

Global mean temperature is calculated from averaging the air temperatures at 2 m above the land or sea surface. Since the oceans have evaporative cooling, the warming has been greater over land. Oceans are also 70 percent of the total surface area.

Most temperatures in this book are temperature differences, not the thermometer reading. Just as a physician might talk of two degrees above normal body temperature as "2° of fever," so climate scientists speak of "temperature anomalies."

What, however, is the equivalent of normal temperature for Mother Earth, the baseline from which anomalies depart? This is arbitrary, but usually it is the global mean temperature about 1990 (actually the average of 1980–1999 readings).

The other baseline temperature used is the preindustrial temperature, usually that estimated for 1750. It is 0.8°C below the other. So when we talk of the prospects for a 3° fever this century, it's 3.8°C above that at the time when our fossil-fuel fiasco began.

The slow temperature rise between 1950 and 1975 confused climate scientists at the time. It now seems likely that vehicular smog played a major global dimming role (Chapter Nine) until the catalytic converter made a difference after 1975. U.S. oil tripled in those years while coal was unchanged (see page 26).

# 3

## Will This Overheated Frog Move?

Particularly in a country of immigrants like the United States, there is a pattern that you see over and over. Parents work very hard at creating a better world for their children, settling for less for themselves if it provides better prospects for their children.

Writ large, it's the story of constructing civilization. Each generation tries to leave things better for the next.

Sometimes things go downhill instead. Indeed, most societies have failed eventually. Often it has been a matter of fouling the nest—as when irrigation eventually adds so much salt to the soil that crops fail. Likely they had no idea what was wrong and thus no idea how to fix things.

One of the sad things about our present situation for my generation is that we seem likely to leave the earth in worse shape than when we took over running things. And this time, it's not because of ignorance. Thanks to science and history, we've known for a long time the consequences of our actions—and kept doing them. The people

building more coal-fired plants have long known what they are doing to the health of the people downwind, even if they didn't understand the greenhouse implications.

The nineteenth-century physicists Joseph Fourier and John Tyndall realized that gases in the earth's atmosphere trapped heat. Then in 1898, Svante Arrhenius in Stockholm calculated that a doubling of the pre-industrial amount of carbon dioxide in the air would cause the Earth to run a fever of 5°C/9°F.

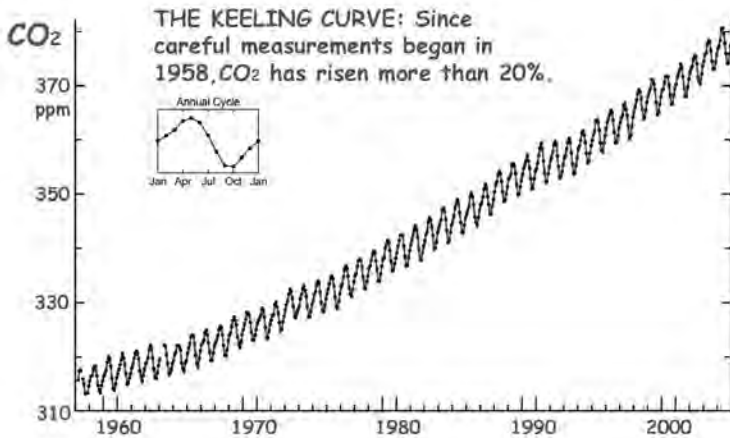
Forty years after Arrhenius, Guy Callendar in the UK noted that the temperature had risen and that the CO<sub>2</sub> was up by at least 10 percent.

In 1956, the American physicist Gilbert Plass got good data on how infrared radiation gets trapped by the atmosphere and began cautioning that rapid industrialization could produce serious climate change.

The oceanographers led by Roger Revelle reported that the oceans just were not up to the task of taking the fossil-fuel CO<sub>2</sub> out of the air in time. In 1958, Dave Keeling started making monthly measurements of CO<sub>2</sub> atop Mauna Loa and confirmed the upward trend with very precise data.

So it's been over half a century since the scientific community realized that greenhouse warming was actually underway and started warning the politicians and the public. Soon thereafter, we began to see some concerted, well-funded efforts to confuse you about the subject. I'm not talking here of disagreements among

scientists but of disinformation campaigns to delay action and profit by it. This manufacturing of controversy included such seductive mantras as “scientists are still uncertain”—as if that excused everyone from doing anything inconvenient this year.



You can actually see the earth breathing in the seasonal variations of the Keeling Curve. The northern forests take some CO<sub>2</sub> out of the air each summer via photosynthesis, cutting into the upward trend. The CO<sub>2</sub> is measured every month in the trade winds flowing over the top of Mauna Loa, Hawaii, well away from any local sources that might complicate the interpretation. By 1961, it was clear there was an upward trend. That gap in 1964 is because the project ran out of money. The Keeling curve has now become twice as steep. With business-as-usual use of fossil fuels, it should climb even faster.

People accustomed to managing high-risk situations—say, my physician colleagues in the medical school—were appalled by the emphasis on “certainty” invented by the disinformation industry. You’re not going to get certainty

about climate illness any more than you do with human disease (or career choices, for that matter). And you can't delay acting just because of remaining uncertainty.

There's a clock running but you don't know when the tipping point will arrive and the patient will slip into irreversible damage. You often have to start treatment early for the most likely disease while continuing diagnostic tests.

No democracy is going to tax itself for a remake without a wide acceptance of what is at stake. Most of us are not climate scientists but many of us will need to understand what's up if we are to collectively take effective action—and we will need to do this on the fly, without going back to school or leaving the problems for the next generation to handle. Our civilization is going to have to make some serious decisions quite soon or risk participating in the familiar downhill spiral that leads to the collapse of a civilization, with ours joining dozens of prior societies in the dust bins of history. Flushed.

That could happen within the lives of people you know, such as you and your children. (I used to say “your children and grandchildren,” but things have been speeding up.)

Let me recast that apocryphal story about cooking a frog. If a frog jumped into a steaming hot tub, he'd leap back out. But if he was already sitting in the tub's rim at the time that the heater was turned on, he might not notice the rising temperature until he had become too weak to respond.

We're not that lethargic frog, however. Frogs don't have foresight and we do. Furthermore, thanks to science, our civilization has developed a warning system. And thanks to our technology, we may be able to rescue ourselves.

Unfortunately, fifty years of warnings have been ineffective at moving most politicians. We'll cook with them if we don't convert them or replace them.

The debate about global fever per se is over. Yes, most of the Earth is overheating. That part is getting a little difficult to deny.

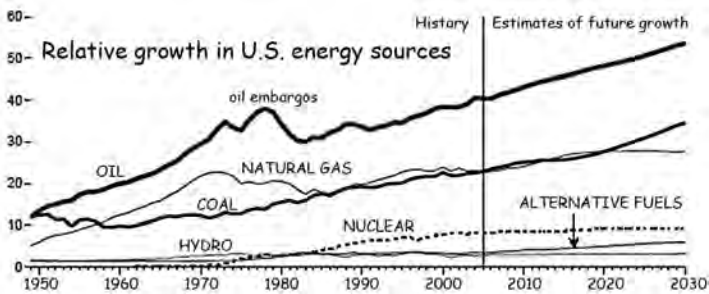
And, yes, it's mostly caused by human actions and inactions. A half century ago, that was still an open question. Now it's clear that the addition of CO<sub>2</sub> to the atmosphere is responsible for much of the overheating after 1950. Methane contributes another big chunk.

Past greenhouse episodes have been due to methane burps, the prolonged belching of volcanoes, or, most recently, the earth getting closest to the sun in July when the tilt of the earth's axis was greater than it is today. This time we did it all by ourselves, via low tech means of burning fossil fuels, making cement, and clearing land.

Europe tackled the problem directly and has markedly reduced its use of fossil fuels since 1980. But an American now uses twice as much energy as a European (and throws out twice as much garbage, and uses twice as much toilet paper).

What's debated now is what happens next. We have good models of future climate. And we have good political

models, such as the 1987 Montreal treaty that reversed the trend in the ozone hole by changing industrial chemicals; the hole itself may be healed by midcentury. It's a great success story of how science and industry, politicians and diplomats can cooperate to reverse a big problem in the making.

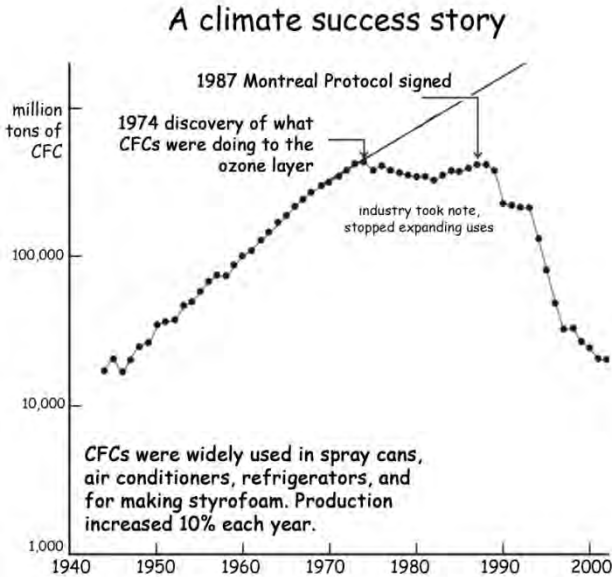


It's worth noting the differences between ozone then and fossil fuels now. The most obvious is that the chlorofluorocarbons (CFCs) were produced by relatively few manufacturers, who could easily find substitutes. The public could hurry them along, since we could readily avoid many products containing CFCs. Fossil fuels are big business worldwide, however, with lots invested up front for profits decades later.

So let us look at the role played by the scientists, the media, special interests, the public, and governments. I'll elaborate on the perceptive comments of climate scientist Jim Hansen to the U.S. National Academy of Sciences.

For ozone and CFCs, scientists transmitted a clear warning—while for global fever, scientists didn't make a

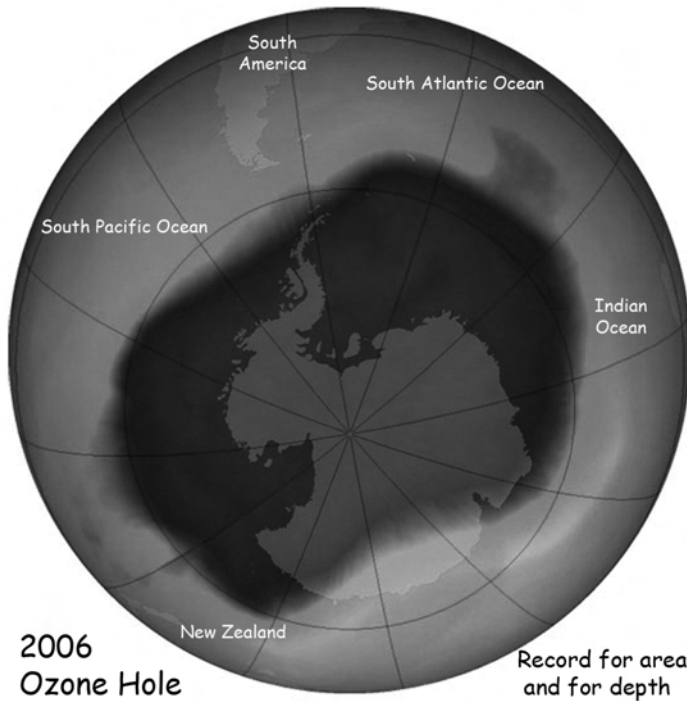
clear distinction between generic climate change and a major makeover, a wholly different planet to live on.



The media transmitted the ozone story well, but for global fever, they got suckered into always “balancing” the science, often with disinformation. Then they leaped to hopelessness, complete with sports metaphors.

The special interests for CFCs denied the science for years but stopped building new capacity and pursued technological innovation. But for global fever, some of the biggest of the oil and coal companies live in their own little bubble of unreality and pursue dangerously irresponsible disinformation campaigns analogous to the misleading representations that constitute fraud in other arenas.





Looking down on the South Pole at the record-sized ozone hole of 2006. It should gradually become smaller as the CFCs decay.

The public had a quick response to the ozone warning. The marketplace worked: the popular spray cans became unpopular and no more CFC infrastructure was built. With global fever, the U.S. public is understandably confused and in 2005 ranked environmental problems low on its list of concerns (and, within environmental problems, ranked global warming near the bottom). Things have since changed.

Governments, with leadership from the U.S. and Europe, did well on ozone and, though it took thirteen years, the Montreal Protocol was finally signed and, two years later under the leadership of Margaret Thatcher, it was considerably strengthened. Europe has taken the lead for the last quarter century on global fever issues, with France getting 78 percent of its electrical power from nuclear reactors with zero carbon emissions.

The first rule of kindergarten remains “Clean up your own mess.” Yet the U.S. government fails to lead, and seems overwhelmed by the special interests. It has taken the lead in delaying effective action with its quibbles about the Kyoto Protocol, with obstruction and foot-dragging tactics at every climate conference since 1997.

The U.S. ought to be using its technological proficiency to solve the CO<sub>2</sub> problems, creating a good example for developing countries to follow, rather than setting them up to feel that their accomplishments will be dwarfed by the profligate waste of the world’s leading polluter.

We scientists have also been pulling our punches, giving out “climate lite” when we should have been stating the prospects as we saw them, “proven” or not. George Monbiot gives a good example:

At a meeting of climate change specialists, Sir David King [chief science advisor to the British government] announced that a “reasonable” target for stabilising carbon dioxide in the atmosphere was 550 parts of the gas per million parts of air. It would be “politically unrealistic,” he said, to demand anything lower.

Simon Retallack, from the Institute for Public Policy Research, stood up and reminded Sir David what his job was. As chief scientist, his duty is not to represent political reality—there are plenty of advisers schooled in that art—but to represent scientific reality . . .

Sir David replied that if he recommended a lower limit, he would lose credibility with the government. As far as I was concerned, his credibility had just disappeared without trace. By shielding his masters from uncomfortable realities, he is failing in his duties as both scientist and adviser.

It's one thing for politicians to engage in understatement when trying to build a consensus or to avoid a second controversial subject when addressing the first—I suspect Al Gore of doing this in *An Inconvenient Truth* when he leaves nuclear power off his list of wedges—but we scientists need to be more straightforward in speaking to the people who need to get their information unfiltered, with the sugar coatings left off.

Climate change, and how we address this issue, is a defining issue of our era.

—UN Secretary-General Ban Ki-moon, 2007

What we need now is good information and careful thinking, because in the years to come this issue will dwarf all the others combined. It will become the *only* issue.

—biologist Tim Flannery, 2005

When I give talks on global warming, quite a few of my over-50 peers in the audience remark that this is, at its heart, an issue of legacy. It is our children's climate, and our grandchildren's, that is being shaped by the building greenhouse effect. One disturbing part of that legacy is this: while half the gas billowing from smokestacks and tailpipes is typically absorbed by the oceans or plants each year, the rest remains stashed in the air for a century or longer, building like unpaid credit card debt.

— science writer Andrew Revkin, 2007

Governments... spend a small slice of tax revenue on keeping standing armies, not because they think their countries are in imminent danger of invasion but because, if it happened, the consequences would be catastrophic. Individuals do so too. They spend a little of their incomes on household insurance not because they think their homes are likely to be torched next week but because, if it happened, the results would be disastrous. Similarly, a growing body of scientific evidence suggests that the risk of a climatic catastrophe is high enough for the world to spend a small proportion of its income trying to prevent one from happening...

The real difficulty is political. Climate change is one of the hardest policy problems the world has ever faced. Because it is global, it is in every country's interests to get every other country to bear the burden of tackling it. Because it is long term, it is in every generation's interests to shirk the responsibility and shift it onto the next one. And that way, nothing will be done...

Developing countries argue, quite reasonably, that, since the rich world created the problem, it must take the lead in solving it. So, if America continues to refuse to do anything to control its emissions, developing countries won't do anything about theirs. If America takes action, they just might.

— from the *Economist*, 9 September 2006

# GLOBAL How to Treat Climate Change FEVER

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*Visit <http://Global-Fever.org> for additional chapters*

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