



JUST THE FACTS

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PIOGA's "Just the Facts" is pleased to turn the pen over this month to Gregory Wrightstone, Executive Director of the CO₂ Coalition. We thank him for taking the time to provide us with the facts about an important and topical issue.

More CO₂ is Good. Less is Bad.

People should be celebrating, not demonizing, modern increases in atmospheric carbon dioxide (CO₂). We cannot overstate the importance of the gas. Without it, life doesn't exist. Rare, exotic exceptions are anaerobic life forms dwelling at out-of-the-way places like ocean-bottom volcanic vents.

First, a bit of history: During each of the last four glacial advances, CO₂'s concentration fell below 190 parts per million (ppm), less than 50 percent of our current concentration of 420 ppm. When glaciers began receding about 14,000 years ago – a blink in geological time – CO₂ levels fell to 182 ppm, a concentration thought to be the lowest in Earth's history.

Line of Death

Why is this alarming? Because below 150 ppm, most terrestrial plant life dies. Without plants, there are no animals.

In other words, the Earth came within 30 ppm in CO₂'s atmospheric concentration of witnessing the extinction of most land-based plants and all higher terrestrial life-forms – nearly a true climate apocalypse. Before industrialization began adding CO₂ to the atmosphere, there was no telling whether the critical 150-ppm threshold wouldn't be reached during the next glacial period.

Contrary to the mantra that today's CO₂ concentration is unprecedentedly high, our current geologic period, the Quaternary, has seen the lowest average levels of carbon dioxide since the end of the Pre-Cambrian Period more than 600 million years ago. The average CO₂ concentration throughout Earth's history was more than 2,600 ppm, nearly seven times current levels.

Beneficial CO₂ Increases

CO₂ increased from 280 ppm in 1750 to 420 ppm today, most of it after World War II as industrial activity accelerated. The higher concentration has been beneficial because of the gas's role as a plant food in increasing photosynthesis.

Its benefits include:

- Faster plant growth with less water and larger crop yields.
- Expansion of forests and grasslands.
- Less erosion of topsoil because of more plant growth.
- Increases in plants' natural insect repellents.

A summary of 270 laboratory studies covering 83 food crops showed that increasing CO₂ concentrations by 300 ppm boosts plant growth by an average of 46 percent. Conversely, many studies show adverse effects of low-CO₂ environments. For instance, one indicated that, compared to today, plant growth was eight percent less in the period before the Industrial Revolution, with a low concentration of 280 ppm CO₂. Therefore, attempts to reduce CO₂ concentrations are bad for plants, animals and humankind.

Data reported in a recent paper by Dr. Indur Goklany, and published by the CO₂ Coalition, indicates that up to 50 percent of Earth's vegetated areas became greener between 1982-2011. Researchers attribute 70 percent of the greening to CO₂ fertilization from fossil fuel emissions. (Another nine percent is attributed to fertilizers derived from fossil fuels.)

Dr. Goklany also reported that the beneficial fertilization effect of CO₂ – along with the use of hydrocarbon-dependent machinery, pesticides and fertilizers – have saved at least 20 percent of land area from being converted to agricultural purposes – an area 25 percent larger than North America.

The amazing increase in agricultural productivity, partly the result of more CO₂, has allowed the planet to feed eight billion people, compared to the fewer than 800,000 inhabitants living a short 300 years ago.

More CO₂ in the air means more moisture in the soil. The major cause of water loss in plants is attributable to transpiration, in which the stomata, or pores, on the undersides of the leaves open to absorb CO₂ and expel oxygen and water vapor. With more CO₂, the stomata are open for shorter periods, the leaves lose less water, and more moisture remains in the soil. The associated increase in soil moisture has been linked to global decreases in wildfires, droughts and heat waves.

Exaggeration of CO₂'s Warming Effect

Alarm over global warming stems from exaggerations of CO₂'s potential to retain heat that otherwise would radiate to outer space. As with water vapor, methane and nitrous oxide, CO₂ retains heat in the atmosphere by how it reacts to infrared portions of the electromagnetic spectrum. However, the gas has saturated to a large extent within the infrared range, leaving relatively little potential for increased warming.

Both sides of the climate debate agree that the warming effect of each molecule of CO₂ decreases significantly (logarithmically) as the concentration increases. This is one reason why there was no runaway greenhouse warming when CO₂ concentrations approached 20 times that of today. This inconvenient fact, despite its importance, is rarely mentioned because

it undermines the theory of a future climate catastrophe. A doubling of CO₂ from today's level of 420 ppm – an increase estimated to take 200 years to attain – would have an inconsequential effect on global temperature.

Pennsylvania's solar-powered fossil fuels

CO₂ being liberated today from Pennsylvania coal was removed from the atmosphere by the photosynthesis of trees that fed on sunlight and carbon dioxide and then died to have their remains accumulate in the vast coal swamps of the Carboniferous Period.

Pennsylvania Marcellus and Utica shale hydrocarbons being exploited today were also the likely hydrocarbon source of shallower reservoirs producing since the late 1800s. The source of those hydrocarbons was algae remains that gathered on the bottom of the Ordovician and Devonian seas. Like the coal deposits, the algae used solar-powered photosynthesis and CO₂ (the algal blooms were likely fueled by regular dust storms) to remove vast amounts of CO₂ from the air and lock it up as carbon-rich organic matter.

The provenance of these hydrocarbons spawns two novel ideas. First, there is a strong case that these are solar-powered fuels. Second, the sequestering of carbon during the creation of the hydrocarbons lowered atmospheric concentrations of CO₂ to sub-optimum levels for plants. Therefore, the combustion of today's coal and gas is liberating valuable CO₂ molecules that are turbocharging plant growth.

The plain fact of the matter is that the modest warming of less than one degree Celsius since 1900, combined with increasing CO₂, is allowing ecosystems to thrive and humanity to prosper.

Additional information on CO₂'s benefits and related topics are available at CO2Coalition.org, which includes a number of publications and resources of interest.



Gregory Wrightstone is a geologist and executive director of the [CO₂ Coalition](http://CO2Coalition.org). He is also the author of the bestselling book "Inconvenient Facts – the science that Al Gore doesn't want you to know." Greg's expertise on climate change was confirmed by his acceptance as an "Expert Reviewer" for the Intergovernmental Panel on Climate Change (AR-6). Greg was also a co-author (along with Bill Zagorski of Range Resources) of the first comprehensive peer-reviewed paper on the geological controls on Marcellus Shale production.



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