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Path to 4.5°C global surface warming again from today's CO₂ level

Earth's surface will warm, due to today's 406 ppm CO₂, by almost 3 times as much as it has since 1880. Already, land surfaces have warmed 1.2°C (5-year mean) over the last 50 years and 1.7°C over the last 130. Sea surfaces have warmed 1.1°C over the past 100. Ocean depths add more heat every 2 years than cumulative human energy use. Analysis and extrapolation from Vostok ice core data connects today's CO₂ levels with 7.4°C surface warming there, above the 1951-80 mean, or Δ 4.5°C globally. This is consistent with CO₂ and Δ°C data from 4 and 14 million years ago. Adding Vostok CH₄ data yields 7.8°C global warming. Δ 4.5°C globally (more inland and poleward) is enough to make future Kansas hotter than Las Vegas now. The analysis

suggests major lag effects to come, mostly from albedo changes. Some come this century, from disappearing Arctic sea ice and anthropogenic sulfates, plus decreasing snow and cloud cover, all multiplied by the greenhouse effect of more water vapor. Albedo effects from ice loss in Greenland and Antarctica, plus Deep Ocean warming, happen more slowly. When Earth last had 400 ppm CO₂, sea levels were 20-35 meters above today's, indicating up to 50% ice loss eventually. Thawing permafrost holds twice as much carbon as the air, threatening 9°C warming if eliminating carbon emissions is delayed. A substantial and rising carbon tax, with tax credits for CO₂ removal (CDR), is vital. 7 CDR methods are discussed briefly.

Biography

Gene Richard Heinze Fry completed his PhD in resource economics from Cornell University in 1989. He was the Director of policy and planning for the Maine Energy Office, then economist in the electric power division of the Massachusetts utility commission for 13 years. After stints as contributing editor for climate change issues at the Global Environmental Change Report and Business and the Environment, he managed energy efficiency program evaluations for Northeast Utilities for 3 years, until he retired in 2011. He has published 2 articles in refereed.

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