A BRIEF LOOK AT CARBON DIOXIDE

If we are to spend trillions of dollars[1] in an attempt to reduce the amount of CO_2 that is produced by Man, then it might be sensible to attempt to find out more about carbon dioxide, especially Man's contribution, and hence gain a feel of how 'bad' it is. This Handout gathers information about CO_2, which will then be used in Handout 3-6 to assess the consequence of Man's actions.

Carbon Dioxide

The Earth's atmosphere is made up of the following constant components (totalling 99.9601% of the atmosphere):

- Nitrogen 78.08%
- Oxygen 20.95%
- Argon 0.93%
- Neon, Helium and Krypton 0.0001%

The following Greenhouse components vary over time and location on the earth, and are additional elements in our atmosphere:

- Water Vapour 0-4%
- Carbon Dioxide 0.038%
- Methane trace
- Sulphur Dioxide trace
- Ozone trace
- Nitrogen Oxides trace

When we are told to be alarmed as Man's CO_2 will destroy the planet, I am surprised to find how little total CO_2 there is in our atmosphere – not even one tenth of one percent.

Carbon Dioxide - Sources, and Sinks

So where does this CO_2 come from (Sources) and where does it go to (Sinks)? By repeatedly informing us of the tons of carbon we release into the atmosphere from every conceivable human activity, we are led to believe that burning of fossil fuel and land clearance is the main source of CO_2. This is incorrect, as the table on the next page shows. We forget how big (and how heavy) the atmosphere is, and should remember that all these tons of natural and man-made CO_2 still only make up 0.038% of the atmosphere. We also should remember the massive amount of CO_2 that is "consumed" each year.

In looking at the table[2] on the next page, it should be remembered that although the figures for fossil fuels can be accurately estimated, the other estimates are harder to make and do vary significantly from year to year.

CARBON DIOXIDE SINKS AND SOURCES

SINKS	Gt/yr	%	Sub Total
OCEANS			
Cold Oceans Absorbing CO2	90	22.0%	
Downwelling of Cold Surface Waters (Near the Poles)	96.2	23.5%	
Advection (Horizontal Transfer of Warm to Cold Surface Water	10	2.4%	
Sedimentation stores CO2 in rock	0.6	0.1%	
			48.1%
MARINE BIOTA			
Cold Surface Marine Biota Photosynthesis	18	4.4%	
Living Marine Biota Respiration and Dead Marine Biota Decay - Cold Waters	14	3.4%	
Sinking Dead Biota - Cold into deep water	4	1.0%	
Sinking Dead Biota - Warm into deep water	6	1.5%	
			10.3%
LAND BIOTA			
Land Biota Photosynthesis	110	26.9%	
Litter Fall and Root transfer to Soil	60	14.7%	
			41.5%
OTHER			
River run off into Sea	0.6	0.1%	
			0.1%
TOTAL	409.4	100.0%	**100%**

SOURCES	Gt/yr	%	Sub Total
OCEANS			
Warm Surface Waters of Oceans Releasing CO2	90	24.2%	
Upwelling of Deep Waters (Near edges of Continents and the Equator)	105.6	28.3%	**52.5%**
MARINE BIOTA			
Warm Surface Marine Biota Photosynthesis	32	8.6%	
Living Marine Biota Respiration and Rapid Decay of Marine Biota - Warm Waters	26	7.0%	**15.6%**
LAND BIOTA			
Land Biota Respiration	50	13.4%	
Micro Organisms Respiration	59.4	15.9%	**29.4%**
OTHER			
Volcanoes	0.6	0.2%	**0.2%**
MAN			
Fossil Fuel Use (as of 2005)	7.4	2.0%	
Deforestation and Land Clearing	1.5	0.4%	**2.4%**
TOTAL	372.5	100.0%	**100%**

SOURCE:
Bice, David, Carleton University
htpp://serc.carleton.edu/files/usingdata/workshop02/dave_bice.pdf
and Hayden, Howard C., A Primer on CO2 and Climate, Second Edition, Vales Lake Publishing, Colorado, 2008, page 23.

Carbon Dioxide Concentrations

On noticing that CO_2 concentrations in the atmosphere had risen approximately 30% (i.e. from 270 ppm to 350 ppm) since 1850, the start of the industrial revolution, the Greens believed that there was a 'cause and effect' relationship between Industrial Man, CO_2, and global warming. If CO_2 concentrations had always been stable before the industrial revolution, and only CO_2 could cause global warming, and nothing else had changed in this period, they may have a good reason to be concerned.

So what has happened in the past, especially the period before Man could have had an effect? In the past, there have been multiple occasions when CO_2 concentrations have been ten times the present concentrations[3]. On at least four separate occasions, concentrations have been twenty times higher than the present concentrations[3]. Apparently, in those days, the planet did not die. Our existing wonderful environment and way of life, that the Greens wish to defend, attests to that fact. Yet the Greens are predicting a terrible future for the planet if the CO_2 concentrations **only** double in the next 100 years. In the past few thousand years, one thing does stand out as extraordinary, and that is how **low** carbon dioxide concentrations have been compared with previous periods.

Because there has never been a stable level of CO_2 concentrations in the past, we can no longer assume that Man has caused the increase in the past 150 years.

Carbon Dioxide in its Traditional Role

Our biology teacher in secondary school taught us that carbon dioxide and water were crucial in the cycle of life. All plant life grows through photosynthesis where carbon dioxide and water are converted to organic molecules (growth) and give off oxygen as a by-product. To live, animals breathe this oxygen, and exhale carbon dioxide. So, carbon dioxide is 'food' for plants and without it, all plant life would die. Then all those animals that ate plants would also die, and other animals who ate the former animals would then find life a little difficult. It very quickly becomes obvious that we should not vilify CO_2 too quickly, as it has such an important role in life on this planet.

However, can you get too much of a good thing, and why should we assume that the present concentrations are ideal and should be maintained? For some time, gardeners who wish to significantly increase plant growth within glasshouses, have increased CO_2 concentrations four to six fold. This has only had beneficial results. With our population steadily increasing and not expected to plateau until 2050, increased crop yields through higher CO_2 concentrations should be considered a benefit and not a threat.

It would be disingenuous of me to imply that the Greens are not aware of the foregoing, or wish all the plant life to die. I have not intended to do so, and have had this discussion solely to remind us that in our rush to vilify CO_2 we should not forget

CO_2's vital traditional role. However, the Green's do have a major problem with CO_2's new role, that the Greens, themselves, have chosen for this gas; - its role within the greenhouse gases.

Carbon Dioxide in its Modern Role

It has been known for some time that the Greenhouse gases heat the planet with many pointing out, that without these gases, the global temperatures would be thirty three degrees lower (i.e. minus 18^0C)[4], which would make it difficult for life to survive in abundance on the planet. This simplistic and partially incorrect view leads some to believe that adding additional amounts of Greenhouse gases will automatically lead to further increases in the global temperatures. However, if we replaced Earth with an inert sphere of the same size and in the same orbit, but one that had no atmosphere, vegetation, and importantly no water on 67% of its surface, yet retained the Greenhouse gases, the temperature on this planet would be raised by 60^0C, not 33^0C[5]. So what stops this happening to Earth?

The short answer to this question is many important feedback loops in the weather system. Two examples are the effects of convection, and the water cycle. Surface air is warmed by the hot planet surface and rises to be replaced by colder air from the higher troposphere. Even after all the cooling of this hot surface air, the average air temperature at 36,000 feet is minus 56^0C[6]. Heated air is also cooled by moving from the hotter places on Earth to cooler regions (e.g. from the tropics to the polar regions, and from hot land to cooler oceans). When moisture from the hot surface evaporates, cooling occurs, and then further cooling of the moisture occurs as it rises. Clouds are then formed, which reflect some of the heat arriving from the sun, and shades the surface of the Earth providing further cooling. When this moisture condenses and falls as rain the surface is cooled further.

In summary, while the Greenhouse gases make the Earth habitably warm, the weather makes it habitably cool. This is achieved, within the troposphere, with heat being transferred from the Earth's surface to the upper atmosphere. As Spencer put it, "Quantitatively, the cooling effects of weather are actually stronger than the Greenhouse warming effect"[7].

Carbon Dioxide's Heating Effectiveness

We have been told that Man, on average, only contributes 3% of all the CO_2 produced annually[2]. Consequently, if all else remains neutral, then Man's impact can, at most, be 3% of the total global warming. However, global warming is caused by all greenhouse gases not just CO_2, which is less than 1% of all the greenhouse gasses. If at first we incorrectly assume that each of the greenhouse gases has the same impact on temperatures per unit of gas then, if all else is neutral, we find that Man's impact now drops to approximately 0.03% of the total warming effect.

However, the assumption that all gases have the same impact per unit is wrong. We are told that methane has the most powerful effect of all greenhouse gases on temperatures but, fortunately, there is only a 'trace' of methane in the atmosphere leading to a very small overall contribution to the heating of the planet. In contrast to methane's steady and powerful impact, we are told that CO_2's impact diminishes with each additional unit added to the atmosphere, leading some scientists to believe that most of the impact of CO_2 has already been seen[8]. Further, water vapour is considered as powerful as CO_2, but there is nearly one hundred times more water vapour than CO_2. Consequently, Man's CO_2 contribution to global warming is significantly lower than 0.03%, and will discussed further in Handout 9-4.

Summary

On learning about carbon dioxide, the following five important points stand out;

- CO_2 is a very small part of the whole atmosphere,
- CO_2 is a very small part of the all the greenhouse gases,
- How the amount of natural CO_2 dwarfs Man's contribution of CO_2,
- How much life on the planet needs CO_2, and
- How additional CO_2, has a diminishing effect on warming

All this should cause us to ask the obvious question. Then how much additional net heating is caused by additional CO_2, and, more importantly, the additional effect of man's contribution? This question is considered in Handout 9-4.

Notes:

1. Lomborg Bjorn, *Cool It,* Alfred A. Knopf, New York, 2007, pp.32-34. Full Kyoto Protocol with the US participating (but not China, India, or Russia) is $5 trillion dollars. If all countries participate $15 trillion dollars. If temperatures are stabilised at 2.7^0F (an ambitious EU target), the cost rises to $84 trillion.
2. Hayden, Howard C., *A Primer on CO2 and Climate,* Second Edition, Vales Lake Publishing, Colorado, 2008, page 23.
3. Hayden, Howard C., *A Primer on CO2 and Climate,* Second Edition, Vales Lake Publishing, Colorado, 2008, page 10.
4. Hayden, Howard C., *A Primer on CO2 and Climate,* Second Edition, Vales Lake Publishing, Colorado, 2008, page 29.
5. Spencer, Roy, *Climate Confusion*, Encounter Books, New York London, 2008, page 53, and 54.
6. Air cools from an average surface temperature of plus 15^0C at a rate of 1.983^0C for each thousand feet above sea level (known as the adiabatic lapse rate). At 36,000 feet above sea level, the average temperature is minus 56.34^0C.
7. Spencer, Roy, *Climate Confusion*, Encounter Books, New York London, 2008, page 53.
8. S. Fred Singer and Dennis T. Avery, *Unstoppable Global Warming,* Rowman & Littlefield Publishers Inc., New York, 2007, page10.