The Kyoto Protocol and Global Warming

Sallie Baliunas

• The Lavoisier Group Inc •
May 2002

About the Author

SALLIE BALIUNAS, an astrophysicist at the Harvard-Smithsonian Center for Astrophysics and deputy director of Mount Wilson Observatory, received her MA and PhD degrees in astrophysics from Harvard University. She is co-host of the Website www.TechCentralStation.com, a senior scientist and chair of the Science Advisory Board at the George C Marshall Institute, and past contributing editor to *World Climate Report*. Her awards include the Newton-Lacy-Pierce Prize of the American Astronomical Society, the Petr Beckmann Award for Scientific Freedom, and the Bok Prize from Harvard University. The author of over 200 scientific articles, Dr Baliunas served as technical consultant for a science-fiction television series, Gene Roddenberry's *Earth: Final Conflict*. Her research interests include solar variability, magnetohydrodynamics of the sun and sun-like stars, exoplanets, and the use of laser electro-optics for the correction of turbulence due to the earth's atmosphere in astronomical images.

The Kyoto Protocol and Global Warming

MORE than one million years ago, the early tool-making hominid species *Homo erectus* controlled fire as a means for bettering the chances of the species' survival. *Homo sapiens*, the modern successor of *Homo erectus*, continues in the hominid legacy of attempting to control, and thereby outlast, the havoc of nature. Early use of fire meant protection from harsh weather and predators, besides safer food. The evolution from fire to fossil fuels to nuclear energy is a path of improving human health and welfare arising from efficient and effective access to energy. One trade-off is that energy use by humans has always produced local environmental change, for example, in the form of human artifacts on the landscape, or removal of trees from large areas for wood burning, or region-wide noxious air pollution from coal burning. On the other hand, the ready availability of energy that produces wealth through the free-market system provides ways to ameliorate or minimize environmental damage from energy use.

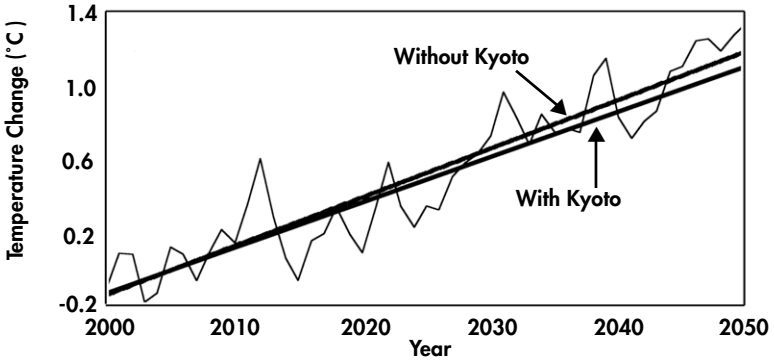
With widespread industrialization, human use of coal, oil and natural gas has become the centrepiece in an international debate about a global environmental impact, *viz.*, global warming, its causes and its future course. Currently, fossil fuels provide around 84 per cent of energy consumed in the United States, and roughly 80 per cent of the energy produced world-wide. The clash between fossil fuel use that emits carbon dioxide to the air, and the risk of deleterious global warming, is embodied in the Kyoto Protocol and its attendant series of international negotiations.

On scientific, economic and political grounds the Kyoto Protocol as a means to control the risk of global warming from fossil-fuel burning, while improving the human condition, is flawed.

What Would Kyoto Do?

Projections of future energy use, applied to the most advanced computer simulations of climate, have yielded wide-ranging forecasts of future temperature increases from a continuing increase of carbon dioxide concentration in the air. These have been compiled by the United Nations' Intergovernmental Panel on Climate Change (IPCC). The middle-range forecast of their estimates of future warming, based on expected growth in fossil fuel use without any curbs, is for a 1 degree Celsius increase between now and 2050 [Chart 1]. A climate simulation including the effect of the as yet unimplemented Kyoto Protocol, negotiated in 1997 and calling for a world-wide 5 per cent cut in carbon dioxide emissions from 1990 levels, would reduce that increase approximately to 0.94°C—an insignificant 0.06°C averted temperature increase [Chart 1].

Chart 1: Forecast Amount of Averted Global Warming (Temperature difference of 0.06°C)



To achieve the carbon dioxide emission cuts by 2012 as required under the Kyoto agreement, the United States would have to slash its projected energy use at that time by about 25 per cent. Why, if the US is required to lower its emissions so greatly, are the ultimate future temperature forecasts so pessimistic, in terms of avoided global warming? Because countries such as China, India and Mexico are

exempt from making emission cuts, and China alone will become the world's leading emitter of carbon dioxide in a few years.

Most economic studies indicate that the cost of the carbon dioxide emission cuts to the US would amount to $100 billion to $400 billion per year. Replacing the fossil fuels on which our economy relies has no simple answer. One major reason why the Kyoto Protocol's mandates are so costly is that energy policy considerations have been constrained by political, cultural and social influences. For example, substantially expanding the number of nuclear power plants and reducing the number of coal plants would enable future energy growth needs and the carbon dioxide emission reductions to be met simultaneously. But no nuclear power plants have been built in the US in over 20 years, owing to non-technical barriers. Further, renewable energy sources such as wind and solar power have been discussed to distraction as potentially meeting energy growth and carbon dioxide emission cuts in the US. Both wind and solar power facilities are boutique energy resources because they are dilute and intermittent sources of energy. While they may be cost-effective in limited locales, they are unreliable for large-scale electricity generation. Also, often overlooked is the enormous environmental footprint that wind and solar farms would require. For example, to replace a conventional 1000 megawatt coal plant that spans tens of acres would require an isolated, uninhabited (and therefore pristine) area with correct meteorological conditions of roughly 400 square miles and over 2,000 wind turbines, plus the associated imprint of high-power transmission lines, roads, etc. Solar panel farms would produce environmental blight and degradation over a similarly sized landscape.

The Kyoto Protocol also has the potential to worsen international relations. The struggling economies of the world rely on the US to maintain stability, provide aid and economic opportunity as a trading partner. While the developing nations are exempt from making carbon dioxide cuts, the severe economic impact on the US overwhelmingly reduces both opportunity and hope for developing economies. Thus, the punishment to the US economy as a result of severe energy restrictions will do little to lower the air's carbon dioxide concentration, but will devastate opportunities for developing economies.

What Does Science Say?

There is a tension between an economic catastrophe occurring because of the implementation of the Kyoto Protocol on the one hand, and the likelihood of an environmental catastrophe resulting from a failure to act on the other. The former is certain; the latter extremely speculative.

What are the scientific facts concerning human global warming effects? The facts in scientific agreement are:

- As a result of human use of coal, oil and natural gas, the air's carbon dioxide content (along with other human-produced greenhouse gases such as methane) is increasing.

- The greenhouse gases absorb infrared radiation, and, as a result, should retain some energy near the surface of the earth that would otherwise escape to space.

- Based on current ideas about how climate should work, the surface temperature and low layer of air (at a height of roughly one to five miles) should warm in response to the addition of the small amount of energy arising from the air's increased carbon dioxide content.

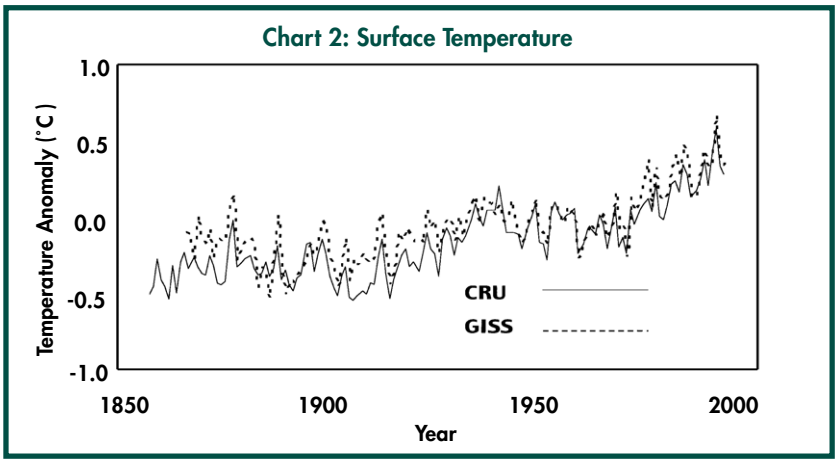
- Carbon dioxide at current or at a dramatically increased concentration in the air is not a toxic pollutant—carbon dioxide is essential to life on earth, because vegetation requires it.

- The main greenhouse effect is natural and is caused by water vapour and clouds (that is, water droplets and ice crystals in clouds). But the impacts of upper level moisture and clouds—the dominant greenhouse factors—are greatly uncertain. Hence, although sophisticated computer simulations of the impacts of increased carbon dioxide concentration in the air can be calculated, the reliability of the results rests on the validation of the computer simulations. However, the uncertainties of clouds and water vapour, besides other important factors like sea-ice changes in climate simulations, are at least ten times greater than the effect of the variable being tracked, that is, the effect of doubling the carbon dioxide in the air's carbon dioxide level.

- Finally, in the absence of any counterpoising or magnifying responses in the climate system, the global average rise in temperature is roughly 1°C (2°F) or less at equilibrium for a doubling of the air's carbon dioxide concentration. That is so meagre a warming for so profound a change in the air's carbon dioxide content, that it is within the order of climate's natural variability.

The Limits to Computer Simulations

One key question that deserves an answer at the start of the debate is the following: What has been the response of the climate thus far to the small amount of energy added by humans from increased carbon dioxide in the air? To prove the reliability of their future forecasts, computer simulations need verification by how they have reproduced past temperature change. Two major records of temperature to be considered are near the surface and in the lower atmosphere.



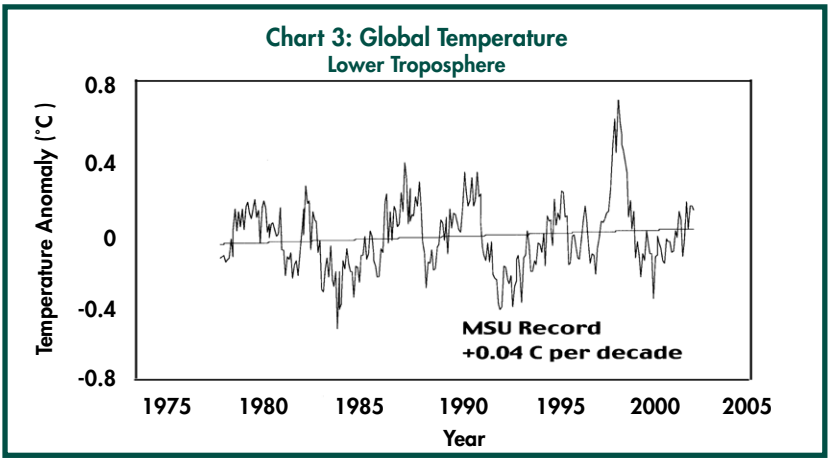
In the twentieth century, the global average surface temperature rose about 0.5°C [Chart 2]. At first glance the warming seems attributable to human fossil fuel use, which increased sharply in the twentieth century. But a closer look at the twentieth-century temperature shows three distinct trends:

First, a strong warming trend of about 0.5°C began in the late nineteenth century and peaked around 1940. Then, oddly, there was a cooling trend from 1940 until the late 1970s. And the third phase of the surface record shows a modest warming trend from the late 1970s to the present. Yet about 80 per cent of the carbon dioxide from human activities was added to the air *after* 1940, and so the air's increased carbon dioxide content cannot account for the first substantial warming trend, which appeared before 1940. Then, as the air's carbon dioxide content increased most rapidly, temperatures dropped for nearly 40 years. Since the 1970s, they have risen again. The early twentieth-century warming had to be largely natural. Human effects at most amount to about 0.1°C per decade—the maximum amount of the warming trend seen since the late 1970s. How does the observed surface warming trend in recent decades—assuming it is all anthropogenic—compare to the results of the computer simulations?

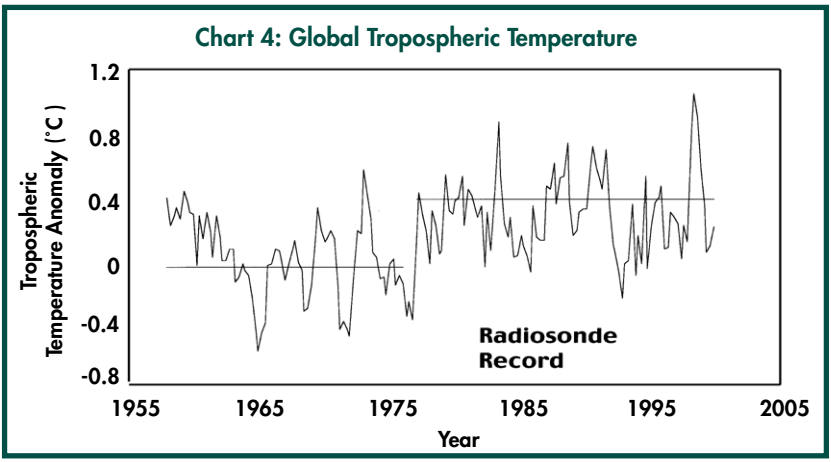
First, climate simulations predict that a smooth, linear rise of at least twice the observed trend should already be occurring, and should continue through the next century. If the warming trend has been observed to be, at most, 0.1°C per decade from human activities, then over 10 decades the forecasts are exaggerating the future warming, and should be adjusted downward to, at most, 1°C warming by 2100. This amount of warming would be very similar to natural variability, which man has dealt with for thousands of years. That warmth may return the climate to conditions seen in the early centuries of the second millennium, from about 800 to 1200 CE, when widespread warming is indicated by numerous proxies of climate, such as glaciers, pollen deposits, boreholes, ice cores, coral, tree growth plus sea and lake floor sediments. The Medieval Climate Optimum saw a human response in the settling of Greenland, Iceland, travel by the Vikings to Newfoundland, higher crop yields and generally rising life spans.

Second, and more important, the recent trends in surface warming may not be primarily attributable to human action at all. US leadership in new space instruments and funding—about $18 billion in the last decade—in global research has yielded critical information indicating a lesser human effect on global climate change than the climate simulations forecast.

The simulations of climate predict that a readily detectable warming both of the surface and of the layer of air above the surface to a few miles altitude—the lower troposphere—*must* occur with the presence of increased atmospheric carbon dioxide concentration. Records from NASA's microwave sounder units aboard satellites [Chart 3], and validated independently by balloon radiosondes, show an absence of the forecast human-made warming trend. In addition to being validated by a separate instrument, the satellite records of the temperature of the lower troposphere are essentially global, while those at the surface cover a mere fifth of the planet. The troposphere temperature does vary, for example, with the strong El Niño warming pulse of 1997–98, but no meaningful human warming trend is seen over the 21-year span of the record.

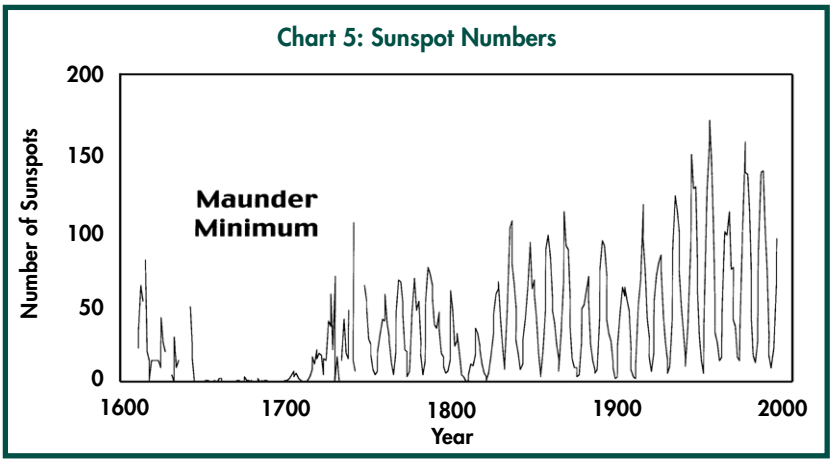


A proposed explanation for the lack of a significant human-made warming trend in the lower troposphere is that human induced global warming is present but masked because soot from sulphur dioxide and other human-made aerosols cool the atmosphere. But that idea of a widespread aerosol shading effect fails the test by the scientific method, because the Southern Hemisphere, which is relatively free of aerosols, shows no long-term warming trend at all. That fact contradicts the models' forecasts of significant human-made global warming and the hypothesis that aerosol pollutants are masking a significant human-made warming trend.



The radiosonde record from balloons also confirms and extends the results of the satellites and finds no trend of warming attributable to human activities going back more than four decades [Chart 4]. Although the radiosonde record lacks the dense spatial coverage of measurements made by satellites, it shows no warming trend in global average temperature that can be attributed to human effects. There is a strong warming in 1976–77—a warming known as the Great Pacific Climate Shift of 1976–77—resulting from a natural, periodic shift in the Pacific, called the Pacific Decadal Oscillation, which is so significant that global average temperatures are affected. Furthermore, the Pacific seems to have shifted, perhaps in 1998–99, back to its pre-1976 phase, which should produce cooler temperatures, especially in Alaska and in the global average.

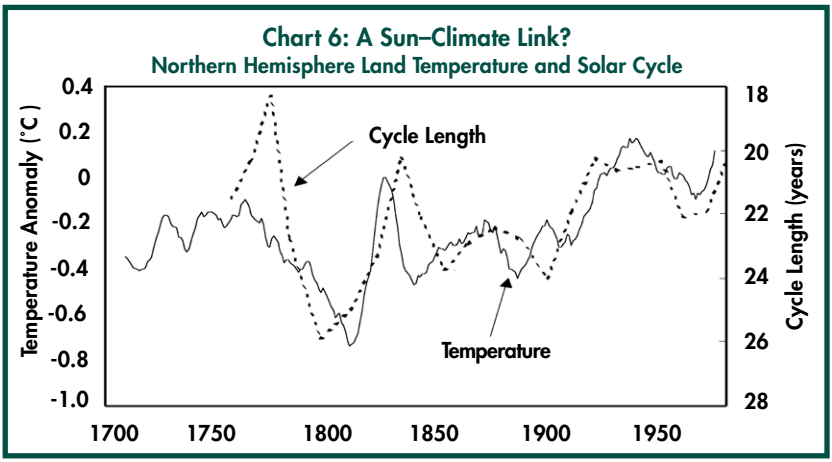
The most reliable data exhibit no evidence for human-made catastrophic warming. When compared to the measurements, the output from computer simulations all forecast exaggerated warming trends for the last four decades, compared to the sensitive lower tropospheric response. The forecasts exaggerate to some degree the warming at the surface, and decidedly in the lower troposphere. Because the models have exaggerated warming trends for the past several decades, the computer results presumably also exaggerate their forecasts of warming for the next century.



The exaggerated trends are not surprising. The computer simulations of climate must track over 5 million parameters relevant to the climate system. To simulate climate change for a period of several decades is a computational task that requires 10,000,000,000,000,000,000 degrees of freedom. And the simulations require accurate information on the two major, natural greenhouse gas effects—water vapour and clouds, which are uncertain at present.

Finally, in looking for natural factors influencing the climate, one area of new research is the effect of a changing sun [Chart 5]. The pattern of twentieth-century temperature change shows a strong correlation to the changing energy output of the sun. Although the causes of the sun's changing particle, magnetic and energy outputs are uncertain, as are the responses of the climate to the sun's various changes, the correlation is pronounced [Chart 6]. It explains especially well the early twentieth-century temperature rise, which cannot have much human contribution, because the lower troposphere has not been warming.

Based on the best temperature measurements of the last several decades, the actual response of the climate to the increased carbon dioxide content of the air has shown an insignificant man-made global warming trend. The magnitude of expected human change is especially



constrained by the observed temperature trends of the lower troposphere.

This is good news. It means that the human global warming effect is small and would be slow to develop, affording an opportunity to continue and improve observations and computer simulations of climate. That will serve to define the magnitude of human-made warming better, and allow the development of an effective, and cost-effective response.

Conclusion

Three things can be said about the risk of perilous global warming from human energy use:

1. No catastrophic human-made global warming effects can be found in the best measurements of climate. The alleged impacts haven't occurred. Hurricanes have not increased in the United States over the last half of the twentieth century; key infectious diseases such as malaria have been eradicated in the United States by the health, living and technological advances made in the last century.

2. Energy-use helped accomplish this last advance and it has also fed vast numbers of people while elevating them from poverty. The longevity, health, welfare and productivity of humans have

improved with the use of fossil fuels for energy, and the resulting human wealth has helped produce environmental improvements beneficial to health as well.

3. Carbon dioxide, the primary greenhouse gas produced by burning fossil fuels is not a toxic pollutant. It is essential to life on earth. Plants, including crops, have flourished owing to the aerial fertilization effect of increased carbon dioxide in the air. Agricultural experts estimate a 10 per cent increase in crop growth in recent decades owing to the heightened concentration of carbon dioxide in the air.

The best science offers little justification for the rapid cuts in carbon dioxide mandated by the Kyoto Protocol. Furthermore, the economic consequences come with considerable human and environmental risk, at the cost of no significant climatic improvement in terms of avoided temperature rise by the middle of the twenty-first century, according to the climate simulations.

Given the lack of benefits for the Kyoto Protocol, what then is guiding its international momentum? One strong factor is the philosophy of the Precautionary Principle in environmental regulation. The Precautionary Principle disallows an action that might harm the environment, until the action is certain to be environmentally harmless. That philosophy is antithetical to science in practice, because it sets an impossible goal in proving harmlessness with certainty.

Despite the lack of evidence for catastrophic global warming and its calamities, the temptation to adopt a policy of "doing something" is promoted as needed "insurance" against the possible risk to the earth. That portrayal of insurance as a prudent hedge is wrong on two counts, notwithstanding the scientific lack of detection of significant human-made warming. First, the actuarial notion of insurance is that of a carefully calculated premium paid against a risk known reasonably well in outcome and probability of outcome. In the case of human-made global effects, the risk, premium and outcomes cannot be well-defined. Yet risk calculations have been attempted by averaging the ensemble of results from various computer simulations, none of which yields reliable results.

More important is the second element of the flawed insurance analogy: the notion that buying the Kyoto Protocol is effective insurance—as stated above, the averted temperature resulting from mandated emission cuts will be inconsequential in terms of natural climate variability. The underlying basis for the international negotiations is the Rio Treaty of 1992, which specifically states that concentrations of greenhouse gases in the atmosphere, not emissions, be stabilized. In order to stabilize the air's concentration of greenhouse gases, emissions would have to be cut some 60–80 per cent.

For the next several decades, fossil fuels are the key to improving the human condition. The scientific facts show that the liberation of fossil fuels from their geologic reservoirs and mankind's use of them provide many economic, health and environmental benefits, whereas the environmental catastrophes forecast from their use by critics have yet to be demonstrated.

About the Charts

Chart 1—Forecast of year-to-year temperature rise from years 2000 to 2050 CE (thin line) assuming an increase in the air's greenhouse gas concentration from human activities, based on the Hadley Center's model (UKMO HADCM3 IS92A version). The upper line (thick black, labelled "Without Kyoto") is the linear trend fit to the model's forecast temperature rise, without implementation of the Kyoto Protocol. The lower line (thick black) is the estimate of the impact on temperature with the implementation of the Kyoto Protocol. By the year 2050, around 0.06°C global warming is averted by the implementation of the Kyoto Protocol.

Chart 2—Surface temperature changes sampled world-wide and analyzed by Cambridge Research Unit (CRU) and NASA-Goddard Institute of Space Studies (GISS). The pattern of twentieth-century temperature change has three distinct phases: an early twentieth-century warming, a mid-century cooling, and a late twentieth-century warming.

Chart 3—Monthly averaged temperatures sampled nearly globally for the lower troposphere (roughly 5,000 to 28,000 feet altitude) from Microwave Sounder Unit (MSU) instruments on board NASA satellites. The large spike of warmth resulted from the temporary natural warming of the Pacific Ocean by the 1997–1998 El Niño event. The linear trend is +0.04°C per decade (data are from http://www.ghcc.msfc.nasa.gov/temperature/)

Chart 4—The seasonal average temperature anomaly sampled world-wide for the lower troposphere as measured by radiosonde instruments carried aboard balloons. Although a linear trend of +0.09°C per decade is present if fitted across the entire period of the record, that trend is affected by the presence of the abrupt warming that occurred in 1976–1977, owing to the action of the Pacific Decadal Oscillation (PDO). The trend lines before and after the 1976–1977 Great Pacific Climate Shift indicate no evidence of a significant human-made warming trend (source of data http://cdiac.esd.ornl.gov/ftp/trends/temp/angell/glob.dat)

Chart 5—The Sunspot Number, which is representative of the surface area coverage of the sun by strong magnetic fields, is shown from the beginning of telescopic measurements early in the seventeenth century. The average 11-year sunspot cycle is prominent. Changes in the decade-to-decade strength of the sun's surface magnetism are also evident—including the low magnetism of the seventeenth century (a period called the Maunder Minimum, coincident with the coldest century of the last millennium) and the sustained, high magnetism of the latter twentieth century. NASA satellite measurements have shown a strong correlation between brightness of the sun and its surface magnetism, on time scales of decades.

Chart 6—Changes in the sun's magnetism (as evidenced by the changing length of the 22-year, or Hale Polarity Cycle, dotted line) and changes in Northern Hemisphere land temperature (solid line) are closely correlated. The sun's shorter magnetic cycles are more intense, suggesting a brighter sun, than longer cycles. Lags or leads between the two curves that are shorter than twenty years are not significant, owing to the 22-year time frame of the proxy of brightness change. The record of reconstructed Northern Hemisphere land temperature substitutes for global temperature, which is unavailable back to 1700 (S. Baliunas and W. Soon, 1995, *Astrophysical Journal*, 450, 896).

The Lavoisier Group Inc

The Lavoisier Group is named after the founder of modern chemistry, Antoine-Laurent Lavoisier, who discovered oxygen, identified carbon dioxide as the product of combustion of carbon in air, and who laid down the theoretical basis of modern chemistry. He was also an ingenious experimenter and instrument-maker who insisted on the highest possible accuracy when taking measurements. He was executed by the French Revolutionary Government in 1794.

The Lavoisier Group was incorporated in April 2000. The founders were concerned that Australia might ratify the Kyoto Protocol without properly understanding either the scientific claims on which it is based, or the economic implications which would follow from the regime of decarbonisation which the Kyoto Protocol requires. The Group seeks to stimulate debate and discussion about the science, the politics and the economics of the Kyoto Protocol, so that even if many other countries ratify it, Australia will make a decision based wholly on our national interest.

The Lavoisier Group holds conferences and publishes papers on its Website: www.lavoisier.com.au People who sympathise with the aims of the Lavoisier Group and who wish to join, can apply for membership through the Website.

The Lavoisier Group's Board comprises Peter Walsh AO, President; Ian Webber AO, Vice President; Harold Clough AO, Treasurer; Peter Murray AOM; Bruce Kean AM; Bob Foster; Ray Evans, Secretary.