COMMITTEE ON NATURAL RESOURCES:
Subcommittee on Oversight and Investigations

114th Congress
April 29 2015

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Zero Accountability: The Consequences of Politically Driven Science

Thank you for the opportunity to be here with you today.[1]

Our topic here today is politically driven science. I speak here as a historian who has spent the bulk of my professional life studying science, and I am interested in particular in the conditions that foster good science, and the conditions that undermine it. I have done research on the history of geology, geophysics and oceanography, focusing on American science in the 20th and 21st century. I have also studied environmental science, including studies of pesticides, endocrine-disrupting chemicals, acid rain, the ozone hole, and man-made climate change.

Witnesses here today are trying to cast doubt on environmental science, arguing that is politically driven, and we should not be using it to make important decisions.

As a guest of the democratic minority, I might be expected to attempt to refute the premise and argue that the science under consideration is *not* politically driven.

What I want to do is slightly different. I want to challenge the presumption that politically-driven science is bad science. That presumption—while widely held—is demonstrably false.

A great deal of science is politically driven

History shows that a much—maybe most—science is driven by political, economic, or social goals. Some of the best and most famous science in the history of our country was driven by goals that were explicitly political.

Consider the Manhattan Project. Scientists during World War II gathered and mobilized to determine the details of fission reactions, of isotope separation, of high-temperature and high-pressure metallurgy and many more matters, for the purpose of building an atomic bomb. The political goal of stopping Adolf Hitler—and the sense that the future of the United States, and perhaps the entire free world, might depend on their success--provided a powerful motivation for scientists to get the science right.

Another example is the space program. The United States first developed rocketry to be able to deliver ballistic missiles, carrying nuclear warheads, to the Soviet Union. The political goal of containing Communism was a power motivation for scientists. In later years, the goal of maintaining peace through the doctrine of Mutual Assured Destruction further motivated our scientists to ensure that our weapons worked, and would go where they were sent. [2]

In the Apollo program, NASA scientists knew that getting the science right would make the difference between astronauts getting to the Moon or not, and more important, getting home. Knowing that the lives may depend on your calculations is a powerful form of accountability.

Some might argue that these were not scientific projects but technological ones, but this is not a meaningful distinction. These various project led to the construction of new and significant technologies, but they all also required—indeed were founded upon—newly developed science. Moreover, we can find examples that are not technological at all, yet still show us how politics can drive good science.

Plate tectonics is the unifying theory of modern earth science, and it too was a product of political goals. The key work that led to this theory came from oceanography and seismology. The oceanography was done as part of the U.S. Navy's programs in underwater warfare to use science to detect Soviet submarines, and to safely hide our own. The seismology emerged largely from efforts to differentiate earthquakes from nuclear bomb tests.

These were military and political goals—part of the Cold War commitment to contain Communism--but they led to research that provided the fundamental understanding of planetary processes; understanding that, not incidentally, forms the basis for oil and gas exploration, for mining and mineral exploration, and for predicting and protecting against seismic hazard.

Nearly all of this work was done by government scientists. It was done either by scientists working directly for the U.S. government, for example at the U.S. Naval Research Laboratory or United States Geological Survey, or by scientists in universities and research institutions like the University of California, Columbia University, and the Woods Hole Oceanographic Institution, with funds that were supplied almost entirely by the U.S. government.

The Manhattan project was government science.

The Apollo program was government science.

Plate tectonics was government science.

Virtually every major development in the physical sciences in America in the second half of the 20th century was government science—either done by scientists in government agencies and national laboratories, or by academics primarily funded by the federal government. The

academic scientists, if they were at public universities, like the University of California, had their salaries paid by their states, so in some sense they were government scientists, too.

Is environmental science any different?

The history of ozone science

Consider the men and women who laid the scientific foundations for the Montreal Protocol to the Vienna Convention for the Protection of the Ozone Layer.[3] The Vienna Convention, established in 1985, protects us from the potentially devastating effects of ozone depletion. Today, the ozone hole is recovering, and scientists expect it to recover fully in the coming decades.[4] This recovery would not have happened without the work of environmental scientists.

Scientists first recognized threats to stratospheric ozone in the early 1970s. Scientists working at NASA and the University of California realized that chemicals released into the atmosphere from supersonic transport and the space shuttle could react with ozone in the stratosphere, and destroy it. Because of this threat, NASA began to fund studies of the chemical reactions involved. Meanwhile, two scientists at the University of California, Irvine, Sherwood Rowland and Mario Molina, realized that a certain class of chemicals known as Chlorinated Fluorocarbons—or CFCs—found in hairspray and other products, had the potential to destroy ozone on a global scale. At first, their predictions were viewed skeptically, even by their colleagues: could hairspray really lead to the end of life on Earth? That seemed a pretty bold—if not outrageous—claim.

But in 1985, Joseph Farmer of the British Antarctic Survey announced the discovery of an "ozone hole" over Antarctica, Farmer had made a set of ground-based observations, using ultra-violet absorption measurements, that demonstrated that ozone was dramatically depleted in the Antarctic region. The following year a team led by NOAA atmospheric scientist, Susan Solomon, undertook further ground-based observations to confirm significant ozone depletion, and suggested that ozone was being depleted by chlorine chemicals—derived from CFCs—in catalytic reactions on polar stratospheric clouds.

In 1987, Harvard Professor James Anderson sent an experiment in a NASA U-2 plane over the Antarctic, establishing through direct measurement that ozone had been massively depleted, and that the depletions correlated in time and space with chlorine compounds derived from CFCs, thus confirming the earlier hypotheses (FIGURE 1). Later his team obtained similar measurements over the Arctic demonstrating the same catalytic chemistry in the northern hemisphere. All this research was NASA funded.

On the basis of this work, President Bush, Secretary of State George Schultz, and Assistant Secretary of State John Negroponte leant their support to the Montreal Protocol to the Vienna Convention, committing the world to reducing the use of CFCs—the chemicals that these scientists had shown had created the ozone hole. In 1988, with the President's support, Congress ratified the Montreal Protocol.[4]

Susan Solomon has been elected to U.S. National Academy of Sciences, the European Academy of Sciences, and the French Academy of Sciences. In 2008, she was named by *Time* magazine as one of the 100 most influential people in the world.

Jim Anderson has won more prizes than you can count, including Harvard University's Ledlie Prize for Most Valuable Contribution to Science by a Member of the Faculty (and I teach at Harvard so I can tell you that the competition at Harvard is stiff.)

In 1995, Rowland and Molina shared the Nobel Prize in chemistry for this work.

If ozone science had been distorted, corrupted or was otherwise incorrect, Rowland and his colleagues would not have received the world's highest scientific honors. More important, if the science had been wrong, the ozone hole would not today be recovering. But it was right, and we were, and are, protected.

President Bush was not duped; President Bush did the right thing. He protected us from harm.

Few people realize how much the Montreal protocol has protected us—and at how little it cost. Were it not for the Montreal Protocol, skin cancer rates in America would be about 60% higher than they are today. Livestock and crops would be affected too. And few people realize how little this protection cost, as DuPont, the major manufacturer of CFCs, realized that it could replace those chemicals with new, less harmful products.

I'd like to underscore two things about this history.

First, this was government science. These men and women worked either at government agencies like NASA and NOAA, publicly-funded universities like the University of California, Irvine, or received their funding through government agencies: NOAA, NASA, and the NSF. And many of these scientists spoke out publicly to explain to the American people—and to Congress—what their work meant, and why it showed that we needed to act.

Second, this science was attacked at the time as corrupt and politically motivated. It was attacked in the Halls of Congress, in much the same way as science is being attacked here today. In 1995, Representative Dana Rohrabacher organized a hearing distressingly similar to the one we are participating in today. Ostensibly it focused on "scientific integrity;" its real purpose was to challenge ozone science.

Industry representatives claimed the science was incorrect and that fixing the problem would be devastating to our economy. They claimed that scientists were exaggerating the threat to get more money for their research. Entered into the Congressional record was the claim that there was "no scientific consensus on ozone depletion," a claim that was shown to be completely false by the award of the Nobel prize just a few weeks later. And, when the DuPont Corporation phased out production of CFCs, our economy did not collapse.

Yet, similar claims are being made today, particularly with respect to climate science. These claims are as misguided today as they were 20 years ago.

Who is behind these attacks?

Many of the same people who attacked ozone science. Climate science is being attacked by many of the same individuals and organizations who attacked ozone science, and using many of the same arguments.

Climate science

Let's look a bit at the history of climate science.

Scientists have known for more than 100 years that greenhouse gases, such as carbon dioxide and methane, are greenhouse gases that trap heat in a planet's atmosphere. If you increase their concentration in a planet's atmosphere, the planet will get hotter. Venus is incredibly hot—864 degrees Fahrenheit) not because it is closer to the sun, but because it has an atmosphere hundreds of times denser than Earth's, and composed mainly of CO_2.

In the United States, the first scientist to focus attention on the risk of increased $CO_2$from burning fossil fuels was oceanographer Roger Revelle. During World War II, Revelle served an officer in the U.S. Navy Hydrographic Office, and he continued to work closely with the Navy throughout his career, including with the Hydrographic Office, the Office of Naval Research, and the Bureau of Ships. In the 1950s, he argued for the importance of scientific research on man-made climate change, calling particular attention to the threat that sea level rise from melting glaciers and thermal expansion of the oceans posed to the safety and security of major cities, ports, and naval facilities.

In the 1960s, he was joined in his concern by several colleagues, including Dave Keeling, the man who first began to measure atmospheric carbon dioxide in 1958, and by Gordon MacDonald, a geophysicist who served on the first Council on Environmental Quality, under President Richard Nixon.

In the 1974, the emerging scientific understanding was summarized by Alvin Weinberg, the head of the Oak Ridge National Laboratory, who explained that our use of fossil fuels was likely to be limited by the threat they represented to the Earth's stable and beneficent climate. He wrote: "Although it is difficult to estimate how soon we shall have to adjust the world's energy policies to take this limit into account, it might well be as little as 30-50 years."[5]

In 1977, Robert M. White, the first administrator of NOAA and later President of the National Academy of Engineering, summarized the scientific findings this way:

> We now understand that industrial wastes, such as carbon dioxide released during the burning of fossil fuels, can have consequences for climate that pose a considerable threat to future society. … [E]xperiences of the past decade have demonstrated the consequences of even modest fluctuations in climatic conditions [and] lent a new urgency to the study of climate.… The scientific problems are formidable, the technological problems, unprecedented, and the potential economic and social impacts, ominous."[6]

In 1979, the U.S National Academy of Sciences concluded: "If carbon dioxide continues to increase, [we] find no reason to doubt that climate changes will result, and no reason to believe that these changes will be negligible." [7]

These findings led the World Meteorological Organization to join forces with the United Nations to create the Intergovernmental Panel on Climate Change, to establish a stable scientific foundation for informed public policies. Just as good science laid the foundation for the Vienna Convention, good science would now lay the foundation for the United Nations Framework Convention on Climate change, signed in 1992 by President George H. W. Bush.

Since then, the scientific world has affirmed and re-affirmed the scientific evidence over and over again. It has been affirmed in the United States by our own National Academy of Sciences, the American Meteorological Society, the American Geophysical Union, the American Association for the Advancement of Sciences, and many more, as well as by leading scientific societies and Academies abroad.

In 2006, 11 national academies of science around the globe, including the oldest in the world—the Accademia nazionale dei Lincei of Italy— issued an unusual joint statement, noting that the " threat of climate change is clear and increasing," and that "delayed action will… incur a greater cost." That was nearly a decade ago. Today scientists tell us that human-made climate change is now "unequivocal" and the costs are already being felt.

This work was done by scientists around the globe—men and women, old and young, Democrats and Republicans. In fact, probably more of them were Republicans than Democrats: Gordon MacDonald was a close advisor to President Nixon; Dave Keeling was awarded the National Medal of Science by President George W. Bush in 2002.

Yet, despite the long history of this work and the bipartisan character of the scientists who did it, climate science continues not merely to be questioned, but to be attacked. Just yesterday, the world's most revered climate scientists met with Pope Francis to advise him on the facts of climate change, and the threat that it represents to the future health, wealth, and well-being of men, women and children—not to mention the other species with whom we share this unique planet we call our Earth. Yet at the same time, climate change deniers met across the road from the Vatican, to attempt to prevent the Pope from speaking out on the moral meaning of climate change. Whenever we see signs that the political landscape is shifting, and that the world might be ready to act to prevent dangerous climate change, the forces of denial redouble their efforts to stop us.

Time does not permit me to recount the long history of climate change denial, so let me just say this. The organization responsible for the denialist meeting in Rome is the Heartland Institute, a group with a long history not only of rejecting climate science, but also of rejecting science generally. They were responsible for the infamous billboards comparing climate scientists to the Unabomber. They have a documented history of working with the tobacco industry to question the scientific evidence of the harms of tobacco. Indeed, many of the groups who today question the reality or significance of human-made climate previously questioned the scientific evidence of the harms of tobacco.[8]

Today, we know that millions of people have died from tobacco-related diseases. Do we really have to wait for people to die before we accept the evidence of damaging climate change?

Does politics distort science?

Let me return to our question of politically-driven science.

Ozone science was not attacked because it was wrong *scientifically*; it was attacked because it was politically and economically *consequential*. The realities of ozone depletion had political and economic consequences that some people did not like, consequences that threatened their interests. It is the same with climate science. The reality is that climate science has told us that business as usual threatens our health, our wealth, and our well-being. Hence it is hardly surprising that some sectors of the business community have tried to undermine that message, supporting attacks on science and scientists, and funding distracting research and misleading conferences to create the impression of scientific debate, confuse the American people, and delay action.

This brings me to my most important point. Science *can* be biased, particularly when the financial support for that science comes from parties who have a vested interest in a particular outcome. But history suggests that such vested interests have, at least in our country, come more from the private sector than from the public sector.

The clearly documented example of this is tobacco.

For decades tobacco companies supported scientific research, both in their own laboratories and in universities, medical schools, and even cancer research institutes. But we know, from their own internal records, that the purpose of this research was not to determine the truth about tobacco, but to create the impression of scientific debate, to create doubt about whether or not tobacco was really harmful, and therefore protect the industry against lawsuits and regulation.

The research that industry funded was less likely to find that tobacco use was damaging than research that was not funded by the industry. Nearly all of that research has today been discredited.

Not only was much of the industry-funded research biased, but the industry knew it was. Industry executives knew in the 1950s that tobacco caused cancer, they knew by the 1960s that it caused a host of other diseases as well, they knew by the 1970s that it was addictive, and they knew by the 1980s that second hand smoke caused cancer in non-smokers, and sudden infant death syndrome in babies.

What lessons can we learn from this experience? One important lesson is the disclosure of funding sources. In preparing my testimony for today I was asked to disclose all sources of

government funding of my research. This is a reasonable request. But there was no comparable request for disclosure of private funding. This is an unreasonable omission.

Because the potential for distortion is real, it is important that funding sources be disclosed. But this means *all* funding sources—both private and public, for profit and not. To ask for disclosure of public funds and not ask the same of private sources would be like asking for automotive inspections of half your engine, or safety inspections of half an airplane.

Concluding remarks

Many people resist accepting the scientific evidence of climate change because they fear it will be used as an excuse to expand big government. The logic of this is wrong on two counts.

The first should be obvious: denying a problem does not make it go away. On the contrary, delay makes the problem harder to cure. Delay in acting on tobacco control led to millions of preventable deaths. Delay in acting on climate change will increase the costs we pay to deal with the impacts, at minimum in dollars and very likely in lives.

The second is perhaps a bit less obvious. By delaying action on global carbon emission for more than two decades, we have increased the likelihood that disruptive global warming will lead to the very government interventions that many of you seek to avoid. Climate change is already causing an increase in extreme weather events—events that almost always need governmental response.

As climate change unfolds here in the United States, natural disasters – especially those that disrupt food and water supply – will cause us to have to rely more on government—especially the federal government—to deal with them. As climate change unfolds around the globe, natural disasters will give undemocratic forces the justification they seek to commandeer resources, declare martial law, interfere with the market economy and, suspend democratic process. But note one thing: our grandchildren will not call them "natural" disasters, because they will know that we caused them.

All of us who care about political freedom—and I believe that is all Americans-- should do everything we can to support our climate scientists, and to act to prevent the threats they have so clearly documented. To do otherwise can only increase the chances that authoritarian forms of governance will come out ahead in the end.

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[1] Unless otherwise noted, the materials presented here are drawn from Naomi Oreskes and Erik M. Conway, *Merchants of Doubt: How a Handful of Scientists Obscured the Truth on Issues from Tobacco Smoke to Global Warming* (Bloomsbury, 2010). On the details of NASA research on ozone, see also Erik M. Conway, Atmospheric Science at NASA: A History (The Johns Hopkins University Press, 2008).

[2] Hugh Gusterson,Nuclear Rites: A Weapons Laboratory at the End of the Cold War (University of California Press,1998).

[3] http://ozone.unep.org/new_site/en/vienna_convention.php

[4] http://montreal-protocol.org/Assessment_Panels/SAP/SAP2014_Assessment_for_Decision-Makers.pdf

[5] Alvin Weinberg, 1974. Global Effects of Man's Production of Energy, *Science* 186: 205. http://www.sciencemag.org/content/186/4160/205.citation

[6] Robert M. White, 1978 Oceans and Climate : An Introduction, Oceanus, 21: 2-3.

[7] Jule Charney et al., Carbon Dioxide and Climate: A Scientific Assessment, Report of an Ad-Hoc Study Group on Carbon Dioxide and Climate, Woods Hole, Massachusetts, July 23–27,1979, to the Climate Research Board, National Research Council (Washington, D.C.: National Academies Press, 1979), on p. 2.

[8] In 1997, Philip Morris paid $50,000 to the Heartland Institute , it gave $200,000 for the Advancement of Sound Science Coalition, $125,000 for the Competitive Enterprise Institute, $100,000 to the American Enterprise Institute, and many more.80 All of these groups have questioned the scientific evidence of man-made climate change. Often financial contributions were referred to in company documents as "philanthropy," and because these organizations all claim to be nonprofit and nonpartisan. But it is hard to see how defending tobacco use exactly qualifies as "philanthropy." Indeed, one wonders if this is not in fact a violation of the tax code. See Oreskes and Conway, Merchants of Doubt, p. 234.