

**AN ANALYSIS OF THE OBAMA
ADMINISTRATION'S SOCIAL COST
OF CARBON**

OVERSIGHT HEARING

BEFORE THE

COMMITTEE ON NATURAL RESOURCES
U.S. HOUSE OF REPRESENTATIVES

ONE HUNDRED FOURTEENTH CONGRESS

FIRST SESSION

Wednesday, July 22, 2015

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OVERSIGHT HEARING ON AN ANALYSIS OF THE OBAMA ADMINISTRATION'S SOCIAL COST OF CARBON

Wednesday, July 22, 2015
U.S. House of Representatives
Committee on Natural Resources
Washington, DC

The committee met, pursuant to notice, at 10:09 a.m., in room 1324, Longworth House Office Building, Hon. Rob Bishop, [Chairman of the Committee] presiding.

Present: Representatives Bishop, Gohmert, Fleming, McClintock, Lummis, Benishek, Duncan, Gosar, Labrador, Cook, Westerman, Newhouse, Zinke, Hice, Hardy; Sablan, Lowenthal, Cartwright, Beyer, Torres, Gallego, Capps, and Polis.

The CHAIRMAN. The committee will come to order.

The committee is meeting today to hear the testimony on an analysis of the Obama administration's social cost of carbon.

Under Committee Rule 4(f), oral opening statements at the hearing are limited to the Chairman and the Ranking Minority Member, the Vice Chair or designee of the Ranking Member. This will also allow us to hear from our witnesses sooner and help Members keep their schedules.

Therefore, I am going to ask unanimous consent that all other Members' opening statements be made part of the hearing record if they are submitted to the Clerk by 5:00 p.m. today.

Hearing no objection, so ordered.

I am now going to recognize myself for an opening statement, if I could.

STATEMENT OF THE HON. ROB BISHOP, A REPRESENTATIVE IN CONGRESS FROM THE STATE OF UTAH

The CHAIRMAN. This is the second of a series of oversight hearings on policies that involve the National Environmental Policy Act, an act which is actually older than some of the Members that are up here. I wish I could say it is older than me, but I was not able to legally vote when it was actually passed, and it has not been changed since that time.

Today's hearing is going to focus on the requirement of CEQ's Draft Greenhouse Gas Emissions Guidance that the social cost of carbon be considered in all NEPA environmental reviews.

Three weeks ago, we invited OMB to testify, and I was hoping to ask them directly about this guidance and their participation in it, but OMB said they could not make it again. Since OMB is usually the one that stops most of the testimony from getting to us on time, perhaps they did not have enough time to clear their own testimony with themselves.

An informal Interagency Working Group led by OMB and the Council of Economic Advisors, with a host of other Federal

agencies, has developed specific numbers for the social cost of carbon using a dollar per metric ton basis. Got to love it.

According to a GAO report though, these closed-door meetings were fairly collegial, and bureaucratic participants were allowed to contribute their input on the final product, but guess who was missing: the public—people, people who know, people who are impacted. They were totally shut out of the process so far.

The Federal working group did produce a specific dollar amount for the cost of carbon using three different models, all of which require arbitrary assumptions about discount rates, socioeconomic predictions, and measuring changes in temperature; and to be doubly safe, the Interagency Working Group even projected the cost of carbon out to the year 2300.

According to Dr. Christy's testimony at our last NEPA hearing, scientists cannot replicate what we know has already happened with temperature, and scientists cannot predict what will happen in the future with the current modeling systems. Meteorologists cannot even predict next week's weather pattern, and yet for the social cost of carbon, this Administration chose to rely on models to predict a whole host of factors beyond temperature out to the year 2300.

Oh, wait, wait. Maybe not necessarily, because even in their own technical support documents, citing a National Academies of Science report, they acknowledge, and I want to quote from their own document, "any assessment will suffer from uncertainty, speculation, and lack of information about: (1) future emissions of greenhouse gas; (2) the effects of past and future emissions on the climate system; (3) the impact of changes in climate on the physical and biological environment; and (4) the translation of these environmental impacts into economic damages."

"As a result," the report concludes, "any effort to quantify and monetize the harms associated with climate change will raise serious questions of science, economics, and ethics and should be viewed as" provincial—"provisional."

Provisional, but it is also provincial, too, but provisional.

It is fair to say that the whole concept of the social cost of carbon is highly speculative. The Interagency Working Group's own documents say it raises serious questions of science, economics, and ethics. Yet the Administration decides to move forward to a plan to ensure that it is used in every NEPA action and it does not matter that it does not work and they cannot prove it.

And the fun part is, guess how the public finally found out about this broad-sweeping, all-encompassing assessment of the cost of carbon on society? We found out about it in interim estimates in Department of Energy regulations for vending machines, we found out about the final estimates in the DOE rule for small electric motors, and we found out about the updated estimates in—wait for it—a DOE rule for microwave ovens.

Now, I don't have anything against vending machines or microwave ovens, but this is not the appropriate way that the most transparent administration in history should go about hatching a plan that assesses the cost of carbon for the next three centuries.

What the Interagency Working Group did not do is develop a formula for the social benefits of carbon. No one can argue that we

are not better off than our ancestors were 300 years ago, and can anyone really argue with a straight face what might happen to the world in the next 300 years?

In summary, we have a social cost of carbon developed behind closed doors, with arbitrary inputs into speculative models over a 300-year time span, the output of which is to be used by a CEQ draft guidance document that is admittedly legally unenforceable without the legal authority to do it in the first place.

One of our witnesses gave us some testimony last night. I would like to quote one line from it. It says, "At last, today's hearing on SCC might simply be a sideshow aimed at undermining climate action." Not only is that sentence insulting, it is totally inaccurate.

If there is a sideshow, it is this Administration, who rejects reality to enforce some kind of dogma, and what we need are policies from the Federal Government that actually empower people and address real-life problems and face our Nation's realities and not simply based on fantasy work.

I expect to hear that from our witnesses today as we move forward.

[The prepared statement of Chairman Bishop follows:]

PREPARED STATEMENT OF THE HON. ROB BISHOP, CHAIRMAN, COMMITTEE ON
NATURAL RESOURCES

This is the second in a series of oversight hearings on policies involving the 45-year-old National Environmental Policy Act. Today's hearing will focus on a requirement in CEQ's Draft Greenhouse Gas Emissions Guidance that the social cost of carbon be considered in all NEPA environmental reviews. Over 3 weeks ago, we invited OMB to testify and I was hoping to ask them directly about this guidance, but OMB said they couldn't make it. Perhaps they didn't have time to clear testimony with OMB.

An informal Interagency Working Group led by OMB and the Council on Economic Advisors, with a host of other Federal agencies, developed specific numbers for the social cost of carbon using a dollars per metric ton basis. According to a GAO report, these closed-door meetings were fairly collegial, and bureaucrat participants were allowed to contribute their input on the final product. Guess who was missing? The public.

The Federal working group did produce a specific dollar amount for the cost of carbon, using three different models, all of which require arbitrary assumptions about discount rates, socioeconomic predictions, and measuring changes in temperature from a doubling of carbon dioxide concentrations in the atmosphere. To be doubly safe, the Interagency Working Group even projected the cost of carbon out to the year 2300.

According to Dr. Christy's testimony at our last NEPA hearing, scientists cannot replicate what we know already happened with temperatures. Scientists cannot predict what will happen in the future with current modeling. Meteorologists barely can predict *next week's weather*. And yet, for the social cost of carbon, this Administration chose to rely on models to predict a whole host of factors beyond temperature out to the year 2300? Oh, wait. Maybe not. Even they, in their own Technical Support Document, citing a National Academies of Science report, acknowledge:

"any assessment will suffer from uncertainty, speculation, and lack of information about (1) future emissions of greenhouse gases, (2) the effects of past and future emissions on the climate system, (3) the impact of changes in climate on the physical and biological environment, and (4) the translation of these environmental impacts into economic damages. As a result, any effort to quantify and monetize the harms associated with climate change will raise serious questions of science, economics, and ethics and should be viewed as provisional."

It's fair to say that the whole concept of Social Cost of Carbon is highly speculative. The Interagency Working Group's own document says it raises serious

questions of science, economics, and ethics. And yet, the Obama administration moved forward with its plan to ensure it's used *in every NEPA action*.

Guess how the public found out about such a broad-sweeping, all-encompassing assessment of the cost of carbon on society? We found out about the interim estimates in a *DOE regulation for vending machines*. We found out about the final estimates in a *DOE rule for small electric motors*. We found out about the updated estimates—wait for it—in a *DOE rule for microwave ovens*. I don't have anything against vending machines, small electric motors, or microwaves, but that is not the appropriate way the most transparent administration in history should go about hatching a plan to assess the cost of carbon for the next three centuries.

What the Interagency Working Group did *not* do was develop a formula for the social benefits of carbon. No one can really argue we are not better off than our ancestors were 300 years ago. Can anybody really argue with a straight face what might happen in the world in another 300 years?

In summary, we have a social cost of carbon, developed behind closed doors with arbitrary inputs into speculative models over a 300-year time span, the output of which is to be used in a CEQ draft guidance document that is admittedly legally unenforceable.

We need policies from the Federal Government that empower people and address the real-life problems our Nation faces, not policies based on fantasy.

I look forward to hearing our witnesses' views on the social cost of carbon—hopefully they will be more realistic.

The CHAIRMAN. I recognize Mr. Lowenthal, who is sitting in for the Ranking Member, to give a statement for the Minority.

STATEMENT OF THE HON. ALAN S. LOWENTHAL, A REPRESENTATIVE IN CONGRESS FROM THE STATE OF CALIFORNIA

Dr. LOWENTHAL. All right. Thank you, Mr. Chairman, and thank you, witnesses, for being here.

For years, the world's top economists have been saying that in not accounting for climate change, we have created a market failure. Let's be clear: a market failure. The market currently fails to account for the costs associated with greenhouse gas emissions and climate change.

Polluting industries are pumping out greenhouse gases free of charge, but others, such as taxpayers, property owners, and also healthcare systems, are and will be paying for the resulting damage to property and human health, to name just two impacted sectors.

To help correct for this market failure, the social cost of carbon, or what I will call SCC, puts the effects of these greenhouse gas emissions into a monetary context so that the agencies and taxpayers can understand the impacts of their actions on infrastructure, on health, and food security.

The SCC, or the social cost of carbon, is derived by estimating the cost of the damage to society of emitting a single metric ton of carbon dioxide. But because most of the damages attributed to the marginal ton occur not in the year that they are emitted, but many years into the future, we must find a way to consider not only this generation's welfare, but the welfare of future generations who are going to be paying for the actions we take, and are also going to be paying if we fail to take actions today.

For this reason, and to use a single dollar figure to compare different regulatory alternatives with different emission time profiles, the scientific literature supports developing discount rates that

consider the long term and intergenerational impacts of climate change.

In other words, with each ton of carbon emitted, we are deciding now between the well-being of current and the well-being of future generations, and the social cost of carbon provides us with the tool to make more informed decisions on one of the greatest ethical questions of our time.

The value derived from calculating the social cost of carbon is then incorporated into an agency's broader cost-benefit analysis, which includes many other costs and many of the other benefits of a given rulemaking.

Republican and Democratic presidents alike have required cost-benefit analyses to be performed on proposed regulations, and as new, modern methods have developed, successive administrations have updated their guidance to agencies on how to perform these analyses. In fact, the Majority has repeatedly supported legislation that would add cost-benefit requirements to agencies' rulemaking.

However, it appears now that we are dealing with climate change cost, the Majority may be having a change of heart. Instead of having a reasonable debate on the proper costs to assign climate change damages, the Majority appears to be attacking the entire premise of the existence of climate change damages.

I say that because, unfortunately, the Majority's witnesses here today appear not to support much of any action on climate change. One witness works for a lobby shop that represents the oil and gas industry; the other two Majority witnesses have ties to the climate change counter-movement, or CCCM, also known as the Climate Denier Campaign. Indeed, one witness has said in the past that he does not even believe we have a climate change problem.

To make matters more difficult, the Majority did not provide the White House enough time to secure someone who could actually talk to the committee about the SCC and the interagency process to develop it, how it was developed.

So it appears that we cannot have a credible discussion about social cost of carbon, which we were told was the focus of this hearing. This is too bad, because I know there are in this room Republican members of this committee who do want to do something about climate change, but sadly this hearing does not appear to be a productive step forward.

Thank you, and I yield back.

[The prepared statement of Dr. Lowenthal follows:]

PREPARED STATEMENT OF THE HON. ALAN S. LOWENTHAL, A REPRESENTATIVE IN
CONGRESS FROM THE STATE OF CALIFORNIA

Thank you Mr. Chairman, and thank you to our witnesses for being here today.

For years, the world's top economists have been saying that in not accounting for climate change, we have created a *market failure*. The market currently fails to account for the costs associated with greenhouse gas emissions and climate change. Polluting industries are pumping out greenhouse gases free-of-charge, but others—such as taxpayers, property owners, and our healthcare system—are, and will be, paying for the resulting damages to property and human health, to name just two impacted sectors.

To help correct this market failure, the social cost of carbon (SCC) puts the effects of those greenhouse gas emissions *into a monetary context* so that agencies and taxpayers can understand the impacts of their actions on infrastructure, health, and food security.

The SCC is derived by estimating the costs of the damages to society of emitting a single metric ton of carbon dioxide. But because most of the damages attributed to that marginal ton occur not in the year emitted, but many years into the future, we must find a way to consider not only this generation's welfare, but the welfare of future generations who will be paying for the actions we take—or fail to take—today.

For this reason, and to use a single dollar figure to compare different regulatory alternatives with different emissions time-profiles, the scientific literature supports developing discount rates that consider the long-term and intergenerational impacts of climate change.

In other words, with each ton of carbon emitted, we are deciding now between the well-being of current and future generations, and the social cost of carbon provides us with a tool to make more informed decisions on one of the greatest ethical questions of our time.

The value derived from calculating the social cost of carbon is then incorporated into an agency's broader cost-benefit analysis, which includes many other costs and benefits of a given rulemaking.

Republican and Democratic presidents alike have required cost-benefit analysis to be performed on proposed regulations. And as new modern methods have developed, successive administrations have updated their guidance to agencies on how to perform those analyses.

In fact, the Majority has repeatedly supported legislation that would add cost-benefit analysis requirements to agency rulemakings. However, it appears that now, when we are dealing with climate change costs, the Majority may be having a change of heart, and instead of having a reasonable debate on the proper costs to assign climate change damages, the Majority appears to be attacking the entire premise of the existence of climate change damages.

I say that because, unfortunately, the Majority's witnesses here today appear not to support much of any action on climate change. One witness works for a lobby shop that represents the oil and gas industry, and the other two Majority witnesses have ties to the climate change counter-movement, also known as the "climate denier campaign." Indeed, one witness has said in the past that he doesn't even believe we have a climate change problem.

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So it appears that we can't have a credible discussion about the social cost of carbon, which we were told was the focus of this hearing. And that is too bad, because I know there *are* Republican members of this committee who *do* want to do something about climate change, but sadly, this hearing doesn't appear to be a productive step forward.

The CHAIRMAN. I now recognize the Vice Chair, Mrs. Lummis for her statement.

STATEMENT OF THE HON. CYNTHIA M. LUMMIS, A REPRESENTATIVE IN CONGRESS FROM THE STATE OF WYOMING

Mrs. LUMMIS. Thank you, Mr. Chairman.

The social cost of carbon estimates that will come out of this Administration's attempt to monetize costs and benefits of carbon emissions are going to be incorporated into project analyses under NEPA.

As this committee explored in a hearing in May, this global warming analysis will be applied to projects in nearly every sector of our economy, including agriculture, energy, infrastructure, and manufacturing, just to name a few. Projects and permits may hinge on what the Administration deems to be their global warming cost or benefit.

The cost-benefit analysis of proposed regulations will be impacted to the tune of billions of dollars under the social cost of carbon. Yet Administration officials concocted the social cost of carbon in a

process lacking transparency, lacking peer review, and, most offensively, lacking public input.

Today we will shine some light on the questionable assumptions that underlie the social cost of carbon, which seeks to predict projects' global warming costs 285 years into the future. In pursuing this brazen endeavor, the Administration has handpicked the science and even the Federal scientific guidance it chooses.

The social cost of carbon risks American jobs and our Nation's prosperity all in the name of questionable statistical models. The Federal decisionmaking process should be held to a higher standard of integrity. The American people, who will ultimately bear the cost of this policy, deserve better from their government.

Thank you, Mr. Chairman.

[The prepared statement of Mrs. Lummis follows:]

PREPARED STATEMENT OF THE HON. CYNTHIA M. LUMMIS, A REPRESENTATIVE IN
CONGRESS FROM THE STATE OF WYOMING

Thank you Mr. Chairman.

The social cost of carbon is this Administration's attempt to monetize the costs and benefits of carbon emissions. These estimates will be incorporated into project analysis under the National Environmental Policy Act.

As this committee explored in a May hearing, this global warming analysis will be applied to projects in nearly every sector of our economy, including energy, agriculture, infrastructure, and manufacturing, just to name a few. Projects and permits may hinge on what the Administration deems to be their global warming cost or benefit.

The cost-benefit analysis of proposed regulations will be impacted to the tune of billions under the social cost of carbon. Yet the Administration concocted the social cost of carbon in a process lacking transparency, peer review, and public input.

Today we will shine some light on the questionable assumptions that underlie the social cost of carbon, which seeks to predict projects' global warming costs 285 years into the future. In pursuing this brazen endeavor, the Administration has hand-picked the science and even the Federal scientific guidance it chooses to follow or not follow.

The social cost of carbon risks American jobs and our Nation's prosperity, all in the name of questionable statistical models. The Federal decisionmaking process should be held to a higher standard of integrity. The American people, who will ultimately bear the cost of this policy, deserve better from their government.

Thank you Mr. Chairman. I yield back.

The CHAIRMAN. Thank you.

Mr. Sablan, I understand you are also speaking for the Minority side.

**STATEMENT OF THE HON. GREGORIO KILILI CAMACHO
SABLAN, A DELEGATE IN CONGRESS FROM THE TERRITORY
OF THE NORTHERN MARIANA ISLANDS**

Mr. SABLAN. Thank you very much, Mr. Chairman, and I would like to welcome today's panel to this hearing.

Flooding is one of the main threats that climate change poses to coastal states, including the Northern Mariana Islands, the district I represent. Flooding could threaten our freshwater lens that protects the drinking water on our islands. Flooding, which affects subsistence farming, has impacted taro patches because taro cannot be planted in saltwater. The archipelago's coral reefs, wetlands, and shoreline vegetation help protect our coast. Flooding and ocean acidification puts them all at risk.

Tourism is a major part of our economy. People come from all over the world to bask on our shores and see our coral reefs. Garapan is one of the most popular tourism areas. It is also one of, if not the most low-lying and vulnerable area on the island of Saipan. American Memorial Park on Saipan is at risk of increasing sea level rise.

If flooding and ocean acidification undermine such a prominent part of our economy, we do not have many other economic options in our small islands. Climate change is very real to my constituents and my son and me, and it is happening now.

And to those who deny the science of climate change, including those in today's panel, then please come join me and I will bring you to a place that has the physical evidence of rising seas.

The traditional cost-benefit analysis that accompanies many Federal rules necessarily leaves out some of the most important factors. The cost of property damage from floods, for example, is left out. The enormous economic impact of loss of agricultural productivity is also left out. The loss of our wetlands, our coral, and our beaches, which are so central to our economy and our livelihoods, are left out.

The social cost of carbon tries to correct that. It incorporates many of the very real costs that we, all levels of government, and other communities are already paying to deal with the effects of climate change.

In the case of climate change, so many of these things that are historically omitted from a cost-benefit analysis are the things that affect those at the margins first and worst. When agricultural productivity goes down and food prices go up, low-income communities are hit the hardest. When jobs are lost from tourism, the lowest income folks often have the fewest options. When drinking water becomes more rare and more expensive, those without means suffer the most.

And if these important impacts are omitted from cost-benefit analyses, they do not exist in the eyes of decisionmakers. Bringing these impacts into the process paints a more complete picture for decisionmakers of the impacts of their decisions. It makes these impacts visible, and failing to do so leaves those at the margins behind.

I want to thank Dr. Patrick Michaels for his candor on this subject. In a talk in June on the social cost of carbon at the Heritage Foundation, he said, and I quote, "People adapt to their environment as long as they have enough money to do so."

I don't know whether Dr. Michaels thinks it is acceptable to rely on adaptation as a primary way of dealing with climate change, and in so doing, leave behind the millions that do not have enough money to adapt. I certainly do not.

We need the social cost of carbon to reflect the full range of the true cost of climate change, the costs that are being borne already. Incorporating the social cost of carbon into decisionmaking increases the chances of an effective policy response. It is a small but necessary act of justice. That is true not just for my community, but for communities through the United States.

Mr. Chairman, I yield back the balance of my time.

[The prepared statement of Mr. Sablan follows:]

PREPARED STATEMENT OF THE HON. GREGORIO KILILI CAMACHO SABLAN, A
DELEGATE IN CONGRESS FROM THE TERRITORY OF THE NORTHERN MARIANA ISLANDS

Thank you, Chairman and I would like to welcome today's panel to the hearing.

Flooding is one of the main threats that climate change poses to coastal states including the Northern Mariana Islands, the district I represent. Flooding could threaten our freshwater lens that protects the drinking water on our islands. Flooding, which affects subsistence farming, has impacted taro patches because the taro cannot be planted in saltwater. The archipelago's coral reefs, wetlands and shoreline vegetation help protect our coasts. Flooding and ocean acidification puts them all at risk.

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The traditional cost-benefit analysis that accompanies many Federal rules necessarily leaves out some of the most important factors. The costs of property damage from floods, for example, is left out. The enormous economic impact of loss of agricultural productivity is left out.

The loss of our wetlands, our coral, and our beaches, which are so central to our economy, are left out. The social cost of carbon tries to correct that. It incorporates many of the very real costs that we, all levels of governments, and other communities are already paying to deal with the effects of climate change.

In the case of climate change, so many of these things that are historically omitted from a cost-benefit analysis, are the things that affect those at the margins first and worst. When agricultural productivity goes down and food prices go up, low income communities are hit the hardest. When jobs are lost from tourism, the lowest income folks often have the fewest options. When drinking water becomes more rare and more expensive, those without means suffer the most.

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We need the social cost of carbon to reflect the full range of the true costs of climate change, the costs that are being born already. Incorporating the social cost of carbon into decisionmaking increases the chances of an effective policy response. It is a small but necessary act of justice. That is true not just for my community, but for communities throughout the United States.

I yield back the balance of my time.

The CHAIRMAN. Thank you very much.

We will now hear from our witnesses. Let's introduce the panel.

We have with us Mr. Patrick Michaels, who is the Director of the Center for the Study of Science at The Cato Institute; Kevin Dayaratna—is that close?—Senior Statistician and Research Programmer for the Center for Data Analysis, The Heritage Foundation; Michael Dorsey, who is the Interim Director for the Energy and Environment Program at the Joint Center for Political and Economic Studies; and Scott Segal, who is the founding partner for the Policy Resolution Group.

We will hear from each of you in that order. For those of you who may be new to this process, I am going to try and strictly hold you to the 5-minute rule. Your written testimony is part of the record. This is the oral testimony only. You will see the lights in front of

you. If it is green, you are in great shape. If it is yellow, you only have a minute to finish, and when it is red, I will probably gavel you down. I apologize for that in advance, but we want to get to all of you in here.

The Chair now recognizes Dr. Michaels to testify.

**STATEMENT OF PATRICK J. MICHAELS, Ph.D., DIRECTOR,
CENTER FOR THE STUDY OF SCIENCE, THE CATO
INSTITUTE, WASHINGTON, DC**

Dr. MICHAELS. Mr. Chairman and standing Ranking Member Lowenthal, members of the committee, thank you for inviting my testimony on scientific problems relating to the current calculation of the social cost of carbon, hereafter SCC.

I am Patrick J. Michaels, Director of the Center for the Study of Science of The Cato Institute. Prior to that I was research professor of environmental sciences at the University of Virginia for 30 years.

The Administration's calculation of the SCC is in contravention of a large and growing body of scientific literature demonstrating that the sensitivity of temperature to human emissions of carbon dioxide is less than was previously thought and, more importantly, that the probability of high values is much lower than previously indicated.

Sensitivity is the amount of net warming one gets for doubling atmospheric carbon dioxide. It also roughly approximates the forecast for total surface warming from carbon dioxide by the end of the 21st century.

I would like the next image please.

[Slide.]

The Administration uses a probability distribution developed by Roe and Baker for warming that runs from roughly 1.7 degrees to about 7.1 degrees, basically the length of this chart. Its mean sensitivity is 3 degrees, and again, the 95 percent confidence limits are 1.72 to 7.14.

Beginning in 2011, with the exception of two papers published a decade earlier by myself and MIT's Richard Lindzen, a growing body of scientific literature has yielded 21 new estimates of the sensitivity generated by 46 researchers from 12 countries, and that is what is shown there. The mean sensitivity is 2.0 °C. The 5 to 95 percent confidence limits are 1.1 to 3.5 °C. Those who deny this are denying science.

Our illustration graphically shows the major differences that have evolved between what the Administration uses and the new scientific reality. The higher probabilities in the Roe and Baker determination resulted mainly because of the extremely wide range of estimates for the cooling effects of sulfate aerosols.

Recently these have been dramatically narrowed by researchers Nick Lewis and by Judith Curry of Georgia Tech, resulting in a vanishingly small probability of major warming.

That would be the next image.

[Slide.]

You can see there, the mean warming predicted for doubling CO₂ sensitivity is around 1.3 and the high end tails are very, very vanishingly small.

As my colleague, Kevin Dayaratna will show, the newer, more constrained science results in a dramatic lowering of the SCC. As an example of the dramatic changes that are evolving in science, an important recent paper by Otto, et al., reports a mean sensitivity of 2.0°C with a 5 to 95 percent confidence range of 1.2 to 3.9°C.

This is noteworthy because there are 15 co-authors on this paper who were lead authors of chapters in the latest report of the Intergovernmental Panel on Climate Change. This is truly a consensus statement that the previously published sensitivity was far too large. Those who deny this are denying science.

Here is another major scientific shortcoming in the Administration's calculation of the SCC. Thousands of scientific papers written around the world demonstrate the direct fertilization effect of atmospheric carbon dioxide on agricultural output.

A recent literature review by Dr. Craig Idso shows it results in a 10 to 15 percent increase in the overall yield of major food crops contributing to an increase in global agricultural output of \$3.2 trillion since 1961. Properly including this well-documented information, as will be demonstrated by Dayaratna, can result in a negative social cost of carbon or a net external benefit from the combustion of carbon dioxide.

[Slide.]

In closing, I implore the committee to require the Administration—next image—to back up their calculation of the SCC with real reproducible science. This graphic was shown to this committee on May 13 by Dr. John Christy. I need say nothing more about it. It is a stark representation of the failure of the climate models that form the basis for the Administration's calculation of the social cost of carbon. Those who deny this are denying science.

I thank you for inviting my testimony, and I note that an expanded version has been submitted to the committee as supplemental material.

[The prepared statement of Dr. Michaels follows:]

PREPARED STATEMENT OF PATRICK J. MICHAELS, DIRECTOR, CENTER FOR THE STUDY OF SCIENCE, CATO INSTITUTE, WASHINGTON, DC

I am Patrick J. Michaels, Director of the Center for the Study of Science at the Cato Institute, a nonprofit, nonpartisan public policy research institute located here in Washington, DC, and Cato is my sole source of employment income. Before I begin my testimony, I would like to make clear that my comments are solely my own and do not represent any official position of the Cato Institute.

My testimony concerns the selective science that underlies the Obama administration's determination of the social cost of carbon (SCC) and how a more inclusive and considered process would have resulted in a lower value for the social cost of carbon.

Earlier this month, the Administration's Interagency Working Group on the Social Cost of Carbon (IWG) released a report that was a response to public comments of the IWG determination of the social cost of carbon that were solicited by the Office of Management and Budget in November 2013. Of the 140 unique set of comments received (including a set of my own from which this testimony in drawn), the IWG adopted none.

Here, I address why this decision was based on a set of flimsy, internally inconsistent excuses and amounts to a continuation of the IWG's exclusion of the most relevant science—an exclusion which assures that low, or even negative values of the social cost of carbon (which would imply a net benefit of increased atmospheric carbon dioxide levels), do not find their way into cost/benefit analyses of proposed Federal actions. If, in fact, the social cost of carbon were near zero, it would eliminate the justification for any Federal action (greenhouse gas emissions regulations,

ethanol mandates, miles per gallon standards, solar/wind subsidies, DoE efficiency regulations, etc.) geared toward reducing carbon dioxide emissions.

EQUILIBRIUM CLIMATE SENSITIVITY

In May 2013, the Interagency Working Group produced an updated SCC value by incorporating revisions to the underlying three Integrated Assessment Models (IAMs) used by the IWG in its initial 2010 SCC determination. But, at that time, the IWG did *not* update the equilibrium climate sensitivity (ECS) employed in the IAMs. This was not done, despite there having been, since January 1, 2011, at least 14 new studies and 20 experiments (involving more than 45 researchers) examining the ECS, each lowering the best estimate and tightening the error distribution about that estimate. Instead, the IWG wrote in its 2013 report: “It does not revisit other interagency modeling decisions (e.g., with regard to the discount rate, reference case socioeconomic and emission scenarios, or equilibrium climate sensitivity).”

This decision was reaffirmed by the IWG in July 2015. But, through its reaffirmation, the IWG has again refused to give credence to and recognize the importance of what is now becoming mainstream science—that the most likely value of the equilibrium climate sensitivity is lower than that used by the IWG and that the estimate is much better constrained. This situation has profound implications for the determination of the SCC and yet continues to be summarily dismissed by the IWG.

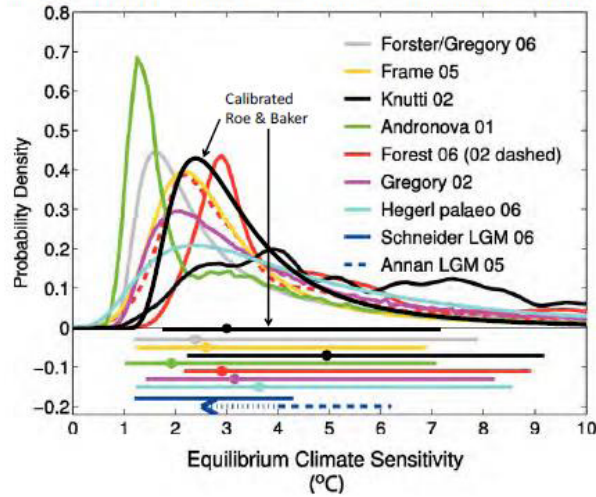
The earth’s equilibrium climate sensitivity is defined by the IWG in its 2010 report (hereafter, IWG2010) as “the long-term increase in the annual global-average surface temperature from a doubling of atmospheric CO₂ concentration relative to pre-industrial levels (or stabilization at a concentration of approximately 550 parts per million (ppm))” and is recognized as “a key input parameter” for the integrated assessment models used to determine the social cost of carbon.

The IWG2010 report has an entire section (Section III.D) dedicated to describing how an estimate of the equilibrium climate sensitivity and the scientific uncertainties surrounding its actual value are developed and incorporated in the IWG’s analysis. The IWG2010, in fact, developed its own probability density function (pdf) for the ECS and used it in each of the three IAMs, superseding the ECS pdfs used by the original IAMs developers. The IWG’s intent was to develop an ECS pdf which most closely matched the description of the ECS as given in the *Fourth Assessment Report* of the United Nation’s Intergovernmental panel on Climate Change which was published in 2007.

The functional form adopted by the IWG2010 was a calibrated version of Roe and Baker (2007) distribution. It was described in the IWG2010 report in the following Table and Figure (from the IWG2010 report):

Table 1: Summary Statistics for Four Calibrated Climate Sensitivity Distributions

	Roe & Baker	Log-normal	Gamma	Weibull
Pr(ECS < 1.5°C)	0.013	0.050	0.070	0.102
Pr(2°C < ECS < 4.5°C)	0.667	0.667	0.667	0.667
5 th percentile	1.72	1.49	1.37	1.13
10 th percentile	1.91	1.74	1.65	1.48
Mode	2.34	2.52	2.65	2.90
Median (50 th percentile)	3.00	3.00	3.00	3.00
Mean	3.50	3.28	3.19	3.07
90 th percentile	5.86	5.14	4.93	4.69
95 th percentile	7.14	5.97	5.59	5.17

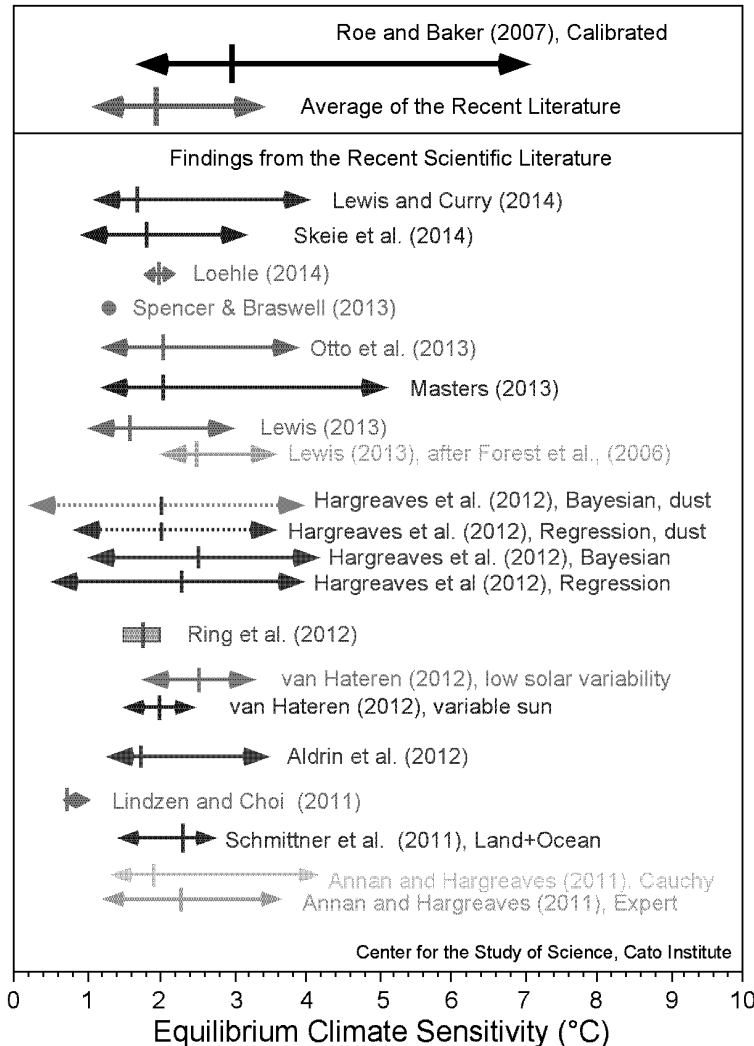
Figure 2: Estimates of the Probability Density Function for Equilibrium Climate Sensitivity ($^{\circ}\text{C}$)

The calibrated Roe and Baker functional form used by the IWG2010 is *no longer scientifically defensible*; nor was it at the time of the publication of the IWG 2013 SCC update, nor at the time of the July 2015 update.

The figure below vividly illustrates this fact, as it compares the best estimate and 90 percent confidence range of the earth's ECS as used by the IWG (calibrated Roe and Baker) against findings in the scientific literature published since January 1, 2011.

Whereas the IWG ECS distribution has a median value of 3.0°C and 5th and 95th percentile values of 1.72°C and 7.14°C , respectively, the corresponding values averaged from the recent scientific literature are 2.0°C (median), 1.1°C (5th percentile), and 3.5°C (95th percentile).

These differences will have large and significant impacts on the SCC determination.



CAPTION: The median (indicated by the small vertical line) and 90 percent confidence range (indicated by the horizontal line with arrowheads) of the climate sensitivity estimate used by the Interagency Working Group on the Social Cost of Carbon Climate (Roe and Baker, 2007) is indicated by the top black arrowed line. The average of the similar values from 20 different determinations reported in the recent scientific literature is given by the grey arrowed line (second line from the top). The sensitivity estimates from the 20 individual determinations of the ECS as reported in new research published after January 1, 2011 are indicated by the colored arrowed lines. The arrows indicate the 5 to 95 percent confidence bounds for each estimate along with the best estimate (median of each probability density function; or the mean of multiple estimates; colored vertical line). Ring et al. (2012) present four estimates of the climate sensitivity and the red box encompasses those estimates. Spencer and Braswell (2013) produce a single ECS value best-matched to ocean heat content observations and internal radiative forcing.

The IWG2010 report noted that, concerning the low end of the ECS distribution, its determination reflected a greater degree of certainty that a low ECS value could be excluded than did the IPCC. From the IWG2010 (p. 14):

“Finally, we note the IPCC judgment that the equilibrium climate sensitivity “is very likely larger than 1.5 °C.” Although the calibrated Roe & Baker distribution, for which the probability of equilibrium climate sensitivity being greater than 1.5 °C is almost 99 percent, is not inconsistent with the IPCC definition of “very likely” as “greater than 90 percent probability,” it reflects a greater degree of certainty about very low values of ECS than was expressed by the IPCC.”

In other words, the IWG used its judgment that the lower bound of the ECS distribution was higher than the IPCC 2007 assessment indicated. However, the collection of the recent literature on the ECS shows the IWG’s judgment to be in error. As can be seen in the chart above, the large majority of the findings on ECS in the recent literature indicate that the lower bound (i.e., 5th percentile) of the ECS distribution is lower than the IPCC 2007 assessment. And, the average value of the 5th percentile in the recent literature (1.1 °C) is 0.62 °C less than that used by the IWG—a sizable and important difference which will influence the SCC determination.

In fact, the abundance of literature supporting a lower climate sensitivity was at least partially reflected in the new IPCC assessment report issued in 2013. In that report, the IPCC reported:

Equilibrium climate sensitivity is *likely* in the range 1.5 °C to 4.5 °C (*high confidence*), *extremely unlikely* less than 1 °C (*high confidence*), and *very unlikely* greater than 6 °C (*medium confidence*). The lower temperature limit of the assessed *likely* range is thus less than the 2 °C in the AR4 . . .

Clearly, the IWG’s assessment of the low end of the probability density function that best describes the current level of scientific understanding of the climate sensitivity is incorrect and indefensible.

But even more influential in the SCC determination is the upper bound (i.e., 95th percentile) of the ECS probability distribution.

The IWG2010 notes (p. 14) that the calibrated Roe and Baker distribution better reflects the IPCC judgment that “values substantially higher than 4.5 °C still cannot be excluded.” The IWG2010 further notes that:

“Although the IPCC made no quantitative judgment, the 95th percentile of the calibrated Roe & Baker distribution (7.1 °C) is much closer to the mean and the median (7.2 °C) of the 95th percentiles of 21 previous studies summarized by Newbold and Daigneault (2009). It is also closer to the mean (7.5 °C) and median (7.9 °C) of the nine truncated distributions examined by the IPCC (Hegerl, et al., 2006) than are the 95th percentiles of the three other calibrated distributions (5.2–6.0 °C).”

In other words, the IWG2010 turned toward surveys of the scientific literature to determine its assessment of an appropriate value for the 95th percentile of the ECS distribution. Now, more than 5 years hence, the scientific literature tells a completely different story.

Instead of a 95th percentile value of 7.14 °C, as used by the IWG2010, a survey of the recent scientific literature suggests a value of 3.5 °C—more than 50 percent lower.

And this is very significant and important difference because the high end of the ECS distribution has a large impact on the SCC determination—a fact frequently commented on by the IWG2010.

For example, from IWG2010 (p. 26):

“As previously discussed, low probability, high impact events are incorporated into the SCC values through explicit consideration of their effects in two of the three models as well as the use of a probability density function for equilibrium climate sensitivity. Treating climate sensitivity probabilistically results in more high temperature outcomes, which in turn lead to higher projections of damages. Although FUND does not include catastrophic damages (in contrast to the other two models), its probabilistic treatment of the equilibrium climate sensitivity parameter will directly affect the non-catastrophic damages that are a function of the rate of temperature change.”

And further (p. 30):

Uncertainty in extrapolation of damages to high temperatures: The damage functions in these IAMs are typically calibrated by estimating damages at moderate temperature increases (e.g., DICE was calibrated at 2.5 °C) and extrapolated to far higher temperatures by assuming that damages increase as some power of the temperature change. Hence, estimated damages are far more uncertain under more extreme climate change scenarios.

And the entirety of Section V [sic] “A Further Discussion of Catastrophic Impacts and Damage Functions” of the IWG 2010 report describes “tipping points” and “damage functions” that are probabilities assigned to different values of global temperature change. Table 6 from the IWG2010 indicated the probabilities of various tipping points.

Table 6: Probabilities of Various Tipping Points from Expert Elicitation -

Possible Tipping Points	Duration before effect is fully realized (in years)	Additional Warming by 2100		
		0.5-1.5 C	1.5-3.0 C	3-5 C
Reorganization of Atlantic Meridional Overturning Circulation	about 100	0-18%	6-39%	18-67%
Greenland Ice Sheet collapse	at least 300	8-39%	33-73%	67-96%
West Antarctic Ice Sheet collapse	at least 300	5-41%	10-63%	33-88%
Dieback of Amazon rainforest	about 50	2-46%	14-84%	41-94%
Strengthening of El Niño-Southern Oscillation	about 100	1-13%	6-32%	19-49%
Dieback of boreal forests	about 50	13-43%	20-81%	34-91%
Shift in Indian Summer Monsoon	about 1	Not formally assessed		
Release of methane from melting permafrost	Less than 100	Not formally assessed.		

The likelihood of occurrence of these low probability, high impact, events (“tipping points”) is *greatly* diminished under the new ECS findings. The average 95th percentile value of the new literature survey is only 3.5 °C indicating a very low probability of a warming reaching 3–5 °C by 2100 as indicated in the 3rd column of the above Table and thus a significantly lower probability that such tipping points will be reached. This new information will have a large impact on the final SCC determination using the IWG’s methodology.

The size of this impact has been directly investigated.

In their *Comment on the Landmark Legal Foundation Petition for Reconsideration of Final Rule Standards for Standby Mode and Off Mode Microwave Ovens*, Dayaratna and Kreutzer (2013) ran the DICE model using the distribution of the ECS as described by Otto et al. (2013)—a paper published in the recent scientific literature which includes 17 authors, 15 of which were lead authors of chapters in the recent Intergovernmental Panel on Climate Change’s *Fifth Assessment Report*. The most likely value of the ECS reported by Otto et al. (2013) was described as “2.0 °C, with a 5–95 percent confidence interval of 1.2–3.9 °C.” Using the Otto et al. (2013) ECS distribution in lieu of the distribution employed by the IWG (2013), dropped the SCC by 42 percent, 41 percent, and 35 percent (for the 2.5%, 3.0%, 5.0% discount rates, accordingly). This is a significant decline.

In subsequent research, Dayaratna and Kreutzer (2014) examined the performance of the FUND model, and found that it too, produced a greatly diminished value for the SCC when run with the Otto et al. distribution of the equilibrium climate sensitivity. Using the Otto et al. (2013) ECS distribution in lieu of the distribution employed by the IWG (2013), dropped the SCC produced by the FUND model to \$11, \$6, \$0 compared with the original \$30, \$17, \$2 (for the 2.5%, 3.0%, 5.0% discount rates, accordingly). Again, this is a significant decline.

The Dayaratna and Kreutzer (2014) results using FUND were in line with alternative estimates of the impact of a lower climate sensitivity on the FUND model SCC determination.

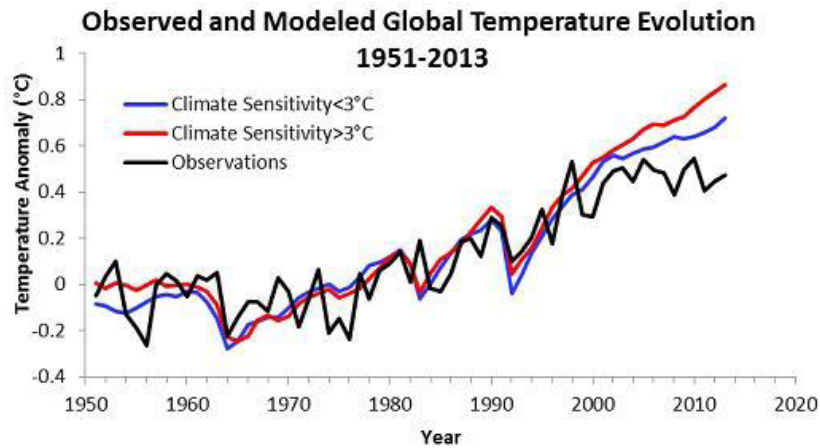
Waldhoff et al. (2011) investigated the sensitivity of the FUND model to changes in the ECS. Waldhoff et al. (2011) found that changing the ECS distribution such

that the mean of the distribution was lowered from 3.0°C to 2.0°C had the effect of lowering the SCC by 60 percent (from a 2010 SCC estimate of \$8/ton of CO₂ to \$3/ton in 1995). While Waldhoff et al. (2011) examined FUNDv3.5, the response of the current version (v3.8) of the FUND model should be similar.

Additionally, the developer of the PAGE (Policy Analysis of Greenhouse Effect) model affirmed that the SCC from the PAGE model, too drops by 35 percent when the Otto et al. (2013) climate sensitivity distribution is employed (Hope, 2013).

These studies make clear that the strong dependence of the social cost of carbon on the distribution of the estimates of the equilibrium climate sensitivity (including the median, and the upper and lower certainty bounds) requires that the periodic updates to the IWG SCC determination must include a critical examination of the scientific literature on the topic of the equilibrium climate sensitivity, not merely kowtowing to the IPCC assessment. There is no indication that the IWG undertook such an independent examination. But what is clear, is that the IWG did *not* alter its probability distribution of the ECS between its 2010, 2013, and 2015 SCC determination, despite a large and growing body of scientific literature that substantially alters and better defines the scientific understanding of the earth's ECS. It is unacceptable that a supposed "updated" social cost of carbon does not include updates to the science underlying a critical and key aspect of the SCC.

We note that there has been one prominent scientific study in the recent literature which has argued, on the basis of recent observations of lower tropospheric mixing in the tropics, for a rather high climate sensitivity (Sherwood et al., 2014). This research, however, suffers from too narrow a focus. While noting that climate models which best match the apparent observed behavior of the vertical mixing characteristics of the tropical troposphere tend to be the models with high climate sensitivity estimates, the authors fail to make note that these same models are the ones whose projections make the *worst* match to observations of the evolution of global temperature during the past several decades. The figure below shows the observed global surface temperature history from 1951–2013 compared with the temperature evolution projected by the collection of models used in the new IPCC 2013 report. We broke the climate models down into two groups—those which have a climate sensitivity greater than 3.0°C (as suggested by Sherwood et al., 2014) and those with a climate sensitivity less than 3.0°C. The Figure shows that while neither model subset does a very good job is capturing evolution of global temperature during the past 15–20 years (the period with the highest human carbon dioxide emissions), the high sensitivity models do substantially worse than the lower sensitivity models.

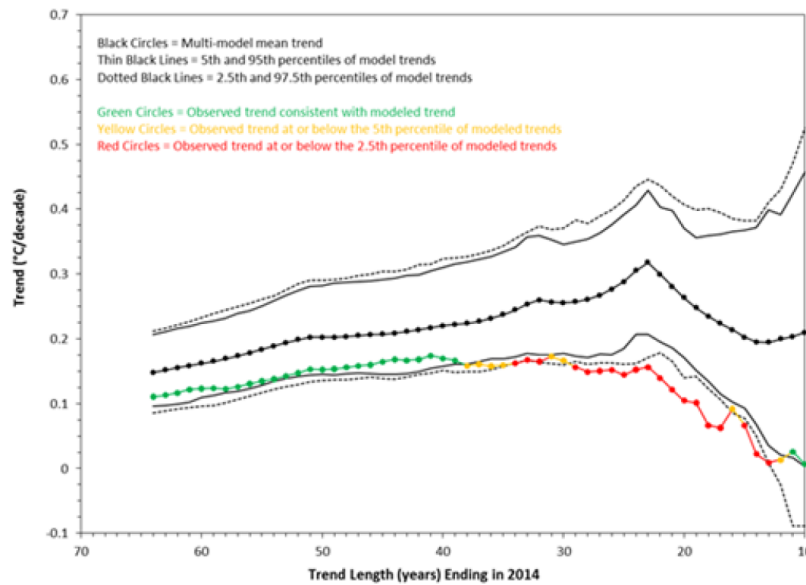


CAPTION: Observed global average temperature evolution, 1951–2013, as compiled by the U.K's Hadley Center (black line), and the average temperature change projected by a collection of climate models used in the IPCC Fifth Assessment Report which have a climate sensitivity greater than 3.0°C (red line) and a collection of models with climate sensitivities less than 3.0°C (blue line).

While Sherwood et al. (2014) prefer models that better match their observations in one variable, the same models actually do worse in the big picture than do models which lack the apparent accuracy in the processes that Sherwood et al. (2014)

describe. The result can only mean that there must still be even bigger problems with *other* model processes which must more than counteract the effects of the processes described by Sherwood et al. After all, the overall model collective is still warming the world much faster than it actually is (see Figures below). In fact, for the observed global average surface temperature evolution for the past 30 years largely lies below the range which encompasses 95 percent of all climate model runs—an indication that the observed trend is statistically different from the trend simulated by climate models. And for periods approaching 40 years in length, the observed surface trend lies outside of (below) the range that includes 90 percent of all climate model simulations—and indication that the observed surface trend is marginally inconsistent with climate model simulations.

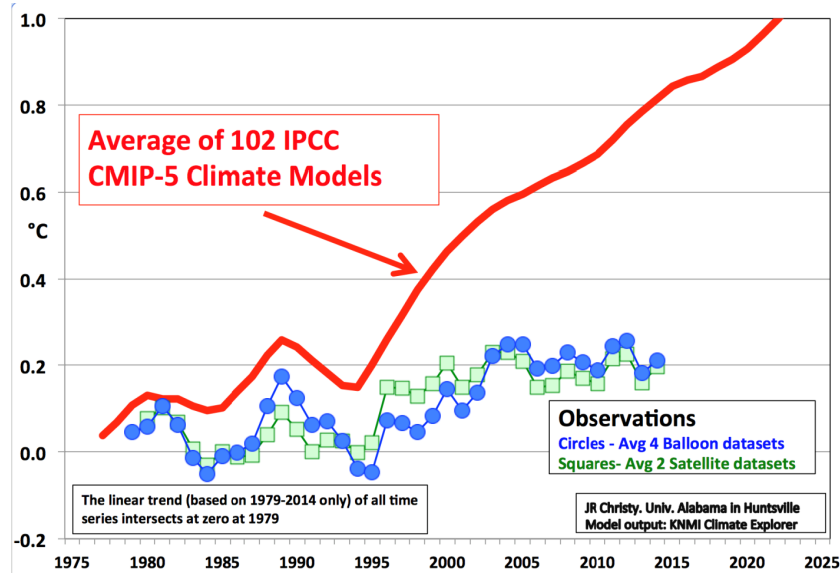
MODELS VS. OBSERVATIONS



CAPTION: The annual average global surface temperature from 108 individual CMIP5 climate model runs forced with historical (+ RCP45 since 2006) forcings were obtained from the Climate Explorer website. Linear trends were computed through the global temperatures from each run, ending in 2014 and beginning each year from 1951 through 2005. The trends for each period (ranging in length from 10 to 64 years) were averaged across all model runs (black dots). The range containing 90 percent (grey lines), and 95 percent (dotted black lines) of trends from the 108 model runs is also indicated. The observed linear trends for the same periods were calculated from the annual average global surface temperature record compiled by the U.K. Hadley Center (HadCRUT4) (colored dots). Observed trend values which were less than the 2.5th percentile of the model trend distribution were colored red, observed trend values which were between the 2.5th and the 5th percentile of the model trend distribution were colored yellow, and observed trend values greater than the 5th percentile of the model trend distribution were colored green. (Source: Michaels and Knappenberger, 2014)

We note that our statistics are based upon both the warm and the cold departures from predicted trends. In reality, the cold departure is what is of most interest from a policy perspective—for if warming is being demonstrably overpredicted, then policies based upon models that are in error are a substantial regulatory over-reach. Our probability estimates are conservative as values at the .05 level are actually at the 2.5th percentile for warmth from the model ensemble.

The divergence between observations and climate model projections is even worse in the earth's low-to-mid atmosphere (Figure below). As shown by Christy (2015), there is a gross departure of "reality" from model predictions. Christy (2015) noted that "On average the models warm the global atmosphere at a rate three times that of the real world."



CAPTION: Five-year running mean temperatures predicted by the UN's climate models, and observed lower atmospheric temperatures from weather balloons and satellites.

These results argue strongly against the reliability of the Sherwood et al. (2014) conclusion and instead provide robust observational evidence that the climate sensitivity has been overestimated by both climate models, and the IWG alike.

AGRICULTURAL IMPACTS OF CARBON FERTILIZATION

Carbon dioxide is known to have a positive impact on vegetation, with literally thousands of studies in the scientific literature demonstrating that plants (including crops) grow stronger, healthier, and more productive under conditions of increased carbon dioxide concentration. A recent study (Idso, 2013) reviewed a large collection of such literature as it applies to the world's 45 most important food crops (making up 95% of the world's annual agricultural production). Idso (2013) summarized his findings on the increase in biomass of each crop that results from a 300 ppm increase in the concentration of carbon dioxide under which the plants were grown. This table is reproduced below, and shows that the typical growth increase exceeds 30 percent in most crops, including 8 of the world's top 10 food crops (the increase was 24% and 14% in the other two).

Idso (2013) found that the increase in the atmospheric concentration of carbon dioxide that took place during the period 1961–2011 was responsible for increasing global agricultural output by 3.2 trillion dollars (in 2004–2006 constant dollars). Projecting the increases forward based on projections of the increase in atmospheric carbon dioxide concentration, Idso (2013) expects carbon dioxide fertilization to increase the value of agricultural output by 9.8 trillion dollars (in 2004–2006 constant dollars) during the 2012–2050 period.

Average percentage increase in biomass of each of the world's 45 most important food crops under an increase of 300 ppm of carbon dioxide.

Crop	% Biomass Change	Crop	% Biomass Change
Sugar cane	34.0%	Rye	38.0%
Wheat	34.9%	Plantains	44.8%
Maize	24.1%	Yams	47.0%
Rice, paddy	36.1%	Groundnuts, with shell	47.0%
Potatoes	31.3%	Rapeseed	46.9%
Sugar beet	65.7%	Cucumbers and gherkins	44.8%
Cassava	13.8%	Mangoes, mangosteens, guavas	36.0%
Barley	35.4%	Sunflower seed	36.5%
Vegetables fresh nes	41.1%	Eggplants (aubergines)	41.0%
Sweet potatoes	33.7%	Beans, dry	61.7%
Soybeans	45.5%	Fruit Fresh Nes	72.3%
Tomatoes	35.9%	Carrots and turnips	77.8%
Grapes	68.2%	Other melons (inc.cantaloupes)	4.7%
Sorghum	19.9%	Chillies and peppers, green	41.1%
Bananas	44.8%	Tangerines, mandarins, clem.	29.5%
Watermelons	41.5%	Lettuce and chicory	18.5%
Oranges	54.9%	Pumpkins, squash and gourds	41.5%
Cabbages and other brassicas	39.3%	Pears	44.8%
Apples	44.8%	Olives	35.2%
Coconuts	44.8%	Pineapples	5.0%
Oats	34.8%	Fruit, tropical fresh nes	72.3%
Onions, dry	20.0%	Peas, dry	29.2%
Millet	44.3%		

This is a large positive externality, and one that is insufficiently modeled in the IAMs relied upon by the IWG in determining the SCC.

In fact, only one of the three IAMs used by the IWG has any substantial impact from carbon dioxide fertilization, and the one that does, underestimates the effect by approximately 2–3 times.

The FUND model has a component which calculates the impact on agricultural as a result of carbon dioxide emissions, which includes not only the impact on temperature and other climate changes, but also the direct impact of carbon dioxide fertilization. The other two IAMs, DICE and PAGE by and large do not (or only do so extremely minimally; DICE includes the effect to a larger degree than PAGE). Consequently, lacking this large and positive externality, the SCC calculated by the DICE and PAGE models is significantly larger than the SCC determined by the FUND model (for example, see Table A5, in the IWG 2013 report).

But even the positive externality that results from carbon dioxide fertilization as included in the FUND model is too small when compared with the Idso (2013) estimates. FUND (v3.7) uses the following formula to determine the degree of crop production increase resulting from atmospheric carbon dioxide increases (taken from Anthoff and Tol, 2013a):

CO₂ fertilisation has a positive, but saturating effect on agriculture, specified by

$$(A.4) \quad A_{t,r}^f = \gamma_r \ln \frac{CO_2_t}{275}$$

where

- A^f denotes damage in agricultural production as a fraction due to the CO₂ fertilisation by time and region;
- t denotes time;
- r denotes region;
- CO_2 denotes the atmospheric concentration of carbon dioxide (in parts per million by volume);
- 275 ppm is the pre-industrial concentration;
- γ is a parameter (see Table A, column 8-9).

Column 8 in the table below shows the CO₂ fertilization parameter (γ_r) used in FUND for various regions of the world (Anthoff and Tol, 2013b). The average CO₂ fertilization effect across the 16 regions of the world is 11.2 percent. While this

number is neither areally weighted, nor weighted by the specific crops grown, it is clear that 11.2 percent is much lower than the average fertilization effect compiled by Idso (2013) for the world's top 10 food crops (35%). Further, Idso's fertilization impact is in response to a 300 ppm CO₂ increase, while the fertilization parameter in the FUND model is multiplied by $\ln(\text{CO}_{2t}/275)$ which works out to 0.74 for a 300 ppm CO₂ increase. This multiplier further reduces the 16 region average to 8.4 percent for the CO₂ fertilization effect—some four times smaller than the magnitude of the fertilization impact identified by Idso (2013).

Although approximately four times too small, the impact of the fertilization effect on the SCC calculation in the FUND model is large.

According to Waldhoff et al. (2011), if the CO₂ fertilization effect is turned off in the FUND model (v3.5) the SCC increases by 75 percent from \$8/tonCO₂ to \$14/tonCO₂ (in 1995 dollars). In another study, Ackerman and Munitz (2012) find the effective increase in the FUND model to be even larger, with CO₂ fertilization producing a positive externality of nearly \$15/tonCO₂ (in 2007 dollars).

Impact of climate change on agriculture in FUND model.

	Rate of change (% Ag. Prod/ 0.04°C)		δ_r^l		δ_r^q		CO ₂ fertilisation (% Ag. Prod)	
USA	-0.021	(0.176)	0.026	(0.021)	-0.012	(0.018)	8.90	(14.84)
CAN	-0.029	(0.073)	0.092	(0.080)	-0.016	(0.009)	4.02	(6.50)
WEU	-0.039	(0.138)	0.022	(0.002)	-0.014	(0.013)	15.41	(11.83)
JPK	-0.033	(0.432)	0.046	(0.022)	-0.024	(0.030)	23.19	(36.60)
ANZ	-0.015	(0.142)	0.040	(0.071)	-0.016	(0.037)	10.48	(8.50)
EEU	-0.027	(0.062)	0.048	(0.097)	-0.018	(0.048)	9.52	(5.14)
FSU	-0.018	(0.066)	0.042	(0.075)	-0.016	(0.039)	6.71	(5.48)
MDE	-0.022	(0.032)	0.042	(0.071)	-0.017	(0.037)	9.43	(2.66)
CAM	-0.034	(0.061)	0.064	(0.043)	-0.030	(0.043)	16.41	(5.38)
SAM	-0.009	(0.060)	0.003	(0.005)	-0.004	(0.003)	5.96	(5.04)
SAS	-0.014	(0.021)	0.025	(0.024)	-0.011	(0.018)	5.80	(1.64)
SEA	-0.009	(0.482)	0.014	(0.004)	-0.010	(0.008)	8.45	(41.81)
CHI	-0.013	(0.075)	0.043	(0.076)	-0.017	(0.040)	19.21	(6.13)
NAF	-0.016	(0.023)	0.033	(0.043)	-0.014	(0.027)	7.27	(1.90)
SSA	-0.011	(0.026)	0.024	(0.034)	-0.010	(0.020)	5.05	(2.20)
SIS	-0.050	(0.103)	0.043	(0.077)	-0.017	(0.040)	23.77	(8.64)

Standard deviations are given in brackets.

Clearly, had the Idso (2013) estimate of the CO₂ fertilization impact been used instead of the one used in FUND the resulting positive externality would have been much larger, and the resulting net SCC been much lower.

This is just for one of the three IAMs used by the IWG. Had the more comprehensive CO₂ fertilization impacts identified by Idso (2013) been incorporated in all the IAMs, the three-model average SCC used by the IWG would be been greatly lowered, and likely even become negative in some IAM/discount rate combinations.

In its 2015 *Response to Comments Social Cost of Carbon for Regulatory Impact Analysis Under Executive Order 12866*, the IWG admits to the disparate ways that CO₂ fertilization is included in the three IAMs. Nevertheless, the IWG quickly dismisses this as a problem in that they claim the IAMs were selected “to reflect a reasonable range of modeling choices and approaches that collectively reflect the current literature on the estimation of damages from CO₂ emissions.”

This logic is blatantly flawed. Two of the IAMs do not reflect the “current literature” on a key aspect relating to the direct impact of CO₂ emissions on agricultural output, and the third only partially so.

[The prepared statement of ??? appears in the appendix.]

CO₂ fertilization is a known physical effect from increased carbon dioxide concentrations. By including the results of IAMs that do not include known processes that have a significant impact on the end product must disqualify them from contributing to the final result. The inclusion of results that are known *a priori* to be wrong can only contribute to producing a less accurate answer. Results should only be included when they attempt to represent known processes, not when they leave those processes out entirely.

The justification from the IWG (2015) that “[h]owever, with high confidence the IPCC (2013) stated in its Fifth Assessment Report (AR5) that ‘[b]ased on many studies covering a wide range of regions and crops, negative impacts of climate change on crop yields have been more common than positive ones’” is completely irrelevant as CO₂ fertilization is an impact that is apart from “climate change.” And further, the IAMs do (explicitly in the case of FUND and DICE or implicitly in the case of PAGE) include damage functions related to the climate change impacts on agriculture. So not only is the IWG justification irrelevant, it is inaccurate as well. The impact of CO₂ fertilization on agricultural output and its impact on lowering the SCC must be considered.

THE MISLEADING DISCONNECT BETWEEN CLIMATE CHANGE AND THE SOCIAL COST OF CARBON IN THE INTEGRATED ASSESSMENT MODELS

It is generally acknowledged, the results from IAMs are highly sensitive not only to the model input parameters but also to how the models have been developed and what processes they try to include. One prominent economist, Robert Pindyck of M.I.T. recently wrote (Pindyck, 2013) that the sensitivity of the IAMs to these factors renders them useless in a policymaking environment:

Given all of the effort that has gone into developing and using IAMs, have they helped us resolve the wide disagreement over the size of the SCC? Is the U.S. Government estimate of \$21 per ton (or the updated estimate of \$33 per ton) a reliable or otherwise useful number? What have these IAMs (and related models) told us? I will argue that the answer is very little. As I discuss below, the models are so deeply flawed as to be close to useless as tools for policy analysis. Worse yet, precision that is simply illusory, and can be highly misleading.

. . . [A]n IAM-based analysis suggests a level of knowledge and precision that is nonexistent, and allows the modeler to obtain almost any desired result because key inputs can be chosen arbitrarily.

Nevertheless, Federal agencies, such as the EPA and DoE incorporate the IWG determinations of the SCC into their cost/benefit analyses of proposed regulations—ill-advisedly so in my opinion.

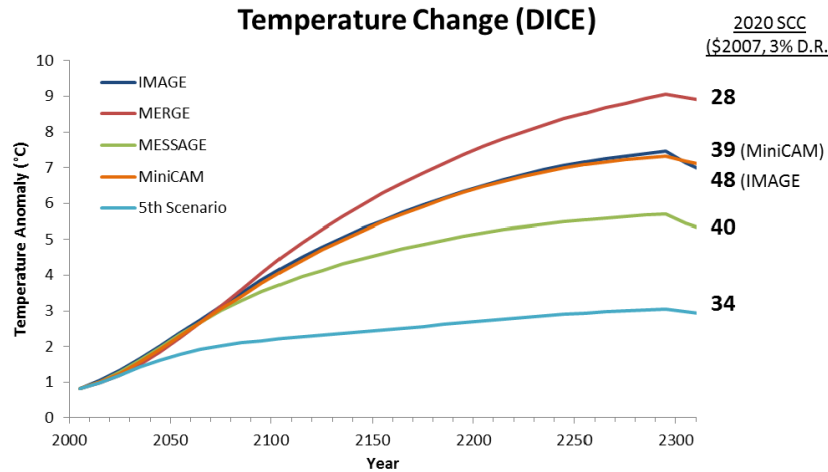
Consider the following: the social cost of carbon should reflect the relative impact on future society that human-induced climate change from greenhouse gas emissions would impose. In this way, we can decide how much (if at all) we are willing to pay currently to reduce the costs to future society. It would seem logical that we would probably be more willing to sacrifice more now if we knew that future society would be impoverished and suffer from extreme climate change than we would be willing to sacrifice if we knew that future society would be very well off and be subject to more moderate climate change. We would expect that the value of the social cost of carbon would reflect the difference between these two hypothetical future worlds—the SCC should be far greater in an impoverished future facing a high degree of climate change than an affluent future with less climate change.

But if you thought this, you would be wrong.

Instead, the IAMs as run by the IWG2013 (and reflected in the July 2015 update) produce nearly the opposite result—the SCC is far *lower* in the less affluent/high climate change future than it is in the more affluent/low climate change future. Such a result is not only counterintuitive but misleading.

I illustrate this illogical and impractical result using the DICE 2010 model (hereafter just DICE) used by the IWG (although the PAGE and the FUND models generally show the same behavior). The DICE model was installed and run at the Heritage Foundation by Kevin Dayaratna and David Kreutzer using the same model set up and emissions scenarios as prescribed by the IWG. The projections of future temperature change (and sea level rise, used later in the Comment) were graciously provided to us by the Heritage Foundation.

The figure below shows the projections of the future change in the earth's average surface temperature for the years 2000–2300 produced by DICE from the five emissions scenarios employed by the IWG. The numerical values on the right-hand side of the illustration are the values for the social cost of carbon associated with the temperature change resulting from each emissions scenario (the SCC is reported for the year 2020 using constant \$2007 and assuming a 3% discount rate—numbers taken directly from Table A3 of the IWG2013 report). The temperature change can be considered a good proxy for the magnitude of the overall climate change impacts.

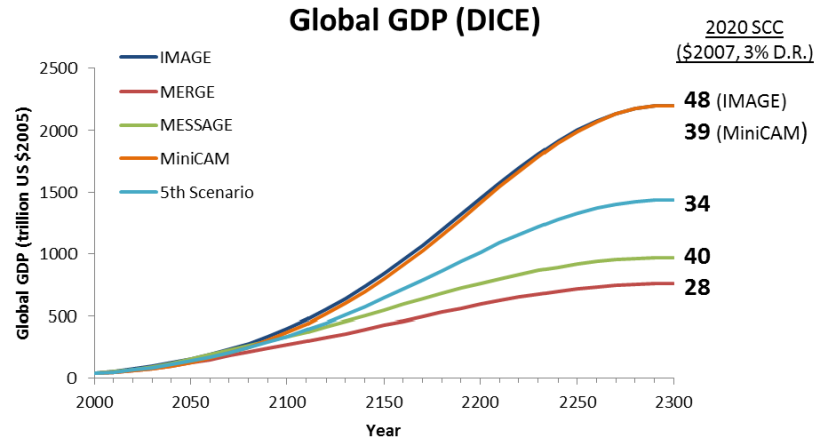


CAPTION: Future temperature changes, for the years 2000–2300, projected by the DICE model for each of the five emissions scenarios used by the IWG2013. The temperature changes are the arithmetic average of the 10,000 Monte Carlo runs from each scenario. The 2020 value of the SCC (in \$2007) produced by the DICE model (assuming a 3% discount rate) is included on the right-hand side of the figure. (DICE data provided by Kevin Dayaratna and David Kreutzer of the Heritage Foundation).

Notice in the figure above that the value for the SCC shows little (if any) correspondence to the magnitude of climate change. The MERGE scenario produces the greatest climate change and yet has the smallest SCC associated with it. The “5th Scenario” is a scenario that attempts to keep the effective concentration of atmospheric carbon dioxide at 550 ppm (far lower than the other scenarios) has a SCC that is more than 20 percent *greater* than the MERGE scenario. The global temperature change by the year 2300 in the MERGE scenario is 9°C while in the “5th Scenario” it is only 3°C. The highest SCC is from the IMAGE scenario—a scenario with a mid-range climate change. All of this makes absolutely no logical sense—and confuses the user.

If the SCC bears little correspondence to the magnitude of future human-caused climate change, than what does it represent?

The figure below provides some insight.



CAPTION: Future global gross domestic product, for the years 2000–2300 for each of the five emissions scenarios used by the IWG2013. The 2020 value of the SCC (in \$2007) produced by the DICE model (assuming a 3% discount rate) is included on the right-hand side of the figure.

When comparing the future GDP to the SCC, we see, generally, that the scenarios with the higher future GDP (most affluent future society) have the higher SCC values, while the futures with lower GDP (less affluent society) have, generally, lower SCC values.

Combining the results from the two figures above thus illustrates the absurdities in the IWG's use of the DICE model. The scenario with the richest future society and a modest amount of climate change (IMAGE) has the highest value of the SCC associated with it, while the scenario with the poorest future society and the greatest degree of climate change (MERGE) has the lowest value of the SCC. A logical, thinking person would assume the opposite.

While we only directly analyzed output data from the DICE model, by comparing Tables 2 and Tables 3 from the IWG2010 report, it can be ascertained that the FUND and the PAGE models behave in a similar fashion.

This counterintuitive result occurs because the damage functions in the IAMs produce output in terms of a percentage decline in the GDP—which is then translated into a dollar amount (which is divided by the total carbon emissions) to produce the SCC. Thus, even a small climate change-induced percentage decline in a high GDP future yields greater dollar damages (i.e., higher SCC) than a much greater climate change-induced GDP percentage decline in a low GDP future.

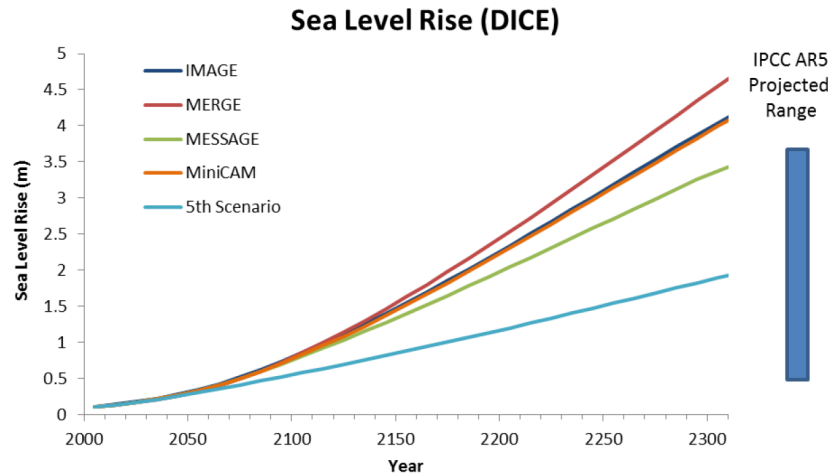
Who in their right mind would want to spend (sacrifice) more today to help our rich decedents deal with a lesser degree of climate change than would want to spend (sacrifice) today to help our relatively less-well-off decedents deal with a greater degree of climate change? No one. Yet that is what the SCC would lead you to believe and that is what the SCC implies when it is incorporated into Federal cost/benefit analyses.

In principle, the way to handle this situation is by allowing the discount rate to change over time. In other words, the richer we think people will be in the future (say the year 2100), the higher the discount rate we should apply to damages (measured in 2100 dollars) they suffer from climate change, in order to decide how much we should be prepared to sacrifice today on their behalf.

Until (if ever) the current situation is properly rectified, the IWG's determination of the SCC is not fit for use in the Federal regulatory process as it is deceitful and misleading.

SEA LEVEL RISE

The sea level rise module in the DICE model used by the IWG2013/2015 produces future sea level rise values that far exceed mainstream projections and are unsupported by the best available science. The sea level rise projections from more than half of the scenarios (IMAGE, MERGE, MiniCAM) exceed even the highest end of the projected sea level rise by the year 2300 as reported in the *Fifth Assessment Report* (AR5) of the Intergovernmental Panel on Climate Change (see figure).



CAPTION: Projections of sea level rise from the DICE model (the arithmetic average of the 10,000 Monte Carlo runs from each scenario) for the five scenarios examined by the IWG2013 compared with the range of sea level rise projections for the year 2300 given in the IPCC AR5 (see AR5 Table 13.8). (DICE data provided by Kevin Dayaratna and David Kreutzer of the Heritage Foundation).

How the sea level rise module in DICE was constructed is inaccurately characterized by the IWG2013 (and misleads the reader). The IWG2013 report describes the development of the DICE sea level rise scenario as:

“The parameters of the four components of the SLR module are calibrated to match consensus results from the IPCC’s Fourth Assessment Report (AR4).⁶”

However, in IWG2013 footnote “6” the methodology is described this way (Nordhaus, 2010):

“The methodology of the modeling is to use the estimates in the IPCC Fourth Assessment Report (AR4).”

“Using estimates” and “calibrating” are two completely different things. Calibration implies that the sea level rise estimates produced by the DICE sea level module behave similarly to the IPCC sea level rise projections and instills a sense of confidence in the casual reader that the DICE projections are in accordance with IPCC projections. However this is not the case. Consequently, the reader is misled.

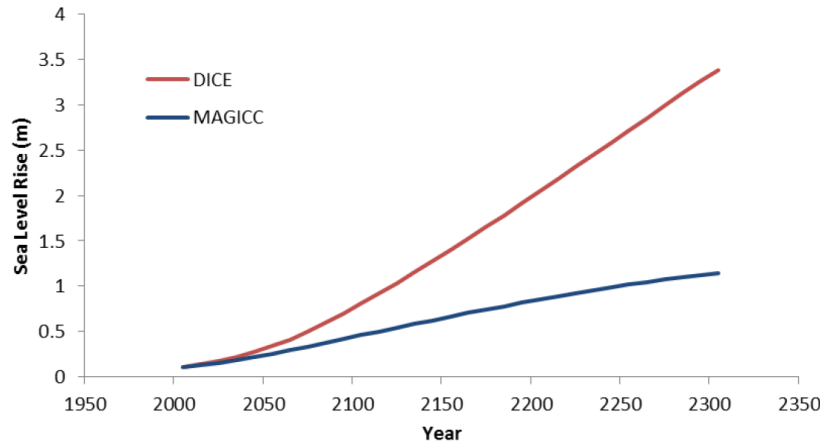
In fact, the DICE estimates are much higher than the IPCC estimates. This is even recognized by the DICE developers. From the same reference as above:

“The RICE [DICE] model projection is in the middle of the pack of alternative specifications of the different Rahmstorf specifications. Table 1 shows the RICE, base Rahmstorf, and average Rahmstorf. *Note that in all cases, these are significantly above the IPCC projections in AR4.*” [emphasis added]

That the DICE sea level rise projections are far above the mainstream estimated can be further evidenced by comparing them with the results produced by the IWG-accepted MAGICC modeling tool (in part developed by the EPA and available from <http://www.cgd.ucar.edu/cas/wigley/magicc/>).

Using the MESSAGE scenario as an example, the sea level rise estimate produced by MAGICC for the year 2300 is 1.28 meters—a value that is less than 40 percent of the average value of 3.32 meters produced by the DICE model when running the same scenario (see figure below).

Projected Sea Level Rise (MESSAGE)



CAPTION: Projected sea level rise resulting from the MESSAGE scenario produced by DICE (red) and MAGICC (blue).

The justification given for the high sea level rise projections in the DICE model (Nordhaus, 2010) is that they well-match the results of a “semi-empirical” methodology employed by Rahmstorf (2007) and Vermeer and Rahmstorf (2009).

However, subsequent science has proven the “semi-empirical” approach to projecting future sea level rise unreliable. For example, Gregory et al. (2012) examined the assumption used in the “semi-empirical” methods and found them to be unsubstantiated. Gregory et al (2012) specifically refer to the results of Rahmstorf (2007) and Vermeer and Rahmstorf (2009):

The implication of our closure of the [global mean sea level rise, GMSLR] budget is that a relationship between global climate change and the rate of GMSLR is weak or absent in the past. The lack of a strong relationship is consistent with the evidence from the tide-gauge datasets, whose authors find acceleration of GMSLR during the 20th century to be either insignificant or small. It also calls into question the basis of the semi-empirical methods for projecting GMSLR, which depend on calibrating a relationship between global climate change or radiative forcing and the rate of GMSLR from observational data (Rahmstorf, 2007; Vermeer and Rahmstorf, 2009; Jevrejeva et al., 2010).

In light of these findings, the justification for the very high sea level rise projections (generally exceeding those of the IPCC AR5 and far greater than the IWG-accepted MAGICC results) produced by the DICE model is called into question and can no longer be substantiated.

Given the strong relationship between sea level rise and future damage built into the DICE model, there can be no doubt that the SCC estimates from the DICE model are higher than the best science would allow and consequently, should not be accepted by the IWG as a reliable estimate of the social cost of carbon.

And here again, the IWG (2015) admits that these sea level rise estimates are an outlier on the high end, yet retains them in their analysis by claiming that they were interested in representing a “range” of possible outcomes. But, even the IWG (2015) admits that the IPCC AR5 assigned “a low confidence in projections based on such [semi-empirical] methods.” It is internally inconsistent to claim the IPCC as an authority for limiting the range of possibilities explored by the IAMs (which it did in the case of equilibrium climate sensitivity) and then go outside the IPCC to justify including a wildly high estimate of sea level rise. Such inconsistencies characterize the IWG response to comments and weaken confidence in them.

I did not investigate the sea level rise projections from the FUND or the PAGE model, but suggest that such an analysis must be carried out prior to extending any confidence in the values of the SCC resulting from those models—confidence that we demonstrate cannot be assigned to the DICE SCC determinations.

HIGH SOCIAL COST OF CARBON ESTIMATES

A few papers have appeared in the recent scientific literature that have argued that the SCC should be considerably higher than that determined by the IWG. However, these papers suffer from serious flaws.

For example, Van den Bergh and Botzen (2014) purport to make a “conservative” estimate of the SCC that is nearly four times larger than the central estimate made by the IWG. This estimate suffers from the many of the issues described previously—a low discount rate, high climate sensitivity, and little to no positive benefits from agriculture. By including all sorts of imagined bad climate outcomes—with high monetary damages—and being largely dismissive of positive impacts, high SCC values are readily created by the authors.

Another recent analysis which arrived at an estimate of the social cost of carbon that was considerably higher than those made by the IWG was conducted by Moore and Diaz (2015). However, a careful examination shows that the assumptions made and methodologies employed therein produce a non-robust and ultimately unreliable result (McKittrick, 2015). Applying a better and more thorough methodology leads to results which are virtually opposite to those initially reported by Moore and Diaz (2015)—one in which the social cost of carbon is quite low and perhaps even positive.

According to McKittrick (2015), the major underlying flaw in the Moore and Diaz paper is the reliance on the results of Dell et al. (2012) in which a warming climate was linked to economic declines in both rich and poor countries. Using a more up-to-date dataset, McKittrick shows that the negative economic linkage to a warming climate is statistically insignificant and “not a robust basis for a policy assertion.”

Furthermore, McKittrick (2015) shows that if a the more standard methodology is applied, where the temperature changes are areally weighted rather than weighted by country-level population, the relationship between economic growth and temperature change reverses for rich countries and becomes statistically significant. According to McKittrick (2015), “each degree of warming significantly *increases* the annual income growth rate in rich countries by over 2 percentage points,” while in poor countries, the relationship “is statistically insignificant.” In conclusion, McKittrick (2015) finds:

The fact that the relevant poor-country coefficients are statistically insignificant implies they should not have been relied upon in Moore and Diaz (2015). And since the rich country coefficient corresponding to the [integrated assessment model] IAM structure is positive and significant, Moore and Diaz (2015) should actually have reported an acceleration of economic growth in rich countries associated with rising temperatures and a correspondingly reduced SCC. Also, since the rich countries begin with a larger GDP it is also likely that the overall global effect of warming on income growth would be positive, even applying the poor country coefficient. In any case the computations in Moore and Diaz (2015) are uninformative since they used coefficients from DJO based on an incomplete sample and a definition of temperature incompatible with their IAM.

Bottom line is that the Moore and Diaz (2015) high SCC estimates as well as the Dell et al. (2012) results upon which they were based, do not stand up under careful re-analysis. In fact, when assessed properly, they produce a low SCC estimate, in support of our overall analysis.

Overall, these new papers provide additional evidence as to the non-robust nature of current SCC determinations.

CONCLUSION

The social cost of carbon as determined by the Interagency Working Group in their May 2013 Technical Support Document (updated in November 2013 and July 2015) is unsupported by the robust scientific literature, fraught with uncertainty, illogical, and thus completely unsuitable and inappropriate for Federal rulemaking. Had the IWG included a better-reasoned and more inclusive review of the current scientific literature, the social cost of carbon estimates would have been considerably reduced with a value likely approaching zero. Such a low social cost of carbon would obviate the arguments behind the push for Federal greenhouse gas regulations.

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QUESTIONS SUBMITTED FOR THE RECORD BY REP. GRIJALVA TO DR. PATRICK MICHAELS, DIRECTOR, CENTER FOR THE STUDY OF SCIENCE, THE CATO INSTITUTE

Question 1. I'd like to follow up on a line of questioning from the hearing about The Advancement of Sound Science Coalition (TASSC). You were asked whether you were a "member scientist" or whether you played some other role at The Advancement of Sound Science Coalition. You replied that you were not active with them. Please help the committee better understand your role.

- a. How long were you a member?
- b. Is it true that you assisted in drafting TASSC's Five Guiding Scientific Principles? (<https://industrydocuments.library.ucsf.edu/docs/#id=nym10028>)
- c. Did you produce anything else for TASSC?
- d. If you were not active with them, does that mean your involvement was limited to lending your name to the organization's efforts?

Answer. My interactions with The Advancement of Sound Science Coalition were, as best as I can recall, extremely limited. I recall that when the organization was formed, some 22 years ago, that I agreed to be on some type of advisory panel. I am sure that I was sent some proposed guidelines for "sound science," and that I had some comments on them. That is the last memory that I have of actually working with them. I see no reference to TASSC in my list of outside presentations on my CV. If I produced anything else, I do not remember doing so, which would mean it would have been highly inconsequential. I was very inactive member (as I am with most groups of this type), and I don't know how long I even was a "member," whatever that means. I hope you are correctly reading that TASSC wasn't exactly a priority of mine.

Question 2. You were also affiliated with the European Science and Environmental Forum (ESEF), another group associated with denying the health effects of cigarette smoke. (<https://industrydocuments.library.ucsf.edu/docs/#id=rsmx0078>)

- a. How long were you a member?
- b. What did you produce for ESEF?
- c. If you were not active with them, does that mean your involvement was limited to lending your name to the organization's efforts?

Answer. My response on ESEF is similar. This was again somewhere around two decades ago. I believe this was a larger organization than TASSC in terms of number of scientists, many of whom were of considerable stature. I see no reference to ESEF in my list of outside presentations on my CV. I am unaware of what you mean by "membership," and therefore could not tell you how long I was a "member." I also think it is also unfair of you to conflate me with the view that smoking is not harmful, as my expertise is largely in climate change and its impacts. That I was not active with them means I felt like I did about most of these types of groups, as per above. I hope you are correctly reading that ESEF wasn't exactly a priority of mine.

Question 3. The Cato Institute is funded by fossil fuel interests, among others. How do you ensure none of that funding, which could constitute a significant conflict of interest, goes to you?

Answer. Cato's Center for the Study of Science is funded entirely from the general fund which is, in turn funded primarily by private, individual donors. The structure of the arrangement—not unique among any charitable organization, just doesn't facilitate narrow *quid pro quo* exchanges. If someone gave us a million dollars to state an opinion about global warming, they are also giving us money to decry sexual discrimination, oppose police brutality, de-escalate the drug war, lower taxes, fight fewer wars, etc. There's no way to untangle these. Our stock and trade is policy analysis and opinion—there's nothing to buy. To the extent we do original research is open to peer review and we do nothing different than other scientists in terms of openness and generally accepted practices and protocols. Mostly we do scientific analysis and publicly subject it to criticism. There's no place to hide, there's no data to fudge, our work is as transparent as it gets. Furthermore, it's absurd to suggest that government funded science is somehow more pure, or free of bias than ours is. Science isn't about dogmatically holding conclusions, but rather it's a method for determining the truth and we have a right to engage in the inquiry process irrespective of where the money comes from.

Question 4. “Western Fuels (Association) approached Pat Michaels about writing a quarterly publication designed to provide its readers with critical insight concerning the global climatic change and greenhouse effect controversy . . . Western Fuels agreed to finance publication and distribution of *World Climate Review* magazine.” (The Heat is On, Ross Gelbspan, 1998). What outside fossil fuel funding, including WFA, have you received in the last 5 years from entities other than the Cato Institute? Please include the amounts, sources, and services rendered.

Answer. I am listing, in order of recency, fossil fuel-related funding of the past 5 years. In the case of Quintana Minerals, all of their funding went to my (closed) consulting firm, New Hope Environmental Services, Inc. New Hope had several employees, and more substantial funding than from Quintana was from the Cato Institute, prior to my becoming a full-time employee (rather than a contractor) at Cato in September, 2012.

As most of my time during this period was spent working with Cato, it is fair to say that the amount of Quintana support that I “received” as per your question, was considerably less than what is listed below.

- June, 2013. Speech to California Independent Petroleum Association. Fee: \$3,300
- March, 2013. Speech to Ohio Oil and Gas Association. Fee: \$2,500
- October, 2012. Speech to North Carolina Coal Institute. Fee: \$1,000
- September, 2011–August, 2012. Quintana Minerals. General research support for New Hope Environmental Services, Inc., \$60,000. Research on climate change.
- September, 2010–August, 2011. Quintana Minerals. General research support for New Hope Environmental Services, Inc., \$95,000. Research on climate change.

The CHAIRMAN. Thank you.

We will now recognize Mr. Dayaratna to testify. You have the same 5 minutes.

STATEMENT OF KEVIN DAYARATNA, Ph.D., SENIOR STATISTICIAN AND RESEARCH PROGRAMMER, CENTER FOR DATA ANALYSIS, THE HERITAGE FOUNDATION, WASHINGTON, DC

Dr. DAYARATNA. Chairman Bishop, standing Ranking Member Lowenthal, and members of the committee, thank you for the opportunity to testify about the social cost of carbon.

My name is Kevin Dayaratna. I am the Senior Statistician and Research Programmer at The Heritage Foundation here in Washington, DC. The views I express in this testimony are my own and should not be construed as representing any official position of The Heritage Foundation.

One of the primary metrics that the Obama administration has used to justify their regulatory agenda on the energy sector of the economy is the so-called social cost of carbon, which is defined as the economic damages associated with a metric ton of carbon dioxide emissions summed across a particular time horizon.

There are three primary statistical models that the Interagency Working Group (IWG) uses to estimate the social cost of carbon: the DICE model, the FUND model, and the PAGE model.

Over the course of my work at The Heritage Foundation, my colleagues and I have used the DICE and FUND models, testing their sensitivity to a variety of important assumptions. Our work has repeatedly illustrated that while these models might be interesting for academic exercises, they are easily manipulated by user-selected assumptions.

Now, at their core, the models are fundamentally flawed because they lack clear mechanisms of the damages of carbon dioxide emissions. Regardless, we will talk about these models anyway.

As with any statistical model, these models are grounded by assumptions. In our work, my colleagues and I have rigorously examined three important assumptions, namely, the choice of a discount rate, the time horizon, and the specification of an equilibrium climate sensitivity distribution.

So let's first talk about the discount rate. Because there are a host of investment opportunities, providing benefits for the future can be achieved in a host of ways. Discounting future benefits and costs to a common year is a tool economists use to measure the impact of a program compared to other possible investments.

The EPA has run these models using 2.5 percent, 3 percent, and 5 percent discount rates despite the fact that the OMB guidance in Circular A-4 has specifically stipulated that a 7 percent discount rate be used as well.

At Heritage, we re-estimated these models using a 7 percent discount rate and noticed drastic reductions to the social cost of carbon. In 2020, for example, according to the FUND model, the social cost of carbon is estimated to be \$19.33 a ton at a 3 percent discount rate, but estimated to be negative 37 cents under a 7 percent discount rate.

This negative value is actually a very interesting aspect about the FUND model and I will come back to it later.

A second assumption that these models are based on is a specification of a time horizon. These models conveniently make projections 300 years into the future in order to increase the social cost of carbon. In our work, we have changed this time horizon to a significantly shorter, but still unrealistic time horizon of 150 years into the future. With the DICE model we noticed that the results plummeted by 25 percent in some instances.

Third, estimating the social cost of carbon requires a specification of what we call an equilibrium climate sensitivity, or ECS, distribution. ECS distributions quantify the earth's temperature response to a doubling of carbon dioxide emissions.

The IWG used an ECS distribution that was published 8 years ago by Gerard Roe and Marcia Baker in the peer-reviewed journal *Science*. Since then, a number of newer ECS distributions have been published and they suggest lower probability of extreme global warming, as my colleague, Pat Michaels, has just alluded to.

Using these more up-to-date ECS distributions has the potential to generate significantly lower estimates of the social cost of carbon by over 40 percent in some instances for both the DICE and the FUND models.

Finally, another interesting aspect about these models is the fundamental question they ask. Are there actually costs associated with carbon dioxide emissions?

Well, according to the FUND model the answer is no, because it actually allows for a negative social cost of carbon. In fact, under some assumptions there are actually substantial probabilities of a negative social cost of carbon. Under some assumptions, the social cost of carbon is negative two-thirds of the time. This would suggest that there are literally no costs, but rather benefits to carbon

dioxide emissions, and if taken at face value, this would suggest that the government should subsidize, not tax carbon dioxide emissions.

So what is the bottom line? As I have demonstrated, measurement of the social cost of carbon can be readily manipulated by conveniently selecting a discount rate, a time horizon, and climate sensitivity. It should be clear that these models are nowhere near reliable enough for energy policy rulemaking.

And as I have illustrated in my own research, taking them seriously would provide significant economic harm and little environmental benefit.

Thank you for your attention, and I look forward to your questions.

[The prepared statement of Dr. Dayaratna follows:]

PREPARED STATEMENT OF KEVIN D. DAYARATNA, PH.D., SENIOR STATISTICIAN AND RESEARCH PROGRAMMER, THE HERITAGE FOUNDATION, WASHINGTON, DC

Chairman Bishop and members of the committee, thank you for the opportunity to testify about the social cost of carbon. My name is Kevin Dayaratna. I am the Senior Statistician and Research Programmer at The Heritage Foundation. The views I express in this testimony are my own and should not be construed as representing any official position of The Heritage Foundation.

It seems to be a fundamental goal of the Obama administration to expand regulations across the energy sector of the economy. One of the primary metrics that the Administration has used to justify these regulations is the social cost of carbon (SCC), which is defined as the economic damages associated with a metric ton of carbon dioxide (CO₂) emissions summed across a particular time horizon.¹

THE MODELS

There are three primary statistical models that the Interagency Working Group (IWG) uses to estimate the SCC—the DICE Model, the FUND model, and the PAGE model.² Over the course of my work at The Heritage Foundation, my colleagues and I have used the DICE and FUND models, testing their sensitivity to a variety of important assumptions. Our work has repeatedly illustrated that while these models might be interesting for academic exercises, they are far too sensitive to the modeler’s assumptions to be legitimate tools for regulatory policy.³

These models are estimated by Monte Carlo simulation. The general idea behind Monte Carlo simulation is that since some aspects of the models are random, the models are repeatedly estimated to generate a range of probable outcomes. As a result of fundamental principles in probability theory, repeated estimation for a sufficient amount of time reasonably characterizes the distribution.

As with any statistical model, however, these models are grounded by assumptions. In our work, my colleagues and I have rigorously examined three important assumptions: the choice of a discount rate, a time horizon, and the specification of an equilibrium climate sensitivity distribution.

¹The official definition of the social cost of carbon is the economic damages per metric ton of CO₂ emissions, and is discussed further in U.S. Environmental Protection Agency, “The Social Cost of Carbon,” <http://www.epa.gov/climatechange/EPAactivities/economics/scr.html> (accessed September 14, 2013).

²For the DICE model, see William D. Nordhaus, “RICE and DICE Models of Economics of Climate Change,” Yale University, November 2006, <http://www.econ.yale.edu/~nordhaus/homepage/dicemodels.htm> (accessed November 6, 2013). For the FUND model, see “FUND—Climate Framework for Uncertainty, Negotiation and Distribution,” <http://www.fund-model.org/> (accessed November 6, 2013). For the PAGE model, see Climate CoLab, “PAGE,” <http://climatecolab.org/resources/-/wiki/Main/PAGE> (accessed November 6, 2013).

³Kevin D. Dayaratna and David W. Kreutzer, “Unfounded FUND: Yet Another EPA Model Not Ready for the Big Game,” Heritage Foundation *Background* No. 2897, April 29, 2014, <http://www.heritage.org/research/reports/2014/04/unfounded-fund-yet-another-epa-model-not-ready-for-the-big-game>; Kevin D. Dayaratna and David W. Kreutzer, “Loaded DICE: An EPA Model Not Ready for the Big Game,” Heritage Foundation *Background* No. 2860, November 21, 2013, <http://www.heritage.org/research/reports/2013/11/loaded-dice-an-epa-model-not-ready-for-the-big-game>; and Kevin D. Dayaratna, and David Kreutzer, “Environment: Social Cost of Carbon Statistical Modeling Is Smoke and Mirrors,” *Natural Gas & Electricity*, Vol. 30, No. 12 (2014), pp. 7–11.

DISCOUNT RATE

Because there are a host of investment opportunities, providing benefits for the future can be achieved in a host of ways. Discounting future benefits and costs to a common year is the tool economists use to measure the impact of a program compared to other possible investments. The discount rate should reflect the return on generally achievable alternative investments. The Environmental Protection Agency has run these models using 2.5 percent, 3 percent, and 5 percent discount rates despite the fact that the Office of Management and Budget guidance in Circular A-4 has specifically stipulated that a 7 percent discount rate be used as well.⁴ At Heritage, we re-estimated these models using a 7 percent discount rate and obtained the following results.

DICE Model Average SCC – Baseline, End Year 2300				
Year	Discount Rate - 2.50%	Discount Rate - 3%	Discount Rate - 5%	Discount Rate - 7%
2010	\$46.57	\$30.04	\$8.81	\$4.02
2020	\$56.92	\$37.79	\$12.10	\$5.87
2030	\$66.52	\$45.14	\$15.33	\$7.70
2040	\$76.95	\$53.25	\$19.02	\$9.85
2050	\$87.69	\$61.72	\$23.06	\$12.25

FUND Model Average SCC – Baseline, End Year 2300				
Year	Discount Rate - 2.50%	Discount Rate - 3%	Discount Rate - 5%	Discount Rate - 7%
2010	\$29.69	\$16.98	\$1.87	-\$0.53
2020	\$32.90	\$19.33	\$2.54	-\$0.37
2030	\$33.16	\$21.78	\$3.31	-\$0.13
2040	\$39.53	\$24.36	\$4.21	\$0.19
2050	\$42.98	\$27.06	\$5.25	\$0.63

As we can see, the SCC estimates are drastically reduced under the use of a 7 percent discount rate. In fact, under the FUND model, the estimates are negative, suggesting that there are actually benefits to carbon dioxide emissions.

TIME HORIZON

Our Founding Fathers almost surely would have had no ability to predict what the American economy looks like today. Similarly, we have no idea what the American economy will look like 300 years from now. Regardless, these SCC models are based on projections that are far out into the future. In my work at Heritage, I have changed this time horizon to the significantly less, albeit still unrealistic, time horizon of 150 years into the future, and we obtained the following results for the DICE model.

⁴ Office of Management and Budget, “Circular A-4,” White House, http://www.whitehouse.gov/omb/circulars_a004_a-4/ (accessed September 14, 2013), and Paul C. “Chip” Knappenberger. “An Example of the Abuse of the Social Cost of Carbon.” Cato-at-Liberty. <http://www.cato.org/blog/example-abuse-social-cost-carbon> (accessed September 14, 2013).

DICE Model Average SCC - End Year 2150				
Year	Discount Rate - 2.50%	Discount Rate - 3%	Discount Rate - 5%	Discount Rate - 7%
2010	\$36.78	\$26.01	\$8.66	\$4.01
2020	\$44.41	\$32.38	\$11.85	\$5.85
2030	\$50.82	\$38.00	\$14.92	\$7.67
2040	\$57.17	\$43.79	\$18.36	\$9.79
2050	\$62.81	\$49.20	\$22.00	\$12.13

Clearly, the SCC estimates drop substantially as a result of changing the end year (in some cases by over 25 percent).

EQUILIBRIUM CLIMATE SENSITIVITY DISTRIBUTION

Estimating the SCC requires the specification of an equilibrium climate sensitivity (ECS) distribution. Scientists concur that the earth's temperature warms in response to carbon dioxide emissions. The real question, however, is how much warming would actually occur in response to a certain change in carbon dioxide emissions. ECS distributions quantify the earth's temperature response to a doubling of carbon dioxide emissions in terms of probabilities.

The ECS distribution used by the IWG is based on a paper published in the journal *Science* 8 years ago by Gerard Roe and Marcia Baker. Since then, a variety of newer and more up-to-date distributions have been suggested in the peer-reviewed literature. Many of these distributions, in fact, suggest lower probabilities of extreme global warming in response to carbon dioxide emissions.⁵

Using the more up-to-date ECS distributions (Otto et al. (2013) and Lewis (2013)), we notice drastically lower probabilities of extreme global warming. At Heritage, we re-estimated the SCC having used these more up-to-date ECS distributions and obtained the following results.

DICE Model Average SCC – ECS Distribution Updated in Accordance with Otto et al. (2013), End Year 2300				
Year	Discount Rate - 2.50%	Discount Rate - 3%	Discount Rate - 5%	Discount Rate - 7%
2010	\$26.64	\$17.72	\$5.73	\$2.80
2020	\$32.65	\$22.32	\$7.82	\$4.04
2030	\$38.33	\$26.74	\$9.88	\$5.26
2040	\$44.54	\$31.63	\$12.24	\$6.69
2050	\$51.19	\$36.91	\$14.84	\$8.29

⁵ Gerard H. Roe and Marcia B. Baker, "Why Is Climate Sensitivity So Unpredictable?" *Science*, Vol. 318, No. 5850 (October 26, 2007), pp. 629–632; Nicholas Lewis, "An Objective Bayesian Improved Approach for Applying Optimal Fingerprint Techniques to Estimate Climate Sensitivity," *Journal of Climate*, Vol. 26, No. 19 (October 2013), pp. 7414–7429; and Alexander Otto et al., "Energy Budget Constraints on Climate Response," *Nature Geoscience*, Vol. 6, No. 6 (June 2013), pp. 415–416.

	FUND Model Average SCC – ECS Distribution Updated in Accordance with Otto et al. (2013), End Year 2300			
Year	Discount Rate - 2.50%	Discount Rate - 3%	Discount Rate - 5%	Discount Rate - 7%
2010	\$11.28	\$6.27	\$0.05	-\$0.93
2020	\$12.66	\$7.30	\$0.36	-\$0.87
2030	\$14.01	\$8.35	\$0.74	-\$0.75
2040	\$17.94	\$11.08	\$1.50	-\$0.49
2050	\$19.94	\$12.69	\$2.21	-\$0.14

	FUND Model Average SCC – ECS Distribution Updated in Accordance with Lewis (2013), End Year 2300			
Year	Discount Rate - 2.50%	Discount Rate - 3%	Discount Rate - 5%	Discount Rate - 7%
2010	\$5.20	\$2.84	-\$0.54	-\$1.06
2020	\$6.20	\$3.65	-\$0.30	-\$1.03
2030	\$7.01	\$4.39	\$0.03	-\$0.93
2040	\$7.83	\$5.18	\$0.47	-\$0.73
2050	\$8.63	\$6.01	\$1.03	-\$0.41

Again, we notice drastically lower estimates of the SCC using these more up-to-date ECS distributions. These results are not surprising—the IWG’s estimates of the SCC were based on outdated assumptions that overstated the probabilities of extreme global warming, which artificially inflated their estimates of the SCC.

NEGATIVITY

When people talk about the social cost of carbon, they tend to think of damages. Not all of these models, however, suggest that there are always damages associated with carbon dioxide emissions. The FUND model, in fact, allows for the SCC to be negative based on feedback mechanisms due to carbon dioxide emissions. In our work at Heritage, we actually calculated the probability of a negative SCC under a variety of assumptions.

	FUND Model Probability of Negative SCC – ECS Distribution Based on Outdated Roe–Baker (2007) Distribution, End Year 2300			
Year	Discount Rate - 2.50%	Discount Rate - 3%	Discount Rate - 5%	Discount Rate - 7%
2010	0.087	0.121	0.372	0.642
2020	0.084	0.115	0.344	0.601
2030	0.080	0.108	0.312	0.555
2040	0.075	0.101	0.282	0.507
2050	0.071	0.093	0.251	0.455

FUND Model Probability of Negative SCC – ECS Distribution Updated in Accordance with Otto et al. (2013), End Year 2300				
Year	Discount Rate - 2.50%	Discount Rate - 3%	Discount Rate - 5%	Discount Rate - 7%
2010	0.278	0.321	0.529	0.701
2020	0.268	0.306	0.496	0.661
2030	0.255	0.291	0.461	0.619
2040	0.244	0.274	0.425	0.571
2050	0.228	0.256	0.386	0.517

FUND Model Probability of Negative SCC – ECS Distribution Updated in Accordance with Lewis (2013), End Year 2300				
Year	Discount Rate - 2.50%	Discount Rate - 3%	Discount Rate - 5%	Discount Rate - 7%
2010	0.390	0.431	0.598	0.722
2020	0.375	0.411	0.565	0.685
2030	0.361	0.392	0.530	0.645
2040	0.344	0.371	0.491	0.598
2050	0.326	0.349	0.449	0.545

Interestingly, under a reasonable set of assumptions, the SCC is overwhelmingly likely to be negative, which would suggest the government should, in fact, subsidize (not limit) carbon dioxide emissions. I do not use these results to suggest that the government should actually subsidize carbon dioxide emissions, but rather to illustrate the extreme sensitivity of these models to reasonable changes to assumptions.

ECONOMIC CONSEQUENCES

Our results clearly illustrate that the models used to estimate the SCC are far too sensitive to reasonable changes in assumptions to be useful tools for policy-making. Even if we were to actually take these models seriously and implement the associated regulations, the results would be very costly. Our research at Heritage has shown that by 2030, we would suffer a peak employment shortfall of over 1,000,000 lost jobs and over 500,000 manufacturing jobs with a negligible impact (less than two-tenths of a degree Celsius) on global temperatures.⁶

⁶Kevin D. Dayaratna, Nicolas D. Loris, and David W. Kreutzer, “The Obama Administration’s Climate Agenda: Will Hit Manufacturing Hard,” Heritage Foundation *Background* No. 2990, November 13, 2014, <http://www.heritage.org/research/reports/2014/11/the-obama-administrations-climate-agenda-underestimated-costs-and-exaggerated-benefits>; Kevin D. Dayaratna, Nicolas D. Loris, and David W. Kreutzer, “The Obama Administration’s Climate Agenda: Underestimated Costs and Exaggerated Benefits,” Heritage Foundation *Background* No. 2975, November 13, 2014, <http://www.heritage.org/research/reports/2014/11/the-obama-administrations-climate-agenda-underestimated-costs-and-exaggerated-benefits>; Nicholas D. Loris, Kevin Dayaratna, and David W. Kreutzer, “EPA Power Plant Regulations: A Backdoor Energy Tax,” Heritage Foundation *Background* No. 2863, December 5, 2013, <http://www.heritage.org/research/reports/2013/12/epa-power-plant-regulations-a-backdoor-energy-tax>; David W. Kreutzer, Nicholas D. Loris, and Kevin Dayaratna, “Cost of a Climate Policy: The Economic Impact of Obama’s Climate Action Plan,” Heritage Foundation *Issue Brief* No. 3978, June 27, 2013, <http://www.heritage.org/research/reports/2013/06/climate-policy-economic-impact-and-cost-of-obama-s-climate-action-plan>; David W. Kreutzer and Kevin Dayaratna, “Boxer-Sanders Carbon Tax: Economic Impact,” Heritage Foundation *Issue Brief* No. 3905, April 11, 2013, <http://www.heritage.org/research/reports/2013/04/boxer-sanders-carbon-tax-economic-impact>; and Patrick J. Michaels and Paul C. “Chip” Knappenberger, “Current Wisdom: We Calculate, You Decide: A Handy-Dandy Carbon Tax Temperature-Savings Calculator,” Cato Institute, July 23, 2013, <http://www.cato.org/blog/current-wisdom-we-calculate-you-decide-handy-dandy-carbon-tax-temperaturesavings-calculator> (accessed September 11, 2014).

CONCLUSION

The SCC is based on statistical models that are extremely sensitive to various assumptions incorporated within the models. The following tables summarize this sensitivity for the year 2020.

	SCC for 2020, DICE Model		
ECS Distribution	3%	5%	7%
Roe-Baker (2007)	\$ 37.79	\$ 12.10	\$ 5.87
Otto et al. (2013)	\$ 22.32	\$ 7.82	\$ 4.04

	SCC for 2020, FUND Model		
ECS Distribution	3%	5%	7%
Roe-Baker (2007)	\$19.33	\$2.54	-\$0.37
Otto et al. (2013)	\$7.30	\$0.36	-\$0.87
Lewis (2013)	\$3.65	-\$0.30	-\$1.03

	Probability of Negative SCC		
ECS Distribution	3%	5%	7%
Roe-Baker (2007)	0.12	0.34	0.60
Otto et al. (2013)	0.31	0.50	0.66
Lewis (2013)	0.41	0.57	0.69

Moreover, the damage functions that the estimates are based on are essentially arbitrary with limited empirical justification. Even if one were to take their results seriously, their use would result in significant economic damages with little benefit to reducing global temperatures. As a result, these models, although they may be interesting academic exercises, are far too unreliable for use in energy policy rulemaking.

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The CHAIRMAN. Thank you. I appreciate so far you have kept the 5-minute rule right there. You have been spot on.

Mr. Dorsey, you are recognized for 5 minutes.

STATEMENT OF MICHAEL K. DORSEY, Ph.D., INTERIM DIRECTOR, ENERGY AND ENVIRONMENT PROGRAM, JOINT CENTER FOR POLITICAL AND ECONOMIC STUDIES, WASHINGTON, DC

Dr. DORSEY. Thank you, Mr. Chairman. As well, thank you standing Ranking Member Lowenthal and members of the committee. It is a pleasure to be here with you this morning.

I am Dr. Michael Dorsey, and I am Director of Energy and Environment Programs at the Joint Center for Political and Economic Studies, which is a nonprofit, nonpartisan public policy think tank here in DC.

I want to make it clear before I start, to some of the colleagues here on the panel, that my comments are solely my own and do not represent policies of the Joint Center.

That said, allow me to begin by just giving some background on the SCC. As you know, since Ronald Reagan, we have decided that significant rules issued by the Federal Government be accompanied through intra-governmental review by cost-benefit analysis. So really the SCC is nothing particularly new.

As you know also, the current administration, following on the previous one before it, has imposed the requirement to assess climate regulation through the lens of a range of figures that we collectively refer to as the social cost of carbon, or the SCC.

The SCC estimates the benefit to be achieved, as many of you have already said, expressed in monetary values, by avoiding damages caused by each additional metric ton of carbon dioxide.

Essentially the SCC relies, as we know, on a discount rate greater than zero for the social cost of carbon. Choosing a discount rate is, indeed, I think a political exercise, but it is also a process, and I would concur that that process has to have a degree of transparency around it. By adding more transparency to that process, we improve efforts to calculate the SCC.

I think when we think about accuracy though, we have to think about making accurate submissions of those who are involved in setting the process, such that what does transparency really mean. It means that any transparent SCC process must include the full disclosures of the financial interests of all those who are involved in trying to configure the SCC.

The full disclosure of financial interests of those involved with the SCC calculations must emphasize I would say the conflicts of interest of all parties. This especially must apply to those parties that have interest in the fossil fuel sector, inasmuch as parties from that sector may have a strong incentive to devalue the SCC or inflate the discount rate used, in part, to calculate it.

The Interagency Working Group, or the IWG's values for the social cost of carbon as they stand indicate that the discount rate used by the IWG may, indeed, be too high. Now, the equity weighting of global damages were not conducted. The IWG does justify including a significantly higher discount rate of up to 5 percent.

I would also add that the IWG should also provide a rationale for excluding significantly lower discount rates.

The Working Group also should equity weigh the expected damages of climate change. Currently the Integrated Assessment Models that are underneath the SCC that the colleague to my right has talked about assumed the relative impacts of the dollar damages not varying regionally, but we know that the impact of one dollar of damages varies widely from region to region, and particularly within the country and between countries.

In addition, climate damages should be weighed by relative per capita income in the region where they occur. This would also justify a much higher range of values for the SCC.

I would add that the SCC should also be concerned with the disproportionate impacts that a dollar of damages will have on different regions in the country, as well as around the world. One of the things that we looked at at the Joint Center a couple of years back was the way in which the response to climate change was very uneven across the country, and we find places like Mr. Sablan pointed out where people are already suffering the early effects of this ongoing problem.

So we need an SCC that really focuses upon the disproportioned impacts of climate change around the country.

I would also say that members of this committee have an obligation to step up and to make sure that they are taking reasonably robust actions to ensure that we are drastically reducing carbon pollution in a timely manner proportionate with the unfolding climate crisis. That actually requires that we have a particularly high SCC and actually a relatively low discount rate.

I think it is that orientation that we need to be focused on, because setting an accurate social cost of carbon that is based and rooted in transparency around critical disclosures is, I think, critical, and it is a critical step to achieving reductions in carbon emissions that we need to see in the future.

Thank you.

[The prepared statement of Dr. Dorsey follows:]

PREPARED STATEMENT OF DR. MICHAEL K. DORSEY, INTERIM DIRECTOR OF THE ENERGY AND ENVIRONMENT PROGRAM, JOINT CENTER FOR POLITICAL AND ECONOMIC STUDIES, WASHINGTON, DC

I am Dr. Michael K. Dorsey, Interim Director of the Energy and Environment Program at the Joint Center for Political & Economic Studies (hereafter, the Joint Center), a nonprofit, non-partisan public policy research institute located here in Washington, DC. Before I begin my testimony, I would like to make clear that my comments are solely my own and do not represent any official position of the Joint Center.

WHAT IS THE SCC

Since Ronald Reagan, we have decided that significant rules issued by the Federal Government be accompanied through intra-governmental review by a cost-benefit analysis.

As you know, the Obama administration, like the Bush administration before it, has imposed a requirement to assess climate regulation through the lens of a range of figures collectively known as the “social cost of carbon” or SCC.

The SCC estimates the benefit to be achieved, expressed in monetary value, by avoiding the damage caused by each additional metric ton of carbon dioxide (CO₂) put into the atmosphere.¹

Accordingly, the U.S. Court of Appeals for the Ninth Circuit ruled that executive branch agencies must include the climate benefits of a significant regulatory action in Federal benefit-cost analyses (BCA) to comply with Executive Order 12,866.

In response, an Interagency Working Group on the Social Cost of Carbon was formed in 2010 to develop a consistent and accurate estimate of the social cost of carbon (SCC) using models drawn from scholarly and expert literature.² The SCC is the global cost to all future generations from one additional unit of carbon pollution in a given time period; forest fires, drought, and disease are just some of the costly consequences of climate change that are ideally included within it.³

Yet we need to keep improving the SCC estimate to ensure it reflects the latest science and economics. Doing so maintains an accurate SCC.

The SCC relies, as we know, on a discount rate greater than zero for the social cost of carbon. When we use such a discount rate we are making a value judgment—a moral judgment—that our society in this period of time is more valuable than future societies—than that of our children and their children. In other words we are saying: that our generation’s burning of fossil fuels is possibly more valuable than a safe and livable planet.

So choosing a discount rate is a moral and political exercise, not only a dispassionate, academic one. It is also a process.

While legally there is no need for increased transparency in the process to set the SCC, we should ensure a transparent process for updating and using this critical number going forward that especially involves citizens (and their designated representatives) that we know will be disproportionately harmed by the unfolding climate crisis.⁴

Further on any transparent SCC process must include the full disclosure of the financial interests of all of those who are involved in configuring the SCC. The full disclosure of the financial interests of those involved with SCC must emphasize the conflicts of interest of all parties. This especially must apply to any parties that have interests in the fossil fuel sector—inasmuch as parties from that sector may have a strong incentive to devalue the SCC (or inflate the discount rate used in part to calculate it).

Alas, today’s House hearing on the SCC might simply be a sideshow aimed at undermining climate action, not likely to focus on issues of substance. Relying on those that downplay the extent of the unfolding climate crisis or seeking “opinions” from fossil fuel backed, industry economists is dangerous for the country—given that such interested parties can have financial and other conflicts with setting an accurate SCC.

WHY DOES THE SCC NEED TO BE ACCURATE

The Interagency Working Group’s (IWG) values for the Social Cost of Carbon (SCC), as they stand, indicate that the discount rates used by the IWG may be too high, and that equity weighting of global damages was not conducted.

The IWG does give a justification for *including* a significantly higher-end discount rate of 5 percent (descriptive analysis of “possibility that climate damages are positively correlated with market returns”).⁵ The IWG should also provide a rationale for *excluding* significantly lower discount rates.

In fact, two members of the IWG—the Environmental Protection Agency (EPA) and Office of Management and Budget (OMB)—suggest that lower discount rates (between .5 and 3%) should be used in their own guidelines. The EPA suggests a use of lower discount rates in situations where there is “long-run uncertainty in economic growth and interest rates, intergenerational considerations, and the risk of high impact climate damages (which could reduce or reverse economic growth).”⁶ OMB notes that although “most people demonstrate time preference [p] in their own consumption behavior, it may not be appropriate for society to demonstrate a similar preference when deciding between the well-being of current and future genera-

¹ Bell, R.G. and D. Callan. 2011. More than Meets the Eye—The Social Cost of Carbon in U.S. Climate Policy, in Plain English. WRI.

² Masur, J. S., & Posner, E. A. (2011). Climate regulation and the limits of cost-benefit analysis. *Cal. L. Rev.*, 99, 1557.

³ Howard, P. 2014. *Omitted Damages: What’s Missing from the Social Costs of Carbon*.

⁴ Cleetus, R. 2013. “The Social Cost of Carbon: Setting the Record Straight Ahead of Today’s House Hearing.”

⁵ See: IWG 2010.

⁶ See: EPA 2008.

tions.”⁷ These scenarios perfectly describe the scenario for rulemaking around carbon dioxide emissions and climate impacts; the lower discount rates, if modeled would, justify a much higher range of values for the SCC.

The IWG must equity-weigh the expected damages of climate change, which means that their models assume that the relative impacts of a dollar of damages do not vary regionally—or that this type of judgment is an inappropriate one to make. Since the IWG used a global social cost of carbon dioxide, which was not mandatory under rulemaking, as they were concerned about the global impacts of emissions. It then follows that they should be concerned about the disproportionate impacts that a dollar of damages might have on different regions of the globe *and in the country*. Climate damages should be weighed by relative per-capita income in the region where they occur. This would also justify a much higher range of values for the SCC. Further on, this could also allow those that bear more responsibility for the generating carbon pollution, share a large burden in abating it—and ultimately avoid catastrophic climate change and the associated political, social, economic and ecological crises associated with it.

Beyond the work on the SCC, we need to develop an Interagency Working Group on the Social Cost of Methane, analogous to the Interagency Working Group on the Social Cost of Carbon. Methane pollution is becoming a greater and greater problem for the United States as we expand our natural gas production. As scientists say we are nearing more and more climate tipping points, methane is also hugely important because although it is shorter lived in the atmosphere, its radiative forcing is much higher than carbon dioxide over any relevant time frame. Promulgating a Social Cost of Methane will allow the Administration to be more proactive in rule-making and allow us to better mitigate the impacts of methane emissions on our Nation and the world.

WHO’S HARMED IF THE SCC IS NOT ACCURATE

There is a highly academic discussion underway on the “right” discount rate to use in calculating the social cost of carbon. Discount rates are based on the assumption that a dollar in the future is worth less than a dollar today, assuming the global economy and prosperity grow. The SCC report provides estimates discounted at 2.5 percent, 3 percent, and 5 percent. The choice of discount rate matters greatly because the impacts and costs of our carbon emissions will be borne primarily by future generations. The concept of discounting makes some *sense when applied to individuals, not across generations*.⁸

Unlike conventional pollutants, CO₂ persists in the atmosphere for 200 years or more. If we use a high discount rate for the SCC calculations, future costs could be minimized to the point of being ignored. And as a result, the benefits of actions to reduce emissions will also be greatly discounted. The math of compounding discount rates means that, for example with a rate of 7 percent, beyond the next two decades even a fairly significant cost would look small, and by the latter half of the century would approach zero. That is neither sensible from an economic point of view or an ethical point of view.⁹

In fact, there is a growing consensus among economists that the best approach would be to use a *declining discount rate* to better reflect inter-generational considerations.

There is a general consensus that future integrated assessment models (IAM) research must focus on hot spots. The “hot spot” regions are those that are geographically predisposed to climate change (for example, low lying nations and island nations), and those nations as well as communities in the United States with insufficient ability to adapt (for example, the poorest amongst us in the United States).¹⁰

In the United States, the number of “hot spots” is growing and perhaps too numerous to elaborate. Examples include, but are by no means limited to Alaska, the southern Gulf Coast states and the West—who are suffering from sea level rise, exceptionally strong hurricane events and sustained carbon pollution exacerbated droughts, respectively.

A small example of the possible magnitude of these relocation costs are Alaskan native villages. In the case of relocating three Alaskan villages (Kivalina,

⁷ See: OMB 2003.

⁸ Cleet, R. 2013. “The Social Cost of Carbon: Setting the Record Straight Ahead of Today’s House Hearing.”

⁹ Cleet, R. 2013. “The Social Cost of Carbon: Setting the Record Straight Ahead of Today’s House Hearing.”

¹⁰ Howard, P. 2014. *Omitted Damages: What’s Missing from the Social Costs of Carbon*.

Shishmaref, & Newtok), the cost is estimated by the U.S. Army Corps of Engineers to be between \$275 million and \$455 million.¹¹

In the United States, morbidity and mortality can be directly influenced by climate in six ways: (1) high and low temperature (that is, heat and cold stress), (2) vector-borne infectious disease, (3) non-vector-borne infectious disease (including, zoonotic and waterborne diseases, (4) air quality, (5) floods and storms, and (6) inter-sector effects of agriculture and water quality.¹²

In a 2012 study we conducted at the Joint Center, we found that marginalized communities of color in six southern and western states (Arizona, Arkansas, Louisiana, Oklahoma, New Mexico and Texas) face a “perfect storm” of poor health, socioeconomic barriers and climate-related challenges, and many are being left out of government climate change and disaster planning activities.¹³

Accordingly, in the face of such knowledge, since the SCC IWG should be concerned about the disproportionate impacts that a dollar of damages *will* have on different regions of *the country*—and world.

Our children and their children deserve to live in a world free from the extremely negative social, political, economic and ecological impacts of unchecked climate change. Our generation and the members of this committee have an obligation to step up to make sure we’re taking reasonably robust actions to ensure that we’re drastically reducing carbon pollution in a timely manner proportionate with the unfolding climate crisis. Setting an accurate social cost of carbon is one critical step to achieve this end. I would urge the members of the committee to keep this in mind.

The CHAIRMAN. Thank you. I appreciate that.
We will now hear from Mr. Segal.

**STATEMENT OF SCOTT H. SEGAL, FOUNDING PARTNER,
POLICY RESOLUTION GROUP, WASHINGTON, DC**

Mr. SEGAL. Chairman Bishop, Mr. Lowenthal, members of the committee, based on 25 years of practice of law and public policy in the environmental field, it is my pleasure to offer some thoughts on the Administration’s use of the social cost of carbon.

In short, the use of social cost is currently not an appropriate basis for setting policy and misleads the public regarding the true cost of government action.

First, social cost is used to make expensive rules appear cost beneficial, when they are not. The methodology was used to make vehicle efficiency standards that had a net cost of \$50 billion appear to have a benefit of \$100 billion, and the EPA’s power plant rules relied on social cost for as much as 65 percent of their alleged net benefits.

As the President’s climate action plan comes further into focus, more and more regulations claiming to reduce carbon emissions will use social cost to appear cost beneficial when the truth might be otherwise. It has already been cited in 114 proposed or final rules across six Federal agencies.

¹¹ Lynn, K., & Donoghue, E. 2011. Tribal Climate Profile: Relocation of Alaska Native Communities. Tribal Climate Change Project at the University of Oregon. Retrieved from http://tribalclimate.uoregon.edu/files/2010/11/AlaskaRelocation_04-13-11.pdf.

¹² National Institute of Environmental Health Sciences. (2010). A human health perspective on climate change: A report outlining the research needs on the human health effects of climate change. In *A Human Health Perspective On Climate Change: A Report Outlining the Research Needs on the Human Health Effects of Climate Change*. Environmental Health Perspectives (EHP); National Institute of Environmental Health Sciences.

¹³ JCPES and THI. 2012. *Climate Change, Environmental Challenges and Vulnerable Communities: Assessing Legacies of the Past, Building Opportunities for the Future*.

When actual environmental benefits fail to satisfy a skeptical audience, social costs should not be used as some type of Hamburger Helper to make the dish look more inviting than it really is.

Some might say, “Well, what is the harm in overestimating benefits?” The Supreme Court reminded us earlier this month that too much wasteful expenditure devoted to one problem may well mean considerably fewer resources available to deal effectively with other perhaps more serious problems. Failing to recognize this reasoned the Court was irrational and inappropriate.

Even EPA’s Air Administrator recently told Congress when asked if a rule can actually claim a particularized benefit related to reducing climate change. She said, “You can’t predict the climate that way,” and of course, she is right. Stopping a particular project or adopting a particular rule does not yield a benefit down to the ton. EPA does not think so, but this is precisely what the social cost purports to do.

As a matter of law, social cost faces numerous legal, procedural, and other shortcomings associated with its development, derivation, and application—enough problems to clearly warrant the immediate discontinuation of the use of social cost values in the regulatory context.

Also, the potential use of social cost by the CEQ as a basis for agencies to reject or condition project approval is troubling. Seemingly it is inconsistent with Supreme Court precedent that requires NEPA, National Environmental Policy Act, conditions to have a real causal relationship to the actual action under review.

One basis for this conclusion is the uncertainty that swirls around the models used to determine social cost. This uncertainty falls short of the complete analytic defense and rational connection between factual inputs, modeling assumptions, and conclusions that have long been required by Federal courts as part of administrative law.

MIT Professor Robert Pindyck said, by contrast, the models the Administration has used have, “crucial flaws that make them close to useless as tools for policy analysis. They are completely ad hoc with no theoretical or empirical foundation.”

The choice of models was never subject to public comment or review. Some have contended that social cost is not a rule. So why worry about procedural niceties like the Administrative Procedure Act.

But APA itself says that rules encompass the “approval and prescription of valuations, costs and accounting.” And it is a good idea that the APA does. What is at stake in the carbon context is substantial. The EPA clean power plant alone may place electrical liability at risk, causing blackouts that can cost millions a minute while endangering human health; energy price increases; shut our businesses; deter hiring; cause layoffs; increase the price of essential goods and services; and increase the cost of living for all Americans, including for people living on fixed incomes, like senior citizens and the poor, who are hardest hit by rate hikes.

If OMB does possess the legal authority to use social cost, which is a very open point, under APA it would still have to comply with the full range of procedural requirements, including advanced

public notice, a full and robust opportunity for comment, and a description of the legal basis and purpose of the mechanism.

The Interagency Working Group seems to concede this point in its recent brief response to comments, when they indicated they would bound the matter over for a potentially lengthy National Academy of Sciences review based on the need for “independent expert advice.” But they would keep the old concept of social cost in place in the meantime.

Ladies and gentlemen, that is not how the administrative process is supposed to work. You do not keep the bad process in place while you are waiting for the better one.

The Administration also reiterated its commitment to calculate global benefits to carbon reductions even when no consideration is given to global dis-benefits associated with perpetuating energy poverty. The Intergovernmental Group says it prefers this because by adopting a global estimate we can signal our leadership, but there is no evidence that our leadership will be copied by other countries who, in fact, are our economic competitors.

Well, thank you for the opportunity to testify. I look forward to working with the committee further as it completes its important oversight tasks.

[The prepared statement of Mr. Segal follows:]

PREPARED STATEMENT OF SCOTT H. SEGAL, FOUNDING PARTNER, POLICY RESOLUTION GROUP, BRACEWELL & GIULIANI LLP

Chairman Bishop, Ranking Member Grijalva, and members of the committee, my name is Scott Segal and I am a partner in the Policy Resolution Group of the law firm Bracewell and Giuliani where I have practiced energy, environmental and natural resource law for over 25 years. I also direct the Electric Reliability Coordinating Council,¹ a group of energy companies working on common-sense environmental policy, including approaches to climate change, but the comments I present today are my own. It is an honor to be here today to address the issue of the use of the social cost of carbon (SCC) in rulemaking and other administrative actions. In short, the methodology promoted by the Administration is not an appropriate basis for setting policy and misleads the public regarding the true costs of government action.

WHY THE SCC IS MISGUIDED

Any part of the regulated community with passing interest in carbon policy and attendant regulatory development needs to be concerned with the development and use of SCC. Because a higher value for SCC can be used directly to justify broader reaching and more expensive regulations, or to deny permits, the SCC itself must be subject to close scrutiny. Let me give you some real world examples:

- A Department of Transportation (DOT) vehicle efficiency standard would impose a cost of \$350 billion on manufacturers and would return conventional benefits of \$278 billion, meaning costs outweigh benefits by more than \$50 billion. But when DOT factored in SCC, suddenly the regulation benefits exceeded cost by \$100 billion;²

¹ ERCC filed comments regarding SCC Technical Support Documents pursuant to the notice at 78 Fed. Reg. 70,586 (Nov. 26, 2013). The comments are available at [regulations.gov](http://www.regulations.gov) as FR Doc #2014-01605, dated Feb. 26, 2014.

² Mark Drajem, Obama Quietly Raises ‘Carbon Price’ as Costs to Climate Increase, BLOOMBERG (June 12, 2013, 2:52 PM), <http://www.bloomberg.com/news/2013-06-12/tougher-regulationseen-from-obama-change-in-carbon-cost.html>; Jay G. Stirling, How to Deal with Hornets: The Administrative Procedure Act and the Social Cost of Carbon, 100 Iowa Law Rev. (2015) at 855–56.

- When the U.S. Environmental Protection Agency (EPA) proposed its carbon emissions guidelines for existing power plants, it estimated net benefits of \$26 to \$46 billion by as soon as 2020—with some 40 to 65 percent of these alleged net benefits deriving directly from SCC.³

And as the President's Climate Action Plan comes further into focus, more and more regulations claiming to reduce carbon emissions as a primary or secondary benefit will use SCC to appear cost-beneficial when the truth might be otherwise. When actual environmental benefits fail to satisfy a skeptical audience, SCC should not be used as *Hamburger Helper* to make the dish look larger than it really is.

But that's the real problem. When rulemakings and other government actions impose real costs, and when benefits analysis can be manipulated to yield almost any number, the result is a serious misallocation of limited societal resources. The U.S. Supreme Court has recently put the EPA on notice that it expects an honest assessment of cost and benefit. In *Michigan v. EPA*, the Court said that, "One would not say that it is even rational, never mind 'appropriate,' to impose billions of dollars in economic costs in return for a few dollars in health or environmental benefits." The Court explains why:

"Consideration of cost reflects the understanding that reasonable regulation ordinarily requires paying attention to the advantages and the disadvantages of agency decisions. It also reflects the reality that 'too much wasteful expenditure devoted to one problem may well mean considerably fewer resources available to deal effectively with other (perhaps more serious) problems.' (quoting Justice Breyer in a previous decision)."⁴

The SCC as it stands now is an admittedly one-sided assessment under which the mere allusion to carbon reductions can confer large benefits, even if the proposed action will have no effect on global warming and related environmental endpoints. The fact that particular rules cannot predictably result in reduction of climate-change endpoints in a linear fashion was recently demonstrated in an exchange between a Member of the House of Representatives and the EPA Acting Assistant Administrator for Air Janet McCabe:

Mr. Pompeo. You have gone from 26 to 30 indicators on your Web site about how you measure impact of what you-all call climate change today. So I want to ask you a series of yes or no questions about this set of regulations, these carbon regulations [on power plants], and what you think they will do to the indicators that EPA uses. So, yes or no, will this set of rules, when fully implemented, reduce sea surface temperatures.

Ms. McCabe. I can't answer that. I don't know.

Mr. Pompeo. Will this reduce ocean acidity?

Ms. McCabe. It will contribute to reducing ocean acidity.

Mr. Pompeo. Do you have the data to support that, and can you tell how much and when we will see reduced ocean acidity as a result of these regulations?

Ms. McCabe. You can't predict the climate this way.

Mr. Pompeo. I will take that as you have no idea."⁵

Ms. McCabe is of course correct. You cannot look at a particular rulemaking or administrative action and determine what effect it will have on any particular climate impact. As she says, "You can't predict the climate this way." Yet, that is precisely what the SCC would purport to do, utilizing hand-picked inputs into hand-picked integrated assessment models (IAMs).

SCC IS INAPPROPRIATE AS A BASIS FOR RULEMAKING AND ADMINISTRATIVE ACTION

Our colleagues at the Utility Air Regulatory Group (UARG) offered a succinct discussion of the legal shortcomings that manifest from reliance on the SCC methodology as currently developed, pointing to "numerous legal, procedural, and other

³ Carbon Pollution Emission Guidelines for Existing Stationary Sources: Electric Utility Generating Units, 79 Fed. Reg. 34,830, 34,840 tbl.1 (June 18, 2014) (to be codified at 40 C.F.R. pt. 60); Stirling at 856.

⁴ *Michigan v. EPA*, 576 U. S. ____ (2015), slip op. at 7.

⁵ Transcript of Hearing on EPA's Proposed Carbon Dioxide Regulations for Power Plants, House Committee on Energy and Commerce, Subcommittee on Energy and Power (June 19, 2014), at 88, available at <http://democrats.energycommerce.house.gov/sites/default/files/documents/Preliminary-Transcript-EP-EPA-Carbon-Dioxide-Regulations-Power-Plants-2014-6-19.pdf>.

shortcomings associated with the development, derivation, and application of the SCC” sufficient to “warrant the immediate discontinuation of the use of SCC values in the regulatory context.” They continue:

“OMB has not identified any legal authority for this proceeding, and lacks statutory authority to promulgate rules that would bind the USG to use its SCC estimates in regulatory analyses and agency proceedings. Adoption of the SCC values would be arbitrary, capricious, and contrary to law because such action would be unauthorized by statute and because the TSD is substantively flawed. Because there are no statutory principles to guide OMB’s exercise of discretion, this action also raises serious constitutional concerns under the non-delegation and separation of powers doctrines. In effect, OMB is purporting to exercise nonexistent legislative authority in prescribing policy to be followed by other agencies regarding consideration of the SCC in regulatory analyses and decisions.”⁶

Others before the committee today can review in greater detail the numerous flaws within models, including underlying sensitivity assumptions. Curious choices abound regarding discount rates inconsistent with growth-rate assumptions and the use of international benefits to reducing carbon when international costs are regarded as too speculative. But in short, there are simply too many uncertainties in both the models themselves and in their application to neat and tidy SCC numbers ready to be plugged in to any regulatory impact analysis.

Sometimes, it appears as though the Intergovernmental Working Group (IWG) tasked with developing the SCC is satisfied to simply state that we live in an uncertain world, and therefore our rulemaking process should expect no better. But we do expect better. And it is long-settled administrative law that the Federal Government cannot waive a wand and call magic numbers into existence to justify its activities. The Federal appeals courts have explained why:

“[The agency] must provide a complete analytic defense of its model [and] respond to each objection with a reasoned presentation. The technical complexity of the analysis does not relieve the agency of the burden to consider all relevant factors . . . There must be a rational connection between the factual inputs, modeling assumptions, modeling results and conclusions drawn from these results.”⁷

As one indication that this minimum threshold is not met by the SCC process, consider the fact that the IWG “simply asserts without any documentation or other justification that the FUND, PAGE, and DICE models now stand as the most comprehensive and reliable efforts to measure the economic damages from climate change. No evidence is offered to support that judgment.”⁸

Further, noted MIT economist Robert Pindyck, despite his general support for the SCC conceptual framework, observed that IAMs “have crucial flaws that make them close to useless as tools for policy analysis . . . [; they] are completely ad hoc, with no theoretical or empirical foundation. . . . IAM-based analyses of climate policy create a perception of knowledge and precision, but that perception is illusory and misleading.”⁹

The stakes in the current context are simply too high to proceed without an adequate framework. If OMB wishes to proceed as indicated in its most recent response to comments, then it must stop, propose an open and transparent basis under the strictures of the Administrative Procedure Act (APA) and invite comments on the legal basis for SCC and its use as a factor in justifying regulations.

VIOLATIONS OF THE ADMINISTRATIVE PROCEDURE ACT

OMB has on several occasions reminded the Congress that SCC is not a rule or regulation, but merely an “ingredient” that is used in a broader cost-benefit

⁶UARG Comments on Social Cost of Carbon Technical Support Document and Updates, 78 Fed. Reg. 70,586 (Nov. 26, 2013), Docket ID No. OMB–2013–0007, at 3. See, e.g., *Coal. for Common Sense in Gov’t Procurement v. Sec’y of Veterans Affairs*, 464 F.3d 1306, 1317 (Fed. Cir. 2006) (“The definition of a substantive rule is broad and includes action that is legislative in nature, is primarily concerned with policy considerations for the future rather than the evaluation of past conduct, and looks not to the evidentiary facts but to policymaking conclusions to be drawn from the facts.”) (internal quotations omitted).

⁷*Sierra Club v. Costle*, 657 F.2d 298, 333 (D.C. Cir. 1981) (internal quotations omitted).

⁸Frank Ackerman & Elizabeth A. Stanton, “The social cost of carbon,” 53 *Real World Economics Review* 129 (2010), at 135.

⁹Robert S. Pindyck, *Climate Change Policy: What do the Models Tell Us?*, National Bureau of Economic Research Working Paper 19244 (abstract) (2013), available at <http://www.nber.org/papers/W19244>.

context.¹⁰ But the APA defines a “rule” as including any “agency statement of general or particular applicability and future effect designed to implement, interpret, or prescribe law or policy,” encompassing “the approval or prescription of . . . valuations, costs, or accounting.”¹¹ Contrary to OMB’s conceptualization, the courts have held that the APA definition includes “virtually every statement an agency may make.”¹² If OMB does possess the legal authority to establish an SCC—an open point—under APA it would still have to comply with the full range of procedural requirements, including advance public notice, a full and robust opportunity for comment, and a description of the legal basis and purpose of the SCC mechanism. Any process short of these safeguard would be regarded, in the famous words of the statute, as “arbitrary, capricious, an abuse of discretion, or otherwise not in accordance with law.”¹³

One cannot consider the development and use of SCC as anything other than a substantive rule. After all, OMB claims that SCC is “extremely important . . . measure of what harm to our society will be” in determining regulatory priorities.¹⁴ Once final, the entire Federal Government is to use SCC in determining and calibrating regulatory standards that impose real burden on the regulated community, and beyond that, on the American public at large.

The case study of the EPA is particularly telling, in light of the disproportionate impact the Agency has had in the development of SCC and the operation of the IWG.¹⁵ The costs to the American public of EPA carbon regulation will indeed be large in the context of the Clean Power Plan (CPP) currently under consideration. The Electric Reliability Coordinating Council reviewed the literature on the proposal and found the following:

- The CPP puts the reliability of the U.S. electricity supply at risk. In fact, a growing chorus of independent experts have expressed their concern for the future of America’s affordable, dependable electricity supply were the CPP to take effect.
- Blackouts cause incalculable economic damage. For example, the direct costs to high technology manufacturing in the San Francisco Bay Area alone during the California blackouts alone ran as high as \$1 million a minute due to lost production, and the relatively brief Northeast blackout of 2003 cost business about \$13 billion in lost productivity.
- The CPP will impose tremendous costs on the U.S. economy and the American people. Higher energy prices will produce a ripple effect throughout the U.S. economy that will shutter businesses, deter hiring, cause layoffs, increase the price of essential goods and services, and increase the cost-of-living for all Americans. People living on fixed incomes, like senior citizens and the poor, will be hardest hit by rate hikes.¹⁶

In this case, the OMB would be attempting to “prescribe law or policy” by specifying particular “valuations, costs or accounting” under alleged executive authority, without authorization by Congress, and without following the full and open APA procedures required by law and designed to subject the SCC to rigorous quality assurance. Meeting these APA standards is required before action is taken, not after the numbers are generated time and time again. To date, OMB has cherry-picked

¹⁰ See, e.g., Examining the Obama Administration’s Social Cost of Carbon Estimates, Hearing before the Subcomm. on Energy Policy, Health Care and Entitlements, Comm. on Oversight and Government Reform, U.S. House of Representatives (July 18, 2013), at 12 (hereinafter “Shelanski testimony”).

¹¹ 5 U.S.C. § 551(4).

¹² *Avoyelles Sportsmen’s League, Inc. v. Marsh*, 715 F.2d 897, 908 (5th Cir. 1983).

¹³ 5 U.S.C. § 706(2)(A).

¹⁴ Shelanski testimony at 12.

¹⁵ While the use of SCC first appeared in relatively obscure U.S. Department of Energy proposed efficiency standards—small engines, coin-operated beverage machines and then microwave ovens—these regulations may merely have been a front to obscure the true beneficiary of the methodology, EPA, an agency committed to far more extensive and expensive rules. The Government Accountability Office (GAO) found in July 2014 that “experts” from the Council of Economic Advisors that had been detailed to the IWG were from EPA, and by the time the methodology was changed and expanded, had even returned to the Agency but still maintained seats on the IWG. With respect to each of the IAM models, it was EPA that made the presentations on how the models worked, and it was EPA that supervised the running of those models to generate the SCC numbers. GAO, *Regulatory Impact Analysis: Development of Social Cost of Carbon Estimates*, GAO-14-663 (July 2014), at pp. 10–15.

¹⁶ ERCC Comments on EPA’s Proposed Clean Power Plan (June 2014), ID No. EPA-HQ-OAR-2013-0602, available at <https://www.cibo.org/wp-content/uploads/2014/07/ERCC-Comments-on-111d.pdf>.

the administrative process by selecting models, generating estimates, and applying them—all before seeking any comment.

OPENNESS AND TRANSPARENCY

President Obama famously instructed heads of executive departments and agencies that:

“My administration is committed to creating an unprecedented level of openness in Government . . . Transparency promotes accountability and provides information for citizens about what their Government is doing. Information maintained by the Federal Government is a national asset.”¹⁷

OMB Director Peter Orszag offered further definition as to how these principles would be implemented:

“The three principles of transparency, participation, and collaboration form the cornerstone of an open government. Transparency promotes accountability by providing the public with information about what the Government is doing. Participation allows members of the public to contribute ideas and expertise so that their government can make policies with the benefit of information that is widely dispersed in society. Collaboration improves the effectiveness of Government by encouraging partnerships and cooperation within the Federal Government, across levels of government, and between the Government and private institutions.”¹⁸

The development of SCC by the IWG has not lived up to the Administration’s explicit commitment. The Federal Government has never discussed openly the fundamental questions regarding the purpose, development, derivations, and bases for applying the SCC in the rulemaking context. These would be the essential elements of transparency and openness as it applies to SCC. Instead, the Administration has only narrowly sought comment on the November update to the May 2013 TSD, an 11-page document modifying the February 2010 document. The choice of models, and their operation, has not undergone peer review, let alone public comment.

RECENT RESPONSE TO COMMENTS

While the IWG has now offered brief response to sophisticated comments challenging the veracity of the SCC development process, the July 2 Response to Comments (RTC) document still forms an inadequate basis for utilizing the SCC in the rulemaking or administrative process.

First, IWG admits that despite the comments filed, it still plans “to seek independent expert advice on technical opportunities to improve the SCC estimates, including many of the approaches suggested by commenters . . .” This independent assessment will come from a tasking of the National Academies of Sciences, Engineering, and Medicine, or NAS, to “examine the technical merits and challenges” present in the effort to improve SCC. But IWG candidly admits that the NAS “review will take some time” during which time “IWG continues to recommend the use of the current SCC estimates in regulatory impact analysis . . .” The only actual revisions to the SCC are described by IWG as constituting “a minor technical revision.”¹⁹ This gets the comment process precisely backwards. Until the NAS has completed its work, the SCC remains too imprecise for use in the policymaking context and should not be utilized. As the IWG reminds readers throughout the RTC, direct costs and benefits to proposed rules and actions may continue to be measured outside of the elaborate artifice of SCC; there is no need to subject the American taxpayer to the results of SCC-driven policy when NAS review is still underway.

Second, the RTC demonstrates continual conflating of policy outcomes under the guise of SCC economic objectivity. For example, IWG states that it has chosen not even to consider the typical 7 percent discount rate that is consistent with IWG’s own economic growth projections because it believes “special ethical considerations”

¹⁷ President Barack Obama, Transparency and Open Government, Memorandum for the Heads of Executive Departments and Agencies, available at <https://www.whitehouse.gov/the-press-office/TransparencyandOpenGovernment>.

¹⁸ Peter R. Orszag, Dir., OMB, Memorandum for the Heads of Executive Departments and Agencies, Open Government Directive (Dec. 8, 2009), available at <http://www.whitehouse.gov/open/documents/open-government-directive>.

¹⁹ IWG, Response to Comments (RTC): Social Cost of Carbon for Regulatory Impact Analysis Under Executive Order 12866 (July 2015) at 5, available at <https://www.whitehouse.gov/sites/default/files/omb/infocreg/scc-response-to-comments-final-july-2015.pdf>.

may obtain in the context of climate change policy development.²⁰ Whether such special considerations are appropriate is clearly not a matter of economics, but of policy consideration that of necessity must be left to the U.S. Congress.

Third, on the matter of consideration of global benefits to carbon reductions—even when no consideration is given to global “dis-benefits” associated with perpetuating energy poverty²¹—IWG indicates that its preference is based in part on the notion that, “By adopting a global estimate of the SCC, the U.S. Government can signal its leadership in this effort.”²² Again, this is a policy assessment better left to Congress—the importance of leadership—and not an objective economic assessment. Indeed, unilateral carbon policy may not only fail to manifest in a copying effect overseas, it may do the opposite resulting in “leakage” of energy-intensive industries to less energy-efficient economies, resulting in greater carbon emissions world-wide!²³

Thank you for this opportunity to testify. I look forward to working with the committee further as it completes its important oversight tasks.

The CHAIRMAN. Thank you.

I want to thank the witnesses for their testimony, reminding Members that we now will enter the question phase with 5-minute time limits on the questions as well.

As usual, I am going to defer until the other committee members have had a chance to ask questions first. So we will start with Mrs. Lummis.

Do you have questions?

Mrs. LUMMIS. Yes, thank you, Mr. Chairman.

I would like to just begin by saying that I believe climate change is real, and I like to watch programs like “Nova” which is on Public Television, and I recall a program that talked about the climate changes that were going on 300 years ago.

So let’s go back to 1715. Let’s think about the fact that the Delaware River was always frozen in the winter. It was always cooler than it is now because when Washington crossed the Delaware, they were dodging ice chunks to get across the river to get to fight the Hessians that were camped on the other side.

There were years in Europe when summer never came, and it is documented. Hence, I really do believe in climate change.

But my question is this for Dr. Dayaratna. Is it reasonable to use 285 years’ time line projecting into the future, given what we know and do not know about climate change that was going on in the past? Is that an appropriate time line to guide regulators?

Dr. DAYARATNA. Thank you for your question.

I do not think it is an appropriate time line because it is difficult to envision what things would look like that far into the future,

²⁰ RTC at 21.

²¹ For more on energy poverty, see e.g., Rep. David McKinley, “Powering Africa by Investing in Coal,” The Hill, Aug. 8, 2014 (citing WH “Next Generation” summit, McKinley observes, “Poverty-stricken countries need access to all forms of energy, not just the forms approved by the Obama administration or the World Bank . . . Without energy, it’s impossible to educate children and give them a brighter future. Without energy it is impossible to grow businesses and encourage entrepreneurship.”), at <http://thehill.com/blogs/congress-blog/energy-environment/214604-powering-africa-by-investing-in-coal>.

²² RTC at 31.

²³ For a fuller explanation of the leakage effect, see ERCC Comments Submitted to EPA on the New Source Performance Standards for Power Plant Carbon Emissions (June 25, 2012), at <http://www.electricreliability.org/ercc-comments-submitted-epa-new-source-performance-standards-power-plant-carbon-emissions> (citing Maguire Energy Institute report and other studies demonstrating that, “Carbon leakage means that the domestic climate mitigation policy is less effective and more costly in containing emission levels, a legitimate concern for policy-makers.”).

just like our Founding Fathers would have no idea what the American economy would look like today. So that is exactly why, when I reran these models in my work, I actually re-estimated them using a shorter time horizon.

And my colleague, Pat Michaels, can also chime in on that.

Dr. MICHAELS. Yes, could you put up the last image I showed? That one right there.

[Slide.]

Congresswoman Lummis, this is a graphic that shows the profound failure of the climate models that are at the basis for the social cost of carbon calculations. It is done by Roy Spencer and John Christy. It was presented in front of this committee. It is the free atmosphere temperature in the dots and the squares taken from weather balloons and satellites, and the red is the average of the United Nations climate models that are capable of measuring free atmospheric temperature.

This graph speaks for itself. If you think we are supposed to be able to do 285 years, the fact of the matter is, we cannot do 20.

Mrs. LUMMIS. Now, Mr. Segal, given those responses, I want to shift and ask this question. Can you explain how this social cost of carbon rule is impacting the cost-benefit analysis of major rules and regulations, like vehicle efficiency standards and the EPA's proposed carbon regulations?

And I further want to ask you: do you believe that the automobile, the internal combustion engines that we use today in some vehicles, will be the same 285 years from now?

Mr. SEGAL. Well, I will answer the last one first. It might be a little beyond my pay grade, but my supposition is no. I think that automobility and also the way we generate electricity are going to be profoundly different as time marches on.

I also think that those technologies which we will deploy to adapt to the effects of climate change, including flooding, ocean acidity, you know, all of the 30 endpoints that the EPA describes as the accepted endpoints for climate change damage, adaptation is also going to occur that does not take into account in a straight linear progression like these models are.

But as far as the question goes to process and procedure is concerned, we are dealing with a situation of radical uncertainty. I mean, you have seen—not only is the nature of your question illustrative of that, but also the presentations that have just been made.

The choice of the very models that went into this was never subject to notice and comment, was never subject to any type of an analytical framework, and even when the Interagency Working Group asked for comment, they assiduously avoided comment on the question of are the fundamental assumptions appropriate and do they have legal authority to utilize social cost as a mechanism to call balls and strikes.

And what is the result? On two separate fronts, the Environmental Protection Agency utilizes social cost and also utilizes something called co-benefits, which I know you are very familiar with, claiming benefits on the health side to augment the benefits case for rules.

Mrs. LUMMIS. Thank you, Mr. Chairman. My time is up.

The CHAIRMAN. Thank you.

Mr. Lowenthal.

Dr. LOWENTHAL. Thank you.

I just want to check just to understand where I am and ask each member of the panel yes or no. Do you believe there should be any social cost of carbon value that agencies should incorporate into their cost-benefit analysis?

Do you believe that we should be coming up with some cost, social cost of carbon value? Yes or no?

Dr. MICHAELS. Yes.

Dr. DAYARATNA. No.

Dr. DORSEY. Yes.

Mr. SEGAL. I'm a lawyer. I can't do yes or no. After an——

Dr. LOWENTHAL. Yes or no?

Mr. SEGAL. After administrative process that's sufficient, yes.

Dr. LOWENTHAL. OK.

Mr. SEGAL. Right now, no.

Dr. LOWENTHAL. So you believe it, yes. You are just saying——

Mr. SEGAL. Yes.

Dr. LOWENTHAL. So you believe that it is not. So I believe that three of you have said yes there is some social cost, we should be having a social cost. So we are really arguing now about a model, not whether we should be reducing.

Do you also agree we should be reducing greenhouse gas emissions in order to lessen the impact on climate?

Dr. MICHAELS. Are we going down the platform?

Dr. LOWENTHAL. Yes.

Dr. MICHAELS. Not necessarily. There are some——

Dr. LOWENTHAL. Not necessarily. Thank you. That is it. Next person.

Should we be lessening, should we be reducing greenhouse gas emissions in order to lessen the impact on climate? Yes or no.

Dr. DAYARATNA. The short answer is no.

Dr. LOWENTHAL. No, and this is—and the first answer was what, maybe?

Dr. MICHAELS. It was not necessarily.

Dr. LOWENTHAL. Not necessarily.

Dr. MICHAELS. Negative can be a benefit.

Dr. LOWENTHAL. So you are saying it is a benefit also.

Dr. MICHAELS. It can be.

Dr. DORSEY. Absolutely.

Dr. LOWENTHAL. Absolutely.

Mr. SEGAL. Sure, I will go along. Yes.

Dr. LOWENTHAL. So we should be reducing it. We are only talking about now, the formulas that we use, not that it exists at all.

So I want to ask how you came up with these kinds of things. Dr. Michaels, your sensitivity estimates that you have given us which you say reflect this new scientific reality, I just want to say that in the past you also have had a number of other predictions. You predicted that the Toyota Prius would never be profitable because clean energy could not be cost effective at scale. It is now the third best selling car.

You attacked the mainstream scientific position on the depletion of the stratospheric ozone layer, and now we understand that the mainstream position was right.

On climate change, you wrote in 2013, it is a pretty good bet that we are going to go nearly a quarter of a century without warming, and now we know that 2014 was the hottest year on record by many indicators.

So with that kind of background, I am just trying to understand who you are. You're a member scientist of the Advancement of Sound Science Coalition, which is an organization that was created and funded by the tobacco industry to fight anti-tobacco legislation.

Now you work for Cato, which is a documented climate denier funding, and you are asking us to trust you on that.

Were you a member scientist or did you play a role in the Advancement of Sound Science Coalition?

Dr. MICHAELS. That was very long ago.

Dr. LOWENTHAL. Were you?

Dr. MICHAELS. If I played a role, it was certainly minimal.

Dr. LOWENTHAL. Were you a member?

Dr. MICHAELS. I have to address—

Dr. LOWENTHAL. Were you a member?

Dr. MICHAELS. Yes, I was. I was—

Dr. LOWENTHAL. Thank you.

Dr. MICHAELS [continuing]. Not active. May I answer your question, your assertion about no warming for 25 years and then you said, well, 2015 is a very warm year so you have to be wrong about that?

Dr. LOWENTHAL. 2013.

Dr. MICHAELS. 2013, 2015, whatever. The fact of the matter is—

Dr. LOWENTHAL. You say in 2013 it is going to be a quarter of a century without warming, and we now know that 2014 was the hottest.

Dr. MICHAELS. Yes, but that did not induce a significant warming trend. The problem is that there are so many background years where there is no warming that even if we resumed the warming rate that occurred from 1976 through 1998 of .17°C per decade—

Dr. LOWENTHAL. Thank you. I do—

Dr. MICHAELS [continuing]. We would have to go 25 years to get to a significant warming trend.

Dr. LOWENTHAL. I have one. Mr. Dayaratna, you work for an organization that not only takes fossil fuel funding, it takes funding from the two organizations—Donors Trust and Donors Capital Fund, which are the largest funders of climate denial efforts.

Does this money ever end up in your pocket?

Dr. DAYARATNA. Congressman, I do not interact with any of the donors whatsoever, and in fact, on the last page of my testimony—

The CHAIRMAN. I appreciate your willingness and desire to answer the question. Time has elapsed.

Dr. DAYARATNA. OK.

The CHAIRMAN. I understand it is somewhat unfair to ask you those questions when you have 2 seconds left, but tough.

So as we continue our expulsion of greenhouse gas with more questions from the committee, Mr. Gohmert.

Mr. GOHMERT. Thank you, Mr. Chairman.

Thank you to the witnesses for being here, and I will try to speak softly so I put out less carbon dioxide.

I am reading an article from yesterday, and it was in numerous publications, but it is saying that the Arctic ice cap has not, contrary to the predictions of climate alarmists, completely disappeared. In fact, it has been growing rapidly, increasing by almost a third just in 2013 and more since. It would suggest that the sea ice is more resilient perhaps. If you get one more year of cooler temperatures, we would almost wind the clock back a few years on this gradual decline that has been happening over the decades.

And that was what Rachel Tilling was telling the BBC, but the Arctic ice has, indeed, chewed up a bit and it goes on to talk about its thickness and its size. Does anybody have an answer for what is causing the increased ice in the Arctic?

Dr. MICHAELS. That is something called natural variability. If I could expand upon your question with a piece of information the committee may find interesting, a scientist by the name of McDonald at UCLA has done extensive work on Eurasia and has discovered that the high Arctic in the Eurasian area was about 7 °C warmer, that is 13 °F warmer, on and off for 3,000 years after the end of this Ice Age.

That means for 3,000 years the Arctic Ocean was likely to be ice free at the end of summer. That was the norm, not the exception.

I would offer you the observation that the polar bear survived and there is much corroborating evidence that shows evidence for the ice-free Arctic Ocean for 3,000 years.

Thank you.

Mr. GOHMERT. And I do appreciate information, Dr.—tell me how to pronounce your name?

Dr. DAYARATNA. Dayaratna.

Mr. GOHMERT. Dayaratna. Thank you.

Because this was something that I had been thinking about not from a scientific standpoint, but from the standpoint that I am in now, and that is representing 700,000-plus people in east Texas. But talking especially to my seniors, they tell me that there is a tremendous social cost in not being able to warm yourself in your home in wintertime, there is a tremendous social cost in not being able to cool yourself in east Texas in the summertime, that there is a tremendous social cost in not being able to heat their food to the point that it kills bacteria, and that there is a tremendous social cost in not having advanced emergency rooms and operating rooms to take care of them when they have a problem.

So I appreciate you taking that social cost into consideration because, especially my seniors, but I think everybody in Texas appreciates what we are able to do and improve not just our standard of living, but our ability to live, and that should be factored in.

Dr. Michaels, I was reading here that the warming of the late 20th century as well as the cessation of warming that occurred since 1998 fall well within the range of natural climate variability. That seems to be an ongoing issue.

If I understand right from history, which was my major in college, at the time of Eric the Red and others sailing, actually things appear to have been warmer in Greenland than they are today, more ability to farm.

Does anybody care to comment on that?

Dr. MICHAELS. It was not called Greenland because it was red.

Mr. GOHMERT. Pardon?

Dr. MICHAELS. It was not called Greenland because it was red.

Mr. GOHMERT. Well, were they able to farm?

Dr. MICHAELS. Yes, they were, and then when the cooling occurred with the initiation of the Little Ice Age, it chased the European settlers off of Greenland.

Mr. GOHMERT. Well, they obviously were not taking accurate temperatures back then, but from what data we have, was it warmer back in those days—

Dr. MICHAELS. Yes, yes.

Mr. GOHMERT [continuing]. Than it is today?

Dr. MICHAELS. And it was also apparently as warm if not warmer in the 1940s, 1930s to 1940s and into the 1950s in Greenland.

Mr. GOHMERT. Yes.

Dr. MICHAELS. A lot of people do not know that.

Mr. GOHMERT. Well, apparently there were a lot of carbon emissions from those sailing vessels that came across the Atlantic.

I yield back.

The CHAIRMAN. Thank you.

I assume I am going down the road with you.

OK. Mr. Cartwright.

Mr. CARTWRIGHT. Thank you, Mr. Chairman.

I would like to thank the Chairman and the Ranking Member for holding this essential hearing today. I do understand people come at this from different viewpoints, but it is a relief finally to see Congress debating at least a partial solution to address climate change, even if some folks continue somehow to deny its existence.

I thank the Vice Chairman, Mrs. Lummis, for saying out loud that climate change is real. I thank all of our witnesses, except apparently Dr. Dayaratna, for agreeing that there should be a value assigned to the social cost of climate change.

The social cost of carbon is going to be one tool in our arsenal to mitigate the effects of climate change. The idea is pretty simple. We need to account for the negative or positive carbon-related effects that a project or a regulation may have.

Understanding the environmental impact of a project or a regulation is the essence of the idea of NEPA. It allows us better to understand and value a proposed project or a regulation based on its true impact to society, a goal we really all ought to share.

One comment was made earlier in this hearing, that the value that the Administration has selected for the SCC is not based on peer-reviewed information. I would like to correct that. The SCC was estimated using three integrated assessment models called FUND, DICE and PAGE, each of which are widely cited in the peer-reviewed literature and which are used by the Intergovernmental Panel on Climate Change.

There was also a criticism that there was a lack of public input in this process. Look, the first SCC estimates were released in

February of 2010. Dozens of opportunities existed for public comment about the SCC directly and about rules that incorporated the SCC. So I did not want to let those falsehoods go un rebutted.

Dr. Dayaratna, you began your testimony with something that has been intoned by many witnesses from The Heritage Foundation, "The views I express are my own and do not necessarily represent those of The Heritage Foundation."

Let me ask you a couple of questions, Mr. Dayaratna.

Dr. DAYARATNA. Go ahead.

Mr. CARTWRIGHT. You are an employee of The Heritage Foundation, are you not?

Dr. DAYARATNA. Correct.

Mr. CARTWRIGHT. They pay you for working there; is that right?

Dr. DAYARATNA. Correct.

Mr. CARTWRIGHT. Are you on working hours right now?

Dr. DAYARATNA. I mean, I do not see how that is relevant right now.

Mr. CARTWRIGHT. Do they know you are here?

Dr. DAYARATNA. Yes, they do know I am here.

Mr. CARTWRIGHT. If you do not want me to tell anybody—

Dr. DAYARATNA. Yes, they do know I am here, yes.

Mr. CARTWRIGHT [continuing]. Your secret is safe with me.

[Laughter.]

Dr. DAYARATNA. Yes.

Mr. CARTWRIGHT. I could not help noticing you submitted written testimony as well; is that right?

Dr. DAYARATNA. Yes.

Mr. CARTWRIGHT. And that appears to be on Heritage Foundation stationery.

Dr. DAYARATNA. Yes, it is right here.

Mr. CARTWRIGHT. Are you allowed to use company stationery?

Dr. DAYARATNA. Yes. I mean, to be quite honest, if a professor from the university comes here and testifies, they may submit their testimony on the university letterhead.

Mr. CARTWRIGHT. Thank you. We do expect—

Dr. DAYARATNA. That does not mean that they are testifying on—

Mr. CARTWRIGHT [continuing]. You to be quite honest, Dr. Dayaratna.

Dr. DAYARATNA [continuing]. Behalf of the university.

Mr. CARTWRIGHT. What I did notice when I went on the official Web site of The Heritage Foundation, is it says in black and white, "Climate policy is used too often as a vehicle to advance special interests and politically-driven agendas that centralize more power in Washington."

That is the official view, and it appears to be that they are against climate change regulations and examinations of this sort, and I suppose that gels very nicely with your view that we should not be appointing a particular figure for the social cost of carbon in distinction with all of the other witnesses here today.

Are you telling us that your views and your opinions, that coincide nicely with the official views of The Heritage Foundation, do so as a coincidence?

Dr. DAYARATNA. Again, as I was referring to earlier, if a professor from a university comes here and they testify, they may submit their testimony on university letterhead. That does not mean whatsoever that they are representing the views of the university.

And my views, again, as in my written testimony and as I said today, do not represent those of The Heritage Foundation.

Mr. CARTWRIGHT. All of us who believe that climate change is happening, I think all of us understand that the longer we wait to address climate change, the more money we will have to spend on adaptation relative to climate change, and that is why I have introduced the bipartisan and heavily Republican supported bill, the PREPARE Act, that requires all branches of the Federal Government affirmatively to prepare and plan for climate change into the future.

With that I yield back, Mr. Chairman.

The CHAIRMAN. Mr. Fleming.

Dr. FLEMING. Thank you, Mr. Chairman.

I would like to specifically question Dr. Michaels and Dr. Dayaratna. I am a physician by training. What we do is we evaluate things based on evidence, what we call evidence-based science. That is why modern medicine is so far advanced just since the 1940s, and so that is key here.

Now from the data, what I see is that there is a zero percent accuracy in prediction of global warming, which by the way, experts tell me that if you cannot predict it, you do not understand it.

So we have a zero percent prediction of global warming. But we have 100 percent accuracy when it comes to economic damage of global warming policies in terms of shutting down coal-fired plants, the effect on the economy, on jobs, and on electricity rates. So we are not really doing very well in dealing with these policies.

But it is also interesting that whenever we get into these discussions, and I must apologize to you for my colleagues who would rather focus on who you work for rather than what the actual science is. I think that is very telling, rather than really let us talk about the science, and that is what is so important.

Dr. DAYARATNA. Thank you, Congressman.

Dr. FLEMING. Also, I am going to give you a chance in just a moment to respond any way you want, but the other thing is since when did truth in science develop out of consensus? I don't get that.

We don't get doctors together in a room and say we don't know the answers to these questions, but we will just take a vote and we will decide that that is the truth and that is how we are going to treat disease. I have never seen that happen, but that is exactly what is happening with this global warming policy effort.

So I would like for both of you to respond to that.

Dr. MICHAELS. I will give you a brief story which will tell you that it is worse than you even think it is. Every 5 years, the U.S. Global Change Research Program is supposed to produce a document assessing the effect of global climate change on the United States, and to do this, they use computer models. The first of these documents came out in the year 2000, and I reviewed it, and I discovered that both of the models that they used resulted in forecasts

that were worse than a table of random numbers. They actually supplied negative information.

So I wrote to the person who was the head of the USGCRP's effort to produce this report. His name is Thomas Carl, and he wrote back to me and he said, "Yes, you are right. In fact, we have run it for more multiple periods. What you found is correct."

And they went forward with the report. That is like a physician prescribing a drug that he knows is either not going to work or is going to harm the patient.

Dr. FLEMING. Yes.

Dr. MICHAELS. Thank you.

Dr. FLEMING. Yes, sir.

Dr. DAYARATNA. OK. So thank you for your question, Congressman.

I am trained as a statistician, not a climate scientist. So in terms of the peer review, my colleague, Pat Michaels, is probably more apt to answer questions like that.

Dr. FLEMING. Sure.

Dr. DAYARATNA. But as I described in my testimony, I rigorously use the social cost of carbon models in my work with my colleagues, and we noticed that they are basically nothing but garbage in and garbage out. You can essentially manipulate these models to achieve any estimate of social cost of carbon that you would like, basically.

Dr. FLEMING. Right.

Dr. DAYARATNA. You can achieve a negative social cost of carbon. You can achieve a positive social cost of carbon, and you can achieve a wide range of estimates through the Monte Carlo simulations.

Dr. FLEMING. Right. So to give you a comparison, if we were to send a rocket, say, and try to land on the moon and we go through all of the mathematics and computer analysis, but we begin with incorrect assumptions, it is probably not likely we will make it to the moon, correct?

Dr. DAYARATNA. Oh, no, absolutely not.

Dr. FLEMING. So you have to start with known information or at least information that the probability is very high to be correct. But as you point out, we make all sorts of assumptions in these computer models. We put them in, and then we spit them out on the other end and we say the computer somehow knows the truth.

Dr. DAYARATNA. Absolutely.

Dr. FLEMING. But the computer does not know anything that we have not told it; is that correct?

Dr. DAYARATNA. Yes, that is correct. I mean, in these papers they have been cited in the peer-review literature, but I mean, just because they are in the peer-review literature, we need to rigorously check these models and look at them. As I mentioned, they are nowhere near reliable enough to be used for policymaking. Interesting academic exercises, though.

Dr. FLEMING. Just quickly, I get the impression that politics is leading science rather than science leading policy. What is your opinion on that?

Dr. DAYARATNA. That may be true. I think my colleague, Pat, might be able to answer that question.

The CHAIRMAN. Saying it is true is good enough. You've got that. You are over time.

Mr. Beyer.

Mr. BEYER. Thank you, Mr. Chairman.

And thank all of you for coming and talking with us.

Dr. Dayaratna, you cited three criticisms of the social cost of carbon models, and one of them was the use of the discount rate.

Dr. DAYARATNA. Yes.

Mr. BEYER. And argued why not 7 percent.

Dr. DAYARATNA. Yes.

Mr. BEYER. In fact, if you move it to 10 percent or 12 percent, you can get a really negative cost.

Dr. DAYARATNA. Yes, probably.

Mr. BEYER. I am not trained as a statistician but rather as an economist, and so the discount rate is used to determine the present value of some future value, and pretty clearly the discount rate should be the time value of money, which should be the real interest rate, which should be the compound rate of interest less inflation.

So how do we ever get to 7 percent when right now we have an interest rate of zero, which may rise to a half or a quarter percent or 1 percent in the years to come? How do you, even looking at stock market or economic growth over the last hundred years, ever get to a 7 percent when you take the compound growth rate minus the rate of inflation?

Dr. DAYARATNA. Well, I am just simply—

Mr. BEYER. We are trying here so hard to get to 4 percent, less the 1 percent inflation rate, which would give us $2\frac{1}{2}$, 3 percent.

Dr. DAYARATNA. Thank you for your question, Congressman.

I am not even recommending this type of discount rate be used. I am not suggesting that the 7 percent rate be the most appropriate rate. I just ran 7 percent simply because OMB Circular A-4, which I have right here, stipulated that 3 and 7 percent discount rates be used as part of this type of cost-benefit analysis.

Mr. BEYER. Doesn't $2\frac{1}{2}$ or 2 make much more sense?

Dr. DAYARATNA. The IWG could use whatever rate they want, but 3 and 7 percent must be used as part of this cost-benefit analysis, according to OMB Circular A-4.

Mr. BEYER. Having been in business for 41 years, I would love to have a 7 percent compound growth rate.

Dr. Michaels, every day, every day there is a new article in the scientific journal, respected, because I get them all in the incoming month, about the observable effects today, not what the IPCC has generated will happen 5, or 20, or 30 years from now, not a set of models of what the EC is.

I was pleased to see the one that Judge Gohmert mentioned about Arctic ice increasing. It was one of the few outliers, the only outlier I have seen in a year, and if you read the entire article yesterday in the *Post* and the *New York Times*, it actually talked about lots of increased melting but for this winter period in the Arctic.

Look, it is Antarctic ice, 2014, hottest year, the animal migrations, tropical disease spread, sea level rise in the eastern United

States and in the Pacific Ocean, deforestation by insects, et cetera, et cetera, et cetera.

So if we do not use the social cost of carbon, how do we quantify this tragedy of the commons where every little business or every consumer can use carbon and it does not have any impact, but in the large thing we are destroying the planet?

Dr. MICHAELS. Well, Congressman Beyer, thank you for being the gentleman from Virginia that you are.

One thing that you did miss is that the earth has two hemispheres, and in the southern hemisphere the Antarctic ice has expanded as high as it has ever been measured. We do not know why that is, by the way, and it is very puzzling to climate scientists.

But other measures of human welfare and health argue that the macro effects of climate are at least minimal. We live in a world where life expectancy has doubled since 1900 in the industrialized world. Per capita wealth, constant dollars is 11 times what it was.

Now, if life expectancy doubles for 200 million people, that is the equivalent of saving 100 million lives. So it is very hard, when you look at the gross figures as opposed to this scare story or that scare story, to deduce a net negative effect.

And I will leave you one which will seem so counterintuitive, but you are an economist and you will say, "Oh, yes, I get that." In 2004, Bob Davis and I published a paper down at UVA in which we found that the more heat waves there are in urban areas, the fewer people die from heat-related causes. So as it gets hotter, people clearly adapt in their life style.

There is one place in the United States where more people are dying from heat-related causes, and that would be our coldest city, which is Seattle.

Mr. BEYER. You should write a book called "Freakenomics."

Quickly, Dr. Dorsey, why not a social benefit of carbon?

Dr. DORSEY. Why not?

Mr. BEYER. Yes. Why don't we also include that as we look at the social cost, to Dr. Michael's point about doubling life span and others?

Dr. DORSEY. Well, I think implied in the social cost is social benefit to some degree. I mean, we do not include it because that is the way it is framed, but the reality is that we have to look out into the future about these damages.

Mr. BEYER. Thank you, Mr. Chairman.

The CHAIRMAN. Thank you. Thank you for the tone of your questions.

Mr. McClintock.

Mr. MCCLINTOCK. The obvious question that arises as we talk about climate change and global warming is exactly how long has the planet's climate been changing. Any thoughts on that?

Dr. MICHAELS. Ever since we became a planet with an atmosphere in rotation with an uneven surface.

Mr. MCCLINTOCK. I believe that predates the invention of the SUV, does it not?

Dr. Michaels. Yes. Climate is one of those variables that the nature of climate is changing.

Mr. MCCLINTOCK. How long has the planet been warming on and off?

Dr. MICHAELS. The planet has been warming on and off for that same period of time, probably about 3 billion years.

Mr. MCCLINTOCK. Well, I mean just in the recent epoch, just in the Holocene.

Dr. MICHAELS. There was a warming period at the end of the Ice Age. Again, the Arctic ice was gone for much of the three millennium period, then it cooled down—

Mr. MCCLINTOCK. My understanding that I gleaned as a grade-schooler on our field trip to the Museum of Natural History was the planet has been warming on and off since the last Ice Age.

Dr. MICHAELS. Or within the Ice Age. May I dispel a myth here? You will like this answer.

It was warm at the end of the last Ice Age, like I said. It looks like it was 6 or 7°C warmer in High Eurasia. The Arctic Ocean was ice free at the end of summer. But at end of the penultimate Ice Age, the one before this one, it was really, really warm. We did not know how warm it was for a 6,000-year period until a glaciologist by the name of Dorte Dahl-Jensen and her team drilled to the bottom of the Greenland ice. They drilled beyond the 6,000-year warm period, and by looking at the isotopes in the ice and some other aspects of the ice, they could deduce how warm it was.

It was between 4 and 8°C warmer for 6,000 years over Greenland for that period. Now, it was thought maybe before that it might have been 2 or 3 degrees warmer in the summer.

Let me just put that figure in perspective. That 6 degrees times 6,000 years, 36,000 degree-years of warmth beating down on the Greenland ice cap, it lost 12 percent of its ice. Human beings could only do at best 5 degrees for 500 years. That is 2,500 degree-years of heat load. Nature did 36,000 and the place survived.

That is the end of the Apocalypse. Thank you very much.

Mr. MCCLINTOCK. And in the recorded history we know that during the medieval warm period they were growing wine grapes in Northern Britain, and Iceland had a thriving agricultural economy for some 500 years.

We also know toward the end of the Little Ice Age, also within recorded history, that exorcisms were being performed on glaciers and people being burned as witches because they were causing this terrible period of cold.

I cannot help but see certain parallels between those days and these. My friends on the other side of the aisle remind me of something Ogden Nash once wrote. He said, "The ass was born in March. The rains came in November. Such a flood as this," he said, "I scarcely can remember."

Let me go on. Has there been an analysis of how much damage is already being done to the economy because of all of the regulations and fees that are being imposed in the name of saving the planet from global warming that has been going on since the last Ice Age?

Dr. MICHAELS. It is a Sisyphean task, but we are working on it in our laboratory.

Mr. MCCLINTOCK. Well, if the planet continues to warm, isn't plentiful and inexpensive energy a good thing, not a bad thing?

Dr. MICHAELS. Yes. Kevin, why don't you answer that?

Dr. DAYARATNA. Yes, Congressman. I have actually researched this and looked at the economic impact of actually instituting the proposed regulations associated with the SCC by instituting an appropriate carbon tax in conjunction with what the SCC is estimated to be, starting at \$37, and we see pretty significant impacts to the economy.

By 2030, there would be over 1 million lost jobs, 500,000 which would be manufacturing jobs, and a marked increase in unemployment and a decline in personal income. So the country would be much worse off actually as a result of these regulations or taxes.

Mr. MCCLINTOCK. Well, let me ask you this. Can we not reasonably expect that the planet is going to continue to warm and cool as it has for billions of years, whether or not we deliberately impoverish our economy?

Dr. MICHAELS. Yes, and there will be an additional increment probably of greenhouse warming in the 21st century.

Mr. MCCLINTOCK. Let me make one other—oh, I am out of time.

The CHAIRMAN. Yes, but thank you for telling me there was a time when it would have been easier for me to get a tan. I appreciate that.

Mrs. CAPPS.

Mrs. CAPPS. Thank you, Mr. Chairman, for this amazing hearing and all of you for your testimonies.

I am going to start with the premise that is abundantly clear to me, which is that the earth's climate is changing and human activity is influencing these changes, and I believe we need to stop debating this reality and start working on solutions.

Second, the fact which was very well stated by Mr. Sablan from personal experience, that the changing climate is already negatively impacting our economy, our environment and human health, and these impacts will only grow worse over time.

These changes include sea level rise, destruction of our agricultural systems and food security, increased rates of asthma which we see in southern California, more extreme storms and droughts, among many others. These changes will not impact all people or places in the same ways. So while precisely predicting future outcomes, costs, and benefits associated with climate change is difficult, scientists and economists can provide good estimates of some of these impacts, and these are what are used to calculate social cost of carbon, which is essentially a policymaking tool, not perfect, but useful, and hopefully will improve over time.

Mr. Dorsey, certain assumptions are important for any scientific endeavor, including the development of models such as the one used to calculate the social cost of carbon. In this case the assumptions used for SCC are quite conservative, are they not?

If all the known impacts of climate change were added in, would we not likely see the cost estimate increase?

Dr. DORSEY. I think that is absolutely the case, Congresswoman Capps. The reality is, like I said, some in the fossil fuel sector have an incentive to basically augment the discount rate as Dr. Dayaratna was proposing and essentially reduce the actual cost.

Mrs. CAPPS. Right.

Dr. DORSEY. The real huge cost, and many of which we are not actually accounting for, there is a great number of omitted costs

that are not actually taken into account in this valuation. It is, indeed, as you say, a tool.

Mrs. CAPPS. Well, let me turn to another topic which our colleagues across the aisle have joined with the fossil fuel industry in claiming the social cost of carbon will be used to open the door to limitless new regulations.

But, Mr. Dorsey, is it not true that the social cost of carbon actually serves as a limitation tool to ensure that the benefits of reducing carbon emissions are properly accounted for?

Dr. DORSEY. Absolutely. I would challenge this idea that there are adverse effects on the economy. The reality is that when we get carbon pollution out of the atmosphere not only does it help to abate unfolding climate crisis and climate change. It also addresses things like you just pointed out in terms of pollution, asthma, and so forth, and a great number of health concerns.

I think really to put it in a nutshell, there are no jobs on a dead planet, and so we have really got to think about what are going to be the steps to move us to quickly reducing carbon pollution in the atmosphere that benefit not just the economy, but society, the polity, as well as the environment.

Mrs. CAPPS. Right. And by setting a consistent value for the cost of carbon, which many companies are already doing on their own, doesn't the social cost of carbon actually provide some long overdue certainty for the private sector?

Dr. DORSEY. Absolutely. A great number of companies in your district as well as in many other Members' in this committee districts are proposing actually quite more stringent steps in reducing emissions, their own company emissions, and because the reality is that doing so is good for their bottom line.

Mrs. CAPPS. You have already said a little about this, but we have heard so much from the Majority that the discount rate used for these calculations should be set much higher at 7 percent. Would you like to comment?

Do you agree? Wouldn't setting the discount rate so high essentially say we place minimum value on the quality of life for future generations?

Dr. DORSEY. A very high discount rate would indeed do that. I mean, there is an argument that it should be negative and thus driving up the social cost of carbon, and such a high rate would actually accelerate the efforts to take carbon pollution out of the atmosphere.

Mrs. CAPPS. I yield back, Mr. Chairman.

Dr. DORSEY. Thank you.

Mrs. CAPPS. Thank you.

The CHAIRMAN. Thank you.

Mr. Duncan.

Mr. DUNCAN. Thank you, Mr. Chairman.

I agree with Mrs. Lummis. I do not disagree with climate change. I do disagree and I am not a believer in man-made climate change. I think the climate has been changing, as we have heard testimony earlier, since the beginning of time.

I will say this. Trey Gowdy from South Carolina, my colleague, says that there is a stubborn thing about facts, and that is that they are facts. So let's talk about some facts.

Let's talk about that the earth has been a lot warmer than it is today in the history of man. In the period known as the Medieval Period and during the Middle Ages, it goes by both names, but somewhere 900 to 1300, somewhere in that period of time the earth was a lot warmer than it is today.

In fact, the facts show that grapes were at a higher latitude, and that means the earth was warmer during that period, showed abundant crops. In fact, man did so well that we saw this renaissance, for lack of another term, where cathedrals were built and there was art, and man did not have to struggle to survive as much as they do when it is colder.

In fact, the earth was warm. They had abundant food. They were able to do a lot of things. In fact, the facts show that a lot of Greenland was ice free. So the Nords settled on that area and they fished. Those are the facts that can be proven.

I believe that my qualifier when I think about climate change is the human standard of living. Are human beings better off by using fossil fuels or not? And I would say that they are.

Let's talk about some facts. The facts are better than predictions. In the 1970s and into the 1980s, we saw a lot of folks predicting the earth would be cooler. We are entering into a little Ice Age.

In fact, in 1975, *Nature* magazine said this, "a recent flurry of papers has provided further evidence for the belief that the earth is cooling. There now seems little doubt that changes over the past few years are more than a minor statistical fluctuation."

James Hansen at NASA in 1986 predicted that temperature changes of .5 to 1 degree higher in the 1990s and 2 to 4 degrees higher in the first decade of the 21st century. That is a NASA scientist who is pointed to as a climatologist.

Accordingly, actual data shows that he was way, way wrong. So you take that data from Mr. Hansen, and Mr. Bill McKibben, who is a leading climatologist for global warming or what is called now climate change, he predicted then using Mr. Hansen's prediction, and he stated confidently that the world "will burn up, to put it bluntly." That was Mr. Bill McKibben.

We have seen nothing of the fact. All these predictions of global cooling have been wrong. All the predictions of global warming and what we would see in the 21st century were wrong. But I will tell you this. Fossil fuels have dramatically improved the lives of human beings. Man does better when it is warmer.

I go back to the Medieval Period and the Middle Ages. When it was warm, man did well. When it got colder, which it did after what is known as the Medieval warming period, it got colder and we had Bubonic Plague. Man does not do well when it is cooler. They do better when it is warmer.

Fossil fuel has increased our abilities. In fact, because of fossil fuels, we are now seeing China and India use more fossil fuels and we are seeing the standard of living go up. We are seeing personal percentage of GDP go up. We are seeing life expectancy in China and India go up. People live longer. They are living better lives because of fossil fuels. So I think that ought to be the standard.

So in the 1970s, earth was going to be cooler. In the 1980s and 1990s we saw it was going to be warmer. Now it is just called

climate change. I know this. I had a premature son. He was able to go into an incubator. He was kept alive based on that.

There are parts of the world that do not have access to ready, reliable, affordable fossil fuels to generate electricity. Because of that failure to have electricity, they cannot have incubators or generators to do C-sections. Children die. The infant mortality rate in areas that do not have access to cheap, reliable, predictable electricity provided by fossil fuels have very low life expectancies. Fossil fuels work.

That is the social cost and the moral cost of not having cheap, reliable fossil fuels.

With that I yield back.

The CHAIRMAN. Thank you.

Mrs. Torres.

Mrs. TORRES. Dr. Dorsey, is the social cost of carbon a brand new concept?

Dr. DORSEY. Absolutely not, no.

Mrs. TORRES. Thank you.

Before the social cost of carbon, how would the government value economic damages in the regulatory context, like damage from flooding, increased health care costs, or the economic damage to the agricultural sector?

Dr. DORSEY. Well, as I said at the outset in my testimony, the typical method was to use benefit-cost, and cost-benefit analysis to do so, to attempt to do so.

Mrs. TORRES. And if we threw away the social cost of carbon and stopped putting those costs on the blocks, would the cost of those damages magically go away?

Dr. DORSEY. No, absolutely not. They would still be there. If we opted not to value the cost of carbon—

Mrs. TORRES. So there is no magic eraser and a board that we can just make all of this reality go away?

Dr. DORSEY. Absolutely not, no.

Mrs. TORRES. So are we already paying for these costs?

Dr. DORSEY. Well, absolutely. I mean, you take, for example, in Alaska where a great number of communities are already in the process of relocating. The low end of some of those community relocation estimates put them in the two hundreds of millions of dollars, sort of the middle range, half a billion dollars to relocate communities that are suffering the effects of essentially rising sea level on the North Slope of Alaska.

We pay a great number of costs in terms of the health effects from carbon pollution. We do, indeed, pay these costs whether or not we decide to make the calculation or not.

Mrs. TORRES. I live about 60 miles from the beach. I am looking forward to having beachfront property in the near future. So if we are already paying for these costs, all we are doing with the social cost of carbon is really acknowledging the existence of these costs, correct?

Dr. DORSEY. Right. It is a framework for acknowledging those costs.

Mrs. TORRES. It is a framework that we ought to be utilizing as our population continues to grow and we continue to expand,

whether it is through development or just population growth, preparation for that, correct?

Dr. DORSEY. That is right.

Mrs. TORRES. Is there anything else you would like to add to that?

Dr. DORSEY. Well, I guess I would add since the conversation has moved this way a little bit, that I just re-emphasize the point that this is not a new sort of approach. It is one that is rooted in the peer review literature, and more importantly, it is not a static measure. It is one that we can re-evaluate and come back to and adjust going forward as we learn more about the severity of the unfolding climate crisis.

And my colleague and I believe that the discount rate that is being used is somewhat high and it needs to be lower to reflect a much larger social cost of carbon.

Mrs. TORRES. So what you are saying is that these policies are really not written in concrete. We can go back and revisit, should climate change in the opposite direction.

Dr. DORSEY. Well, absolutely, but the tendency is not that it is going to go in the opposite direction. It is likely to get worse really with that issue, and we can adjust as it gets worse as well.

Mrs. TORRES. Right. What do you have to say to first responders? Their job is a bit more challenging as they prepare to respond to catastrophes that happen because of climate change.

Dr. DORSEY. Not being a medical doctor, I think that, indeed, I would concur that the challenge is difficult. They certainly need more and more resources. We know in a great number of places, particularly take the tri-state area—Connecticut, New York and New Jersey—in the aftermath of Hurricane Sandy. Tremendous additional resources could have been used in that area.

We know the same thing in the Gulf after Hurricane Katrina. We are looking at the 10th anniversary of that. So I would say that we need to provide more resources to first responders certainly.

Mrs. TORRES. Thank you for your testimony.

I yield back.

The CHAIRMAN. Thank you.

Mr. Gosar.

Dr. GOSAR. Yes, Mr. Chairman.

Before I go into my testimony, I would like to have the Iran deal placed into the record in regards to trying to take away coal from the United States but it is good enough to sell to Iran for their uses.

The CHAIRMAN. Without objection.

Dr. GOSAR. Thank you.

First of all, I am extremely disappointed that the Office of Management and Budget declined to testify today. I am not surprised though, as apparently the Administration is just making this stuff up as they go.

The flawed estimates and the worthless models that are of today's topic were developed behind closed doors and are so indefensible that it makes sense why the Obama administration will not want to send a single person to answer on those questions.

Just as the President has used the Department of Justice, the IRS, and the Department of Homeland Security as a political

weapon, he now has expanded his arsenal to include a new tool for the EPA and his regulatory henchmen.

The far-reaching application of this new climate change model is so broad and inaccurate that there is no telling how many jobs will be lost as the President seeks to further his far left political agenda by any and all means necessary.

The so-called social cost of carbon will result in the death of the conventional cost-benefit analysis utilized for the proposed regulations. It will be replaced with a system that employs flawed calculations that are not based on real science and which cannot be accurately reproduced in the real world.

If we allow this to move forward, regulatory agencies will be able to cook the books to whatever manner they dream of.

Now, Mr. Segal, it is great to see you. Because this Administration continues to be so secretive about the new climate change models, 10 U.S. Senators sent a letter yesterday demanding the EPA provide all documents and communications relating to the SCC.

Now, as you know, the Administration refuses to comply with requests from Members of Congress about this new model and has done so for some time now. In your opinion, why the secrecy?

And why didn't one of the President's minions show up today to answer questions about the application of this new climate change model?

Mr. SEGAL. Well, first of all, with respect to the letter that was sent the other day from the Senate, it raised some very, very important points and some of which I think you have heard on review here. It said that the Administration has only provided general information. They have outright ignored requests for documents. They have not even discussed who the actual participants were in the Interagency Working Group. You would think that would not be deliberative. You could say he was actually in the room. That does not seem too bad.

Also if you look at the GAO, the Government Accountability Office's report on the development of this process, they spent an inordinate amount of time talking about how the agency which charges us the most for carbon regulations, the U.S. Environmental Protection Agency, actually played a disproportionate role in the Interagency Working Group process. Yet that was not what Howard Shelanski at OIRA testified to last time he was before Congress.

So I do think it is a shame that a member of the Administration cannot be here to testify on these matters.

Second, I really do not see the Administration as being particularly transparent. Look, President Obama himself and his then-head of the OMB, Peter Orszag, said we were going to be the most transparent administration ever. That has not been the case here.

In fact, the very way this document has been rolled out, vending machines, small engines—and by the way, when they talk about small motors, they are talking about motors that are smaller than household blenders, all right?—and microwave ovens, this is where we get our indication of the changes that were made.

If they wanted to have an open and robust discussion, then the owner of a major utility, for example, in Arizona ought not to have

to be looking to see what the coin-operated vending machine folks are getting in their rules. It is obviously an opportunity to hide the ball.

Last item, I have heard some Members of Congress say, and I heard my colleague Dr. Dorsey say, that he thinks it ought to be a negative discount rate because it ought to drive policy outcome. I heard two Congressmen indicate it is a policymaking tool. Ladies and gentlemen, if it is a policymaking tool, it needs authorization by the policymaking body, the U.S. Congress. We must be able to point to where in legislation this is authorized, and then we must have full and robust notice and comment rulemaking, starting with the choice and the administrative record about the various records. We've got to have it all.

Dr. GOSAR. I believe the Antideficiency Act is very specific about that. It must be defined specifically in statute and policy, and then let's define the budget to go with that before the agency or the President can spend it.

So I thank you very, very much for your testimony.

I yield back.

The CHAIRMAN. Thank you.

Mr. Westerman.

Mr. WESTERMAN. Thank you, Mr. Chairman.

In the narrow topic of today's hearing of SCC, we could and have talked about many other peripheral issues related to the social cost of carbon, such as the science, the models behind the calculations, the impact of man on greenhouse gas emissions and things like 300-year economic investment horizons.

In thinking about this in this narrow scope, I thought of a quote by a guy who is recognized as a pretty smart guy in today's terms, Steve Jobs. He said that you cannot connect the dots looking forward. You can only connect them looking backwards. So you have to trust that the dots will somehow connect in your future. You have to trust in something, your gut, destiny, life, karma, whatever. This approach has never let me down and has made all of the difference in my life.

So if we think about the social cost of carbon, we know that man-made carbon emissions can be traced back to the Industrial Revolution, and as carbon emissions increased, real wages increased, meaning that they rose faster than inflation. Agricultural production increased, meaning food supply and quality increased. Populations increased. Life expectancy increased, and quality of life improved. Technology and health care improved.

At the same time, poverty rates decreased. Mortality rates decreased, and social barriers were removed. So until the EPA figures out how to permit and regulate acts of God, then there is not really anything we can do about autogenic greenhouse gases.

And in the narrow window of the social cost of manmade carbon, please help me look back and in the words of Mr. Jobs connect the dots. So I've got just a series of questions here. The first one is: can the increase in manmade carbon be correlated with the advent of the Industrial Revolution and advancements since then? Just go down the panel.

Dr. MICHAELS. Yes.

Dr. DAYARATNA. Yes.

Dr. DORSEY. Yes.

Mr. SEGAL. Of course.

Mr. WESTERMAN. Pretty obvious, pretty common sense. We can look back on history and see that.

OK. So also to follow up with that, can multiple indicators of quality of life and social benefits be connected to the Industrial Revolution and advancements since then?

Dr. MICHAELS. Yes.

Dr. DAYARATNA. Yes.

Dr. DORSEY. Yes.

Mr. SEGAL. Yes.

Mr. WESTERMAN. Again pretty self-explanatory.

I took a logic class in college, and they said, if this, then this. So if the Industrial Revolution correlates with increased carbon emissions and the Industrial Revolution also correlates with increased social benefits, is it fair to say that as carbon emissions have increased, the social benefits to society have increased?

Dr. MICHAELS. I believe I said that earlier.

Dr. DAYARATNA. Yes.

Dr. DORSEY. Not exactly.

Mr. WESTERMAN. Could you explain that more?

Dr. DORSEY. Well, I mean it does not necessarily follow. Technology is not a static thing, and you certainly must be aware of this based on the questioning here.

So it just so happens that we have found some technologies that have been around actually a while that do not need us to rely on fossil fuels and do not need us to rely on increasing emissions, and so there is an opportunity we have to deploy those technologies. Those are technologies in the renewable space in terms of wind energy, in terms of solar energy, and they—

Mr. WESTERMAN. Many of those technologies we were using before the Industrial Revolution, such as biomass and wind.

Dr. DORSEY. Well, on the wind side we certainly were using them, indeed, and actually the evolution of wind, it comes before the Industrial Revolution and has picked up in a certain way where now we have the ability to do not just terrestrial wind but a tremendous amount of power generation from offshore wind.

Mr. WESTERMAN. So we have developed technologies to better harness the renewables in the future.

Dr. DORSEY. Indeed, and so we can cut our reliance on fossil fuel.

Mr. WESTERMAN. Mr. Segal?

Mr. SEGAL. Well, what Dr. Dorsey just pointed out proves why the social cost of carbon is completely bankrupt, because the social cost of carbon looks at a 300-year time frame and determines that we will have continued linear recapitulation of the harms of climate change.

But as he has just discussed, technology is verdant. Technology alters over time, and so our ability to adapt either by adapting to the endpoints or by bringing new technology onboard is important.

The underlying message of your questions though is undeniably correct, and what I would suggest is there is an excellent report entitled, "The Social Costs of Carbon? No, the Social Benefits of Carbon," that comprehensively attempts to identify the social benefits of carbon. It was submitted for the record for the social cost of

carbon documentation of the Interagency Working Group, and they, of course, did not respond to it in their response to comments.

I might suggest if the Chairman is game or if you would like that it might be submitted to the record. It seems like it would be useful.

Mr. WESTERMAN. Mr. Chairman, I would like to submit that to the record.

The CHAIRMAN. No objection. Done, and so are you.

Mr. Newhouse.

Mr. NEWHOUSE. Thank you, Mr. Chairman.

I appreciate your indulgence and allowing us to expend a little bit of CO₂.

I appreciate the panel being here, and the line of questioning on both sides has been very interesting. You know, I am a farmer by trade and always felt that we considered ourselves, the agriculture industry, being the original conservationists and we understand fully the need to wisely utilize the resources that are available to us and protect them into the future.

But certainly to do that the best, most efficient way, you have to have information, and good information, and so that is why the subject of today's hearing is so interesting.

Just a couple of questions in the short time I have. First of all, for Mr. Segal, in your testimony you have given several examples of how the SCC can be used to skew cost-benefit analyses of Federal regulations even though the courts have ruled that a Federal agency must provide a complete analytical defense of its model and respond to each objection with a reasoned presentation.

You also state that one cannot consider the development and use of SCC as anything other than a substantive rule.

So then does the social cost of carbon on its own constitute a rule under the Administrative Procedure Act?

And if so, could not all Federal regulations utilizing SCC be open to judicial review and then, in turn, be overturned by courts?

Mr. SEGAL. Well, every step of that analysis, of course, I agree with. The bottom line is people tend to think of rules as impacting the direct endpoint of behavior, but the Administrative Procedure Act is smarter than that, and it says that changes in accounting principles, for example, that reflect on the ability of the Federal Government to choose outcomes, to reject a project, to implement a new rule are themselves rules and must be treated with the full complement of notice and comment rulemaking. That is something we have not had.

Every argument in favor of the social cost of carbon has proven the point of why they want this methodology to be used as a rule, as a mechanism to affect rights and responsibilities of people in the regulated community.

Take the discount rate. I love this. Give me a low enough discount rate or a negative one and give me a long enough time period, and I will justify the Federal Government expending money on anything you can imagine.

Independence Avenue is busy. I have trouble getting across it because I'm not so fast. If I wanted to build a bridge over Independence Avenue and they told me it would cost \$10 billion, if I have a low enough discount rate and a long enough period of

time to add up the traffic safety deaths that would be avoided by it, you will build that bridge.

And if you are mandated to do so by the approval of permits through the Council on Environmental Quality's oversight of the NEPA process or by Federal regulation, this tool can be used to be an incredible waster of money.

And why? Because the Interagency Working Group says we have ethical considerations which force us to use very, very low rates and very, very long time frames because we want to be leaders.

But that is what Congress is about. You make those choices. That is not for a group of bureaucrats, when they will not even tell you who is on the list at the IWG, to make those decisions.

That is usurpation of power. It is contrary to our Constitution.

Mr. NEWHOUSE. Well, the issue of time is certainly one of the more serious challenges that we face in important infrastructure projects.

Mr. SEGAL. Right.

Mr. NEWHOUSE. We are seeing that in my own state of Washington as we try to develop an energy future for the modern times.

So in pursuing permits and licenses and approval from the Federal Government, delays in the NEPA process I think are impeding both renewable and energy projects such as oil and natural gas, coal, as well as pipelines, rail expansions, terminals for exporting and importing, highways, bridges, even if it is over Independence Avenue.

So could you or any of the others discuss how incorporating the SCC does and will impact the current and future domestic energy development?

We just have a very short time.

Mr. SEGAL. I will give 1 second on that. You need permits to build infrastructure. You need infrastructure to realize the benefits of our new energy revolution, and incorporating SCC into that process stifles the ability to predictably get permits to advance energy infrastructure.

Mr. NEWHOUSE. Anybody else?

Dr. DAYARATNA. The use of the SCC in rulemaking, and if you actually implement it in terms of regulations or taxes, will actually increase electricity costs.

Mr. NEWHOUSE. Thank you, Mr. Chairman. My time is up.

The CHAIRMAN. Mr. Hice.

Dr. HICE. Thank you, Mr. Chairman.

Very interesting. I appreciate each of you being here today. The questioning has been very, very helpful in your answers.

Dr. Michaels, let me just begin real quickly with you. I am assuming it is correct for us to say that carbon dioxide can have positive impact on vegetation and crops.

Dr. MICHAELS. Absolutely.

Dr. HICE. OK. With that, can you elaborate somewhat on how the positive externalities such as this are insufficiently modeled in the integrated assessment models?

Dr. MICHAELS. It is very clear that only one of them even considers the fertilization effect of carbon dioxide. The other two do not very well. Kevin would probably give a better answer on that.

Dr. HICE. OK.

Dr. DAYARATNA. Yes, the FUND model out of the three models is the only one that actually considers the fertilization impacts and the potential benefits of carbon dioxide emissions, which is why it allows for a negative social cost of carbon.

And as I alluded to in my testimony, under some circumstances the social cost of carbon can actually be substantially negative depending on the equilibrium climate sensitivity distribution and the choice of the discount rate.

You will actually notice the probability of the social cost of carbon being negative, close to 70 percent. So, yes, that is the short answer to your question.

Dr. HICE. OK. So what is the outcome of not including some of this in the SCC?

Dr. DAYARATNA. What is the outcome of not including the benefits?

Dr. HICE. Right, in the models and so forth. If it is not included, what is the outcome? What are we going to get?

Dr. DAYARATNA. The SCC becomes inflated.

Dr. MICHAELS. May I offer another piece of information that may not be right in your head? We now have 20 years' worth of satellite data that measures the greenness of the earth, called the normalized vegetation index, and the greening of the plant as a whole, not just the increased agricultural production, is stunning. And where it is greening the most are the areas of the planet that were given up as ecological hell holes, the Sahelian region south of Africa, the semi-desert region of Western India, Southwestern Desert, Australia. These places are greening up dramatically.

That is not considered one lick in any one of these models; am I not correct?

Dr. DAYARATNA. I do not know. I just do know that there are potential benefits of CO₂ fertilization included in the FUND model. Beyond that I am not completely sure.

Dr. HICE. OK. Well, keep your mike on. Let me go back to the Circular A-4.

Dr. DAYARATNA. OK.

Dr. HICE. There were some questions on this a while ago, and of course, the discount rates of 3 and 7 percent were supposed to be used, and it says, as I understand it, that if others are appropriate, that they can be used in addition to the 3 and the 7 percent.

So was there a violation? Just explain.

Dr. DAYARATNA. I do not believe that Circular A-4 was properly adhered to in the computation of the social cost of carbon.

Dr. HICE. All right. So there is a difference between it being properly adhered to and violating.

Dr. DAYARATNA. No, I think Circular A-4 was violated.

Dr. HICE. OK.

Dr. DAYARATNA. It specifically says in here that 3 and 7 percent should be used as discount rates.

Dr. HICE. Right.

Dr. DAYARATNA. In addition to whatever else they want to use.

Dr. HICE. Right. So it is pretty clear.

Dr. DAYARATNA. Yes.

Dr. HICE. Mr. Segal, did you want to respond?

Mr. SEGAL. Yes, I just wanted to say one thing. If you wonder why they chose—and this is awesome. Go to the response to comments, and the IWG says the reason they chose the lower number is because of, “certain ethical considerations.”

The ethical considerations they are talking about is that future generations should be treated with more speciality. I think we would agree that that might be an important social policy, but here is the point. This is supposed to be an economic assessment.

Dr. HICE. Right.

Mr. SEGAL. Dispassionate economic assessment. If we are going to do ethical considerations and base public policy on that, that is for this chamber to decide, to authorize, and then to have notice and comment, not for the agency, not even the agency to make it up out of whole cloth.

Dr. HICE. While you are going, just keep elaborating. Didn't this put some of the agencies in a difficult position? I mean we've got what was put out for them to follow is violated, and now in place of 3 and 7, we've got 2½, 3 percent, whatever.

Mr. SEGAL. Right.

Dr. HICE. This puts agencies though in an ethical and difficult situation.

Mr. SEGAL. Particularly agencies that might have the job of authorizing the construction of infrastructure of the sort Mr. Newhouse was talking about or other projects. Those agencies are put in a terrible bind.

Dr. HICE. Ten seconds. Do you have something else?

Dr. DAYARATNA. Yes, I was just going to add if you look at the section in Circular A-4, intergenerational discounting, the last paragraph it specifically says, “If your rule will have important intergenerational benefits or costs, you might consider a further sensitivity analysis using a lower but positive discount rate in addition to calculating net benefits using discount rates of 3 and 7 percent.”

Dr. HICE. Thank you.

Thank you, Mr. Chairman.

The CHAIRMAN. All right. Before I ask the last set of questions, I want to thank you for spending 2 hours of your time with us. I know it has been fascinating for you.

Mr. Lowenthal, do you have a motion to add something to the record.

Dr. LOWENTHAL. Yes, I have some unanimous consents. First I would like to ask unanimous consent to insert five articles, three of them peer reviewed from *Science* that refute the graph that Mr. Michaels first put up.

I also ask unanimous consent to enter into the record the most recent scientific articles on the mythical pause in global warming. There are two articles here from the most recent *Scientific American Journal* that says there is no pause in global warming.

And I also want to ask unanimous consent to insert three more peer-reviewed articles to refute Mr. Michaels' assertion that CO₂ will only have a positive effect on crop yield and the agricultural sector.

The CHAIRMAN. Without objection, so ordered.

I would also like to ask unanimous consent to have four papers that were co-authored by Mr. Dayaratna——

Dr. DAYARATNA. Excuse me?

The CHAIRMAN. No, I am just putting your stuff into the record.

Dr. DAYARATNA. Oh, those papers, yes.

The CHAIRMAN. Without objection that is ordered as well.

Dr. DAYARATNA. Thank you.

The CHAIRMAN. Let me ask as we conclude this a couple of questions just for the two of you.

Actually I feel like with some of the questions you have been peppered with today, I should ask the first two witnesses on the left as I am looking at you if you are now or have ever been a member of the Communist Party.

Dr. DAYARATNA. Excuse me?

The CHAIRMAN. Nothing. Never mind. That was sarcasm. Obviously no one got it.

I have one question for Mr. Michaels. Mr. Segal talked about the ethical consideration concept that was in there. In your testimony you made a point that the social cost of carbon should reflect relative impact, i.e., as I read that, that we would be willing to pay more today if we knew that a future society would be impoverished and suffer from extreme climate change than we would be willing to sacrifice if we knew that a future society would be well off and subject to more moderate change.

Mr. Michaels, is that what the Administration's social cost of carbon does?

Dr. MICHAELS. No. It goes the other way around, unfortunately.

The CHAIRMAN. Give me 1 minute and explain why.

Dr. MICHAELS. What it does is it takes money from nations that are wealthy, large amounts of money, and charges them much for very little effect when, in fact, it is the poor nations of the world that are affected mainly by climate change. We are spending the money the exact wrong way.

The CHAIRMAN. Perfect. You did that in 20 seconds.

So what we have clearly heard today is, and we have gone far afield talking about climate change because we are really talking about this proposed rule on a social cost of carbon. But what we clearly heard today is the models are iffy. They can be changed dramatically depending on what kind of criteria you use and the assumptions that you use.

In essence, what we have is a process that is being proposed for the government to select winners and losers in the future based on political considerations, which is why in my humble opinion it makes this a really dumb rule, but that is not unusual with a lot of the rules that we have been hearing lately.

I have one last question for Mr. Segal if you would please, and you have reported to a couple of people here, so I just want to re-emphasize that you believe that this rule violates the Administrative Procedure Act, and I appreciate that.

Is there any statutory authority for OMB of which you know, because I know of none, that would purport to act on this social cost of carbon?

Is there a statute that allows them to do that?

Mr. SEGAL. See, if they followed the strictures of the Administrative Procedure Act, the first thing they would have to do, Mr. Chairman, is explain what is the legal basis for the rule and what is the purpose of the rule, and these are two things that are controversial and can be utilized in the context of judicial review later.

They have never explained the legal basis because there is none.

The CHAIRMAN. All right. Last question.

Mr. SEGAL. Yes.

The CHAIRMAN. I have a question whether there is a legal ability to do this, and also, is there a legal ability to statutorily enforce this, which I do not think they claim they have that in the process?

But that is the other question. I wanted to re-emphasize this one last time. Is this therefore a potential constitutional issue?

Mr. SEGAL. Well, I believe it is a usurpation of what are political questions wrapped up in the guise of economic assessment and then carried off by the executive branch.

Now, we have seen this in similar contexts before. So I believe that is the heart of the constitutional issue.

There is one other constitutional issue, too. You have a right if you are in the regulated community to know what of your behaviors will cause what particular result, and since there is radical uncertainty regarding these models, you cannot know that. That raises other constitutional concerns.

The CHAIRMAN. Which makes this simply a political exercise, not necessarily an exercise in policy.

Mr. SEGAL. Correct.

The CHAIRMAN. And there is no amount of procedure that can cure the lack of statutory authority.

Mr. SEGAL. Right. You can do all the notice and comments you want, but if you lose the argument that you do not have legal authorization to proceed, procedure will not rescue you.

The CHAIRMAN. Thank you. And that ought to be a concern of Congress as part of the discussion.

I thank the witnesses for your testimony and for the Members who have been here asking those questions.

And for the four of you, Members may have additional questions, and we will ask you to respond to those in writing. Under Committee Rule 4(h), the hearing record will be open for 10 business days for those responses.

If there is no further business by members of the committee and since I am the only one here and I have no further business, without objection the committee stands adjourned with, once again, gratitude for you being here.

[Whereupon, at 12:05 p.m., the committee was adjourned.]

[LIST OF DOCUMENTS SUBMITTED FOR THE RECORD RETAINED IN THE
COMMITTEE'S OFFICIAL FILES]

Items submitted for the Record by Chairman Bishop

Heritage Foundation report titled "The Obama Administration's Climate Agenda Will Hit Manufacturing Hard: A State-by-State Analysis"; <http://www.heritage.org/research/reports/2015/02/the-obama-administrations-climate-agenda-will-hit-manufacturing-hard-a-state-by-state-analysis>

Heritage Foundation report titled "Loaded DICE: An EPA Model Not Ready for the Big Game"; <http://www.heritage.org/research/reports/2013/11/loaded-dice-an-epa-model-not-ready-for-the-big-game?ac=1>

Heritage Foundation report titled "Unfounded FUND: Yet Another EPA Model Not Ready for the Big Game"; <http://www.heritage.org/research/reports/2014/04/unfounded-fund-yet-another-epa-model-not-ready-for-the-big-game?ac=1>

Heritage Foundation report titled "The Obama Administration's Climate Agenda: Underestimated Costs and Exaggerated Benefits"; <http://www.heritage.org/research/reports/2014/11/the-obama-administrations-climate-agenda-underestimated-costs-and-exaggerated-benefits>

**Items submitted for the Record by Ranking Member
Lowenthal**

Food and Energy Security article titled "How seasonal temperature or water inputs affect the relative response of C3 crops to elevated [CO₂]: a global analysis of open top chamber and free air CO₂ enrichment studies"; <http://onlinelibrary.wiley.com/doi/10.1002/fes3.44/pdf>

Science article titled "Food for Thought: Lower-Than-Expected Crop Yield Stimulation with Rising CO₂ Concentrations"; <http://www.sciencemag.org/content/312/5782/1918.abstract>

Nature article titled "Increasing CO₂ threatens human nutrition"; <http://www.nature.com/nature/journal/v510/n7503/full/nature13179.html>

Scientific American article titled "No Pause in Global Warming" <http://www.scientificamerican.com/article/no-pause-in-global-warming/>

Think Progress article titled "Faux Pause: Ocean Warming, Sea Level Rise And Polar Ice Melt Speed Up, Surface Warming To Follow"; <http://thinkprogress.org/climate/2013/09/25/2562441/faux-pause-ocean-warming-speed-up/>

Science article titled "The Effect of Diurnal Correction on Satellite-Derived Lower Tropospheric Temperature"; <http://www.sciencemag.org/content/309/5740/1548.abstract>

Science article titled "Amplification of Surface Temperature Trends and Variability in the Tropical Atmosphere"; <http://www.sciencemag.org/content/309/5740/1551.abstract>

Science article titled “The Reproducibility of Observational Estimates of Surface and Atmospheric Temperature Change”; <http://www.sciencemag.org/content/334/6060/1232.abstract>

Fact sheet for “Human and natural influences on the changing thermal structure of the atmosphere”; (saved electronically as PDF)

Santer et al. Catch Christy Exaggerating; <http://www.skepticalscience.com/santer-catch-christy-exaggerating.html>

Satellite measurements of warming in the troposphere; <https://www.skepticalscience.com/satellite-measurements-warming-troposphere.htm>

**Report submitted for the Record by Congressman
Westerman**

A report prepared for the American Coalition for Clean Coal Electricity by Management Information Services titled “The Social Costs of Carbon? No, the Social Benefits of Carbon”

