TOWARD A CLEAN ENERGY FUTURE: ENERGY POLICY AND CLIMATE CHANGE ON PUBLIC LANDS

OVERSIGHT HEARING

BEFORE THE

SUBCOMMITTEE ON ENERGY AND MINERAL RESOURCES

OF THE

COMMITTEE ON NATURAL RESOURCES
U.S. HOUSE OF REPRESENTATIVES

ONE HUNDRED TENTH CONGRESS

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OVERSIGHT HEARING ON "TOWARD A CLEAN ENERGY FUTURE: ENERGY POLICY AND CLIMATE CHANGE ON PUBLIC LANDS."

Tuesday, March 20, 2007
U.S. House of Representatives
Subcommittee on Energy and Mineral Resources
Committee on Natural Resources
Washington, D.C.

The Subcommittee met, pursuant to call, at 2:56 p.m. in Room 1334, Longworth House Office Building. Hon. Jim Costa [Chairman of the Subcommittee] presiding.

Present: Representatives Costa, Pearce, Faleomavaega, Hinchey, Kennedy, and Solis.

STATEMENT OF THE HONORABLE JIM COSTA, A REPRESENTATIVE IN CONGRESS FROM THE STATE OF CALIFORNIA

Mr. COSTA. The Subcommittee on Energy and Mineral Resources, as a part of the Committee on Natural Resources, will come to order. I apologize to those of you who have been waiting patiently in the audience. Unfortunately, as I think most of you know, we have no control over or very little control over how votes are scheduled on the House Floor, and unfortunately, that has delayed us this afternoon. But I believe those are the last votes for the day, so we should be uninterrupted at this point.

So the oversight hearing of the Subcommittee will now come to order. The Subcommittee is meeting today on the impacts of the energy policy, as the Speaker has indicated she wants to get ideas from the House by June. We are looking at that in context this afternoon with changes that are occurring in the climate, and on public lands, as it impacts our public lands.

Under Rule 4(g), the Chairman and the Ranking Minority Member may make opening statements. I have a brief statement to make. If any Members have any other statements, we would like to therefore include them in the record under unanimous consent.

Additionally, under Committee Rule 4(h), additional material for the record should be submitted by Members or witnesses within 10 days of the hearing. We would appreciate the witnesses' cooperation, and also Members, as I oftentimes have questions that I want to submit. I ask that material be submitted in a timely way to the Committee staff because we then have to forward them to our wit-

nesses so that we can get responses, and request they be in writing.

While this is a meeting of the Subcommittee, I also want to remind members, because we get interest from time to time, depending upon the subject matter, that under Committee Rule 3(e), all members of the Committee may sit with this subcommittee during any hearing, and of course, by unanimous consent members of the Subcommittee may participate in any meeting or hearing. If other members are present, I ask them to participate. So I ask unanimous consent, if there is no objection, that any members of our Full Committee that want to participate with the Subcommittee today have the ability to do so. Any opposition?

All right. To the degree that we have some of our other colleagues here from the Full Committee, we will welcome them, obviously. I think we have that bit of housekeeping done.

Let me just talk briefly in my opening statement about our efforts to examine what I think many folks are concerned about as it relates to climate change. This afternoon I think we are going to see in the best sense of the House and representative democracy how we have differences of opinion, and how those differences of opinion are opined and how those relate to questions. Obviously, there are different points of view on this issue, and I suspect this afternoon we will hear those different points of view.

Chairman Rahall, as I indicated at our previous hearing, has asked the various subcommittees, including this one, in response to Speaker Pelosi's direction, to look at legislation that we might recommend over the next two and a half months, three months, and we are doing that. We are trying to do that.

Today's hearing, I think, will provide another opportunity for members to learn more about the differences of opinions that the effects of climate change may have on public lands and our resources. The Subcommittee starts by considering the scientific community's premise and I think there is a large testimony of point of view that the planet's climate is changing.

I was in Antarctica about a year and a half ago, and saw a lot of research that currently NOAA, NASA, the Department of Defense, and others are doing as it relates to the study of climate change, as well as many of the leading universities in our country who were down there during the summer months, as they are in other parts of the world, trying to make a determination.

So to that end, I am pleased that we are going to have the opportunity to have that discussion here this afternoon, and I guess when you get down to the bottom line, and this is where we may agree to disagree, certainly if you study the history of this planet over 4.5 billion years, it is constantly changing and evolving. But I think the difference of opinion that we will see exhibited here today is really to what degree as climates have historically changed, to what degree we as mankind have impacted that change during and since the Industrial Age.

So I am looking forward to hearing the testimony from all the witnesses. We are going to begin, first of all, with Mr. Mark Myers who is the Director of the U.S. Geological Survey, who will report on ongoing work that the Department is doing as it relates to climate change.

Then we also have our second panel, and to accommodate one of the witnesses, we will be making changes to try to accommodate one individual's time situation. The Chair always tries to be sensitive to folks and to be accommodating if I have sufficient information and it works. We are pleased to see our colleagues here, and before we have our next witness, I will defer to the Ranking Member for an opening statement.

[The prepared statement of Mr. Costa follows:]

Statement of The Honorable Jim Costa, Chairman, Subcommittee on Energy and Mineral Resources

This afternoon the Subcommittee will begin an examination of the effects climate change and our domestic energy policy and laws are having on the public lands, waters and resources. Chairman Rahall has tasked the Subcommittee, in response to Speaker Pelosi's direction, with crafting legislation that will address climate change and energy security goals by June 1, 2007.

Today's hearing will provide an opportunity for Members to learn more about the effects of climate change on the public lands and resources. The Subcommittee starts by considering the scientific community's premise that the Earth is getting warmer and that there are negative impacts associated with climate change.

To that end, I am pleased to welcome our witnesses: Dr. Mark Myers, the Director of the U.S. Geological Survey who will report on the ongoing work of the Department of the Interior as it relates to climate change, Mr. Auden Schendler, a representative of the skiing industry who will report on climate change effects on tourism and recreation, Mr. Noah Matson, an advocate for wildlife conservation to report on the effects of climate change on fish and wildlife populations, Ms. Deborah Williams, a conservation advocate to report on the climate change effects in Alaska, and Dr. Anthony Westerling, Director of the Sierra Nevada Research Institute to report on the effects of climate change on wildfire and forestry. Also testifying at the request of the minority, will be Dr. Timothy Ball, Director, Natural Resources Stewardship Project, located in British Vancouver, Canada, and Mr. Robert Murray, Chairman, Murray Energy Corporation

In the coming weeks, the Subcommittee will investigate specific issues, including carbon sequestration opportunities on public lands, renewable energy development, offshore energy, the application of advanced technologies to reduce the adverse greenhouse effects of fossil fuel development, and economic opportunities associated with climate change. All of these hearings will be focused on public land issues within the Committee or Subcommittee's jurisdiction.

STATEMENT OF THE HONORABLE STEVAN PEARCE, A REPRESENTATIVE IN CONGRESS FROM THE STATE OF NEW MEXICO

Mr. PEARCE. Thank you, Mr. Chairman. I appreciate the hearing and the opportunity to bring witnesses in to talk about this climate change. It is a very timely and controversial issue, and it has gotten much attention from the House, House of Representatives, from Hollywood, from the press. It seems like everybody is talking about climate change. In fact, the Speaker is setting up her select committee on climate changes and her call to the Committee Chairman to change climate, to effect a change by summer deadline. I am sure it will garner even more attention.

I am going to respectfully ask that we not fall victims to hyperbole, instead approach this issue seriously and deliberately. We should not limit ourselves to artificial deadlines or leadership pressure to produce legislation. Man is a part of the environment, not an intruder, and our responsibility is to enhance the lives of the American people, and our way of life depends upon taking this issue very seriously.

Carbon dioxide or CO_2 is portrayed as a gun by Hollywood, and some people in the political community. It is not a gun, it is not a poisonous fruit. I am not a scientist but I know that when we breathe we exhale CO_2, but plants inhale CO_2. In other words, they need that to live. That requirement on all sides to understand the beneficial nature of CO_2 is extraordinarily important as we consider policy decisions that will affect all people in the country.

I look forward to this hearing. Our two panels of witnesses has an opportunity to begin understanding what we know and much more importantly, what we don't know about CO_2 and climate change, especially as it relates to our national energy policy and managing Federal lands and waters.

I worry that the political momentum being given to climate change will lead to rash and even dangerous results. Indeed, this committee was originally scheduled to hold the hearing tomorrow regarding oil and gas royalty collections. Instead of addressing a very serious issue like that, which is within the jurisdiction of the Committee, the hearing was rescheduled to next week because there were concerns that others would steal our press thunder.

I wonder if this is how the policy priorities will be set in the future. I am not a scientist but I read that there are different views in the science world whether climate change is caused by human activity or whether it is by natural activity. So members in this Congress have given much deference to an executive summary of the United Nations Intergovernmental Panel on Climate Change, the IPCC, which states that climate change is very likely due to human causes.

I want to caution that the IPCC executive summary is not the full report. The full report is not scheduled to be released until after a markup schedule by Chairman Rahall to move climate change legislation out of this committee. If there were ever an example of a cart ahead of the horse, this might well be it.

The bottom line is that until the scientific community is clear Congress cannot justify policies that would double or triple our constituents' power bills that are already very high, that would double or triple the cost of the commute work, which is already expensive, or which would send jobs to China, and that is exactly what proposed legislative policies to date will do.

We want to thank the witnesses today for taking the time to testify. I especially want to thank the two witnesses on the second panel, Mr. Bob Murray. He is the CEO of Murray Energy. Thank you for being here today. He represents the largest independent coal producer in the country. The United States, of course, is a Saudi Arabia of coal. Over 50 percent of our electricity comes from coal, and we have to continue to be able to use coal as a source of electricity. However, coal will bear the brunt of many climate change legislation.

Mr. Murray, we can make coal cleaner but not without more technological development. Mr. Murray, I look forward to hearing from you what climate change energy policies would mean for coal development and cost, what it will mean for jobs in this country.

I also look forward to hearing from Mr. Ball, the only actual climate scientist testifying today. I understand that his research raises questions on whether humans have caused climate change

as opposed to the sun, for example. Dr. Ball's research shows that the science is not clear as Hollywood would have us believe. It concerns me that his work has sparked severe backlash for questions he has raised.

Last, I want to ask the Chairman going forward for a commitment regarding this invitation. I know it is essentially a Full Committee hearing, which is being held in the Subcommittee. This committee will take a lot of testimony today that is the jurisdiction of other subcommittees. This is the Energy and Mineral Resources Subcommittee. I hope we can focus on energy issues.

In addition, I will hope that we can do our part and give witnesses, both Federal and private, enough advanced notice to meet their internal needs and our deadlines. We short-change both ourselves and our witnesses if we do not allow adequate time. The goal we all share is to have an informative dialogue so that we can report out the best legislation possible.

Again I would like to welcome all of you and thank you again, Chairman Costa, for the hearing.

Mr. COSTA. Thank you very much the gentleman from New Mexico. As I indicated on the outset, you would find some differences of opinion, and clearly by your opening statement and mine we have witnessed that.

I do want to correct for the record, this committee was never scheduled to meet next week to deal with the subject matter. The Full Committee is going to meet next week, and while we have our Subcommittee hearing this week, our Subcommittee will not meet again until after the Easter Recess. Next week, it will be the Full Committee that talks about royalties at risk, and the administration of mineral management services which is a continuation of the Full Committee hearing that took place in February.

So Chairman Rahall is using his discretion as the Chair to continue that discussion that began back in February, and so we will be meeting on March 28, the Full Committee, not the Subcommittee. We have not changed the order.

Hearing that, let us get on with the witnesses because a colleague of ours, Gil McCarthy and I had a hearing session in Bakersfield, and I asked, when we were putting the witness list together, one of them I am quite familiar with said, "I am happy to participate, but are you guys going to listen or are you going to talk?" And I said, "This listening session is to listen, not to hear us talk."

So with that thought in mind, I would like to listen to our witnesses, both from the first and second panel, and our first witness here is Mr. Myers from the United States Geological Service who has been doing a lot of good work, and we will look forward to hearing your testimony. Would you please open, Mr. Myers.

STATEMENT OF MARK MYERS, DIRECTOR, UNITED STATES GEOLOGICAL SURVEY

Mr. MYERS. Mr. Chairman and Members of the Subcommittee, fist of all, thank you for the opportunity to testify on the role the USGS science in addressing climate change impacts on public lands and potential energy resources.

The USGS has a longstanding history of conducting research, monitoring and modeling of climate change and its physical and biological impacts.

Mr. COSTA. Your microphone is not on. You might want to start over again.

Mr. MYERS. Is that better?

Mr. COSTA. That is much better.

Mr. MYERS. OK.

Mr. COSTA. We can't listen if we can't hear. Thank you.

Mr. MYERS. Well, thank you.

The USGS has a longstanding history of conducting research, monitoring and modeling of climate change and physical and biological impacts of climate change. this work includes strong multidisciplinary capabilities and expertise that are well established and distributed across the United States, along with a proven capacity to assess prehistoric, historic, and current climate effects.

The strengths the USGS provides are a well-balanced niche predominantly conducting but leading climate change science across the nation's terrestrial, freshwater, and coastal systems. The USGS is unable to provide unbiased science to decision makers.

Global climate change is one of the most complex and formidable challenges facing society today. While climate change is a naturally continuous earth process, it is also related to human-induced activities as well. Whether the causes are natural or from human influence, our focus is on the impacts of climate change and the potential ecological and economical responses, including those impacts to energy infrastructure, production, and transportation.

Climate change affects biota, water, ecosystems, cultures, and economies. The Department of Interior therefore has a unique responsibility to further the scientific understanding of climate change processes and impacts in order to effectively manage its lands and trust resources. In addition, there is a critical connection between climate change, energy issues, including energy use, production, and transportation.

Figure 1 in my written testimony illustrates the climate/energy feedback loop where the two have complementary impacts, and that perpetuates continual impacts, both positive and negative with respect to energy.

Continued increases in fossil fuel energy will lead to increasing greenhouse has emissions. This, in turn, may potentially lead to increased global temperatures and increases in climate change impacts such as permafrost degradation, sea-level rise, and increased intensity of strong storms. These climate change impacts lead to a completion of the feedback with energy, including a decreased water availability to generate hydro power and damage to oil and gas production infrastructures, including coastal and Arctic pipelines.

Some feedback impacts actually may have positive impact. For example, a decline in Arctic sea ice will lead to greater access to energy resources in the Arctic.

The USGS provides on-the-ground science information from its numerous observation and monitoring networks and research activities that span the biological, geological, and hydrological sciences. These observations and related research efforts are impor-

tant components for building climate models, energy assessments, and especially those to deal with the impacts of climate changes to terrestrial freshwater marine ecosystems.

Our findings and data are critical information to decision makers regarding many important climate issues such as, one, the future availability of water for people in ecosystems in arid regions; proliferation of invasive species, and impacts of biodiversity, critical habitat, and ecosystems; current and future trends in climate warming in the Arctic and resultant permafrost degradation; and the impacts on energy and transportation; consequences of abrupt changes in climate, including suitable rise and impacts to low-lying coastal communities; and the extent to which current climate change in climate variables are due to natural versus manmade causes.

The Department of Interior has a significant stake in mitigation of and adaption to climate change due to the vast lands' natural resources in communities for which it has responsibilities. Of particular interest to this committee are those impacts on public lands and the point where those public lands intersect energy infrastructure, production, and transportation.

Although science has come far in understanding the impacts of climate change and human ecosystems, many significant challenges and unique opportunities to better understand the long-term effects of our climate remain. These include: a need to develop holistic earth systems science approach to help communities and natural resource management prepare for and reduce climate change impacts; to help better distinguish natural changes from those imposed from the natural system by human activities.

The science must also address human-induced global change so the cost/effect of mitigation strategies can be developed and implemented by decision makers; and developing a better understanding of how the earth and its physical and biological processes interplay, and therefore collectively respond to climate change over short term, and well into the future.

In summary, to further our scientific understanding of climate change and impacts, we need to better forecast climate-related impacts to physical and biological systems; forecast precipitation changes as a consequence of changing climate; and understand how processes that regulate climate will be affected by the range of temperature change as well as abrupt climate change events; determine how global warming affects or may affect the frequency and intensity and path of strong storms, including hurricanes; and understand the outcomes of climate changes on ecosystem.

Thank you, Mr. Chairman. I would be happy to answer any questions.

[The prepared statement of Mr. Myers follows:]

Statement of Dr. Mark D. Myers, Director, U.S. Geological Survey, U.S. Department of the Interior

Mr. Chairman and Members of the Subcommittee, thank you for the opportunity to present testimony on the role of U.S. Geological Survey (USGS) science in addressing climate change impacts on public lands and potential energy resources.

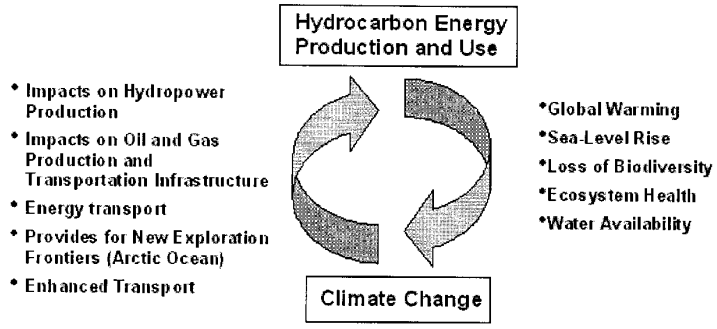
The USGS has a long-standing history of conducting research, monitoring and modeling of climate change and its physical and biological impacts. This work includes strong multi-disciplinary capabilities and expertise that are well established and distributed across the United States, along with a proven capacity to assess pre-

historic, historic, and current climate effects. These strengths provide USGS with a critical role in conducting climate change science across the Nation's terrestrial, freshwater, and coastal systems and in providing unbiased science to decision makers. The USGS works closely with our partners in the U.S. Climate Change Science Program to address the challenges posed by global climate change.

Global climate change is one of the most complex and formidable challenges facing society today. While climate change is a natural, continuous Earth process, changes to the Earth's natural climate are related to human activities as well. Whether the causes are natural or from human influence, our focus is on the impacts of climate change and the potential ecological and economic responses, including those impacts to energy infrastructure, production, and transportation.

Climate change affects biota, water, ecosystems, cultures, and economies. The Department of the Interior (DOI) therefore has a responsibility to further the scientific understanding of climate change processes and impacts in order to effectively manage its lands and trust resources. In addition, there is a critical connection between climate change and energy issues, including energy use, production, and transportation.

The Energy-Climate Feedback Loop



The figure above illustrates the climate-energy feedback loop where two components impact each other and perpetuate continued impacts (both positive and negative). Continued increases in fossil fuel energy use will lead to an increase in greenhouse gas emissions. This, in turn, may potentially lead to increased global temperatures and increases in climate change impacts such as permafrost degradation, sea-level rise, and an increased incidence of strong storms. These climate change impacts lead to a completion of the feedback loop with energy, including a decrease of water available to generate hydropower and damage to gas and oil production infrastructure (coastal and arctic pipelines). Some feedback impacts may actually have a positive effect on energy. For example, a decline in Arctic sea-ice may lead to enhanced oil and gas exploration within the coastal zones of the Arctic Ocean.

The United States and other nations will be challenged to develop adaptation and mitigation strategies that will anticipate the effects of a changing climate and its impacts on humans and ecosystems.

As the science bureau within DOI, USGS has a long history of participation as a member of the climate change science community. DOI, represented by USGS, is one of 13 Federal agencies engaged in global change research in support of the U.S. Global Change Research Act of 1990 and is represented as a member of the U.S. Climate Change Science Program and the Arctic Monitoring and Assessment Programme (AMAP). The USGS strives to understand how the Earth works and to anticipate changes in earth systems. To accomplish this, USGS science aims to understand the interrelationships among earth surface processes, ecological systems, and human activities. This includes understanding current changes in the context of prehistoric and recent earth processes, distinguishing between natural and human-influenced changes, and recognizing ecological and physical responses to changes in climate. The USGS has multi-disciplinary capabilities (biologic, geologic, hydrologic, geographic, remote sensing, and socio-economic) with scientific expertise distributed across the United States and many parts of the world. This ability to provide ground-truthing across multiple scientific disciplines in a wide variety of spatial and

temporal scales enables USGS to play a key role within the climate science community.

The USGS provides on-the-ground science information from its numerous observation and monitoring networks and research activities that span the biological, geological, geographical, and hydrological sciences. These observations and related research efforts are important components for building climate models, especially those that deal with the impacts of climate change to terrestrial, freshwater, and marine ecosystems.

Our findings and data provide critical information to decision-makers regarding many important climate-related issues, such as:

- Future availability of water for people and ecosystems. Specific projects include hydroclimatology studies in the Pacific Northwest and arid southwest for assessing current and future changes in water availability and related impacts on dam and reservoir management. The Bureau of Reclamation, as well as several State water agencies, are principal stakeholders for this work.
- Proliferation of invasive species and impacts on biodiversity, habitat, and ecosystems. USGS is conducting several major studies throughout the United States looking at the evolution of forest and rangeland communities as a response to warming climate and changes in precipitation. The U.S. Forest Service, several land resource bureaus of the Department of the Interior, and numerous State resource agencies are important stakeholders.
- Current and future trends of climate warming in the Arctic and resultant permafrost degradation and impacts on energy and transportation. USGS is conducting several coordinated studies on the North Slope and Yukon Basin of Alaska. Emphasis is on permafrost and climate effects monitoring and related ecological and socio-economic changes. This work is a partnership with the U.S. Forest Service, the U.S. Fish & Wildlife Service, the Bureau of Land Management, the National Park Service, the University of Alaska, Alaska State agencies, and various Native communities.
- Consequences of abrupt changes in climate including sea-level rise and impacts on low-lying coastal communities. USGS projects include the Chesapeake Bay and Greater Everglades Priority Ecosystem Studies. The USGS is collaborating with many partners, including the U.S. Army Corps of Engineers, the U.S. Environmental Protection Agency, the National Oceanic and Atmospheric Administration, and the land management bureaus within DOI.
- Impacts of climate change on land use and landscape change. In partnership with NASA and NOAA, USGS is involved in a variety of activities that are critical to understanding the impacts of climate change on public lands. These include monitoring of coastal zone topography and bathymetry; the production and distribution of national topography data; and improving our knowledge or topographic surface change through lidar and radar imaging of the U.S. national land surface.

The scientific and policy implications of mitigation strategies associated with these issues are complex. For example, rising sea-level exacerbates the vulnerability of coastal resources to coastal change due to storms and erosion. Vulnerable areas include thousands of miles of coastal resources for which DOI has land management responsibility. Efforts to alleviate coastal erosion and storm vulnerability often include "beach nourishment," the placement of large quantities of beach-quality sand on the beach and nearshore to build protective barrier beaches and dunes. With rising sea-level, the demands for beach quality sand, commonly extracted from offshore deposits, is likely to increase. In most regions, the quantity of this sand is limited, and the ability of recoverable resources to meet increased needs is in doubt. Moreover, recovery of in place resources can impact habitat and modify the natural movement of sediment between the nearshore and the coast. Additionally, the increasing demand is occurring as on-land sources for sand and gravel for construction are becoming more costly.

DOI has a significant interest in the mitigation of and adaptation to climate change due to the vast lands, natural resources, and communities for which it has responsibility. Of particular interest to this Committee are those impacts to public lands and the point where those public lands intersect with energy infrastructure, production, and transportation. These impacts may include:

- Shifts in carbon cycle, accelerated greenhouse gas emissions, and resultant effects on native communities, transportation networks, and managed infrastructure in high-latitude landscapes;
- Possible increases in the magnitude, frequency, and northern migration of strong storms and tidal surges related to changing climate and the associated risk to offshore and onshore oil and gas infrastructure and managed resources;

- Changes to strategies and cost of remediation and reclamation of lands disturbed by energy and mineral production, because of the added complexity created by climate change.
- Changes in the extent and severity of forest fires and associated effects on land management, forest composition, and carbon storage.

The USGS and other Federal agencies are actively engaged in understanding the impacts of climate change on both humans and ecosystems. USGS studies show that some impacts of climate change may be more urgent than others. For example, recent USGS image analysis of coastal erosion along a permafrost coastline in Northern Alaska showed a dramatic rate of coastal erosion—in some areas almost a kilometer of coastal erosion over the last 50 years. These findings have significant implications for energy development, native coastal villages, endangered species, and other land and resource management responsibilities.

Although science has come far in understanding the impacts of climate change on humans and ecosystems, many significant challenges and unique opportunities to better understand the long-term climate future for our planet remain. These include:

- Developing a holistic, earth-systems science approach to help communities and natural resource managers prepare for and reduce climate change impacts;
- Better distinguishing natural climate change from that imposed upon the natural system through human activities. The science must also address human-induced global change so that cost effective mitigation strategies can be developed and implemented by decision makers;
- Developing a better understanding of how the earth and its physical and biological processes interplay, and therefore collectively respond to climate change over the short-term and well into the future;
- Forecasting climate-related impacts to physical and biological systems;
- Forecasting precipitation changes as a consequence of changing climate;
- Determining how global warming affects, or may affect, the frequency, intensity, and paths of strong storms, including hurricanes;
- Understanding outcomes of climate change on ecosystems.

Thank you, Mr. Chairman, for the opportunity to present this testimony. I will be pleased to answer questions you and other Members of the Subcommittee might have.

Response to questions submitted for the record by Mark Myers, Director, U.S. Geological Survey

1. In your written and oral testimony you said that global warming will cause an increase in the frequency and intensity of storms. Climatologists say that the intensity of storms is related to temperature gradients between different air masses and climate models show that temperature gradients will diminish during warming. If that is the case, why do you anticipate that global warming will cause an increase in the intensity of storms?

My written statement uses the word "may" as opposed to "will" in connection with a potential increased incidence of strong storms. Specifically, my testimony stated that "to further our scientific understanding of climate change and its impacts we need to better determine how global warming affects, or may affect, the frequency, intensity, and paths of strong storms, including hurricanes." We cannot say for certain whether global warming has or will cause an increase in the frequency and intensity of storms.

This is an area of intense debate among the scientific community. Ongoing research has demonstrated multi-decadal cyclical behavior in the Atlantic region is an important factor in determining hurricane activity, however, recent research indicates global warming has an impact on hurricane intensity. It is important to stress that there are many factors such as air and ocean temperature, wind shear, and other conditions such as El Niño and La Niño that impact hurricanes. More research is needed to fully understand how these factors interrelate.

2. Satellite images taken over the last 20 years have shown that the greenness of the environment has increased. This should improve and enhance biodiversity. Why do you say that global warming will adversely impact biodiversity?

The point here is that increases in overall greenness do not necessarily coincide with increase in biodiversity; biodiversity is not simply a function of "greenness" or related increase of global temperature. Biodiversity is related to a combination of

many factors, including ideal precipitation, timing of precipitation, seasonality, plant community health, diseases including those related to insect infestation, and competition with other native and invasive species. Ongoing science that is looking at the issue of biodiversity changes along with changing climate have shown that certain areas of the world, including the Pacific Northwest (transitions in plant communities) and Alaska (encroachment of the Boreal forest into the Arctic tundra) are facing, and will continue to face, losses in biodiversity within a warming climate. Other areas, such as the Great Basin, are also seeing an overall decline in biodiversity as invasive cheat grass overtakes areas once dominated by native desert and high plains scrub plants.

3. If carbon dioxide is a more significant greenhouse gas than water vapor, why does it generally cool down in the desert at night during the summer and remain hot and miserable in the southeast?

Carbon dioxide is a more significant greenhouse gas only from the standpoint of its human-induced contribution to the atmosphere (from fossil fuel combustion) and its effect on climate change. Water vapor is the most abundant, naturally-occurring greenhouse gas, and plays a major role in controlling climate. Its abundance is expressed in terms of relative humidity. Water vapor absorbs energy radiating from the earth's surface and warms the atmosphere. The example expressed in this question is a case of contrasting humidity conditions. In the desert, where the humidity is low, the sun sets and the energy radiated from the earth's surface escapes quickly due to the lack of water vapor in the atmosphere. Thus, the air cools quickly. In the southeast, where the humidity levels are high, the energy radiated from the earth's surface at night is trapped by the water vapor in the atmosphere keeping the air warmer longer.

4. How do you know that carbon dioxide is causing the changes in climate today when it has not in the past?

Carbon dioxide is a strong greenhouse gas that has been tied to past changes in climate in ice core records and other proxies. Scientists involved in the recent Intergovernmental Panel on Climate Change (IPCC) concluded with "very high confidence" (IPCC WGI uses "very high confidence" to express expert judgment that a statement has a 9 out of 10 chance of being correct) that recent climate changes are being caused in part by anthropogenic activities, including the addition of carbon dioxide to the atmosphere (IPCC Fourth Assessment, Working Group I) from the burning of fossil fuels. In fact, the IPCC report called carbon dioxide "the most important anthropogenic greenhouse gas."

5. What scientific research and data did you use to support your statement that human activity and specifically the use of fossil fuels is adversely affecting the Earth's climate?

My testimony referred to both positive and negative impacts of the climate-energy feedback loop. Specifically, I testified that continued increases in fossil fuel energy use will lead to an increase in greenhouse gas emissions which may lead to increased global temperatures and increased climate change impacts. There are now many scientific studies that have drawn a direct correlation between human activity, specifically fossil fuel use, and changes in the Earth's climate. The best and most authoritative example is the Intergovernmental Panel on Climate Change (IPCC) Fourth Assessment Working Group I, Executive Summary which states that there is unequivocal evidence that humans and their carbon dioxide emissions are having a warming effect on today's climate. In 2005, the White House issued a statement acknowledging that global warming is occurring and that humans are a significant contributor to overall warming of the planet.

6. What climate models, if any, are you using to support your testimony? Has the model been validated by hind casting? Please provide the data used in the model and the results.

I did not use any specific models in order to develop my remarks for either the written or oral testimonies. I referred only to general results that can be corroborated through the past and current IPCC reports which do rely on the 23 global climate models, all of which have well-defined uncertainties and error estimates, and which are frequently hindcasted against both past instrumental (approximately 100 year records) and geologic (thousand-year timescale) information in order to assess their accuracy in use for predicting future climate change.

Mr. COSTA. Thank you very much, Mr. Myers. I want to begin with the round of questioning.

Let me remind members so that we can have an opportunity to listen, that the Committee Rule 3(c) imposes a five-minute limit on questions, and I will, for the sake of allowing all the members to ask questions, try to keep that more or less on point given the time nature.

There is a couple of questions I want to ask, and others I will submit later on for the record. Mr. Myers, as the Department of the Interior's science bureau, do you believe that the Department should have a role in addressing climate change, and if so, what is that appropriate role?

Mr. MYERS. Mr. Chairman, the Department of Interior manages one in every five acres in the United States. Also, the Department of Interior lands are a key component in the production of energy for this country, including coal, oil, and gas, and other non-conventional resources. So the Department definitely has a role in both climate, in terms of managing the lands and understanding the effects of climate change and doing what it can to adapt to those changes in lands that Interior manages.

Mr. COSTA. All right, one in five acres. That is obviously significant. Because there is a lot of Federal agencies involved and engaged in this effort today, notwithstanding those from the private sector, how does your scientific capabilities compare—the Geological Survey—from other Federal scientific contributors?

I mean, are we being redundant? Is there a collaboration?

Mr. MYERS. Well, first of all, there is a collaboration to the climate change science program, so there is integration of that science that occurs on the national level.

But second, the USGS has some unique characteristics because of its ability to integrate geological, biological, water data, and geospatial mapping capabilities.

Mr. COSTA. That is the heart of the question, the niche that you have to play with the other Federal agencies.

Mr. MYERS. Yes.

Mr. COSTA. And your experience and your technological and scientific capacity that exists within the service you think provides that niche?

Mr. MYERS. We certainly fill that particular niche. Now, there are other areas in the atmospheric area and the deep oceans where NOAA and NASA are the key players.

Mr. COSTA. That is why I referenced that observation I had when I was in Antarctica about 14 months ago.

You talked about the realities of climate change and the impacts of various responses, and I have a particular focus because of many of us who live in the Southwest obviously are very concerned as it relates to water availability, and how we provide our water supply when you have an arid or semi-arid conditions.

We have designed a water management system in California that is based upon what we believe is the history of the last 110 years. Clearly, that is small snapshot whether or not to whatever level you attribute the causes of man to the climate change, it is a small snapshot to try to base—based upon literally millions and billions of years of climatic changes that have taken place.

How do we get a better handle on the impact of water availability on areas where the Sierra Nevada, for example, is Mother

Nature's icebox where we store our snow from November through March, and of course, if that snow is not available there, it makes it very difficult throughout the rest of the year.

Mr. MYERS. Mr. Chairman, you need an integrated approach. The first component is looking at the long-term geologic record so you have a long-term baseline. The second is taking those records that you have that are highly accurate but a shorter span, like stream gauge records, understanding the last 30 to 50 years where we might have good stream gauge data, and look at changes. The third is using remote sensing, other monitoring techniques to look at changes in snow pack and conditions, and then relate that back to atmospheric climate models that need to be regionalist.

So that combination will give you trend line data, for instance, that will show you a decrease, an overall decrease in the snow pack, which is again leading to a change in water availability in the West.

Mr. COSTA. Just recently, we have looked at some tree ring studies over the last eight-nine hundred years, and the time period that we have been in compared to the other cycles has been unusually wetter than it has been in previous cycles, and if that is a pattern that will continue, we are going to get more drier weather, which will make it difficult for a growing stage.

I have some other questions, but my time is almost up so I will yield to the Ranking Member for purpose of his ability to ask questions or make comments.

Mr. PEARCE. Thank you, Mr. Chairman. Thanks for being here, Mr. Myers. We appreciate your testimony.

In your paper, you have the circular diagram and you have one end of it with a gap, the hydrocarbon, energy, and product use, and the bottom end of that circular diagram shows climate change. Is it your intent to draw the conclusion for us people up here on the panel that hydrocarbon, energy, and production use would be then the major impact of climate change, of global warming? Is hydrocarbon use—in other words, it is there in a block, it jumps off the page at one—is that the only factor?

Mr. MYERS. It is clearly not the only fact. We are trying to show the relationship of the feedback mechanisms and——

Mr. PEARCE. What other things might affect that?

Mr. MYERS. Well, certainly variations in solar radiation, the amount of dust, the availability and amount of sea ice; in the long term, the earth's rotation and other long-term climatic effects. But certainly the effects of increased CO_2 from certain type of fossil fuel energy production does add a factor to it.

Mr. PEARCE. If we are talking about the level of CO_2 as it relates to climate change, is there an optimal level of CO_2? In other words, we are about what, 385 parts per million right now?

Mr. MYERS. We are.

Mr. PEARCE. And is there an optimal level?

Mr. MYERS. I wouldn't know what that was. Again, it is a feedback mechanism. Certainly from best calculations about 31 percent of——

Mr. PEARCE. Basically you are saying we don't know. What happens as we reduce the carbon in the atmosphere? What scientific outcome on that?

Mr. MYERS. Reducing CO_2 in the atmosphere, if everything else is held constant, will decrease the absorption capability of solar radiation, and therefore cool the climate somewhat.

Mr. PEARCE. OK. What happens if we decrease it all the way to zero? Is that a desirable outcome?

Mr. MYERS. Not if humans want to live in earth.

Mr. PEARCE. So what happens?

Mr. MYERS. Basically, the temperature would get to cold to sustain life.

Mr. PEARCE. Yes, because CO_2 has a function. Where do plants, in other words, you got 385 parts per million, and plants require CO_2 in the atmosphere. At what point do plants begin to suffer?

Mr. MYERS. Well, certainly as you change CO_2 in any given part of the environment, given temperature, water availability and other issues, you change the plant biome.

Mr. PEARCE. Do we know at what level that plants begin to suffer? In other words, if you them in a closed environment, maybe just a little glass beaker, you put a bean plant in there and you grow it, and you begin to withdraw CO_2, at what part per million does it begin to suffer?

Mr. MYERS. With a plant in isolation it would depend on the plant type, and I don't have an exact number for you. We can get that.

Mr. PEARCE. But there is a quantifiable level at which we begin to effect the ability of the planet to breathe or whatever.

One of the panelists that is coming up declares that there is no remaining scientific debate we are causing global warming, and it is past time to do something about that. Would you be willing to testify that we are through with the scientific debate, that there is no more scientific debate?

Mr. MYERS. Certainly the state of science is always that we improve our knowledge in an incremental basis.

Mr. PEARCE. No, that is not my question. My question is are you willing to affirm that the science debate is over, that there are no really viewpoints on the opposite side held by credible scientists?

Mr. MYERS. There are certainly viewpoints on the other side, but the preponderance of evidence is that the climate is in fact increasing in that both the——

Mr. PEARCE. No, this is the time to—this says we are ready to do the policy. Is the science, in your mind, fixed enough that we are ready to do policy?

Mr. MYERS. In my mind, from the Department of Interior's perspective, we need to start adapting to the changes that we are seeing with respect to climate in the environment.

Mr. PEARCE. Just yes or no. Let us try it that way.

Mr. COSTA. I think that is a yes. I would interpret that as a yes.

Mr. PEARCE. All right, put it in the record as a yes. I am from the West. I don't know all these languages here. I barely speak West Texan adequately.

Let us see, what about major inputs other than humans—volcanos, forest fires—are those inputs of carbon measured by USGS?

Mr. MYERS. Well, certainly there is an input, a significant input——

Mr. PEARCE. No, no, no, I have 18 seconds left.

Mr. MYERS. Yes.

Mr. PEARCE. You are going to have to have a short answer. Are they measured by USGS?

Mr. MYERS. Yes.

Mr. PEARCE. And can you tell me what those measures are? In other words, compared to the human input, somewhere on a scale of importance, do they put more or less than humans?

Mr. MYERS. In current conditions in the last say 30 years, less.

Mr. PEARCE. Less?

Mr. MYERS. Less, yes.

Mr. PEARCE. In the last 30 years?

Mr. MYERS. For instance, like volcano eruption. Now, obviously, the overall carbon cycle still produces the majority of CO_2 in the atmosphere, the natural recurring CO_2 cycle, but with respect to say volcanos versus human conditions, humans are——

Mr. PEARCE. Can you declare how much less?

Mr. MYERS. I will have to get the numbers for you, sir.

Mr. PEARCE. If you would, please, because this becomes a very important thing because we need to see relative effects on the climate, relative effects on the carbon, and as I see the wild fires raging through——

Mr. COSTA. He is going to respond to your question.

Mr. PEARCE. I would appreciate that. Thank you, Mr. Chairman.

Mr. COSTA. Thank you.

Our next member, the gentleman from American Samoa, Eni.

Mr. FALEOMAVAEGA. Thank you, Mr. Chairman, and I want to commend Mr. Myers for his testimony here this afternoon, and I would like to first commend the Speaker of the House of Representatives for taking the initiative in making global warning an issue as a national issue that we ought to honestly debate.

I recall that some six years ago we simply shut out the whole issue of global warming when our President decided to no longer continue the dialogue when the Kyoto Protocol was proposed. Out of some 150 countries that signed the Kyoto Protocols, two have not signed, and that is Australia and our own country.

I recall even one of my colleagues or our colleagues called global warming as global bologna, and it is unfortunate because it seems that some of our leaders make light of this issue, whether is there really a serious issue concerning global warming.

I wanted to commend Mr. Myers for his testimony saying that Geological Survey truly gives out unbiased science, and I want to thank you for that. If I read it correctly in your testimony, the Geological Survey has multi-disciplinary capabilities dealing with biological, geologic, hydrologic, geographic, remote sensing, and social-economic—I have no idea what these words mean—with scientific expertise—OK.

I understand from your testimony that Geological Survey does do concurrent studies together with several other Federal agencies, and my question is, where are we at? Do we really have a serious problem with global warming or is it just someone's figment of imagination?

Mr. MYERS. Thank you. We believe, yes, we do have a problem with respect to change in climate, and then the changes in the environment that we are seeing, and the need to adapt to those

changes. It is not my position, again, from a scientific organization to suggest what those policies might be, but we are in fact observing significant changes to the planet with respect to climate and associated effects.

Mr. FALEOMAVAEGA. You know, the problem we are having is almost like getting an expert witness in court, and depending on what persuasion you are in for, pro energy and the heck with global warming, so you get your line of experts, and this seems to be going on, we have had this news for years. Unfortunately, also when the Vice President called all the chief, major CEO executives about energy, corporations, they had a great meeting at the White House. Guess what? To this day we have no idea what they talked about. Now, to me, that is not a very good way of conducting or trying to find out exactly what is in the public interest about this very issue of global warming.

I will try this question again, Mr. Myers. Are we really seriously having a problem with global warming?

Mr. MYERS. Yes, I believe we are seeing——

Mr. FALEOMAVAEGA. Don't say yes. Please, you are the unbiased science, and I am really happy that you made that distinction with all other agencies. You give us the unbiased science. Are we really having this serious problem of global warming?

Mr. MYERS. Yes. Again, we are seeing significant effects in changes to the planet because of changes in climate.

Mr. FALEOMAVAEGA. And this ongoing study has been going on for four years now? Three years? Two years?

Mr. MYERS. The survey has been studying the effects of climate change for over 20 years.

Mr. FALEOMAVAEGA. And for the 20-year period, and I don't know how long you have been there, Mr. Myers, in the Geological survey, it is in your best judgment as a scientist I assume that yes, there definitely is an impact on global warning on our planet? Is this in your best judgment? I am not asking you as a Democrat or a Republican, as a scientist, in your best opinion we really do have a problem with global warming?

Mr. MYERS. Because the USGS is primarily designed an operational observational science, we are seeing significant changes to the landscape because of changes to climate.

Mr. FALEOMAVAEGA. I note with interest that Mr. Murray is the chief executive of one of the best operated energy companies in the country. Here is my problem—I'm trying to figure out how you establish a balance between human needs and maintaining the cleanliness of our natural resources?

I think that seems to be the issue that we are trying to resolve here, but, unfortunately, it always seems to be one extreme to the other, but never trying to find out what can we do without any ideological preferences, but just to say what can we do to resolve this basic issue?

Mr. MYERS. Well, certainly some things we can bring to the table is research in alternative energy sources. For example, natural gas hydrates, huge potential source of energy in the Gulf of Mexico, and on the Alaska North Slope, and off many islands in the world that could be harnessed as a very clean source of energy; increased use of geothermal, and other sources of energy; recognizing mecha-

nisms to classify and understand geologic carbon sequestration. We know we could do significant research, and research is going on, but on a national level scale, understanding of the capability of the geologically sequestered carbon; the baseline work for some of the alternative energies as well as conventional energy resources like natural gas, again the ability—I will go back to carbon sequestration.

If you do have coal, and you want to store that carbon, where are you going to put it? We need to understand the basic underlying geologic reservoirs, the sustainability, the capability of those reservoirs to store it, and we need to understand what infrastructure we need to build and the cost of that infrastructure.

Mr. FALEOMAVAEGA. Of interest I note that we have enough supply of coal and shale in our own country that will give us enough energy for our needs for the next 1,000 years I am told if we properly harvest it or whatever we do to create a clean environment if ever coal is to become one of our prime, as it is now.

Do you think that the technology can be done in such a way that coal is a good source of energy?

Mr. MYERS. Certainly. There are wonderful coal technologies that can be used very cleanly. There are conventional coal technologies that can be used as well. Again, the USGS brings an understanding of where that coal is, we do the national, and we actually do the world assessment of coal availability. We can understand the qualities of that coal. We can also look at the environmental effects of producing that coal, and then alternative technologies, like carbon sequestration, which could limit CO_2.

Mr. FALEOMAVAEGA. Thank you, Mr. Chairman. Thank you.

Mr. COSTA. Thank you very much, and as our tradition to alternate back and forth between the majority and the minority, I will refer back to the Ranking Member for clean up.

Mr. PEARCE. Thank you, Mr. Chairman. We are going to try to work our way through this quickly because we do have two panels. The vote ran us late.

Mr. Myers, on the whole concept of beneficial outcomes, is the human race going to be better or worse served by any cooling in the climate or any warming in the climate? I will say warming in the climate. Does that affect human race, say if it is increased by a degree or two, three, whatever?

Mr. MYERS. Certainly the human race will have to adapt to certain different conditions in key ecosystems such as in the Arctic where the permafrost is melting we are seeing an increased coastal erosion. We are seeing a disappearance of sea ice. That is going to change that environment, so humans have to adapt to that.

Water availability is going to change. There are going to be some areas are going to be under a change of a couple degrees. They are going to receive more water. Other areas are going to receive less water. Storm severity is going to increase, coastal issue will be an issue.

So I believe there is a need for adaptation to the changes we are going to see, going to see with respect to environment. Again, as you go back into the geologic record, the planet has sustained significant changes over its history, and changes that exceed the current changes that we have seen, but that is before we were so prev-

alent on the planet. So I do believe there is going to be a need to be adaptation as we see the climate change.

Mr. PEARCE. I don't know exactly what you feel like, but as far as with respect to the climate, can we get where we need to go without significant reductions in the coal or oil and gas uses for energy development? Can we get there without those decreases?

Mr. MYERS. I don't feel qualified really to answer that question. Again, it is a policy question rather than a science question. I think certainly technologies that are out there——

Mr. PEARCE. No, I mean coal and oil and gas, you use them in your chart here, hydrocarbons. My question is can that square remain unchanged and get where we need to go with the carbon levels?

Mr. MYERS. Certainly under current levels' production atmospheric CO_2 will increase. That said there are hydrocarbon sources, such as natural gas, a conversion to a greater use of natural gas that would lead to less greenhouse gas.

Mr. PEARCE. As far as coal, coal provides 50 percent of our energy, 53 percent, can we get where we need to go with current level of coal use or do we need to diminish that?

Mr. MYERS. We certainly could adapt coal——

Mr. PEARCE. No, not could. I am just asking——

Mr. MYERS.—technology. You could dramatically decrease if you left coal stable for electrical generation, but for other purposes use increased amount of natural gas or decreased——

Mr. PEARCE. I don't mean to be putting you in a position that obviously you are really uncomfortable because we are sitting up here trying to get the best that we can. I know one or two scientists in Congress. The rest of us are like me, just I have studied in science in the ninth, tenth, eleventh grade, I am not sure I did in the twelfth grade. We are trying to see or way through this, and that is a fairly simple question, and a direct answer would help. I am going to ask everybody on the next panel, give them a heads up. We have asked the same question, so your answer gets averaged down there.

I am going to yield back to the Chairman here in the interest that we do need to get finished up. I have a couple more if we get another chance.

Mr. COSTA. All right. You know, I think it is good to point that out. One of the areas that we are going to be in the future here talking about is carbon sequestration, and obviously the Chairman, who comes from a large coal area, is focused about how we can continue. We know that about half of our energy is produced from—electricity, excuse me, as you stated, from coal in the country, and obviously how we deal with that is an important factor. I think we are all aware of that.

The gentleman, Mr. Hinchey is—you are correct. Thank you for pointing that out. Mr. Kennedy, the gentleman from Rhode Island.

Mr. KENNEDY. Thank you, Mr. Chairman. Mr. Chairman, if I could, I would just say I think you are very generous and I commend you with respect to acknowledging the minority and giving the minority a chance to speak at every chance in between because I haven't been at any committee hearing in all my 12 years where

the minority would have a chance to speak in place of not having any other members of the minority there.

Mr. PEARCE. Would the gentleman yield?

Mr. KENNEDY. Yes, I would be happy to do that.

Mr. PEARCE. We did it exactly that way at the last hearing.

Mr. COSTA. The last hearing, I was the only one here and there were three other members, and so it was a great day for me, I must tell you. I got all my questions in.

Mr. KENNEDY. Oh, then it is the first experience I have ever had with it, so I am happy to be enlightened.

Mr. COSTA. I try to be even-handed on these things.

Mr. KENNEDY. I am happy to be enlightened.

Mr. COSTA. So you have stolen my thunder this afternoon, but I am glad to have you here.

Mr. KENNEDY. And I was commending you for that, Mr. Chairman.

[Laughter.]

Mr. COSTA. Thank you.

Mr. KENNEDY. Mr. Myers, I wanted to ask you, I come from a state called the Ocean State, so you can imagine my concern with all of the prospects of global warming and the increased sea level. Could you tell me what plans there are in the offing to prepare for the increased seal level, and the possible flooding that would take place should these geological predictions take place? Do you have those kinds of forecastings and what do they look like?

Mr. MYERS. Mr. Kennedy, we do a lot of baseline scientific work with respect to coastal processes, not only the sea level rise but subsidence in some areas where the ground mass is actually going down, so it is a combination. We do a fair amount of work on oceans. I think the President's proposed budget on ocean action plan is to look seriously at some of those issues in a holistic way. We tend to look at watersheds in a holistic way, and look at the effects of that.

Certainly the work, the scientific work we do, and other agencies do hopefully gets incorporated into the Corps of Engineers and other agencies, FEMA and other agencies that deal with emergency disaster. I know there is good working relationships both with the Corps and FEMA on that. I don't know the details of all the planning efforts. Again, we provide baseline by science, and then they develop the plans and the mitigation strategies.

Mr. KENNEDY. Because obviously we can't begin to prepare early enough now if this—you know, the predictions of increased sea level between 11 and 16 inches over the course of the next century are to come true, we can't even begin early enough now in our State of Rhode Island in terms of the economic impact that it will have on our state. I should dare say the country, given the juxtaposition of where the population is in our country vis-a-vis the ocean, and I would hope that this policy of what we are doing here today would be to lay out the groundwork as to what we need to do as a country to prepare for those rising sea levels as well as what to do to prevent those rising sea levels, which is what I think we are ultimately here to do is to prevent those rising sea levels, but at the same time we ought to be prepared to deal with what may inevitably be taking place.

I would also like to ask you about what the capability is between you and NASA in terms of the mission to plant earth, and what the satellite capability is that you have or do not have insofar as doing these measurements. Do you feel that NOAA needs more capacity, that NASA and Mission to Planet Earth needs more capacity for you to do a better job at what you do?

Mr. MYERS. Mr. Kennedy, we use a number of satellites, including NOAA and NASA, but also the USGS run Landsat 5 and 7 satellites, and we are trying to make sure we can get Landsat 8 satellite built in a timely way to get launched in about a 2011 time frame.

It is important to have long-term continuity of data. Again, you need the satellite coverage, but the continuation of existing satellite coverage, the same parameters, so we can get a 30-40-year history because again as you look at change, looking at it over a few year time frame doesn't give you really a very good picture. You have to have a long period of records. So those satellites that sustain that long period of record, and also repeatable so you can repeat the imagery on a regular basis are critical satellite data which then links into in-situ monitoring on the ground to match up with the satellite data.

Mr. KENNEDY. If you would prepare for the Committee some more detailed recommendations as to the needs that you have in doing the spectrum kind of measurements from space through the Mission to Plant Earth, geological surveys, just as we would in a "go-to-space" look at other planets, the way we would look at our own, I think it would be very helpful because the point of these hearings is to work with other committees, to inform them as to what they need to be doing from our own hearings, and support their efforts as well, and I know many members of this committee, including myself, set on other committees. I sit on the Commerce Appropriations Committee that funds NOAA. I also sit on the committee that funds NASA, and we will be considering funding for new satellites, and also the schedule of launches and things of that sort, and it would be really good to have your input in those regards.

Thank you.

Mr. MYERS. Thank you. I would be happy to provide that.

Mr. COSTA. The gentleman from Rhode Island, we are attempting—for your information—to possibly look at doing a joint subcommittee meeting with the Subcommittee on Oceans and Fisheries to look at those impacts, so it is not really quite of the purview of this subcommittee. But for the State of the—what did you refer to that—Oceans?

Mr. KENNEDY. The Ocean State.

Mr. COSTA. The Ocean State. OK. If we are able to work that out, you will obviously want to participate in that subcommittee hearing.

All right, the next, my gentleman from New Mexico.

Mr. PEARCE. Thank you, Mr. Chairman. I only have one question and then I will probably yield back the rest of the time so we can get on to the second panel, and Mr. Myers, so you can stop smiling quite that big.

What were the CO_2 levels prior to the Industrial Revolution, and prior to the 1940s or whatever? I don't know if I have the right terminology or not, but you know what I am talking about. People are saying that since the industrialization the levels have really jumped.

Mr. COSTA. It would be the Nineteenth Century, aren't we talking about? Not the 1940s? Two hundred years?

Mr. PEARCE. The 1940s are key.

Mr. MYERS. Certainly below 300 parts per million in, I believe, around the 250 range.

Mr. PEARCE. About 250, and then they are what today?

Mr. MYERS. They are again 385.

Mr. PEARCE. OK, so 385 versus 250. What would happen if that number were significantly changed, that pre-industrial number, that 1940s number? What would happen if that were say 380? What would that do to all the models?

First of all, is the actual science occurring by measurement or models?

Mr. PEARCE. The actual parts per million in the atmosphere today, and then back-casting in the geological record through ice cores is in actual measurements.

Mr. PEARCE. OK, those are actual measurement, but the conclusions, are those models or are those actual demonstrated scientific effects?

Mr. MYERS. The future projections?

Mr. PEARCE. Yes.

Mr. MYERS. Those are modeled.

Mr. PEARCE. OK. So now then obviously if that number was not 250 like you said but was a higher number, say 380, what if it is almost exactly the same as today, how would that change the models? Significantly or not significantly?

Mr. MYERS. Mr. Pearce, for what period of time? For a long period of time or just a blip?

Mr. PEARCE. No. You would know that better than I do. Just all the assumptions that are being made, what if that assumption is wrong? What is the assumption is low, and what if the actual fact is closer to 380?

Mr. MYERS. Certainly there are times in the geologic records that——

Mr. PEARCE. No, no, no. I am asking—that is not my question.

Mr. MYERS. OK.

Mr. PEARCE. My question is what if that is an inaccurate number? What does it do to the models? Does it affect them drastically or not drastically. From my standing up here, it appears like a significant piece of the equation?

Mr. MYERS. Mr. Pearce, I don't know. We would have to rerun the models. Again, that would be—generally the GS does not run those models. It would have to be Encars or some other——

Mr. PEARCE. OK. You are testifying here the—I mean, you are putting strong words in the testimony, and so it is kind of a key thing. You did state that human activity is causing global warming, and if that number were different, would that change that statement?

Mr. MYERS. What I said was human impacts are part of the global climate change and global warming. Certainly natural impacts are also part of it.

Mr. PEARCE. All right. I am not trying to get—I mean we are trying to come up with the best that we can because we have to choose the right course of action for the whole country for a long period of time. If we choose incorrectly on either side, and so that to me appears to be a significant number, and if it is incorrect, then that is a significant change in our philosophical debate.

Let me see. I will yield back, and thank you, Mr. Chairman.

Mr. COSTA. Maybe during the sequestration hearing, we will get a chance to examine those numbers.

The next member is a person I have had the pleasure to serve with for many years, the gentlewoman from Southern California, Congresswoman Solis.

Ms. SOLIS. Thank you, and thank you, Mr. Chairman, for having this very important hearing, and I am delighted that the discussion is centering on this important topic because, as you know, the Speaker did develop this select committee on energy independence and global warming.

Obviously, for many, this is much more important than in locals that you would probably not even think of, and I want to kind of address myself to those core cities, the large cities in the United States, and to see if there is any data that is out there regarding any different trends in climate change as that has occurred over the last 20 or 30 years, partly because we see a large infusion of population in our inner cities, and different rural areas that are now being more heavily occupied.

What does that mean for the future, not just in the Southwest, but in those heavily populated areas where perhaps our infrastructure needs aren't quite there?

Mr. MYERS. Thank you for that question. I think you can categorize it in different areas. Among the Gulf Coast or the Southeast Coast where hurricanes are a significant factor, in fact, the severity of hurricanes are increasing, then the civil preparedness needs to be looked at with respect to larger storms and have typically been modeled. A Katrina-level storm, for example, it certainly wasn't modeled for with respect to the level of storm surge because we hadn't demonstrated that level of storm. So certainly severity of storm needs to be looked at, and the effect on coastal environments.

Sea level rise is an issue in those areas that are very low lying, and with respect to the populated areas in large cities that are in these low-lying areas.

In the West, water availability would be an issue as we see changes in the distribution, the amount of snow pack, and the availability of water, and competition for use of that water.

Ms. SOLIS. In the Southwest, and especially in Southern California, we have had a very unseasonably warm winter, and here, so to speak, as well in the Northeast. But it has a general high impact with respect to the use of energy, and the flow of that energy, and I am just wondering, are there models where we might be able to predict where we are going to see drought and severe types of weather where in California, for example, at this particular time

we are seeing outbursts of fire, uncontrolled fire that is affecting many parts of the southern part of the state?

Mr. MYERS. Certainly there are models now. The models that we have need improvement in terms of being effective regional models, and that is being looked at. I think that is one of the future research areas.

As was talked about before, understanding the variability in climate from an historical perspective and then from a geological perspective allows to very fine tune those models with the observational data, and hopefully will be able to actual have shorter-term models that have utility with respect to water availability supply in the future.

Ms. SOLIS. Do you plot out that information right now based on geography and demographics?

Mr. MYERS. Certainly the regulatory bodies do, like the Bureau of Reclamation in the West. They are pretty careful about that. We actually record, for instance, stream gauge data, the long-term stream gauge record, and use that to look at the amount of discharge and the predictable, not only season by season, but year by year over a long-term record.

We also look, in doing the science with respect to groundwater and groundwater availability, soil moisture.

Ms. SOLIS. All right. One of the concerns that I have is someone representing a more suburban/urbanized area is that recently many of our cities, I would say well over—I believe it is 409—have agree through their own, I guess, discussions, the Conference on Mayors passing protocols and goals and standards to try to mitigate the negative effects of global warming and climate change in their cities, and I am wondering what can we do in terms of the Federal government to help provide our states amply and our cities with information that they might be able to include in their general planning and things of that nature.

Mr. MYERS. I think there is two thrusts. One is the water availability, the ability to develop models, the ability to help predict so you can have a predictable understanding of the availability of water, the changes in the biomes, but also on the hazards front, work to help predict, and in the case of some of the coastal states that have earthquake effects, what happens when the aqueducts get broken? You know, what is the combination effects? What is the fire, earthquake risk, and then combine it with the availability of water?

So I think a lot of that work the survey has been involved with that with a lot of the local communities, and I think that is an incredibly valuable and important service. Again, as the adaptation component to recognize climate changes are occurring, and what those effects might be in urban areas.

Ms. SOLIS. Mr. Chairman, I know my time is up, but I would like to for the record enter in a report by the Conference of Mayors that was issued in Chicago 2005, wherein there is an outline of what many of our local communities and cities have done across the country. In many ways they are far ahead of the game than we are, if I might.

Mr. COSTA. All right, without objection.

[NOTE: The report submitted for the record has been retained in the Committee's official files.]

Mr. COSTA. Congresswoman Solis, I also will reference, I don't know if you will be able to say for the second panel, but Dr. Westerling is an associate professor at our newest UC campus in California, Merced, and his focus is the impact of research on, in part, forest fires, and their impact on climate changes, so that might be a good question you want to ask him at that time.

All right, Mr. Myers, thank you. You are so prestigious to be a panel one. We appreciate your time and we need to get some of those maps. We are working on that, right?

Mr. MYERS. We are working on it.

Mr. COSTA. That is a totally different subject.

Mr. MYERS. Yes.

Mr. COSTA. But members of the Subcommittee and, of course, the Full Committee, know that the United States Geological Service is one of, I think, the best of map makers in the world, and they have tremendous information for us, and would urge the members of the Subcommittee as well as the Full Committee to avail themselves of the USGS information that they have. Anyway, thank you.

Mr. MYERS. Thank you.

Mr. COSTA. All right, our next panel, we have six members, I believe, on that panel, and if you will all come forward. I am going to go through the list of the six witnesses, and then we will begin with our rounding questioning, and the first witness that we have before us is Ms. Deborah Williams, who is President of the Alaska Conservation Solutions, and a former Special Assistant to the Department of Interior as it relates to Alaska, and it is my understanding that while she is originally from California, she for the last 20 years has adopted Alaska as her state. So with that understanding, we will begin with you, Ms. Williams, if you are ready to go.

I want to apologize to the members, by the way, of the kind of setup here. Members, I like to have—when witnesses have the multimedia stuff, but we are kind of handicapped in this room. It is far away and it is hard to see. In the future, we will try to also have handouts that complement whatever presentation folks are making. It is what it is this afternoon.

STATEMENT OF DEBORAH WILLIAMS, PRESIDENT, ALASKA CONSERVATION SOLUTIONS, FORMER SPECIAL ASSISTANT TO THE DEPARTMENT OF THE INTERIOR, ALASKA

Ms. WILLIAMS. Thank you so much, Mr. Chairman.

Global warming represents the single greatest threat to Alaska's public lands and to the people who rely on those public lands. The impacts from global warning in Alaska are scientifically measurable, costly, damaging to Alaska Native cultures, harmful to treasured plants and animals, and detrimental to future generations of Americans.

Fortunately, we can successfully address this tremendous problem utilizing multiple strategies, including the rapid deployment of renewable energy resources.

My name is Deborah Williams. I am President of Alaska Conservation Solutions, and formerly served as a Special Assistant to

the Secretary of Interior for Alaska. I have also been asked to testify on behalf of the Alaska Conservation Alliance, representing 40 organizations with a combined membership of over 38,000 Alaskans.

Alaska is very significant with respect to global warming on public lands for two reasons:

First, Alaska contains a substantial percentage of our nation's public lands. For example, Alaska contains approximately 50 percent of all the lands that the Department of Interior manages.

Also, Alaska is warming faster than anywhere else in the nation. In the last 50 years, we have warmed 4 degrees Fahrenheit according to the National Assessment Synthesis team, while the rest of the globe has warmed 1 degree.

As described more fully in my 12-page testimony, the impacts in the last frontier from global warming are pervasive, damaging, and include, to name a few, dramatic declines in sea ice, glaciers and permafrost, significant losses in ponds and lakes. In fact, in some public lands in Alaska, we have lost over 54 percent of the ponds. They have completely dried up.

We have had substantial reductions in wetlands. We have had measurable and pervasive decreases in tree growth, record-breaking tree diseases, and we have had massive fire seasons. In two years alone, in 2004 and 2005, 11 million acres of Alaska burned.

We have had substantial increases in certain diseases that have caused declines in certain animal populations such as salmon, and most notably, in King salmon in the Yukon River. The Yukon River in Alaska has increased over 10 degrees Fahrenheit in the last 25 years, and that has resulted in new terrible diseases for our salmon populations.

We have had adverse impacts on Alaska Native subsistence and other peoples' subsistence. We have had ocean acidification. We have had damage to and loss of infrastructure, and we have had adverse impacts on health for Alaskans throughout the state.

Because of this committee's jurisdiction, I wanted to highlight three impacts that demand protective action with respect to nonrenewable resource development. As this committee know. polar bears in Alaska are deeply threatened. They have experienced drownings, dislocation from sea ice, cannibalism, starvation, smaller skull size, and significantly higher cub mortality. Furthermore, polar bears are now denning primarily on land instead of ice.

Therefore, first recommendation: Protecting the coastal plain of the Arctic National Wildlife Refuge which supports the highest concentration of polar bear denning sites in our nation is more important than here.

The Bering Sea, which is our nation's fish basket, is experiencing significant declines. Recommendation: Because this tremendously important asset and ecosystem, which provides almost 50 percent of all the fish produced in our nation, is undergoing stresses from global warming, Congress, through the recommendation of this committee, should re-institute the moratorium on offshore oil and gas production as soon as possible.

Global warming is causing accelerated shoreline erosion, and as a result is redefining our public land maps in Alaska. For instance, Newtok has lost two to three miles of shoreline in the last

40 years. The critical habitat area north of Teshekpuk Lake, in the northeast corner of the National Petroleum Reserve Alaska, is already losing low elevation lakes to rising ocean. This inundation not only affects habitat, it is also affecting oil and gas infrastructure. At least one older drilling site in the National Petroleum Reserve is now under water.

The third recommendation: This committee should order a study to examine the threats to oil and gas infrastructure and past drilling sites on public lands in Alaska from inundation caused by global warming, particularly within the National Petroleum Reserve.

Unfortunately, there were wonderful representatives from Utah, Shishmaref, and Kivalina, the three communities most at risk and that must be relocated now who were here for this committee, they had to leave. But on their behalf we truly need this committee to recommend and Congress to help relocate these communities, and as a nation we have a moral obligation to relocate them.

Now for the good news. Fortunately, Alaska has a very positive role to play in the reduction of greenhouse gas emissions. As described fully in the Renewable Energy Atlas of Alaska, Alaska has outstanding and inexhaustible geothermal wind, biomass, wave, tidal, and hydro electric energy supplies. There are some exciting developments in Alaska regarding renewable energy, but there needs to be much more done. Congress needs to assist Alaska, the nation, and the world in developing renewable energy potential. I would like to highlight three recommendations in that regard.

Geothermal, wind and ocean: With respect to wind, Congress should support the work of the Denali Commission and others in the instillation of wind generation capacity throughout Alaska, and throughout the nation. We also have the potential for wind to create hydrogen for local use and ultimately for export. That is something that this committee can recommend.

With respect to biodiesel, there is tremendous potential with respect to biodiesel, and that is something both in Alaska and throughout the Nation that this committee should recommend and we should explore.

And geothermal, this committee should quickly and decisively support expanded geothermal research and power production, including supporting Senator Murkowski's REFRESH Act of 2007, and finally, ocean power. With our 34,000 miles of coastline, more than the rest of the nation, in Alaska, we offer one of the best wave resources and tidal resources in the world.

Final recommendation: Congress needs to support the research and financial assistance associated with developing a renewable wave and tidal energy as soon as possible. MIT and others have recently come out with reports strongly recommending this.

We, in America, are indeed a great people. It is time to address the tremendously destructive reality of unaddressed global warming, and seize the wonderful opportunities associated with renewable energy, energy conservation and energy efficiency.

Mr. COSTA. Thank you, Ms. Williams.

Ms. WILLIAMS. One last sentence?

Mr. COSTA. One last sentence.

Ms. WILLIAMS. That is it.

Mr. COSTA. You got a little more time than——

Ms. WILLIAMS. I know. Wasn't that fabulous.

With this committee's assistance——

Mr. COSTA. Well, but I am supposed to be even-handed in this.

Ms. WILLIAMS. This is indeed my one last sentence, and thank you so much, Mr. Chairman.

With this committee's assistance, we can and must move toward a clean and renewable energy path to protect the Nation and the public lands that we cherish.

Thank you so much.

[The prepared statement of Ms. Williams follows:]

Statement of Deborah L. Williams, President, Alaska Conservation Solutions

It is an honor to testify before the Subcommittee on Energy and Mineral Resources about the significant, pervasive, and costly impacts that climate change is having on public lands in Alaska, and Alaska's potential renewable energy contributions to the nation. As described more fully below, global warming represents the single greatest threat to Alaska's public lands, and to the people who rely on those public lands. Fortunately, renewable energy from Alaska and elsewhere will benefit our environment, our economy, and our national security. Accordingly, I urge this Subcommittee to expand renewable energy opportunities and to support other actions to reduce greenhouse gas emissions and to protect our public lands in response to global warming.

I. Alaska's Public Lands and Global Warming: We are the Paul Revere of Climate Change

More than anywhere else in the United States, Alaska has experienced widespread, adverse impacts from global warming, which are negatively affecting our public lands and our public resources. These impacts are well documented and representative of many of the substantial human and economic costs associated with climate change. Alaska serves as an early warning system for the rest of the nation and world. We demonstrate clearly the need to recognize the assault of BTUs associated with global warming—and the imperative to take action now.

A. Alaska's Public Lands: Their scope and contributions. Alaska is very significant with respect to global warming on public lands for two reasons. First, Alaska contains a substantial percentage of our nation's public lands:

National Park acreage:	approximately 68% in Alaska
BLM Public Lands:	approximately 33% in Alaska
National Forest Service Lands:	approximately 11% in Alaska
National Wildlife Refuge:	approximately 83% in Alaska

There are also many other public land superlatives that apply to Alaska. Alaska hosts the largest National Forest (the Tongass), the largest National Wildlife Refuge (the Arctic National Wildlife Refuge), and the largest National Park (Wrangell-St. Elias National Park). Approximately half of the nation's congressionally designated wilderness resides in Alaska. Our vast public lands nourish species that migrate to states throughout the nation. Of particular importance, Alaska's public lands nourish vibrant Alaska Native cultures through fish and wildlife subsistence opportunities, a unique and priceless relationship. Others in Alaska and throughout the nation benefit from Alaska's public lands, and the fish and wildlife that these lands sustain, through tourism; ecosystem services; recreational opportunities; existence values; the support of beloved and irreplaceable ecosystems (such as the temperate rainforest) and species (such as the polar bear); and other services. Alaska's national public lands are a priceless national asset.

B. Alaska Has Warmed Four Times More than the Global Average. Alaska is also significant because we have warmed much more than the rest of the nation, and we are able to document scientifically and with traditional knowledge dramatic impacts throughout the state. While the earth as a whole has warmed approximately 1o F in the last 50 years, according to the National Assessment Synthesis Team, Alaska has warmed approximately 4o F during this same time period. The impacts in the Last Frontier are pervasive and include, with respect to public lands, damage to: Alaska's water bodies and wetlands; vegetation; ice, glaciers, and permafrost;

animals; and subsistence opportunities. Because of global warming, Alaska has also experienced damage to our infrastructure, health, economy, and quality of life.

In this testimony, after a brief background section, I will describe the major scientific evidence regarding the impacts of global warming on public lands and related resources, and I will make recommendations to the Subcommittee associated with certain section as appropriate. Attached to this testimony is a comprehensive bibliography of the sources that support the factual information presented.

II. Background

I currently serve as President of Alaska Conservation Solutions, located in Anchorage, Alaska. Founded in 2005, Alaska Conservation Solution (AkCS) exclusively addresses the impacts of and solutions to global warming, with a focus on Alaska. As President of AkCS, I have extensively toured the state of Alaska. In this capacity, I have not only observed the clear, dramatic impacts of global warming on our public lands, but I have also talked with federal land managers, scientists, Alaska Natives, and others about the impacts that they are measuring, documenting and observing. Furthermore, I have had the opportunity to work with many groups, companies and individuals regarding Alaska's renewable energy potential and contributions.

In the past, I have had the privilege of working for the Department of Interior, and have been extensively engaged in public land issues. Upon graduating from Harvard Law School in 1978, I participated in the Department of Interior's Solicitor's Honors Program in Washington DC. After the completion of the program, I transferred to Alaska to represent the National Park Service and the Fish and Wildlife Service in the Department of Interior's Regional Solicitor's Office in Anchorage.

Subsequently, in 1995, I received a Presidential Appointment as the Special Assistant to the Secretary of Interior for Alaska. In this position, I managed the Secretary's office in Alaska, the only such office outside of Washington, DC, and assisted the Secretary in overseeing the Department's extensive legislative mandates in the 49th state. I held this position for five years. Among my many responsibilities, I was actively engaged in public lands issues, subsistence matters, and climate change.

III. The Adverse Impacts of Climate Change on Alaska's Public Water Bodies and Wetlands

Because of global warming, water bodies throughout Alaska's public lands are shrinking substantially in size and numbers. In an exhaustive study of 10,000 closed ponds, scientists with the University of Alaska have documented a significant loss in the number of ponds, and in the surface area of those ponds, in key public land areas in the last half of the 20th century. For example, Innoko Flats National Wildlife Refuge lost 30% of its ponds during the last fifty years and experienced a total pond surface area loss of 31%. Similarly, the Copper River Basin, Wrangell St. Elias National Park, lost 28% of its pond surface water area in the last half century. Tetlin National Wildlife Refuge lost 20% of its ponds. According to the scientists, these dramatic changes present

> "profound consequences for provisioning services and the management of natural resources on National Wildlife Refuges in Alaska...These refuges provide breeding habitat for millions of waterfowl and shorebirds that winter in more southerly regions of North America. Wetland areas have also been traditionally important in the subsistence lifestyles of native peoples in interior Alaska, and changes in the structure and function of wetlands has the potential to affect the sustainability of subsistence lifestyles" (Riordan 2006).

Similarly, wetlands in studied areas in the Kenai National Wildlife Refuge have decreased by 88% and pond area has declined by over 70% from 1950 to 1996. According to evidence from peat core samples, bushes are now in areas in the Kenai where there were no trees or shrubs during the last 8,000 to 12,000 years. These and other scientific studies confirm reports of disappearing and shrinking ponds from Alaska Native elders, with many ramifications including adverse impacts on migratory birds, water dependent species, subsistence opportunities, and fire.

There are other documented impacts from global warming on Alaska's public waterways, the "life blood line" of Alaska's public lands. Rivers, like the Yukon River, have warmed substantially. According to temperature graphs produced by Dr. Richard Kocan from the University of Washington, the summer temperature of the Yukon River has increased over 10oF in the last 25 years. (The impact of this increase on salmon is discussed below.) Also, massive collapses of river-side permafrost are increasing sedimentation in the waterways. Unfortunately, however, we have very little information about the warming. Recommendation 1: There is

inadequate stream and river monitoring data regarding temperatures and resulting impacts; Congress should fund additional monitoring, analysis and management response in this critical area.

IV. The Adverse Impacts of Climate Change on Vegetation on Alaska's Public Land

A. Trees. Trees throughout Alaska's public lands have been adversely affected by global warming, including white and black spruce, yellow cedar, birch and larch. According to a study that analyzed thousands of satellite images taken over two decades, there are vast reaches of boreal forest on our public lands where photosynthesis has clearly decreased over the last 22 years. In central Alaska where it is dry, white spruce and black spruce have shown documented declines in growth. Projecting forward, a 4oC increase in July temperatures would result in no growth of these species in much of interior Alaska (Please see Figures 1 and 2).

Trees throughout Alaska are also subject to substantially increased diseases because of warmer temperatures. Southcentral Alaska experienced the world's largest outbreak of spruce bark beetle, killing mature trees on over 4 million acres of land, including vast forests in the Kenai National Wildlife Refuge, the Chugach National Forest, Lake Clark National Park, and other areas. Three global warming factors contributed to this. With longer warmer summers the spruce bark beetle can complete its life cycle in one instead of two years. Winter temperatures have not been cold enough for two consecutive years to depress survival rates. Lastly, the trees have not been able to defend themselves with sufficient pitch because of the stress of heat and drought.

Other serious warming-related diseases that have damaged or killed large numbers of trees on public lands include the larch saw fly, spruce bud worm, birch leaf miner, aspen leaf miner, spruce aphid, and birch leaf rollers. For example, before 1990, spruce budworm was not able to reproduce in central Alaska. After warming in the 1990's, large infestations of budworms have occurred. With increased warming, all white spruce in Alaska will be vulnerable to outbreaks. Furthermore, trees in Southeast Alaska, including in the Tongass National Forest, are now, with warming, harboring aphid infestations.

In Southeast Alaska's Tongass National Forest, scientists have documented a massive die-off of yellow cedar on over 500,000 acres of land. Many consider yellow cedar the Tongass National Forest's most valuable tree both economically and culturally. Because of warmer temperatures, there has been less snow to protect the tree roots and also early dehardening of the foliage. Then, when a subsequent late freeze occurs, the foliage and roots are severely injured, leading to tree death.

B. Fires. Vegetation on Alaska's public lands has also been impacted by record breaking fire seasons. In 2004, over 6.6 million acres burned, the largest Alaska fire season ever documented. In 2005, approximately 4.6 million acres of Alaska burned, the third largest area ever recorded. (Please see Figure 3). Cumulatively, during these two years, over 25% of the forests in the northeast sector of Alaska perished. These burn rates are entirely consistent with global warming models and predictions. Some of the public lands most impacted by massive, global warming enhanced fires are Kanuti and Tetlin National Wildlife Refuges.

C. Invasive Species. Finally, because of warming, Alaska's public lands and waters are now subject to increasing threats from invasive species. Plants that could not previously reproduce in a colder Alaska can now do so with our warmer climate. One example is Purple Loosestrife. This plant is an aggressive invader of wetlands, and a serious threat to habitat and biodiversity. It requires warm temperatures for germination (15-20C), and now, for the first time, can reproduce in Alaska waterways.

V. Dramatic Reductions in Ice, Glaciers and Permafrost, and their Impacts on Public Lands

A. The Arctic Ice Cap. The Arctic Ice Cap is a key ecological component of our nation's northernmost public marine environment and the adjacent public lands: the Arctic National Wildlife Refuge and the National Petroleum Reserve—Alaska. There was a record low amount of Arctic sea ice in September 2005. Between 1979 and 2005, an area twice the size of Texas has melted away, over a 20% decrease in the minimum summer area. It has since failed to fully recover. In November 2006, ice coverage was the lowest ever recorded for that month. Another way of stating this substantial loss is that, according to the IPCC, "since 1978...(the) annual average Arctic sea ice extent has shrunk by 2.7 (2.1 to 3.3)% per decade, with larger decreases in summer of 7.4 (5.0 to 9.8)% per decade." Throughout the Arctic Ice Cap, the thickness has also decreased on average by 40%. Arctic ice is critical habitat

for polar bears, ice seals, walruses, certain species of bird, and other animals. It is also essential for the traditional subsistence activities of Alaska's Inupiat people.

Equal to any other evidence, the projected modeling of the future of the Arctic Ice Cap supports the importance taking meaningful action now to reduce greenhouse gas emissions. The modeling shows that if we continue to increase emissions of greenhouse gases that the Arctic Ice Cap, and the entire critical habitat that it fosters, could be eliminated as early as 2040. However, that same modeling shows that if we substantially reduce emissions, we can save the Arctic Ice Cap and even expect some recovery. In other words, according to Dr. Marika Holland with the National Center for Atmospheric Research, their modeling "indicates that society can still minimize the impacts on Arctic ice." Recommendation 2: Explore further the emission reduction scenarios that will, according to modeling, help sustain the Arctic Ice Cap, and support legislation that achieves those reductions.

B. Glaciers. The rapid retreat of Alaska's glaciers represents about 50% of the estimated mass loss by glaciers through 2004 worldwide. Between 1961 and 1998, Alaska and a small part of Canada lost over 588 billion cubic yards of glacial mass. In southeast Alaska, glacier surface elevations decreased over 95% of the area analyzed, with some glaciers thinning in a 52 year period by as much as 640 m (approximately 2,100 feet). The loss of Alaska's glaciers alone has contributed over 9% to global sea level rise.

Glaciers are an important component of many of Alaska's public lands, ecologically, aesthetically, recreationally, and for tourism. Repeatedly, Alaska tourists list glaciers as one of the top three reasons they visit the state. Unfortunately, many of our most visited glaciers are retreating quickly and significantly. An entire U.S. Forest Service Visitor Center was built on a site to view the Portage Glacier in the Chugach National Park. That glacier is no longer visible from the visitor center. The most observed glacier in Alaska, the Mendenhall Glacier in the Tongass National Forest, has retreated hundreds of feet a year, and is projected to recede from its frequently photographed lake terminus.

Rapidly retreating glaciers disrupt both fish and birds associated with our public lands. Sockeye salmon fry in Skilak Lake, part of Kenai National Wildlife Refuge, showed substantial declines in size in two recent years of large glacial melting. Fry in 2004 were about 50% smaller than average for the prior decade; fry in 2005 were 60% smaller. Similarly, the Kittlitz's murrelet, which feeds at the edge of glaciers, declined 60% between 1991 and 1999 in Glacier Bay National Park and declined 83% since 1976 in Kenai Fjords National Park (Please see Kittlitz murrelets photo, Photo 1).

C. Permafrost. With respect to permafrost, all of the observatories in Alaska, on both public and private lands, have shown a substantial warming during the last 20 years, often resulting in damage to infrastructure, rivers, shorelines, lakes, and forests. (Please see Photo 2 demonstrating damage to National Wildlife Refuge forests from melting permafrost). In locations such as Franklin Bluff on the North Slope, the top layer of permafrost has warmed 3oC between 1987 and 2003. Notably, the warming of permafrost has penetrated great depths, with observations of 2oC warming 60 feet under the ground. One should note that melting and warming permafrost also makes the construction of oil and gas infrastructure more difficult and costly.

VI. The Impact of Global Warming on Animals Associated with Alaska's Public Lands

Whether on ice, land, or water, animals throughout Alaska, have experienced declines due to global warming within our public areas.

A. Polar Bears and Other Ice Dependent Species. Polar bears rely on sea ice for their survival, including feeding, mating, and resting. Because of global warming, Alaskan polar bears have experienced less ice, drownings, dislocation from sea ice, cannibalism, starvation, smaller skull size, and higher cub mortality. Similar ice conditions and trends in the Western Hudson Bay population in Canada have resulted in a 22% population decline in 17 years. In the last fifteen years, the population of Southern Beaufort Sea polar bears has been estimated to be as high as 2,500 bears, and then 1,800 bears. Recently, using the most rigorous surveying methodology to date, the population is believed to be only 1,526 bears.

The decrease in sea ice jeopardizes this iconic national species. The impacts include a statistically significant decline in the survival rate for first year polar bear cubs in the southern Beaufort Sea from 61 cubs per 100 adult females between 1967-89 to 25 cubs per 100 adult females between 1990-2006. Furthermore, skull measurements of both first year cubs and adult males were also statistically significantly smaller. Previously, between 1979 and 1991when there was more ice, 87% of Alaska polar bears surveyed were found on sea ice. This percentage fell to 33%

from 1992 to 2004. This, and increased storm intensity, have contributed to documented drownings.

Finally, the Arctic National Wildlife Refuge coastal plain and other coastal areas are becoming more important to the survival of this species. Between 1985 and 1994, 62% of Alaska polar bears denned on ice. That has shifted dramatically. Between 1998 and 2004, only 37% denned on ice, the rest denned on land. The Arctic Refuge supports the highest concentration of polar bear denning sites for our nation.

As a result of the all the evidence the World Conservation Union (IUCN) in 2006 classified polar bears as vulnerable, concluding that five populations, including Alaska's southern Beaufort Sea population. Recommendation 3: The House Natural Resources Committee should support listing polar bears as threatened under the Endangered Species Act. Recommendation 4: As sea ice thins and retreats due to global warming, protecting the coastal plain of the Arctic National Wildlife Refuge is more important than ever to safeguard polar bear denning sites on public lands.

Other Alaska ice dependent species are also showing signs of global warming stress. As ice pulls away from the continental shelf there are observations of walrus mothers having abandoned their calves. Further out on the ice, the snow cavities for some ring seals and other ice seals are collapsing with warming temperatures, exposing their young to predation or freezing.

B. Salmon. Salmon populations in Alaska depend on public lands and these ecologically, economically and culturally significant species are adversely affected by increased temperatures. One of the state's most important rivers with respect to public lands, the mighty Yukon, flows through or is adjacent to multiple parks and refuges, including the Yukon Delta National Wildlife Refuge (our nation's second largest refuge), Innoko National Wildlife Refuge and Yukon Flats National Wildlife Refuge. In the last 25 years, the Yukon has warmed more than 10oF in summer months. As a result, up to 45% of Yukon salmon are now infected with the parasite Icthyophonus, never found before 1985. This disease weakens fish because it attacks heart and skeletal muscle tissue. It also prevents the drying of fish, making infected fish inedible as fish-rack dried subsistence foods, a critical component of many Alaska Native diets.

Global warming has also adversely affected other public land dependent salmon. After the warm summer of 2004, the pink salmon harvest in Southeast Alaska, which mostly relies on the Tongass National Forest, was dramatically lower than predicted in 2006. The Alaska Department of Fish and Game (ADF&G) had forecast a purse seine catch of 52 million. According to ADF&G, the actual harvest was only 11.4 million, 40 million less than predicted. Officials with ADF&G targeted warmer temperatures as the cause. Fewer salmon are bad for fisherman, the fishing economy, and the entire ecosystem, which relies on abundant salmon runs for nutrition and nutrients.

ADF&G has established standards for water temperatures, concluding that temperatures above 55oF are unhealthy for spawning areas. In four streams monitored in Alaska's salmon-rich Kenai Peninsula in 2005, there were more than 80 days that exceeded this temperature threshold. (Please see Figure 4).

C. Ungulates. Other species on our public lands are also experiencing declines because of global warming. The Porcupine Caribou herd, which relies on the Arctic National Wildlife Refuge as well as public lands in Canada, has experienced a population decline since 1989 of 3.5% per year to a low of 123,000 animals in 2001." (ACIA 2004) Scientists believe this is attributable to global warming caused by freezing rain (which coats their lichen making it very hard to access in the winter), changing river conditions, and less tundra.

For species that rely on high elevation ecosystems on public lands, they are also experiencing the impacts of global warming. For example, Dall sheep live exclusively in alpine tundra. Due to warmer temperatures, the treeline in the Kenai Mountains of the Kenai National Wildlife Refuge has risen at a rate of about 1 meter/year over the past 50 years. According to Dr. John Morton, chief scientist with the Refuge, "...we're going to have declining Dall sheep. We're losing their habitat."

D. Bering Sea Species. Fish and other species in the Bering Sea, our nation's fish basket, are also showing signs of impact. Because certain National Wildlife Refuge islands are surrounded by the Bering Sea and because many other Refuges and Parks are adjacent to the Bering Sea, the health of the Bering Sea has a major impact on them. The Northern Bering Sea is changing from arctic to subarctic conditions caused by warmer air and water temperatures, and less sea ice. Even bottom water temperatures are demonstrably increasing. As a result, the prey base of benthic (bottom) feeding walrus, endangered sea ducks like spectacled eiders, and gray whales is declining; snow crab catches have declined 85% in six years along

with other crab decreases; and crab populations have shifted northward. Yellowfin sole and Greenland turbot catches have been dropping, in addition to declines in fur seals and seabirds. Some pollock are moving into cooler Russian waters because of global warming. Recent surveys have measured the first decrease in U.S. pollock stocks in Alaskan waters in six years, resulting in a reduction of the catch allotment. In short, warming waters are creating a northward migration of marine life on an unprecedented scale. Recommendation 5: Because the Bering Sea is so important to the nation for fishery production (including salmon, pollock, crab and halibut), for sustaining marine mammals, and for nourishing Alaska Natives and others; and because the Bering Sea is already being stressed by global warming, Congress should re-instate the Moratorium on off-shore oil and gas production. Instead, renewable energy options, such as wind, wave and geothermal should be fully explored and implemented.

E. Migratory Birds. Unfortunately, in addition to the impacts described above, there are many more species of animals that reside on public lands, which are being adversely affected by global warming. Because of space constraints, I will discuss just one more: a representative migratory bird that touches many states in the union, the scaup. Population of these diving ducks appears "to be in peril" (Consensus Report 2006). They have declined from over 7 million in 1970s to a record low in 2006—3.2 million (Ducks Unlimited 2007). Why? We see the fingerprints of global warming, once again, with respect to Alaska public lands. Approximately 70% of these birds breed within western boreal forests, where there is the fastest rate of decline (94,000 birds per year [1978 to 2005]). These declines reflect breeding season events. There has been a19% wetland loss in Yukon Flats (1985-89 v. 2001-03). Recently, scientist have determined that where ponds lose 20% or more of their surface, there is a decline in scaup food sources such as amphipods, gastropods and chironomid larvae (Corcoran et. al 2007). Therefore, where there is more warming, less water, and less food, there are population declines.

VII. Greater Storms, Sea Level Rise and Ocean Acidification from Global Warming and Their Impacts on Public Lands

Global warming causes more intense ocean-based storms, not only in the Atlantic Ocean, but also in the Bering Sea and the Arctic Ocean. While in 2005 the nation focused on hurricanes in the Gulf of Mexico, Western Alaska experienced a brutal storm, adversely affecting 34 communities and our public lands. The storm surge in Nome was 9 feet above normal high tides with waves of 12 to 15 feet. Newtok saw 5 to 10 feet of beach disappear along with equipment like a 1,000 gallon fuel tank. Unalakleet lost 10 to 20 feet of beach.

Much less noticed, this global warming fueled storm also had a serious impact on public lands, including the Yukon Delta National Wildlife Refuge, one of the nation's most important geese breeding areas. Because so much of the Refuge is low in elevation, it was heavily influenced by storm surges of at least 9 feet that inundated considerable areas of fresh water lakes and wetlands. As a result, animals such as lemmings were killed, and as a precaution, the Refuge instituted a large fox trapping program to reduce predator populations to protect geese eggs. Major storms have also damaged Fish and Wildlife property.

More generally, because global warming in Alaska is resulting in accelerated shoreline erosion, melting permafrost and greater flooding, global warming is redefining our public land maps in Alaska. Some shorelines have retreated more than 1500 feet over past few decades, and in one area in Western Alaska, Newtok lost 2-3 miles of shore in 40 years. The critical habitat area north of Teshekpuk Lake in the northeast corner of the NPR-A, is already losing low elevation lakes, as the ocean breaches their boundaries and erases previous land masses. This inundation not only affects habitat, in some places on Alaska's North Slope, it is also affecting past and current oil and gas infrastructure. Older drilling sites in the National Petroleum Reserve—Alaska are now under water. Recommendation 6: Study the likely threats to oil and gas infrastructure and past drilling sites on public lands in Alaska, especially on or adjacent to the National Petroleum Reserve, from inundation caused by global warming.

Notably, according to a General Accounting Office estimate, approximately 184 communities in Alaska are at risk from flooding and erosion. In response to a Congressional request, the Army Corps of Engineers issued a report detailing relocation needs for seven Alaska coastal communities. The report estimates that Shishmaref, Kivalina and Newtok have only 10 to 15 years left at their present storm-battered locations, and predicts that it will cost as much as $355 million to move them. This cost estimate does not include the social upheaval associated with relocating, as in the case of Shishmaref, from a special location that has been occupied for over 4,000 years by a culturally recognized tribe. Because most of these communities are sur-

rounded by public lands, their moves will have consequences to these lands, in many cases requiring land exchanges (as was necessary with Newtok), road access, and other responses. Recommendation 7: Our nation has a moral responsibility to assist in and finance these moves in a culturally and environmentally sound manner, while at the same time insuring that the impacts on our public lands are minimized. In this appropriations cycle, Congress should insure adequate funding for planning and initial relocation efforts for the communities of Shishmaref, Kivalina, and Newtok, while determining future funding sources for these relocation needs.

Ocean Acidification. The acidification of our oceans is probably the least studied—but unquestionably represents one of the direst consequences—associated with human emissions of carbon dioxide. Since the Industrial Revolution, humans have increased the acidity of our oceans by over 30% as we have augmented the amount of CO_2 in our atmosphere from approximately 270 ppm to 380 ppm. Scientists are just beginning to understand the effects of current and projected acidification. Alaska's waters, and associated public lands and resources, will probably be the most negatively effected. For example, acidification dissolves food chain building blocks like the plankton known as pteropods, which are critical food sources for Alaska salmon fry and other species. Acidification also reduces the saturation of carbonate ions, which especially represents a very serious problem for deep water corals found offshore of many of Alaska's public lands, including the Alaska Maritime National Wildlife Refuge. Recommendation 8: Congress should definitely authorize more research on the status of and impacts from ocean acidification on our public resources and economy.

VIII. Adverse Impacts of Global Warming on Alaska's Oil and Gas Economy and Public Lands-Based Economies

Many sectors of Alaska's economy have been negatively impacted by global warming. The oil industry on Alaska's North Slope has experienced a much shorter winter season in which it can build ice roads and otherwise traverse the tundra for exploratory and drilling activities (Please see Figure 5). Even in the summer, oil production on the North Slope has decreased due to warmer temperatures, since compressor efficiency is reduced. Gas compression is needed to reinject produced gas into the gas cap, and this process represents a major constraint on production rates, particularly with warmer temperatures.

Fires and fishery losses due to global warming also have economic consequences for the nation. Fires are not only costly to health, but also to fight. The record-breaking 2004 season in Alaska cost over $108 million, while in 2005 fire fighting cost $56 million. Representing a loss of tens of millions of dollars, the 6% pollock quota reduction is one of the many fishery economic losses associated with global warming.

IX. Impacts of Global Warming on Indigenous Cultures, Subsistence Activities on Public Lands, and other Matters

Because of their close connection with land, water, vegetation, animals, and weather conditions, Alaska Native cultures are experiencing many severe consequences from global warming. A large number of these impacts are associated with public lands, which surround most Alaska Native villages and have served as their hunting and gathering areas for millennia. According to the Arctic Climate Impact Assessment, "Climate change is occurring faster than people can adapt. [It] is strongly affecting people in many communities, in some cases threatening their cultural survival." The ACIA further notes: "...the Arctic is becoming an environment at risk...sea ice is less stable, unusual and highly variable weather patterns are occurring, vegetation cover is changing, and particular animals are no longer found in traditional hunting areas during specific seasons. Local landscapes, seascapes, and icescapes are becoming unfamiliar, making people feel like strangers in their own land."

The former Chair of the Inuit Circumpolar Conference, Sheila Watt-Cloutier summarizes it well when she states: "For the Inuit, climate change is a matter of livelihood, food, health, and individual and cultural survival. The erosion and potential destruction of our way of life brought about by climate change resulting from emission of greenhouse gases amounts to a violation of the fundamental human rights of Inuit."

Alaskans in rural areas, and especially Alaska Natives, are threatened with increased health problems associated with global warming, including giardia from expanding beaver populations, botulism when storing their food in warming soils, increasing accidents from thinner ice and more intense storms, failing water and sewer systems, greater incidences of paralytic seafood poisoning, and decreased availability of nutritious subsistence foods. Other health problems include res-

piratory stress due to increased smoke from fires. More generally, larger fires from global warming are also releasing sequestered mercury, especially in Alaska and Canada, at levels up to 15 times greater than previously estimated.

Because of these grave, adverse impacts and threats, Alaska Natives have recently taken the opportunity to speak with a strong voice, stating that they are very detrimentally affected by global warming, that they are deeply concerned about the future of their subsistence way of life and their culture, and that they want Congress to take action to implement mandatory emission reductions. In the last few months, over 130 tribes, Native Corporations and major Alaska Native organizations—representing tens of thousands of Alaska Natives—have passed strongly worded separate Resolutions seeking meaningful legislative action (please see the representative resolution from the Alaska Federation of Natives that is appended to this testimony.) Congress has a responsibility to heed their compelling observations, meaningful experiences, significant concerns and justified request for action on global warming.

X. The Future is in Our Hands

The future course of global warming in Alaska depends on whether the United States and the rest of the world take the actions necessary to significantly reduce greenhouse gas emissions. If we do not, substantial warming is predicted (up to 25oF by the end of the century). The probable consequences of this amount of warming are many, including: the elimination of the Arctic Ice cap, the extinction of American polar bears, the inundation of hundreds of thousands of acres of land and scores of communities, the loss of most of Alaska's boreal forest, substantial increases in diseases, the significant decline and elimination of numerous arctic and subarctic species, the deterioration of our public lands, multiple adverse impacts on Alaska Native cultures, and the loss of billions of dollars of infrastructure. Notably, most scientists believe we still have time to avoid these cataclysmic changes, if we act to reduce emissions quickly and meaningfully.

XI. Renewable Energy in Alaska—Our Contribution

Fortunately, Alaska has a positive role to play in the reduction of greenhouse gas emissions. As described fully in the Renewable Energy Atlas of Alaska (accessible online at www.akenergyauthority.org), America's northernmost state has outstanding and inexhaustible geothermal, wind, biomass, wave, tidal, and hydroelectric energy supplies. As the Renewable Energy Atlas states, "With some of the best renewable energy resources in the country, Alaska has an opportunity to be a leader in their development..."

There are some early, exciting developments in Alaska regarding renewable energy, but there needs to be much more Congressional assistance to achieve Alaska's renewable energy potential.

A. Geothermal. Alaska has tremendous geothermal potential, both for direct use (including district heating, greenhouses, hydrogen production, absorption chilling, process heating in the seafood industry) and for electricity production. Currently there is an exciting example of geothermal use at Chena Hot Springs Resort that can serve as a model for many locations in Alaska as well as the nation and the world. Other large scale plants are also being investigated in Alaska. Recently, MIT issued a report declaring that geothermal power has tremendous potential for the United States, and needs more research and investment. Recommendation 9: Congress should quickly and decisively support expanded geothermal research and power production, including supporting Senator Murkowski's REFRESH ACT of 2007.

B. Wind. Alaska has tremendous wind resources that are highly suitable for the generation of electricity and hydrogen in both urban and rural locations. Alaska's first wind farm, located on the Northwest coast of Alaska, has been displacing a significant portion of the utility's diesel fuel since 1997. To the south, a recently installed wind project in Toksook Bay is providing renewable energy to three communities. Wind power is economic, clean, local, and inexhaustible, and deserves considerable support as a major energy producer of the future. Recommendation 10: Congress should support the work of the Denali Commission and others in the installation of wind generation capacity, and also research the potential for wind to create hydrogen for local use, and ultimately for export.

C. Ocean Power (Wave and Tidal). With our 34,000 miles of coastline (more than the rest of the nation), Alaska offers exciting opportunities for testing and implementing wave and tidal power. According to the Atlas of Renewable Energy, "Alaska has one of the best wave resources in the world, with parts of its Southcentral and Southeast coastlines averaging 60kW per meter of wave front. The total wave power flux on southern Alaska's coast alone is estimated at 1,250 TWh per year, or almost

300 times the amount of electricity Alaskans use every year!" Recommendation 11: Congress needs to support the research and financial assistance associated developing our renewable wave energy as soon as possible.

D. Biomass. Two exciting biomass fuels in Alaska are fish byproducts and municipal waste. Recently, with government assistance, a major processor conducted successful tests of raw fish oil/diesel blends, and now uses approximately one million gallons of up to 70% fish oil for power production each year. There is much more potential. According to the Atlas, "currently state, federal and university groups are working together to assess the potential for recovering a portion of the estimated 12 million gallons of fish oil returned to the ocean each year as fish processing waste". Recommendation 12: this research and analysis deserve to be supported, and other biofuel opportunities studied and implemented. With respect to waste product, Eielson Air Force Base densifies paper separated from the Fairbanks area waste stream and then uses the paper "cubes" at the base's coal-fired power plant. Between 600 to 3,000 tons of this fuel have been produced per year in 1997. This possibility should be explored throughout the nation.

XII. Conclusion

The impacts from global warming on Alaska's public lands are real, scientifically measurable, costly, damaging to Alaska Native cultures, harmful to treasured plants and animals, bad for the economy, and detrimental to future generations of Americans.

Because of Alaska's rich ecological and cultural heritage, there is much at stake in the Last Frontier as the planet warms. Alaska's experiences with global warming are also informative to the rest of the nation. Going forward, Alaska represents a compelling reason to implement mandatory reductions on greenhouse gas emissions promptly and significantly, as we move toward a clean and renewable energy path with determination.

[NOTE: Photographs have been retained in the Committee's official files.]

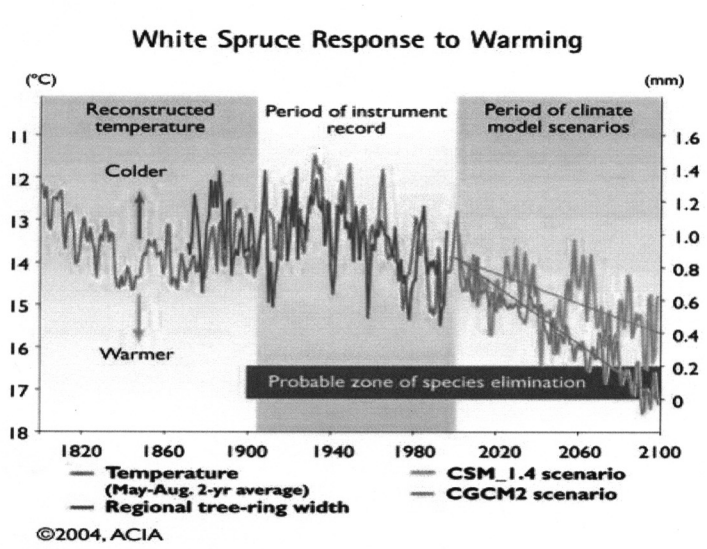


Figure 1

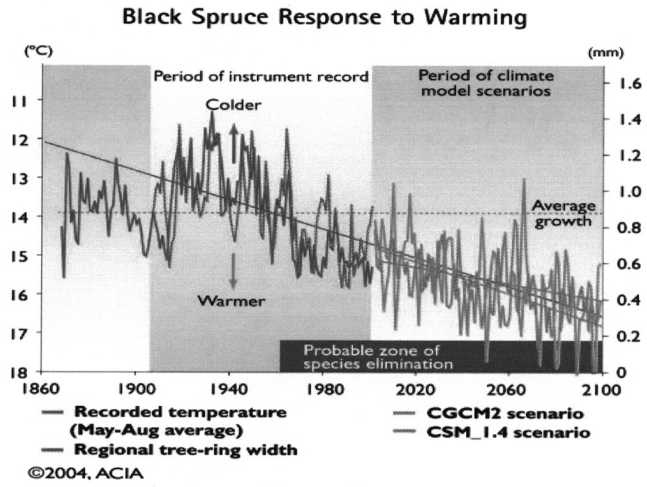


Figure 2

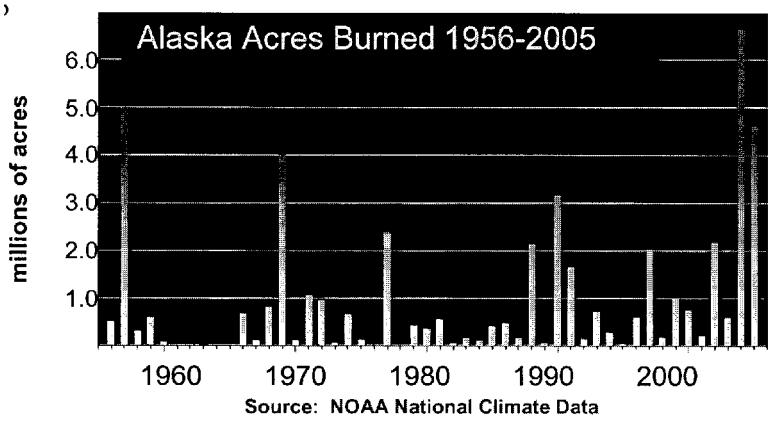
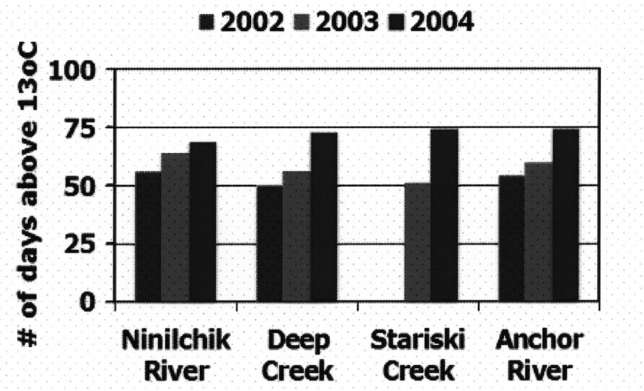


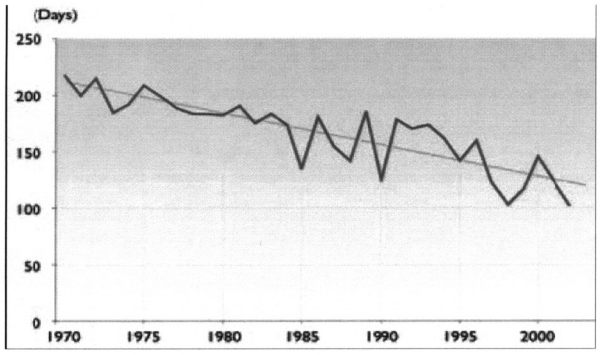
Figure 3



Source Cook Inlet Keeper January 2006

Figure 4

Alaska Winter Tundra Travel Days



ACIA, 2004

Figure 5

Mr. COSTA. All right. I am going to accommodate Mr. Murray, who I understand has a time issue. He is the Chairman of Murray Energy Corporation. Mr. Murray, you are at the plate.

STATEMENT OF ROBERT E. MURRAY,
CHAIRMAN, MURRAY ENERGY CORPORATION

Mr. MURRAY. Chairman Costa, Members of the Committee.

Mr. COSTA. We need to get the microphone in there. There you go.

Mr. MURRAY. Thank you for the invitation to provide this testimony this afternoon.

I am Bob Murray. I am the founder of Murray Energy Corporation from a mortgaged home. The United States of America is a wonderful country.

Twenty years ago, today I have 3,000 employees working in the most depressed areas of the United States of America. Penn State University says for every one of these 3,000 employees up to 11 secondary jobs are created to provide goods and services to our employees, so I am pleased to say that they tell me that I account for 36,000 high-paying, well-benefitted jobs in America. We also mine 32 million tons of coal a year, all from a mortgaged home, for American's electric utilities.

Our subject today is the implications of proposed carbon dioxide emission limits on public lands. We operate in Utah, 500 employees, UtahAmerican Energy, Inc., produce about 7 million tons a year, in Carbon and Emery Counties, and I can tell you these folks there are very, very happy to have these jobs, high-paying, well-benefitted, and that is where they want to live.

You see, Federal lands should not only have adequate stewardship for environmental purposes, but they also should be prudently developed to provide a high standard of living for our citizens. They and I are very threatened and troubled by the so-called global warming alarmism that is going on, whether carbon emission constraint measures, because they are going to have much worse adverse consequences to American citizens than what I have already experienced with the Clean Air Act Amendments of 1990.

You see, so-called global warming alarmism is a human issue to me as well as an environmental one. The unfolding debate is totally skewed and one-sided, and it is preoccupied with possible speculative environmental disasters of climate change. Few are giving adequate attention to the destruction that we will definitely see, not speculative, for American working people from environmental climate change proposals that have been introduced in the Congress to date, every single one of them.

Low-cost electricity is a staple of life today. A poll counts for 52 percent of that electricity is by far the lowest cost electricity, one-third to one-fourth the cost of natural gas. The Energy Information Agency says that electricity consumption in our country will go up 41 percent between now and 2030, and there is no other form of generating electricity in this country, and certainly not renewable that could replace this 52 percent of our electricity that coal accounts for.

While we have been losing high-paying manufacturing jobs in America to foreign countries, you can imagine the havoc brought on our country as a result of curbing coal's use or destroying its potential as a vital domestic fuel, which every singe piece of legislation introduced in this Congress to date does.

Local tax base will be destroyed, standards of living will be destroyed, and communities will be wiped out. All these bills will throw the prospects for our citizens and their economies in a spiraling reverse. It is a human issue to me, ladies and gentlemen, because I know the names of the people whose lives will be destroyed as a result of this rampage to enact global warming legislation when the science is not certain.

While some want us to believe that it is certain, it is really highly speculative, and I can tell you there is far more risk that these limits on carbon dioxide will destroy coal and manufacturing-dependent communities in this country and inflict great hardships on American families, that we know.

Further carbon capture, transfer, and sequestration technologies have not been commercially developed, and the need of investment in them will be thwarted with these discussions of global warming legislation. Some wealthy elitists in our country who can't tell fact from fiction can afford an Olympian detachment from the impacts of Draconian climate change policy. For them, the jobs and the dreams destroyed as a result will be nothing more than statistics, and the cares of other people. These consequences are abstractions to them, but they are not to me. I can name many of the thousands of the American citizens whose lives will be destroyed by these elitists ill-conceived global goofiness campaigns.

A number of companies are promoting constraints on coal use to achieve greater profits and/or competitive advantages. These people are not acting, and these companies, in the best interest of America. To name some of them, General Electric, duPont, Alcoa, Caterpillar, Shell Oil, British Petroleum, Excelon Energy, and there are others.

You see, ladies and gentleman, I have seen the effect of the 1990 Clean Air Act Amendments, and the drastic reductions in coal production, and the wrenching impact on our communities. One hundred and eighteen mines were closed in Ohio, 36,000 primary and secondary jobs were lost, families broke up, many homes were lost, some were impoverished, and all this the environmentalists call success.

I did not learn of this havoc from computer models, and I emphasize I didn't learn it from computer models, I lived it. I lived it. I saw it firsthand.

Now we are globally discussing mandatory carbon emission reductions which will be far more sweeping and far deeper reductions and wreck economic carnage on our quality of life and on our standard of living of many Americans.

The impacts on the economy's jobs and quality of life will not be equal around the country. Rather, the states that depend on coal-fired electricity will be damaged the greatest.

What will a worldwide environmental gain be from the pain that will be suffered on millions of Americans? Very little. Since 1990, U.S. greenhouse emissions have increased by 18 percent. China's have increased by 77 percent. China's emissions will surpass ours by 2009. China and India will emit twice as much carbon as the United States and the European Union, E-15, combined in 2050.

The G-77 group of developing countries, led by China, which is building 50 new coal-fired power plants right now, again reiterated this winter that they will not agree to mandatory carbon emission constraints in a second Kyoto Round after 2012, nor have they actually ever reduced any emissions to date.

What do you hope to accomplish by putting all of these people out of work and exporting these jobs if the rest of the world is not going to follow suit? Absolutely nothing but more economic havoc

on America. All America is doing is exporting more jobs to other countries.

The Kyoto Protocol was mentioned earlier. It has been a farce. There are only two nations that have met their Kyoto commitments. Canada's emissions are up 28 percent. Ours are up 1 percent, 1 percent growth. The E-15 nations since Kyoto who signed it are emitting more than the United States where they have a flat population growth, and we are increasing 1 percent.

The science is uncertain. Carbon dioxide-captured technology has not been proven on a commercial scale. The Congress must not be stampeded into preempting thorough climate research and the development of carbon capture, transfer, and sequestration technologies with emotionally developed or politically motivated legislation in an historical rampage, which it is, to enact carbon dioxide emission limitation mandates.

We urge all members of the Committee and their colleagues in Congress to consider carefully the impact that climate change bills will have, not only on the environment, but also on the American people, too. This is a human issue to me as well as an environmental one.

Thank you for allowing me to appear today.

[The prepared statement of Mr. Murray follows:]

Statement of Robert E. Murray, Chairman, President and Chief Executive Officer, Murray Energy Corporation, Cleveland, Ohio

We thank the Members of the Energy and Mineral Resources Subcommittee and the House Natural Resources Committee for inviting me to provide this testimony today.

I am Bob Murray, the Chairman, President and Chief Executive Officer of Murray Energy Corporation ("Murray Energy"), which I founded from a mortgaged home about twenty (20) years ago. Today, Murray Energy operates eleven (11) coal mines in the most economically depressed areas of Ohio, Illinois, Kentucky, Pennsylvania and Utah, which produce thirty-two million (32,000,000) tons of high quality coal per year for America's electric utilities, with about three thousand (3,000) employees. Current studies show that up to eleven (11) secondary jobs are created to provide the goods and services required by our miners. Thus, I am proud of the fact that we are advised that we have created up to 36,000 high-paying, well-benefited jobs in our Country since our inception in May, 1988.

Our principal subject today is the impact of any proposed carbon dioxide emission limits or climate change measures on the coal industry...its employees...and its implications for public lands.

UtahAmerican Energy, Inc. ("UtahAmerican"), a Subsidiary of Murray Energy, produces up to about seven million (7,000,000) tons of coal per year, with about five hundred (500) direct employees from Federal coal lands in Carbon and Emery Counties, Utah, and this production and employment will increase by about fifty percent (50%) in the years hence. Let me assure you that these Utahans are very pleased that we have heavily invested in their lives and futures and in this locale, which is where they want to live. You see, Federal lands should not only have adequate stewardship for environmental purposes, but they also should be prudently developed to provide a high standard of living for our citizens. They and I are very threatened and troubled by the so-called "global warming" or carbon emission constraint measures that have been introduced into the Congress that will ration the use of coal, with much worse adverse consequences to our American citizens than those that I have already experienced in my lifetime as a result of enactment of the 1990 Clean Air Act Amendment legislation.

You see, so-called "global warming" is a human issue to me, not just an environmental one. The unfolding debate over atmospheric warming in the Congress, the news media, and by the pundits has been skewed and totally one-sided, in that they have been preoccupied with possible, speculative environmental disasters of climate change. However, few are giving adequate attention to the destruction that we will definitely see for American working people from all of the climate change proposals that have been introduced in the House and Senate to date.

Today low cost electricity is a staple of life for all Americans, and fifty-two percent (52%) of this electricity is generated from coal. Further, coal-fired electricity is, by far, the lowest cost—about one-fourth (1/4) to one-third (1/3) of the cost of natural gas-fired electricity. Moreover, the Energy Information Agency states that our electricity consumption in America will rise forty-one percent (41%) between now and 2030. It is projected that, over the next twenty (20) years or so, coal must be counted on to generate fifty-seven percent (57%) of America's electricity, which cannot be replaced by any other form of generation—not natural gas, nuclear, or water, and certainly not renewables.

America is dependent on our coal because it is abundant, with some of our best deposits located on public lands; it is affordable; and it is critical to our energy security to protect all Americans from the hostile and unstable governments from which much of our Country's energy is currently imported.

While we have been losing high-paying manufacturing jobs in America to foreign countries, can you imagine the havoc that will be wrought on our Country as a result of curbing coal's use, or destroying its potential as a vital domestic fuel, which every single piece of legislation introduced in the Congress to date does, by slapping mandatory controls on carbon dioxide emissions and United States coal utilization? Draconian legislation, such as the McCain/Lieberman or Bingaman Bills, would thoughtlessly impose arbitrary caps on the use of coal, despite the destructive implications to our economy.

The West, where public lands dominate, is one of the regions where the twelve (12) Bills introduced to date to limit carbon dioxide emissions will inflict the maximum damage and destruction to human lives. High wage employment and concomitant benefits, local tax revenues, and the standards of living for our people will be brutally wiped out in many of our western communities, notwithstanding the implications against strengthening America's energy independence. All of the so-called "global warming" Bills introduced to date will throw the prospects for our citizens and their economies in a spiraling reverse. It is a human issue to me, as I know by name many of the thousands of persons whose lives will be destroyed from the current deceitful, hysterical, out of control, rampage perpetrated by fear-mongers in our society and some legislators to mandate carbon dioxide emission limits.

While some want us to believe that the science behind so-called "global warming" is certain, to the contrary, the actual environmental risk associated with carbon emissions is highly speculative. It is a fact, however, that every proposal introduced to date will provide a far more certain risk that carbon dioxide emission limits will destroy coal and manufacturing dependent communities and inflict great hardships on America's families.

Further, carbon capture, transfer, and sequestration technologies have not been commercially developed, and the needed investment in them must not be thwarted by discussions of "global warming" legislation. Also, I am a skeptic relative to our Country's commitment to gasification, liquification, or other technologies for the use of coal in processes other than pulverized coal combustion. I worked on the Great Plains Coal Gasification project in North Dakota, the only one in the western hemisphere, from 1968 to 1983, and there has not been another one built in the ensuing forty (40) years. Again, carbon emission legislation must not thwart the needed investment in coal utilization technologies.

Some wealthy elitists in our Country, who cannot tell fact from fiction, can afford an Olympian detachment from the impacts of draconian climate change policy. For them, the jobs and dreams destroyed as a result will be nothing more than statistics and the cares of other people. These consequences are abstractions to them, but they are not to me, as I can name many of the thousands of the American citizens whose lives will be destroyed by these elitists' ill-conceived "global goofiness" campaigns.

Also, there are a number of companies that are promoting constraints on coal use to achieve greater profits and/or competitive advantages, which transparent motivations are not in the best interests of Americans. These, in part, include Excelon, Entergy, British Petroleum, Shell Oil, Caterpillar, Alcoa, Dupont and General Electric.

You see, ladies and gentlemen, I have seen the effect of the 1990 Clean Air Act Amendments, the drastic reductions in coal production, and wrenching impact on hundreds of communities as a result of that legislation. In Ohio alone, from 1990 to 2005, about one hundred eighteen (118) mines were shut down, costing more than thirty-six thousand (36,000) primary and secondary jobs. These impacted areas have spent years recovering, and some never will. Families broke up, many lost homes, some were impoverished, because of legislation that the environmentalists call a "success". Again, I did not learn of this havoc from computer models. I lived it and saw it firsthand.

Now, we are glibly discussing mandatory carbon emission reductions, which will have far more sweeping and far deeper reductions in coal production, and will reek much greater economic carnage and reductions in the quality of life and standard of living of many Americans, than the Clean Air Act Amendments. But, the destruction from limiting coal use will not stop there. Natural gas costs will rise, further damaging the agricultural and chemical industries, and the loss of American manufacturing jobs, which depend on low cost electricity, will be accelerated.

Also, the adverse impacts on the economy's jobs and quality of life will not be equal throughout the Country. Rather, the States that depend on coal-fired electricity will be damaged the greatest. Every State in our Country has a "target" on its back from proposed "global warming" legislation, except those on the West Coast and in New England, where much of the hysteria for draconian legislation is originating, and which States already pay the most for their electricity, many twice as much, as shown in the attachment to my testimony.

What will the world-wide environmental gain be from the pain that will be suffered on millions of American citizens? The answer is, very little. Since 1990, U.S. greenhouse gas emissions have increased by eighteen percent (18%), while China's have increased by seventy-seven percent (77%). China's emissions will surpass ours by 2009. By the middle of the century, China and India will emit twice as much carbon as the United States and the European Union, combined.

The G-77 group of developing countries, led by China, which is building about fifty (50) new coal-fired power plants, again reiterated this winter that they will not agree to mandatory carbon emission constraints in a second Kyoto round after 2012, nor have they actually ever reduced any emissions to date. All America will be doing is exporting more of our jobs to these Countries, and widespread hardship will be reeked on thousands of American families as a result of further industrial contraction in our Country.

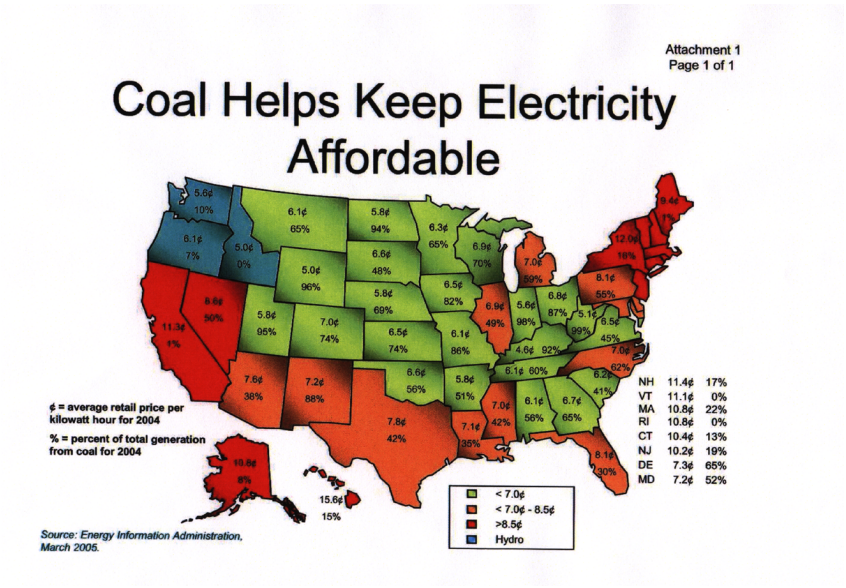
The so-called Kyoto Treaty commitments by other countries have been a farce. European Union nations, with no population growth, have increased their emissions faster than the United States which has had a one percent (1%) population growth. Canadian emissions have increased twenty-eight percent (28%) since it signed the Kyoto Treaty, and only two (2) of the signatories thereto have achieved their emission reduction commitments.

The climate change science is uncertain, and carbon dioxide capture technology has not been proven on a commercial scale. The Congress must not be stampeded into preempting thorough climate research and the development of carbon capture, transfer, and sequestration technologies with emotionally developed or politically motivated legislation in the current hysterical rampage to enact carbon dioxide emission limitation mandates.

We urge all Members of this Committee and their colleagues in the Congress to consider carefully the impact that climate change Bills will have, not only on the environment, but on the American people, too. This is a human issue as well as an environmental one.

Thank you for your invitation to appear before you today.

Attachment



Mr. COSTA. Thank you.

Now I would like to hear from Dr. Anthony Westerling, Associate Professor, the Sierra Nevada Research Institute of the University of California. Dr. Westerling, we appreciate your research, and your academics, and your work in this area for many years. Thank you for your coming here today to present your work. You may proceed.

STATEMENT OF ANTHONY WESTERLING, ASSISTANT PROFESSOR OF ENVIRONMENTAL ENGINEERING, UNIVERSITY OF CALIFORNIA, MERCED

Mr. WESTERLING. Thank you, sir. Just a moment, please.

Just for the record, I would like to correct. I am an assistant professor. I appreciate the promotion.

Mr. COSTA. Don't worry, around here, we take credit for everything we can.

[Laughter.]

Mr. WESTERLING. Well, I will skip on ahead.

I suspect that the reason I was asked to come here was this particular paper, so I thought I would highlight the results right off the top.

If you look in the upper left corner there, you will see a map of the western United States, and those green areas are Federal lands in the Forest Service and Park Service that are mostly forested, and have reported fires consistently since 1970.

In the lower panel there, you can see a time series. The vertical red bars are the number of fires that have burned at least a thousand acres each on those lands since 1970, and you will notice that there is a very abrupt ramping up in the number of fires on average each year in the mid-1980s.

Superimposed on this is a time series, the black line there, and it shows the temperature, the average spring and summer temperature, and you will note that it highly correlated with the annual number of large forest fires.

I would like to point out in particular the non-linear relationship between temperature and forest wild fire in the western United States, and I think this is a very important point to bring home if I don't get anything else through today.

If you look here, the horizontal access of this figure is showing deviations in the average temperature each year from the long-term average, and the vertical access is showing the number of large fires. In this case, it is a more comprehensive data set, 500 acres and above, and includes the Indian Affairs lands as well. And you will notice that as the temperature has increased you get more fires, but as you pass a certain threshold you get a very non-linear response, and you can have an enormous number of fires compared to the average for a small additional increase in temperature.

The reason this is so has to do with the timing of spring. So we have mid to high elevation forests in mountains of the western United States that have significant snow cover. Most of the precipitation comes in the wintertime. If it warms up in the spring, the snow melts out earlier and the area dries out sooner. Summer comes months early, in a sense, and everything dries out. You get a lot more fires.

What I am showing here is the timing of spring on the horizontal access as measured by streamflow in snow melt-dominated streams of the western United States, and on the vertical access we have again the number of large fires in forests of the western United States.

So as you look to the left, those are earlier years. As you look to the right, those are later springs, and so when you have a very early spring, that is when you get all of the large fire years.

Just to bring the point home, here I am showing you on the left side all the fires that occurred, that were at least 1,000 acres in size, in years that had late snow melt, and on the right side, in years that have an early spring snow melt, and they have been scaled up. I don't know if I have an arrow here. I do.

OK, so you see this big circle here. That is a 500,000-acre fire. This is a 400,000-acre fire. This is maybe 200,000 acres. These little dots over here, that is 1,000 acres. So all the big fires are occurring in years with early snow melt, and very few are occurring in years with late snow melt.

Now, the mechanism by which this has an impact, this non-linear impact, is as I mentioned before, the drying of the western forests, and what this map is showing here is the degree of drying associated with the changes in the timing of spring, and in particular, the redder the pixels are the more drying there was, and you can see that most of the drying was concentrated in the Northern Rockies and in the Yellowstone area and parts of the Colorado Rockies, in particular, whereas in the Southwest, there was very little drying associated with this, and it stands to reason. That is a drier, warmer climate down there, and so a change in the timing of spring doesn't have as big an impact.

But a very important point is that that region is relatively—most affected by fire suppression in terms of its impact on fuels, whereas in the Northern Rockies the area that has been most affected by changes in the timing of spring, you have a very large forest area. It shows the biggest increase in wild fire occurs there, an which were least affected by suppression.

I should point out that this increase in fires is essentially fourfold increase in large fires, and a sixfold increase in the area burned in those large fires.

It is important to note that these increases have occurred during a time when temperatures have increased less than 1 degree Celsius in the spring and summer in this part of the United States, and this is an important point because this is less than half of the minimum projections of the IPCC for this region in the coming decades of the Twenty-First Century.

So we can expect without a doubt an acceleration of wildfire in terms of a great increase in the number of very active fire seasons that we are going to see. The process that we have experienced up until now will continue.

My final point is just that there is a great deal of carbon sequestered in these forests already and in the soils underneath them, and that burning them more frequently releases this carbon into the atmosphere, and so this is a positive feedback on climate change occurring on Federal lands in the West.

Thank you.

[The prepared statement of Mr. Westerling follows:]

Statement of Dr. Anthony Westerling, Assistant Professor of Environmental Engineering, University of California, Merced

I thank Congressman Jim Costa and the members of the subcommittee on Energy and Mineral Resources for this opportunity to testify on recent research regarding the impact of climate change on public lands. I have a PhD in Economics from the University of California, San Diego. I currently hold joint appointments as Assistant Professor of Environmental Engineering and Assistant Professor of Geography at the new University of California campus in Merced, California. Prior to taking these appointments, I worked as a research scientist in Scripps Institution of Oceanography for six years, focussing primarily on climate and wildfire. I am a principal investigator in the NOAA Regional Integrated Science and Assessment (RISA) Program for California and in the California Energy Commission-supported California Climate Change Center, both centered at Scripps Institution of Oceanography. The research I will present in my testimony today was conducted at Scripps Institution of Oceanography supported by the NOAA RISA program, the USDA Forest Service, and the California Energy Commission.

WILDFIRE HAS GREATLY INCREASED IN WESTERN FORESTS.

Since the 1970s and early 1980s, the frequency of large forest wildfires (those greater than 1000 acres) has increased roughly 300 percent. The area burned in these fires has increased more than 500 percent. That is, there has been a substantial shift toward larger wildfires in western forests since the mid-1980s. (Westerling et al 2006).

The length of time individual fires burn on average has increased from one week to five weeks. The wildfire season itself has also lengthened by about two thirds. (Westerling et al 2006).

The greatest increase in forest wildfire has occurred in the Northern Rockies, between 6000 and 8000 feet in elevation. (Westerling et al 2006).

MOST OF THIS INCREASE IN WILDFIRE IS DUE TO WARMING AND EARLIER SPRINGS.

A trend towards warmer temperatures that has intensified in recent decades has resulted in a trend toward earlier Spring snowmelts (which are now occurring 1-

4 weeks earlier than they did 50 years ago), and this has led to more large wildfires in western forests. (Mote et al 2005, Stewart et al 2005, Westerling et al 2006)

Since 1970, 56% percent of large forest wildfires and 72% of area burned in large forest wildfires occurred in years with early Spring snowmelts, while only 11% of large wildfires and 4% of area burned in large wildfires occurred in years with late spring snowmelt. (Westerling et al 2006)

In years with warm temperatures and early springs, the snow has melted out earlier from mid-elevation forests. Snow carries over a significant portion of the winter precipitation that falls in western mountains, releasing it more gradually in late spring and early summer, providing an important contribution to spring and summer soil moisture (Sheffield 2004). An earlier snowmelt can lead to an earlier, longer dry season, providing greater opportunities for large fires due both to the longer period in which ignitions could potentially occur, and to the greater drying of soils and vegetation. Consequently, it is not surprising that the incidence of large forest fires is strongly associated with snowmelt timing (Westerling et al 2006)

It is true that 20th Century fire suppression and land use have lead to increased fuel loads in some western forests, such as dry ponderosa pine forests in the Southwest and parts of the Sierra Nevada (Allen et al 2002, Covington et al 2000). However, the greatest increase in forest wildfires has occurred in more moist and naturally more dense forests of the Northern Rockies where plentiful fuel loads and the risk of large fires have not been significantly increased by the cumulative effects of fire suppression and land use (Schoennagel et al 2004, Schoennagel et al 2005, Whitlock 2004). Furthermore, even in forests that grew thicker over the 20th Century due to fire suppression and land uses such as grazing, large forest wildfires still tend to occur in warm years with early springs.

AS HUMAN-CAUSED CLIMATE CHANGE CONTINUES, WE WILL SEE MORE VERY ACTIVE FOREST WILDFIRE SEASONS.

The results of this research have important implications for resource management on federal lands in a warmer climate. They demonstrate that warmer temperatures result in more (and larger) large forest wildfires.

The increased frequency of large forest wildfires observed in recent decades, considered in isolation, is not by itself evidence of climate change. However, we know from other research that human activity is warming the climate (IPCC 2007), and increased forest wildfire due to warming and earlier springs is an effect we expect to see in a world with a warming climate.

The very substantial increase in large wildfire frequency, in area burned, in the length of time fires burn, and in the length of the fire season in western forests have been associated with an increase in average spring and summer temperatures of less than 1 degree Celsius since the 1970s (Westerling 2006). This is less than half the IPCC's consensus range of temperature increase by 2040 to 2069 for western North America (Running 2006).

Thus, it is likely that forest wildfire activity will continue to intensify over the coming century. However, the full effects are difficult to anticipate, because we expect there will also be changes in the structure and species composition of western forests due to changes in climate and in wildfire, and these are likely to have feedback effects on wildfire. Assessments of the synergistic effects of changes in vegetation, wildfire, and other disturbances like insects in a warming climate are urgently needed.

FIRE SUPPRESSION, FUELS MANAGEMENT AND ECOLOGICAL RESTORATION ALL HAVE A ROLE TO PLAY. THERE IS NO SINGLE POLICY THAT IS LIKELY TO REVERSE THE TREND TOWARD MORE WILDFIRES.

Western forests are diverse, and the risk of a large fire burning in these forests is the result of complex interactions between climate, ecosystems, and past wildfire and management. Different forest ecosystems can have different responses to climate change and to management policies. Policies need to be tailored to the needs of diverse ecosystems.

Thinning forests that have been "thickened" by past management practices may help to reduce fuel loads that have lead to more severe fires in some places (for example, Ponderosa pine forests in the Southwest).

However, thinning naturally dense forests (such as lodgepole pine in mid-elevation Northern Rockies forests) is a very different matter: it amounts to introducing an additional disturbance to forests already stressed by warming and earlier springs. It is not necessarily the case that such thinning would make these ecosystems more resilient to climate change, nor reduce the likelihood of large fires.

Fuels management around structures and communities in the wildland/urban interface will continue to be an important means of protecting property at risk.

Increased fire suppression efforts in forests where in the past such efforts have resulted in increased fuel loads might, if effective in actually suppressing fires, further increase the vulnerability of these forests to climate change by preventing the reduction of (or further increasing) fuel loads. Appropriate use of natural and management fires might reduce fuel loads and the risk of large, severe fires in these forests.

Further intensification of fire suppression efforts may not be very effective. Federal land management agencies devote considerable resources to suppressing wildfires, and the technologies employed have developed in sophistication over the last century. However, fire suppression technologies are still not very effective under climatic conditions that foster the rapid spread of wildfires.

CONCLUSION

Warming and earlier springs have led to increases in forest wildfire, including more large fires, more area burned in large fires, longer burning fires, and a longer fire season.

Human-caused climate change will lead to additional warming in future decades, and this will lead to further increases in forest wildfire in the western US.

There is no single, simple management policy that will reverse this trend: complex problems don't always have simple answers.

Policies that mitigate climate change by reducing the rate at which greenhouse gasses accumulate in the atmosphere will help to mitigate future increases in wildfire.

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Mr. COSTA. Thank you very much, and knowing that you are a Southern Californian that has recently been transplanted to part of the strait that I live in, it is good to have you here, and good to have you back in Washington.

Mr. WESTERLING. Thank you, sir.

Mr. COSTA. Our next witness is Mr. Auden Schendler, Executive Director for Environmental Projects for the Aspen Skiing Company, a company and industry that I have some familiarity with. Obviously it has been an important industry throughout the country, especially post-World War II. Mr. Schendler, would you please begin your testimony.

STATEMENT OF AUDEN SCHENDLER, EXECUTIVE DIRECTOR, COMMUNITY AND ENVIRONMENTAL RESPONSIBILITY, ASPEN SKIING COMPANY

Mr. SCHENDLER. Right, and it was the——

Mr. COSTA. Hold on a second. We are having trouble here with the time clock. There you go. All right.

Mr. SCHENDLER. It was the 10th Mountain Veterans who created the ski industry in the U.S. actually and Aspen Skiing Company, so right after World War II, they said enough of this, we will go skiing, and I brought you only two slides, and this slide I bring you out of sympathy for the fact that you are stuck in this room this afternoon instead of being outside and you can look at this beautiful picture of Aspen, and powder skiing.

Mr. COSTA. That is very frustrating. You didn't have to bring that one.

Mr. SCHENDLER. And I do say I question your judgment in being here versus at Aspen skiing.

[Laughter.]

Mr. COSTA. That is the question before us. Please go ahead.

Mr. SCHENDLER. Unfortunately, skiing in Aspen doesn't look like this right now. We have just finished up the warmest winter in the Northern Hemisphere in recorded history. It is 65 degrees and sunny in Aspen right now, and we just found out three days ago that we have the third least sub-zero days in history, and so Aspen Skiing Company is concerned about this issue.

Just briefly, we bring 1.4 million skiers to our four mountains, 15 restaurants and two hotels every year. We employ 3,400 people in winter, and the ski industry in Colorado is a $2 billion industry. It employees fully 8 percent of the state. That is the winter sports industry, but if you include other climate-affected industries, such as hunting, river rafting and so on, a large part of our economy is based on stable and predictable climate.

In some ways you could describe the ski industry as reluctant warriors on the issue of climate. It is not an issue we particularly want to talk about. Skiing is difficult. It takes 10 years to learn how to ski well. It is a sport that in some cases is made financially viable by condominium selling, and if you don't want to buy a condo because you think the ski resort will be gone, or if you don't want to teach your kids to ski because you think the snow will be gone, that is problematic for our business.

So in response to growing coverage of climate change, the ski industry said, we are going to look at this. We hope there is not a problem but we are going to look at the best science out there, and the criteria we had was that this would be peer-reviewed science, and we would not look at opinion. We would simply look at science.

What is interesting is the cities of Aspen and Park City both did studies. They said, we want to see what is going to happen 10, 15, 20, all the way into 100 years from now, and those studies have come out in the last year.

Aspen, according to this again peer-reviewed science would look like Colorado Springs by 2050. I don't know if you have been to Colorado Springs, but it is not a real skier-friendly place. It is more like the desert. We would have the climate of Amarillo by 2100, New Mexico by 2085, ski resorts like Taos, which is a wonderful area, would lose 90 percent of their snowpack. They would essentially be out of business.

More important, all the science and climate modeling we have tells us that our season would be shortened. While the economics

of the ski industry are pretty interesting, we are running in deficit until March, and then we start making our money, and if we were to lose March, we would go out of business. So this is of huge concern to us.

I want to take off my corporate hat, and put on my human hat, my father hat. This is Willa. She refers to herself as a baby duck or a baby frog, depending on the day, and as I have dug into the sciences part of my job, trying to figure out what this means for our industry and our business, the more I study the science the more I realize that climate change is redefining the very terms we use. Words like environmentalism, sustainability, even government, and for me in particular, parenthood, now mean substantially dealing with climate change.

I used to say this unfortunately isn't our issue. This is our children's issue, but James Hanson, who is the leading climatologist in the world, has said that we have 10 years to solve this problem. If we don't solve this problem within a decade, our children will be living on a planet that is unrecognizable to us.

So I no longer say this is our children's issue. I say this is our issue. This is a problem we will solve for Willa in our lifetimes, in your lifetimes.

Thank you.

[The prepared statement of Mr. Schendler follows:]

Statement of Auden Schendler, Executive Director, Community and Environmental Responsibility, Aspen Skiing Company

The mountain resort economy in the West is as endangered as the Polar Bear but a heck of a lot more valuable.

You could say the ski industry is the Canary in the coal mine for climate change. If there's one business sector that is going to suffer most and earliest, it's skiing. And that's not good for the economy: the ski and winter recreation industry in Colorado alone accounts for over $2 billion in revenue annually and is responsible for 8% of employment in the state.[1] To understand the impact of the snowsports industry on a national scale, roughly quintuple that revenue number. That's why, in response to growing media coverage, scientific consensus, and observed climate changes on our mountains, we decided to explore the science. It turns out that the cities of Aspen, CO and Park City, UT independently commissioned studies to determine what, exactly, the future might look like, because that information is obviously critical to future planning. The Aspen and Park City studies focused exclusively on peer-reviewed science, and found that the consequences for Aspen were dire. According to the study "climate models indicate that if global greenhouse gas emissions are reduced, Aspen is projected to experience about 6°F of additional warming by 2100, giving it a similar climate to that of Los Alamos, New Mexico. If global emissions continue their rapid rise, Aspen is projected to warm 14°F by the end of this century, giving it a similar climate to that of Amarillo, Texas."[2] For Park City, consequences were even worse, because they are at a lower altitude.

Aspen Skiing Company is the owner and operator of four major destination winter recreation complexes located in the central Rocky Mountain region of Colorado, spanning over 5,200 acres of public and private land on four mountains: Aspen, Buttermilk, Highlands and Snowmass, as well as two hotels, a golf course, and 15 restaurants. We host 1.4 million skiers annually and employ 3,400 people in winter. Aspen Skiing Company, along with the rest of the ski industry, is a reluctant warrior on the climate issue. Our entire business model is threatened by the problem. It's a difficult message for us, because global warming forces the questions: "Why teach your children to ski?" "Why invest in a slopeside condo?"

But the ski industry is also particularly sensitive to climate: skiers start banging down the doors around Halloween, so opening earlier than Mother Nature dictates (though use of artificial snow) has become part of the business. At the same time,

[1] The data comes from Colorado Ski Country USA, Economic Impact Study, March 2004.
[2] http://www.aspenglobalwarming.com/westerncoloradodata.cfm

our (and most) ski resorts operate in deficit until March, when we make most of our profit. If you shorten our season on either end—take away March, for example—we go out of business. The problem: a shortened season is a consistent predication of the climate modeling and science. A second prediction of the models is that we'll see warmer nights. In fact, we're seeing these already. The problem: in order to stay open later, and open early enough for customer demand, we need to make snow. And with warm nights, it becomes exponentially more expensive to make artificial snow. This fall and early winter, it was actually so warm that on many nights in December it was impossible to make snow at all.

In some ways, focusing on the ski industry when thinking about climate change is trivial. The declining snowpacks we're seeing affect skiing for certain, but more importantly they affect water supply in the west and in particular California. The Colorado River supplies water to 25 million people in 6 western states and California, according to the Arizona Dept. of Environmental Quality. But scientific models predict the Colorado River basin will lose 24% of its snowpack by 2010-2039.[3] This is for a system that is fully allocated today and already "at the brink of failure."[4]

Nonetheless, the ski industry is a good early indicator of the scope and scale of change we expect to see. And there are four major reports, published recently, that predict significant economic harm to the American ski industry and the region as a result of climate change. They are: Less Snow, Less Water: Climate Disruption in the West, by Stephen Saunders and Maureen Maxwell of the Rocky Mountain Climate Organization; Climate Change: Modeling a Warmer Rockies and Assessing the Implications, by Gregory Zimmerman, Caitlin O'Brady, and Bryan Hurlbutt of Colorado College; Climate Change and Aspen: An Assessment of Impacts and Potential Responses, by the Aspen Global Change Institute; and Save Our Snow: Climate Change in Park City by Stratus Consulting Group. Each of the studies relies on the best third party science available, and the best modeling and experts in the field. This testimony cites specific text from these reports related to the predicted economic impact of climate change on Aspen Skiing Company and the Colorado ski industry.

First, it should be noted that the generally lower altitude European ski industry—itself a coal mine Canary for what we might expect here in the West—is already the suffering direct economic impact of climate change. And skiing is an even greater economic driver in Europe than in the U.S. This year, the Office for Economic Cooperation and Development released a study warning that climate change was threatening Europe's skiing trade.[5] And this year, several January World Cup races were cancelled due to rain or lack of snow, even though officials tried to salvage the events by helicoptering-in snow. Meanwhile several Scottish resorts have shut down, and, according to a European chamber of commerce member who asked to remain anonymous, 47 ski resorts in the Alps simply did not open last year from lack of snow, warm glaciers that were out of condition for skiing, or long periods of rain. "We don't expect to have snow in low lying resorts such as Klosters for more than the next 10 years," said Werner Schmultz, from the World Radiation Centre in Switzerland. And in July 2006, "Swiss researchers from the University of Zurich concluded that the Alps will lose 80 percent of their glaciers by the end of the century. (That's the average temperature rise scenario of 3 degrees Celsius. The high end projections—a 5 degree C increase—will result in the loss of all Alpine glaciers.)"[6] In response, some Swiss resorts are wrapping their glaciers in reflective blankets to try to protect them.

"Temperatures have risen to the point where artificial snow is melting faster than the snow machines can churn it out," Bill Wright of the Cairngorms Campaign envi-

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[3] N.S. Christensen, A.W. Wood, N. Voison, D.P. Lettenmaier, and R.N. Palmer, "The Effects of Climate Change on the Hydrology and Water Resources of the Colorado River Basin," Climatic Change 62(2004): 337-363, 349-350.

[4] T. Barnett, R. Malone, W. Panel, D Stammer, B. Semtner, and W. Washington, "The Effects of Climate Change on Water Resources in the West: Introduction and Overview," Climatic Change 62(2004): 7.

[5] http://www.swissinfo.org/eng/front/detail/Climate__change__threatens__ski__resorts__in__Europe.html?siteSect=105&sid=7347238&cKey=1166083840000

[6] From the Save Our Snow website, http://www.saveoursnow.com/facts.htm. Accessed August 11, 2006.Harrison, Pete. "Scottish Skiing Meets Global Warming," Reuters. January 2, 2004. Available online at http://www.zapworld.com/about/news/watch__scottishskiing.asp. Accessed February, 2006.

ronmental group told Reuters. "The Scottish skiing situation is verging on crisis," he said. "It's hard to resist the conclusion that global warming is a factor." [7]

Resorts in Scotland are moving away from ski-based economies. Some are successfully transitioning to non-winter-sports economies; others are going out of business. [8]

A growing concern in Europe is the financing of the ski industry. In Switzerland, for example, "Banks have stopped lending to resorts below 1,500 meters, worried that they will never get their money back." [9]

Back to the American West, the Colorado College report analyzed climate modeling data to try to predict ski country April 1 snowpack loss, from 1976 to 2085. Some areas, like the Utah resorts of Alta and Snowbird, are predicted to see 84% snowpack loss. Southern resorts like Taos will see 89% loss, essentially putting them out of business. (In the winter of 2005-6 New Mexico resorts received virtually no snow, and, by all accounts, had a catastrophic season.) Aspen's resorts—Highlands, Aspen Mountain and Snowmass, are predicted to see a 43% loss in April 1 snowpack. The reports notes that "Most ski counties in Colorado are predicted to lose around 50% [of April 1 snowpack.] Predictions for future mountain climate are warmer winters and shorter snow seasons. Winter sports dependent upon snow: downhill skiing, cross-country skiing, snowshoeing, and snowmobiling, are expected to decrease in popularity with warming because of worsening conditions, potentially becoming unviable as soon as 2050. According to Aspen Skiing Company CEO Patrick O'Donnell...if climate change shortens the ski season, 'it is going to be an economic disaster.'" [10]

The report Less Snow, Less Water: Climate Disruption in the West predicts that by the end of the century, with a mid-range estimate of predicted warming, Aspen would have the climate of Colorado Springs, a desert community in southern Colorado with no ski business. The report also predicts smaller snowpacks and earlier snowmelt. In fact, new data already shows declining snowpacks, and increased warming, particularly at night and in winter, [11] with consequent impacts on snowmaking that have been previously described.

The 150-page study Climate Change and Aspen: An Assessment of Impacts and Potential Responses reports that "sometime between 2030 and 2100, Aspen climate will work against its reputation as a destination ski resort...The scenarios do imply greater costs and effort in terms of mountain and visitor management. If season delay or poor conditions do shave 5 to 20 percent off of skier numbers by 2030, then the economic consequences could be significant, ranging from losses of $16m to $56m in total personal income (in today's dollars.) Though it cannot be reliably quantified, poorer ski conditions are likely to affect the resort real estate market in Aspen, thus adding to losses." [12]

Most strikingly, according to the report: "High greenhouse gas emissions scenarios (A1FI) are likely to end skiing in Aspen by 2100, and possibly well before then, while low emission path scenarios preserve skiing at mid- to upper mountain elevations. In either case, snow conditions will deteriorate in the future." [13]

The Park City study reports that by 2075, Thanksgiving will no longer be a ski holiday, and midseason snow depths will be 15 to 65 percent lower—meaning an end to Utah's famous champagne powder. Throughout the Rockies, atmospheric warming will increase roughly a third faster than the global mean temperature, which means that snowmaking won't be possible, in most years, until the end of November. [14]

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[7] Seenan, Gerard. "Global warming forces sale of Scottish winter sports resorts," The Guardian, Saturday, February 14, 2004. Available online at http://sport.guardian.co.uk/news/story/0,10488,1148094,00.html

[8] Harrison, Pete. "Scottish Skiing Meets Global Warming," Reuters. January 2, 2004. Available online at http://www.zapworld.com/about/news/watch__scottishskiing.asp. Accessed February, 2006.

[9] Ibid.

[10] Zimmerman, Gregory, O'Brady, Caitlin, and Hurlbutt, Bryan. Climate Change: Modeling a Warmer Rockies and Assessing the Implications. p. 99. From The 2006 Colorado College State of the Rockies Report. April 10, 2006. http://www.coloradocollege.edu/stateoftherockies/06ReportCard/Climate%20Change,%20updated%2005-01-05.pdf Accessed August 11, 2006.

[11] Saunders, Stephen, and Maxwell, Maureen. Less Snow, Less Water: Climate Disruption in the West. September, 2005. pp 13-15. Available online at http://www.rockymountainclimate.org/website%20pictures/Less%20Snow%20Less%20Water.pdf. Accessed August 11, 2006.

[12] Katzenberger, et al. Climate Change and Aspen: An Assessment of Impacts and Potential Responses. A Report of the Aspen Global Change Institute. July, 2006. pp 71-81. Available online at http://www.agci.org/aspenStudy.html. Accessed August 11, 2006.

[13] Ibid, Katzenberger, et al. P. xvi, Executive Summary.

[14] An executive summary of the study, which isn't public yet, is available at http://www.saveoursnow.org/Executive__Summary.pdf

According to a Deseret News report, the Park City study "painted a bleak picture for Utah, where the tourism industry relies on the winter ski and snowboarding season. By 2100, the ski season could extend only from Christmas to Presidents Day, under the best-case scenario. Even a small 4- to 5-degree warming could be disastrous for the resorts—and winter. "We only maintain snow under the low-emission scenario through midwinter. Remember, that's a 10- to 15-degree increase," said Brian Lazar of Stratus Consulting, which conducted the study with the Institute of Arctic and Alpine Research at the University of Colorado in Boulder. "Under the high-emission scenario, we don't get snow." The report used a snow-modeling computer program to estimate the climate changes and snow levels for 2030, 2075 and 2100 under three different emission scenarios. Lazar said global warming will even affect the quality of the snow, turning the current Utah powder into skiers' cement."[15] [16]

In short, there is compelling evidence that the ski industry stands to suffer significant financial losses from global warming induced changes such as shorter seasons, warmer nights, and reduced snowpack, and that impact is just one indicator of later, broader impacts of climate change. In a worst-case scenario, the industry will be gone by 2100. In a best case scenario, the cost of doing business will increase exponentially and profit margins will drop precipitously, along with the quality of the product offered to guests. The irony is that this threatened industry operates mostly on public lands—and how the United States chooses to use other public lands will affect the future of our industry.

At the same time, in CO in particular, we see the response to climate change—and even how public lands are used in this effort—as an economic opportunity. In fact, this is a major piece of our current Governor's platform. A great example of the potential for our state is the Grand Junction, CO based ski lift manufacturer Poma, which is moving towards manufacturing wind turbines. This could be an indigenous business in Colorado that provides manufacturing jobs while helping ranchers and farmers, who can install turbines, making their land do double duty. Might it be possible to make BLM lands easier to lease for wind farms? Would a federal fee for fossil fuel extraction help address the impacts of burning that fuel? We're not experts in public lands solutions to climate change, but in the end, global warming is clearly both a challenge and opportunity for Colorado and the West.

Mr. COSTA. Thank you very much, Mr. Schendler, and thank you for staying within the five minutes as well.

Mr. Noah Matson is our next witness. He is the Director of Federal Lands for the Defenders of Wildlife. Mr. Matson.

STATEMENT OF NOAH MATSON, DIRECTOR, FEDERAL LANDS PROGRAM, DEFENDERS OF WILDLIFE

Mr. MATSON. Thank you, Mr. Chairman, and to the Members of the Subcommittee.

I am the Director of the Federal Lands Program at Defenders of Wildlife, and I want to thank you for the opportunity to testify before this committee.

Energy policy, climate change, and public lands are inextricably linked. Current energy policy on America's public lands is doubly damaging for wildlife. The rapid and haphazard expansion of oil and gas drilling has devastated wildlife habitat, while the ultimate burning of these fossil fuels contributes to global warming pollution, which is the single greatest threat facing people and biolife today.

Mr. COSTA. We need to have the microphone a little closer. I am sorry.

Mr. MATSON. Sure. Auden mentioned the economic value of skiing to Colorado. Wildlife-dependent recreational uses throughout the United States, hunting, fishing, and bird watching, contribute

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[15] http://deseretnews.com/dn/view/0,1249,650221809,00.html

[16] http://www.saveoursnow.org/Executive__Summary.pdf.

over $100 billion to the U.S. economy, and the ecological services provided by fish, wildlife, and plants are almost incalculable. Yet wildlife is already bearing the brunt of global warming. The impacts of global warming of wildlife includes melting sea ice, habitat shifts, rising sea levels, longer droughts, increased wildfire, changes in weather extremes, and the spread of invasive species. As Deborah Williams testified, global warming is reeking havoc on Alaska wildlife and ecosystems. Sea levels are also on the rise. There are approximately 160 national wildlife refugees and 50 national park units in coastal areas. Many of these refugees and parks protect coastal marshes that are only one or two feet above the current sea level. Even the lowest estimated sea level rise over the next century will have profound effects on these wetlands upon which millions of ducks and geese and other migratory birds depend.

These are just some examples of the myriad global warming impacts wildlife are already experiencing. According to the Intergovernmental Panel on Climate Change, even if we stopped emissions today global warning and associated sea level rise will continue for centuries due to the time scales associated with climate processes.

In other words, there is at least a century's long bottleneck that we must help wildlife navigate so that they can survive to reap the benefits from reductions in greenhouse gas emissions undertaken now.

Consequently, our national strategy for combating global warming must include reducing greenhouse gas emissions, and responses to help wildlife navigate the looming bottleneck of complex threats caused by global warming.

If global warming was the only stress on wildlife, more species might be able to weather it. Wildlife will have little chance of adapting to the impacts of global warming, however, if already stressed by loss and fragmentation of habit, competition with invasive species, and pollution. Thus reducing these other problems affecting wildlife is key to ensuring that wildlife and wildlife habitat are resilient to these changes.

Unfortunately, our current energy policy does the exact opposite. The Bush Administration has treated wildlife as an impediment to the distraction of the energy and other resources from America's public lands. On national forests, the Bush Administration eliminated the 20-year-old requirement that national forests maintain viable wildlife populations, giving the Forest Service the green light to offer our national forests to energy companies with little assurance that wildlife populations would be left when these companies have gone.

The administration has essentially converted the Bureau of Land Management into an agency dedicated to energy development. The number of drilling permits approved by the BLM has quadrupled over the last five years. The result, an industry-funded study in Pine Dale, Wyoming, documented a 46 percent decline in the mealier population in an area of rapid energy development, reflective of the dramatic adverse effects to the ecology of the entire region.

The direct impacts of energy development are just a tip of the melting iceberg. These impacts compound the threats of global

warming as Well. Take the sage grouse. There is broad overlap between known oil and gas reserves and sagegrass habitat in the intermountain west. Oil and gas development requires clearing of habitat for roads, well pads, and pipelines. Noise from oil and gas operation interferes with the breeding behavior of sage grouse, which must hear distant calls to locate mates.

Oil and gas development also facilitates the spread of noxious weeks like cheatgrass. Cheatgrass, a fire-adapted species, increases the risk of devastating fires in sagebrush habitats. Cheatgrass has also well adapted to global warming and will take over sagebrush habitats that sage grouse and other species depend on as the climate of the West changes.

This emphasizes the importance of conservation measures now, to increase sagebrush and other vulnerable habitats resilience, the impacts of global warming. Unfortunately, most of the core sage grouse strongholds have been leased for oil and gas development. On top of this, staff and funding from BLM's wildlife program are regularly diverted to process drilling permits.

A coordinated interagency response is essential to address the impacts of global warming. It makes no sense for each coastal wildlife refuge or national seashore to re-invent responses to rising sea levels. Agencies should also be required to address global warming in their program planning, land management, and environmental analyses.

Finally, substantially more money than is currently provided to conservation is needed to help wildlife navigate the global warming bottleneck.

Defenders of Wildlife looks forward to working with the Committee to ensure that wildlife survive the next century. Thanks again for the opportunity speak to speak before you.

[The prepared statement of Mr. Matson follows:]

Statement of Noah Matson, Director,
Federal Lands Program, Defenders of Wildlife

Mister Chairman and members of the subcommittee, I am Noah Matson, Director of the Federal Lands Program at Defenders of Wildlife. Founded in 1947, Defenders of Wildlife has over 500,000 supporters across the nation and is dedicated to the protection and restoration of wild animals and plants in their natural communities.

I want to thank you for the opportunity to testify before the subcommittee. Energy policy, climate change and public lands are inextricably linked. Current energy policy on America's public lands is doubly damaging for wildlife: the rapid and haphazard expansion of oil and gas drilling has devastated wildlife habitat, while the ultimate burning of these fossil fuels contributes to global warming pollution, which is the single greatest threat facing people and wildlife today.

Fish and wildlife are a fundamental part of America's history and character, and the conservation of fish and wildlife is a core value shared by all Americans. Wildlife conservation provides economic, social, educational, recreational, emotional and spiritual benefits. The economic value of hunting, fishing, and wildlife-associated recreation alone is estimated to contribute over $100 billion to the U.S. economy, through job creation, tourism infrastructure, and recreational spending. In addition to these direct economic benefits, fish, wildlife, and plants provide important ecological services to our economy that are irreplaceable, including pollination of our crops, water and air purification, flood control, and an increasingly important service: carbon sequestration.

Our vast system of federal public lands is critical to the future of wildlife in America. Public lands protect endangered and threatened species, and help prevent species declining to the point where Endangered Species Act listings are necessary. Public lands provide comparatively intact tracts of land that serve as refuges from human development and other pressures, and provide important migration corridors

for many species to respond to the changing climate. They help keep common species common, including game species valued for hunting and fishing activities. They provide refuge for species impacted by the effects of global climate change, and will play an important role in the adaptation of both people and wildlife to those impacts in the future.

To ensure that our cherished wildlife survive beyond the next century, we must reduce our greenhouse gas emissions, reform the way energy and other extractive uses are produced on our public lands, and develop programs to assist wildlife in the face of global warming.

Impacts of Global Warming on Wildlife

The subcommittee's hearing could not have come at a more important time. Last month the Intergovernmental Panel on Climate Change (IPCC) concluded that evidence of global warming is unequivocal, and that dramatic changes to the planet's climate are, with a 90 percent certainty, the result of human-generated emissions of greenhouse gases. Quite simply, there is no remaining scientific debate: we are causing global warming and it is past time that we do something about it.

We are already in the midst of what Harvard Professor Edward O. Wilson and others have referred to as the sixth great mass extinction crisis in the history of the planet. However, unlike previous extinction events, this one is due entirely to human activity, principally habitat destruction, pollution, and overexploitation of wildlife and finite natural resources. In the United States, over 15,000 species are at risk of extinction and the country loses a staggering 6,000 acres of open space a day, stressing natural systems and diminishing recreational opportunities and quality of life. Moreover, in each of the previous mass extinctions, it took more than 10 million years for new species to evolve to replenish the biodiversity that was lost.

Global warming only makes a bad situation worse. Under some climate change scenarios, the National Academy of Sciences predicts extinctions of 60% of all species on the planet. Extinctions alter not only biological diversity but also the essential evolutionary processes by which diversity is generated and maintained. Furthermore, we continue to destroy much of the habitat needed for species to survive and recover.

The first response to reduce the impacts of global warming on wildlife must be to reduce greenhouse gas emissions so wildlife can have a future. Second, immediate steps must be taken to reduce the non-climate related threats that wildlife is facing. Securing and restoring habitat, fighting invasive species, and reducing pollution all strengthen natural resilience in wildlife and wildlife habitat to cope with global warming. Finally, strategies must be developed to help wildlife adapt to changing ecological conditions.

Types of Global Warming Impacts

Global warming will impact—and is already impacting—wildlife in a variety of ways:

Sea and land ice meltdowns

According to the IPCC, average Arctic temperatures increased at almost twice the global average rate in the past 100 years. Satellite data since 1978 show that annual average Arctic sea ice extent has shrunk by 2.7% per decade. Temperatures at the top of the Arctic permafrost layer have generally increased since the 1980s (by up to 3°C). The maximum area covered by seasonally frozen ground has decreased by about 7% in the Northern Hemisphere since 1900, with a decrease in spring of up to 15%.

Indeed, polar bears depend entirely on sea ice as platforms for hunting the marine mammals that provide their nutritional needs. Because the necessary ice bridges linking land and sea have disappeared, adult and young polar bears have starved and drowned. Some polar bears have even resorted to cannibalism, leading scientists to remark that they are witnessing stressors unprecedented in decades of observation. Consequently, the U.S. Fish and Wildlife Service has proposed listing the polar bear as threatened under the Endangered Species Act, a proposal which Defenders of Wildlife strongly supports. There are numerous other arctic species that are fairing no better than polar bears.

On land, prospects are no better. Disappearance of permafrost has led to draining of Arctic wetlands, aquatic habitats used extensively by the breeding waterfowl that winter in the lower 48 states and support a multi-billion dollar sport hunting economy.

One place where all of these changes are occurring is the Arctic National Wildlife Refuge in Alaska. The Arctic Refuge is the most important on-shore denning habitat for polar bears in the United States. As offshore sea-ice denning areas melt away, the Arctic Refuge becomes one of the last places for these polar bears to winter with

their newborn cubs. The refuge's famed Porcupine caribou herd is also being affected by global warming. Caribou are departing their wintering grounds a month earlier than normal and are still having trouble making it to the coastal plain of the Arctic Refuge in time for the earlier arrival of spring, when the most nutritious forage is available for their calves. Thus, the importance of the Arctic Refuge to wildlife is made even greater by global warming, making proposals to open the refuge to oil and gas development even more misguided.

Habitat shifts

As the planet warms, the habitat occupied by particular species shifts as well, typically northward in the northern hemisphere, upslope, and inland. Species' northern and elevational ranges have shifted, on average, almost four miles northward and 20 feet upward each decade. Clearly, if you're a species that already lives at high elevation, you may be out of luck as habitat choices simply run out.

The Environmental Protection Agency (EPA) estimates that many tree species may shift their ranges 200 miles to the north. Places like the Green Mountain and White Mountain National Forests are expected to lose tree species wholesale, including the regionally important sugar maple whose range may shift entirely out of the United States. Changing forest composition will directly affect wildlife that depends on the current tree species of New England's forests, like Bicknell's Thrush, a very rare bird dependent on New England's high elevation balsam fir trees, which may decline 96% by century's end due to global warming, according to the EPA.

Rising sea levels

Estimates of sea level rise from global warming range from 7 to 22 inches over the next century, according to the latest IPCC report. Catastrophic melting of Antarctica or Greenland could raise sea levels by over ten feet. However, even a minor rise will have negative consequences for some wildlife. Coastal species like the endangered Florida Key deer depend entirely upon low-elevation barrier islands, and are especially vulnerable to sea level rise.

Federal properties and resources are at serious risk. There are approximately 160 national wildlife refuges and 50 national park units in coastal areas. Many of these refuges, like Breton National Wildlife Refuge in Louisiana, protect coastal marshes that are only a foot or two above the current sea level. Even the lowest estimated rise in sea level over the next century will have profound effects on coastal wetlands, which are one of the most biologically productive ecosystems on earth. Coastal marshes also happen to be tremendous carbon sinks, and their loss will reduce their ability to absorb carbon and potentially even release more carbon dioxide into the atmosphere as inundated marsh plants decompose.

Longer droughts

Drought resulting from global warming poses an additional threat to species that rely on already scarce water in arid environments such as the American southwest. For example, even in the best of times, survival can be precarious for desert bighorn sheep. Inhabiting steep, rocky terrain in the driest areas of the American southwest, they live in small groups isolated by miles of blazingly hot terrain. In southeastern California, rainfall has declined by up to 20%, leading to drying up of springs and disappearance of plants. More than a third of the sheep populations that once lived in California's mountains have disappeared in the last century.

Non-arid regions are going to face dramatic changes as well. In our recent report, Refuges at Risk—The Threat of Global Warming: America's 10 Most Endangered National Wildlife Refuges 2006, Defenders of Wildlife highlights the impact of global warming on the National Wildlife Refuge System. We point out that the prairie pothole region of the country is the nation's "duck factory"; its thousands of small lakes and ponds providing ideal habitat for breeding waterfowl. Over 50 national wildlife refuges, such as Medicine Lake refuge in eastern Montana, and Devils Lake Wetland Management District in North Dakota, have been established in this region to protect breeding bird habitat. Climate scientists predict that warmer climates in the northern prairie wetlands region will increase the frequency and severity of droughts—so much so that the number of breeding ducks in this region could be cut in half.

Increased wildfire

Related to longer droughts is increased frequency and intensity of wildfires. Fire suppression and risk reduction programs already consume almost half of the U.S. Forest Service's budget. Increased fire directly inhibits our public lands from providing the suite of benefits we demand from them, including supporting wildlife, recreation, and timber production. In a study published in the journal Science, researchers found that compared to data from the 16 years prior, the period from 1987

to 2003 was 1.5 degrees higher in the West, had a 78-day longer fire season and four times as many large wildfires, which burned over six times more land than the previous study period. These dramatic changes were correlated with decreased winter rains, earlier snowmelt caused by warming temperatures, and have caused dramatic changes to national forests and other public lands.

Excess carbon dioxide

Often described as the rainforests of the ocean, coral reefs support a dazzling array of creatures. But die-offs of corals, as much as 98% in some locations during the last 25 years, landed two coral species on the endangered species list. Staghorn and elkhorn coral form massive thickets, provide cover for numerous reef fish, and are essential for the health of entire reef ecosystems. However, warming ocean temperatures are stripping corals of the algae they need to survive, while carbon dioxide emissions are increasing the acidity of the oceans. Reefs subsequently turn into rubble because of decreased concentrations of carbonate ions, a key building block for calcium carbonate required by the corals.

The threat from global warming to coral reefs affects many national wildlife refuges, including the Northwest Hawaiian Islands refuge, Guam National Wildlife Refuge, and the Palmyra Atoll, Midway Atoll, and Kingman Reef refuges in the south Pacific.

Other impacts

Global warming will affect wildlife in other ways as well. For example, changes in migration patterns will alter some species' ability to find suitable habitat and food. For example, the timing of bird migration is finely tuned to available food resources, and many species are struggling to cope with changing seasonal patterns. Changes in average precipitation (far more or far less annual rain and snow than falls currently) will place strain on species adapted to current precipitation patterns.

Another result of global warming is that certain weather events will become more extreme, causing a greater probability of freshwater flooding inland and more intense and violent storms and other weather events, such as hurricanes, along the coasts. Rapidly changing environments will also heighten the risk of invasive native and invasive non-native species, both of which can pose threats to the species they displace. For example, global warming has been implicated in the recent severe outbreak of bark beetles in southwestern forests including New Mexico and Arizona. In the 2002-2003 season, 3.5 million acres of piñon pine and 2 million acres of ponderosa pine were affected. Warming-induced drought stressed trees so they were unable to protect themselves with increased sap production. Warmer winters also reduced bark beetle mortality and expanded their breeding season.

Helping wildlife navigate the global warming bottleneck

According to last week's IPCC report, global warming and associated sea level rise will continue for centuries due to the timescales associated with climate processes and delayed feedbacks, even if greenhouse gas concentrations are stabilized now or in the very near future. Thus, even if we act now, as we must, to reduce greenhouse gas emissions, wildlife will continue to feel the effects of global warming for at least the next 100 years, the period in which carbon dioxide already in the atmosphere will persist. In other words, there is at least a century-long bottleneck that we must help wildlife navigate, so that it can survive to reap the benefits from reductions in greenhouse gas emissions undertaken now. Consequently, our national strategy for combating global warming must consist of two parts. First, we must act now to reduce greenhouse gas emissions, to address the root cause of climate change. Second, we must also craft responses and mechanisms now to help wildlife navigate the looming bottleneck of complex threats caused by global warming. Some ways to do this are suggested in the following pages of my testimony.

Energy Policy Reform and Building Resilience to Global Warming

Many species and ecological systems have the ability to tolerate and adapt to some degree of ecological and climate changes. If global warming was the only stress on wildlife, more species might be able to weather it. Wildlife will have little chance of adapting to the impacts of global warming if already stressed by loss and fragmentation of habitat, competition with invasive species, and pollution. Thus, reducing other stressors on wildlife is key to helping wildlife navigate the bottleneck of global warming impacts, and ensuring that wildlife and wildlife habitat are resilient to these changes should be a top priority. Unfortunately, our current energy policy does the exact opposite.

The Bush administration has treated wildlife as an impediment to the extraction of energy and other resources from America's public lands. On National Forests, the Bush administration eliminated the 20 year old requirement that national forests

maintain viable wildlife populations. This requirement, adopted under the Reagan administration, helped ensure the persistence of wildlife while Forest Service pursued timber and energy production and other uses. Without this requirement, the Forest Service has been given the green light to offer our national forests to energy and timber companies with little assurance that, after these companies reap the benefits of public resources and leave, wildlife populations will be left for Americans to enjoy.

The Bureau of Land Management (BLM), unfortunately, has never had such a requirement. Still, the agency is supposed to sustain wildlife in managing the suite of multiple-uses BLM lands provide. Yet, the administration's energy policy has essentially converted the BLM into a dominant-use agency, an agency dedicated to energy development. Wildlife protections under the Bush administration have been specifically targeted as impediments to energy development, instead of viewing wildlife conservation as the cost of doing business on public lands.

The result: Nationwide, the number of oil and gas drilling permits approved by BLM more than quadrupled, from 1,803 to 7,736 for the years 1999 through 2005. Last year the BLM predicted they would receive over 10,000 drilling permit applications in 2007. There are over 60,000 producing wells on public lands and over 35 million acres are under active leases.

The impacts on wildlife are clear. In the Farmington, New Mexico field office, BLM approved plans to develop nearly 10,000 new wells. Yet the high level of drilling that has already occurred in the area has devastated wildlife. According to the New Mexico Department of Game and Fish, the elk population in the area plummeted 88% from 1999 to 2004. Even an industry funded study in Pinedale, Wyoming documented a 46% reduction in the mule deer population in an area of rapid energy development. Gas and oil drilling doesn't just impact elk or mule deer, of course, but these species are indicative of the dramatic adverse affects to the ecology of the entire region.

In addition to the direct impacts all this development has on wildlife through habitat loss and on-site pollution, the processing of thousands of drilling permits is consuming all BLM staff time in the field offices where energy development is greatest. According to the GAO, "dramatic increases in oil and gas permitting activity have lessened BLM's ability to ensure that environmental impacts are mitigated." Worse still for wildlife, according to a BLM internal review, up to 50% of staff and funding from BLM's fish, wildlife, and threatened and endangered species programs have been diverted to support the energy program, slashing the agency's ability to conduct habitat management and restoration, population monitoring and other wildlife management activities.

The synergistic effects of global warming and energy development and other non-climate related threats to wildlife and ecosystems are best illustrated by two examples: sage grouse and coastal wetlands.

Sage grouse, oil and gas development, and global warming

Two years ago, the Fish and Wildlife Service was petitioned to list the sage grouse under the Endangered Species Act. This caused wide-spread concern within the BLM and with the many users of BLM lands, particularly the oil and gas industry. And for good reason: There is broad overlap between known oil and gas reserves and sage grouse habitat in the Intermountain West. For example, in Wyoming, 26,000,000 acres (66.7%) of the state's remaining sage grouse habitat falls within areas of potential oil/gas development; 9,000,000 acres (28.1%) in Colorado; 3,000,000 acres (43.5%) in Utah; and 1,700,000 acres (16.2%) in Montana, according to an analysis conducted by Trout Unlimited.

Oil and gas development requires clearing of habitat for roads, well pads, and pipelines. In many areas, new power lines are erected to operate equipment, providing raptor perches where none previously existed, threatening sage grouse with increased predation. Noise from oil and gas operations interferes with the breeding behavior of sage grouse, which must hear distant calls to locate localized mating grounds. Finally, there is always the likelihood of spills, leaks and explosions of natural gas, oil, and other chemicals and contaminated water.

Oil and gas development also facilitates the spread of invasive species like cheatgrass. Cheatgrass, a fire-adapted species, alters the fire regime of sagebrush ecosystems causing larger-scale, hotter fires than would normally burn in this system. Oil and gas development also increases the risk accidental human-caused wildfire ignition. Sagebrush typically recovers very slowly after a fire, and may take 30 years or more to reestablish at the same level of coverage as pre-fire conditions. In the period of time before regrowth has occurred, sage grouse lack cover and are more vulnerable to predators, and there are fewer succulent plants and insects available for them to eat.

Cheatgrass is well adapted to global warming, and is an example how global warming can disrupt ecosystems. Because cheatgrass is fire adapted, it can withstand the increased fire risk of the drier conditions caused by higher evaporation rates with global warming. Cheatgrass and other exotic grasses have also been shown to out-compete native plants with increased atmospheric concentrations of carbon dioxide, the main contributor to global warming. In other words, global warming is expected to significantly alter sagebrush ecosystems that sage grouse and other species depend on.

This emphasizes the importance of conservation measures now to increase sagebrush and other vulnerable ecosystems' resilience to the impacts of global warming. Unfortunately, most of the core sage grouse strongholds have been leased for oil and gas development. On top of this, stipulations to development designed to limit disturbance to sage grouse during the sensitive breeding period are regularly waived by the BLM. Add to this the diversion of staff and funding from BLM's wildlife program to process drilling permits and the gutting of the Forest Service's wildlife viability requirement, and the picture looks grim for the future of sage grouse, even if global warming were not a threat to its survival.

Restoring the Forest Service's requirement to maintain viable populations of wildlife and instituting a similar requirement for BLM would go a long way towards restoring the balance of uses on our public lands and help wildlife survive now and in the future in the face of global warming.

Coastal wetlands, oil and gas development, and global warming

Coastal wetlands are extremely productive ecosystems, important to both migratory waterfowl and commercial fisheries. Louisiana is home to 40 percent of remaining wetlands in the contiguous U.S. Louisiana's coastal marshes provide vital wintering areas for millions of ducks and other birds, and important resting areas for birds crossing the Gulf of Mexico. These wetlands also produce 20 percent of the country's commercial fish harvest, according to the USGS National Wetlands Research Center. These wetlands serve as vital buffers against storm surges. For every mile of coastal wetlands, storm surges are reduced by one foot in height.

These important wetlands are disappearing at the rate of 40 square miles of marsh a year—a full 80 percent of the wetland losses in the country. This devastating loss is caused by a variety of factors, including the loss of marsh-building sediment from the historic flooding of the Mississippi River, subsidence, sea level rise, and oil and gas development.

Louisiana is the portal for most of the offshore oil and gas production in the Gulf of Mexico. The oil and gas industry has dredged thousands of miles of canals through Louisiana's coastal wetlands, including through federal lands like Delta National Wildlife Refuge at the mouth of the Mississippi River. Canals allow saltwater to intrude into freshwater marshes, killing sediment-trapping vegetation, speeding the pace of erosion.

Global warming-induced sea level rise will further accelerate this problem. Not only will the loss of these wetlands have dire consequences for fish and wildlife, it will harm the oil and gas industry itself. Over 20,000 miles of oil pipelines crisscross these marshes from offshore—pipelines that will be directly exposed to whims of nature as wetlands recede around them.

Again, this example emphasizes the critical importance of timely conservation measures to buffer against the effects of global warming. Though we cannot stop the seas from rising, we can fill in canals and restore a portion of the historic sediment flows from the Mississippi River to these wetlands to prevent catastrophic loss of coastal marshes.

A Coordinated, Interagency Response is Essential

In addition to building ecological resilience to global warming by reducing the current threats to wildlife and habitat, federal agencies must use their existing authorities and be given additional direction to consider the impacts of global warming on wildlife in program planning, land management, and environmental analysis pursuant to the National Environmental Policy Act, the Endangered Species Act, and other relevant laws. Though the brunt of some global warming impacts may not be fully felt for a number of years, planning to address and ameliorate those impacts on wildlife and wildlife habitat must begin now.

Equally important, new governmental processes and structures need to be explored that will themselves be resilient and adaptive to the threats from global warming. While it is important for each federal agency to develop measures for protecting wildlife from the effects of global warming, it is insufficient for individual agencies, or even individual federal land units, to contemplate and plan strategies purely on their own. The problem is simply too complex.

We believe it is imperative that a national strategy be developed for addressing the impact of global warming on wildlife, with the express purpose of helping wildlife navigate the bottleneck of global warming impacts over the next century. This strategy should examine management issues common to geographic areas and threat type (e.g., sea level rise, increased hurricane frequency and intensity). Individual agencies and land management units should then coordinate their management activities with these national and regional goals and strategies. State strategies, particularly those set forth in state wildlife action plans, should address global warming impacts on wildlife and also be coordinated with the national strategy.

Scientific Capacity Should be Enhanced

Building more robust scientific, inventory and monitoring programs is essential to managing wildlife and federal lands in a world altered by global warming. The scientific capacity of federal agencies, however, is woefully inadequate. No federal land system has a comprehensive biological inventory of their lands. The National Park Service has completed inventories on individual units, but other federal land systems, including the National Wildlife Refuge System, do not have comprehensive biological inventories. How are agencies to know how ecological systems are changing as a result of global warming, and subsequently what adaptive responses may be necessary, if they do not even know what is there? Building applied research, inventory and monitoring capacity across the agencies is essential.

A coordinated science arm of a national strategy for addressing the impacts of global warming on wildlife will also be essential in developing and determining the efficacy of specific measures to address those impacts. A number of different types of responses have already been proposed by the scientific community including the protection and restoration of habitat corridors to assist species in shifting their ranges and the protection of climate "refugia"—areas that are not as vulnerable to the whims of a changing climate and are better able to preserve biodiversity through the climate bottleneck. These and other strategies will need to be further developed and tested.

Providing Funding to Address Global Warming's Impacts on Wildlife

Development and implementation of a national strategy to address global warming's impacts on wildlife, providing the necessary science to underpin that strategy, and taking action to reduce other stressors on wildlife will require substantially more money than is currently provided to conservation. As Congress develops legislation to cap greenhouse gas emissions, it is likely to create a system of emissions credits that can be traded. In the process, there is an opportunity to auction some of these credits, producing substantial revenue for the federal Treasury. A portion of that revenue should be dedicated to programs to offset the impacts of global warming on wildlife, with special emphasis on providing funding to address federal responsibilities for wildlife and land conservation in the face of global warming.

In addition, as the subcommittee explores methods to capture the true costs of energy development on public lands, including requiring mitigation fees and increased royalties, a portion of these funds should be dedicated to restoring wildlife and wildlife habitat to build natural resilience to the impacts of global warming.

This was the promise of the Land and Water Conservation Fund (LWCF). The LWCF, funded largely by a portion of federal offshore oil and gas royalties, was designed to provide a permanent conservation benefit to the American public in exchange for the liquidation of federal natural resources. The promise of the LWCF, however, has never been fulfilled. In fact, the Bush administration's FY 2008 budget request includes the second lowest request in the history of the 40 year program. The need for land protection through the LWCF and programs like it has never been greater. In designing revenue streams for conservation, the subcommittee should ensure that funds are dedicated to conservation and mitigation purposes.

Conclusion

Global warming is the conservation challenge of our time. It casts a long shadow over all of our other efforts to conserve and recover wildlife. We must act promptly to reduce greenhouse gas emissions to halt and eventually reverse the changes we are causing to our planet from global warming. At the same time, we must take steps to enable wildlife to survive the next century of inevitable impacts from global warming, to navigate this bottleneck, so that wildlife and, ultimately, humans, will benefit from the actions we take now to stop global warming.

On behalf of Defenders of Wildlife, thank you for the opportunity to share our perspective on this critical issue. We look forward to working with this subcommittee and others in Congress to develop a program that will result in effective measures to help wildlife navigate the global warming bottleneck so that our children and

grandchildren will be able to enjoy the wealth of wildlife and its habitat that we have enjoyed.

Mr. COSTA. Thank you very much, Mr. Matson.

Our last witness, and we will be able to go to questions, comments of the Committee on the second panel, is Dr. timothy Ball, who is the Chair of the Natural Resources Stewardship Project. So you have a presentation as well, a PowerPoint. Very good, Mr. Ball.

I really apologize to members of the Subcommittee. We have to have a better presentation than this. For those of us who are now getting to a chronological age where we are being challenged, this is a tough, tough read for me. But I think you have the accompanying documents in our packets. So with that understood, please begin.

STATEMENT OF TIMOTHY F. BALL, CHAIR, NATURAL RESOURCES STEWARDSHIP PROJECT

Mr. BALL. Thank you, Mr. Chairman, and Members of the Subcommittee, and pictures are worth a thousand words, and maybe in my case, a million.

It is interesting to sit here and listen to these presentations, and as Yogi Berra said, "It is deja vu all over again," because I remember when I started my career in the 1970s, I was hearing exactly the same arguments about global cooling, about the impending doom, about the disaster on species, and so on. And so as I said, it is an extremely interesting experience for me.

I am also pleased to hear that climate change is finally being accepted. I have been called as recently as the last six months in The Times of London a climate change denier. My whole career has been going around the country and the world telling the people that climate changes all the time. The illustration I have before you is a production from the Canadian Geological Survey, and it shows you the ice conditions just 22,000 years ago, and you see the dark blue area there, the largest area is ice up to 10,000 feet thick, covering almost all of central and eastern Canada, and the ice stretching down into the northeastern and central United States, and I say that is just 22,000 years ago.

There was a similar ice sheet in Scandinavia and two more in Siberia, and at that time sea level was 500 feet lower than it is at present. So the idea about sea level changing is nothing new, and what is significant about this is that all that ice melted in about 5,000 years, and this was long before there was human CO_2 or anything else, and the explanation for that melting is primarily given by these factors which are called the Milankovitch Effect, and interestingly enough, this is not included in most of our textbooks across North America today. I have checked them out.

What it shows in the lower right is the orbit of the earth around the sun as an almost circular but slightly elliptical orbit. That is the situation right now. But the orbit is changing every single year pulled by the gravitational pull of the planet Jupiter, and what you see on the lower left is the orbit as it was 22,000 years ago, an extreme eclipse, so the orbit is changing every single year.

And in the center of the diagram you see that the tilt is shown at 23.5 degrees. It isn't. It is just close enough for government

work. But it also constantly changes from 21.4 to 24.8, and that has nothing to do with the wobble. That is a straight change in tilt.

Both of those factors are changing every single year. None of these things are included in the IPCC climate models, and they argue is because they are too short a time span. But we are talking about projections of 50 and 100 years when they become significant.

In the IPCC report and all the studies, they only look at one factor of solar variability and that is changes in the electro-magnetic radiation or heat and light. But even with that, they acknowledge that it explains 50 percent of the warming of the last 130 years. What they leave out is what I have just shown you, the sun/earth relationships, the orbit tilt. They also leave out what is called the corpuscular radiation or the solar winds, and that very, very highly correlates with climate changes I will show you shortly.

This is an ice core temperature record from Greenland, and what it shows you on the right side is the dramatic warming that occurred about 10,500 years ago as we came out of that Ice Age, and the ice sheets started to melt, and then on the left side it shows you the present temperature, and you will see that for most of the last 10,000 years the world has been warmer than it is at present. In fact, you could argue that it has been cooling since about 8,000 to the present.

This warming between four and 8,000 years is called the Holocene Optimum, and there are people that are trying to get rid of it, just like they tried to get rid of the Medieval warm period, because it hampers their argument that today is warmer than it has ever been. It is simply not true.

We don't need just scientific graphs to show it. This is a photograph of a white spruce. It is 100 kilometers north of the current tree line taken by Professor Ritchie and used with his permission. Its radio-carbonated at 4,940 years old, and in order to have a tree of that dimension growing that far north of the current tree line, the world would have had to have been between 3 and 5 degrees Celsius warmer than it is at present. So we have seen much warmer, even since the end of the last Ice Age, so what is going on today is well within our normal variability.

What you see here is the sunspot data starting at 1610, and it shows you that the variability, and basically when the sun is warmer, or when the sunspots are higher the earth is warmer. When the sunspots are lower the earth is cooler. This shows you the greenhouse gases, water vapors. Ninety-five percent of the greenhouse gas is virtually ignored. CO_2 is less than 4 percent.

And just to finish up, Mr. Chairman, I beg for five second, this shows you the CO_2 record for 600 million years from the geologic record. We are currently at an all-time low of CO_2, at 385 parts per million. Plants operate best at 1,000 parts per million, and that is being done in commercial greenhouses, so the plants essentially are CO_2 low and starved. So to suggest lowering the CO_2 is just ludicrous.

[The prepared statement of Mr. Ball follows:]

Statement of Dr. Timothy F. Ball, Chair,
Natural Resources Stewardship Project

Rapid change is normal especially in climate. Despite scientific knowledge of this most people still view change as gradual. This allows extremists to argue that any new change is not normal and therefore due to human activities. Climate always changes. Just 22,000 years a massive ice sheet covered ago Canada. Thirty years ago the scientific consensus said we were entering another ice age.

Science works by creating then testing theories. Each theory is only as valid as its assumptions. If the assumptions prove correct and the theory produces accurate predictions then it may become a law.

The theory of global warming assumes; CO_2 is a greenhouse gas that traps heat keeping the earth warm; that if the atmospheric levels increase the global temperature will rise; that human addition of CO_2 will cause an increase in CO_2 and therefore temperature.

The warming theory became a fact and a law before the research had even begun. Scientists who tried to question the theory were sidelined as skeptics. The scientific method was almost completely thwarted.

The evidence continues to grow and show that the theory is completely wrong. Ice core records show that the temperature rises before CO_2 not as assumed. Geologic and other records show no correlation between CO_2 and temperature. Changes in the sun explain almost all of the temperature known change.

The biggest problem is that all "predictions" of global warming are based on computer models (known as General Circulation Models (GCM) that simply don't work. The models can't recreate known conditions, can't handle clouds and are unable to forecast for six months from now, yet we're expected to accept forecasts for 100 years are accurate and certain. This is now the basis of massive and expensive public policy.

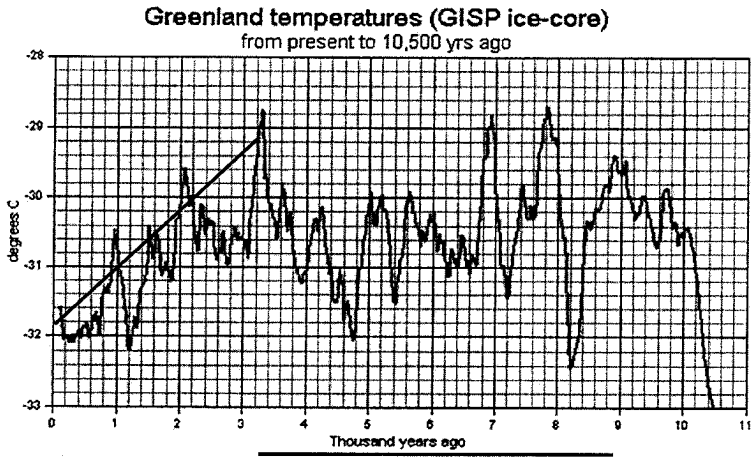
What's wrong with warming? In fact most of the world is better off in warmer times.

They say we should act anyway. This is known as the Precautionary Principle. However, it assumes there is some validity to your theory and it can make accurate predictions. This is simply not true for the global warming theory. Besides, there are far more important issues.

We are totally committed to warming, but the scientific evidence is we are cooling.

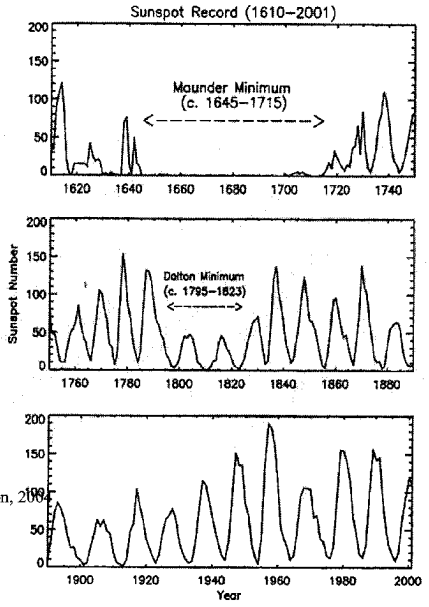
[NOTE: Photographs and "180 YEARS OF ATMOSPHERIC CO_2 GAS ANALYSIS" by Ernst-Georg Beck, Reprinted from ENERGY & ENVIRONMENT, Volume 18, No. 2 2007, have been retained in the Committee's official files.]

[Attachments to Mr. Ball's statement follow:]



Holocene Optimum

Temperature curve, 10,500 years (right) to present from ice cores in Greenland. Note dramatic warming to high around 8000 years ago then another warm peak 3200 years ago, both warmer than today.

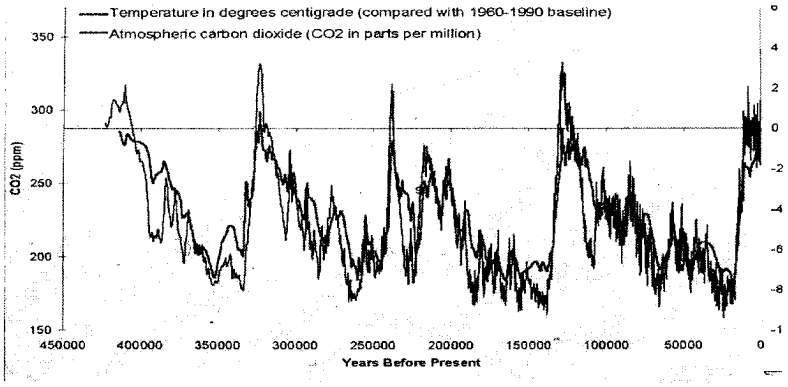


Sunspot records begin with Galileo in 1610 That is cycle 1. We are currently entering cycle 23

Basically, when Sunspot number is low the earth is cold, when it is high the earth is warm.

Source:
Wei-Hock Soon, 2004

Antarctic ice core records showing temperature and CO2 changes for last 420,000 thousand years.



Basic assumption is CO_2 change causes temperature change.
The ice core record shows exactly the opposite. Present temperature on right.
Note higher temperatures 130,000 and 320,000 years ago.
Average CO_2 is 260 ppm. Note variability of the readings.

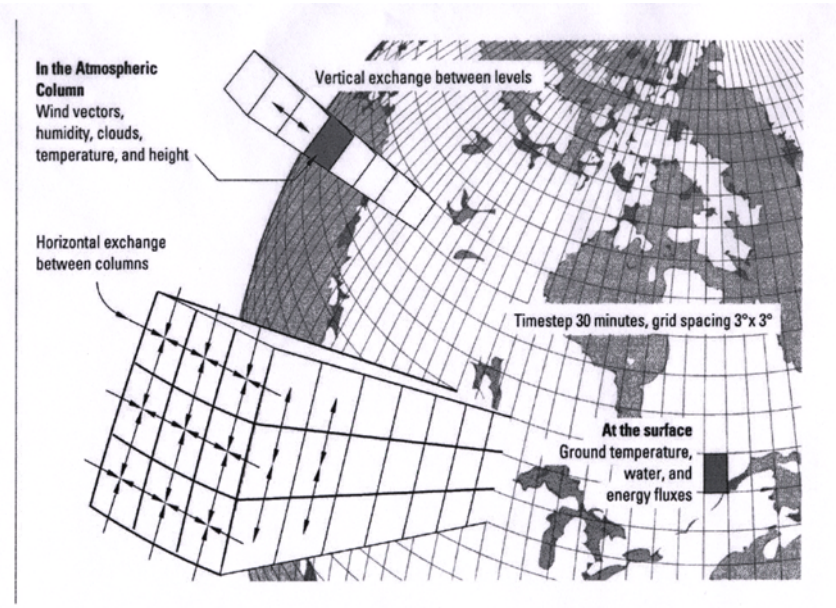
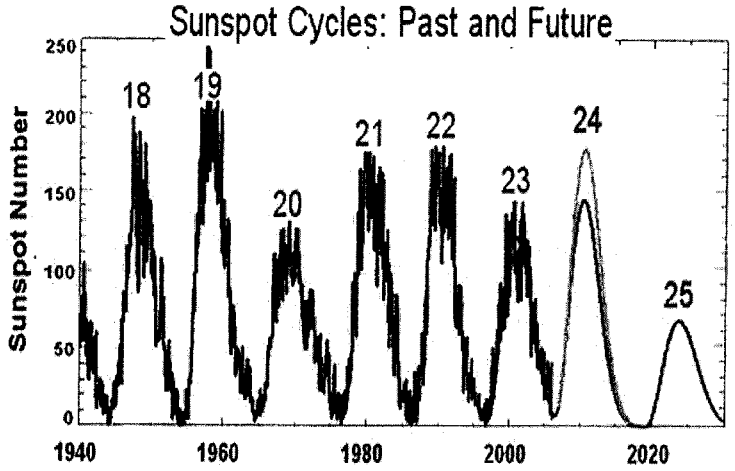
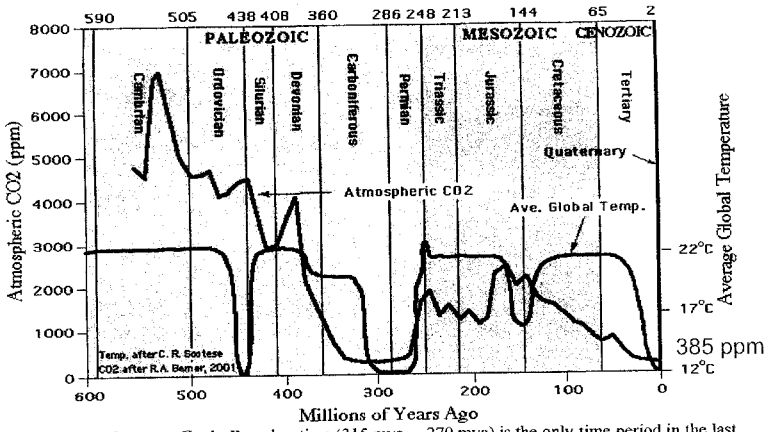


Diagram of computer climate model. What data is used to create the model?
Limited surface data, virtually nothing above the surface. Smoking Gun?





Late Carboniferous to **Early Permian** time (315 mya -- 270 mya) is the only time period in the last 600 million years when **both** atmospheric **CO2** and **temperatures** were as low as they are today **(Quaternary Period).**

Temperature after C.R Scotese

CO2 after R.A. Berner, 2001 (GEOCARB III)

Note (black line) CO_2 is the lowest in 600 million years.
It does not correlate with temperature (blue line) at any point.

Mr. COSTA. All right. Thank you very much, Mr. Ball, for your testimony, and now we will have the opportunity to question the witnesses. I will begin.

Dr. Westerling, in your testimony you used the Intergovernmental Panel on Climate Change as one of your baseline sources for tracing warming trends. There are a lot of other studies that I keep hearing about, and projections on trends that are specific to the western United States.

Can you give us a bottom line based on your studies and looking at others what trends do you see in the next five to 10 years? I know you spoke while I was gone, but you had made a presentation yesterday, and I know about the correlation with regards to forest fires.

Mr. WESTERLING. Yes, sir. Five to 10 years is a very short time frame.

Mr. COSTA. I think so.

Mr. WESTERLING. And one of the things to keep in mind is that all of the IPCC projections, the Intergovernmental Panel on Climate Change projections, whether you vary the models or the scenarios or the types of emissions we have, basically have identical results for the next decade or so because they don't begin to diverge until later in the century as the small differences between these models and between the scenarios tend to accumulate over time.

Mr. COSTA. Let us stipulate for the record there are a number of factors, but do you want to respond?

Mr. WESTERLING. Right. So what I am going to say is that over the next five to 10 years I would expect to see just a lot like the last five to 10 years.

Mr. COSTA. OK.

Mr. WESTERLING. And whereas, you know, mid-century I would expect to see, according to the IPCC, minimum warming in the western United States that is double what produced the very impressive increase in wildfire activity in the western Iraq.

Mr. COSTA. I am concerned not only about wildfires, but also the impacts on our water supply and water quality. Let me ask another quick question, then I want to move on to one of the other witnesses.

You are doing work for Governor Schwarzenegger with the State of California, and you have quantified economic costs and risk. Can that analysis that you are doing be expanded to other western states that have similar forestry conditions?

Mr. WESTERLING. Certainly it could be done. Yes, we could expand it to the rest of the western United States very easily.

Mr. COSTA. All right. Ms. Williams, quickly again because of time, I am familiar with, you know, all politics is local, but when I was first in the legislature with the first energy crisis and Governor Brown created an energy commission, and did a lot of interesting things, some better than others, but to try to find a mix of renewables. One of the areas in conservation that we did with btu's allowed, and of course, our climate that is more temperate so that makes it better in California, of course, but where we used a lot less than the national average in terms of thermal units per individual.

Any thoughts on how that is applied in Alaska and where that can be applied elsewhere?

Ms. WILLIAMS. Well, Congressman, you are absolutely correct. The very first strategy should be energy conservation and energy efficiency.

My father was a great Republican Conservative, and he taught me at an early age the base of conservative is conserve, and so first and foremost we, as Americans, should lead the way on energy conservation and energy efficiency, and that is something that we are

discussing a great deal in Alaska and trying to implement, and that is something that we should do as a nation and that is something that this committee can certainly promote.

Mr. COSTA. Appreciate that.

Mr. Ball, I was interested in your comments. Let us say for the sake of argument that some of the information that you provided here is not used in some of the other evaluations that has been done, but it just seems to me that, based on some of the slides you showed us, that I don't think there is a debate that the climate is changing, and has constantly changed, so I think you testified to that, is that not correct?

Mr. BALL. I think that the public has generally been educated in what is called the——

Mr. COSTA. No, no, I am talking about what—you said what your view was on the public, how they have been educated. But I am just saying I don't think there is a debate that the climate has not changed, will continue to change. That is a force of nature.

Mr. BALL. I don't agree with that. With 30 years of speaking to the public and educating, most of the public think change is very gradual over long periods of time. What we are really talking about, the rate of change and the variability, the degree of variability of change, and it is much greater than the public have been led to believe.

Mr. COSTA. But I am not talking about the public. I am talking about the facts that scientific testimony, I think, has clearly indicated, going back to the Ice Age, to your information, that it is a natural evolving for a lot of factors, some of which you submitted in your testimony, that the climate continues to change.

Mr. BALL. Well, as I said, I respectfully disagree. My experience is that that is not what is taught in the schools. That is not——

Mr. COSTA. No, I am not talking about what is taught in the schools. I am asking you if you believe whether or not the climate is staying the same constantly, or whether you believe it is changing. That is what I am asking.

Mr. BALL. No, I have said right in my comments that I was accused of being a climate change denier. My whole career has been trying to get people to understand the rate at which climate changes in very short periods all throughout the earth's history. That is the point I am trying to make.

Mr. COSTA. Well, I know, but I think the discussion, the debate, and that is what I opened up here with my comment, and I have run out of time now, excuse me for a second, if you will bear with me, is the debate is as to what impact man is having on climate change. But my point is that I don't think there is any debate that the climate has continued to change over the 4.5 billion years of the history of the plant, and Ice Age to receding Ice Age, I mean, how the Great Lakes broke from the Ice Age. I don't think there is any debate about the climate changing. We may not agree on this point. I thought we might.

Mr. BALL. Well, I think we can to some extent, but I say the degree to which it has changed, but also until you understand the extent of natural variability and the mechanisms of natural variability, it is simply impossible to separate out any minuscule effect that humans might have, and so I think that that is——

Mr. COSTA. Well, that, I think, is the subject of the debate, but I understand that. I understand your point on that, and I thought your testimony was helpful in highlighting your view on that. All I am trying to do is make the point that—and again I have gone beyond my time, thank you for bearing with me, my colleague—the degree man is impacting is minuscule, I think is the term you just used.

Mr. BALL. Minuscule. Yes.

Mr. COSTA. Thank you.

Mr. PEARCE. Thank you.

Mr. Murray, I am told that China plans to build 544 new coal-powered plants. That would be one new coal plant every week for more than 10 years, and so my question is will regulating CO_2 unilaterally by the U.S. serve any purpose if developing nations do not likewise do something?

Mr. MURRAY. It would do very little for the climate on earth, very little. As I testified, they are currently building 50, and that would fit well with the 544 over 10 years. They are not looking at any sort of carbon capture, transfer, or sequestration. They don't even consider it.

The G-77 countries, all developing countries led by China, told us this winter that post-Kyoto in 2012 they have no intention of capturing carbon dioxide. So what we are really talking about here is killing American jobs, exporting more American jobs for little or no environmental benefit.

Mr. PEARCE. OK. In your testimony, you mentioned some companies that have come out in obvious support of global warming. Would you explain to me why—I mean, you are a business guy, they are business guys—why would companies do that? They are worried about exporting jobs, too.

Mr. MURRAY. Congressman Pearce, I can answer it in one word. Profit. And they are not acting in the best interests of the United States of America. Let me explain.

Energy and Excelon have nuclear power and natural gas plants, so they want to see coal-fired go away, so their power can compete in the global marketplace. Had a discussion with Jeffrey Immelt, Chairman and CEO of General Electric. He is out to make a profit off of the global warming, and says that. Caterpillar, Alcoa and you have two European companies here, BP American and Shell, and, of course, they want economically dominate the United States.

Mr. PEARCE. Sure, I understand. Now, you are in the coal business, and coal provides about 52 or 53 percent of our nation's energy.

Mr. MURRAY. Correct.

Mr. PEARCE. Now, what is going to happen to coal-producing states if we implement the legislation that is before us? What is going to be the—in other words, we have go coal exporter states, coal importer states. So what is going to happen to the coal exporter states?

Mr. MURRAY. Folks on fixed incomes will have a great deal of time, trouble maintaining their standard of living. That is the first thing that will happen because electric rates will go out of sight. These proposals right now are equivalent to a $65 a ton tax on coal that I sell for 20.

Mr. PEARCE. Why will electric utility rates go out of sight? I am not sure I understand what you——

Mr. MURRAY. Because right now coal accounts for 52 percent of the electricity in the country. But it is the cheapest. It is one-third to one-fourth the cost of electricity from natural gas.

Mr. PEARCE. OK.

Mr. MURRAY. And it is even cheaper to nuclear. It is disparate across the country. Some states like Ohio have 88 percent coal-fired. They are going to be hurt. People on fixed incomes are going to lose their standard of living, and, sir, Ohio is never going to export another product in the global marketplace because low-cost electricity is a staple of life, and something we have got to have in this country to export our products competitively in the global marketplace for no environmental benefit. That is what we are looking at.

Mr. PEARCE. So again, what about the job bases then in these coal-producing states like West Virginia?

Mr. MURRAY. It will be depressed and placed into reverse the economy of this United States. We are exporting jobs right now to China, and they have told us they don't plan to do anything between now and 2012, and after 2012, yet we are exporting jobs to China. Why are we—this Congress—are not looking at this side of it? We are exporting jobs to China. We are going to continue to do it because they are going to be more competitive while this Congress shoots every American worker in the head.

Mr. PEARCE. I appreciate your passion for workers. I had employees, too, and you get invested in their lives. You get to understand their kids, and you understand what that is like to be—I was in the oil and gas business in 1999 and 2000, when the price of oil fell to $6, and I saw competitors lay off 68 percent of their employees. My wife and I made the choice to be buyers after fixed pay, with no pay cuts, and I mean, I understand what you are talking about.

Mr. MURRAY. It is a human issue, sir.

Mr. PEARCE. I know.

Mr. MURRAY. And I know the names of the people whose lives are going to be destroyed for little or no environmental benefit here.

Mr. PEARCE. I appreciate——

Mr. MURRAY. It has become a political hysterical rampage.

Mr. PEARCE. Appreciate your passion for the employees and employees' families, and I know that you said you have a plane to catch, you need to get out.

Mr. Chairman, I think if that is OK with you, we will watch him depart there.

Mr. COSTA. I did have a couple of questions but I can submit them in writing.

Mr. MURRAY. No, sir. Go ahead. Mr. Chairman, I am at your pleasure, sir.

Mr. COSTA. All right. Quickly, Mr. Murray, as one of the largest independent cooperators, if I understand that correctly, we are talking—I mean, first of all, I come from a perspective where I don't think there is one silver bullet, and notwithstanding my support for renewables, I represent a large agriculture area looking at

what agriculture could do to reduce our dependency, every conversation I have ever had with folks talk about the important role that coal has in America's future.

I don't like to make blanket statements, but that is just me, but I do believe that clean coal technology in large-scale applications of emission reduction is going to be part of our future. I would like to get your take on what you think the possibilities are in the coal area for emission reduction.

Mr. MURRAY. Thank you, Mr. Chairman. That is an excellent question.

I spent 15 years of my life building the Great Plains Coal/Gasification Project in North Dakota. That is the only clean coal technology project that has been built to a commercial scale in the Western Hemisphere. I am as skeptic about clean coal technology because there is no commitment to it.

First, the Congress has appropriated funds for clean coal technology, but the administration hasn't spent it, and that has gone on now for years. So I am skeptic about clean coal technology. It has been 40 years since I spent 15 years of my life building the Great Planes Coal/Gasification Project. I know clean coal technology as well as anybody alive. I am an engineer, and I have lived it, and I am a real skeptic that there is any commitment in this country to a development of clean coal technology, and that needs to come first before the legislation because, Mr. Chairman, we have no way of getting and capturing CO_2 right now on a commercial scale.

Mr. COSTA. Well, I believe this is one of the areas that certainly the Subcommittee intends to look at, and I wanted to get your take based upon your own experience on that area.

Let me move on to, and if you need to leave, Mr. Murray, we will release you.

Mr. MURRAY. Please, sir.

Mr. COSTA. Mr. Schendler, as an industry that works with Federal lands and having——

Mr. MURRAY. Are you finished with me, sir?

Mr. COSTA. I am finished.

Mr. MURRAY. Thank you, Mr. Chairman.

Mr. COSTA. I mean for this afternoon.

Mr. MURRAY. Thank you, sir.

[Laughter.]

Mr. MURRAY. Thank you. You have been very gracious. Thank you.

Mr. COSTA. Thank you.

I am sorry, Ms. Williams, do you have to leave too?

Ms. WILLIAMS. No, I deferred my appointment. Thank you.

Mr. COSTA. All right. I am trying to be fair with all of our witnesses.

Mr. Schendler, a lot of complaints are oftentimes with Federal regulations on public lands, and certainly I have constituents who come to me in the past with trying to just fix the problem. I would like to know your business, you know, is in some of the very beautiful parts of the Rockies, as we say, how the ski industry has been able to impact or deal with the various government types of regulation that for the best of intentions try to protect public lands?

Mr. SCHENDLER. Historically, government regulations have not affected the industry. If anything, it has enabled it, so we have had a very positive relationship, I think, with the government on the use of public lands.

Mr. COSTA. I think the time has gone to reset, but I am going to defer to my colleague here, because I don't know what is happening with this time thing. We are going to have to get a better sink here.

Mr. PEARCE. All right, thanks.

Mr. Ball, you heard the discussion earlier with Mr. Myers about the level of carbon pre-1940. What was that level? He said 250, and my question is, is there any——

Mr. BALL. The pre-industrial level was set at 280 parts per million——

Mr. PEARCE. OK.

Mr. BALL.—based on the ice core record, and also on an article by Tom Wigley, on climate change in 1983, and also by the research of Calendar. There is an article that came out just today in the Journal of Energy and Environment by Ernst Beck, which takes the 90,000 atmospheric readings from the Nineteenth Century, starting in 1812, and shows that the CO_2 level in the Nineteenth Century was actually at 360 parts per million.

Mr. PEARCE. That is a significant difference.

Mr. BALL. Sir?

Mr. PEARCE. Significant difference in the——

Mr. BALL. Oh, tremendous difference.

Mr. PEARCE. Is Mr. Beck a scientist?

Mr. BALL. sir?

Mr. PEARCE. Mr. Beck is a scientist?

Mr. BALL. Mr. Beck is an atmospheric chemist in Germany, and I have been working with him for a year on this article, and he not only shows that the average level of pre-industrial, but also that the CO_2 varies tremendously from year to year.

Mr. PEARCE. What would this do to the models if that—Mr. Chairman, I would ask unanimous consent to submit an article like that.

Mr. BALL. Yes.

Mr. COSTA. Without objection.

Mr. BALL. Thank you.

Mr. COSTA. OK.

[NOTE: The article submitted for the record has been retained in the Committee's official files.]

Mr. PEARCE. What would it do to the models if that input is significant?

Mr. BALL. Well, it changes the whole slope of the CO_2, the whole argument of human injuring global warming is based on that slope of a pre-industrial natural level of 280 to a current level of 385. If you push up the 280 to 360, the slope virtually disappears.

By the way, that also speaks to some of the serious problems with the CO_2 record in the ice cores, and in that CO_2 record in ice cores, the temperature changes before the CO_2, not as the basis assumption is.

Mr. PEARCE. OK. Mr. Westerling quoted significantly from that IPCC report. Have you read the report or just the executive summary?

Mr. WESTERLING. You mean the new report?

Mr. PEARCE. No.

Mr. WESTERLING. Since it is not published yet.

Mr. PEARCE. Have you read the new report?

Mr. WESTERLING. I have read the executive summary.

Mr. PEARCE. And were scientists, Mr. Ball, were scientists allowed to give input on that executive summary or was that policy——

Mr. BALL. There were two people that were involved with the guidance of the politicians and the bureaucrats that wrote the report. One was Phil Jones and the other was Kevin Trenberth.

Mr. PEARCE. So the executive summary does not have the scientific input——

Mr. BALL. No.

Mr. PEARCE. OK. I am going to walk down, and just yes or no, and if it is not a yes or no, I am sorry, I am going to take my time back because we are up against this clock and that clock.

Coal generates about 52 percent of the energy today. Do you believe that with your world view that you are describing here today that America can continue to get 50 percent of its power from coal and help you to achieve your world views? Yes or no, Mr. Matson?

Mr. COSTA. Who are you directing the question to?

Mr. PEARCE. I am going to walk straight down the panel.

Mr. COSTA. Oh, OK.

Mr. PEARCE. Mr. Matson.

Mr. COSTA. Mr. Matson.

Mr. PEARCE. Ms. Williams and right on down the panel. Yes or no?

Mr. MATSON. Repeat the question. Sorry.

Mr. PEARCE. Yes, can we continue to get 50 percent of our energy from coal and achieve what you feel like we need to achieve as far as climate?

Mr. MATSON. Unlikely, but I think there are alternatives to coal.

Mr. PEARCE. Unlikely. Ms. Williams?

Ms. WILLIAMS. Unlikely.

Mr. PEARCE. Unlikely. Mr. Schendler?

Mr. SCHENDLER. Mr. Schendler or Mr. Westerling?

Mr. PEARCE. I am sorry. Yes, Mr. Westerling. Mr. Schendler, you will be next.

Mr. WESTERLING. Not with current topology.

Mr. PEARCE. Not with current.

Mr. SCHENDLER. No. Yes, with sequestration.

Mr. PEARCE. Mr. Ball?

Mr. BALL. Yes.

Mr. PEARCE. OK. We are going to do the same exercise on nuclear technology. If we are going to convert from coal, something has to be there. In other words, we know we provide 300 million people, about 1 million get energy from wind, and about 1 million for solar, so something has to have enough capability, enough quantity. Nuclear, yes or no?

Mr. MATSON. To do what? To entirely place our energy?

Mr. PEARCE. Yes, to fill the void left by the coal that we are going to shut down.

Mr. MATSON. I think there is a tremendous opportunity in energy efficiency.

Mr. PEARCE. Yes or no? Can you give a yes or no, nuclear?

Mr. MATSON. We should be using it as an alternative. There are plenty of other alternatives to examine.

Mr. PEARCE. Nuclear, yes or no? Nuclear, yes or no, Ms. Williams?

Ms. WILLIAMS. To fill the entire void, no.

Mr. PEARCE. No. No.

Ms. WILLIAMS. To fill some of the void, yes.

Mr. PEARCE. Nuclear, yes or no?

Mr. WESTERLING. Depends on the time frame of nuclear.

Mr. PEARCE. Yes or no?

Mr. WESTERLING. Yes or no? Yes or no to what? I mean, it really——

Mr. PEARCE. To fill the void. We are going to shut down coal to achieve your world view, and I am just asking if you will accept technology of the nuclear to provide that void.

Mr. WESTERLING. I think there is going to be an important component, but I don't think it would be——

Mr. PEARCE. OK.

Mr. WESTERLING.—sufficient by itself to fill the void.

Mr. PEARCE. Mr. Schendler?

Mr. SCHENDLER. As a portion, nuclear would be part of the solution.

Mr. PEARCE. All right.

Mr. BALL. Yes.

Mr. PEARCE. OK, just trying to figure out what our options are going to be.

I see my time has expired, Mr. Chairman, and I would have another round if you have the opportunity.

Mr. COSTA. Mr. Westerling, Dr. Westerling, excuse me, in your testimony you talked about the cost of fire suppression, and the human terms of the severe fire seasons. Any of us who live in western states understand the cost impacts and the map that we looked at yesterday clearly indicates that.

Both the Government Accountability Office and the Inspector General have raised related concerns in escalating wildfire costs. Assuming that the trends are going to continue, and you and I kind of got in between five or 10 years what those trends are, what is your recommendations on how we can continue to protect our communities that today have been impacted by forest fires?

Mr. WESTERLING. There are a range of measures and some of them are already being done, and I would refer you to say literature on the fire-wise communities, for example. So there are ways to make homes and communities more resistant to wildfire by, for example, clearing vegetation around structures, changing the kinds of materials used in building the structures. So we can continue to do more of that, but we are already doing quite a lot in that area.

Another set of measures is related to fire suppression, and as you pointed out yourself, we are already spending a great deal of

money on fire suppression in the western United States, and there has been very significant technical innovation in the kinds of resources that we have to apply to suppress fires. And so it is not likely that we will see any sort of revolutionary impact of additional resources or technological change in fire suppression in the near future.

Mr. COSTA. Regardless, it is going to cost us——

Mr. WESTERLING. It is going to——

Mr. COSTA.—on the Federal level and it is going to cost us on the state level.

Mr. WESTERLING. For the longer term, the best thing that we could do would be to reduce the growth of sprawl, reduce the growth of urban——

Mr. COSTA. Sound planning would obviously impact not just forests, but our farming as well, but I don't want to get into that. That is not the subject of our hearing.

Our friend from Alaska, Ms. Williams, you mentioned something in your comments about conserving and conservation. Of course, one of the great conservationists, presidents of the Twentieth Century was Theodore Roosevelt, and you know, I guess it is because I just don't see the world through black and whites, but shades of gray, and unless you are trying to play a "gotcha", I am really looking for how we deal with the challenges we face.

Let us say for just a moment for the sake of the discussion that the climate warming issue and man's impact was just put on the side for a moment, but just common sense in terms of, you know, the planet had less than 200 years ago 2 billion people on it, today it has got more than 6 billion. I like to joke I am one of the few people, much to my mother's dismay, who is actually doing something about this population issue, because I have not contributed to the problem, but when we talk about sustainability, I mean doesn't common sense tell us that we have to employ a host of management tools to deal with our sustainability notwithstanding the argument or the discussion or the debate that we have had this afternoon on climate impacts?

Ms. WILLIAMS. I agree with you very much, Mr. Chairman, and I think that is the role of Congress in tackling this greatest threat that we face. There are many contributors to it. We have discussed some of them today. What we have also discussed is just some of the costs.

We have heard from a couple of the witnesses about the human costs of maybe restricting coal production, but I can assure you, Mr. Chairman, the human costs of climate change are very dramatic, and I would invite the Subcommittee and the entire committee to come to Alaska. Go to Shishmaref, and see the tears going down peoples' faces as they have to relocate their community that they have been occupying for 4,000 years because of the impacts of global warming are requiring relocation.

So when we see the impacts, my mother had to be hospitalized because of smoke from the 2004 fires, at 90. And so when you look at health costs, cultural costs, economic costs, I have friends who fish and their children may not be able to fish because of the acidification of the ocean and the loss in fishing opportunities.

Mr. COSTA. My time has expired.

Ms. WILLIAMS. So, Mr. Chairman, our goal is indeed to look at the full spectrum of contributors to this because this is the greatest threat that we face as a nation.

Mr. COSTA. We may take you up on your suggestion. Informed sources tells me that the Chairman has committed to the Ranking Member of the Full Committee—I am not talking about the two of us here—but Mr. Young, the Representative, the gentleman from Alaska, for the Committee to actually go up to Alaska in August, I believe, of this year.

Ms. WILLIAMS. Wonderful.

Mr. COSTA. And so how many of the members will be able to make the trip up there, but I will certainly suggest to the Chairman your reference about the visit you suggested, and I would suggest to all the members of the Committee, having been up to Alaska several times, that those that can do because it is one of America's great treasures and great resources, and it would be good to see firsthand some of the issues you pointed out.

For the last round, the gentleman from New Mexico.

Mr. PEARCE. Thank you, Mr. Chairman. How long are we going to have to submit questions?

Mr. COSTA. Standard 10 days.

Mr. PEARCE. OK.

Mr. COSTA. I made that in the opening comment.

Mr. PEARCE. OK. I am sorry.

Mr. Ball, up here I am looking at a chart of the sources of greenhouse gases. Now, when I look, I see the orange is water vapor, and then the other biological activity and the human element at about .28.

Is that the standard view? In other word, is that a correct scientific view that that is about the size of the human element?

Mr. BALL. Yes, that is about the size.

Mr. PEARCE. All right. Let us move to the next chart here. We have a lot of ground to cover so I don't mean to cut everybody off but we are going to go through a lot of questions.

Now, this one doesn't show, but you can barely see a turquoise line which shows the increase of carbon, and it is moving up on this scale right in there. In other words, they had to blow that thing up quite a bit. This is the scale really shows how the CO_2 has changed. If we blow it up a thousand times, then we go to this chart, and so am Y reading these charts correctly that to get this kind of really dramatic increase in carbon where it shows up on the scale you have to blow the scale up tremendously big?

Mr. BALL. The top graph is from Mount Aloa, and of course, the first about 15 years of that record is very questionable and not usually used. And yes, it is the way that it is presented to——

Mr. PEARCE. OK. Ms. Williams raised questions about the polar bears. You just wrote an article about polar bears. Tell me what happened to polar bears in the medieval time?

Mr. BALL. Mitch Taylor is the expert in Nunavik, up in Iglulik, and worked with him, and also with Marcel Dick of Churchill, and of the 14 groups of polar bears in the Canadian Arctic, which are the majority, only one has shown any sign of decline, and that is the group around Churchill, and the evidence is that they have shown decline. They are the ones where they talk about thinning,

the animal getting thinner and sparser, smaller. That is because of a decrease in the food supply.

Mr. PEARCE. OK. We need to move on. I am sorry to interrupt. We have just got a very short period of time here.

Just to get into the record, we had testimony that the elk population—in one of our written testimonies—in New Mexico have decreased, and yet when I look at the 1912—1875, there was 2,000 elk; 1912, decreased down to 60; 1956, 213 released, 365 on private lands; 1958, 8,000; today we are at about 72,000, so I am not sure where we got the 88 percent decline in our population for New Mexico, but just to put that into the record.

Let us see, we talked about modeling. Many of the people today talked about modeling, Mr. Ball. Tell me about scientific process versus modeling. Help me understand that.

Mr. BALL. The modeling leaves out so many of the variables on global climate that it really does not simulate. When they run them backwards in what is called hindsight forecasting, they can't re-create conditions of even 30-40 years ago. They certainly can't re-create the Ice Age conditions.

Mr. PEARCE. The modeling is a leap of some sort.

Mr. BALL. Yes.

Mr. PEARCE. Now, we had testimony also that within a decade the children will live in a plant that is unrecognizable, and then we also had testimony that everything is kind of in this long playout, that even if we put changes in today, you get a century's worth of effects. Is it believable that within 10 years our children are going to live in a plant that is unrecognizable?

Mr. BALL. No, absolutely not, and these kind of predications, we have a fellow in Canada by the name of David Suzuki. He said we have 10 years to live, but he said it 20 years ago.

Mr. PEARCE. OK. Mr. Westerling, your testimony says that where the changes observed in western hydroclimate and wildfires as a result of greenhouse is presently unclear. That is an article back July of 2006. So you are describing it as very unclear, and that is in the "Science Express."

Then in today's testimony you say that it is an absolute slam-dunk. That it is a human-caused climate change.

Which of those is really—there is a difference in those. Would you like to address that?

Mr. WESTERLING. Yes. Well, first, I would like to correct you if I may, sir, that the actual language in the published paper after peer review, which is not the "Science Express" version, says "Beyond the scope of this study," not presently unclear.

Mr. PEARCE. So the article is incorrect, the way it was printed?

Mr. WESTERLING. Yes, sir.

Mr. PEARCE. So you didn't say it was unclear?

Mr. WESTERLING. No, sir.

Mr. PEARCE. OK.

Mr. WESTERLING. But it——

Mr. PEARCE. It is published under your name.

Mr. WESTERLING. That is correct. Have you ever published a paper with Science, sir? It is a rather chaotic experience.

What I would say is that the work I presented in this paper was not intended to be evidence of climate change with only a 34-year

record, and what we wanted to make clear was that we were taking that as a given, but we were not establishing that with our work.

Mr. PEARCE. OK. But your testimony today, you slam-dunk it. That is absolute. You make a very strong connection between the human activity——

Mr. WESTERLING. Of course.

Mr. PEARCE. Yes, OK.

Mr. WESTERLING. I have great confidence, sir, in the scientific process and in the IPCC process.

Mr. PEARCE. OK.

Mr. WESTERLING. And I think it produces science that we can rely on.

Mr. PEARCE. Is the science unclear? Is the science a slam-dunk, Mr. Ball?

Mr. BALL. Absolutely not, and as I said, there are so many variables. I mentioned the sun, and other variables not included, so it is not a slam-dunk at all.

Mr. PEARCE. OK, that is all I needed to know. Appreciate it.

Mr. Chairman, thanks for your indulgence. Great hearing.

Mr. SCHENDLER. May I make a correction to the record?

Mr. COSTA. I am sorry, Mr. Schendler. You wanted to correct the record?

Mr. SCHENDLER. Just one quick note. What I said was that if we don't act within 10 years, this is quoting James Hanson, we would live on a planet that would be unrecognizable to us, not that the plant would be unrecognizable in 10 years. Thank you.

Mr. COSTA. All right. Sometimes we speak and we convey images—I mean, I do it on occasion—that have unintended consequences, and so I certainly want to allow opportunities for people to make sure that people understand clearly what they intended to say, and so I certainly allow you that opportunity.

I want to thank all the witnesses for your valuable testimony. I want to thank the members for your questions. As I indicated, if there are additional questions for the witnesses, we would ask that you respond in writing. We have a 10-day rule. I will urge all the members of the Subcommittee for Subcommittee staff purposes to not wait until the ninth day to submit the questions or like some students do their homework, but preferably if you can get the questions in within the next couple of days, that will make it very helpful to the members of the staff.

If there is no further business before the Subcommittee, once again I want to thank everyone, and the Subcommittee is now adjourned.

[Whereupon, at 5:15 p.m., the Subcommittee was adjourned.]

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