UNDERSTANDING THE CHALLENGES OF GLOBAL WARMING

By Peter Smith, B.Sc., P.Eng.

That our atmosphere insulates the earth's surface from the near absolute zero temperature of space has been known for centuries. That the concentration of carbon dioxide (CO2) in the atmosphere is a major factor in preventing the earth from radiating heat into space has also been known for almost 150 years, and the mathematics of global warming have been greatly refined since Arrhenius first published his paper in 1895. In addition, scientists have been warning us of the increasing levels of greenhouse gases (GHG's) in our atmosphere for the last 40 years or more. So why are we all so surprised that we finally have to take action on this issue, and why do some of us still insist that it is all an illusion?

Carbon is the very building block of life, and the past life on this planet converted the original CO2 rich atmosphere into an oxygen rich atmosphere. Some of that carbon became locked up safely in chalk and limestone rock; some was sequestered underground where it became coal, natural gas or oil; some is temporarily stored in the soil and oceans, and much is still contained in the living biosphere. There it has remained, in approximate balance for millions of years, subject only to the natural cycles of the earth.

However, a new force entered the equation when the first farmer cut down the first tree and cleared the land by burning the vegetation, thereby releasing the locked-in carbon into the atmosphere as carbon dioxide. An insignificant act in itself, but one that became significant, as land was cleared and farming spread.

As the population increased and, with it, the extent of cleared and farmed land, so too did the burning of coal and oil. By about 1910 the burning of fossil fuels was adding CO2 to the atmosphere at a faster rate than land clearing. However, it was not until about 1970 that the cumulative total of atmospheric CO2 from fossil fuel burning exceeded that from land clearing. Global atmospheric CO2 levels had, by then, risen from a pre-industrial 280 ppmv to 325 ppmv. Although this increase was noted, there seemed to be little public concern about the trend. In fact, as the 70's turned into the 80's, it was the prospect of exhausting our supply of fossil fuels that gave greater popular cause for concern.

By 1990 however, human activity was releasing over 7 billion tonnes of carbon a year into the atmosphere and alarm bells were beginning to ring more loudly. The first attempt at a global compact to reduce emissions was held in Rio in 1992, however a loose-knit group of nations and commercial interests nicknamed the "Carbon Club" prevented any binding agreements from being made. With only a voluntary agreement reached in Rio and little or no real reductions being made, unofficial negotiations continued until the next scheduled international meeting in Kyoto, Japan in 1997, where binding international agreement was finally reached.

The Kyoto Accord divided the nations of the world into two groups. The developed nations are referred to as Annex 1 nations, and each is required to reduce its average GHG emissions in the period between 2008-2012 to a defined percentage below their 1990 emissions. The developing nations, or Annex 2 nations, were given no reduction targets. However, even though it is the industrialized Annex 1 nations that are largely responsible for the past increase in atmospheric CO2 concentration, it was recognized that the developing Annex 2 nations are also increasing their emissions as they industrialise. The Annex 1 nations are therefore required to transfer their energy efficient technology to the Annex 2 nations so that they can implement that technology in meeting their growing needs. Although it was signed in 1997, ratification by Canada did not occur until 2002, and ratification by the required number of nations is not expected until late 2003. However, the situation has grown more urgent since 1992 and we now have an atmospheric CO2 concentration of over 370ppmv and a rate of increase of 1.5ppmv/year.

Continued on page 48

Table 1 – Emissions from Fuels Burned in 1999

Fuel Burned	Quantity Burned	Million Tonnes Carbon Emitted	Energy Released [illegible]	[illegible]
Natural Gas	[illegible]	[illegible]	[illegible]	[illegible]
Oil	[illegible]	[illegible]	[illegible]	[illegible]
Coal	[illegible]	[illegible]	[illegible]	[illegible]
Nuclear	[illegible]	0	[illegible]	[illegible]
Hydraulic	[illegible]	0	[illegible]	[illegible]
Other Renewable	Not Avail	0	Not Avail	[illegible]
Total	[illegible]	[illegible]	[illegible]	

Notes:
[illegible]

Continued from page 47

Carbon dioxide isn't the only GHG, in fact it is the least potent of the group, but its relative abundance results in its total warming impact being greater than that of all the other gases combined. By comparison, pound for pound methane has 21 times as much global warming effect as CO2, and even though its concentration in the atmosphere is also increasing, it has less than half the total impact of CO2. Other GHG's such as nitrous oxide (laughing gas, not NOx) with 296 times the potency of CO2, CFC's and HCFC's with approximately 8,000 times the potency of CO2 and sulphur hexafloride with 22,200 times the potency of CO2 have even less total impact, because of their relatively low atmospheric concentrations.

Not only is there debate as to what can be done to reduce emissions, but many industries and nations have even denied that anything needs to be done. The arguments against taking action have changed over time as more evidence of human impact has been presented. However there are still a few who claim that human activities are not responsible for global warming, in addition to those who oppose action for economic reasons. While we can never expect every scientist to agree on such a complex issue (there are still a few researchers who claim that the link between smoking and lung cancer has not been proven), the 3000+ leading scientists of the Intergovernmental Panel on climate Change (IPCC) were quite clear in their 2001 report when they said that "an increasing body of observations gives a collective picture of a warming world" with "new and stronger evidence that most of the warming observed over the last 50 years is attributable to human activities".

Opponents argue that, since it's business as usual in the US, Canada will be at an economic disadvantage and our manufacturers will lose the economic war with the US and other nations that are not bound by the agreement. The automotive and oil companies have used this same argument in the past, predicting economic disaster when the government tried to introduce lead free or low sulphur gas. Their concerns turned out to be overblown as they soon found simpler ways to achieve the goal and frequently ended up saving money in the process. In 1998 the BP Oil Company decided to reduce its emissions to 10 per cent below its 1990 level by 2010. In May 2002 it announced that it had already achieved that goal at virtually no cost, but with savings of $650 million. Britain also achieved its Kyoto target in 2002 at minimal cost and is now going on to reduce its emissions even further. But these are not exceptions; there are a number of companies that have found it relatively easy and profitable to reduce their energy consumption by 20-30 per cent or even 40 per cent.

Opponents also frequently suggest that we should ignore the Kyoto targets and create some "Made in Canada" solution. It makes it sound as though Kyoto is some form of foreign imposition, where in fact the Canadian negotiators agreed to the 6 per cent below 1990 emissions target and how we achieve that target is entirely up to Canada. What they really mean is that we should cut our emissions by some smaller amount or extend the timetable to make it easier to achieve. However, what they don't explain is how we will then make the much sharper reductions required in the future to prevent the total atmospheric loading from exceeding the critical value. We can't have it both ways, if we don't do it today we will have to do even more tomorrow.

Others have suggested that, in order to maintain North American consistency, we follow the US approach to emissions reductions. President Bush has committed America to reduce its emissions per dollar of economic activity (what he termed "greenhouse gas intensity") by 18 per cent by 2010. Sounds pretty much the same as what we need to do, so why all the fuss? It is only when you look behind the numbers that you see how empty the Bush commitment is. For several decades now the service industry has been the fastest growing sector of the US economy. Compared to manufacturing, which it easily outperformed, the service industry uses very little energy per dollar of economic activity. When you couple this with some moderate improvement in manufacturing energy efficiency, you find that during the 1980's the US achieved a 21 per cent improvement in its "greenhouse gas intensity". In the 1990's it achieved a further 17 per cent improvement. This means that, if the economy continues its present trend, even without taking any specific measures, the US will probably reach its 18 per cent goal by 2010. However, the US economy will still be growing, and even after achieving Mr. Bush's target, CO2 emissions will actually be about 29 per cent higher in 2010 than they were in 1990. Talk about hot air!

Table 2 – Proven Reserves of Fossil Fuels

Fuel	Quantity Available (Million tonnes oil equiv.)	Billion Tonnes Carbon Produced if Burned	Energy Available [illegible]	[illegible] Availability [illegible]
Natural Gas	[illegible]	70	[illegible]	[illegible] years
Oil	140,000	[illegible]	5,850,000	40.4 years
Coal	[illegible]	[illegible]	[illegible]	[illegible] years
Renewables	No Limit	Zero	No Limit	No Limit
Total Fossil	[illegible]	[illegible]	[illegible]	

Notes:
Source: BP-Amoco Statistical Review of World Energy [illegible]
[illegible]

The impact of the greenhouse warming process is a cumulative one such that, even if we stabilise atmospheric levels at some value, it may still take a century or more before we reach the new equilibrium temperature. Scientists are concerned, not only about the ultimate increase in average temperature, but also about the rate of increase that could prove too rapid for many species to adapt to. In addition they warn that the warming will be most severe in the sensitive Polar Regions, and there is also an increasing risk of runaway reactions as the temperature rises. Although there are mixed opinions about both the temperature impact of increasing CO2 and Methane levels and the implications of increased temperatures, given the nature of what we risk, most scientists suggest that we err on the side of caution. Based on 140,000 years of comparative data obtained from the Antarctic ice, the consensus opinion of scientists seems to be that we should limit the overall temperature increase to 1-2°C and our additional atmospheric emissions to 2-300 billion tonnes of carbon equivalent.

According to the BP-Amoco Statistical Review of World Energy, excluding the former Soviet Union nations, world-wide fossil fuel consumption has been increasing by about 1.75 per cent per year over the last decade. This demand is being driven not only by the increasing world population, but also by the increasing per capita energy demand as the developing nations become more industrialized.

The task is huge, but not insurmountable. The first step is in understanding that, although our CO2 and Methane emissions are the result of our growing hunger for energy, we already know many of the solutions. Firstly, we need to be clear that it is not the energy itself that we want, but the comfort, convenience and luxury that it brings us. We want comfortable homes and buildings,

Continued on page 50