Challenging "Net Zero" with Science

William Happer
Professor of Physics, Emeritus
Princeton University

Richard Lindzen
Alfred P. Sloan Professor of Atmospheric Science Emeritus
Massachusetts Institute of Technology

CO_2 Coalition
Gregory Wrightstone, Executive Director
Nonprofit 501(c)(3) Educational Foundation
Arlington, Virginia

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CO_2 COALITION

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EXECUTIVE SUMMARY

Governments around the globe are taking actions to implement fossil fuel-free or "Net Zero" energy systems without a thorough examination of the scientific basis for doing so. This paper undertakes that examination by reviewing the scientific support (or lack thereof) that has been used to justify this transition to Net Zero. No attempt is made to address the significant economic, societal or environmental consequences of a near-total reliance on renewable energy and the required battery-backup that is necessary to transition to a fossil fuel free future.

Two of the paper's authors – Drs. William Happer and Richard Lindzen, professors emeriti at Princeton University and Massachusetts Institute of Technology, respectively – have spent decades studying and writing about the physics of Earth's atmosphere. The third, Gregory Wrightstone, a geologist of more than 40 years, has spent much of the last decade writing and speaking about the interplay of geology, history and climate.

The authors find that Net Zero – the global movement to eliminate fossil fuels and its emissions of CO_2 and other greenhouse gases – to be scientifically invalid and a threat to the lives of billions of people. Among the paper's findings are:

- Net Zero proponents regularly report that extreme weather is more severe and frequent because of climate change while the evidence shows no increase – and, in some cases, a decrease – in such events.
- Computer models supporting every government Net Zero regulation and the trillions of dollars subsidizing renewables and electric cars, trucks, home heating, appliances and many other products do not work.
- Scientific research and studies that do not support the "consensus" narrative of harmful man-made global warming are routinely censored and excluded from government reports such as the Intergovernmental Panel on Climate Change and the National Climate Assessment.
- Conclusions of the Intergovernmental Panel on Climate Change that contradict the narrative of catastrophic global warming from fossil fuels are rewritten by government bureaucrats for public reports to support the false narrative of Net Zero.
- The many benefits of modest warming and increasing carbon dioxide are routinely either eliminated or minimized in governmental reports.
- Eliminating fossil fuels and implementing Net Zero policies and actions mean the elimination of fossil fuel-derived nitrogen fertilizers and pesticides that will result in about half the world's population not having enough food to eat. Many would starve.
- The adoption of Net Zero is the rejection of overwhelming scientific evidence that there is no risk of catastrophic global warming caused by fossil fuels and CO_2.

Net Zero, then, violates the tenets of the scientific method that for more than 300 years has underpinned the advancement of western civilization.

INTRODUCTION

There are already many "Net Zero" regulations and actions by the Federal government, with more to come, to eliminate fossil fuels and CO_2 emissions. A small sample includes 13 Federal agencies that comprise the U.S. Global Climate Research Program (USGCRP) that is developing a 5th National Climate Assessment, regulations imposing a Social Cost of Carbon of $51 per ton and soon likely to be $190 per ton,[1] carbon disclosure requirements by many federal agencies, and a looming ban on gas stoves, furnaces and other gas appliances.[2]

We (Happer and Lindzen) are career physicists who have specialized in radiation physics and dynamic heat transfer for decades. These are processes integral to atmospheric climate science.

In our scientific opinion, all of these "Net Zero" regulations and actions are scientifically invalid and fatally flawed science because they:

- Fabricate data or omit data that contradicts their conclusions, for example, on extreme weather.
- Rely on models that do not work.
- Rely on IPCC findings, which are government opinions, not science.
- Omit the extraordinary social benefits of CO_2 and fossil fuels.
- Omit the disastrous consequences of reducing fossil fuels and CO_2 emissions to "Net Zero".
- Reject the science that demonstrates there is no risk of catastrophic global warming caused by fossil fuels and CO_2.

As to the disastrous consequences of eliminating fossil fuels, it "is estimated that nitrogen fertilizer [derived from fossil fuels] now supports approximately half of the global population."[3]

As one of us (Happer) has made clear, without the "use of inorganic fertilizers" derived from fossil fuels, the world "will not achieve the food supply needed to support 8.5 to 10 billion people."[4]

The recent experience in Sri Lanka provides a red alert. "The world has just witnessed the collapse of the once bountiful agricultural sector of Sri Lanka as a result of government restrictions on mineral fertilizer."[5] The government of Sri Lanka banned the use of fossil fuel-derived nitrogen fertilizers and pesticides, with disastrous consequences on food supply there. If similarly misguided decisions are made eliminating fossil fuels and thus nitrogen fertilizer, there will be a starvation crisis worldwide.

It is critical to repeat: Eliminating fossil fuel-derived nitrogen fertilizer and pesticides will create worldwide starvation. And scientifically there is no risk of catastrophic global warming caused by fossil fuels and CO_2. (See parts II E & F for details).

SCIENTIFIC DETAILS

I. Reliable Scientific Theories Are Determined By The Scientific Method, Validating Theoretical Predictions With Observations, Not By Fabricated and Omitted Contradictory Data, Models that Do Not Work, Government Opinion, Consensus or Peer Review.

Reliable scientific knowledge is determined by the scientific method, where theoretical predictions are validated by observations or rejected by failing to do so. Agreement with observations is the measure of scientific truth. Scientific progress proceeds by the interplay of theory and observation. Theory explains observations and makes predictions of what will be observed in the future. Observations anchor understanding and weed out theories that do not work. This has been the scientific method for more than three hundred years.

Prof. Richard Feynman, a Nobel Laureate in Physics, incisively explained the scientific method:

> "[W]e compare the result of [a theory's] computation to nature, ... compare it directly with observations, to see if it works. If it disagrees with experiment, it is wrong. In that simple statement is the key to science." *The Character of Physical Law* (1965), p. 150.

Thus, the scientific method is very simple and very profound: Does theory work with observations? If not, it is rejected and not used.

However, Scientific Knowledge Is <u>Not</u> Determined By:

A. Fabricated and Omitted Contradictory Data.

Since theories are tested with observations, fabricating data and omitting contradictory facts to make a theory work is an egregious violation of the scientific method.

Richard Feynman stated this fundamental principal of the scientific method:

> "If you're doing an experiment, you should report everything that you think might make it invalid – not only what you think is right about it.... Details that could throw doubt on your interpretation must be given, if you know them." 1974 Caltech commencement address, *Surely You're Joking, Mr. Feynman!* (1985), p. 311-12.

In our experience and as exemplified below, one of us (Lindzen) frankly explained:

> "Misrepresentation, exaggeration, cherry-picking, or outright lying pretty much covers all the so-called evidence" marshalled in support of the theory of imminent catastrophic global warming caused by fossil fuels and of the urgent need to achieve "Net Zero" fossil fuel and other human CO_2 emissions by 2050.[6]

B. Models That Do Not Work.

Models are a type of theory; they predict physical observations. The scientific method requires models to be tested by observations to see if they work. If a model's prediction disagrees with observations of what it purports to predict, it is wrong and never used as science.

It is astounding that one of the most complex questions in physics (namely, the behavior of a multi-phase, radiatively active, turbulent fluid) should be labeled by the government—and funding agencies it controls—to be so settled that skeptics are told to be silent. That the models supporting the climate-crisis narrative fail to describe observations of the phenomena they are supposedly designed to predict confirms that the puzzle remains unsolved. Making this peculiar situation particularly dangerous are world leaders who have abandoned the science and intellectual rigor bequeathed to us by the Enlightenment and its forebears.

C. Government Opinion.

Nobel physicist Richard Feynman put it unambiguously:

> "No government has the right to decide on the truth of scientific principles." *The Meaning of It All* (1998), p. 57.

The importance of the scientific principle that government does not determine science was chillingly underscored recently in Sri Lanka and earlier in Russia under Stalin.

> "Ideologically driven government mandates on agriculture have usually led to disaster," one of us (Happer) explained. "The world has just witnessed the collapse of the once bountiful agricultural sector of Sri Lanka as a result of government restrictions on mineral [nitrogen] fertilizer."[7]

Earlier in Russia, Stalin made Trofim Lysenko the czar of Russian biology and agriculture. False biology prevailed for 40 years in the Soviet Union because Lysenko gained dictatorial control, providing one of the most thoroughly documented and horrifying examples of the politicization of science. Lysenko was strongly supported by "scientists" who benefitted from his patronage. Millions died as a result of his ruthless campaign against science in agriculture. William Happer, Chapter 1 "Harmful Politicization of Science," Michael Gough Ed., *Politicizing Science* (2003), pp. 29-35.

D. Consensus.

What is correct in science is not determined by consensus, but by experiment and observations. Historically, scientific consensuses have often turned out to be wrong. The greatest scientists in history are great precisely because they broke with consensus. The frequent assertion that there is a consensus behind the idea that there is an impending disaster from climate change is not how the validity of science is determined. To quote the profoundly true observation of Michael Crichton: "If it's consensus, it isn't science. If it is science, it isn't consensus."

E. Peer Review.

Peer review can be helpful in many areas of science, but it does not determine scientific validity. Agreement of theoretical predictions with observation or experiment, the scientific method, is the real touchstone of truth in science.

In our decades of personal experience in the field, we have been dismayed that many distinguished scientific journals now have editorial boards that further the agenda of climate-change alarmism rather than objective science. Research papers with scientific findings contrary to the dogma of climate calamity are commonly rejected by reviewers, many of whom fear that their research funding will be cut if any doubt is cast on the coming climate catastrophe. Journal editors have been fired for publishing papers that go against the party line of the climate-alarm establishment.

Alas, peer review of the climate literature is now a joke. It is pal review, not peer review. The present situation violates the ancient principle that "no man shall be a judge in his own cause." Accordingly, all peer reviewed climate publications need to be viewed with skepticism. Some are right, but many have serious problems with confirmation bias.

These fundamental principles of what science and the scientific method are, and are not, are applied to "Net Zero" government regulations and actions for challenging them in court, Congress or agencies (the same analysis applies to academic and any other "Net Zero" publications).

II. Science Demonstrates That Any "Net Zero" Regulation Is Fatally Flawed Science Because It:

A. Fabricates Data or Omits Contradictory Data.

Prof. Steven Koonin in his book *Unsettled* (2021) devotes 86 pages and five chapters applying the scientific method to the facts of extreme weather, including heat waves, hurricanes, tornadoes, sea level rise and wildfires. We also provide extensive data supporting Prof. Koonin's conclusion after a thorough application of the scientific method to all the facts and the opposite of what seems to be in the media every day about extreme weather:

> "The bottom line is that the science says that most extreme weather events show no long- term trends that can be attributed to human influence on the climate."
>
> "[S]cience tells us … [that] [o]bservations extending back over a century indicate that most types of extreme weather events don't show *any* significant change – and some such events have actually become less common or severe – even as human influences on the climate grow."
>
> "[T]he public perception that *extreme* high temperatures are on the rise – fostered by headlines like 'Daily temperature records are running rampant as the globe roasts!' – is simply incorrect." Id. pp. 99, 97, 100 (emphasis added).

Surprisingly, he also provides multiple egregious examples of both fabricating data and omitting contradictory data on extreme weather in the 4th National Climate Assessment Climate Science Special Report (CSSR) of 2017.

Heat Waves

In "Hyping the Heat," Chapter 5, Prof. Koonin provides frank and blunt examples of omitted contradictory and fabricated data in CSSR. After a lengthy analysis of the facts, he states:

> "The US government's … Climate Science Special Report (CSSR) is not just misleading on this point [high temperatures] – it's wrong. I say that, to use the assessment reports' lingo, with *Very High Confidence* because of some sleuthing I did in the spring of 2019. What emerged is a disturbing illustration of how non-experts are misled and science is spun to persuade, not inform.
>
> "In fact, page 19 of the CSSR's Executive Summary says (prominently and with *Very High Confidence*):
>
> "There have been marked changes in temperature extremes across the contiguous United States. The number of high temperature records set in the past two decades far exceeds the number of low temperature records. (Chapter 6, Fig. ES.5)" Id. p. 101 (emphasis added).

He explained the CSSR presented the chart below with the alarming heading "Record Warm Daily Temperatures Are Occurring More Often."[8] The chart is a textbook example of fabricating data. Note that the 4th National Climate Assessment CSSR chart does not provide temperature data but an unusual ratio, "the ratio of record highs to lows."

He continued:

> "I suspect that most readers were shocked by that figure, as I was when I first saw it. Who wouldn't be? An attention-grabbing title ("Record Warm Daily Temperatures Are Occurring More Often") backed up by data with a hockey-stick shape veering sharply upward in recent years…. It sure looks like temperatures are going through the roof." Koonin, *supra*, p. 102.

Record Warm Daily Temperatures Are Occurring More Often

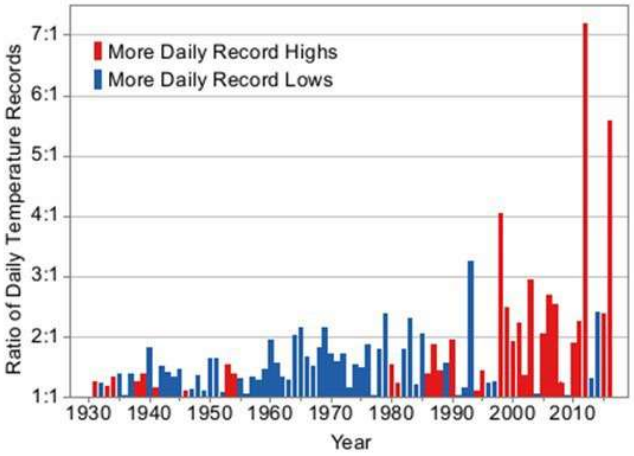
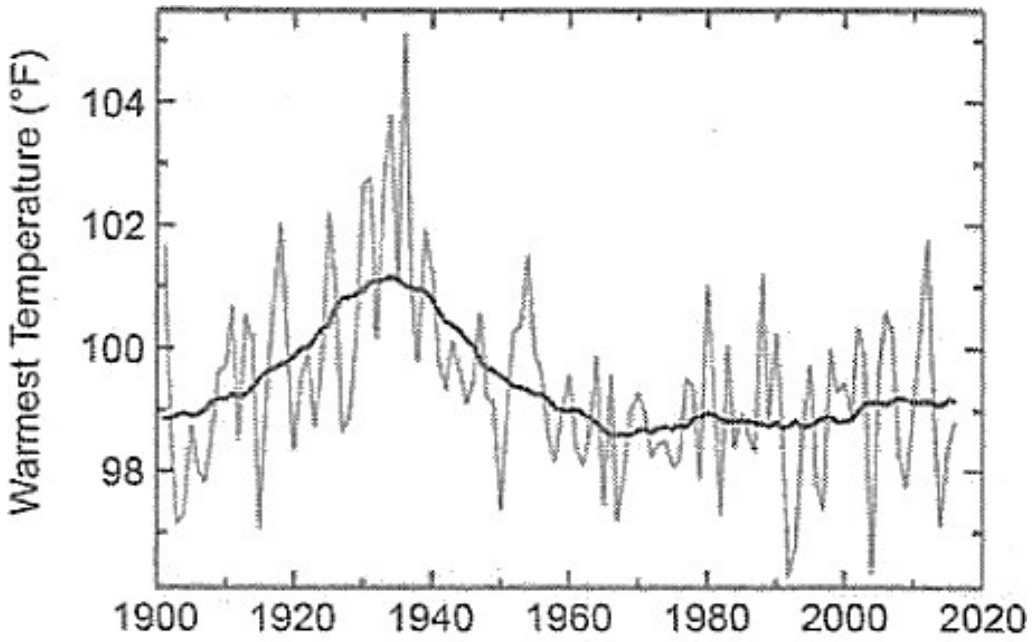


Figure ES.5: Observed changes in the occurrence of record-setting daily temperatures in the contiguous United States. Red bars indicate a year with more daily record highs than daily record lows, while blue bars indicate a year with more record lows than highs. The height of the bar indicates the ratio of record highs to lows (red) or of record lows to highs (blue). For example, a ratio of 2:1 for a blue bar means that there were twice as many record daily lows as daily record highs that year. (Figure source: NOAA/NCEI). *From Figure 6.5 in Chapter 6.*

So, he looked deeper. "I was disturbed by an apparent inconsistency between that figure and some others deeper in the report, particularly the figure reproduced in our figure 5.2." Id. p.102. The dark line shows the average temperature, and the spiked lines show yearly values:



CSSR Fig. 6.3, p. 190, his Fig. 5.2, p, 102.

This chart, deep in the CSSR, on p. 190, clearly shows warm temperatures were not occurring more often, that the "average warmest temperature has hardly changed over the last 60 years and is about the same today as it was in 1900." Id. p. 102.

He also confirmed this fact by contacting Prof. John Christy, who did an analysis of U.S. daily temperature extremes from 1895 until 2018. Prof. Christy's results were similar to the CSSR chart above:

> "The record highs clearly show the warm 1930s [during the Dust Bowl], but there is no significant trend over the 120 years of observations, or even since 1980, when human influences on the climate grew strongly." Id. pp. 106-07.
>
> "Inconsistencies are red meat to a scientist," Prof. Koonin emphasized. Id. p. 103.

Frankly, he did not mince words about the CSSR fabricating data:

> "[T]he Executive Summary of the CSSR prominently features the ratio graph (our figure 5.1) with the legend 'Record warm daily temperatures are occurring more often' … it is shockingly misleading." Id. p. 107 (emphasis added).
>
> "How could a report that proclaims itself 'designed to be an authoritative assessment of the science of climate change' so mischaracterized the data? After all, the CSSR was subject to multiple reviews, including one by an expert panel convened by the National Academies of Science, Engineering, and Medicine (NASEM)." Id. p. 108 (footnote omitted).

He concluded in even stronger terms, that the 4th National Assessment's CSSR is "a prominent misrepresentation of climate science:"

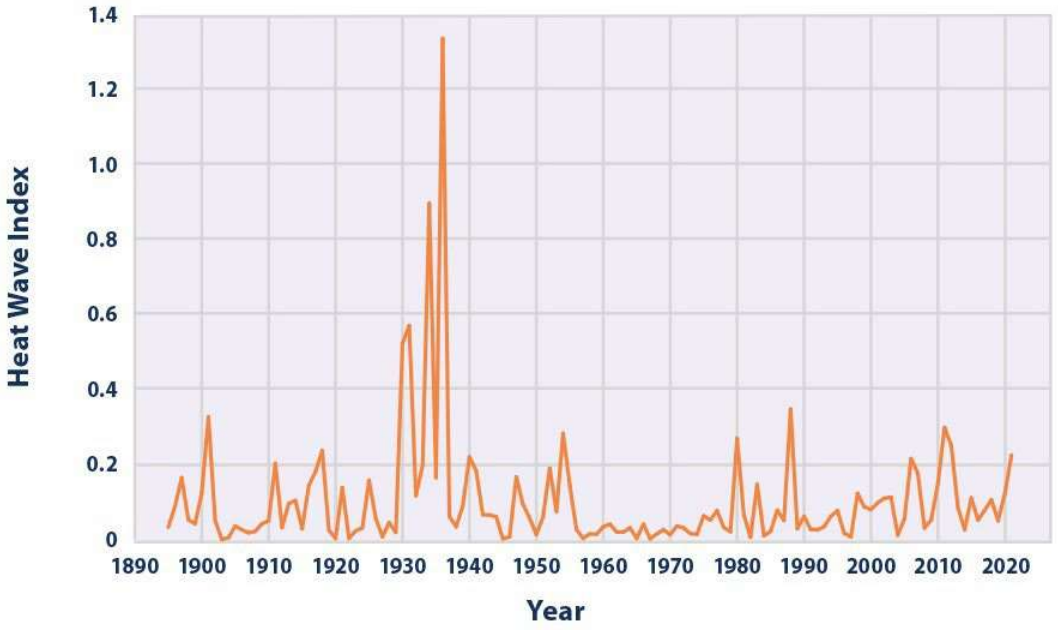
> "I have *Very High Confidence* in identifying and correcting a prominent misrepresentation of climate science in an official government report. This isn't picking at a nit; it really does matter. The false notion of more frequent U.S. high temperature records is likely to pollute subsequent assessment reports, which invariably cite prior reports. More generally, it matters for those who care about the quality of scientific input to societal decisions and the integrity of the processes by which it is generated. It should also matter to those who proclaim the unimpeachable authority of assessment reports. And it matters for media representations of climate science, which give voice to such misleading 'conclusions.'" Id. p.109 (emphasis added).

Koonin's Conclusion:

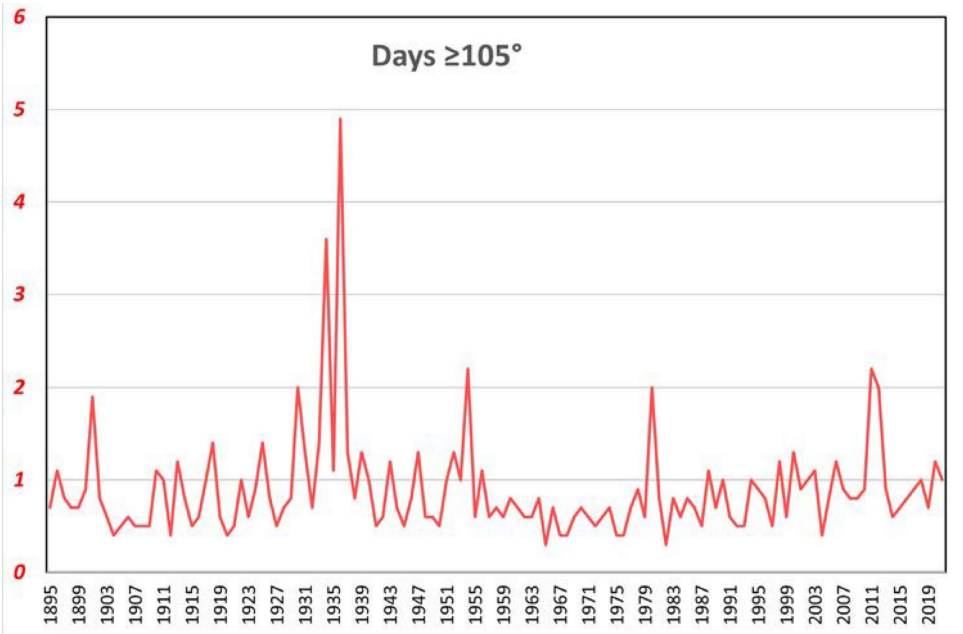
> "In short, I would summarize the data on extreme temperatures … *The annual number of high temperature records set shows no significant trend over the past century, nor over the past 40 years."* Id. p. 110 (emphasis added).

Additional evidence that every agency analyzing extreme weather must include a sound scientific analysis, and that also buttresses Prof. Koonin's conclusion, includes the following:

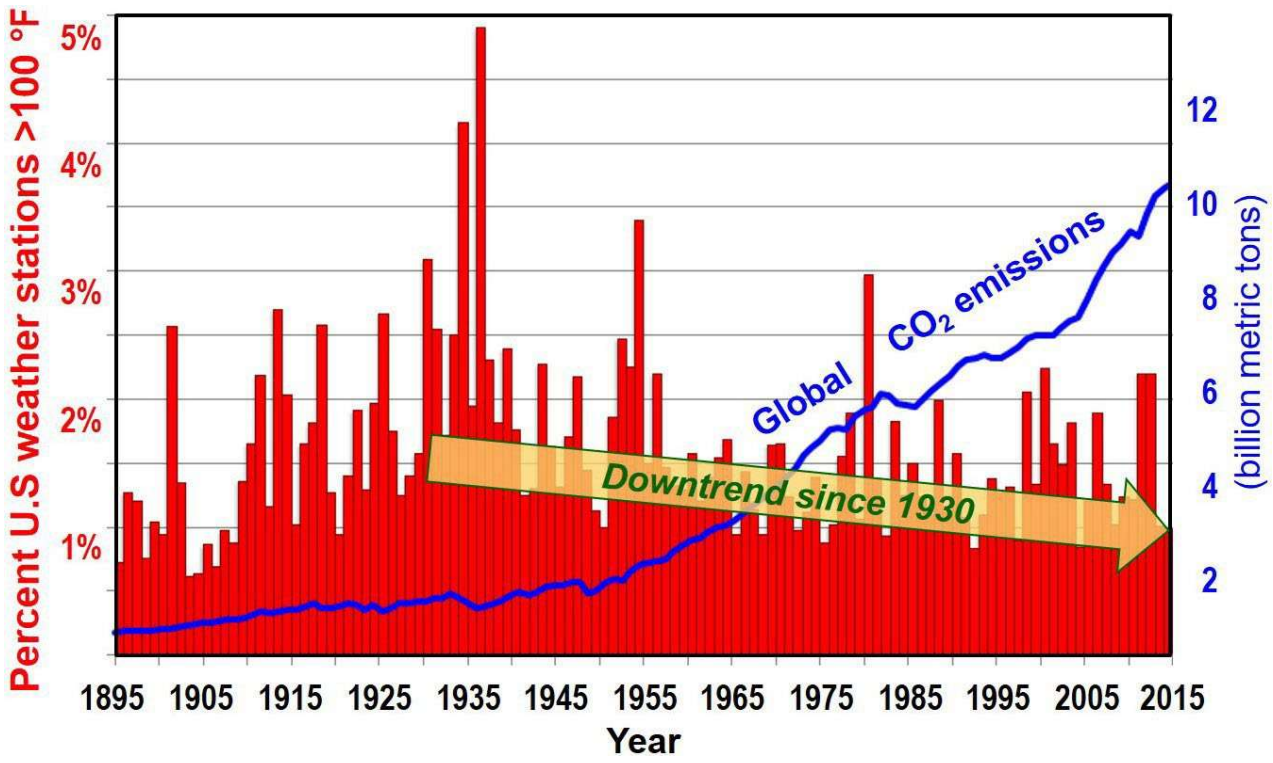
One example of omitting contradictory data are arguments that begin in the 1960s, when the world was cooling, and omitting the full range of longer-term contradictory data. The graph below shows there is nothing out of the ordinary about recent heatwaves, an index of heat waves from 1890 to 2020. [9]



Days with temperatures of at least 105° F peaked in the 1920s and 1930s, including during the Dust Bowl, and are currently a fraction of those numbers.[10]



Dr. John Christy is the Distinguished Professor of Atmospheric Science and Director of the Earth System Science Center at The University of Alabama in Huntsville, where he began studying global climate issues in 1987. Since November 2000 he has been Alabama's State Climatologist. Below is a chart he prepared showing the percentage of U.S. weather stations that exceeded 100° F at nearly 1,000 stations across the country.[11]



Note in the above chart that there is often an opposite relationship between temperature and CO_2 with the highest temperatures, e.g., in 1935, at low levels of CO_2 and lower temperatures after 1955 in spite of the large increase in CO_2.

Accordingly, we respectfully suggest that every agency analyzing heat waves and high temperatures, including the USGCRP for its 5th National Climate Assessment, has the scientific obligation to apply the scientific method to contradictory facts and avoid fabricating facts which, in our opinion, will require adopting Prof. Koonin's conclusions.

Further, there is no risk of increased damage by high temperatures as a result of increasing atmospheric CO_2 from fossil fuels. High temperatures may cause damage, but the resulting increased financial losses will have nothing to do with increases of CO_2 and fossil fuels.

Hurricanes

Prof. Koonin's "Tempest Terrors" Chapter 6 deals with the assertion, "Storms are becoming more common and more intense and rising greenhouse gas emissions are going to make it all a lot worse." Id. p. 111. After a deep analysis of the facts, he proves that "the data and research literature are starkly at odds with this message," and that "hurricanes and tornadoes show no changes attributable to human influences." Id. pp. 111-12.

His analysis also includes two more examples, frankly, of the USGCRP's in its 3rd and 4th National Climate Assessments, fabricating data and omitting contradictory data. He cites the 3rd National Climate Assessment in 2014 asserting:

"Key Message 8. The intensity, frequency and duration of North Atlantic hurricanes, as well as the frequency of the strongest (Category 4 and 5) hurricanes, have all increased since the early 1980s.... Hurricane-associated storm intensity and rainfall rates are projected to increase as the climate continues to warm. Id. p. 115 (emphasis added).

He explains:

"The report backs up that statement with the graph reproduced in figure 6.3 showing a seemingly alarming increase in the North Atlantic PDI (that is, the strongest hurricanes)," and a "general upward trend is emphasized, so that in the non-expert eye, it looks like we're in trouble – and headed for more." Id. p. 115.

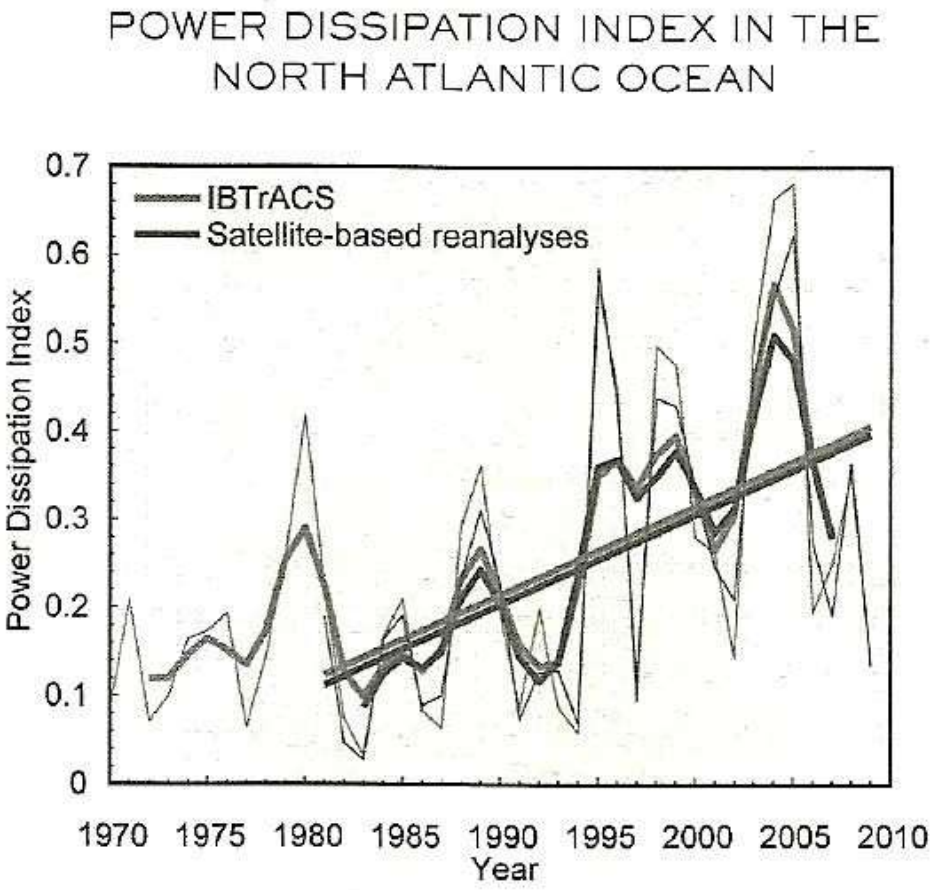


FIGURE 6.3 **Power Dissipation Index in the North Atlantic Ocean.** Two different analyses of the data are shown, along with straight lines indicating the trend in each. (NCA2014, Figure 2.23.)

Applying the scientific method, Prof. Koonin examined the facts more deeply to see if they supported the theory that hurricanes were getting much stronger. Once again, he found that these two USGCRP National Climate Assessments fabricated facts and omitted contradictory data and, therefore, were wrong.

First, he looked at the main research paper cited by the 3rd National Climate Assessment:

> "To my surprise, I found it stated quite explicitly that there are *no* significant trends beyond natural variability in hurricane frequency, intensity, rainfall or storm surge flooding." Id. p. 115.

Next, he searched the 3rd National Climate Assessment more thoroughly and found on page 769, buried in the text of appendix 3, this statement:

> "There has been no significant trend in the global number of tropical cyclones nor has any trend been identified in the number of U.S. land-falling hurricanes." Id. p.117 (footnotes omitted & emphasis added).

Next, he examined the 2017 CSSR of the 4th National Climate Assessment to see if it corrected the 3rd National Climate Assessment.

It did not. Indeed, it repeated the same false science:

> "Human activities have contributed substantially…to the observed upward trend in North Atlantic hurricane activity since the 1970s." Id. p. 118 (footnote omitted).

As a result, he again did not mince words:

> "The discussion of hurricanes in the 2017 CSSR is a profound violation of Feynman's… [the scientific method] caution, that a scientist must 'try to give all of the information to help others to judge the value of your contribution; not just the information that leads to judgment in one particular direction or another.'" Koonin, *supra*, p. 119.

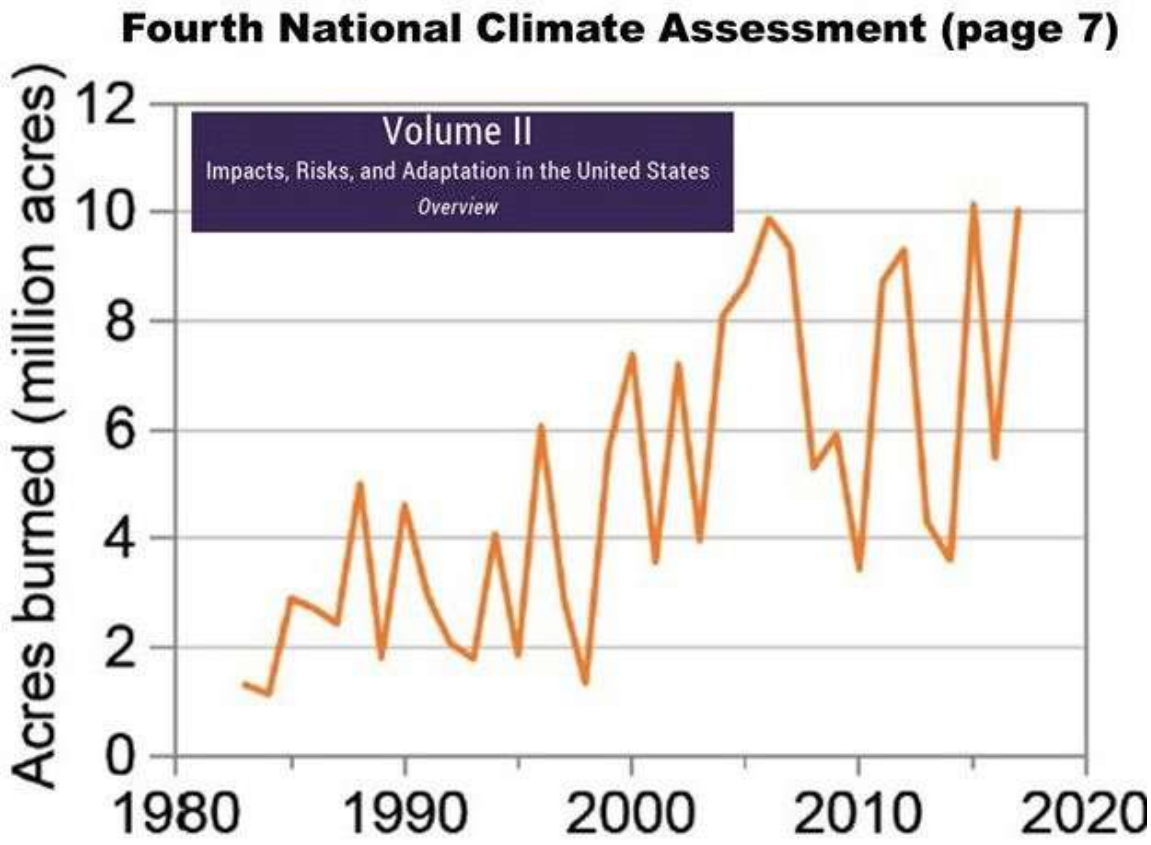
Thus, both the 3rd and 4th National Climate Assessments fabricated facts and omitted contradictory data which, in science, corrupts them both and makes them scientifically invalid.

Accordingly, we respectfully suggest that every agency analyzing hurricanes, including the USGCRP for its 5th National Climate Assessment, has the scientific obligation to apply the scientific method to contradictory facts and avoid fabricating facts which, in our opinion, will require adopting Prof. Koonin's conclusions.

Further, the scientific method applied to all the facts shows that there is no risk of increased damage by hurricanes as a result of increasing atmospheric CO_2 from fossil fuels. Hurricanes will continue to cause damage, and the damages will increase with time, as combination of upward inflationary pressure and as more valuable infrastructure is located in other hazardous areas. But the resulting increased financial losses will have nothing to do with increases in CO_2.

Wildfires

The 4th National Climate Assessment presents a chart showing a huge increase in the amount of acres burned since 1984:[12]



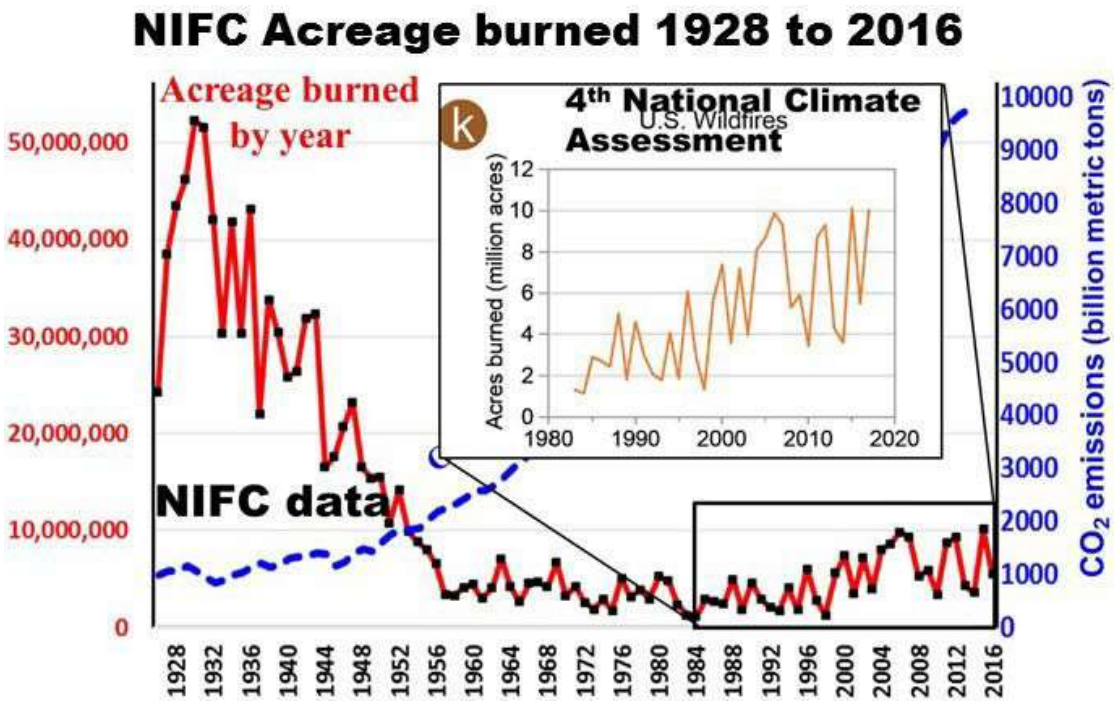
The "Key Finding 6 of the CSSR Chapter 8" is the incidence of large forest fires in the West has increased since the early 1980s:

> "The incidence of large forest fires in the western United States and Alaska has increased since the early 1980s (*high confidence*) and is projected to further increase in those regions as the climate warms, with profound changes to certain ecosystems (*medium confidence*). Koonin, *supra*, p. 143 (emphasis added).[13]

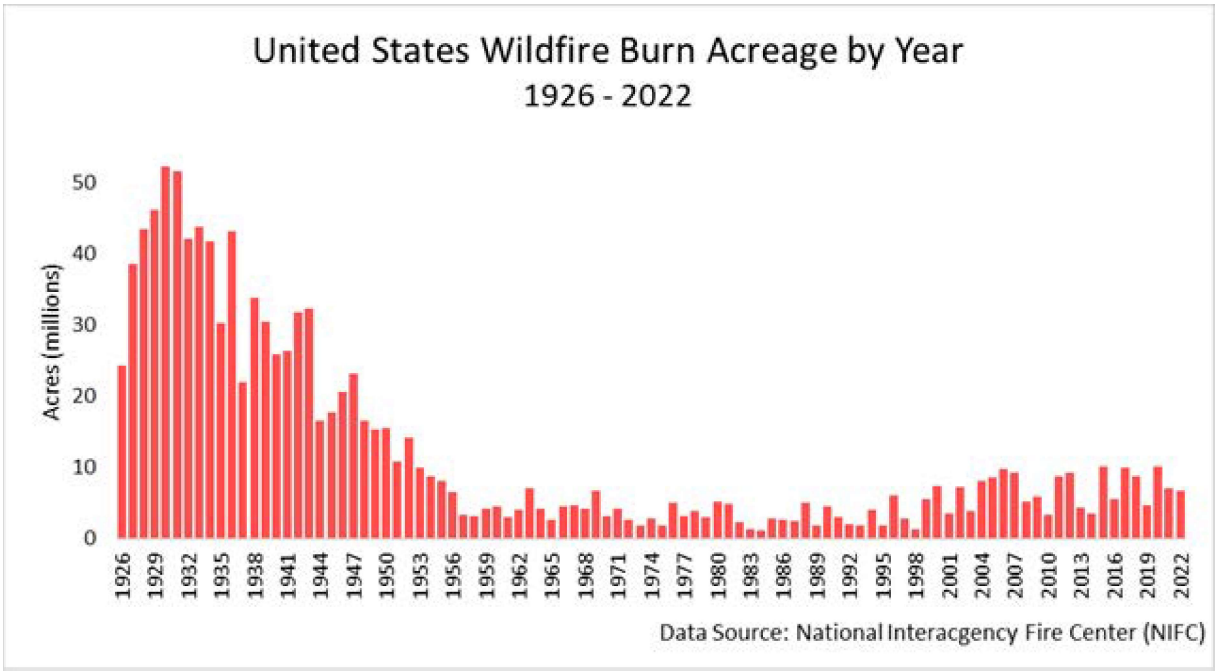
The obvious question is what happened before 1984, a very short time ago in geological terms. Unfortunately, this is once again an example of the USGCRP omitting contradictory data in its National Climate Assessments.

The National Interagency Fire Center (NIFC) and the U.S. Census Bureau provide data going back to 1928 and reveal that the number of fires in the United States and the area burned have been in a significant and long-term decline, with both exhibiting a more than 75% reduction since their peak in the 1920s and 1930s, while CO_2 has been inexorably increasing.

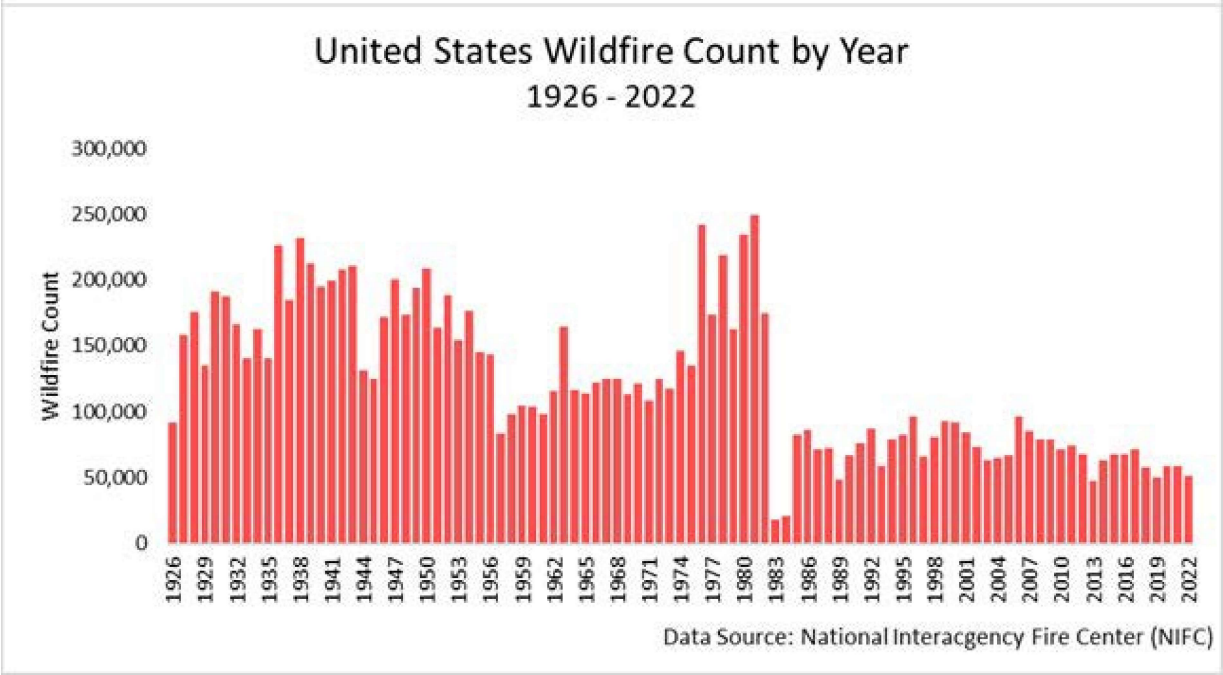
The following chart shows both the NIFC data and CSSR data in one chart for comparison purposes:



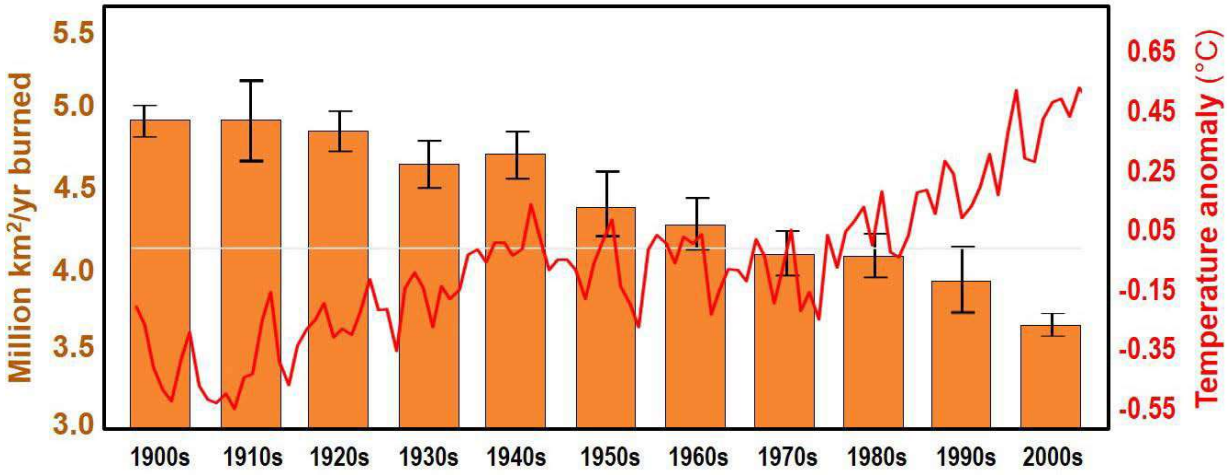
Again, looking at contradictory omitted data before 1984, it shows the United States fared much better than in the past, with the decline in the amount of wildfire-burned acreage declining dramatically from 1929 to 1956 and has remained at a much lower level ever since then[14]:



Similarly, the total number of wildfires in the United States has dropped enormously since the 1930s. Id.



Several large studies of the incidence of fire globally and in the northern hemisphere do not support the National Climate Assessment case linking fire burned acreage (orange boxes) to warming (red line).[15]



Similarly, a study by scientists with the Canadian Forest Service compared temperatures and CO_2 concentration versus frequency of forest fires over the last 150 years in North America and northern Europe and catalogued a significant decline reaching back to 1850.[16]

Prof. Koonin also reports that satellite-gathered data shows that, globally, wildfires have declined about 25% from 1988 to 2015:

> "Sophisticated satellite sensors first began monitoring wildfires globally in 1998. Unexpectedly, this analysis of the images shows that the area burned annually declined by about 25% from 1998 to 2015. That's evident in figure 7 from NASA, which shows that the global area burned by fires each year from 22,003 to 2015, with the straight line indicating the trend. Despite the very destructive wildfires in 2020, that year was among the least active globally since 2003." Koonin, *supra,* p. 142.

Nearly all these fire experts agree that increased soil moisture due to climate change is one of the primary causative agents. Warming temperatures lead to more water vapor and precipitation, and increasing CO_2 leads to less water use by plants.

Accordingly, we respectfully suggest that every agency analyzing wildfires, including the USGCRP for its 5th National Climate Assessment, has the scientific obligation to apply the scientific method to contradictory facts and avoid fabricating facts which, in our opinion, will require adopting these conclusions.

First, there is no long trend of increased wildfires but, to the contrary, a long-term trend of decreasing wildfires.

Second, "the conversation about wildfires [should change from] only one of unavoidable doom due to 'climate change'" to a conversation about how "to take steps that would more directly curtail these catastrophes" as "we have significant power to address … human factors." Id. p. 144.

Further, although CO_2 from fossil fuels has been increasing, the scientific method applied to the facts implies there is no risk of increased real or financial damage by wildfires as a result of increasing atmospheric CO_2 from fossil fuels. Wildfires will cause damage, but the resulting increased losses will have nothing to do with increases of CO_2 rather will be due to upward inflationary pressure and increase in infrastructure in fire-prone areas.

Sea-Level Rise

The issue of sea level rise provides yet another disturbing example of the 4th National Climate Assessment CSSR fabricating and omitting contradictory data, again in Prof. Koonin's words, the 4th National Climate Assessment of sea level rise is "one of the more egregious misrepresentations in the CSSR." Koonin, Chapter 8 "Sea Level Scares," p. 157.

He wrote an Op-Ed in the *Wall Street Journal* on the CSSR, "A Deceptive New Report On Climate"(Nov. 2, 2017) explaining how the CSSR and others arguing fossil fuels and CO_2 will cause catastrophic global warming, cherry-picking short periods of time that support their theory and omitting the contradictory data over a much longer period of time:

> "One notable example of alarm-raising is the description of sea-level rise, one of the greatest climate concerns. The report ominously notes that while global sea level rose an average 0.05 inch a year during most of the 20th century, it has risen at about twice that rate since 1993. But it fails to mention that the rate fluctuated by comparable amounts several times during the 20th century… The report thus misleads by omission." Id.[17]

CSSR emphasized the increase between 1993–2013, but totally omitted the same increase between 1925-1940. "[T]he reports are filled with the graphs the rising sea level itself, such as Figures 8.3 and 8.4, from which it's almost impossible to judge the variations in, and significance of, how quickly sea level is going up." Id. p. 157.

Note Figure 8.4 follows the usual CSSR template of an alarming upward slope for just 1992 – 2020 (which is also the standard template used by others in the catastrophic global warming community). Id. p. 154.

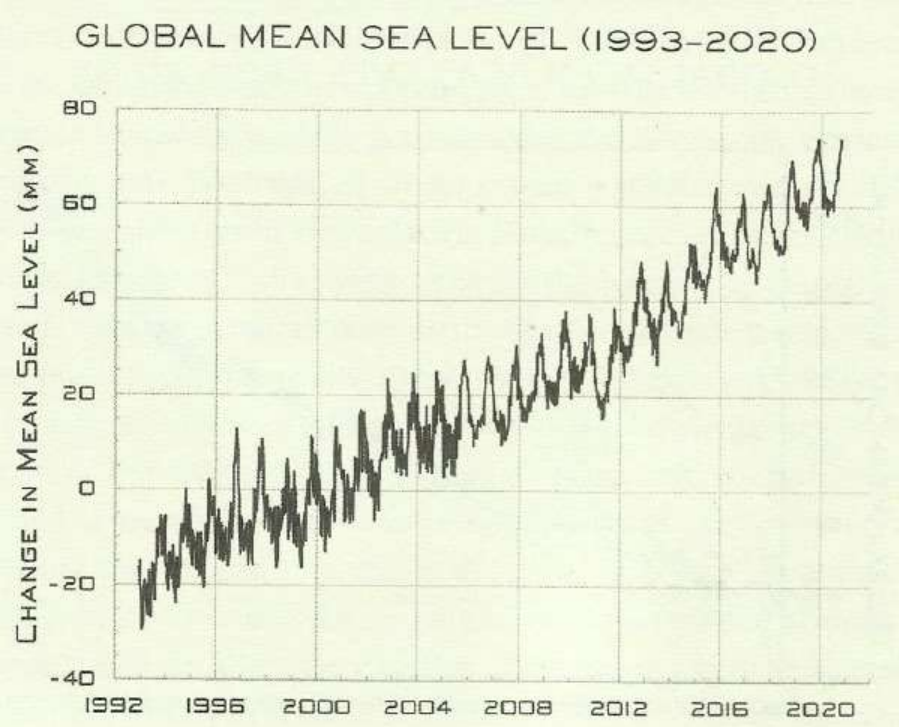


FIGURE 8.4 **Changes in Global Mean Sea Level as measured by satellite altimetry.** A seasonal cycle of about 7 mm (0.2 inches) is superimposed on a trend of 3.0 ± 0.4 mm/yr (0.12 ± 0.02 in/yr).7

Again, applying the scientific method to all the relevant facts, Prof. Koonin explains the obvious:

> "The rate of rise over the most recent twenty-five-years should be compared to that other twenty-five-year period [also .12 inches/year] to understand just how significant the recent rate is." Id. p. 158.

Koonin's Conclusions:

> "The CSSR and other assessments discussions of sea level rise omit important details that weaken the case for the rate of rise in recent decades being outside the scope of historical variability and, hence, for attribution to human influences. There is little doubt that by contributing to warming we have contributed to sea level rise, but there is also scant evidence that this contribution has been or will be significant, much less disastrous." Id. p. 165 (emphasis added).

Accordingly, we respectfully suggest that every agency analyzing sea level rise, including the USGCRP for its 5th National Climate Assessment, has the scientific obligation to apply the scientific method to contradictory facts and avoid omitting facts which, in our opinion, will require them to adopt Prof. Koonin's conclusions.

Further, the scientific method shows that there is no risk of increased damage from rising sea levels as a result of increasing atmospheric CO_2 from fossil fuels. Sea levels may rise and cause damage, but the resulting increased financial losses will have nothing to do with increases in CO_2 but will be due to upward inflationary pressure and increase in infrastructure in high-risk areas.

Tornadoes

Tornadoes are particularly feared in the United States because they kill and injure more U.S. citizens than any other type of storm. While many other countries are spared the twisters' wrath, the United States is the world leader in the number of tornadoes per year— 1,250—with Canada trailing in a distant second place, with just 100.

The National Oceanic and Atmospheric Administration NOAA says early historic records of tornadoes are unreliable: "One of the main difficulties with tornado records is that a tornado, or evidence of a tornado, must have been observed. Unlike rainfall or temperature, which may be measured by a fixed instrument, tornadoes are short-lived and very unpredictable. A tornado in a largely unoccupied region is not likely to be documented. Many significant tornadoes may not have made it into the historical record, since Tornado Alley was very sparsely populated during the early 20th Century."

NOAA produced an alarming graph that indeed shows the annual number of tornadoes in the U.S. have more than doubled in frequency over the last 20 years compared to the 20 years from 1950 to 1970. Koonin, *supra*, p. 122.

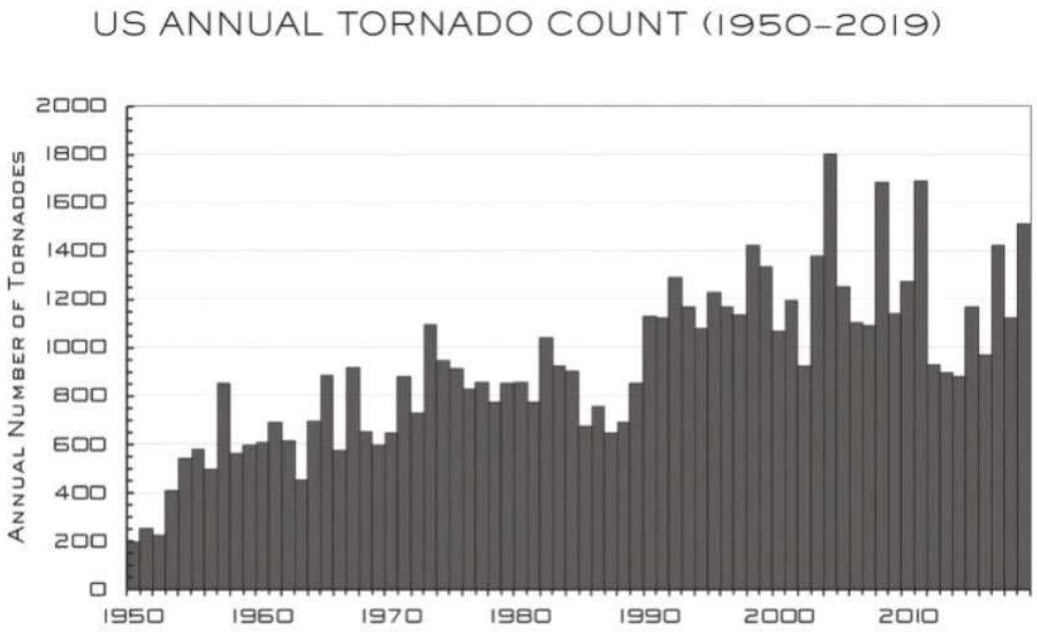
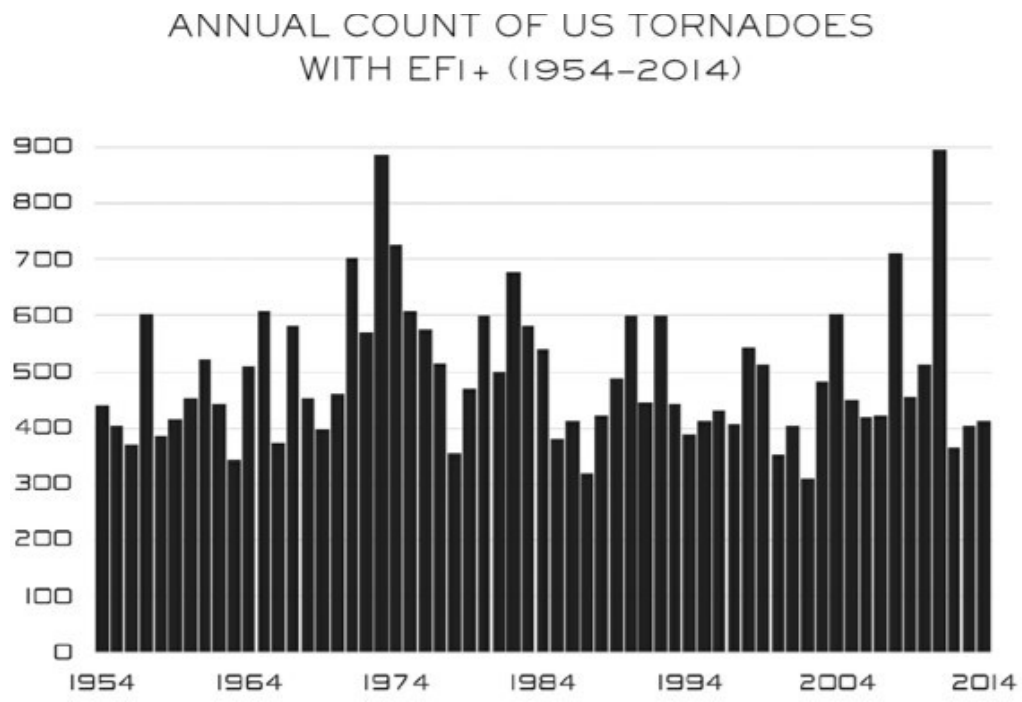


FIGURE 6.5 **Number of tornadoes recorded by NOAA each year from 1950 to 2019 in the contiguous forty-eight states.**[25]

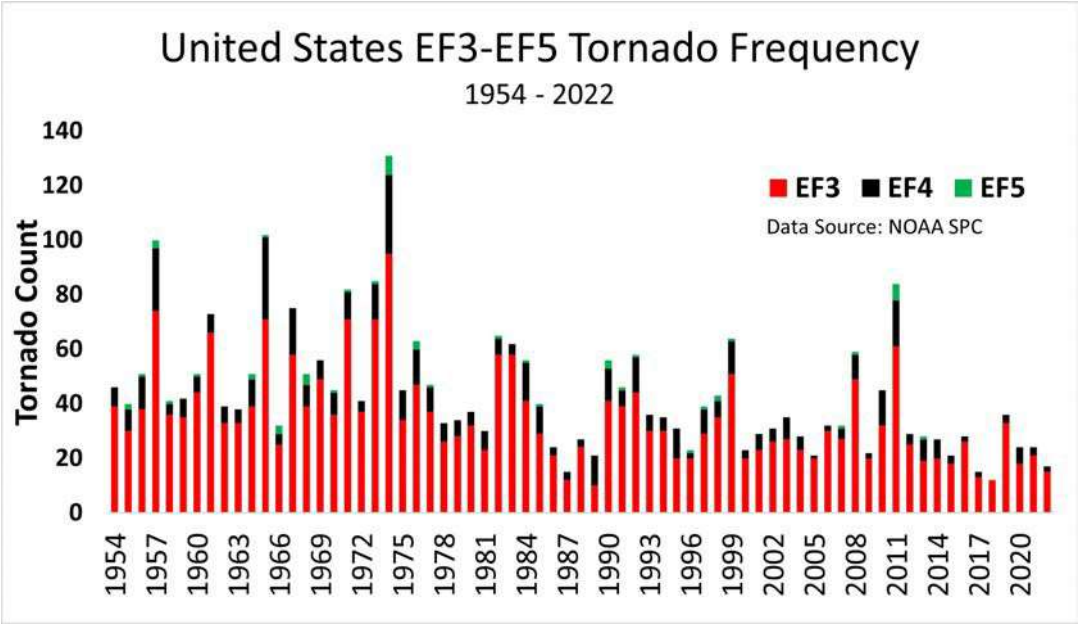
Unfortunately, this is another example of fabricated and omitted contradictory data by government. Prof. Koonin explained why this is false. He said that radar could only detect strong tornadoes, not weak ones, until the last 20 years or so. Thus, the alarming 1950 to 1970 NOAA graph could only include strong tornadoes because weak tornadoes could not be detected, but today's count includes both weak and strong. So, the increase could be simply the result of adding the count of weak tornadoes to the more recent tally and not being able to include the weak ones until 2007. Thus, to get an accurate comparison, it is necessary to include both weak and strong, which the top graph in his Fig. 6.6 does (EF measures tornado strength, from 0 the weakest and 6 the strongest).

Good news: The combined graph of weak and strong tornadoes shows the number of tornadoes has not increased over the past 60 years.



With increasing population, Doppler radar detection and better reporting, the number of tornadoes identified has significantly increased in recent years. Because of this, NOAA recommends only using the strongest tornadoes as a measure of pre-radar numbers. Large and violent tornadoes might well have been identified even in days before better reporting was in place.

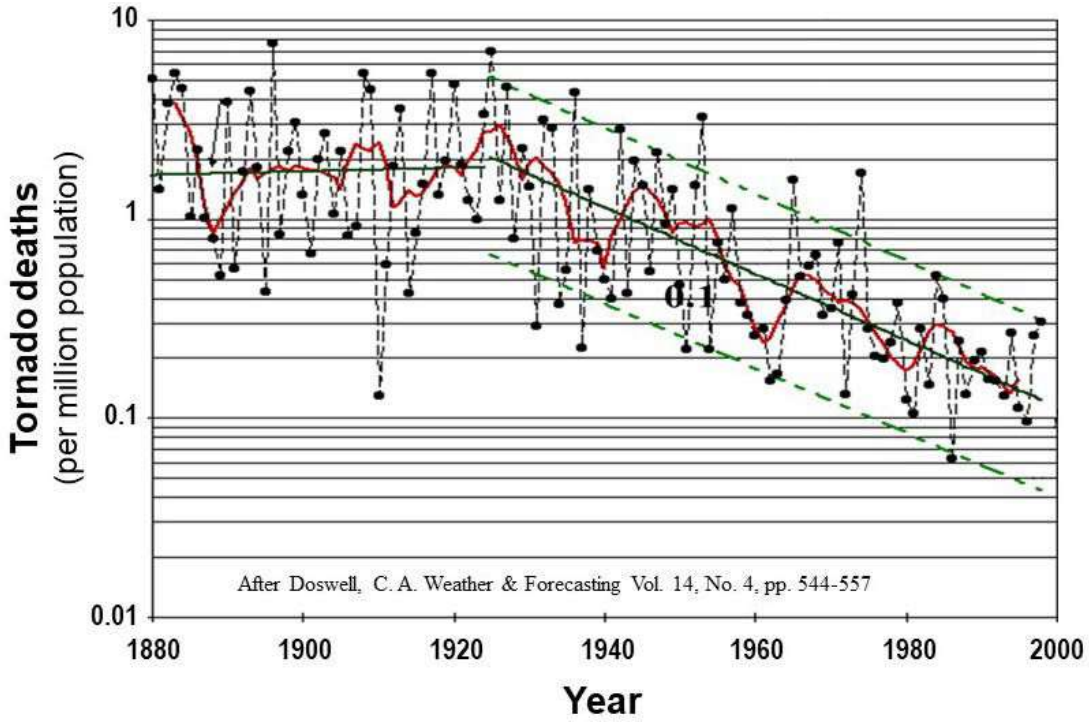
The chart below of these very strong tornadoes (≥F 3.0) shows declining numbers of tornadoes over the last 60 years.[18]



Courtesy Chris Martz (2022)

Outside the tropics (and probably within the tropics too), storminess of all kinds is expected to decrease gently with warmer weather because it is differentials between temperatures that cause storms, and warming reduces those differentials.

Greater improvements in detection and early warning are the primary reason that deaths per million due to tornadoes in the U.S. have been in a long-term decline, but a decline in the number of the storms surely cannot hurt.[19]



Accordingly, we respectfully suggest that every agency analyzing tornadoes, including the USGCRP for its 5th National Climate Assessment, has the scientific obligation to apply the scientific method to contradictory facts and avoid fabricating facts, which in our opinion will require adopting Prof. Koonin's conclusions:

> "[A]s human influences have grown since the middle of the twentieth century, the number of significant tornadoes hasn't changed much at all," "the strongest storms have become less frequent," and "U.S. tornadoes have become more benign as the globe has warmed over the past seventy-five years." Id. pp. 123, 126.

Further, applying the scientific method and analyzing the facts show there is no risk of increased damage by tornadoes as a result of increasing atmospheric CO_2 from fossil fuels. Tornadoes will continue to cause damage, but the resulting increased financial losses will have nothing to do with increases in CO_2 but will be due to upward inflationary pressure and increase in infrastructure in high-risk areas.

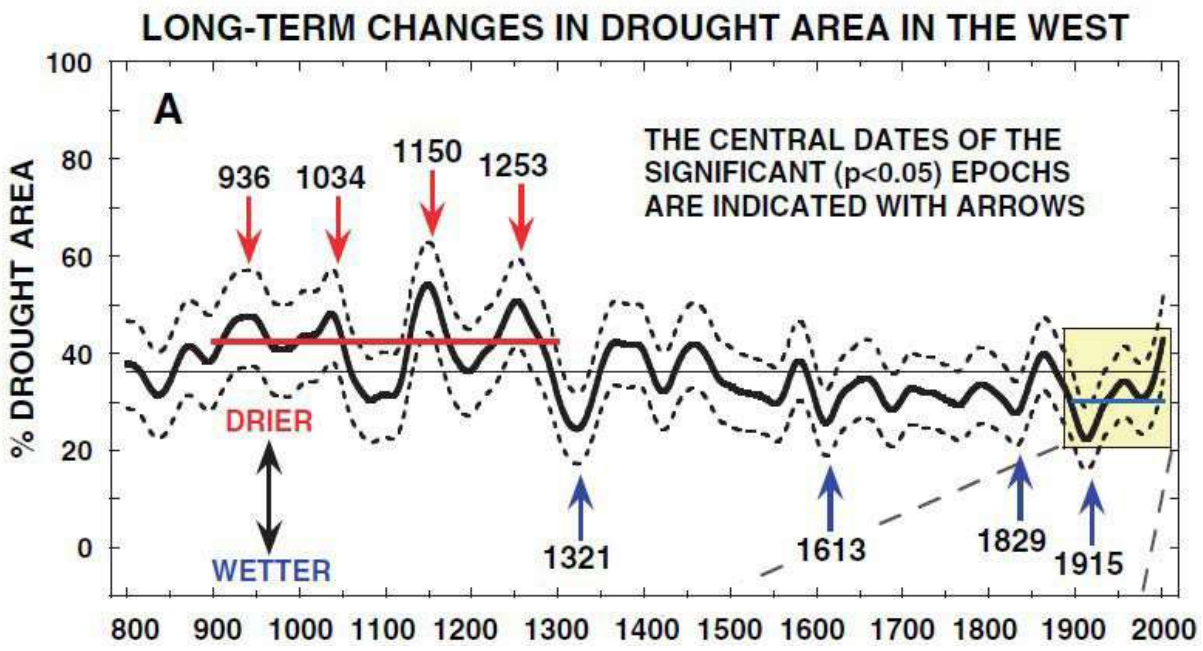
Flooding

As to floods, in Prof. Koonin's Chapter 7 "Precipitation Perils--From Floods to Fires", he reports the U.S. data show only "modest changes in U.S. rainfall during the past century haven't changed the average incidence of floods." Factually, he concludes, "We don't know whether floods globally are increasing, decreasing, or doing nothing at all." Id. p. 137.

Accordingly, we respectfully suggest that every agency analyzing flooding, including the USGCRP for its 5th National Climate Assessment, has the scientific obligation to apply the scientific method to contradictory facts and avoid fabricating facts which, in our opinion, will require adopting Prof. Koonin's conclusions.

Drought

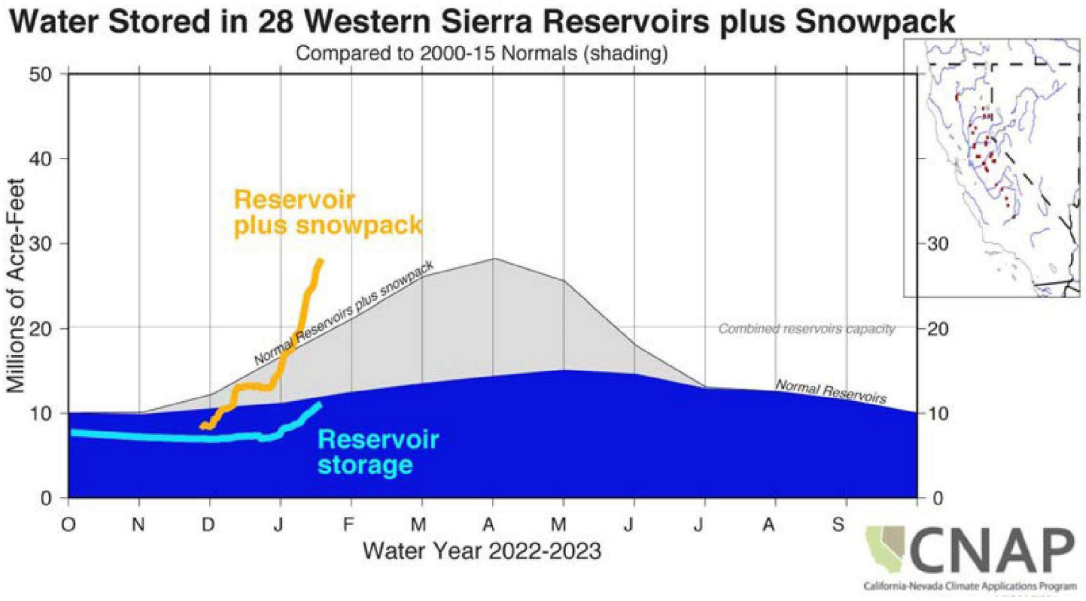
Multiple long-term studies of drought in the southwest confirm that there were periods of horrific drought significantly longer and worse than the southwest drought (that just ended). Cook (2015) studied long-term changes in drought in the area and concluded that the current drought shows "that this drought pales in comparison to an earlier period of elevated aridity and epic drought in AD 900 to 1300." Their chart supporting this is shown below.[20]



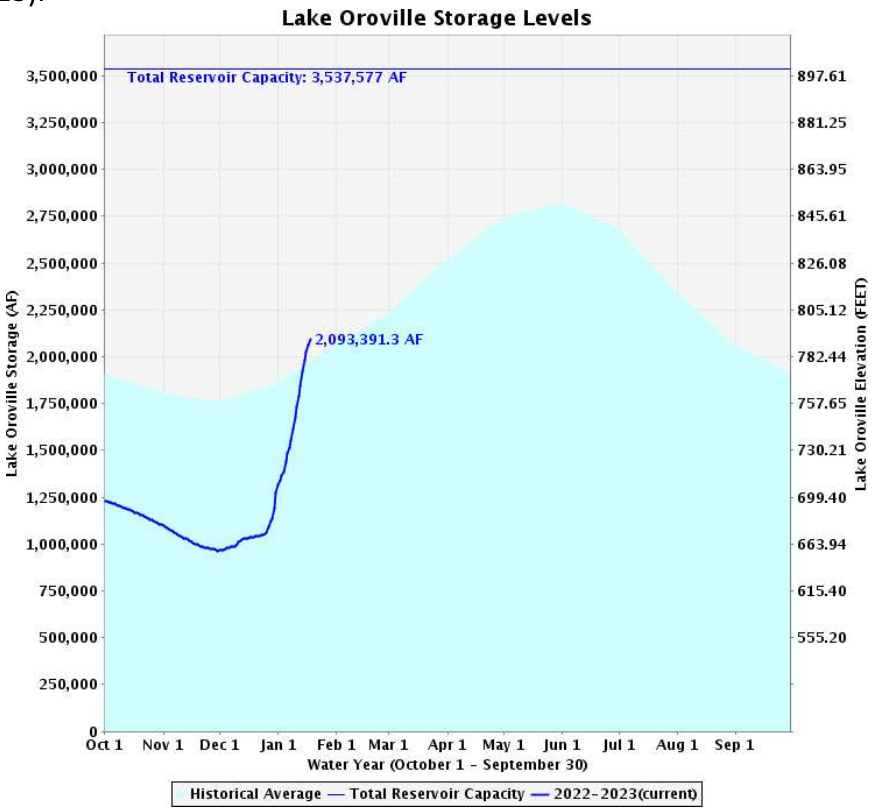
Confirming the existence of significantly longer and worse droughts are confirmed by others, including Kleppe (2011), who stated:

> "Evidence for Medieval droughts of duration and magnitude much larger than those in the instrumental record has been reported throughout much of the world, but a particularly robust signal is expressed in the western United States."

The above discussion is irrelevant now that the southwest drought has likely ended with recent significant precipitation. For example, the total water available right now (February 2023) in the western Sierra snowpack is greater than normally available in April (yellow line is the 2022/2023 data). It is now over 200% of normal for all major Sierra regions…and nearly 300% for the south Sierra area.[21]



The previous deficit in California reservoir water storage is now gone. For example, consider the huge Lake Oroville Reservoir in Northern California during the past month. It went from roughly 60% of normal to 106% (Mass 2023).

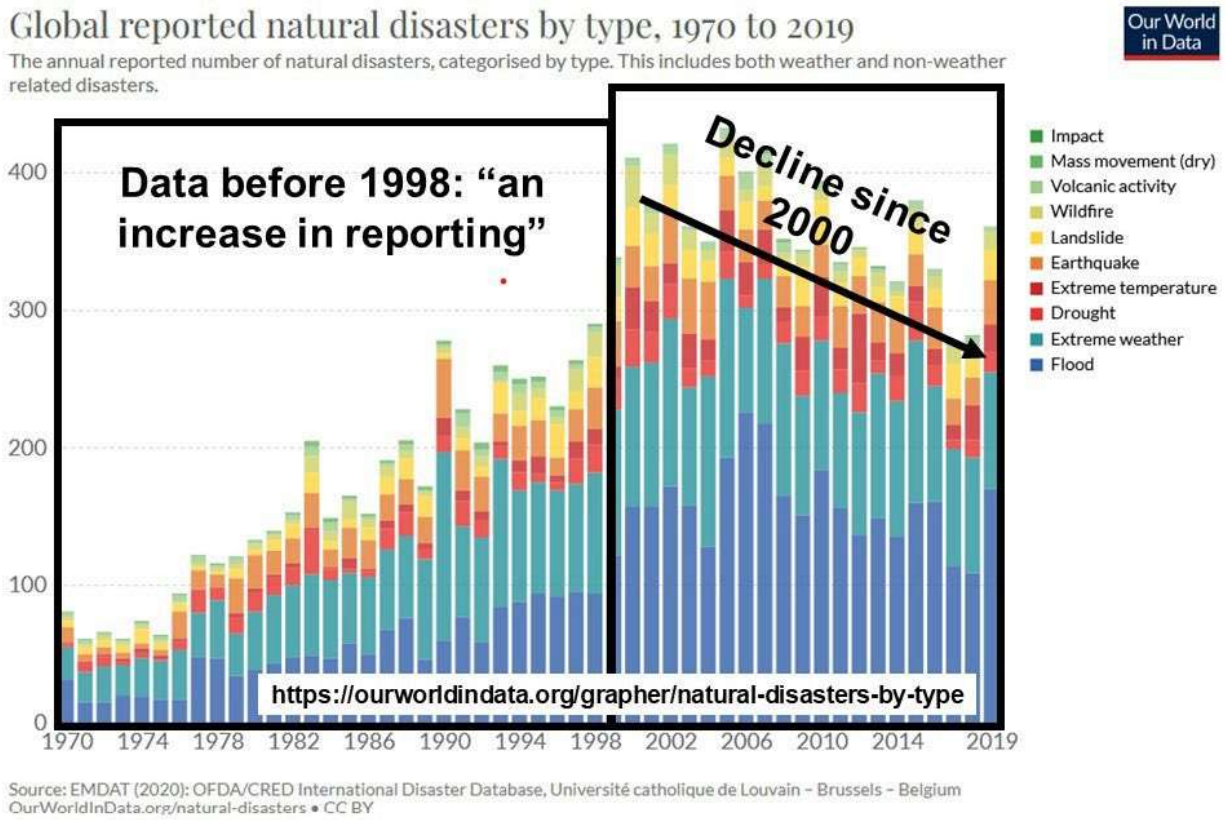


Accordingly, we respectfully suggest that every agency analyzing drought, including the USGCRP for its 5th National Climate Assessment, has the scientific obligation to apply the scientific method to contradictory facts and avoid fabricating facts.

Natural Disasters and Extreme Weather Generally

The data above and more below demonstrate the peoples of the world and the United States are much safer from extreme weather events today.

The World Meteorological Organization (WMO) in 2021 published a review of extreme weather. The report was titled *The Atlas of Mortality and Economic Losses from Weather, Climate and Water Extremes (1970 – 2019)*. The report drew on data gathered by the Centre for Research on Epidemiology of Disasters (CRED), a Brussels-based organization that collaborates with the U.N. shown below.[22]

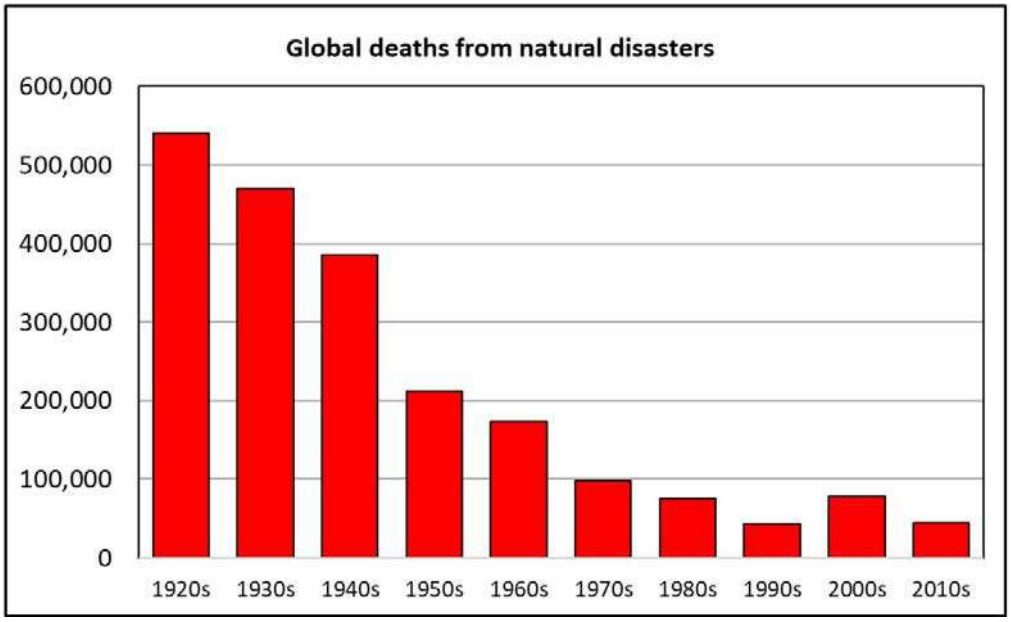


News reports used this chart to claim a "five-fold increase" in natural disasters and, indeed, there was such an increase from 1970 until 2000. It turns out that the initial 30 years reviewed by the report (1970 to 2000) are when the system for collecting information on natural disasters was being developed by CRED. During the first few years of the system's operation in the 1970s, external sources were reporting fewer than 100 disasters a year. In the 1980s, the count reached 200 a couple of times. By the year 2000, annual disaster totals ranged between 300 and 400 and mostly remained that way until 2019, the last year shown.

In other words, the CRED system's counts rose as it received reports from more sources over the years. Comparing totals from the 1970s with 21st century data is not only inappropriate, but also a blatant misuse of statistics to bolster a pre-ordained conclusion — a classic apples and oranges pairing. Our suspicions were confirmed in an email exchange with Regina Below, CRED database manager and documentalist. When asked if the difference between disaster totals in 1970 and the late 1990s was the result of an increase in reporting rather than a greater incidence of disasters, she answered: "You are right, it is an increase in reporting."

Since the complete build-out of their reporting network in 2000, the data show a ten percent decline in natural disasters.

As reported above, the Centre for Research on the Epidemiology of Disasters does a fine job of collecting data on natural disasters for the World Health Organization and the Belgian Government. According to their data, deaths from natural disasters have plunged more than 90 percent from a yearly average of 540,000 in the 1920s to 45,000 in the last decade.[23]



The incredible reduction in natural disaster-related deaths is due to a combination of factors, including better forecasting and warnings ahead of severe weather events and also a buildout of infrastructure to protect the populace. Nonetheless, this flies in the face of claims of increasing deaths from ever-increasing events.

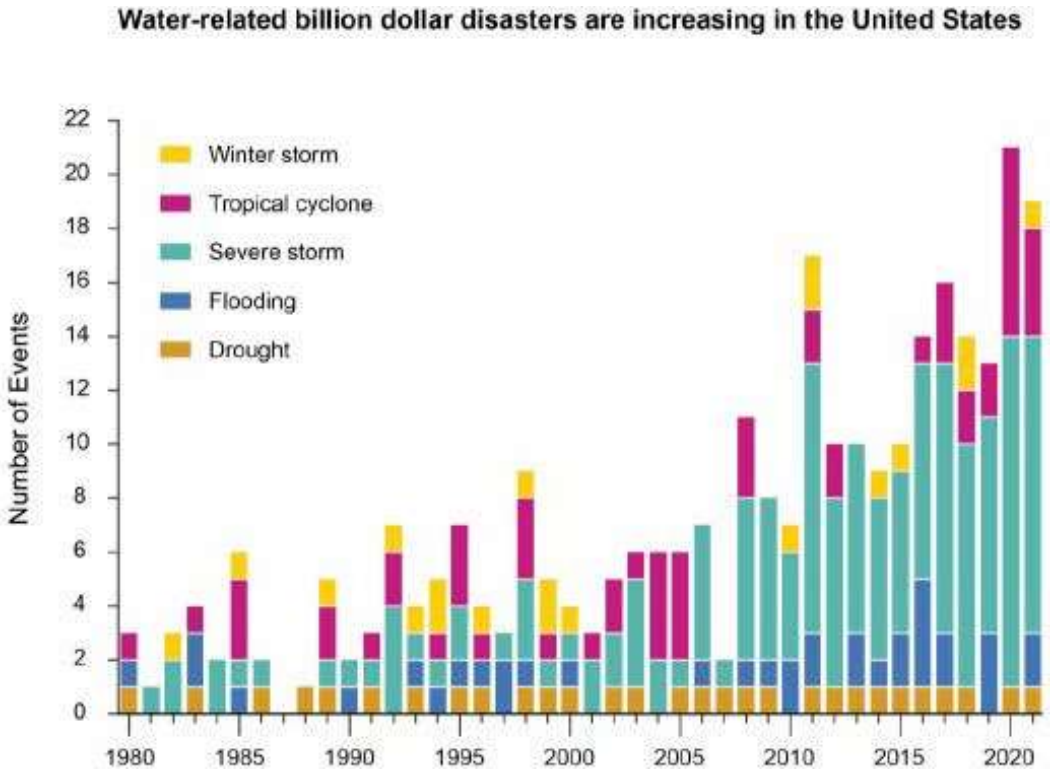
This is more good news about extreme weather.

Monetary Losses from Extreme Weather

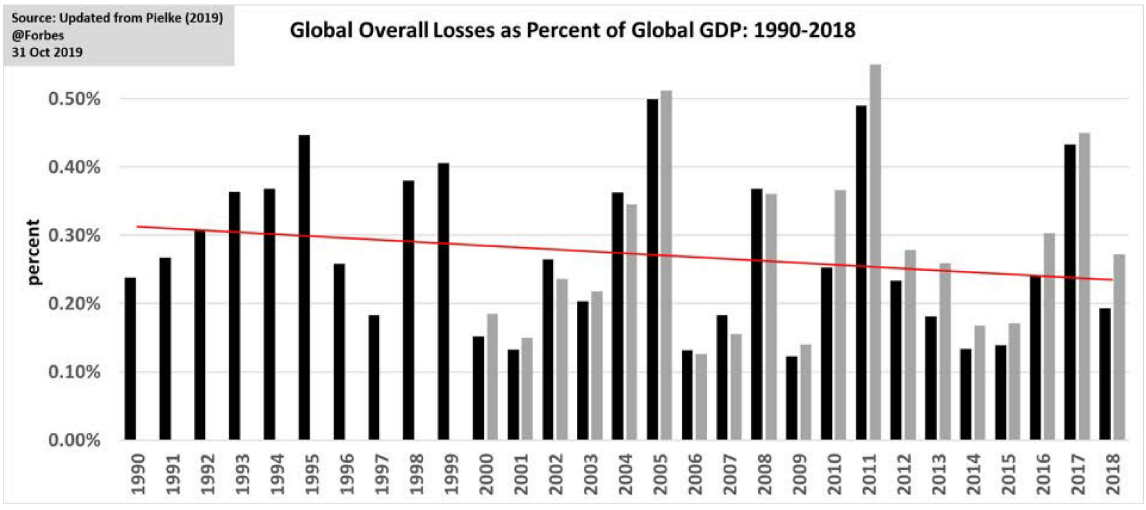
It is incorrect to conflate an increase in monetary losses to increases in severe weather and natural disasters. For example, *Figure 4.1. Water-Related Billion Dollar Disasters* reveals that the number of billion-dollar water-related disasters in the U.S. has increased substantially over the last 60 years. No one

disputes that fact, but it is a meaningless statistic due to inflation and an increase in expensive infrastructure development in high-risk areas.

The dollar had an average inflation rate of 3.02% per year between 1980 and today, producing a cumulative price increase of 260.19%. This means that a $300 million-dollar disaster in 1980 would be a $1 billion-dollar disaster today without factoring in increased infrastructure.



This is a statistical sleight of hand used to exaggerate dangers. In order to use monetary data, it should either be adjusted based on inflation or compare it as a percentage of GDP. In this chart, Roger Pielke, Jr compared global losses from natural disasters to global GDP to reveal that there has been a decline in this metric.[24]



Conclusions About Extreme Weather

Prof. Koonin also analyzes other extreme weather events in the 86 pages of his book that need not be presented here but provide omitted contradictory data that must be analyzed by any of the agencies analyzing extreme weather events.

In conclusion, as to all types of extreme weather, the enormously important good news is that Prof. Koonin rigorously applied the scientific method to the extreme weather facts above and demonstrated:

1. "The bottom line is that the science says that most extreme weather events show no long-term trends that can be attributed to human influence on the climate."

2. "Observations extending back over a century indicate that most types of extreme weather events don't show *any* significant change – and some such events have actually become less common or severe – even as human influences on the climate grow." Id. pp. 99, 98 (emphasis added).

   His conclusions are strengthened by the additional facts presented above.

3. CSSR of the USGCRP 4th National Climate Assessment is fatally flawed as science and should be viewed as only 13 government agencies' opinion, not science. Remember Prof. Koonin's words: "The U.S. government's Climate Science Special Report … does not provide that foundation ["a complete portrayal of science."] Instead, it reinforces alarm with incomplete information and highlights the need for more-rigorous review of climate assessments." Koonin, "A Deceptive New Report on Climate," *Wall Street Journal* (Nov. 2, 2017).

Remember also what the Lysenko experience chillingly reminds us about government- controlled science and opinions. Accordingly, the 4th National Climate Assessment's CSSR must be understood as having no value as science.

Accordingly, we respectfully suggest that every agency analyzing extreme weather events and all others climate issues, including the USGCRP for its 5th National Climate Assessment, has the scientific obligation to apply the scientific method to contradictory facts and avoid fabricating facts which, in our opinion, will require adopting Prof. Koonin's conclusions as to extreme weather and his scientific conclusions on other climate issues.

B. Relies on Models that Do Not Work

"Computer modeling," Prof. Koonin explained in *Unsettled,* "is central to climate science," as their "results underpin the reports of the other UN working groups that assess the impact of a changing climate on ecosystems and society." Id. p. 78. Computer modeling is also central to theory that fossil fuel CO_2 will cause catastrophic global warming and, therefore, to every present and future "Net Zero" regulation pursued by the Biden Administration and others.

The dominant model is the Coupled Model Intercomparison Project (CMIP), now in its 6th version. To illustrate, the CSSR of the 4th National Climate Assessment has more than 250 citations to the CMIP model. The CSSR explains:

> "Here, the primary resource for this assessment is more recent global model results and associated downscaled products from CMIP5." Id. p. 5 (footnotes omitted).

To be used as science, the models must pass the simple and profound test of the scientific method: Do they work? Do they reliability predict temperatures and other climate variables or not?

As demonstrated next, they do not. Thus, CMIP and dependent models should not be used in support of any present or future government regulation or action intended to reduce fossil fuels and CO_2 to "Net Zero."

Prof. Koonin devotes an entire chapter in his book to "Many Muddled Models," pp. 77-96. As personal background he notes that he has been "involved with scientific computing for my entire career," publishing his first paper in 1974 on computer modeling and wrote one of the first textbooks on computer modeling.

He asks, "How good are our climate models? And how much confidence should we have in what they say about future climates?" Id. pp. 77-78.

Applying the basic test of the scientific method – do the climate theoretical models' predictions work – with observations, he demonstrated that they do not.

"Projections of future climate and weather events (rely) on models demonstrably unfit for the purpose." Id. p. 24 (emphasis added). He elaborated:

> "The uncertainties in modeling of both climate change and the consequences of future greenhouse gas emissions make it impossible today to provide real, quantitative statements about relative risks and consequences and benefits of rising greenhouse gases to the Earth system as a whole, let alone to specific regions of the planet." Id. p. 96.

He focused on the dominant model used in climate science, the CMIP model, which has gone through six versions over time. The most recent is CMIP6. He demonstrated the CMIP6 theoretical model did not reliably predict observations in detail, and thus would not be used in science:

> "An analysis of 267 simulations run by 29 different CMIP6 models created by 19 modeling groups around the world shows that they do a very poor job [1] describing warming since 1950 and… [2] underestimate the rate of warming in the early twentieth century [1910-1940]." Id. p. 90 (emphasis added).

> "Comparisons among the [29] models [show]...model results differed dramatically both from each other and from observations...[and] disagree wildly with each other." Id. p. 90 (emphasis added).

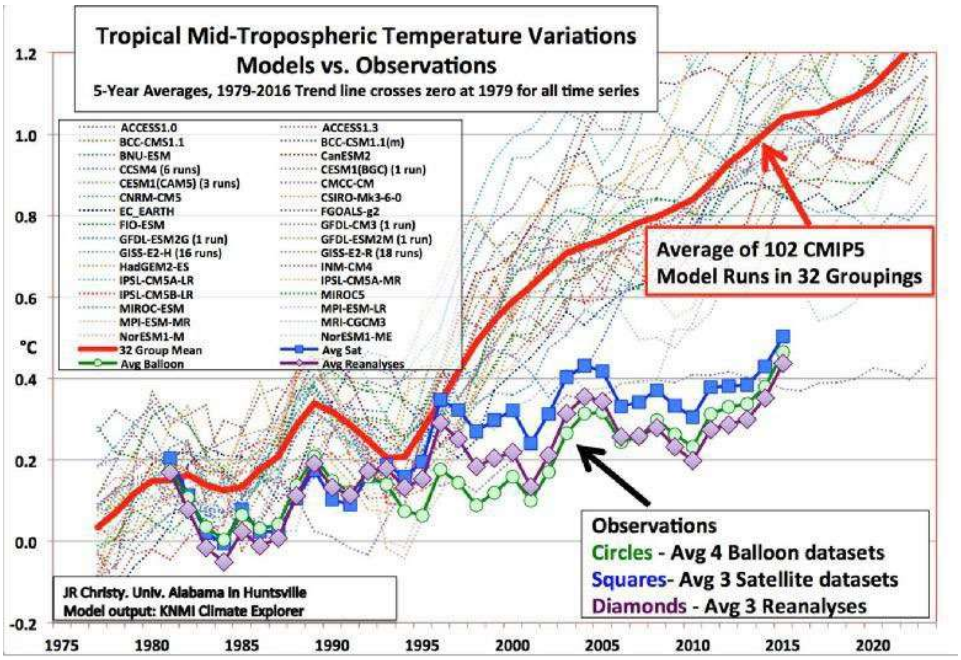
> "One particularly jarring failure is that the simulated global average surface temperature ...varies among models...three times greater than the observed value of the twentieth century warming they're purporting to describe and explain." Id. p. 87 (emphasis added).

As to the early twentieth century warming when CO_2 levels only increased from 300 to 310 ppm, "strong warming [was] observed from 1910 to 1940. On average, the models give a warming rate over that period of about half what was actually observed. That the models can't reproduce the past is the big red flag -- it erodes confidence in their projections of future climate." Id. pp. 88, 95 (emphasis added).

Finally, we understand the CMIP, and other models analyzed in part IIB, often include the CO_2 saturation effect. Yet, despite this, all the models still fail miserably at predicting the future; they simply do not work. Under these circumstances, the model results must be rejected by applying the scientific method.

Accordingly, the CMIP6 model fails the fundamental test of the scientific method. It does not work. It has been demonstrated to be incapable of predicting the past and a preposterous tool for predicting the future climate of the Earth. In science, and for public decision-making, it should never be used.

John Christy, PhD, Professor of Atmospheric Science at the University of Alabama, analyzed the previous version of CMIP5. He demonstrated that its 102 predictions also failed miserably when tested by observations, as shown in the following chart:[25]



- The gray dotted lines are the CMIP5 model's 102 predictions of temperatures ("simulations") for the period 1979-2016.
- The red line is the average, called the "consensus," of the models.
- The blue, purple and green lines show the actual temperatures that were observed against which the models' predictions were tested.

The predicted values are from the 102 climate model realizations from 32 different base model groups. These models are from the most recent science compendium of the UN's Intergovernmental Panel on Climate Change (IPCC) and are the most comprehensive set available. Data for the chart were recently published in the *Bulletin of the American Meteorological Society*.

The squares are the average of the three extant datasets for satellite-sensed global temperatures in the same zone, the circles are the average of the four weather balloon records, and the diamonds are the "reanalysis" data which uses a physical model to compensate for the fact that not all three-dimensional "soundings" of the atmosphere are from the same stations every day.

The difference between the predicted changes and observed is striking, with only one model, the Russian INCM4, appearing realistic. The graph clearly shows that 101 of the 102 predictions by the CMIP5 models (dotted lines) and their average (red line) failed to match the real-world observations significantly.

Focusing on the consensus red line, he concluded:

> "When the 'the scientific method' is applied to the output from climate models of the IPCC AR5, ...I demonstrate that the consensus of the models [red line] fails the test to match the real-world observations by a significant margin. As such, the average of the models is untruthful in representing the recent decades of climate variation and change, and thus would be inappropriate for use in predicting future changes in the climate or related policy decisions." Id. p. 13 (emphasis added).

Simply stated, the CMIP model essential to every government "Net Zero" regulation, action and the trillions of dollars subsidizing renewables and electric cars, trucks, home heating, appliances and many other products do not work.

Therefore, totally contrary to accepted wisdom, applying the scientific method demonstrates the CMIP and dependent models cannot be used as scientific support for, and should be deleted from, any "Net Zero" regulation, action or subsidy. They do not work.

C. Relies on IPCC Findings, Which Are Government Opinions, Not Science

Unknown to most, two IPCC rules require that IPCC governments control what it reports as "scientific" findings on CO_2, fossil fuels and manmade global warming, not scientists. IPCC governments meet behind closed doors and control what is published in its Summaries for Policymakers ("SPMs"), which controls what is published in full reports.

The picture below shows government delegates (not scientists) voting on what to include in the Summary for Policymakers, which the Lysenko tragedy underscores should never be considered as science.[26]

IPCC government delegates crafting the "Summary for Policymakers" document

Deliberation by politically designated officials is not how scientific knowledge is determined. In science, as the Lysenko experience chillingly underscores, and as Richard Feynman emphasized:

"No government has the right to decide on the truth of scientific principles."

The two IPCC rules are:

IPCC SPM Rule No.1: All Summaries for Policymakers (SPMs) Are Approved Line by Line by Member Governments

"IPCC Fact Sheet: How does the IPCC approve reports? 'Approval' is the process used for **IPCC Summaries for Policymakers (SPMs). Approval signifies that the material has been subject to detailed, line-by-line discussion, leading to agreement among the participating IPCC member countries**, in consultation with the scientists responsible for drafting the report."[27]

Since governments control the SPMs, the SPMs are merely government opinions. Therefore, they have no value as reliable science.

What about the thousands of pages in the IPCC reports? A second IPCC rule requires that everything in an IPCC published report must be consistent with what the governments agree to in the SPMs about CO_2 and fossil fuels. Any drafts the independent scientists write are rewritten as necessary to be consistent with the SPM.

IPCC Reports Rule No. 2: Government SPMs Override Any Inconsistent Conclusions Scientists Write for IPCC Reports

IPCC Fact Sheet: "'Acceptance' is the process used for the full underlying report in a Working Group Assessment Report or a Special Report after its SPM has been approved.... **Changes ...are limited to those necessary to ensure consistency with the Summary for Policymakers**." IPCC Fact Sheet, *supra*. (Emphasis added).

IPCC governments' control of full reports using Rule No. 2 is poignantly demonstrated by the IPCC's rewrite of the scientific conclusions reached by independent scientists in their draft of Chapter 8 of the IPCC report *Climate Change 1995, The Science of Climate Change ("1995 Science Report").*

The draft by the independent scientists concluded:

> "No study to date has positively attributed all or part (of the climate warming observed) to (manmade) causes."
>
> "None of the studies cited above has shown clear evidence that we can attribute the observed [climate] changes to the specific cause of increases in greenhouse gases." Frederick Seitz, "A Major Deception on Climate Warming," *Wall Street Journal* (June 12, 1996).

However, the government written SPM proclaimed the exact opposite as to human influence:

> "The balance of evidence suggests a discernible human influence on global climate."
> *1995 Science Report* SPM, p. 4 (emphasis added).

What happened to the independent scientists' draft? IPCC Rule No. 2 was applied, and their draft was rewritten to be consistent with the SPM in numerous ways:

- Their draft language was deleted.
- The SPMs opposite language was inserted in the published version of Chapter 8 in the *1995 Science Report,* on page 439: "The body of statistical evidence in chapter 8 ... now points towards a discernible human influence on global climate."
- The IPCC also changed "more than 15 sections in Chapter 8 of the report ... after the scientists charged with examining this question had accepted the supposedly final text." Seitz, *supra*.

As to the full IPCC reports, hundreds of world-class scientists draft some very good science. What to do? Use a presumption that anything in IPCC reports should be presumed to be government opinion with no value as reliable science unless independently verified by the scientific method.

The "USGCRP website states: 'When governments accept the IPCC reports and approve their Summary for Policymakers, they acknowledge the legitimacy of their scientific content.'"[28] Id. (footnote omitted).

As Richard Feynman made clear, as noted:

> "No government has the right to decide on the truth of scientific principles."

The legitimacy of scientific content is determined by the scientific method. None of the IPCC SPMs, models, scenarios and other findings asserting that dangerous climate warming is caused by CO_2, GHG emissions and fossil fuels is valid science; they are merely the opinions of IPCC governments.

Thus, no present or future government "Net Zero" regulation, policy or action should rely on IPCC government opinions. To illustrate how extensive the reliance on IPCC government opinions is, the 4th National Climate Assessment CSSR has over 200 citations to IPCC findings. All references to the IPCC should be deleted from all future National Climate Assessments and all other analyses supporting "Net Zero" regulations, policies or actions. They are not science; they are only government opinions.

D. Omits the Extraordinary Social Benefits of CO_2 and Fossil Fuels

There is overwhelming scientific evidence that CO_2 and fossils fuels provide many benefits such as preventing great harm to those living in poverty and providing enormous social benefits for the United States, people worldwide and future generations.

CO_2's Six Extraordinary Social Benefits

1. CO_2 is Essential to Food and Thus to Life on Earth

We owe our existence to green plants that, through photosynthesis, convert CO_2 and water, H_2O, to carbohydrates with the aid of sunlight and release oxygen. Land plants get the carbon they need from the CO_2 in the air. Other essential nutrients—water, nitrogen, phosphorus, potassium, etc.—come from the soil. Just as plants grow better in fertilized, well- watered soils, they grow better in air with several times higher CO_2 concentrations than present values. As far as green plants are concerned, CO_2 is part of their daily bread—like water, sunlight, nitrogen, phosphorus, potassium and other essential elements.

Without CO_2, there would be no photosynthesis, no food and no human or other life.

2. More CO_2, including CO_2 from Fossil Fuels, Produces More Food

A major social benefit of increasing CO_2 in the atmosphere is that it increases the amount of food plants produce through what is known as "CO_2 fertilization." More CO_2 means more food for people around the world.

A graphic illustration of the response of plants to increases in CO_2 is shown below. Dr. Sherwood Idso grew Eldarica (Afghan) pine trees with increasing amounts of CO_2 in experiments, starting with an ambient CO_2 concentration of 385 ppm. He showed what happens when CO_2 is increased from 385 ppm to 535 ppm, 685 ppm and 835 ppm over 10 years:[29]

Thousands upon thousands of experimental results demonstrate that more CO_2 increases the amount of food that a large variety of plants produce. See the Plant Growth Database on the Center for the Study of Carbon Dioxide and Global Change website:
http://www.co2science.org/data/plant_growth/dry/dry_subject.php

Mathematically, there are two formulas to calculate the amount of food that results from increasing CO_2 in the atmosphere.

Linear Formula

Dr. Idso advised there is a linear relationship between CO_2 levels and the amount of food produced between 280 ppm and 800 ppm. "Generally, increasing CO_2 since the Industrial Revolution has elicited a linear response through the present. And that response remains linear for most plants through 800 ppm." (Personal communication).

He further explained that an increase of CO_2 from 280 ppm in 1750 to 800 ppm would increase the amount of food by approximately 80% or more. "[W]hat is the total benefit from [increasing CO_2 from] 280 to 700 or 800 ppm? When you use those values, your increase …is probably closer to 70-80% (or more!)." Id.

Accordingly, this implies a linear formula. A CO_2 increase from 280 ppm to 800 ppm, a 520 ppm increase, produces approximately an 80% increase in crop production, which implies a 15.4% increase in food produced per 100 ppm increase of CO_2 in the atmosphere.

Happer Formula

The second formula is one of the author's (Happer). Experiments with CO_2 enrichment show that many crop yields increase by a factor √x with adequate water and other nutrients, where x is the ratio of the current CO_2 ppm level to the former level.

Since 1750, How Much More Food Resulted From the 120 ppm Increase in CO_2?

Applying these two formulas to the frequently cited 120-ppm increase in CO_2 since the beginning of the Industrial Age around 1750 shows the 120-ppm increase in CO_2 greatly benefited people around the world by increasing the amount of food available by about 20%![30]

How Much More Food Would Result from Doubling CO_2 400 to 800 ppm?

What if the CO_2 in the atmosphere doubled from about 400 ppm today to 800 ppm, the number used for the Equilibrium Climate Sensitivity (ECS)?

Using the Happer formula, the amount of food available to people worldwide would increase by about 40%.[31] Using the linear formula, the increase would be about 4×15.4%, about 60%.
Thus, doubling CO_2 from 400 ppm to 800 ppm would increase the food available worldwide 40% – 60%.

What if the "Net Zero" fossil-fuel CO_2 policy was in effect worldwide in 1750?

The amount of food available to people around the world would have been a disastrous 20% less!

What if the "Net Zero" fossil-fuel CO_2 policy stopped CO_2 from doubling 400 ppm to 800 ppm? The amount of food available to people worldwide would be 40%-60% less, greatly increasing the possibility of massive human starvation.

3. In Drought-Stricken Areas, More CO_2 Produces More Food

Another social benefit of increasing CO_2 in the atmosphere is that drought-stricken areas will have more food. Science demonstrates that increasing CO_2 increases plant water-use efficiency by lessening water lost by plant transpiration.

"In some cases, a doubling of the air's CO_2 content may actually double plant" water use efficiency. C. Idso & S. Idso, *The Many Benefits of Atmospheric CO_2 Enrichment* (2011), p. 340.

4. Different Plants with More CO_2 Produce Vastly More Food

Another major social benefit of raising the amount of CO_2 in the atmosphere is there are huge variations in how different plants respond to increased CO_2.

Dr. Idso's *Climate Change Reconsidered II: Fossil Fuels* reported how six categories of plants responded to a 120-ppm increase in CO_2 ranging from 28% to 70%:[32]

> "Since the start of the Industrial Revolution, it can be calculated…that the 120-ppm increase in atmospheric CO_2 concentration [from 280 ppm to about 400 pm today] increased agricultural production per unit land area" for various crops averaging 57% and ranging from 28% to 70% as follows, listed in order of the largest increase:
>
> "70% for C3 cereals"
> "67% for root and tuber crops" "62% for legumes"
> "51% for vegetables"
> "33% for fruits and melons"
> "28% for C4 cereals."

Similarly, 2050 Global Food Estimates Table 2 shows that the 90 crops that make up 95% of the total food produced in the world respond to a 300 ppm increase in CO_2 over a wide range – a 176% increase for coffee, 135% increase for onions, 110% increase for pigeon peas and a 5% increase for pineapples. Id. p. 12.

Thus, the opportunity to significantly increase food production is to identify and harvest the plants that produce the most food in response to CO_2 fertilization.

5. Different Varieties of the Same Plant with More CO_2 Produce Vastly More Food

Another way more CO_2 produces more food is because different varieties of the same plant, called genotypes, respond to increased CO_2 fertilization in widely different amounts.

For example, 16 varieties of rice respond to CO_2 fertilization by producing an amount of rice that ranges from decreasing 7% to increasing 263%. Id. pp. 30-31.

Thus, identifying and harvesting the crop varieties that produce the most food in response to CO_2 fertilization, like the rice variety that increases the amount of rice produced by 263%, is another opportunity to significantly increase food production.

Dr. Idso underscored the remarkable impact this method by itself can have reducing human starvation by 2050. If we "learned to identify which genotypes provided the largest yield increases per unit of CO_2

rise, and then grew those genotypes, it is quite possible that the world could collectively produce enough food to supply the needs of all of its inhabitants." Id. p. 31 (emphasis added).

Accordingly, identifying and harvesting the crop varieties with the largest yield increases, for example, the rice variety that yields 263%, would have a major impact in helping to prevent massive human starvation by 2050.

6. CO_2 and Other Greenhouse Gases Keep Us from Freezing to Death

CO_2 and other greenhouse gases hinder the escape of thermal radiation to space. We should be grateful for them. Greenhouse gases keep the Earth's surface temperature warm enough and moderate enough to sustain life on Earth. Without them, we would freeze to death.

Fossil Fuels' Four Extraordinary Social Benefits

There are four, little reported, extraordinary social benefits of fossil fuels.

1. Burning Fossil Fuels Creates More CO_2 and Thus More Food

As explained, increasing the CO_2 in the atmosphere can substantially increase the amount of food available to people worldwide. But where can we get more CO_2? Continue using and, even better, increase the use of fossil fuel. Fossil-fuel CO_2 has the same power to create more food through photosynthesis.

2. Fossil Fuels are Essential to Making Fertilizers

Also, as explained previously, in the early 1900s, Fritz Haber and Carl Bosch developed a process and method of production by which natural gas and atmospheric N_2 could be converted into ammonia (NH_3), an extraordinarily effective fertilizer for growing plants as shown above.

As noted, today it "is estimated that nitrogen fertilizer now supports approximately half of the global population." Thus, if "Net Zero" and "Carbon-0" policies and actions to eliminate fossil fuels are implemented, about half the world's population would not have enough food without fossil fuel-derived nitrogen fertilizers.

3. Fossil Fuels are Essential to Making Key Pesticides

Many pesticides (and countless other chemicals in everyday use) are produced from gas and oil, including chlorobenzene, neonicotinoids, pyrethroids, and glyphosate. About one billion pounds of pesticides are used each year in the United States to control weeds, insects, and other pests.

The use of pesticides has resulted in a range of benefits, including increased food production and reduction of insect-borne disease. Those benefits would be greatly diminished and more expensive if nitrogen derived from fossil fuels were unavailable.

Thus, eliminating fossil fuels would be disastrous by itself for eliminating fertilizers and pesticides that the world's food supply depends on and without which there will be massive human starvation.

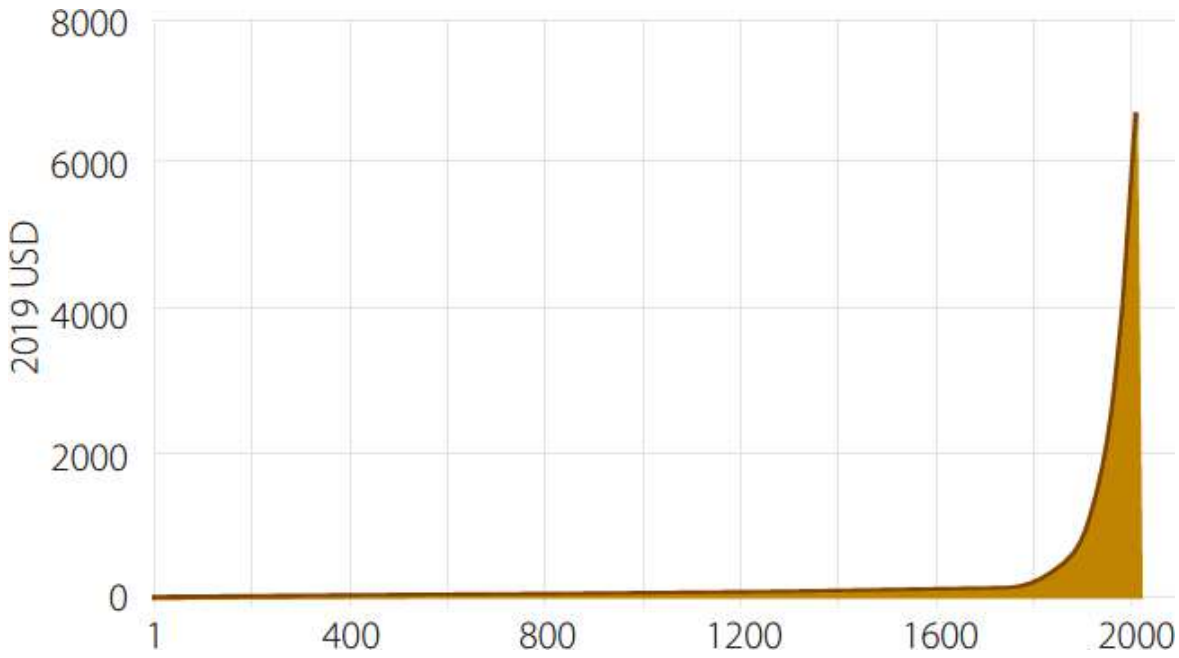
As noted previously, Sri Lankan President Rajapaksa in April 2021 banned "the importation and use of synthetic fertilizers and pesticides and ordered the country's 2 million farmers to go organic."[33] The result was disastrous. "Its rice production has dropped more than 50%, while domestic rice prices have increased more than 80%." Id. This is a real-life warning of the worldwide disaster that will result by eliminating fossil fuels and implementing "Net Zero" and "Carbon-0" policies and actions.

4. Fossil Fuels are the Most Reliable, Low-Cost Source of Energy

The fourth extraordinary social benefit of fossil fuels, of course, is that they provide low-cost energy and resulting jobs.

Affordable, abundant fossil fuels have given ordinary people the sort of freedom, prosperity and health that were reserved for kings in ages past.

The following chart of the GDP per person for the last 2,000 years powerfully illustrates what has happened:[34]



Any present or future government "Net Zero" regulation, policy or other action that omits analysis of the six extraordinary social benefits of CO_2 and/or omit analysis of the four extraordinary social benefits of fossil fuels is fatally flawed science.

E. Omits the Disastrous Consequences of Reducing Fossil Fuels and CO_2 to "Net Zero"

There is also overwhelming scientific evidence that eliminating CO_2 and fossil fuels will have disastrous consequences by causing great harm to those living in poverty and destroying the enormous social benefits for the United States, people worldwide and future generations.

Eliminating Fossil Fuels Will Eliminate Nitrogen Fertilizer That Feeds Half the World. The importance of fossil fuel-derived nitrogen fertilizers cannot be overstated. It is "estimated that nitrogen fertilizer now supports approximately half of the global population" by itself.[35]

As background, Fritz Haber and Carl Bosch in the early 1900s developed a process and method of production by which natural gas and atmospheric N_2 are converted into ammonia (NH_3), a game changing fertilizer for growing plants as shown in the following chart:[36]

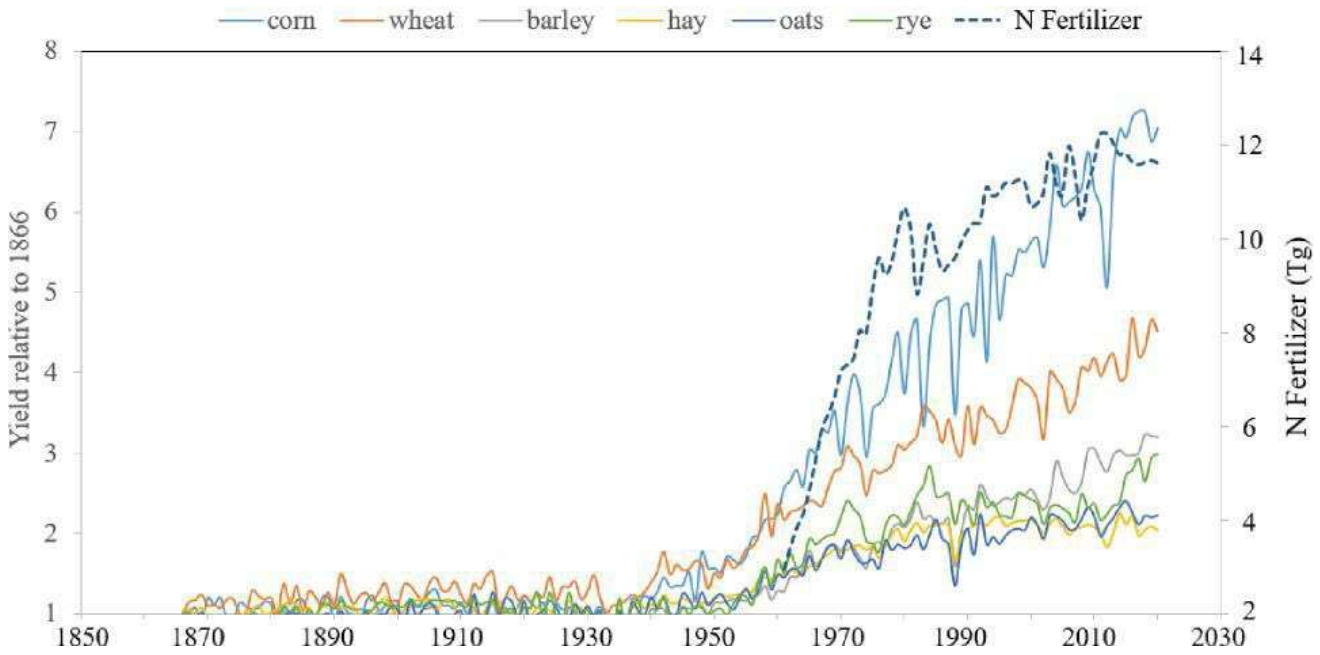


Figure 14: Crop yields relative to yields in 1866 for corn, wheat, barley, grass hay, oats and rye in the United States. Also shown from the year 1961 is the annual mineral nitrogen fertilizer (in Tg = megatonnes) used in agriculture. Crop yields are from the USDA, National Statistical Service [62] and nitrogen fertilizer usage is from the Food Agriculture Organization statistical database [58]. Note the high correlation between yields and the use of nitrogen fertilizer.

The chart shows a remarkable increase in crop yields after the widespread use of fossil fuel-derived nitrogen fertilizer began around 1950 compared to crop yields from 1866 to 1950.

The following chart shows more specifically what happened after the widespread use of nitrogen fertilizer started around 1950, with a threefold increase in cereal crop production between 1950 and 2020. Id. p. 38:

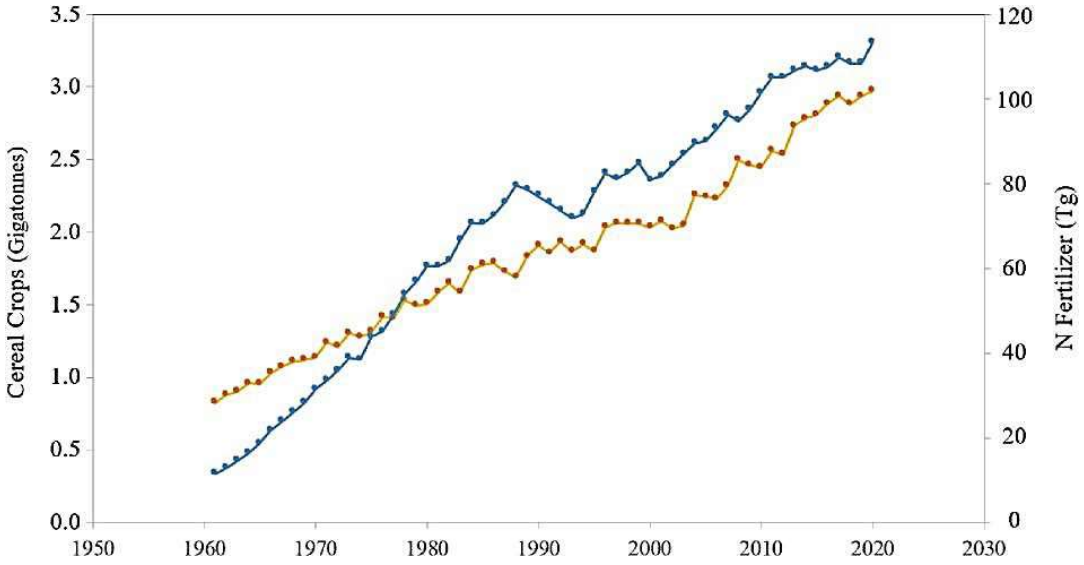
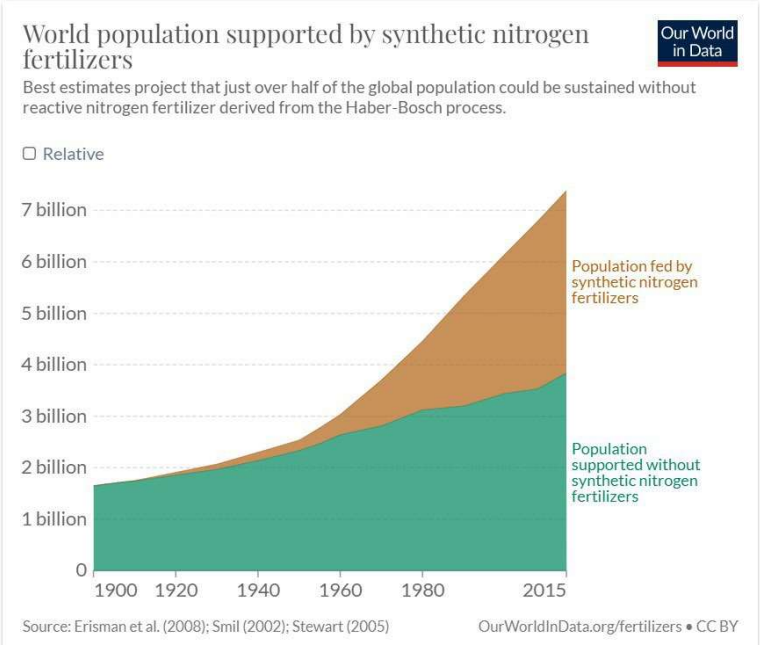


Figure 13: Annual world production of nitrogen fertilizer used in agriculture (blue, in Tg) and world production of all cereal crops (orange, in gigatonnes) from 1961 to 2019. Data from reference [58]. The threefold increase of cereal crop yields was largely due to the use of mineral nitrogen fertilizer. Additional contributors to the increased yields were other mineral fertilizers like phosphorus and potassium, better plant varieties like hybrid corn, increasing concentrations of atmospheric CO_2 , etc.

Today, as noted, it "is estimated that nitrogen fertilizer now supports approximately half of the global population," shown in the following chart: [37]



Accordingly, it cannot be overemphasized that eliminating fossil fuels and implementing "Net Zero" policies and actions mean the elimination of fossil fuel-derived nitrogen fertilizers and pesticides will result in about half the world's population not having enough food to eat.

As noted, Sri Lanka recently demonstrated this is not mere theory by foreshadowing the human tragedy that the elimination of fertilizers and pesticides dependent on fossil fuels will cause. Sri Lankan President Rajapaksa in April 2021 banned "the importation and use of synthetic fertilizers and pesticides and ordered the country's 2 million farmers to go organic."[38] The result was disastrous. "Its rice production has dropped more than 50%, while domestic rice prices have increased more than 80%." Id. Hungry and angry Sri Lankans stormed the President's office, and he fled the country.

Any present or future government "Net Zero" regulation, policy or other action that omits analysis of the disastrous consequences of reducing fossil fuels and CO_2 to "Net Zero" for low-income people, people worldwide, future generations and the United States is fatally flawed science and appalling government policy.

F. Rejects the Science There is No Risk of Catastrophic Global Warming Caused by Fossil Fuels and CO_2

Scientific knowledge, as detailed above, is determined by the scientific method which requires validating theoretical predictions with observations.

We are not aware of any reliable science that supports the National Climate Assessments or others' theory that fossil fuels and CO_2 will cause catastrophic global warming. We have written extensively on this issue for decades.

Generally, all of the theories and studies arguing that there is a risk of catastrophic global warming caused by fossil fuels and CO_2, that we are aware of, use the same basic method that is totally contrary to the scientific method:

- cherry-pick a tiny amount of time, geologically speaking, that supports their theory,
- omit the millions of years of data that contradicts the theory, or worse, fabricate data, and
- often use a chart that points sharply upward.

Specifically focusing on the use, or failure to use, the scientific method provides four scientific reasons, each of which alone demonstrates there is no risk of catastrophic global warming caused by fossil fuels and CO_2:

1. None use the scientific method.
2. None of the models work.
3. All omit contradictory data.
4. CO_2 is "saturated" at today's level, so more CO_2 will cause little warming

Scientific details follow:

1. None Use the Scientific Method

The only arguments we are aware of marshalled to support the theory of catastrophic global warming caused by fossil fuels and CO_2 do not rigorously apply the scientific method. Instead, one or more of the following methods are used. They may, or may not, provide useful information. However, none determine scientific knowledge:

- consensus
- peer review
- government opinion
- models that do not work
- fabricating data
- omitting contradictory data
- ideology
- politicized science

Accordingly, for this reason alone, none of these methods advocating the theory fossil fuels and CO_2 will cause catastrophic global warming is scientifically based and do not provide scientific knowledge.

2. None of the Models Work

All of the models we are aware of use asserting fossil fuels and CO_2 will cause catastrophic global warming do not work; all of the model predictions fail miserably, as shown above. Thus, none of them can be used as science.

Thus, without models reliably predicting catastrophic increases in temperature, the models cannot be used to predict catastrophic warming for this reason alone.

3. All Omit Contradictory Data

All of the theories and studies we are aware of violate the scientific method by either omitting data that contradict theory, or worse, fabricating data. As noted, in our experience and as demonstrated above, "misrepresentation, exaggeration, cherry-picking, or outright lying pretty much covers all the so-called evidence" marshalled in support of theory of catastrophic global warming caused by fossil fuels and CO_2.[39]

All of the studies we are aware of concluding there will be catastrophic global warming unless fossil fuels and CO_2 are reduced to "Net Zero" utilize very short periods of geological time even though there is extensive data for hundreds of millions of years. For example, short for cherry-picked time periods are often as low as 50-200 years. Also, a frequently used turning point is the beginning of the Industrial Revolution in the mid-1700s, but that's a trivially short few hundred years ago in geological time.

The obvious question is: What happened over the hundreds of millions of years of geological time that is omitted?

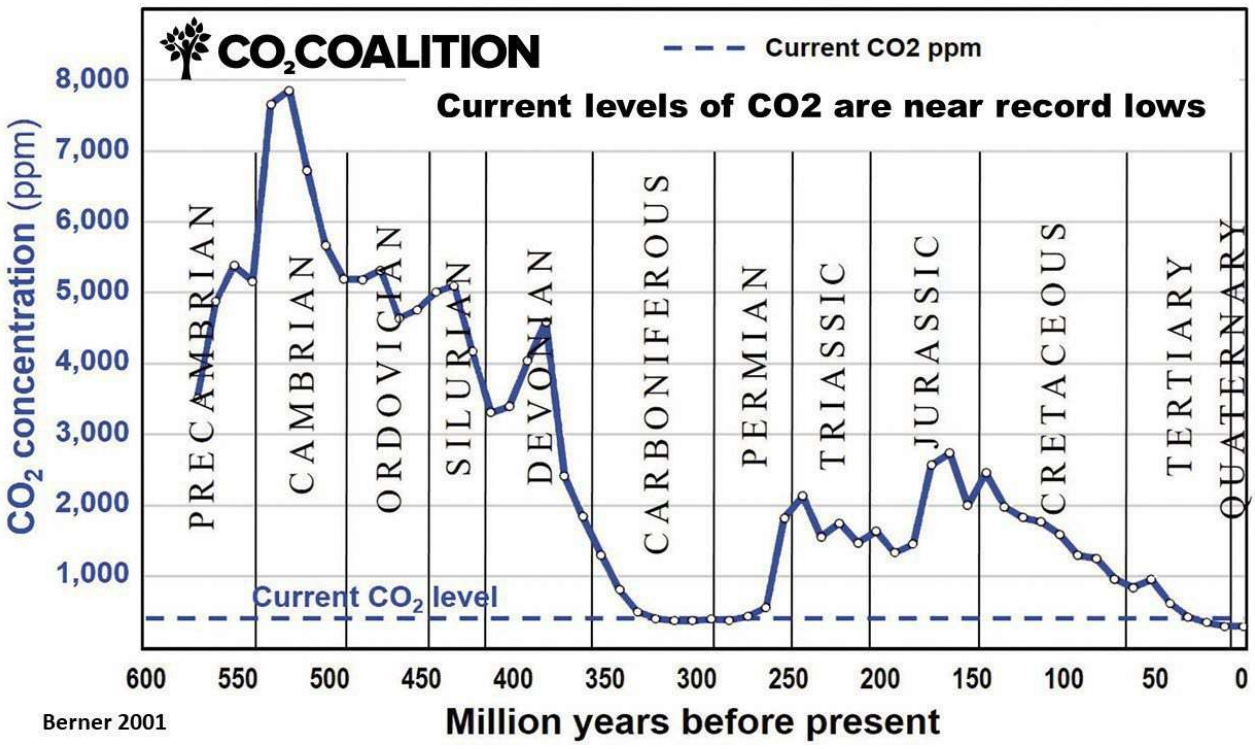
The answer is the omitted data contradicts the theory that fossil fuels and CO_2 will cause catastrophic global warming, demonstrated by the two charts below.

600 Million Years of Data Show Today's 419-ppm CO_2 Level is Near a Record Low, Not Dangerously High

Common in all government and other studies warning that there will be catastrophic global warming unless fossil fuels and CO_2 emissions are reduced to "Net Zero" is the common method of cherry-picking trivially short periods of geological time that supports a theory and omitting hundreds of millions of years of geological data that contradicts theory, and usually applying the standard chart template of a line rising dramatically upward.

As noted, in science, it is an egregious violation of the scientific method to omit contradictory data or, worse, fabricate data to make a theory work.

In climate science, it is often argued that today's 419 ppm CO_2 is dangerously high. What is omitted are hundreds of millions of years of data that prove CO_2 levels today is near a record low and nowhere near being dangerously high:[40]



What is omitted are hundreds of millions of years of data on CO_2 levels that prove that:

- CO_2 levels ranged from a high of over 7,000 ppm -- almost 20 times higher than today's 419 ppm, to a low of 200 ppm, close to today's low 419 ppm.
- Today's 419 ppm is not far above the minimal level when plants die of CO_2 starvation, around 150 ppm, when all human and other life would die from lack of food.
- CO_2 levels were more than 1,000 ppm for nearly all of the last 600 million years.
- The often highly emphasized 135 ppm increase in CO_2 since the beginning of the Industrial Age is trivial compared to CO_2 changes over the geological history of life on Earth.

What about temperatures?

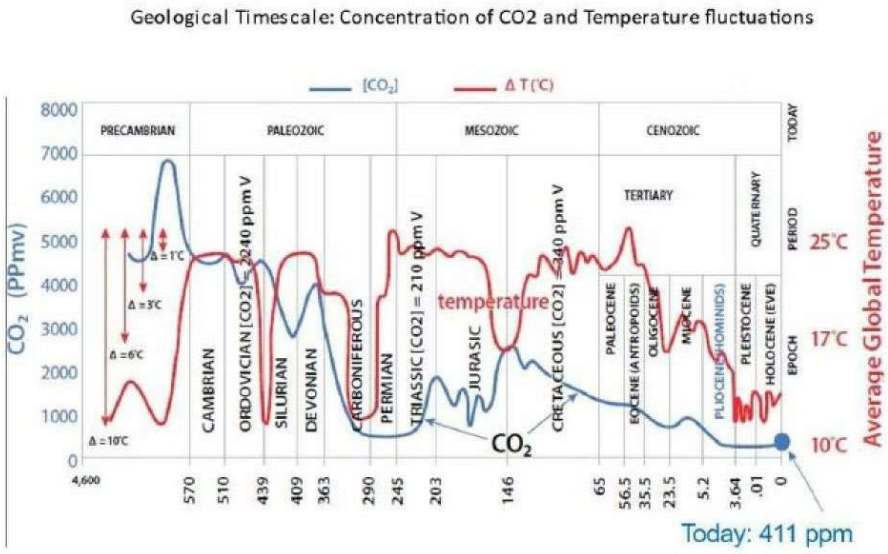
600 Million Years of CO_2 and Temperature Data Contradict Theory that High Levels of CO_2 Will Cause Catastrophic Global Warming

The chart below shows 600 million years of CO_2 levels and temperature data.[41]

It shows an inverse relation between CO_2 and climate temperatures during much of Earth's history over the last 600 million years, with higher levels of CO_2 correlated with lower temperatures and vice versa.

Although the data are based on various proxies, with the attendant uncertainties, they are good enough to demolish the argument that atmospheric CO_2 concentrations control Earth's climate and theory that fossil fuels and CO_2 will cause catastrophic global warming. They will not.

The blue line shows CO_2 levels. The red line shows temperature.



1- *Analysis of the Temperature Oscillations in Geological Eras* by Dr. C. R. Scotese © *2002*. 2. Ruddiman, W.F. 2001. *Earth's Climate: past and future* W.H. Freeman & Sons. New York, NY. 3 - Mark Pagani *et al.* *Marked Decline in Atmospheric Carbon Dioxide Concentrations During the Paleocene.* Science; Vol. 309, No. 5734; pp. 600-603. 22 July 2005. *©rrected on 07 July 2008 (CO2: Ordovician Period).*

Reconstructed atmospheric carbon dioxide concentrations (Berner, 2001) & global mean surface temperature (Scotese, 1999) over the last 550 million years

Specifically, the chart shows:

- For hundreds of millions of years, temperatures were low when CO_2 levels were high, and temperatures were high when CO_2 levels were low.
- When CO_2 was at a record high at about 7,000 ppm, temperatures were at a near-record low.
- CO_2 levels were low when temperatures were at the highest they have ever been about 60 million years ago.
- CO_2 concentrations and temperatures are not correlated over the 600 million years.
- CO_2 levels have been relatively low for the last 300 million years and have been declining from 2,800 ppm to today's 420 ppm over the last 145 million years.
- Temperatures have been higher than today over most of the 600 million years and life flourished.

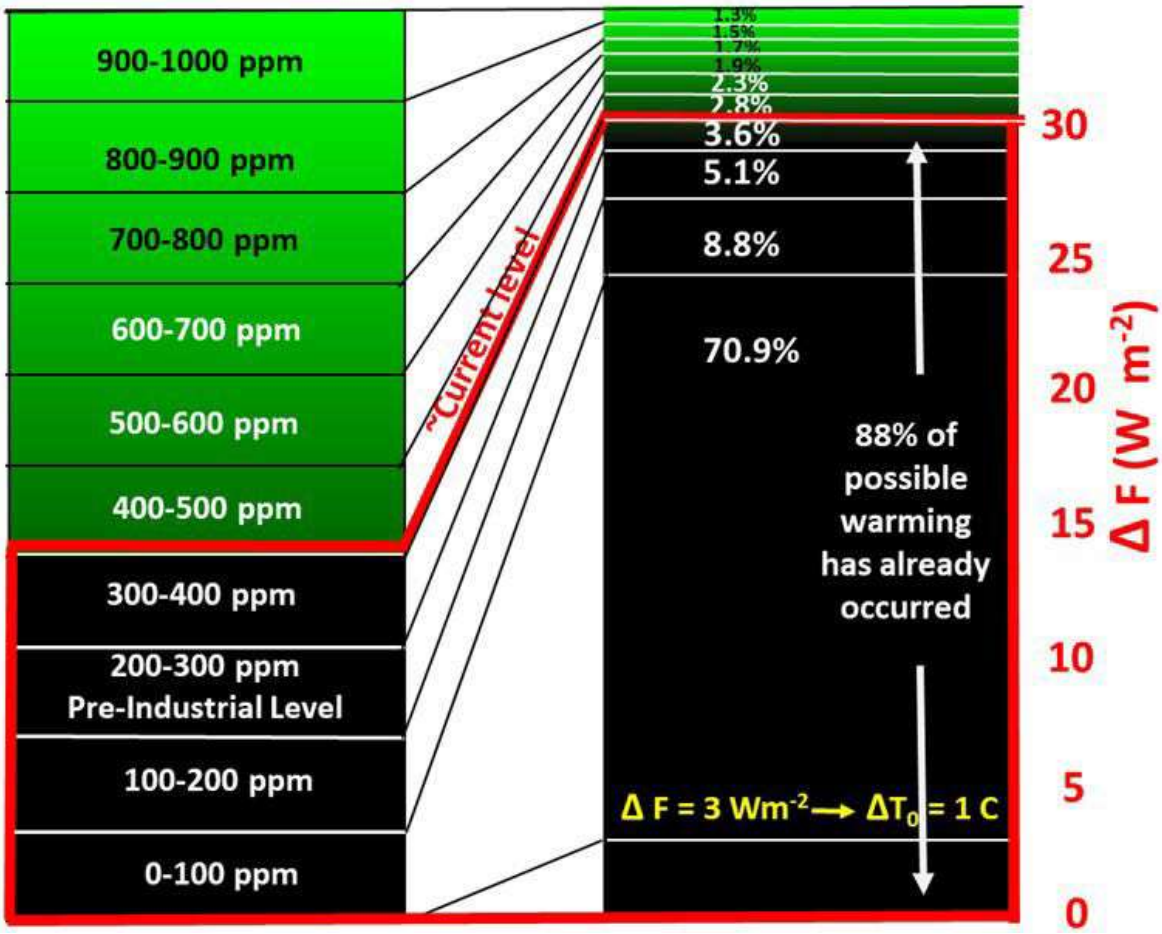
Thus, applying the scientific method to the 600 million years of omitted data contradicts the theory that fossil fuels and CO_2 will cause catastrophic global warming. Theory does not agree with the observations. Scientifically, it must be rejected. For this reason alone, there is no risk of catastrophic global warming.

4. CO_2 is "Saturated" at Today's Level, So More CO_2 Will Cause Little Warming

Both of us have special expertise in radiation transfer, the prime mover of the greenhouse effect in Earth's atmosphere. It is important to understand the radiation physics of what the effect is of adding CO_2 at current atmospheric concentrations.

CO_2 becomes a less effective greenhouse gas at higher concentrations because of what is often called "saturation." Each additional 100 ppm increase of CO_2 in the atmosphere causes a smaller and smaller change in "radiative forcing," or in temperature. The saturation is shown in the chart below.[42]

Less Global Warming for Each Additional 100 Parts-Per-Million- by-Volume of CO_2 Concentration (1,000 ppm maximum)



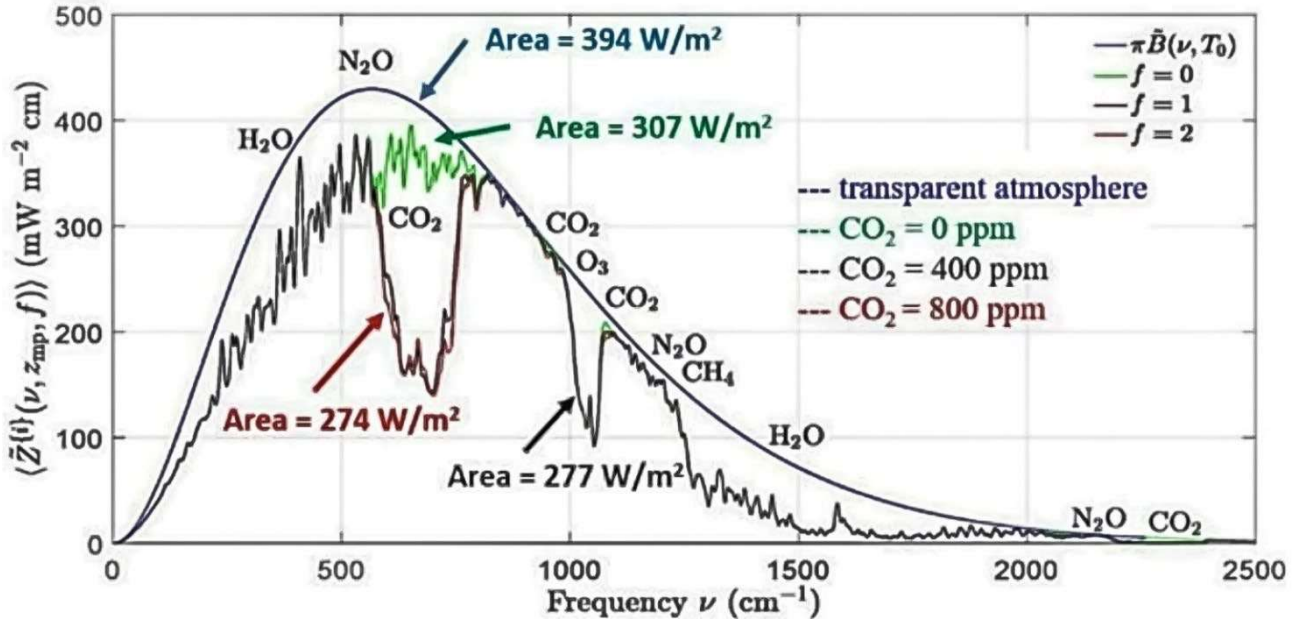
(The radiative forcings, ΔF from CO_2 of concentration c are well described by the formula $\Delta F = \delta F \log_2 (1 + c/c0)$ for the top of the atmosphere, $\delta F = 3$ Wm^{-2} and the saturation concentration is $c0 = 0.3725$ ppm.)

This means that from now on our emissions from burning fossil fuels will have little impact on global warming. We could emit as much CO_2 as we like with little warming effect. There is no climate emergency. No threat at all.

Saturation also explains why temperatures were not catastrophically high over the hundreds of millions of years when CO_2 levels were 10-20 times higher than they are today, shown in the chart "Geological times scale: Concentration of CO_2 and Temperature fluctuations" above.

Further, as a matter of physics, saturation explains why reducing the use of fossil fuels to "Net Zero" by 2050 would have a trivial impact on climate, also contradicting theory it is urgently necessary to eliminate fossil fuel CO_2 to avoid catastrophic global warming. Adding more CO_2 to the atmosphere slightly decreases the amount of long-wave infrared radiation that goes to space, called the "flux." The details are shown in the graph below.[43]

The blue curve shows the heat energy the Earth would radiate to space if our atmosphere had no greenhouse gases or clouds. The magnitude is measured in Watts per square meter (W/m^2). Without greenhouse gases, the total heat loss of 394 W/m^2 would soon cool the Earth's surface to 16° F, well below freezing. Most life would end at these low temperatures. Thus, we should be grateful for greenhouse warming of the Earth.



The jagged black curve below the blue curve shows how much less the Earth radiates infrared radiation to space with the current concentration of greenhouse gases water vapor (H_2O), nitrous oxide (N_2O), carbon dioxide (CO_2), ozone (O_3), and methane (CH_4). Because of these greenhouse gases, the Earth radiates 277 W/m^2 rather than 394 W/m^2 to space, 70% (277/394) of what it would radiate with no greenhouse gases.

What would happen if CO_2 concentrations were to be doubled from 400 ppm to 800 ppm? See the red curve.

Without detailing the mathematics here, basic physics shows that doubling CO_2 would result in a temperature increase of a trivial amount, less than 1° C (2° F).

In summary:

- 394 W/m^2 would be radiated to space without the greenhouse effect.
- 277 W/m^2 only is radiated to space because of the greenhouse effect.
- 3 W/m^2 more warming if CO_2 is doubled from 400 ppm 800 ppm.

Finally, we understand the CMIP, and other models analyzed in part IIB, often include the CO_2 saturation effect. This is further proof that all the models must be rejected applying the scientific method because the models still fail miserably at predicting the future and do not work.

Accordingly, since CO_2 at today's level is "saturated," for this reason alone there is no risk fossil fuels and even doubling CO_2 will cause catastrophic global warming.

In conclusion, there are four reasons, separately and together, when applying the scientific method, that indicate there is no risk that fossils fuels and CO_2 are causing, or will cause, catastrophic global warming. There is, however, a real risk that eliminating fossil fuels and CO_2 emissions will cause massive starvation and other disastrous consequences.

CONCLUSION

Thus, in our scientific opinion, any government or other analysis advocating "Net Zero" regulation, policy or other action is scientifically invalid and fatally flawed science if it:

A. Omits unfavorable data that contradicts conclusions, for example, on extreme weather events such as heat waves, wildfires, hurricanes, tornadoes, fires and droughts.

B. Relies on models that do not work and thus would never be used in science.

C. Relies on IPCC findings, which are government opinions, not science.

D. Omits the extraordinary social benefits of CO_2 and fossil fuels.

E. Omits the disastrous consequences of reducing fossil fuels and CO_2 to "Net Zero."

F. Rejects the science that demonstrates there is no risk of catastrophic global warming caused by fossil fuels and CO_2.

We urge all government agencies involved in "Net Zero" regulation, policy or other action, including USGCRP in its final version of the 5th National Climate Assessment, to apply the scientific method and

- Delete any reliance on and citation to IPCC government-controlled findings.
- Delete any reliance on and citation to CMIP models and any other models unless they have been proven to work.
- Delete any reliance on methods other than the scientific method, such as peer review and consensus.
- Include and analyze the enormous social benefits of CO_2.
- Include and analyze the enormous social benefits of fossil fuels.
- Immediately stop all efforts to eliminate fossil fuels to avoid massive human starvation in the future.

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https://archive.ipcc.ch/news_and_events/docs/factsheets/FS_ipcc_approve.pdf; http://www.ipcc.ch/pdf/ipcc-principles/ipcc-principles-appendix-a-final.pdf (Emphasis added).

28. Endangerment and Cause or Contribute Findings for Greenhouse Gases Under Section 202(a) of the Clean Air Act, 74 *Fed. Reg.* 66496 (Dec. 15, 2009)("Endangerment Findings"), p. 66511.

29. CO_2 Coalition, CO2_3.jpg (1280×720) (co2coalition.org)

30. Using the linear formula, 1.2 × 15.4% = 18% increase. Using the Happer formula with an increase from 280 ppm to 400 ppm, x = 410/280 = 1.46 and √x = 1.21, a 21% increase in food.

31. x = 800/400 = 2 and √2 = 1.41, approximately a 41% increase.

32. Climate Change Reconsidered II: Fossil Fuels, p. 322, section 3.3.2 Aerial Fertilization.

33. Raleigh, "Sri Lanka Crisis Shows the Damning Consequences of Western Elites Green Revolution," *Federalist* (July 15, 2022).

34. Rupert Darwall, *Climate Noose: Business, Net Zero and the IPCC's Anticapitalism* Global Warming Policy Foundation (2020), p. 21.

35. Ritchie, "How Many People Does Synthetic Fertilizer Feed?," Our World in Data (November 7, 2017), How many people does synthetic fertilizer feed? - Our World in Data.

36. Happer *et al.*, *supra*, p. 39.

37. Ritchie, *supra*.

38. Raleigh, "Sri Lanka Crisis Shows the Damning Consequences of Western Elites Green Revolution," *Federalist* (July 15, 2022).

39. Lindzen, *supra*.

40. Wrightstone (2017*)* revision, *Inconvenient Facts – the science that Al Gore doesn't want you to know.*

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CURRICULUM VITAE

William Happer, Ph.D.

I am a Professor Emeritus in the Department of Physics at Princeton University.

I began my professional career in the Physics Department of Columbia University in 1964, where I served as Director of the Columbia Radiation Laboratory from 1976 to 1979. I joined the Physics Department of Princeton University in 1980.

I invented the sodium guidestar that is used in astronomical adaptive optics systems to correct the degrading effects of atmospheric turbulence on imaging resolution. I have published over 200 peer-reviewed scientific papers, am a Fellow of the American Physical Society, the American Association for the Advancement of Science, and a member of the American Academy of Arts and Sciences, the National Academy of Sciences and the American Philosophical Society.

I served as Director of Energy Research in the U.S. Department of Energy from 1991 to 1993. I was a co-founder in 1994 of Magnetic Imaging Technologies Incorporated (MITI), a small company specializing in the use of laser-polarized noble gases for magnetic resonance imaging. I served as Chairman of the Steering Committee of JASON from 1987 to 1990.

I served as Deputy Assistant to the President and Senior Director for Emerging Technologies at The National Security Council in the White House from 2018 to 2019.

I am the Chair of the Board of Directors of the CO_2 Coalition, a nonprofit 501(c)(3) organization established in 2015 to educate thought leaders, policy makers and the public about the vital contribution made by carbon dioxide to our lives and our economy.

Richard Lindzen, Ph.D.

I am an Alfred P. Sloan Professor of Atmospheric Science Emeritus at MIT. After completing my doctorate at Harvard in 1964 (with a thesis on the interaction of photochemistry, radiation and dynamics in the stratosphere), I did postdoctoral work at the University of Washington and at the University of Oslo before joining the National Center for Atmospheric Research as a staff scientist.

At the end of 1967, I moved to the University of Chicago as a tenured associate professor, and in 1971 I returned to Harvard to assume the Gordon McKay Professorship (and later the Burden Professorship) in Dynamic Meteorology.

In 1981 I moved to MIT to assume the Alfred P. Sloan Professorship in Atmospheric Sciences. I have also held visiting professorships at UCLA, Tel Aviv University, and the National Physical Laboratory in Ahmedabad, India, and the Hebrew University in Jerusalem, the Jet Propulsion Laboratory in Pasadena, and the Laboratory for Dynamic Meteorology at the University of Paris.

I developed our current understanding of the quasi-biennial oscillation of the tropical stratosphere, the

current explanation for dominance of the solar semidiurnal and diurnal tides at various levels of the atmosphere, the role of breaking gravity waves as a major source of friction in the atmosphere, and the role of this friction in reversing the meridional temperature gradient at the tropopause (where the equator is the coldest latitude) and the mesopause (where temperature is a minimum at the summer pole and a maximum at the winter pole).

I have also developed the basic description of how surface temperature in the tropics controls the distribution of cumulus convection and led the group that discovered the iris effect where upper-level cirrus contract in response to warmer surface temperatures. I have published approximately 250 papers and books.

I am an award recipient of the American Meteorological Society and the American Geophysical Union. I am a fellow of the American Meteorological Society, the American Geophysical Union and the American Association for the Advancement of Science, and a member of the National Academy of Sciences and the American Academy of Arts and Sciences. I have served as the director of the Center for Earth and Planetary Sciences at Harvard and on numerous panels of the National Research Council. I was also a lead author on the Third Assessment Report of the UN's Intergovernmental Panel on Climate Change – the report for which the IPCC shared the Nobel Peace Prize with Al Gore. I am currently a member of the CO_2 Coalition.

Gregory Wrightstone

I am a geologist with degrees in geology from Waynesburg University (BS) and West Virginia University (MS). I was deeply involved in the early research and exploration for the vast shale gas reserves in the eastern United States.

I was the co-author of the first peer-reviewed comprehensive paper on the Marcellus Shale Mega giant Gas Field, the largest natural gas accumulation in the world. I also authored studies on a previously undocumented Super-Giant field, the Burket Shale.

I am the author of the climate change-related *Inconvenient Facts*, a #1 bestseller. I was accepted as an Expert Reviewer for the Intergovernmental Panel on Climate Change (AR6). I am Executive Director of the CO_2 Coalition.

CO_2 Coalition

The CO_2 Coalition is the nation's leading organization providing facts, resources and information about the vital role carbon dioxide plays in our environment.

Membership is comprised of more than 100 of the world's foremost experts on climate change and represents a wide range of expertise including atmospheric physics, geology, oceanography, economics and more.

The Coalition provides facts and science without political ideology to the public through publications, public presentations, commentaries and interviews. Our membership has published many thousands of peer-reviewed scientific papers over a wide spectrum of climate-related topics.