

Global Warming and Carbon Emissions Trading: An Overview of the Issues

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Introduction

Although disputed by some politically motivated groups, it is generally accepted by the scientific community that increased global carbon dioxide production has contributed to global warming [1, 2]. As an illustration, Figure 1 shows the dramatic rate at which carbon emissions have increased in recent years, contributing to increases in atmospheric carbon dioxide concentrations (Figure 2), and leading to subsequent increases in the earth's temperature (Figure 3). The increase in atmospheric carbon dioxide is primarily the result of the burning of fossil fuels, although the release of gases from melting ice caps and permafrost is believed to play a role as well [3].

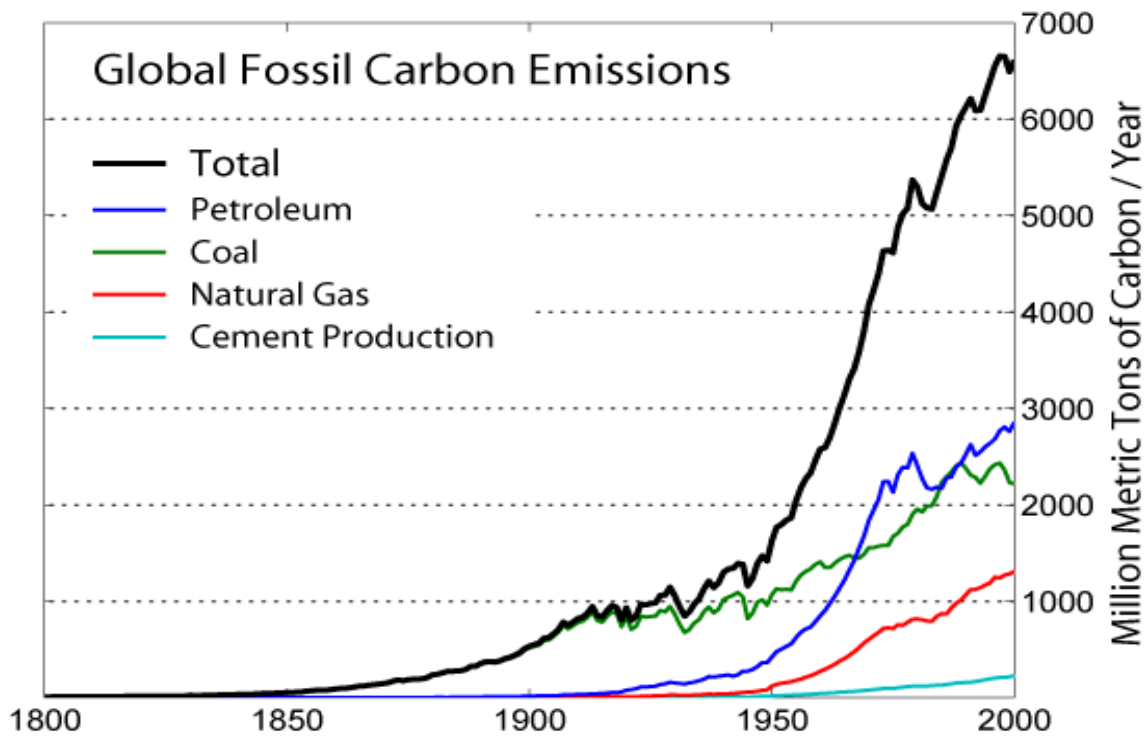


Figure 1. Carbon emissions have increased in recent years, contributing to increases in atmospheric carbon dioxide concentrations and increased global temperatures. From http://www.globalwarmingart.com/wiki/Image:Global_Carbon_Emission_by_Type.png

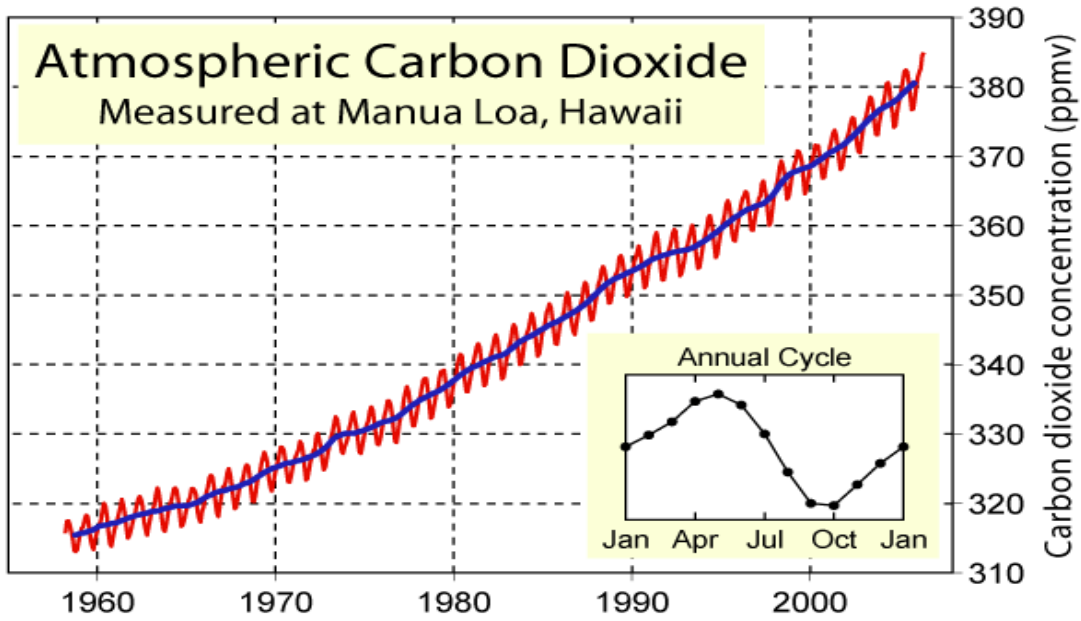


Figure 2. Atmospheric carbon dioxide concentration increases in recent decades. Note how the curve has an annual variation of about 5 ppmv as a result of seasonal changes in uptake of carbon dioxide from land vegetation. [ppmv = parts per million by volume]. From http://www.globalwarmingart.com/wiki/Image:Mauna_Loa_Carbon_Dioxide.png

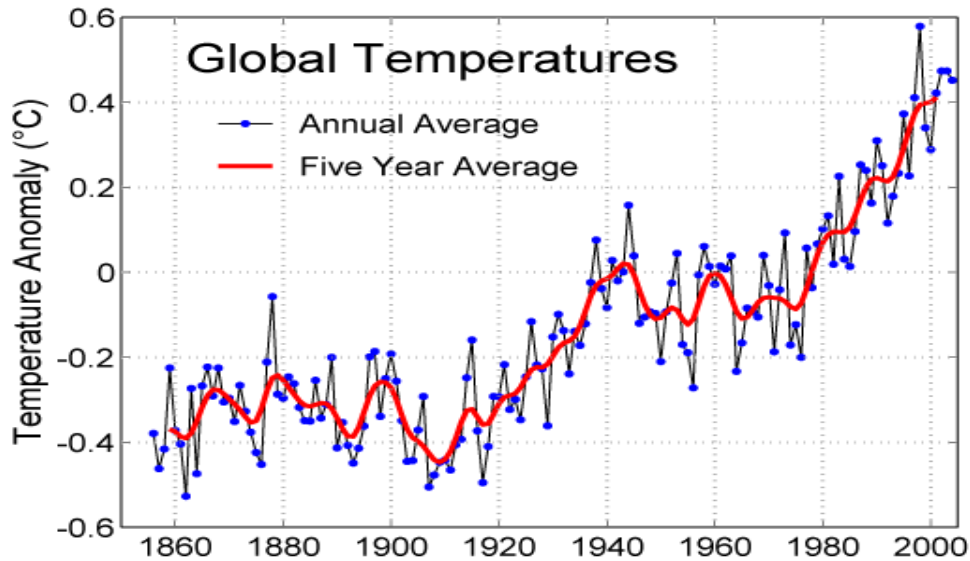


Figure 3. Global temperature increases in recent decades over a 150 year span. From http://www.globalwarmingart.com/images/f/f4/Instrumental_Temperature_Record.png

A Call to Action

The rising global temperatures illustrated in Figure 3 are expected to continue to raise sea levels (Figure 4), with consequent meteorological changes such as changes in precipitation. Such changes in climate conditions will inevitably change forest composition, affect crop yields, and alter the distribution of available water. Climatic changes resulting from these events would be expected to impact on a variety of ecosystems as well as on the health of humans and animals. In addition, changes in sea levels might even end up placing a number of coastal cities under water [4].

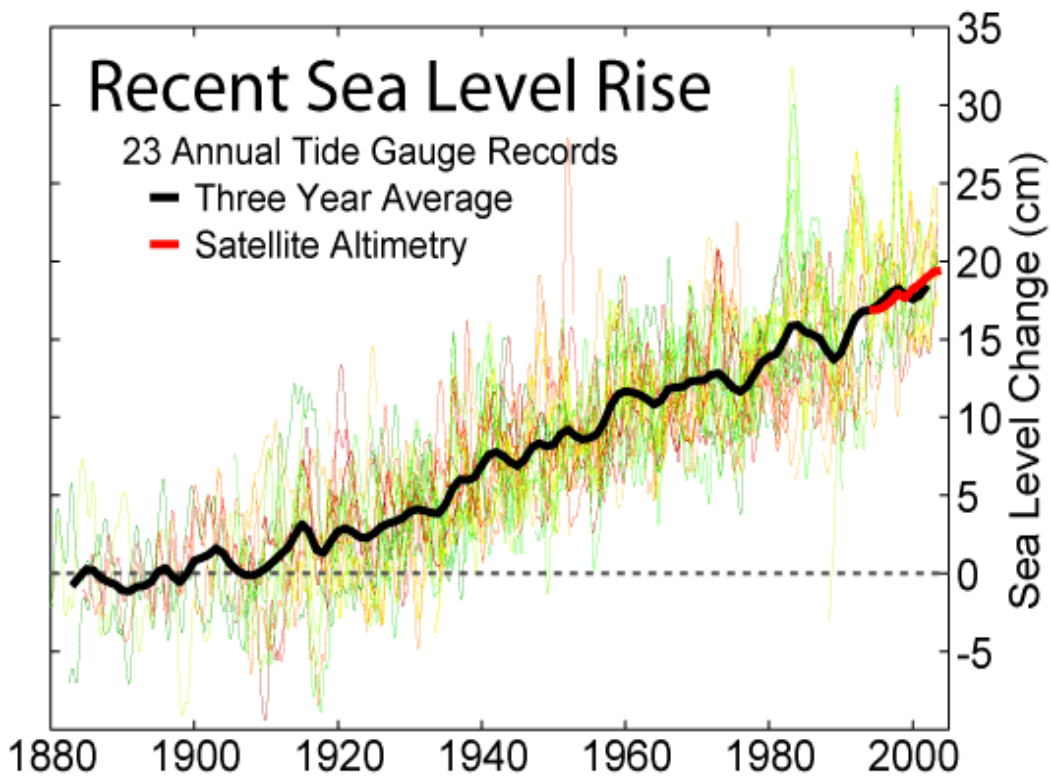


Figure 4. Increases on sea level plotted graphically over the last 125 years. From http://www.globalwarmingart.com/images/0/0f/Recent_Sea_Level_Rise.png

Concern about the consequences of global warming has led to both remedial international action, as in the ratification of the *Kyoto Protocol to the United Nations Framework Convention on Climate Change* by a number of nations [5], as well as to increase scientific exploration concerning the genesis and remediation of this problem. Countries that sign and ratify the Kyoto Protocol agree to reduce their emissions of carbon dioxide and other specified greenhouse gases, or alternatively, agree to engage in carbon emissions trading if they fail to reduce emissions of these gases. The Kyoto Protocol now covers more than 163 countries and more than half of global greenhouse gas (GHG) emissions [6]. While the United States is a signatory to the protocol, it has not ratified it.

According to a press release from the United Nations Environment Programme [7]:

"The Kyoto Protocol is an agreement under which industrialised countries will reduce their collective emissions of greenhouse gases by 5.2% compared to the year 1990 (but note that, compared to the emissions levels that would be expected by 2010 without the Protocol, this target represents a 29% cut). The goal is to lower overall emissions of six greenhouse gases - carbon dioxide, methane, nitrous oxide, sulfur hexafluoride, HFCs, and PFCs - calculated as an average over the five-year period of 2008-12. National targets range from 8% reductions for the European Union and some others to 7% for the US, 6% for Japan, 0% for Russia, and permitted increases of 8% for Australia and 10% for Iceland."

Carbon Emissions Trading

Carbon emissions trading is one of the ways participants in the Kyoto protocol can meet their emission obligations. The central notion behind carbon emissions trading is that industrial companies are granted carbon emissions credits from a national authority and that some of these credits can either be utilized in industrial production or traded for money. In essence, under this arrangement companies that can reduce their carbon emissions at a modest cost will do so and then sell their remaining credits to companies that are less able to reduce their carbon emissions because of the high associated costs. This concept is illustrated in Figure 5, on the next page.

As an example, a company may plant trees and use validated biological models to determine the degree of carbon dioxide reduction that would be expected to occur over the life span of each tree. If, for instance, this amount turns out to be one metric ton of carbon dioxide, a carbon emissions credit of this amount is granted, which may be traded for money from an industrial concern wishing to reduce its emission account. At the moment, the value of the carbon emissions credit corresponding to one metric ton of carbon dioxide varies between ten and 30 U.S. dollars, depending on factors such as market location [8]. Web sites such as www.pointcarbon.com, www.carbontrust.co.uk and www.co2e.com offer frequently updated information on pricing, scientific developments and other issues related to carbon emissions trading.



Figure 5. Illustration of the concept of the carbon emissions trading market. Participating nations place limits on carbon emissions and industrial concerns are allocated emission allowances up to this limit. A special marketplace allows for companies to determine the most economical method of reducing emissions: producers can choose between implementing technical measures in order to lower emissions, purchasing additional emission allowances or refraining from producing altogether and instead selling their emission allowances on the market. This will ensure that the measures to reduce emissions are managed in the most cost-effective way. From http://www3.vattenfall.com/annual_report_2005/img/small/utslappsrott.gif

Global Warming Potential Index

It should be emphasized that industries may produce chemical emissions other than carbon dioxide that are still problematic from a global warming perspective. Emissions that are equivalent carbon dioxide in some manner are characterized by their “global warming potential index” or GWPI. This index relates the amount of chemical released into the environment to the equivalent carbon dioxide released as follows [9]:

$$\text{Equivalent CO}_2 \text{ released (metric tons)} = \text{chemical released (metric tons)} \times \text{GWPI}$$

Table 1 below shows the GWPI data for a variety of chemicals frequently released into the environment.

Carbon Dioxide	1
Methane	21 x CO ₂
Difluoroethane	140 x CO ₂
Nitrous Oxide	310 x CO ₂
Tetrafluoroethane	1,300 x CO ₂
Trifluoromethane	1,700 x CO ₂
Pentafluoroethane	2,800 x CO ₂
Sulfur Hexafluoride	23,900 x CO ₂

Table 1: GWPI data for a variety of chemicals frequently released into the environment as a consequence of industrialization. Of particular importance, some of these chemicals are thousands of time more harmful than ordinary carbon dioxide in contributing to global warming.

Case Study: Blue Zone Technologies Ltd.

Earlier, reference was made to companies planting trees as a means to participate in carbon emissions trading. In Canada, one company has come up with an even more innovative approach. At Blue Zone Technologies Ltd, in Concord, Ontario, engineers and scientists have developed a means to collect and recycle volatile anesthetic agents used during surgery as an alternative to releasing them into the environment. Their patented method uses a porous, synthetic, crystalline material (“zeolite”) which act like a molecular sieve, adsorbing anesthetic molecules and rejecting other molecules. As the data in Table 2 shows, volatile anesthetic agents have considerable global warming potential, and efforts to prevent their release into the atmosphere are clearly worth pursuing. In addition, Blue Zone earns money in two ways with its innovative technology. First, it can sell the credits it collects by preventing the release of these agents into the environment, and second, the anesthetic drugs it collects in this manner can be resold after purification.

Isoflurane : 1100 x CO₂

Desflurane: 1900 x CO₂

Sevoflurane: 1600 x CO₂

Table 2: GWPI data for a three commonly used volatile anesthetic agents. These drugs are used to maintain general anesthesia in operating rooms around the world and are ordinarily administered by inhalation. Unfortunately, the anesthetic agents present in expired breath are usually released to the atmosphere rather than recycled.

Ethical Issues

Environmental ethics is a relatively recent branch of philosophy that is concerned with the “moral relationship of human beings to, and also the value and moral status of, the environment and its nonhuman contents” [10]. In this final section I would like to briefly explore some of the environmental ethics issues related to emissions trading in the context of global warming.

The first ethical issue relates to a concern that some of the global warming science may be influenced by political interests, in the sense, for example, that some funding agencies with a “pro-business, right-wing” agenda have funded scientists whose work tends to focus on discrediting evidence for global warming. (This is in a number of respects similar to concerns that tobacco industry interests have funded scientific studies aimed at discrediting evidence for the dangers of smoking, or (in more recent times) discrediting evidence for the dangers of second-hand smoke.) A related issue is that some environmental scientists with left-leaning political views may be biased in their research in the opposite direction, ignoring some of the scientific valid criticisms of global warming models.

A second ethical issue relates to the allocation of resources and money to fight global warming. For instance, some critics argue that the enormous amount of money needed to implement the terms of the Kyoto protocol would be much better spent on more well-established needs like providing clean water to third-world nations or providing

immunization programs throughout the world. These critics argue that resources would be best directed towards real, obvious and well-established problems as opposed to problems that – at least at the moment – are as much theoretical as real.

For instance, consider the words of Bjørn Lomborg, best known for his book *The Skeptical Environmentalist*. In a rebuttal to a critique of his work published on the Scientific American web site [11] he writes:

The Kyoto Protocol will do very little good—it will postpone warming for six years in 2100. Yet the cost will be \$150 billion to \$350 billion annually. Because global warming will primarily hurt Third World countries, we have to ask if Kyoto is the best way to help them. The answer is no. For the cost of Kyoto in just 2010, we could once and for all solve the single biggest problem on earth: We could give clean drinking water and sanitation to every single human being on the planet. This would save two million lives and avoid half a billion severe illnesses every year. And for every following year we could then do something equally good.

A third ethical concern has to do with fairness issues in the context of the Kyoto protocol. For instance, while some nations (e.g., Japan) are expected to decrease carbon emissions, others (e.g., Russia) are not required to decrease carbon emissions and others still (e.g., Australia) are actually allowed to increase their carbon emissions under the agreement. The genesis for this arrangement is complex, involving issues related to carbon sources

and sinks, as well as the political, cultural and social issues that exist in any multilateral negotiation process. Regardless, concerns have been raised that the burden of the Kyoto protocol has not been fairly distributed amongst the participant nations. This is a substantial part of the reason that the USA chose not to ratify the Kyoto protocol, as emphasized by President Bush in a policy statement on the Kyoto protocol [12]:

This is a challenge that requires a 100% effort; ours, and the rest of the world's. The world's second-largest emitter of greenhouse gases is China. Yet, China was entirely exempted from the requirements of the Kyoto Protocol. India and Germany are among the top emitters. Yet, India was also exempt from Kyoto ... America's unwillingness to embrace a flawed treaty should not be read by our friends and allies as any abdication of responsibility. To the contrary, my administration is committed to a leadership role on the issue of climate change ... Our approach must be consistent with the long-term goal of stabilizing greenhouse gas concentrations in the atmosphere.

However, it should be emphasized that to many environmentalists, the failure of the USA to ratify the Kyoto protocol is taken to be a particularly egregious breach of environmental ethics.

One final ethical issue involves the perspective of third-world nations. Some thinkers from the third-world view environmental ethics as a first-world luxury, arguing that the primary focus of third-world nations should be on the elimination of starvation and

poverty, for instance via national policies favoring industrial development. A discussion by Attfield [13] provides details.

Conclusions

Global warming is now becoming more than a mere theoretical concern, and nations are now seriously looking at ways to attenuate or delay the process and mitigate its consequences. One imaginative scheme that has been launched as a result of the Kyoto protocol on global warming is carbon emissions trading, an arrangement where companies are granted carbon emissions credits from a national authority and where some of these credits can either be utilized in industrial production or traded for money.

However, despite widespread ratification of the Kyoto protocol, some nations such as the USA have declined to join in, citing concerns of fairness. In addition, a number of influential thinkers have voiced a number of other ethical concerns. Still others view the failure of the USA to ratify the Kyoto protocol as a serious violation of environmental ethics at the national policy level.

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