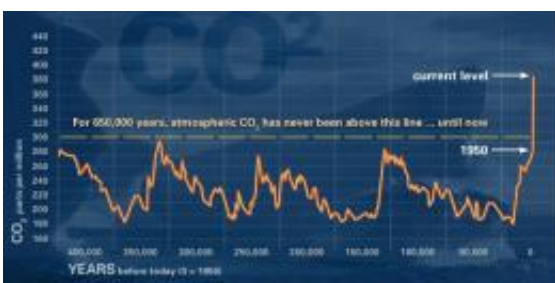


Climate experts debate strategies for reducing atmospheric carbon and future warming

November 25 2009, By Krishna Ramanujan



This graph, based on the comparison of atmospheric samples contained in ice cores and more recent direct measurements, shows atmospheric CO₂ increases since the Industrial Revolution.

(PhysOrg.com) -- Reducing carbon dioxide to safe levels may require extracting carbon from the air, says Cornell climate researcher.

Even if the world's policymakers all agree to dramatically reduce atmospheric [carbon dioxide](#) (CO₂) emissions, and everything were in place by the middle of the century, the world still could not meet the goals of the climate change meetings in Copenhagen, Dec. 8-18, of reducing CO₂ in the [atmosphere](#) to 350 parts per million (ppm), say Cornell researchers.

If everyone were on board, maybe we could contain CO₂ in the

atmosphere to about 400 ppm by 2050, said Cornell climate expert Charles Greene, who has published numerous papers on climate change and global [ocean ecosystems](#).

There is already too much carbon dioxide in the atmosphere, the world is just too dependent on fossil fuels and such obstacles as the United States' poor climate record and skyrocketing emissions from India and China make lower levels unrealistic, he said.

David Wolfe, a Cornell ecologist who studies the potential impacts of climate change on plants, soils and ecosystems, agreed, adding that "the 550 target is more realistic, where we replace fossil fuels with alternative energies in a number of decades." Wolfe likens reducing CO₂ levels to reversing the direction of a cruise ship. "At 3 degrees Celsius warming [roughly what 550 ppm of CO₂ would yield], we would have some chance to adapt, but if we allow emissions and temperatures to go higher than this, the impacts could be catastrophic and beyond our capacity to adapt."

Most people do not find the 350 goal realistic, he said. Even if all [CO₂ emissions](#) were to stop today, the gas already in the atmosphere would stay there for another century or two, maintaining warmth. But activists need to set firm goals.

"It's the best political strategy," Wolfe said of the 350 ppm goal. "If we allow slack, it will never happen."

But Greene says that reaching 350 ppm is not a matter of choice but a necessity, requiring diverse strategies that go beyond simply reducing emissions.

Even 450 ppm is way beyond the safe levels, said Greene. "People are only talking about reducing emissions. I am arguing that we actually need

to extract CO₂ from the atmosphere." Such geo-engineering strategies would include biogeochemical and human engineered systems that sequester carbon directly from the air.

One reason that Greene says we cannot wait to reduce CO₂ to 350 ppm is because new research predicts that the Earth system is on the threshold of exceeding several menacing, non-linear "tipping points" triggered by rising temperatures.

The European Union announced in 2005 that to avoid such dangerous climate impacts as melting glaciers and ice sheets, severe droughts and catastrophic sea level rise, Earth's average global temperatures must not increase by more than 2 degrees Celsius above pre-industrial levels. For example, Himalayan glaciers that feed the Indus, Ganges and Yellow rivers and provide water to more than a billion people are already rapidly melting. In simple analyses, atmospheric CO₂ that is less than 450 ppm should yield a 2 degree Celsius increase; however, when feedback loops associated with aerosols and ocean warming are accounted for, such temperature increases may already be in the works, according to a 2008 report in the *Proceedings of the National Academy of Sciences*.

Part of the problem are delayed effects that have already committed the planet to warming on the order of 2.4 degrees Celsius (4.3 degrees Fahrenheit) by the end of the century, regardless of reductions in greenhouse gas emissions from today's levels. For example, as the ocean warms, it stores the heat and very slowly releases it to the atmosphere, creating a lag time in temperature equilibrium between the atmosphere and the ocean. Furthermore, due the ocean's great mass and heat capacity, it will take 1,000 years to reverse this century's warming and gradually reduce the heat already building up in the ocean, said Greene. Also, as pollution abatement strategies kick in this century, aerosols that now cool the atmosphere will decline, adding to warmth.

But, Greene added, the goal of 350 ppm can be reached and a calamitous warming halted if governments finance geo-engineering strategies that pull CO₂ from the air and store it in the Earth.

For example, Greene and others advocate research to try to scale up simple machines already devised that draw CO₂ from the atmosphere and then find ways to pump the gas into underground geological formations.

Greene also advocates growing algae for biofuel; algae is 10 times more productive per hectare than current biofuel crops. Such bio-petroleum recycles CO₂ from the air into algae and then into fuel, unlike [fossil fuels](#) that put carbon stored in the earth into the air. Then, he said, power plants running on such bio-petroleum could be outfitted with scrubbers to capture and sequester CO₂ to help create a system that actually reduces fossil carbon in the atmosphere.

"I think there are some real solutions out there; we just need to think big," he said.

Provided by Cornell University ([news](#) : [web](#))

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