

## **CLIMATE SCIENCE IN THE POLITICAL ARENA**

Statement of

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Energy Independence and Global Warming  
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Mr. Chairman and members, thank you for the opportunity to appear before the House Select Committee on Energy and Global Warming. My name is William Happer, and I am the Cyrus Fogg Brackett Professor of Physics at Princeton University. I have spent my professional life studying the interactions of visible and infrared radiation with gases – one of the main physical phenomena behind the greenhouse effect. I have

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published over 200 papers in peer reviewed scientific journals. I am a member of a number of professional organizations, including the American Physical Society and the National Academy of Sciences. I have done extensive consulting work for the US Government and Industry. I also served as the Director of Energy Research at the Department of Energy (DOE) from 1990 to 1993, where I supervised all of DOE's work on climate change. The views I express today are my own, and not official views of my main employer, Princeton University, nor of any other organization with which I am associated. I was given less than 24 hours to prepare this testimony, so I beg your indulgence for deficiencies in it.

Let me state clearly where I probably agree with the other witnesses. We have been in a period of global warming over the past 200 years, but there have been several periods, like the last ten years, when the warming has ceased, and there have even been periods of substantial cooling, as from 1942 to 1975. Atmospheric concentrations of carbon dioxide (CO<sub>2</sub>) have increased from about 280 to 385 parts per million over past 100 years. The combustion of fossil fuels, coal, oil and natural gas, has contributed to the increase of CO<sub>2</sub> in the atmosphere. And finally, increasing concentrations of CO<sub>2</sub> in the atmosphere will add a warming *trend* to the natural warmings and coolings of the earth's surface. The key question is: how much warming will there be, and will the warming, and any other effects of the CO<sub>2</sub>, be good or bad for humanity? I, and many other scientists, think the warming will be small compared the natural fluctuations in the earth's temperature, and that the warming and increased CO<sub>2</sub> will be good for mankind.

In his invitation letter, Mr. Markey asked me to comment on three questions. I will address these questions with crisp answers followed by some discussion.

**Question 1: To what extent does CO<sub>2</sub> lead to global warming?**

**Answer: Doubling CO<sub>2</sub> will probably lead to less than 2C surface warming.**

The earth's climate really is strongly affected by the greenhouse effect, although the physics is not the same as that which makes real, glassed-in greenhouses work.

Without greenhouse warming, the earth would be much too cold to sustain its current abundance of life. However, well over half of the greenhouse warming is due to water vapor and clouds. There is little argument in the scientific community that a direct effect of doubling the CO<sub>2</sub> concentration will be a small increase of the earth's temperature -- on the order of one degree Kelvin. Additional increments of CO<sub>2</sub> will cause relatively less direct warming because we already have so much CO<sub>2</sub> in the atmosphere that it has blocked most of the infrared radiation that it can. The technical jargon for this is that the CO<sub>2</sub> absorption band is nearly "saturated" at current CO<sub>2</sub> levels. Adding more CO<sub>2</sub> is like putting an additional ski hat on your head when you already have a nice warm one below it, but you are only wearing a windbreaker. The extra hat makes you a little bit warmer but to really get warm, you need to add a jacket. The IPCC thinks that this jacket is water vapor and clouds.

Most of the greenhouse effect for the earth is due to water vapor and clouds,. To get the frightening global warming scenarios that are bandied about, the added CO<sub>2</sub> must substantially increase water's contribution warming. The jargon is "positive feedback" from water vapor and clouds. With each passing year, experimental observations further undermine the claim of a large positive feedback from water. In fact, observations suggest that the feedback is close to zero and may even be negative. That is, water vapor and clouds may actually diminish the relatively small direct warming expected from CO<sub>2</sub>, not amplify it. The evidence here comes from satellite measurements of infrared radiation escaping from the earth into outer space, from measurements of sunlight reflected from clouds and from measurements of the temperature the earth's surface or of the troposphere, the roughly 10 km thick layer of the atmosphere above the earth's surface that is filled with churning air and clouds, heated from below at the earth's surface, and cooled at the top by radiation into space. My own educated guess is that doubling CO<sub>2</sub> from our current value of about 380 ppm to 760 ppm will warm the atmosphere by less than 2 C – and perhaps less if there is negative feedback from water-vapor and clouds.

This leads to Mr. Markey's second question:

**Question 2. “How are important climatic systems (e.g. the role of clouds, water vapor, etc.) simulated in computer models that are used to predict climate change.”**

**Answer 2. Most models predict that water vapor and clouds will greatly amplify the warming due to CO<sub>2</sub> alone. There is little observational support for these predictions. Furthermore, the models do not explain relative large climate changes in past when there was negligible combustion of fossil fuels.**

The current warming period began about 1800 at the end of the little ice age, long before there was appreciable burning of fossil fuel. There have been similar and even larger warmings several times in the 10,000 years since the end of the last ice age. These earlier warmings clearly had nothing to do with the combustion of fossil fuels. It is hard for many scientists to understand why some significant fraction of the current warming might not also due to similar natural causes. Over the past ten years there has been no statistically global warming. This is not at all what was predicted by the IPCC computer models. The existence of large climate variability in the past has long been an embarrassment to those who claim that all climate change is due to man and that man can control the climate. To the best of my knowledge, none of the climate models designed to predict future climate have been successful in explaining these past fluctuations of the climate. If you can't model the past, where you know the answer pretty well, how can you model the future?

I was very surprised when I first saw the celebrated “hockey stick curve,” in the Third Assessment Report of the IPCC. Both the little ice age and the medieval warm period were gone, and the newly revised temperature of the world since the year 1000 had suddenly become absolutely flat until the last hundred years when it shot up like the blade on a hockey stick. This was far from an obscure detail, and the hockey stick was trumpeted around the world as evidence that the end was near. We now know that the hockey stick has nothing to do with reality but was the result of incorrect handling of proxy temperature records and incorrect statistical analysis. There really was a little ice

age and there really was a medieval warm period that was as warm or warmer than today. I bring up the hockey stick as a particularly clear example that the IPCC summaries for policy makers are not dispassionate statements of the facts of climate change. It is a shame, because many of the IPCC chapters are quite good.

Modelers have been wrong before. One of the most famous modeling disputes involved the physicist William Thompson, later Lord Kelvin, and the naturalist Charles Darwin. Lord Kelvin was a great believer in models and differential equations. Charles Darwin was not particularly facile with mathematics, but he took observations very seriously. For evolution to produce the variety of living and fossil species that Darwin had observed, the earth needed to have spent hundreds of millions of years with conditions not very different from now. With his mathematical models, Kelvin rather pompously demonstrated that the earth must have been a hellish ball of molten rock only a few tens of millions of years ago, and that the sun could not have been shining for more than about 30 million years. Kelvin was actually modeling what he thought was global and solar cooling. I am sorry to say that a majority of his fellow physicists supported Kelvin. Poor Darwin removed any reference to the age of the earth in later editions of the "Origin of the Species." But Darwin was right the first time, and Kelvin was wrong. Kelvin thought he knew everything but he did not know about the atomic nucleus, radioactivity and nuclear reactions, all of which invalidated his elegant modeling calculations.

**Question 3: What policies are necessary to protect and improve scientists' ability to conduct research and share scientific information with policymakers.**

**Answer 3. Global-warming alarmists have tried to silence any who question the party line of impending climate apocalypse. We need to establish a Team B of competent scientists, charged with questioning the party line. The DoD and the CIA do this, there was a devil's advocate (promoter fidei) for sainthood, why not the same for climate change?**

The climate-change establishment has tried to eliminate any who dare question the science. This was made very clear in the Climategate Letters, which reveal the blacklisting of research that strays from the party line with the aid of hostile peer reviewers and helpful editors, and threats to any journal that did not cooperate -- in some cases leading to the removal of editors. Climate change science needs a “team B.” This happens in many other areas, for example, weapons systems for DoD, or intelligence assessments at CIA. Both of these organizations, and many others, routinely establish robust team B’s, that is, groups of experts who work full time, sometimes for several years, to challenge the establishment position. This has given us much better weapons systems and intelligence. The team-B concept has not been embraced by the climate change establishment. Indeed, we read testimony by Dr. James Hanson in the Congressional Record, that climate skeptics are guilty of “high crimes against humanity and nature.” There are many similarly intimidating statements made by establishment climate scientists and by like-thinking policy-makers – you are either with us or you are a traitor.

Let me turn to a few additional thoughts that concern me today. I keep hearing about the “pollutant CO<sub>2</sub>,” or about “poisoning the atmosphere” with CO<sub>2</sub>, or about minimizing our “carbon footprint.” This brings to mind a comment by George Orwell: “But if thought corrupts language, language can also corrupt thought.” CO<sub>2</sub> is not a pollutant and it is not a poison and we should not corrupt the English language by depriving “pollutant” and “poison” of their original meaning. Our exhaled breath contains about 4% CO<sub>2</sub>. That is 40,000 parts per million, or about 100 times the current atmospheric concentration. CO<sub>2</sub> is absolutely essential for life on earth. Commercial greenhouse operators often use CO<sub>2</sub> as a fertilizer to improve the health and growth rate of their plants. Plants, and our own primate ancestors evolved when the levels of atmospheric CO<sub>2</sub> were at least 1000 ppm, a level that we will probably not reach by burning fossil fuels, and far above our current level of about 380 ppm. We try to keep CO<sub>2</sub> levels in our US Navy submarines no higher than 8,000 parts per million, about 20 time current atmospheric levels. Few adverse effects are observed at even higher levels.

We are all aware that “the green revolution” has increased crop yields around the world. Part of this wonderful development is due to improved crop varieties, better use of mineral fertilizers, herbicides, etc. But no small part of the yield improvement has come from increased atmospheric levels of CO<sub>2</sub>. Plants photosynthesize more carbohydrates when they have more CO<sub>2</sub>. Plants are also more drought-tolerant with more CO<sub>2</sub>, because they need not “inhale” as much air to get the CO<sub>2</sub> needed for photosynthesis. At the same time, the plants need not “exhale” as much water vapor when they are using air enriched in CO<sub>2</sub>. Plants decrease the number of stomata or air pores on their leaf surfaces in response to increasing atmospheric levels of CO<sub>2</sub>. They are adapted to changing CO<sub>2</sub> levels and they prefer higher levels than those we have at present. If we really were to decrease our current level of CO<sub>2</sub> of around 400 ppm to the 270 ppm that prevailed a few hundred years ago, we would lose some of the benefits of the green revolution. Crop yields will continue to increase as CO<sub>2</sub> levels go up, since we are far from the optimum levels for plant growth. Commercial greenhouse operators are advised to add enough CO<sub>2</sub> to maintain about 1000 ppm around their plants. Indeed, economic studies like those of Dr. Robert Mendelsohn at Yale University project that moderate warming is an overall benefit to mankind because of higher agricultural yields and many other reasons.

That we are (or were) living at the best of all CO<sub>2</sub> concentrations seems to be an article of faith for the climate-change establishment. Enormous effort and imagination have gone into showing that increasing concentrations of CO<sub>2</sub> will be catastrophic: cities will be flooded by sea-level rises that are ten or more times bigger than even IPCC predicts, there will be mass extinctions of species, billions of people will die, tipping points will render the planet a desert. Any flimsy claim of harm from global warming brings instant fame and many rewards.

This brings up the frequent assertion that there is a consensus behind the idea of an impending disaster from climate change, and that it may already be too late to avert this catastrophe --even if we stop burning fossil fuels now. We are told that only a few flat-earthers still have any doubt about the calamitous effects of continued CO<sub>2</sub> emissions. There are a number of answers to this assertion. First, what is correct in science is not determined by consensus but by experiment and observations.

Historically, the consensus has often been wrong. Secondly, I do not think there is a consensus about an impending climate crisis. I do not believe we are facing a crisis unless we create one for ourselves. Before making policy on climate change, we should heed the ancient bit of wisdom, "First, do no harm!"

The sea level is indeed rising, just as it has for the past 20,000 years since the end of the last ice age. Fairly accurate measurements of sea level have been available since about 1800. These measurements show no sign of any acceleration. The rising sea level can be a serious local problem for heavily-populated, low-lying areas like New Orleans, where land subsidence compounds the problem. But to think that limiting CO<sub>2</sub> emissions will stop sea level rise is a dangerous illusion. It is also possible that the warming seas around Antarctica will cause more snowfall over the continent and will counteract the sea-level rise. In any case, the rising sea level is a problem that needs quick local action for locations like New Orleans rather than slow action globally. Indeed, had we taken a few of the many billions of dollars we have been spending on climate-change research and propaganda and fixed the levees and pumps around New Orleans, most of the damage from Hurricane Katrina could have been avoided.

I regret that the climate-change issue has become confused with serious problems like secure energy supplies, protecting our environment, and figuring out where future generations will get energy supplies after we have burned all the fossil fuel we can find. We should not confuse these laudable goals with hysterics about carbon footprints. For example, when weighing pluses and minuses of the continued or increased use of coal, the negative issue should not be increased atmospheric CO<sub>2</sub>, which is probably good for mankind. We should focus on real issues like damage to the land and waterways by strip mining, inadequate remediation, hazards to miners, the release of real pollutants and poisons like mercury, other heavy metals, organic carcinogens, etc. Life is about making decisions and decisions are about trade-offs. The Congress can choose to promote investment in technology that addresses real problems and scientific research that will let us cope with real problems more efficiently. Or they can act on unreasonable fears and suppress energy use, economic growth and the benefits that come from the creation of national wealth.