

Climate Change Reconsidered

The 2009 Report of the Nongovernmental International Panel on Climate change (NIPCC)

Executive Summary

The Fourth Assessment Report of the Intergovernmental Panel on Climate Change's Working Group-1 (Science) (IPCC-AR4 2007), released in 2007, is a major research effort by a group of dedicated specialists in many topics related to climate change. It forms a valuable compendium of the current state of the science, enhanced by having an index which had been lacking in previous IPCC reports. AR4 also permits access to the numerous critical comments submitted by expert reviewers, another first for the IPCC.

While AR4 is an impressive document, it is far from being a reliable reference work on some of the most important aspects of climate change science and policy. It is marred by errors and misstatements, ignores scientific data that were available but were inconsistent with the authors' pre-conceived conclusions, and has already been contradicted in important parts by research published since May 2006, the IPCC's cut-off date.

In general, the IPCC fails to consider important scientific issues, several of which would upset its major conclusion—that “most of the observed increase in global average temperatures since the mid-20th century is *very likely* due to the observed increase in anthropogenic greenhouse gas concentrations [emphasis in the original].” The IPCC defines “very likely” as at least 90 percent certain. They do not explain how they derive this number. The IPCC also does not define the word “most,” nor do they provide any explanation.

The IPCC does not apply generally accepted methodologies to determine what fraction of current warming is natural, or how much is caused by the rise in greenhouse gases (GHG). A comparison of “fingerprints” from best available observations with the results of state-of-the-art GHG models leads to the conclusion that the (human-caused) GHG contribution is minor. This fingerprint evidence, though available, was ignored by the IPCC.

The IPCC continues to undervalue the overwhelming evidence that, on decadal and century-long time scales, the Sun and associated atmospheric cloud effects are responsible for much of past climate change. It is therefore highly likely that the Sun is

also a major cause of twentieth-century warming, with anthropogenic GHG making only a minor contribution. In addition, the IPCC ignores, or addresses imperfectly, other science issues that call for discussion and explanation.

These errors and omissions are documented in the present report by the Nongovernmental International Panel on Climate Change (NIPCC). The report is divided into nine chapters that are briefly summarized here, and then more fully described in the remainder of this summary.

Chapter 1 describes the limitations of the IPCC's attempt to forecast future climate conditions by using computer climate models. The IPCC violates many of the rules and procedures required for scientific forecasting, making its “projections” of little use to policymakers. As sophisticated as today's state-of-the-art models are, they suffer deficiencies and shortcomings that could alter even the very *sign* (plus or minus, warming or cooling) of earth's projected temperature response to rising atmospheric CO₂ concentrations. If the global climate models on which the IPCC relies are not validated or reliable, most of the rest of the AR4, while it makes for fascinating reading, is irrelevant to the public policy debate over what should be done to stop or slow the arrival of global warming.

Chapter 2 describes feedback factors that reduce the earth's temperature sensitivity to changes in atmospheric CO₂. Scientific studies suggest the model-derived temperature sensitivity of the earth for a doubling of the pre-industrial CO₂ level is much lower than the IPCC's estimate. Corrected feedbacks in the climate system reduce climate sensitivity to values that are an order of magnitude smaller than what the IPCC employs.

Chapter 3 reviews empirical data on past temperatures. We find no support for the IPCC's claim that climate observations during the twentieth century are either unprecedented or provide evidence of an anthropogenic effect on climate. We reveal the methodological errors of the “hockey stick” diagram of Mann *et al.*, evidence for the existence of a global Medieval Warm Period, flaws in the surface-based temperature record of more modern times, evidence

from highly accurate satellite data that there has been no net warming over the past 29 years, and evidence that the distribution of modern warming does not bear the “fingerprint” of an anthropogenic effect.

Chapter 4 reviews observational data on glacier melting, sea ice area, variation in precipitation, and sea level rise. We find no evidence of trends that could be attributed to the supposedly anthropogenic global warming of the twentieth century.

Chapter 5 summarizes the research of a growing number of scientists who say variations in solar activity, not greenhouse gases, are the true driver of climate change. We describe the evidence of a solar-climate link and how these scientists have grappled with the problem of finding a specific mechanism that translates small changes in solar activity into larger climate effects. We summarize how they may have found the answer in the relationships between the sun, cosmic rays and reflecting clouds.

Chapter 6 investigates and debunks the widespread fears that global warming might cause more extreme weather. The IPCC claims global warming will cause (or already is causing) more droughts, floods, hurricanes, storms, storm surges, heat waves, and wildfires. We find little or no support in the peer-reviewed literature for these predictions and considerable evidence to support an opposite prediction: That weather would be *less* extreme in a warmer world.

Chapter 7 examines the biological effects of rising CO₂ concentrations and warmer temperatures. This is the largely unreported side of the global warming debate, perhaps because it is unequivocally good news. Rising CO₂ levels increase plant growth and make plants more resistant to drought and pests. It is a boon to the world’s forests and prairies, as well as to farmers and ranchers and the growing populations of the developing world.

Chapter 8 examines the IPCC’s claim that CO₂-induced increases in air temperature will cause unprecedented plant and animal extinctions, both on land and in the world’s oceans. We find there little real-world evidence in support of such claims and an abundance of counter evidence that suggests ecosystem biodiversity will *increase* in a warmer and CO₂-enriched world.

Chapter 9 challenges the IPCC’s claim that CO₂-induced global warming is harmful to human health. The IPCC blames high-temperature events for increasing the number of cardiovascular-related deaths, enhancing respiratory problems, and fueling a more rapid and widespread distribution of deadly

infectious diseases, such as malaria, dengue and yellow fever. However, a thorough examination of the peer-reviewed scientific literature reveals that further global warming would likely do just the opposite and actually reduce the number of lives lost to extreme thermal conditions. We also explain how CO₂-induced global warming would help feed a growing global population without major encroachment on natural ecosystems, and how increasing production of biofuels (a strategy recommended by the IPCC) damages the environment and raises the price of food.

The research summarized in this report is only a small portion of what is available in the peer-reviewed scientific literature. To assist readers who want to explore information not contained between the covers of this volume, we have included Internet hyperlinks to the large and continuously updated databases maintained by the Center for the Study of Carbon Dioxide and Global Change at www.co2science.org.

Key Findings by Chapter

Chapter 1. Global Climate Models and Their Limitations

- The IPCC places great confidence in the ability of general circulation models (GCMs) to simulate future climate and attribute observed climate change to anthropogenic emissions of greenhouse gases.
- The forecasts in the Fourth Assessment Report were not the outcome of validated scientific procedures. In effect, they are the opinions of scientists transformed by mathematics and obscured by complex writing. The IPCC’s claim that it is making “projections” rather than “forecasts” is not a plausible defense.
- Today’s state-of-the-art climate models fail to accurately simulate the physics of earth’s radiative energy balance, resulting in uncertainties “as large as, or larger than, the doubled CO₂ forcing.”
- A long list of major model imperfections prevents models from properly modeling cloud formation and cloud-radiation interactions, resulting in large differences between model predictions and observations.
- Computer models have failed to simulate even the correct sign of observed precipitation anomalies, such as the summer monsoon rainfall over the Indian

region. Yet it is understood that precipitation plays a major role in climate change.

Chapter 2. Feedback Factors and Radiative Forcing

- Scientific research suggests the model-derived temperature sensitivity of the earth accepted by the IPCC is too large. Corrected feedbacks in the climate system could reduce climate sensitivity to values that are an order of magnitude smaller.
- Scientists may have discovered a connection between cloud creation and sea surface temperature in the tropics that creates a “thermostat-like control” that automatically vents excess heat into space. If confirmed, this could totally compensate for the warming influence of all anthropogenic CO₂ emissions experienced to date, as well as all those that are anticipated to occur in the future.
- The IPCC dramatically underestimates the total cooling effect of aerosols. Studies have found their radiative effect is comparable to or larger than the temperature forcing caused by all the increase in greenhouse gas concentrations recorded since pre-industrial times.
- Higher temperatures are known to increase emissions of dimethyl sulfide (DMS) from the world’s oceans, which increases the albedo of marine stratus clouds, which has a cooling effect.
- Iodocompounds—created by marine algae—function as cloud condensation nuclei, which help create new clouds that reflect more incoming solar radiation back to space and thereby cool the planet.
- As the air’s CO₂ content—and possibly its temperature—continues to rise, plants emit greater amounts of carbonyl sulfide gas, which eventually makes it way into the stratosphere, where it is transformed into solar-radiation-reflecting sulfate aerosol particles, which have a cooling effect.
- As CO₂ enrichment enhances biological growth, atmospheric levels of biosols rise, many of which function as cloud condensation nuclei. Increased cloudiness diffuses light, which stimulates plant growth and transfers more fixed carbon into plant and soil storage reservoirs.
- Since agriculture accounts for almost half of nitrous oxide (N₂O) emissions in some countries, there is concern that enhanced plant growth due to

CO₂ enrichment might increase the amount and warming effect of this greenhouse gas. But field research shows that N₂O emissions fall as CO₂ concentrations and temperatures rise, indicating this is actually another negative climate feedback.

- Methane (CH₄) is a potent greenhouse gas. An enhanced CO₂ environment has been shown to have “neither positive nor negative consequences” on atmospheric methane concentrations. Higher temperatures have been shown to result in reduced methane release from peatbeds. Methane emissions from cattle have been reduced considerably by altering diet, immunization, and genetic selection.

Chapter 3. Observations: Temperature Records

- The IPCC claims to find evidence in temperature records that the warming of the twentieth century was “unprecedented” and more rapid than during any previous period in the past 1,300 years. But the evidence it cites, including the “hockey-stick” representation of earth’s temperature record by Mann *et al.*, has been discredited and contradicted by many independent scholars.
- A corrected temperature record shows temperatures around the world were warmer during the Medieval Warm Period of approximately 1,000 years ago than they are today, and have averaged 2-3°F warmer than today’s temperatures over the past 10,000 years.
- Evidence of a global Medieval Warm Period is extensive and irrefutable. Scientists working with a variety of independent methodologies have found it in proxy records from Africa, Antarctica, the Arctic, Asia, Europe, North America, and South America.
- The IPCC cites as evidence of modern global warming data from surface-based recording stations yielding a 1905-2005 temperature increase of 0.74°C +/- 0.18°C. But this temperature record is known to be positively biased by insufficient corrections for the non-greenhouse-gas-induced urban heat island (UHI) effect. It may be impossible to make proper corrections for this deficiency, as the UHI of even small towns dwarfs any concomitant augmented greenhouse effect that may be present.
- Highly accurate satellite data, adjusted for orbit drift and other factors, show a much more modest warming trend in the last two decades of the twentieth

century and a dramatic decline in the warming trend in the first decade of the twenty-first century.

- The “fingerprint” or pattern of warming observed in the twentieth century differs from the pattern predicted by global climate models designed to simulate CO₂-induced global warming. Evidence reported by the U.S. Climate Change Science Program (CCSP) is unequivocal: All greenhouse models show an increasing warming trend with altitude in the tropics, peaking around 10 km at roughly twice the surface value. However, the temperature data from balloons give the opposite result: no increasing warming, but rather a slight cooling with altitude.
- Temperature records in Greenland and other Arctic areas reveal that temperatures reached a maximum around 1930 and have decreased in recent decades. Longer-term studies depict oscillatory cooling since the Climatic Optimum of the mid-Holocene (~9000-5000 years BP), when it was perhaps 2.5° C warmer than it is now.
- The average temperature history of Antarctica provides no evidence of twentieth century warming. While the Antarctic peninsula shows recent warming, several research teams have documented a cooling trend for the interior of the continent since the 1970s.

Chapter 4. Observations: Glaciers, Sea Ice, Precipitation, and Sea Level

- Glaciers around the world are continuously advancing and retreating, with a general pattern of retreat since the end of the Little Ice Age. There is no evidence of an increased rate of melting overall since CO₂ levels rose above their pre-industrial levels, suggesting CO₂ is not responsible for glaciers melting.
- Sea ice area and extent have continued to increase around Antarctica over the past few decades. Evidence shows that much of the reported thinning of Arctic sea ice that occurred in the 1990s was a natural consequence of changes in ice dynamics caused by an atmospheric regime shift, of which there have been several in decades past and will likely be several in the decades to come, totally irrespective of past or future changes in the air’s CO₂ content. The Arctic appears to have recovered from its 2007 decline.
- Global studies of precipitation trends show no net increase and no consistent trend with CO₂,

contradicting climate model predictions that warming should cause increased precipitation. Research on Africa, the Arctic, Asia, Europe, and North and South America all find no evidence of a significant impact on precipitation that could be attributed to anthropogenic global warming.

- The cumulative discharge of the world’s rivers remained statistically unchanged between 1951 and 2000, a finding that contradicts computer forecasts that a warmer world would cause large changes in global streamflow characteristics. Droughts and floods have been found to be less frequent and severe during the Current Warm Period than during past periods when temperatures were even higher than they are today.
- The results of several research studies argue strongly against claims that CO₂-induced global warming would cause catastrophic disintegration of the Greenland and Antarctic Ice Sheets. In fact, in the case of Antarctica, they suggest just the opposite—i.e., that CO₂-induced global warming would tend to buffer the world against such an outcome.
- The mean rate of global sea level rise has not accelerated over the recent past. The determinants of sea level are poorly understood due to considerable uncertainty associated with a number of basic parameters that are related to the water balance of the world’s oceans and the meltwater contribution of Greenland and Antarctica. Until these uncertainties are satisfactorily resolved, we cannot be confident that short-lived changes in global temperature produce corresponding changes in sea level.

Chapter 5. Solar Variability and Climate Cycles

- The IPCC claims the radiative forcing due to changes in the solar output since 1750 is +0.12 Wm⁻², an order of magnitude smaller than its estimated net anthropogenic forcing of +1.66 Wm⁻². A large body of research suggests that the IPCC has got it backwards, that it is the sun’s influence that is responsible for the lion’s share of climate change during the past century and beyond.
- The total energy output of the sun changes by only 0.1 percent during the course of the solar cycle, although larger changes may be possible over periods of centuries. On the other hand, the ultraviolet radiation from the sun can change by several percent over the solar cycle – as indeed noted by observing

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changes in stratospheric ozone. The largest changes, however, occur in the intensity of the solar wind and interplanetary magnetic field.

- Reconstructions of ancient climates reveal a close correlation between solar magnetic activity and solar irradiance (or brightness), on the one hand, and temperatures on earth, on the other. Those correlations are much closer than the relationship between carbon dioxide and temperature.
- Cosmic rays could provide the mechanism by which changes in solar activity affect climate. During periods of greater solar magnetic activity, greater shielding of the earth occurs, resulting in less cosmic rays penetrating to the lower atmosphere, resulting in fewer cloud condensation nuclei being produced, resulting in fewer and less reflective low-level clouds occurring, which leads to more solar radiation being absorbed by the surface of the earth, resulting (finally) in increasing near-surface air temperatures and global warming.
- Strong correlations between solar variability and precipitation, droughts, floods, and monsoons have all been documented in locations around the world. Once again, these correlations are much stronger than any relationship between these weather phenomena and CO₂.
- The role of solar activity in causing climate change is so complex that most theories of solar forcing must be considered to be as yet unproven. But it would also be appropriate for climate scientists to admit the same about the role of rising atmospheric CO₂ concentrations in driving recent global warming.

Chapter 6. Observations: Extreme Weather

- The IPCC predicts that a warmer planet will lead to more extreme weather, characterized by more frequent and severe episodes of drought, flooding, cyclones, precipitation variability, storms, snow, storm surges, temperature variability, and wildfires. But has the last century – during which the IPCC claims the world experienced more rapid warming than any time in the past two millennia – experienced significant trends in any of these extreme weather events?
- Droughts have not become more extreme or erratic in response to global warming. Real-world evidence from Africa, Asia, and other continents find no trend toward more frequent or more severe

droughts. In most cases, the worst droughts in recorded meteorological history were much milder than droughts that occurred periodically during much colder times.

- Floods were more frequent and more severe during the Little Ice Age than they have been during the Current Warm Period. Flooding in Asia, Europe, and North America has tended to be less frequent and less severe during the twentieth century.
- The IPCC says “it is likely that future tropical cyclones (typhoons and hurricanes) will become more intense, with larger peak wind speeds and more heavy precipitation associated with ongoing increase of tropical sea surface temperatures.” But 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 oceans.
- A number of real-world observations demonstrate that El Niño-Southern Oscillation (ENSO) conditions during the latter part of the twentieth century were not unprecedented in terms of their frequency or magnitude. Long-term records suggest that when the earth was significantly warmer than it is currently, ENSO events were substantially reduced or perhaps even absent.
- There is no support for the model-based projection that precipitation in a warming world becomes more variable and intense. In fact, some observational data suggest just the opposite, and provide support for the proposition that precipitation responds more to cyclical variations in solar activity.
- As the earth has warmed over the past 150 years, during its recovery from the global chill of the Little Ice Age, there has been no significant increase in either the frequency or intensity of stormy weather.
- Between 1950 and 2002, during which time the air’s CO₂ concentration rose by 20 percent, there was no net change in either the mean onset date or duration of snow cover for the continent of North America. There appears to have been a downward trend in blizzards.
- Storm surges have not increased in either frequency or magnitude as CO₂ concentrations in the atmosphere have risen. In the majority of cases investigated, they have tended to decrease.
- Air temperature variability almost always *decreases* when mean air temperature *rises*, be it in

cases of temperature change over tens of thousands of years or over mere decades, or even between individual cooler and warmer years when different ENSO states are considered. The claim that global warming will lead to more extremes of climate and weather, including more extremes of temperature itself, is not supported by real-world data.

- Although one can readily identify specific parts of the planet that have experienced both significant increases and decreases in land area burned by wildfires over the last two to three decades of the twentieth century, for the globe as a whole there was no relationship between global warming and total area burned over this period.

Chapter 7. Biological Effects of Carbon Dioxide Enhancement

- A 300-ppm increase in the air's CO₂ content typically raises the productivity of most herbaceous plants by about one-third; and this positive response occurs in plants that utilize all three of the major biochemical pathways (C₃, C₄, CAM) of photosynthesis. For woody plants, the response is even greater. The productivity benefits of CO₂ enrichment are also experienced by aquatic plants, including freshwater algae and macrophytes, and marine microalgae and macroalgae.

- The amount of carbon plants gain per unit of water lost—or water-use efficiency—typically rises as the CO₂ content of the air rises, greatly increasing their ability to withstand drought. In addition, the CO₂-induced percentage increase in plant biomass production is often greater under water-stressed conditions than it is when plants are well watered.

- Atmospheric CO₂ enrichment helps ameliorate the detrimental effects of several environmental stresses on plant growth and development, including high soil salinity, high air temperature, low light intensity and low levels of soil fertility. Elevated levels of CO₂ have additionally been demonstrated to reduce the severity of low temperature stress, oxidative stress, and the stress of herbivory. In fact, the percentage growth enhancement produced by an increase in the air's CO₂ concentration is often even greater under stressful and resource-limited conditions than it is when growing conditions are ideal.

- As the air's CO₂ content continues to rise, plants will likely exhibit enhanced rates of photosynthesis

and biomass production that will not be diminished by any global warming that might occur concurrently. In fact, if the ambient air temperature rises, the growth-promoting effects of atmospheric CO₂ enrichment will likely also rise, becoming more and more robust.

- The ongoing rise in the air's CO₂ content likely will not favor the growth of weedy species over that of crops and native plants.

- The growth of plants is generally not only enhanced by CO₂-induced increases in net photosynthesis during the light period of the day, it is also enhanced by CO₂-induced decreases in respiration during the dark period.

- The ongoing rise in the air's CO₂ content, as well as any degree of warming that might possibly accompany it, will not materially alter the rate of decomposition of the world's soil organic matter and will probably enhance biological carbon sequestration. Continued increases in the air's CO₂ concentration and temperature will not result in massive losses of carbon from earth's peatlands. To the contrary, these environmental changes—if they persist—would likely work together to enhance carbon capture.

- Other biological effects of CO₂ enhancement include enhanced plant nitrogen-use efficiency, longer residence time of carbon in the soil, and increased populations of earthworms and soil nematodes.

- The aerial fertilization effect of the ongoing rise in the air's CO₂ concentration (which greatly enhances vegetative productivity) and its anti-transpiration effect (which enhances plant water-use efficiency and enables plants to grow in areas that were once too dry for them) are stimulating plant growth across the globe in places that previously were too dry or otherwise unfavorable for plant growth, leading to a significant greening of the Earth.

- Elevated CO₂ reduces, and nearly always overrides, the negative effects of ozone pollution on plant photosynthesis, growth and yield. It also reduces atmospheric concentrations of isoprene, a highly reactive non-methane hydrocarbon that is emitted in copious quantities by vegetation and is responsible for the production of vast amounts of tropospheric ozone.

Chapter 8. Species Extinction

- The IPCC claims “new evidence suggests that climate-driven extinctions and range retractions are already widespread” and the “projected impacts on biodiversity are significant and of key relevance, since global losses in biodiversity are irreversible (very high confidence).” These claims are not supported by scientific research.
- The world’s species have proven to be remarkably resilient to climate change. Most wild species are at least one million years old, which means they have all been through hundreds of climate cycles involving temperature changes on par with or greater than those experienced in the twentieth century.
- The four known causes of extinctions are huge asteroids striking the planet, human hunting, human agriculture, and the introduction of alien species (e.g., lamprey eels in the Great Lakes and pigs in Hawaii). None of these causes are connected with either global temperatures or atmospheric CO₂ concentrations.
- Real-world data collected by the United Nations Environmental Program (UNEP) show the rate of extinctions at the end of the twentieth century was the lowest since the sixteenth century—despite 150 years of rising world temperatures, growing populations, and industrialization. Many, and probably most, of the world’s species benefited from rising temperatures in the twentieth century.
- As long as the atmosphere’s CO₂ concentration rises in tandem with its temperature, most plants will not need to migrate toward cooler conditions, as their physiology will change in ways that make them better adapted to warmer conditions. Plants will likely spread poleward in latitude and upward in elevation at the cold-limited boundaries of their ranges, thanks to longer growing seasons and less frost, while their heat-limited boundaries will probably remain pretty much as they are now or shift only slightly.
- Land animals also tend to migrate poleward and upward, to areas where cold temperatures prevented them from going in the past. They follow earth’s plants, while the heat-limited boundaries of their ranges are often little affected, allowing them to also expand their ranges.
- The persistence of coral reefs through geologic time—when temperatures were as much as 10°-15°C warmer than at present, and atmospheric CO₂ concentrations were two to seven times higher than

they are currently—provides substantive evidence that these marine entities can successfully adapt to a dramatically changing global environment.

- The 18- to 59-cm warming-induced sea-level rise that is predicted for the coming century by the IPCC falls well within the range (2 to 6 mm per year) of typical coral vertical extension rates, which exhibited a modal value of 7 to 8 mm per year during the Holocene and can be more than double that value in certain branching corals. Rising sea levels should therefore present no difficulties for coral reefs.
- The rising CO₂ content of the atmosphere may induce very small changes in the well-buffered ocean chemistry (pH) that could slightly reduce coral calcification rates; but potential positive effects of hydrospheric CO₂ enrichment may more than compensate for this modest negative phenomenon. Real-world observations indicate that elevated CO₂ and elevated temperatures are having a positive effect on most corals.
- Polar bears have survived changes in climate that exceed those that occurred during the twentieth century or are forecast by the IPCC’s computer models.
- Most populations of polar bears are growing, not shrinking, and the biggest influence on polar bear populations is not temperature but hunting by humans, which historically has taken a large toll on polar bear populations.
- Forecasts of dwindling polar bear populations assume trends in sea ice and temperature that are counterfactual, rely on unvalidated computer climate models that are known to be unreliable, and violate most of the principles of scientific forecasting.

Chapter 9. Human Health Effects

- The IPCC alleges that “climate change currently contributes to the global burden of disease and premature deaths” and will “increase malnutrition and consequent disorders.” In fact, the overwhelming weight of evidence shows that higher temperatures and rising CO₂ levels have played an indispensable role in making it possible to feed a growing global population without encroaching on natural ecosystems.
- Global warming reduces the incidence of cardiovascular disease related to low temperatures and wintry weather by a much greater degree than it

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increases the incidence of cardiovascular disease associated with high temperatures and summer heat waves.

- Mortality due to respiratory diseases decrease as temperatures rise and as temperature variability declines.
- Claims that malaria and tick-borne diseases are spreading or will spread across the globe as a result of CO₂-induced warming are not supported in the scientific literature.
- Total heat-related mortality rates have been shown to be lower in warmer climates and to be unaffected by rising temperatures during the twentieth century.
- The historical increase in the air's CO₂ content has improved human nutrition by raising crop yields during the past 150 years on the order of 70 percent for wheat, 28 percent for cereals, 33 percent for fruits and melons, 62 percent for legumes, 67 percent for root and tuber crops, and 51 percent for vegetables.
- The quality of plant food in the CO₂-enriched world of the future, in terms of its protein and antioxidant (vitamin) contents, will be no lower and probably will be higher than in the past.
- There is evidence that some medicinal substances in plants will be present in significantly greater concentrations, and certainly in greater absolute amounts, than they are currently.
- The historical increase of the air's CO₂ content has probably helped lengthen human lifespans since the advent of the Industrial Revolution, and its continued upward trend will likely provide more of the same benefit.

- Higher levels of CO₂ in the air help to advance all three parts of a strategy to resolve the tension between the need to feed a growing population and the desire to preserve natural ecosystems: increasing crop yield per unit of land area, increasing crop yield per unit of nutrients applied, and increasing crop yield per unit of water used.
- Biofuels for transportation (chiefly ethanol, biodiesel, and methanol) are being used in growing quantities in the belief that they provide environmental benefits. In fact, those benefits are very dubious. By some measures, "the net effect of biofuels production ... is to increase CO₂ emissions for decades or centuries relative to the emissions caused by fossil fuel use."
- Biofuels compete with livestock growers and food processors for corn, soybeans, and other feedstocks, leading to higher food prices. Rising food prices in 2008 led to food riots in several developing countries. The production of biofuels also consumes enormous quantities of water compared with the production of gasoline.
- There can be little doubt that ethanol mandates and subsidies have made both food and energy more, not less, expensive and therefore less available to a growing population. The extensive damage to natural ecosystems already caused by this poor policy decision, and the much greater destruction yet to come, are a high price to pay for refusing to understand and utilize the true science of climate change.

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