OPINION

By Alex Nicolson and Dr. Lars Schernikau

CO_2 Beneficial to Earth, Impact on Global Warming Vastly Exaggerated

Background

There is a great deal of discussion on global warming and the supposed dangers of carbon dioxide gas (CO_2) released from fossil fuel combustion around the world. In 1988, the IPCC (International Panel on Climate Change) was set up to investigate and document this danger. Many papers and articles have been written and international meetings held to see if agreements can be made to mitigate this supposed problem for our planet.

Targets have been set to reduce CO_2 emissions for the near future and programs are being introduced in developed countries on how to meet them. These targets are not easy to meet as so much of a country's growth over the past two hundred years has been due to the discovery and ever increasing use of affordable energy derived from fossil fuels such as coal, oil, and natural gas. This affordable energy drove industrial expansion, created millions of jobs, and generated wealth for a large portion of the global population.

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Stress on Developing Countries

The rising stars of tomorrow's industrial world are now being forced to comply with unrealistic targets and spend their money on CO_2 mitigation – while in fact it would be urgently needed to develop their country's infrastructure, improve the health system and reduce environmental pollution of the air, water and soil. At the same time, higher CO_2 level will increase crop output and help feeding growing human and animal population.

Gross domestic product in all modern and developing countries correlates directly with consumption of energy as does life expectancy. Until a reliable, new, and reasonably priced base-load source of energy is found, fossil fuels are required. Quickly and drastically reducing the use of fossil fuels by a large percentage, as has been mandated by some governments, creates a serious problem. It would have negative effects on the social welfare of so many people in the energy industry and related sectors and many millions more people's lives will be threatened.

Renewable Energy Sources

New energy technologies are being funded and developed and solar panels,

geothermal wells, wind farms and tidal turbines are being installed to produce electricity. That's good but except for geothermal and tidal they have a key problem: Their power sources are transient and cannot yet be used for base-load service; a key factor for a stable power to a city, town or industrial center. Solar produces no power at night and windmills only work when there is sufficient wind and they shut down if the wind speed is too high. Thus, storage and re-distribution of extra power has become the key challenge. Only an advanced storage solution that can be applied on a global scale and is affordable will allow for large-scale economic use of solar and wind power. Fossil fuel power is steady, still relatively cheap and runs continuously 24 hours a day. Therefore, there is no way around fossil fuels for many decades to come.

Key Forces Affecting Climate

The question we need to ask is, are we sure that this costly and drastic move away from fossil fuels just to reduce CO_2 is urgently needed? What are the key forces that affect the Earth's climate? Do higher CO_2 levels not benefit plant growth and therefore are beneficial to our environment?

To answer this question, let us have a look at the Earth's climate history over the past 400.000 years and the role of CO_2. This is in contrast to the typical 150-year time span depicted in global media.

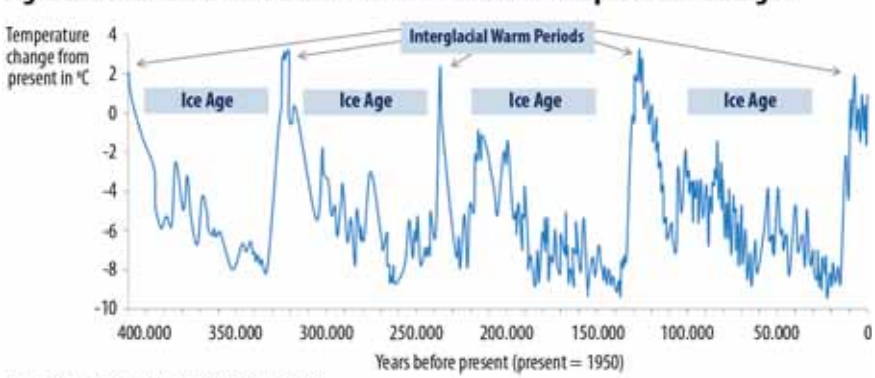
Past History of Earth's Climate

In the last 400.000 years of Earth's climate, extracted from Vostok ice core data in Antarctica, we can see in Figure 1 below that the Earth went through four Ice Ages. The earliest Ice Age lasted 55.000 years, then they expanded up to the most recent Ice Age of 95.000 years.

In all four Interglacial warm periods, **excluding the present one**, the Earth warmed up and the temperature peaked for about 4.000 years then quickly cooled down again. The present Interglacial period has already lasted about 12.000 years, which is unprecedented.

Over the recent 400.000 years, Earth has gone through long Ice Ages, with short warm periods, except for the present one. This repeating pattern can be seen in Figure 1[(1)]. We are near the end of the current warm period and soon the Earth will cool down and go into another Ice Age.

Figure 1: Vostok Ice Core Data – 400.000 Years of Temperature Changes



Source of Graph: J.R. Petit et al: Nature 399, pp429-436,1999

Source of the Ice Ages and Interglacial Warm Periods

These large temperature swings are likely caused by well-known and documented changes such as Sun activity, the shape of the Earth's orbit around the Sun, changes in the tilt of the Earth to the Sun and other factors which changed the amount and distribution of solar energy arriving on Earth and later being re-radiated back into space from the surface. This is described in the Milankovitch Cycle.

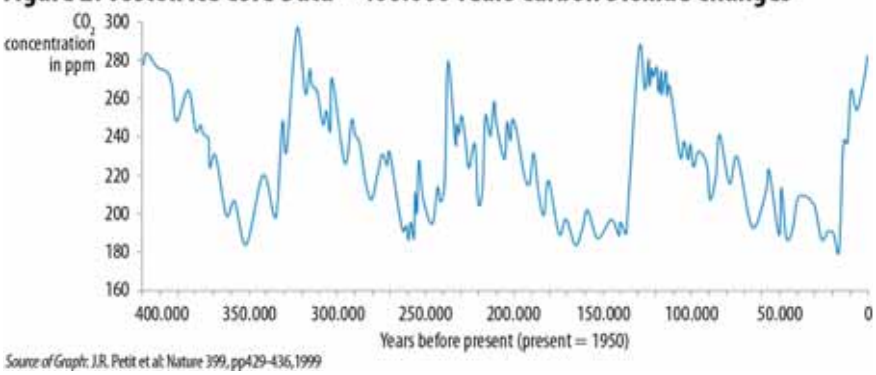
It appears that we are still 2^0C below the peak Interglacial temperatures of two of the last four Ice Ages. Could this be the source of the 2^0C max increase limit being set by IPCC and other agencies?

Carbon Dioxide Levels over the past 400.000 Years

Over the time period of 400.000 years, the levels of CO_2 varied from 180 ppm during the lowest temperature points of the Ice Ages, then rose to the 280-300 ppm range in the warm period, like the current one. Presently, the CO_2 concentration in the atmosphere is about 400 ppm and it is rising about 2 ppm per year.

That level is 100 ppm above the highest levels in the earlier warm periods (though still far below peak levels looking a few million years into history), and is therefore the concern of the IPCC and others. This concern, however, is unfounded since the warming potential of additional CO_2 above its present level is very limited as described below. In addition, one should keep in mind that the CO_2 concentration in the atmosphere reached over 6.000 ppm in the earlier history of the Earth[(6)]. These CO_2 concentrations of the past 400.000 years can be seen in Figure 2 below[(2)] which illustrates the range of CO_2 from Ice Ages to warm periods.

Figure 2: Vostok Ice Core Data – 400.000 Years Carbon Dioxide Changes



Source of Graph: J.R. Petit et al: Nature 399, pp429-436,1999

A key factor is that the warming effect of CO_2 is highly non-linear. As the ppm value goes up, the warming of CO_2 effect diminishes rapidly[3]. We invite you to read two detailed accounts by the most renowned scientist and atmospheric specialist Prof. William Happer of Princeton University[4,5].

Prof. Happer's educated guess is that doubling CO_2 from the present 400 ppm to 800 ppm is expected to warm the surface only an extra 1^0C. He also states that when CO_2 doubles, plants reduce their water usage by 50%. And since most land plants currently need at least 100 grams of water to produce 1 gram of carbohydrate, that 50% will create enormous water savings in all regions of the world.

As Earth comes out of each Ice Age, about 10^0C of warming occurs as in Figure 1[1] above. Most of the global warming is caused not by rising CO_2 emissions but by the massive changes affecting solar energy levels reaching Earth, explained in the Milankovitch Cycle. In fact, rising temperatures cause CO_2 levels to increase rather than the other way around. We later discuss correlation and causality when looking at temperatures and CO_2 levels.

The Role of CO_2 in Global Warming

To better understand the role that CO_2 plays in global warming, we shall look at energy and radiation:

- Most incoming sunlight (short-wave radiation SWR) is absorbed and converted to heat at the surface or in the atmosphere.
- Outgoing thermal radiation (long-wave radiation LWR) from the surface and green-house gases (GHG's) carry energy back to space and cool the Earth.

Some of this incoming SWR solar energy is absorbed principally by H_2O in the atmosphere. Then a much larger amount of outgoing thermal LWR is absorbed, again mainly by H_2O and some by CO_2 and other trace gases, which heat up the atmosphere and keep the Earth in a comfortable temperature range suitable for human survival. Without the absorption of thermal LWR by water vapor and green house gases, the Earth's temperature would alternate between very hot days and freezing nights. This would make life as we know it impossible.

John Tyndale, who discovered green house gases around 1850, recognized their great benefit to life on Earth when he said:

> *"Aqueous vapor is a blanket, more necessary to the vegetable life of England than clothing is to man. Remove for a single summer-night the aqueous vapor from the air which overspreads this country, and you would assuredly destroy every plant capable of being destroyed by a freezing temperature. The warmth of our fields and gardens would pour itself unrequited into space, and the sun would rise upon an island held fast in the iron grip of frost."*
> (J. Tyndall:"Heat, A Mode of Motion", Longmans, Green and Company, London 1875)

Key Facts about Solar Energy Absorption

1. Incoming Solar Energy

This is where it becomes interesting. Let us have a look at this radiation and the amount of radiation being absorbed: Solar energy from the Sun has a wide range of wavelengths when reaching Earth. It also has a highly variable energy level over the wavelength band, as can be seen in the following Figure 3[7].

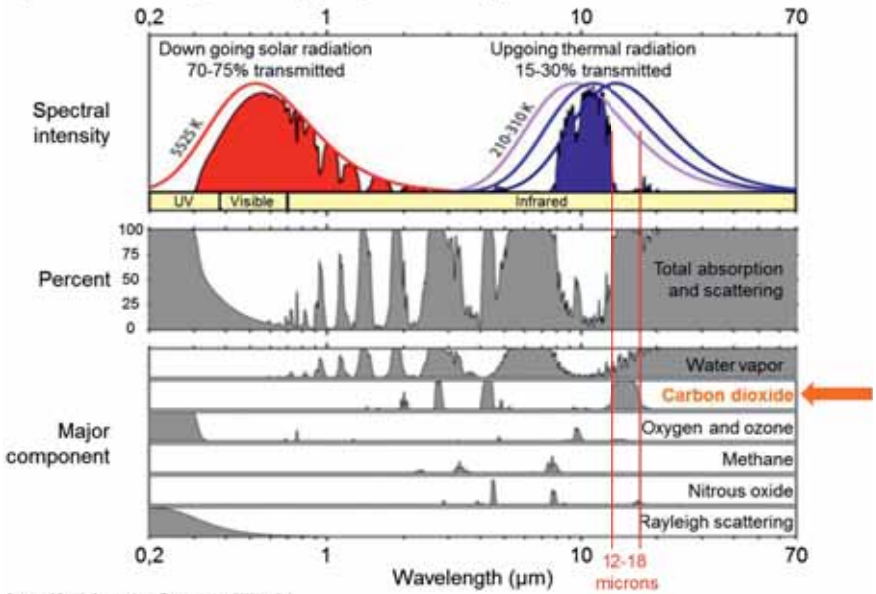
In Figure 3, the graph (red) on the upper left shows that very little energy from sunlight entering the Earth's atmosphere is absorbed by CO_2. This supports the IPCC statement that CO_2 does not majorly influence incoming solar radiation. One can also see that the water molecule H_2O absorbs incoming solar energy at 4 wave bands.

2. Re-Radiated Solar Energy – the Main Source of Global Warming

Some of the solar energy that is absorbed by the Earth's land masses and oceans is re-radiated upwards into the atmosphere, as thermal radiation (LWR) shown in the right side of the graph (blue).

The majority of that LWR is absorbed by H_2O in two broad wavelength bands at the lower temperatures of higher altitudes. CO_2 absorbs thermal radiation from the Earth's surface in a band of wavelengths between 12 and 18 microns (red arrow), wavelengths that are also absorbed by H_2O. This process is the well-known and wrongly labeled "green house effect." This is where CO_2 does essentially all of its "global warming".

Figure 3: Incoming and Outgoing Solar Energy



Source of Graph: Atmospheric Transmission (Wikipedia)

The absorption of LWR from the warm surface and re-radiation from higher altitudes by CO_2 and H_2O moderates what would otherwise be huge temperature swings between night and day, and raises the average temperature of the Earth's surface. Somewhat misleadingly, it is called the "green house effect" since green houses with their glass roofs also let in sunlight and suppress the escape of heat. But heat retention in a real green house is due to suppression of convecting currents of warm air. Real green houses work just as well with windows that are transparent to LWR. The green house effect of the Earth is mainly due to the suppression of radiative heat transport.

More importantly, at the present 400 ppm level of CO_2, the wavelength bands where CO_2 can absorb LWR solar energy are essentially complete. ***Based on this data, not much global warming is possible from any further increase in CO_2 because not much additional energy is left to be absorbed in that (12 to 18 micron) wavelength band.***

What other source other than human activity could be contributing to the current increase of CO_2 to make it rise above all earlier warm periods? The reason may be due to the unprecedented extended time-span of the current warm period and its long-term effect on ocean temperatures. Higher temperatures result in less CO_2 being stored in the oceans. Please note that we do not dispute that humans have also added to the CO_2 in the atmosphere.

3. The Role of the Oceans in Global Warming

As Figure 1 above shows, in every one of the last four warm periods, temperatures rose sharply, peaked and then within 4.000 years, the temperature sank back down into the next Ice Age. The present warm temperature peaked about 12.000 years ago and then stayed flat up to present time, so it has lasted three times longer!

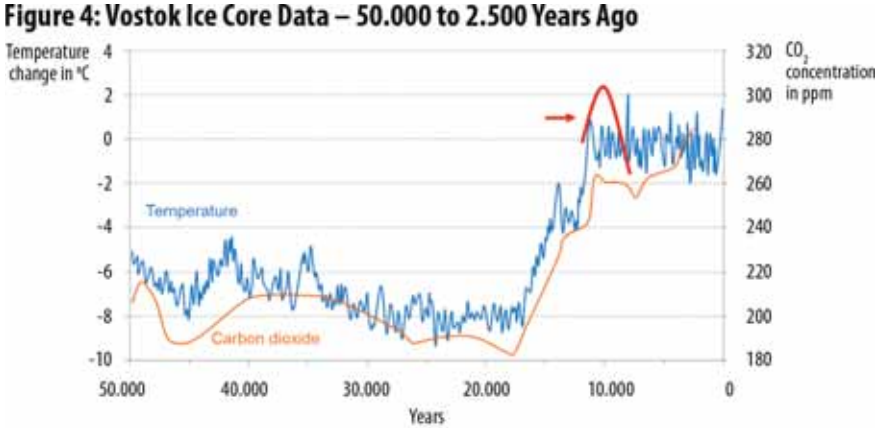
Around 10.000 years ago, there were about 5 million humans living a hunter-gatherer existence, so human-based CO_2 emissions were minimal. Then about 200 years ago, populations rose to around 500 million as the warm period continued. Only in the last 100 years has fossil fuels consumption reached significant levels. Human population reached about 1 billion by 1900 and now, 116 years later, has reached over 7 billion.

This extended warm period has nothing to do with human activity and can be seen more clearly in the following Figure 4[8] of the last 50.000 years of Vostok ice core data. The red curve added below reflects the more typical temperature rise and decline that one would expect from the previous three warm periods.

This extended warm period did not occur during the last three Ice Age cycles!

The oceans absorb significant amounts of CO_2. When ocean temperatures drop, more CO_2 is absorbed and when they rise, the reverse happens and CO_2 is released back into the atmosphere. The current long warm period could allow enough time for

Figure 4: Vostok Ice Core Data – 50.000 to 2.500 Years Ago



Source of Graph: Author's analysis based on cosmoquest.org

the ocean temperatures to rise much more than during any other warm period, causing the release of large quantities of extra CO_2 into the atmosphere. The following Figure 5[9] shows the solubility variations of CO_2 in water as the temperature changes.

It is known that the ocean temperature has risen about 1^0C since 1880. Calculations show that a 1^0C rise in ocean temperature over that 136-year period released an extra 200 billion tons of CO_2 into the atmosphere each year!

Since 1980, ocean temperature has risen about $0,6^0$C and the estimated release of CO_2 over that 36-year period is about 640 billion tons per year! The current atmospheric rise of CO_2 is about 2 ppm/year which equates to an increase of 12 billion tons[11] per year, which is 2% of the current ocean yearly release of CO_2.

Human activity currently releases about 40 billion tons of CO_2 per year from fossil fuels, so oceans have released about 16 times more every year for the past 36 years.

For some odd reason, this highly significant causality (that higher temperatures cause higher CO_2 levels) is never discussed in the global media. Correlation does not automatically mean causality. Clearly we should be investigating the key factors that caused an unprecedented 8.000-year increase in the current warm period which has allowed a much longer time for the ocean temperature to rise and release enormous amounts of CO_2 into the atmosphere.

The Question of Ocean Acidification from CO_2

A great deal of controversy exists on the acidification of the oceans as CO_2 levels increase but this is grossly exaggerated.

R. Cohen and Prof. Happer[10] point out, "*If there were no CO_2 in the atmosphere, the ocean pH would be about 11,3, close to that of household ammonia and much too caustic for most life.*

It is CO_2 that gets the ocean pH down to values hospitable to life. Doubling the atmospheric CO_2 level from the present value of 400 ppm to 800 ppm would reduce the pH from 8,2 to 7,9, a change comparable to normal variations of pH with position and time in the oceans today."

Please also keep in mind that the effect of CO2 on ocean pH reduces rapidly as CO2 increases. For example, quadrupling CO2 to 1.600 ppm would change the pH value of the oceans to 7,5 which is still well within the alkaline range!

The Fallacies of a Carbon Tax

In order to more rapidly reduce the use of fossil fuels, a $40/ton carbon tax is proposed and given serious consideration in Washington and similarly in other developed nations. This would affect mainly the use of natural gas, oil, and coal which make up 80% of the energy used in the US. One estimate predicts this would add about 36 US[c] per gallon to gasoline.

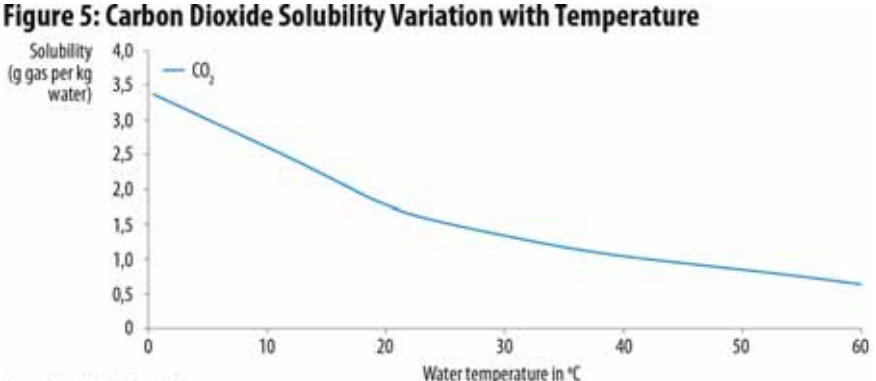
Based on the data presented here, we consider this to be a big mistake which would force energy companies to close down otherwise productive power plants too early and increase the cost of power beyond what is economically viable.

Carbon Capture and Storage (CCS) has also been proposed to remove CO_2 from a power plant exhaust, transport it by pipeline and inject and store it in state approved deep underground sites. It is estimated that CCS could double the base cost of electricity production from coal, oil, and natural gas. This would be highly prohibitive and the costs were to fall first on the public who depend on stable energy sources and as explained above, it serves no useful purpose for controlling climate change.

Another key point about CO_2 is that all plant life thrives in high CO_2 environments and farmers routinely pump CO_2 into greenhouses to 1.500 ppm CO_2, which greatly increases growth rate (see Figure 6). It is the key nutrient for all plant life and when it drops below 150 ppm, very few plants and animals can survive. Plants also handle drought conditions better as CO_2 rises as they expire less water in the process of absorbing CO_2, their principal food source. If CO_2 in the air were to double, their water needs would drop by 50%. This will be an enormous boon for agriculture everywhere especially in arid regions around the world and would support feeding our growing population.

The CO_2 content in the air in our homes is also much higher than outside and is safe to breath. Remember that CO_2 is not a pollutant as the media would like us to believe but a vital basic building block of all life on Earth, on land and in the oceans!

Figure 5: Carbon Dioxide Solubility Variation with Temperature



Source of Graph: Engineering Tool Box

Conclusions

1. Reviewing the above data makes clear that no significant global warming from re-radiated solar energy can be created by an increase in CO_2 above current levels.
2. CO_2 is beneficial for our environment and not a pollutant, it benefits plant life by increasing biomass and thus improves the basis for all human life on Earth.
3. The present warm period has lasted over 8.000 years longer than any of the three prior ones, giving the oceans a much longer time to warm up and release more CO_2 into the atmosphere, which would greatly contribute to the current level of 400 ppm.
4. Tripling the present value of CO_2 to 1.200 ppm will not result in ocean acidification, as has been proposed, and the pH would be about 7,8 which is still a satisfactory alkaline level in which ocean life can flourish – as it did over most of geolocial history when CO_2 levels were several times higher than those today.

Figure 6: Here Is What Happens with More CO_2

Source of Graph: Prof. William Happer, Princeton University, November 2015

Proposed Future Energy Development Plan

Of course, fossil fuel sources have a limited useful time span and technological advancement will ensure that we will not rely anymore on fossils possibly latest by 2200. We need to develop a well-planned economic, environmental and social introduction of viable and affordable new energy sources. We need to gradually change our social infrastructures and improve the lives of people and futures of whole towns, cities and regions across the US and in every country around the world. And the reason for this is not the CO_2 that fossil fuels emit, but because there will be more efficient and less polluting ways of producing energy developed in the next two centuries.

As Prof. Happer[4,5] and Dr. Schernikau[6] stated, there are real issues related to fossil fuels that need to be addressed such as groundwater contamination and smog from release of smoke particles and corrosive gases containing sulfur as well as safer storage of fly ash from coal combustion. That's where our resources should be spent and our ingenuity used to improve existing conditions.

The thousands of billions of USD to be spent or better wasted on CO_2 mitigation could – if employed elsewhere - truly make a difference to improve the health of our planet and our populations. We have the time to do this, so let's do it more wisely and practically.

We would like you to keep in mind that within another 2.000 years or maybe less, no matter how much CO_2 is produced, it is very likely the Earth will once again cool down rapidly and enter the next Ice Age.

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