_state.xls](http://www.eia.doe.gov/cneaf/electricity/epa/existing_capacity_state.xls). Last accessed 11/14/03.

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<sup>13</sup> *Table 8.2a Electricity Net Generation: Total (All Sectors), 1949-2002*. Energy Information Administration. Available online: <http://www.eia.doe.gov/emeu/aer/txt/ptb0802a.html>. Last accessed 11/14/03.

<sup>14</sup> *Electric Sales and Revenue 2001 Spreadsheets (Data Tables). Table 1. U.S. Average Monthly Bill By Sector, Census Division and State, 2001*. Energy Information Administration. Available online: [http://www.eia.doe.gov/cneaf/electricity/esr/esr\\_tabs.html](http://www.eia.doe.gov/cneaf/electricity/esr/esr_tabs.html). Last accessed 11/14/03.

<sup>15</sup> Bast, Taylor, Lehr. *State Greenhouse Gas Programs: An Economic and Scientific Analysis*. Heartland Institute, Feb. 2003.

<sup>16</sup> Energy Information Administration. *Impact of the Kyoto Protocol on U.S. Energy Markets and Economic Activity, 1998*.

<sup>17</sup> Bast, Taylor, Lehr. *State Greenhouse Gas Programs: An Economic and Scientific Analysis*. Heartland Institute, Feb. 2003.

<sup>18</sup> Thorning, M., *New Directions of U.S. Climate Change Policy and Energy Security*, June 2001

# EXHIBIT 49



## Global Warming FAQ

**Overview.** Alarm over the prospect of the Earth warming is not warranted by the agreed science or economics of the issue. Global warming is happening and man is responsible for at least some of it. Yet this does not mean that global warming will cause enough damage to the Earth and humanity to require drastic cuts in energy use, a policy that would have damaging consequences of its own. Moreover, science cannot answer questions that are at heart economic or political, such as whether the Kyoto Protocol is worthwhile

### 1. The Science

Isn't there a scientific consensus that global warming is real and bad for us?

- There is no “scientific consensus” that global warming will cause damaging climate change. Claims that there is mischaracterize the scientific research of bodies like the United Nations Intergovernmental Panel on Climate Change (IPCC) and the U.S. National Academy of Sciences (NAS).

What do scientists agree on?

- Scientists do agree that: (1) global average temperature is about 0.6°Celsius—or just over 1°Fahrenheit—higher than it was a century ago; (2) atmospheric levels of carbon dioxide (CO<sub>2</sub>) have risen by about 30 percent over past 200 years; and (3) carbon dioxide, like water vapor, is a greenhouse gas whose increase is likely to warm the Earth's atmosphere.<sup>1</sup>

What don't scientists know yet?

- Scientists do not agree on whether: (1) we know enough to ascribe past temperature changes to carbon dioxide levels; (2) we have enough data to

confidently predict future temperature levels; and (3) at what level temperature change might be more damaging than beneficial to life on Earth.

Didn't the National Academy of Science say greenhouse gases cause global warming?

- The NAS reported in 2001 that, "Because of the large and still uncertain level of natural variability inherent in the climate record and the uncertainties in the time histories of the various forcing agents...a causal linkage between the buildup of greenhouse gases in the atmosphere and the observed climate changes during the 20th century cannot be unequivocally established." It also noted that 20 years' worth of data is not long enough to estimate long-term trends.<sup>2</sup>

Hasn't the Earth warmed alarmingly over the past 100 years?

- The temperature rise of 0.6°C over the last century is at the bottom end of what climate models suggest should have happened. This suggests that either the climate is less sensitive to greenhouse gases than previously thought or that some unknown factor is depressing the temperature.<sup>3</sup>

Don't climate models warn of alarming future warming?

- Predictions of 6°C temperature rises over the next 100 years are at the extreme end of the IPCC range, and are the result of faulty economic modeling, not science (see economics section below).

What are the realistic current estimates of future warming?

- Both James Hansen of NASA (the father of greenhouse theory) and Richard Lindzen of MIT (the most renowned climatologist in the world) agree that, even if nothing is done to restrict greenhouse gases, the world will only see a global temperature increase of about 1°C in the next 50-100 years. Hansen and his colleagues "predict additional warming in the next 50 years of  $0.5 \pm 0.2^\circ\text{C}$ , a warming rate of  $0.1 \pm 0.04^\circ\text{C}$  per decade."<sup>4</sup>

What about satellite temperature measurements?

- Evidence from satellite and weather balloon soundings suggests that the atmosphere has warmed considerably less than greenhouse theory suggests.<sup>5</sup> There is a disparity between the surface temperature measurements, which cover only a small fraction of the Earth but show sustained warming, and these measurements, which cover the whole atmosphere and show only a very slight warming.

Hasn't the disagreement between satellite and surface temperatures been resolved?

- No. There is still substantial disagreement between the mid-range of the satellite measurements and the mid-range of the surface measurements. This is a problem for climate models.

Are there other man-made factors besides greenhouse gases that influence temperature?

- New research also suggests that the role of greenhouse gases in warming has been overestimated, as factors like atmospheric soot,<sup>6</sup> land use change,<sup>7</sup> and solar variation<sup>8</sup> all appear to have played significant parts in recent warming.

### **Specific Scare Stories**

Is the world in danger of plunging into a new ice age, as in *The Day After Tomorrow*?

- No. The scenario presented in *The Day After Tomorrow* is physically impossible. While research does suggest that the Gulf Stream has switched on and off in the past, causing temperature drops in Europe, oceanographers are convinced that global warming does not present any such danger.<sup>9</sup>

Is the world in severe danger from sea level rise?

- No. Research from Nils-Axel Mörner of Stockholm University demonstrates that current sea levels are within the range of sea level oscillation over the past 300 years, while the satellite data show virtually no rise over the past decade.<sup>10</sup> The IPCC foresees sea-level rise of between 0.1 and 0.9m by 2100. The Earth experienced a sea-level rise of 0.2m over the past century with no noticeable ill effects.
- Update 1/1/06: Another study relevant to this controversy is Zwally et al. (2005), which examined changes in ice mass "from elevation changes derived from 10.5 years (Greenland) and 9 years (Antarctica) of satellite radar altimetry data from the European Remote-sensing Satellites ERS-1 and -2." The researchers report a net contribution of the three ice sheets to sea level of  $+0.05 \pm 0.03$  mm per year. CO2Science.Org puts this in perspective:

"At the current sea-level-equivalent ice-loss rate of 0.05 millimeters per year, it would take a full *millennium* to raise global sea level by *just 5 cm*, and it would take fully *20,000 years* to raise it a *single meter*."

Weren't recent extreme weather events caused by global warming?

- There is no provable link to global warming. For example, research by German scientists has demonstrated that the devastating floods in central Europe in 2002 were perfectly normal when compared against the historical record.<sup>11</sup> Allegations that extreme weather has been more damaging recently do not take into account the fact that mankind is now living and investing resources in more dangerous



areas. The World Meteorological Organization has acknowledged that increases in the recorded number of extreme weather events may well be due to better observation and reporting.<sup>12</sup> A top expert from the IPCC resigned in January 2005 in protest that IPCC science was being misrepresented by claims that last year's hurricane season was exacerbated by global warming. Most hurricane scientists agree that there is no way that Hurricane Katrina can be blamed on global warming.

- Update 6/1/06: Recent published research casts extreme doubt on the influence of warming on hurricanes. Kotzbach<sup>13</sup> finds “The data indicate a large increasing trend in tropical cyclone intensity and longevity for the North Atlantic basin and a considerable decreasing trend for the Northeast Pacific. All other basins showed small trends, and there has been no significant change in global net tropical cyclone activity. There has been a small increase in global Category 4–5 hurricanes from the period 1986–1995 to the period 1996–2005. Most of this increase is likely due to improved observational technology. These findings indicate that other important factors govern intensity and frequency of tropical cyclones besides SSTs [sea surface temperatures].”

Update 1/1/06: Aren't the snows of Kilimanjaro disappearing because of global warming?

- That's not the verdict of scientists who study Mount Kilimanjaro most closely. In “Modern Glacier Retreat on Kilimanjaro as Evidence of Climate Change: Observations and Facts<sup>14</sup>,” Kaser et al. “develop a new concept for investigating the retreat of Kilimanjaro's glaciers, based on the physical understanding of glacier–climate interactions.” They say, “The concept considers the peculiarities of the mountain and implies that climatological processes other than air temperature control the ice recession in a direct manner. A drastic drop in atmospheric moisture at the end of the 19th century and the ensuing drier climatic conditions are likely forcing glacier retreat on Kilimanjaro.”

Won't global warming lead to the spread of malaria?

- Climate is not a significant factor in the recent growth of vector-borne diseases such as *malaria*. Most experts on this subject agree that other factors are much more important in predicting future spread of these diseases.<sup>15</sup>

Didn't the Pentagon conclude global warming poses a national security threat?

- The *Pentagon* is not convinced that global warming represents a major security threat to the United States. The “secret paper” that garnered much publicity in Europe was a self-admitted speculative exercise that went beyond the bounds of measured research and had been released to the press long before the sensationalist stories surfaced in Europe. Nor did the paper recommend “immediate action” beyond better climate modeling.<sup>16</sup>

Haven't recent climate models found that global warming will be much worse than previously thought?

- The news that Oxford University has found that temperatures may increase by up to  $11^{\circ}\text{C}$  severely misrepresents the scientific findings. According to the actual scientific paper,<sup>17</sup> the frequency distribution of the results suggests that the lower end of temperature rises, in the  $2^{\circ}\text{C}$  to  $4^{\circ}\text{C}$  range, is the most likely.

Haven't the National Academies of all the major countries agreed that global warming is a serious threat?

- Claims that the scientific consensus is represented by a statement drafted by the Royal Society of London and signed by the *national scientific academies* of the G8 countries plus India, Brazil and China ignore the politicized nature of the statement. The climate change committee of the Russian Academy of Sciences says its president should not have signed the statement, while the use to which it was put was condemned by the outgoing president of the U.S. National Academy of Sciences, Bruce Alberts, who called the Royal Society's presentation of the statement "quite misleading."<sup>18</sup>

Aren't polar bears drowning because of melting ice?

- These claims are overblown. A leading Canadian polar bear biologist wrote recently, "Climate change is having an effect on the west Hudson population of polar bears, but really, there is no need to panic. Of the 13 populations of polar bears in Canada, 11 are stable or increasing in number. They are not going extinct, or even appear to be affected at present."<sup>19</sup>

Update 1/1/06: Isn't there a scientific consensus such that one researcher found no disagreement about global warming in the literature?

- The research by Naomi Orsekes published in Science in December 2004 was flawed. She studied about 1000 scientific abstracts, but admitted to a sympathetic journalist that she made a major mistake in her search terms. In fact, she should have reviewed about 12,000 abstracts. Even taking her sample, another researcher who tried to replicate her study came to quite different conclusions<sup>20</sup>.
- In addition, the most recent survey of climate scientists, following the same methodology as a published study from 1996, found that while there had been a move towards acceptance of anthropogenic global warming, found that only 9.4% of respondents "strongly agree" that climate change is mostly the result of anthropogenic sources. A similar proportion "strongly disagree." Furthermore, only 22.8% of respondents "strongly agree" that the IPCC reports accurately reflect a consensus within climate science<sup>21</sup>.

## So what is the state of play with global warming science?

There is scientific agreement that the world has warmed and that man is at least partly responsible for the warming—though there is no consensus on the precise extent of man’s effect on the climate. There is ongoing scientific debate over the parameters used by the computer models that project future climatic conditions. We cannot be certain whether the world will warm significantly and we do not know how damaging—if at all—even significant warming will be.

## 2. The Economics

Why is economics important to the study of global warming?

- Predictions of global warming catastrophe are based on models that rely on economics as much as on science. If the science of greenhouse theory is right, then we can only assess its consequences by estimating future production of greenhouse gases from estimates of economic activity.

Is there anything wrong with the economics underlying warming projections?

- The economic modeling by the U.N. Intergovernmental Panel on Climate Change (IPCC) is badly flawed (*The Economist* called it “dangerously incompetent”), relying on economic forecasts that show much faster growth rates for developing countries than is justified.<sup>22</sup> The IPCC economic scenarios show significantly greater economic development globally than other recognized, comparable scenarios.

What will the Kyoto Protocol do to reduce warming?

- The Kyoto Protocol, most observers agree, will have virtually no effect on temperature increase, as it imposes no restrictions on greenhouse gas emissions upon major developing nations like China and India. These nations have publicly refused to accept any restrictions now or in the future.<sup>23</sup>

Can’t we reduce emissions without affecting the economy?

- Greenhouse gas emissions derive from energy use which in turn derives from economic growth. Therefore, nations that restrict emissions are almost certain to reduce their rate of economic growth.

Update 1/1/06: Isn’t global warming all cost and no benefit?

- Even substantial global warming is likely to be of benefit to the United States. As eminent Yale professor Robert Mendelsohn testified to the Senate in 2000<sup>24</sup>, “Climate change is likely to result in small net benefits for the United States over the next century. The primary sector that will benefit is agriculture. The large

gains in this sector will more than compensate for damages expected in the coastal, energy, and water sectors, unless warming is unexpectedly severe. Forestry is also expected to enjoy small gains. Added together, the United States will likely enjoy small benefits of between \$14 and \$23 billion a year and will only suffer damages in the neighborhood of \$13 billion if warming reaches 5C over the next century. Recent predictions of warming by 2100 suggest temperature increases of between 1.5 and 4C, suggesting that impacts are likely to be beneficial in the US.”

Haven't economic models predicted no effect of reducing emissions on growth?

- European models of the effect of greenhouse gas emission restrictions (such as PRIMES) are sectoral models that look at the effects on only one economic sector and therefore badly underestimate the negative effects of emission restrictions on other economic sectors. General equilibrium models, which take into account the effects of emissions restrictions on other economic sectors, show much greater negative economic effects than sectoral models.<sup>25</sup>

What do the better economic models say Kyoto will do?

- Recent research from general equilibrium models suggests strongly negative impacts on European economies from adopting Kyoto targets (or going beyond the targets, as in the case of the United Kingdom). One model shows the economic effects by 2010 of adopting Kyoto targets as follows (remember that the Protocol achieves virtually nothing in reducing global temperature):<sup>26</sup>

Germany	-5.2% GDP	-1,800,000 jobs
Spain	-5.0% GDP	-1,000,000 jobs
United Kingdom	-4.5% GDP	-1,000,000 jobs
Netherlands	-3.8% GDP	-240,000 jobs

Isn't Europe on track to meet its Kyoto targets?

- Kyoto targets are unrealistic. Regardless of announced targets, 11 of the 15 pre-enlargement EU countries are on course to increase their greenhouse gas emissions well beyond their individual Kyoto targets.<sup>27</sup>

## Specific Economic Issues

Isn't President Bush to blame for holding up Kyoto?

- It is not the case that **President Bush** has unilaterally held up ratification of the Kyoto treaty. The United States Senate must ratify any treaty signed by a President. In 1997, during Bill Clinton's presidency, the Senate (including recent Democratic presidential candidate John Kerry) voted 95-0 not to accept any Kyoto-style treaty that would significantly harm the U. S. economy and did not

include participation by major developing countries.<sup>28</sup> The U.S. President has no power to impose Kyoto, or any other treaty, on an unwilling Senate.<sup>29</sup>

Doesn't Russia's participation demonstrate the appeal of Kyoto?

- **Russia** agreed to ratify the Kyoto Protocol only after being pressured by the European Union, which held out the prospect of endorsing Russia's entry into the World Trade Organization. Both the Russian Academy of Sciences and several Duma committees reported that Kyoto has no scientific substantiation and may harm Russia's economy.

Isn't global warming a worse threat than terrorism?

- The charge that global warming is *worse than terrorism* in terms of damage to the world is hyperbole. The implausible and unsubstantiable claim of many deaths each year—the figure is often put at 150,000—owing to global warming ignores the fact that most of those alleged deaths are due to diseases such as malaria, which have historically existed even in cold climates and could easily be controlled if the environmental lobby dropped its opposition to the use of DDT.<sup>30</sup> Moreover, that number is itself dwarfed by the number killed by poverty, which will be increased if the world decides to suppress the use of energy.

Can't we replace fossil fuels cheaply and effectively with renewable energy?

- Alternative sources of energy such as **renewables** are not yet cost-effective and come with environmental costs of their own (the veteran British environmentalist David Bellamy is leading opposition to wind farms).<sup>31</sup> The only currently cost-effective alternative to fossil fuel use is nuclear power, which environmental activists continue to oppose in direct contradiction to their assertions that global warming is the gravest danger the planet faces.

Aren't market-based solutions the way to reduce emissions?

- “**Cap and Trade**” schemes that allow firms and governments to trade the right to emit greenhouse gases up to certain limits are not economically efficient. By creating rent-seeking opportunities, they promote the development of a carbon cartel seeking to exploit the system to make profits. A simple carbon tax would be much more economically efficient, although likely to prove unattractive to voters in democracies.<sup>32</sup> The recent collapse of the carbon market in Europe shows how dependent such markets are on political considerations.

## Summary

Europe and the world face severe economic consequences from currently proposed strategies to deal with global warming. These approaches will produce job losses and consume scarce resources that could be better spent on handling other world problems such as AIDS or access to water.<sup>33</sup> The economic consequences of global warming

mitigation strategies currently proposed will probably be worse than the effects of global warming itself. Therefore, adaptive and resiliency strategies should be considered as a more cost-effective alternative. In addition, “no regrets” strategies that will provide benefits from greater economic growth whether global warming proves to be a problem or not should be adopted at once.<sup>34</sup>

## Notes

<sup>1</sup> Professor Richard Lindzen, testimony to the United States Senate, May 1, 2001.

<sup>2</sup> Committee on the Science of Climate Change [Cicerone et al.], *Climate Change Science: An Analysis of Some Key Questions*, National Research Council, Washington D.C., 2001.

<sup>3</sup> See testimony of Prof. Richard Lindzen to UK House of Lords Committee on Economic Affairs, January 21, 2005. Available at <http://www.publications.parliament.uk/pa/ld/lduncorr/econ2501p.pdf>.

<sup>4</sup> Sun, S., and J.E. Hansen 2003. Climate simulations for 1951-2050 with a coupled atmosphere-ocean model. *J. Climate* 16, 2807-2826.

<sup>5</sup> Christy, J.R., and R.W. Spencer, *Global Temperature Report: April 2003*, UAH Earth System Science Center, May 9, 2003, Vol. 12, No. 12.

<sup>6</sup> Sato, M. et al., 2003: “Global Atmospheric Black Carbon inferred from AERONET,” *Proceedings of the National Academy of Sciences*, vol. 100, no. 11: 6319-6324.

<sup>7</sup> Pielke et al. 2002, “The Influence of Land-use Change and Landscape Dynamics on the Climate System: Relevance to Climate-change Policy beyond the Radiative Effect of Greenhouse Gases,” *Phil. Trans. R. Soc. Lond. A* (2002) 360, 1705-1719.

<sup>8</sup> Friis-Christensen, E. & Lassen, K. 1991. “Length of the Solar Cycle: An Indicator of Solar Activity Closely Associated with Climate,” *Science* 254, 698-700; Thejil, P. and Lassen, K. 1999, *Solar Forcing of the Northern Hemisphere Land Air Temperature: New Data*, DMI-report #99-9, Danish Meteorological Institute, Copenhagen 1999.

<sup>9</sup> Weaver, A.J., and Hillaire-Marcel, C. 2004, “Global Warming and the Next Ice Age,” *Science*, Vol 304, Issue 5669, 400-402; Wunsch, C. 2004, “Gulf Stream Safe if Wind Blows and Earth turns,” *Nature* 428, 601.

<sup>10</sup> Mörner, N.-A. 2003. “Estimating Future Sea Level Changes from Past Records,” *Global and Planetary Change* 40: 49-54.

<sup>11</sup> Mudelsee, M., et al., 2003. No upward trends in the occurrence of extreme floods in central Europe. *Nature*, 425, 166-169.

<sup>12</sup> The Director of the World Climate Program for the WMO, Ken Davidson, replied to a questioner in Geneva in 2003, “You are correct that the scientific evidence (statistical and empirical) are (sic) not present to conclusively state that the number of events have (sic) increased. However, the number of extreme events that are being reported and are truly extreme events has increased both through the meteorological services and through the aid agencies as well as through the disaster reporting agencies and corporations. So, this could be because of improved monitoring and reporting,” quoted at <http://www.john-daly.com/press/press-03b.htm>.

<sup>13</sup> Klotzbach, P. J. (2006), Trends in global tropical cyclone activity over the past twenty years (1986–2005), *Geophys. Res. Lett.*, 33, L10805, doi:10.1029/2006GL025881.

<sup>14</sup> *International Journal of Climatology* (24; 329-339)

<sup>15</sup> Reiter, P. et al, “Global Warming and Malaria, A Call for Accuracy,” *Lancet Infectious Diseases* 2004 Jun; 4(6):323-4.

<sup>16</sup> Schwartz, P. and Randall, 2003, *An Abrupt Climate Change Scenario and Its Implications for United States National Security*, paper submitted to Pentagon October 2003. Available at [http://www.ems.org/climate/pentagon\\_climate\\_change.html#report](http://www.ems.org/climate/pentagon_climate_change.html#report).

<sup>17</sup> Stainforth, D. et al., “Uncertainty in predictions of the climate response to rising levels of greenhouse gases,” *Nature*, 433, 403-406.

<sup>18</sup> Sam Knight, “Anti-Bush gibe by Royal Society sparks climate change row,” Times Online, July 5, 2005, <http://www.timesonline.co.uk/article/0,,22649-1681145,00.html>

<sup>19</sup> Dr Mitchell Taylor, Dept. of the Environment, Government of Nunavut, in The Toronto Star, May 1, 2006.

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- <sup>20</sup> <http://www.staff.livjm.ac.uk/spsbpeis/Scienceletter.htm>
- <sup>21</sup> <http://w3g.gkss.de/G/Mitarbeiter/bray.html/BrayGKSSsite/BrayGKSS/WedPDFs/Science2.pdf>
- <sup>22</sup> Ian Castles, "Greenhouse Emissions Calculations Quite Wrong," *Canberra Times*, August 29, 2002, available in Castles, I. & Henderson, D. 2003: "The IPCC Emission Scenarios: An Economic-Statistical Critique," *Energy & Environment*, Nos. 2 & 3: 166-168.
- <sup>23</sup> Cooler Heads Newsletter, Nov. 12, 2003. See <http://www.globalwarming.org/article.php?uid=233>.
- <sup>24</sup> <http://64.233.179.104/search?q=cache:ctDw6sczNv0J:www.senate.gov/~commerce>
- <sup>25</sup> Canes, M., *Economic Modeling of Climate Change Policy*, International Council for Capital Formation, October 2002.
- <sup>26</sup> Thorning, M., *Kyoto Protocol and Beyond: Economic Impacts on EU Countries*, International Council for Capital Formation, October 2002.
- <sup>27</sup> Press Release, *EU15 greenhouse gas emissions decline after two years of increases*, European Environment Agency, 15 July 2004.
- <sup>28</sup> S.98 Expressing the sense of the Senate regarding the conditions for the United States becoming a signatory to any international agreement on greenhouse gas emissions under the United Nations, 1997.
- <sup>29</sup> U.S. Constitution, Article II, Section 2, Clause 2.
- <sup>30</sup> Reiter et al.
- <sup>31</sup> Schleede, G. 2004, *Facing up to the True Costs and Benefits of Wind Energy*, paper presented to the owners and members of Associated Electric Cooperative, Inc., at the 2004 Annual Meeting in St. Louis, Missouri. Available at <http://www.globalwarming.org/aecifa.pdf>.
- <sup>32</sup> McKittrick, R. 2001, *What's Wrong With Regulating Carbon Dioxide Emissions?*, Briefing at the United States Congress, October 11, 2001. Available at <http://www.cei.org/gencon/014.02191.cfm>.
- <sup>33</sup> See the work of the Copenhagen Consensus: <http://www.copenhagenconsensus.com>.
- <sup>34</sup> See, for example, Adler et al., *Greenhouse Policy Without Regrets: A Free Market Approach to the Uncertain Risks of Climate Change*, Competitive Enterprise Institute, 2000.