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This written debate took place in 2002.

The format of the original document has been altered in order to present a side-by-side comparison of the arguments; the content has not been altered. Please refer to the original on-line link (as posted above) for confirmation of content.

## POINT

**BY MATT McCULLOCH, P.ENG.  
and MATTHEW BRAMLEY, PhD**

Atmospheric concentrations of greenhouse gases (GHGs) are rising rapidly as a result of human activities, mainly the burning of fossil fuels. Almost all leading climate scientists agree that a profound transformation of the global environment is likely to occur this century if this trend continues. Heeding the scientific advice, the world's governments agreed more than 10 years ago on the need to stabilize GHG concentrations. They formalized this objective in the United Nations Framework Convention on Climate Change, which has been ratified by virtually every nation in the world (Canada and the U.S. included).

Carbon cycle modelling shows clearly that stabilizing GHG concentrations will require global GHG emissions to be reduced by more than half from today's levels. This is a very considerable challenge, but it is one that we collectively need to surmount within just a few decades if the most damaging of the expected impacts are to be avoided. Yet GHG emissions are currently growing almost everywhere in the world. This

## COUNTERPOINT

**BY DR. SALLIE BALIUNAS  
DR. TIM PATTERSON  
and ALLAN MacRAE, P.ENG.**

### **Climate Is Always Changing**

The only constant about climate is change. For as long as Earth has existed, natural climate changes have occurred and will continue. Change occurs at many scales, from gradual variation over millions of years, to rapid climate shifts in a decade or less. The question is how to distinguish between natural climate variation and possible change caused by human activity.

During the past two million years, the Earth has been as ice-age cold as it has ever been, experiencing more than 30 glaciations. In the past 800,000 years, the pattern has been approximately 100,000 years of extensive glaciation, interspersed with warmer interglacials of around 15,000 years. By studying climate changes through these previous cycles, we surmise that the next ice age is less than 5,000 years ahead. At that time, large portions of North America will be buried under kilometres of ice.

### **Greenhouse Gases & Climate**

The greenhouse effect has an important influence on the climate of the Earth. The temperature of the

creates a real urgency in beginning the job of slowing and then reversing that growth.

The world's governments quickly recognized that meeting the objective of the Framework Convention would require legally binding limits on GHG emissions. In 1997, as a first step in that direction, they negotiated the Kyoto Protocol, which sets emissions targets for industrialized countries for the period 2008-2012. In most cases, these represent modest reductions in emissions below 1990 levels - a six-per-cent reduction in the case of Canada. The vast majority of cumulative GHG emissions from human activities to date originated in industrialized countries. If the latter are not willing to take the small first step represented by Kyoto, developing countries - which have vastly inferior resources on a per-capita basis - will simply refuse to take on their own emissions constraints in the subsequent steps needed to cut global emissions in half.

Most industrialized countries have already ratified the Kyoto Protocol, and only Russia's ratification (expected within a few months) is now needed for the protocol to have legal force. Only the U.S. has refused outright to ratify. Canadians generally believe strongly in participating in multilateral, cooperative efforts to solve major global problems, which explains why polls show large majorities in favour of ratifying the Kyoto Protocol. Canada has the second highest per-capita level of GHG emissions in the world - over twice as high as Western Europe or Japan. If Canada does not ratify the protocol, the international community will see it - as the U.S. is already seen - as selfishly resisting a reasonable solution to a problem to which it is a leading contributor.

So why are some influential voices in Canada opposing Kyoto? Most stress the

Earth is primarily maintained by the transport of energy by atmospheric circulation and ocean currents and the balance between the flux of incoming solar radiation and the amount of outgoing infrared radiation back to space. Greenhouse gases, clouds and aerosols in the atmosphere trap some of the reflected radiation from the surface, causing a natural greenhouse effect that makes the planet habitable. Without this natural greenhouse effect, the global ambient temperature would be substantially colder.

Atmospheric greenhouse gases comprise less than 0.1 per cent of the air. These gases include carbon dioxide (CO<sub>2</sub>), methane (CH<sub>4</sub>), nitrous oxide (N<sub>2</sub>O), as well as the most important one, water vapour (H<sub>2</sub>O).

Water vapour is the principal greenhouse gas, comprising 99 per cent of greenhouse gases in the atmosphere. The amount of water vapour has the most significant influence on global temperature of any greenhouse gas, followed by the warming effect of water in all its phases in clouds.

Despite the rhetoric of the Kyoto Protocol, CO<sub>2</sub> is at most a minor contributor to global climate change. The proportion of CO<sub>2</sub> in the atmosphere has varied significantly over geologic time. Through most of the last 500 million years atmospheric CO<sub>2</sub> content has been higher - up to 18 times higher - than at present. Strikingly, the atmospheric concentration of CO<sub>2</sub> was more than 10 times higher than today's value during the Ordovician glaciation, around 440 million years ago. CO<sub>2</sub> is simply a minor driver in the many factors that influence climate.

The percentages of CO<sub>2</sub> in the atmosphere above the Antarctic Ice Cap for the last 150,000 years have been measured in air bubbles enclosed in ice cores. Over this interval, CO<sub>2</sub> levels have closely paralleled temperatures. However, detailed analysis of CO<sub>2</sub> concentrations indicates that CO<sub>2</sub> levels often rose and peaked several hundred years after temperature. These results further emphasize that climate change drives major changes in CO<sub>2</sub>,

potential effect of the protocol on the economy. But the most credible and detailed economic modelling by federal and provincial governments, taking account of U.S. non-participation, shows that the most likely macroeconomic effect would be to change Canada's projected GDP growth between 2000 and 2012 from 31 per cent growth to somewhere between 30 per cent and 31.5 per cent. For sure, economic modelling is an uncertain art, but no studies suggest anything worse than a slight slowing of strong underlying economic growth.

The real economic issue is not the overall impact, but how any impact will be shared out. Alberta, with the highest per-capita emissions in Canada, and the oil industry, often viewed as the main culprit, understandably feel vulnerable in this regard.

It is therefore important to recall federal and provincial governments' repeated joint affirmations that no region or sector should bear an unreasonable burden as a result of the Kyoto Protocol. Governments have powerful policy tools at their disposal to ensure that that is the case - notably, flexibility in the way emissions permits are allocated under the domestic emissions trading system that is expected to be at the centre of Canada's Kyoto implementation plan.

The Pembina Institute believes in fair sharing of responsibility to reduce emissions between regions and economic sectors. But Canada's Kyoto implementation plan must also initiate a shift in the economy away from the most GHG-intensive resources, like oilsands and coal, towards less GHG-intensive ones like natural gas, renewable energy, and the enormous "resource" that is energy efficiency. This is a shift that Alberta can lead and benefit from if it so

not the reverse. Temperature change affects the carbon cycle, which then produces fluctuations in atmospheric CO<sub>2</sub> concentration.

During the last 300 years, atmospheric CO<sub>2</sub> concentrations have risen from 275 parts per million to around 360 parts per million, a 30-per-cent increase. Most of the increase has been recent, caused by fossil fuel burning and deforestation. As discussed below, the increase in atmospheric CO<sub>2</sub> content, while clearly linked to post-Second World War industrialization, cannot be closely linked to global surface warming trends.

Computer models that predict catastrophic human-induced global warming have consistently failed to accurately reproduce past and present climate changes, so their predictions of future climate changes are highly suspect. These models incorrectly assume that increased CO<sub>2</sub> concentration is a major driver of atmospheric warming, and also assume large positive feedbacks arising from increased CO<sub>2</sub> concentration, for which there is no scientific evidence. Without these speculated positive feedbacks, even a doubling of CO<sub>2</sub> concentration would lead to a theoretical warming of only approximately 1° C.

### **Kyoto is Ineffective**

Computer simulations of climate have yielded wide-ranging forecasts of future temperature increases from rising atmospheric CO<sub>2</sub> concentrations, based on projections of future energy use. The United Nations' Intergovernmental Panel on Climate Change has compiled these simulations. The middle range forecast of future warming, based on expected growth in fossil fuel use without any curbs, is for a 1° C increase between now and 2050. The Kyoto Protocol would reduce that increase by an insignificant 0.06° C. If increased atmospheric concentrations of CO<sub>2</sub> were a major problem, then as many as 40 Kyoto-type emission cuts would be required to stop the predicted human-made warming.

chooses.

Opponents of Kyoto often focus on risks to our competitiveness if Canada ratifies while the U.S. does not. But several studies indicate that the U.S. withdrawal has actually lowered the protocol's cost in Canada by reducing the expected price of international emissions credits. This is a result of the protocol's flexibility in allowing countries to meet their emissions targets partly by purchasing such credits. The Pembina Institute wants Canada to maximize the amount of domestic emissions reductions, and reap the associated benefits (mentioned later in this article), but the safety valve of international emissions trading refutes Kyoto opponents' claim that our target is a strait-jacket.

Emissions trades occurring today are confirming the low price of credits. It is also important to understand that governments in the U.S. have taken far more significant action to date to reduce GHG emissions than governments in Canada - as detailed in a recent Pembina Institute report. By implementing Kyoto, Canada will initially be catching up with the U.S., not getting ahead.

Perhaps what most undermines Kyoto opponents' forecasts of economic damage is the fact that major Canadian GHG emitters such as Suncor and TransAlta have voluntarily taken on Kyoto-level targets for their net corporate emissions. They would hardly have done so if they believed the protocol would seriously harm their economic prospects. BP's CEO recently described how his company had met its global 10 per cent GHG reduction target seven years ahead of schedule and "at no net economic cost."

Indeed, implementing the Kyoto Protocol will have several important benefits for

To prove the reliability of future forecasts, computer simulations need verification by testing past, well-documented temperature fluctuations. New investment in technology, especially that of space-based instrumentation, has helped address the issue of observed response of the climate to increased greenhouse gas concentrations. Two tests of the reliability of the computer simulations are the past decades of surface temperature and lower troposphere change.

### **Record of Surface Temperature**

The Earth has been much warmer and colder in the past, before we started burning fossil fuels. From about 900 to 1300 AD, during the Medieval Warm Period, the Earth was warmer than it is today. In the 20th century the global average surface temperature rose about 0.6° C, as measured by thermometry, after a 500-year cool period called the Little Ice Age. Only the 20th century warming trend may have a human component attributable to fossil fuel use, which increased sharply after 1940.

A closer look at the 20th century temperature record shows three distinct trends: First, a warming trend of about 0.5° C began in the late 19th century and peaked around 1940. Next, temperature decreased from 1940 until the late 1970s. Then a third warming trend occurred from 1976 to 1986, after which the trend flattens.

Because about 80 per cent of the CO<sub>2</sub> from human activities was added to the air after 1940, the early 20th century warming trend should be largely natural. The cooling from 1940 to the late 1970s, when CO<sub>2</sub> concentrations were rapidly increasing, also tends to contradict the theory that CO<sub>2</sub> is a major driver of global temperature.

Even if one arbitrarily assumed that all of the late 20th century warming was caused by increased concentrations of industrially produced greenhouse gases, this would amount to at most 0.1°C warming per decade - the maximum amount of the surface-warming trend seen since the late

Canada. It will result in a more energy-efficient economy and create major new business opportunities in low-GHG technologies, benefiting rapidly growing, innovative Canadian companies like Vision Quest (windpower), Ballard (fuel cells), Iogen (ethanol fuel) and many others. Far from harming our economic competitiveness, these things will enhance it and position Canada advantageously for the future and inevitable tightening of international restrictions on GHGs. A reduction in fossil fuel use will mean a reduction in the several thousand premature deaths that the medical community estimates occur annually in Canada as a result of urban air pollution.

Last but not least, concerted international action to reduce GHG emissions will make a start towards avoiding the enormously costly storms, droughts, coastal flooding and other impacts that climate models tell us to expect if emissions continue to rise unchecked.

If these benefits are there for the taking, why not pursue them with a "made in Canada" plan instead of tying ourselves to Kyoto? The answer is that despite the good initiatives of a few far-sighted companies, formidable vested interests and inertia prevent Canada from controlling its GHG emissions in the absence of strong government leadership in the form of regulations and economic instruments. During the 1990s, when governments relied instead on voluntary and educational initiatives, Canada's GHG emissions rose by 20 per cent, a gross violation of our commitment, enshrined in the Framework Convention on Climate Change, to bring our emissions back to the 1990 level by 2000.

The problem was that this commitment was not legally binding, and so governments failed to muster the political will to

1970s. This surface warming would suggest a temperature trend of about 1° C per century, which is less than that predicted by the computer simulations, but it is unlikely that even this recent trend in surface warming is primarily attributable to human-made greenhouse gases.

### **Record of Lower Troposphere Temperature**

Computer simulations of climate, in which atmospheric greenhouse gas concentrations increase due to human activities, predict detectable warming not only near the surface but also in the layer of air above the surface, the lower troposphere, which rises in altitude from roughly two to eight kilometres. Records from NASA's Microwave Sounder Units aboard satellites extend back 22 years and cover most of the globe (Figure 1). The satellite-derived record is validated independently by measurements from NOAA balloon radiosonde instruments, and those records extend back 45 years. Both records show that the temperature of the lower troposphere does vary as a result of natural factors, e.g., the strong El Niño warming pulse of 1997-98 is obvious. However, no meaningful human warming trend, as forecast by the computer simulations, can be found.

Although the radiosonde record lacks the dense spatial coverage from satellites, it does extend back to 1957, a period that includes the recent rapid rise in atmospheric CO<sub>2</sub> concentration. The radiosonde record shows no linear warming trend in global average temperature prior or subsequent to a dramatic shift in 1976-77. That warming, known as the Great Pacific Climate Shift of 1976-1977, is not attributable to human causes but is a natural shift in the Pacific that occurs every 20 to 30 years.

When compared to the observed response of the climate system, the computer simulations all have forecast warming trends much steeper over the last several decades than measured. The forecasts exaggerate to some degree the warming at the surface, and profoundly in the lower troposphere.

### **Natural Climate Variability: Sun's Influence**

implement the policies needed to meet it. This situation will certainly continue if Canada pursues a unilateral approach to climate change. By ratifying Kyoto, on the other hand, we will be held to our emissions target by the international community and face sanctions in case of non-compliance. That is essential to create the political will to implement the strong policies that Canada needs to reduce our emissions.

The notion that the federal government has no idea how to implement the Kyoto Protocol, or, alternatively, that the government has a plan but has not consulted industry and the provinces about it, is nonsense. The two-year National Climate Change Process, established in 1998, entailed exhaustive consultations with industry associations, provinces and environmental groups and identified more than 300 individual measures that governments could implement to reduce GHG emissions. The federal government then put forward four different packages of such measures in a May 2002 discussion paper that was subject to further nationwide consultations.

The government will publish its chosen Kyoto implementation plan prior to putting Kyoto ratification to a vote in Parliament before the end of this year. Canadians' true interests demand that our elected representatives choose the cooperative, international approach to addressing this major global challenge, rather than a path of isolation and inaction that shirks our global responsibilities.

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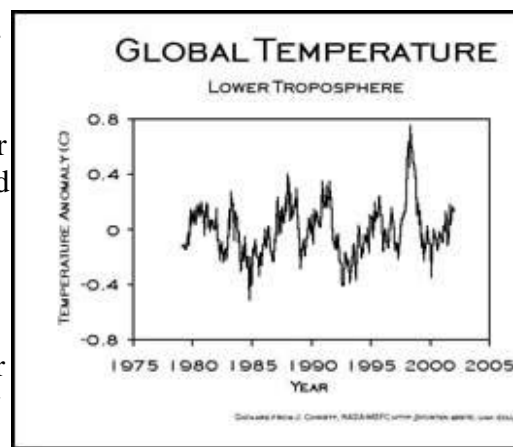
**Dr. Matt Bramley is the Pembina**

Given the lack of a meaningful observed warming trend in the lower troposphere, computer model results say that most of the surface warming in recent decades is not caused by a human-made enhanced greenhouse effect. However, the 20th century temperature pattern does show a strong correlation to energy output of the sun (Figure 2). Although the causes of the changing sun's particle, magnetic and energy outputs are uncertain, as are the responses of the climate to the sun's various changes, the correlation is pronounced. It explains especially well the warming trend up to 1940, which cannot have much human contribution, and the cooling trend from 1940 to the late 1970s. Increased solar activity, not increased atmospheric CO<sub>2</sub>, can also be the primary cause of the warming trend since the late 1970s.

### Conclusion

Based on analysis of ancient and recent temperature and atmospheric data, increased atmospheric concentrations of CO<sub>2</sub> are not a cause of significant global warming. Contrary to forecasts by computer simulations, there is no evidence of catastrophic global warming due to burning of fossil fuels. The magnitude of human-caused warming is especially constrained by the observed temperature trends of the lower troposphere. There is strong evidence that natural variation in the sun's activity is a much more significant driver of temperature than human-made greenhouse gases.

**Figure 1 -** Monthly averaged temperatures sampled nearly globally for the lower troposphere (roughly two to eight



**Institute's director of climate change.**

## **REBUTTAL OF POINT**

(BY COUNTERPOINT AUTHORS)

The Pembina Institute's authors have chosen to avoid the science topic, perhaps because there is no credible scientific basis for the Kyoto Protocol.

Advocates of Kyoto mistakenly cite the United Nations IPCC 2001 report and the U.S. National Academy of Sciences 2001 report as authoritative scientific sources. Dr. Richard Lindzen, Sloan professor of meteorology at MIT and a co-author of both reports, wrote in 2001:

"We are not in a position to confidently attribute past climate change to carbon dioxide or to forecast what the climate will be in the future..."

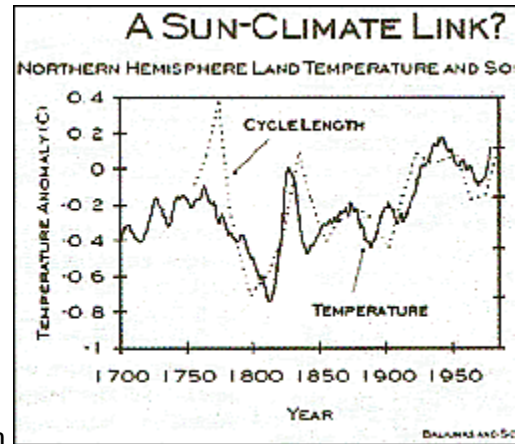
"Science, in the public arena, is commonly used as a source of authority with which to bludgeon political opponents and propagandize uninformed citizens. This is what has been done with both the reports of the IPCC and the NAS. It is a reprehensible practice that corrodes our ability to make rational decisions. A fairer view of the science will show that there is still a vast amount of uncertainty - far more than advocates of Kyoto would like to acknowledge..."

Kyoto has many fatal flaws, any one of which should cause this treaty to be scrapped.

Climate science does not support the theory of catastrophic human-made global warming - the alleged warming crisis does not exist.

kilometres altitude) from microwave sounder unit instrument s onboard NASA satellites. The large spike of warmth resulted from the temporary natural warming of the Pacific Ocean by the 1997-1998 El Niño event.

**Figure 2** - 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 smoothed Northern Hemisphere land temperature



Kyoto focuses primarily on reducing CO<sub>2</sub>, a relatively harmless gas, and does nothing to control real air pollution like NO<sub>x</sub>, SO<sub>2</sub>, and particulates, or serious pollutants in water and soil.

Kyoto wastes enormous resources that are urgently needed to solve real environmental and social problems that exist today. For example, the money spent on Kyoto in one year would provide clean drinking water and sanitation for all the people of the developing world in perpetuity.

Kyoto will destroy hundreds of thousands of jobs and damage the Canadian economy - the U.S., Canada's biggest trading partner, will not ratify Kyoto, and developing countries are exempt.

Kyoto will actually hurt the global environment - it will cause energy-intensive industries to move to exempted developing countries that do not control even the worst forms of pollution.

Kyoto's CO<sub>2</sub> credit trading scheme punishes the most energy efficient countries and rewards the most wasteful. Due to the strange rules of Kyoto, Canada will pay the former Soviet Union billions of dollars per year for CO<sub>2</sub> credits.

Kyoto will be ineffective - even assuming the overstated pro-Kyoto science is correct, Kyoto will reduce projected warming insignificantly, and it would take as many as 40 such treaties to stop alleged global warming.

The ultimate agenda of pro-Kyoto advocates is to eliminate fossil fuels, but this would result in a catastrophic shortfall in global energy supply - the wasteful, inefficient energy solutions proposed by

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**Dr. Sallie Baliunas is deputy director at Mount**



Kyoto advocates simply cannot replace fossil fuels.

**Wilson Observatory and an astrophysicist at the Harvard-Smithsonian Center for Astrophysics.**

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**Views expressed are not necessarily those of any institution with which they are affiliated.**

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## **REBUTTAL OF counterPOINT**

(BY POINT AUTHORS)

The connection between greenhouse gas (GHG) emissions from human activities and climate change is a complex scientific issue. How should policymakers and other interested non-experts, such as APEGGA members, make good judgments as to whether or not these emissions pose a major threat?

The only reliable approach is a review of the full body of research published in the peer-reviewed international scientific literature. Only such a process can allow each individual study and opinion to be placed in context, and a fully balanced picture of the current state of scientific knowledge to be arrived at. The Intergovernmental Panel on Climate Change, comprising the world's most respected climate researchers, was set up by the world's governments precisely for this purpose. In 2001, the work of the IPCC was endorsed by the U.S. National Academy of Science plus 17 other national science academies. The latter, in a joint statement in the journal *Science*, went further and urged governments to implement the Kyoto Protocol.

What does the IPCC1 have to say about the three most significant claims made by Counter-point authors Baliunas, Patterson and MacRae?

*"CO<sub>2</sub> is at most a minor contributor to climate change."* According to the IPCC, in its Third Assessment Report Summary for Policymakers, Working Group I (available at [www.ipcc.ch](http://www.ipcc.ch)): "In the light of new evidence and taking into account the remaining uncertainties, most of the observed warming over the last 50 years is likely to have been due to the increase in greenhouse gas concentrations." Also: "The globally averaged surface temperature is projected [in business-as-usual scenarios] to increase by 1.4 to 5.8° C over the period 1990 to 2100." It should be noted that the difference in global average temperature between an ice age and the present day is only about 5° C, so this projected warming represents a profound transformation of the global environment.

*"Computer models that predict catastrophic human-induced global warming have consistently failed to accurately reproduce past and present climate changes."* The IPCC, however, finds good agreement between model simulations and observed temperature over the past 140 years, including the temperature increase up to 1940, if the simulations include solar variation and volcanic activity along with emissions of GHGs and particulates. Relative to the pre-industrial era, the IPCC estimates that the radiative forcing (i.e., the contribution to warming) by GHGs from human activities is currently over nine times the forcing from increased solar radiation.

*"Recent temperature trends in the lower troposphere do not support meaningful human-induced warming."* According to the IPCC, overall global temperature increases since the late 1950s (the beginning of adequate weather balloon data) in the lower troposphere have been similar to those at the surface. Since 1979 (the beginning of the satellite record), there has been a significant difference in warming rates, but "it is physically plausible to expect that over a short time period

	<p>(e.g., 20 years) there may be differences in temperature trends. In addition, spatial sampling techniques can also explain some of the differences in trends, but these differences are not fully resolved."</p> <p>The authors barely mention the IPCC. Readers should be very suspicious of scientific arguments about climate change that fail to give space to the findings of the world's dominant scientific authority on the subject. APEGGA members would also be well advised to avoid basing their views on climate science on arguments advanced by individuals who are specialists in only very narrow portions of that broad field (Baliunas is an expert in solar radiation; Patterson is a paleoclimatologist).</p> <p>In our opening article, we did not spend much time on the science of climate change because the IPCC picture of the subject is almost universally accepted, not just among professional climate scientists but among the broader community engaged in the climate change issue, including most of the largest GHG-emitting corporations. The climate change debate has now moved on to economic and political issues. In this area, the authors did make one important point, with which we agree: Kyoto is only a small first step and many further ones will be needed. Let's get on with the job.</p>
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