

**PITFALLS OF UNILATERAL NEGOTIATIONS
AT THE PARIS CLIMATE CHANGE CONFERENCE**

HEARING
BEFORE THE
**COMMITTEE ON SCIENCE, SPACE, AND
TECHNOLOGY**
HOUSE OF REPRESENTATIVES
ONE HUNDRED FOURTEENTH CONGRESS

FIRST SESSION

December 1, 2015

Serial No. 114-52

Printed for the use of the Committee on Science, Space, and Technology



Available via the World Wide Web: <http://science.house.gov>

U.S. GOVERNMENT PUBLISHING OFFICE

97-771PDF

WASHINGTON : 2017

For sale by the Superintendent of Documents, U.S. Government Publishing Office
Internet: bookstore.gpo.gov Phone: toll free (866) 512-1800; DC area (202) 512-1800
Fax: (202) 512-2104 Mail: Stop IDCC, Washington, DC 20402-0001

COMMITTEE ON SCIENCE, SPACE, AND TECHNOLOGY

HON. LAMAR S. SMITH, Texas, *Chair*

FRANK D. LUCAS, Oklahoma	EDDIE BERNICE JOHNSON, Texas
F. JAMES SENSENBRENNER, JR., Wisconsin	ZOE LOFGREN, California
DANA ROHRABACHER, California	DANIEL LIPINSKI, Illinois
RANDY NEUGEBAUER, Texas	DONNA F. EDWARDS, Maryland
MICHAEL T. McCAUL, Texas	SUZANNE BONAMICI, Oregon
MO BROOKS, Alabama	ERIC SWALWELL, California
RANDY HULTGREN, Illinois	ALAN GRAYSON, Florida
BILL POSEY, Florida	AMI BERA, California
THOMAS MASSIE, Kentucky	ELIZABETH H. ESTY, Connecticut
JIM BRIDENSTINE, Oklahoma	MARC A. VEASEY, Texas
RANDY K. WEBER, Texas	KATHERINE M. CLARK, Massachusetts
BILL JOHNSON, Ohio	DON S. BEYER, JR., Virginia
JOHN R. MOOLENAAR, Michigan	ED PERLMUTTER, Colorado
STEVE KNIGHT, California	PAUL TONKO, New York
BRIAN BABIN, Texas	MARK TAKANO, California
BRUCE WESTERMAN, Arkansas	BILL FOSTER, Illinois
BARBARA COMSTOCK, Virginia	
GARY PALMER, Alabama	
BARRY LOUDERMILK, Georgia	
RALPH LEE ABRAHAM, Louisiana	
DARIN LAHOOD, Illinois	

CONTENTS

December 1, 2015

Witness List	Page 2
Hearing Charter	3

Opening Statements

Statement by Representative Lamar S. Smith, Chairman, Committee on Science, Space, and Technology, U.S. House of Representatives	5
Written Statement	7
Statement by Representative Eddie Bernice Johnson, Ranking Member, Com- mittee on Science, Space, and Technology, U.S. House of Representatives	9
Written Statement	11

Witnesses:

Mr. Oren Cass, Senior Fellow, Manhattan Institute for Policy Research	
Oral Statement	13
Written Statement	16
Mr. Andrew Grossman, Associate, Baker & Hostetler LLP	
Oral Statement	33
Written Statement	36
Dr. Andrew Steer, President and CEO, World Resources Institute	
Oral Statement	53
Written Statement	55
Dr. Bjorn Lomborg, President, Copenhagen Consensus Center	
Oral Statement	98
Written Statement	100
Discussion	119

Appendix I: Answers to Post-Hearing Questions

Dr. Andrew Steer, President and CEO, World Resources Institute	152
Dr. Bjorn Lomborg, President, Copenhagen Consensus Center	158

Appendix II: Additional Material for the Record

Document submitted by Representative Gary Palmer, Committee on Science, Space, and Technology, U.S. House of Representatives	162
Statement submitted by Representative Suzanne Bonamici, Committee on Science, Space, and Technology, U.S. House of Representatives	170
Statement submitted by Representative Elizabeth H. Esty, Committee on Science, Space, and Technology, U.S. House of Representatives	175

**PITFALLS OF UNILATERAL NEGOTIATIONS
AT THE PARIS CLIMATE CHANGE
CONFERENCE**

TUESDAY, DECEMBER 1, 2015

HOUSE OF REPRESENTATIVES,
COMMITTEE ON SCIENCE, SPACE, AND TECHNOLOGY,
Washington, D.C.

The Committee met, pursuant to call, at 10:08 a.m., in Room 2318, Rayburn House Office Building, Hon. Lamar Smith [Chairman of the Committee] presiding.

LAMAR S. SMITH, Texas
CHAIRMAN

EDDIE BERNICE JOHNSON, Texas
RANKING MEMBER

Congress of the United States
House of Representatives

COMMITTEE ON SCIENCE, SPACE, AND TECHNOLOGY

2321 RAYBURN HOUSE OFFICE BUILDING

WASHINGTON, DC 20515-6301

(202) 225-6371
www.science.house.gov

Full Committee

***Pitfalls of Unilateral Negotiations at the Paris Climate Change
Conference***

Tuesday, December 1, 2015
10:00 a.m. – 12:00 p.m.
2318 Rayburn House Office Building

Witnesses

Mr. Oren Cass, Senior Fellow, Manhattan Institute for Policy Research

Mr. Andrew Grossman, Associate, Baker & Hostetler LLP

Dr. Andrew Steer, President and CEO, World Resources Institute

Dr. Bjørn Lomborg, President, Copenhagen Consensus Center

**U.S. HOUSE OF REPRESENTATIVES
COMMITTEE ON SCIENCE, SPACE, AND TECHNOLOGY**

HEARING CHARTER

Pitfalls of Unilateral Negotiations at the Paris Climate Change Conference

Tuesday, December 1, 2015
10:00 a.m. – 12:00 p.m.
2318 Rayburn House Office Building

PURPOSE

The Committee on Science, Space and Technology will hold a hearing entitled *Pitfalls of Unilateral Negotiations at the Paris Climate Change Conference* on Tuesday, December 1, 2015, in Room 2318 of the Rayburn House Office Building. The hearing will examine the various scientific and policy issues surrounding the United States commitment to a United Nations-led effort to limit greenhouse gas emissions.

WITNESS LIST

- **Mr. Oren Cass**, Senior Fellow, Manhattan Institute for Policy Research
- **Mr. Andrew Grossman**, Associate, Baker & Hostetler LLP
- **Dr. Andrew Steer**, President and CEO, World Resources Institute
- **Dr. Bjørn Lomborg**, President, Copenhagen Consensus Center

BACKGROUND

The United Nations Climate Change Conference (COP 21) is meeting in Paris from November 30 to December 11. COP21's objective is to achieve a legally binding agreement on greenhouse gas emissions from all nations of the world.¹ In November 2014, the Obama Administration announced that the U.S. would reduce its economy-wide greenhouse gas emissions by 26%-28% by 2025 compared to a 2005 baseline, and re-iterated this pledge this past March to the international community through the "Intended Nationally Determined Contribution (INDC)."² So far the Administration has not released an analysis on how it developed this pledge compared to other levels of commitment to reduce greenhouse gases. In addition to a pledge to reduce such emissions, then-Secretary of State Hillary Clinton in 2009 pledged to raise \$100 billion annually for a Green Climate Fund to aid developing countries coping with climate change.³ It is unclear how the Administration intends to fund any public financial support without Congressional approval through the authorization and appropriations

¹ <http://www.cop21paris.org/about/cop21>

² <https://www.whitehouse.gov/the-press-office/2015/03/31/fact-sheet-us-reports-its-2025-emissions-target-ufccc>

³ <http://www.nytimes.com/cwire/2009/12/17/17climatewire-hillary-clinton-pledges-100b-for-developing-96794.html>

process.⁴ The Green Climate Fund faces considerable uncertainty with a lack of financial commitments from developed nations.⁵

An important policy debate lies in how the Obama Administration intends for the United States to meet its proposed commitments to the United Nations on greenhouse gas emissions (the INDC) and financial aid (Green Climate Fund) that will bind future Administrations and Congresses for the next decade. In addition, the Obama Administration expects the EPA's Clean Power Plan (announced last August, but not published as final until October) to play a central role towards achieving this pledge, while the Plan appears to have little effect on global warming. Furthermore, at least twenty-six states have sued EPA over the Clean Power Plan, citing an overreach of the agency's authority under the Clean Air Act and an unlawful attempt to usurp states' ability to regulate electrical generation systems as the basis for their challenge.⁶ These legal challenges, in addition to the complicated implementation schedules associated with regulations, make it unlikely that the Plan will be actually implemented, and thus call into question the Administration's ability to make commitments to limit greenhouse gases to the United Nations without support from the majority of states or the U.S. Congress.⁷

⁴ http://www.nytimes.com/2015/09/30/business/getting-to-100-billion-in-climate-change-aid.html?_r=0

⁵ http://www.business-standard.com/article/current-affairs/green-climate-fund-faces-uncertainty-115111300600_1.html

⁶ <http://www.rpc.senate.gov/policy-papers/avalanche-of-opposition-hits-epas-co2-rule>

⁷ http://www.epw.senate.gov/public/_cache/files/21ffe37a-8052-4498-ba78-18395db0fc42/holmstead.pdf

Chairman SMITH. The Committee on Science, Space, and technology will come to order. Without objection, the Chair is authorized to declare recesses of the Committee at any time.

Welcome to today's hearing entitled "Pitfalls of Unilateral Negotiations at the Paris Climate Change Conference." I'll recognize myself for an opening statement and then the Ranking Member.

The Obama Administration's new electricity regulations will increase the control of the federal government over the lives of Americans and will burden American families. President Obama intends to submit these costly new requirements as the cornerstone of his proposal at the Paris U.N. climate conference. These severe measures will adversely affect our economy and have no significant impact on climate change.

The President has pledged that the United States will cut its greenhouse gas emissions by as much as 28 percent over the next decade and by 80 percent or more by 2050. The pledge was made in preparation for the U.N. meeting now underway in Paris, which seeks to produce an international agreement that would impose legally binding requirements on the United States for decades to come.

However, the Committee learned from last month's hearing that the cornerstone of this Administration's climate pledge reduction, the so-called Clean Power Plan, will do nothing to meet the President's pledge.

Moreover, this regulation will cost billions of dollars, cause financial hardship for American families, and diminish the competitiveness of American employers, all with no significant benefit to climate change. In other words, it's all pain and no gain.

It is well-documented that the EPA's Power Plan will shut down power plants across the country, increase electricity prices and cost thousands of Americans their jobs.

The U.S. pledge to the U.N. is estimated to prevent only one-fiftieth of one degree Celsius temperature rise over the next 85 years. Incredible. This would be laughable if it weren't for the tremendous costs it imposes on the American people. EPA's own data shows that this regulation would reduce sea level rise by only 1/100 of an inch, the thickness of three sheets of paper.

The President's Power Plan is nothing more than a power grab. It disregards the opposition of the majority in Congress and the governors of most states. The President attempts to justify his actions by scaring people with worst-case scenarios and biased data.

An example of how this administration promotes its suspect climate agenda can be seen at the National Oceanographic and Atmospheric Administration. Its employees altered historical climate data to get politically correct results in an attempt to disprove the 18-year lack of global temperature increases.

NOAA further perpetuates the administration's agenda by dismissing accurate and calibrated satellite data. This data, considered by many to be the most objective, has clearly showed no warming for the past two decades. So NOAA and this Administration simply chose to ignore the satellite data in its recent report. NOAA conveniently issued its news release promoting this report just as the Obama administration was about to announce its extensive climate change regulations.

When the Science Committee raised concerns about NOAA's report, the agency refused to explain its findings and provide documents to the Committee. The American people have a right to see the data and know the motivations behind the study. The American people should be suspicious of this Administration when it continually impedes Congressional oversight of its extreme climate agenda.

Furthermore, statements by President Obama and others that attempt to link extreme weather events to climate change are completely unfounded. The lack of evidence is clear: no increased tornadoes, no increased hurricanes, no increased droughts or floods. The Administration's claims are contradicted by the United Nation's Intergovernmental Panel on Climate Change itself.

For instance, the IPCC found that there is "low confidence on a global scale," that drought has increased in intensity or duration. The same lack of evidence can be found in the IPCC reports for almost every type of extreme weather.

The administration's alarmism and exaggeration is not good science and intentionally misleads the American people. Congress has repeatedly rejected the President's extreme climate agenda. So the administration instead attempts to create laws on its own and to twist environmental regulations in ways Congress never intended. Now the administration has packaged up all these regulations and promised their implementation to the U.N.

The President's pledge to the U.N. would increase electricity costs, ration energy and slow economic growth. The President's plan ignores good science and only seeks to advance a partisan political agenda. The President should come back to Congress with any agreement that is made in Paris. He won't because he knows the Senate will not ratify it.

Today's hearing will demonstrate that the President's U.N. climate pledge is destructive to the American economy and would produce no substantive environmental benefits.

[The prepared statement of Chairman Smith follows:]



COMMITTEE ON
SCIENCE, SPACE, & TECHNOLOGY
Lamar Smith, Chairman

For Immediate Release
December 1, 2015

Media Contact: Zachary Kurz
(202) 225-6371

Statement of Chairman Lamar Smith (R-Texas)
Pitfalls of Unilateral Negotiations at the Paris Climate Change Conference

Chairman Smith: The Obama administration's new electricity regulations will increase the control of the federal government over the lives of Americans and will burden American families.

President Obama intends to submit these costly new requirements as the cornerstone of his proposal at the Paris U.N. climate conference. These severe measures will adversely affect our economy and have no significant impact on climate change.

The president has pledged that the United States will cut its greenhouse gas emissions by as much as 28 percent over the next decade and by 80 percent or more by 2050.

The pledge was made in preparation for the U.N. meeting now underway in Paris, which seeks to produce an international agreement that would impose legally binding requirements on the United States for decades to come.

However, the Committee learned from last month's hearing that the cornerstone of this administration's climate pledge reduction, the so-called Clean Power Plan, will do nothing to meet the President's pledge.

Moreover, this regulation will cost billions of dollars, cause financial hardship for American families, and diminish the competitiveness of American employers, all with no significant benefit to climate change. In other words, it's all pain and no gain.

It is well-documented that the EPA's Power Plan will shut down power plants across the country, increase electricity prices and cost thousands of Americans their jobs.

The U.S. pledge to the U.N. is estimated to prevent only one-fiftieth of one degree Celsius temperature rise over the next 85 years! Incredible! This would be laughable if it weren't for the tremendous costs it imposes on the American people.

EPA's own data shows that this regulation would reduce sea level rise by only 1/100th of an inch, the thickness of three sheets of paper.

The president's "Power Plan" is nothing more than a power grab. It disregards the opposition of the majority in Congress and the governors of most states. The president attempts to justify his actions by scaring people with worst-case scenarios and biased data.

An example of how this administration promotes its suspect climate agenda can be seen at the National Oceanographic and Atmospheric Administration (NOAA). Its employees altered historical climate data

to get politically correct results in an attempt to disprove the eighteen year lack of global temperature increases.

NOAA further perpetrates the administration's agenda by dismissing accurate and calibrated satellite data. This data, considered by many to be the most objective, has clearly showed no warming for the past two decades. So NOAA and this administration simply choose to ignore the satellite data in its recent report.

NOAA conveniently issued its news release promoting this report just as the Obama administration was about to announce its extensive climate change regulations.

When the Science Committee raised concerns about NOAA's report, the agency refused to explain its findings and provide documents to the Committee. The American people have a right to see the data and know the motivations behind this study.

The American people should be suspicious of this administration when it continually impedes Congressional oversight of its extreme climate agenda.

Furthermore, statements by President Obama and others that attempt to link extreme weather events to climate change are completely unfounded. The lack of evidence is clear: no increased tornadoes, no increased hurricanes, no increased droughts or floods.

The administration's claims are contradicted by the United Nation's Intergovernmental Panel on Climate Change (IPCC) itself. For instance, the IPCC found that there is "low confidence on a global scale," that drought has increased in intensity or duration. The same lack of evidence can be found in the IPCC reports for almost every type of extreme weather.

The administration's alarmism and exaggeration is not good science and intentionally misleads the American people. Congress has repeatedly rejected the President's extreme climate agenda. So the administration instead attempts to create laws on its own—and to twist environmental regulations in ways Congress never intended. Now the administration has packaged up all these regulations and promised their implementation to the U.N.

The president's pledge to the U.N. would increase electricity costs, ration energy and slow economic growth. The president's plan ignores good science and only seeks to advance a partisan political agenda. The President should come back to Congress with any agreement that is made in Paris. He won't, because he knows the Senate would not ratify it.

Today's hearing will demonstrate that the President's U.N. climate pledge is destructive to the American economy and would produce no substantive environmental benefits.

###

Chairman SMITH. That concludes my opening statement, and the Ranking Member, the gentlewoman from Texas, Eddie Bernice Johnson, is recognized for hers.

Ms. JOHNSON OF TEXAS. Thank you very much, Mr. Chairman.

Let me welcome our witnesses. I'd like to especially thank Dr. Steer for his testimony today. I understand that he's changed his flight to Paris at the last minute to accommodate this committee's invitation, and we need your expertise and opinions. And they will be appreciated as much here as in Paris.

As we speak, representatives from more than 190 countries are meeting in Paris to reach a historic agreement to achieve reductions in global carbon emissions. I am pleased and proud to support the efforts of this Administration, and now the rest of the world, in taking meaningful steps to change—to address climate change.

Every day, more and more people are waking up to the reality that climate is changing. Over the weekend, my constituents in Dallas, Texas, woke up from the Thanksgiving holiday to find streets submerged and homes flooded due to extreme rainfall that is only now showing signs of subsiding, cars being overrun. Sadly, eight people lost their lives in North Texas as a result of these floods. These same circumstances played out 6 months ago with equally tragic consequences.

These kinds of extreme precipitation events are predicted to become more common with a changing climate, and they serve as a reminder that we must not forget how high the stakes truly are and what the true cost of inaction will be. The United States has been a leader on the world stage before and should be again. When faced with a difficult task, our nation has historically risen to the challenge. Our efforts to reduce carbon emissions through the Clean Power Plan and the Climate Action Plan have helped to motivate other nations to act in a similar manner.

Climate change is not the problem of any one country. It is a problem facing all nations. And only through a combined effort can we be successful. Climate plans submitted ahead of the Paris talks are a clear indication that we are not alone in our commitment to reducing carbon emissions and to finding solutions to the impacts of climate change. These plans are already expected to reduce emissions substantially and reduce the average rise in global temperature to around 2.7 degrees Celsius.

Ideally, the final agreement should have mechanisms in place to allow nations greater flexibility to change emission goals over time that will ultimately bring the average global temperature rise down to 2 degrees Celsius or less.

Support for this kind of international agreement can only be found domestically among U.S. companies and leaders of industry. Eighty one companies, including Coca-Cola, AT&T, and the Walt Disney Company signed on to the American Business Act on Climate Pledge.

Despite what some of my colleagues have been fond of saying, the long-recognized reality of good environmental regulation is that it helps, not hinders, the growth of economies. Further evidence of that fact was on display yesterday as leaders in China, India, Saudi Arabia, Brazil, and more than a dozen other nations joined

the United States in launching Mission Innovation, a pledge to double investments in clean energy R&D over the next 5 years.

At the same time, a group of 28 influential investors from 10 countries led by Bill Gates has formed the Breakthrough Energy Coalition. These business leaders are committing billions of dollars of their own money to commercialize promising early-stage technologies developed in countries that are part of the Mission Innovation initiative. This powerful public-private partnership is just the most recent sign that the entire world is prepared to act accordingly and meaningfully to address climate change.

The global climate system is complex. Solutions to address these problems are equally complex. However, I am confident that the enthusiasm for change going into the Paris conference will lead to a meaningful agreement to reduce carbon emissions.

Mr. Chairman, I thank you and yield back. And I have to excuse myself to go to a conference committee. And I will try to return.

[The prepared statement of Ms. Johnson of Texas follows:]

Opening Statement

Ranking Member Eddie Bernice Johnson
Committee on Science, Space, and Technology

Pitfalls of Unilateral Negotiations at the Paris Climate Change Conference

December 1, 2015

Thank you, Mr. Chairman and welcome to our witnesses. I would first like to thank Dr. Steer for his testimony today. I understand that he changed his flight to Paris at the last minute to accommodate the Committee's invitation. Your expertise and opinions are as appreciated here as they will be in Paris.

As we speak, representatives from more than 190 countries are meeting in Paris to reach a historic agreement to achieve reductions in global carbon emissions. I am pleased and proud to support the efforts of this Administration, and now the rest of the world, in taking meaningful steps to address climate change.

Every day, more and more people are waking up to the reality that the climate is changing. Over the weekend, my constituents in Dallas woke up from the Thanksgiving holiday to find streets submerged and homes flooded, due to extreme rainfall that is only now showing signs of subsiding. Sadly, eight people lost their lives in North Texas as a result of these floods. These same circumstances played out six months ago, with equally tragic consequences.

These kinds of extreme precipitation events are predicted to become more common with a changing climate, and they serve as a reminder that we must not forget how high the stakes truly are, and what the true costs of inaction will be.

The United States has been a leader on the world stage before and should be again. When faced with a difficult task, our nation has historically risen to the challenge. Our efforts to reduce carbon emissions through the Clean Power Plan and the Climate Action Plan have helped to motivate other nations to act in a similar manner. Climate change is not the problem of any one country; it is a problem facing **all** nations and only through a combined effort can we be successful.

Climate plans submitted ahead of the Paris talks are a clear indication that we are not alone in our commitment to reducing carbon emissions and to finding solutions to the impacts of climate change. These plans are already expected to reduce emissions substantially and reduce the average rise in global temperature to around 2.7 degrees Celsius.

Ideally, the final agreement should have mechanisms in place to allow nations greater flexibility to change emission goals over time that will ultimately bring the average global temperature rise down to 2 degrees Celsius or less.

Support for this kind of international agreement can also be found domestically, among U.S. companies and leaders of industry. 81 companies, including Coca-Cola, AT&T, and the Walt Disney Company signed on to the “American Business Act on Climate Pledge.”

Despite what some of my colleagues have been fond of saying, the long-recognized reality of good environmental regulation is that it helps – not hinders – the growth of economies.

Further evidence of that fact was on display yesterday, as leaders of China, India, Saudi Arabia, Brazil, and more than a dozen other nations joined the United States in launching “Mission Innovation,” a pledge to double investments in clean energy R&D over the next five years. At the same time, a group of 28 influential investors from 10 countries led by Bill Gates has formed “The Breakthrough Energy Coalition.” These business leaders are committing billions of dollars of their own money to commercialize promising early-stage technologies developed in countries that are part of the Mission Innovation initiative.

This powerful public-private partnership is just the most recent sign that the entire world is prepared to act meaningfully to address climate change.

The global climate system is complex. Solutions to address these problems are equally complex. However, I am confident that the enthusiasm for change going into the Paris Conference will lead to a meaningful agreement to reduce carbon emissions.

Thank you and I yield back.

Chairman SMITH. Okay.

Ms. JOHNSON OF TEXAS. Thank you.

Chairman SMITH. Thank you, Ms. Johnson.

Our first witness today is Mr. Oren Cass, Senior Fellow for the Manhattan Institute for Policy Research. Mr. Cass focuses on energy, environmental, and antipoverty policy. He was the Domestic Policy Director of Mitt Romney's presidential campaign. Prior to joining the Manhattan Institute, Mr. Cass was a Management Consultant for Bain & Company. There he advised global companies across a range of industries on how to implement growth strategies in performance improvement programs. Mr. Cass received his bachelor's degree in political economy from Williams College and his law degree from Harvard University.

Our second witness is Mr. Andrew Grossman, an associate at Baker & Hostetler. He has served as counsel in many prominent cases that raise significant issues of federal authority, the constitutional separation of powers, and individual rights. As a scholar, Mr. Grossman has written on administrative law, national security law, and the constitutional separation of powers. Mr. Grossman is a graduate of Dartmouth College and of University of Pennsylvania's Fels Institute of Government. He received his law degree from George Mason.

Our third witness is Dr. Andrew Steer, President and CEO of World Resources Institute. Dr. Steer joined WRI from the World Bank where he served as Special Envoy for Climate Change since 2010. Prior to this position, Dr. Steer was Director General and member of the Management Board at the United Kingdom Department of International Development. Dr. Steer served with the World Bank for over 20 years and has held a number of positions that include Country Director for Indonesia and Vietnam, and Director of the Environment Department. Dr. Steer received his Ph.D. in economics from the University of Pennsylvania.

Our final witness today, and this is unusual, joins us from Paris via Google Hangout, and he is Dr. Bjorn Lomborg, President of the Copenhagen Consensus Center. The Copenhagen Consensus Center brings together many of the world's top economists, which include several—excuse me—seven Nobel laureates, to seek priorities for the world. Dr. Lomborg is an academic and the author of the best-selling books "The Skeptical Environmentalist" and "Cool It." In addition, he is a visiting professor at Copenhagen Business School. Dr. Lomborg received his Ph.D. in political science from the University of Copenhagen.

Now, Dr. Lomborg will actually be testifying last today because the videoconference that we have set up. And we'll begin now with the testimony from Mr. Cass.

**TESTIMONY OF MR. OREN CASS, SENIOR FELLOW,
MANHATTAN INSTITUTE FOR POLICY RESEARCH**

Mr. CASS. Thank you, Mr. Chairman, and thank you to the Committee for inviting me to participate in today's hearing.

My name is Oren Cass. I'm a Senior Fellow at the Manhattan Institute for Policy Research. My primary message to the committee is this: the climate policies pursued by this country under

President Obama are a bad deal for the climate and a bad deal for the country.

Globally, climate negotiations no longer bear a substantial relationship to the goal of reducing greenhouse gas emissions. The commitments known as INDCs made by various countries are voluntary, and those made by developing nations do not depart from their existing emissions trajectories.

Ms. Johnson in her opening statement suggested that pledges will lower warming by 2100 to 2.7 degrees Celsius, but that analysis assumes other better actions will be taken at some point in the future and does not reflect what is actually included in the INDC commitments.

The sum of all INDCs will likely affect the global temperature by the end of this century by 0 to 0.2 degrees Celsius. Indeed, the only likely achievement of the Paris conference is an agreement by developed nations, including the United States, to transfer enormous sums of—excuse me—enormous sums of wealth to poorer countries.

This outcome is not surprising to those skeptical that U.S. leadership on climate policy could persuade the developing world to make economic sacrifices for the sake of reducing emissions. However, it differs dramatically from the popular narrative in which Paris represents the historic combination of an effective process to bring the world together and act on climate.

And it deals the harshest blow to anyone concerned about rising greenhouse gas emissions or interested in holding nations accountable for action. If progress under this process is supposed to come from peer pressure and so-called naming and shaming, then countries failing to take substantial and costly action should be named, shamed, and pressured. Instead, they are being applauded by the United Nations, the White House, the media, and nongovernmental organizations committed to climate action. This fatally undermines the entire enterprise for the sake of photo ops and political point-scoring.

Domestically, even the Obama Administration acknowledges that its policies make sense only if they influence international action. For instance, EPA Administrator Gina McCarthy testifying before this committee in July did not argue that the Clean Power Plan will have a detectable impact on global temperatures. Rather, she suggested “the value of this rule is not measured in that way. It is measured in showing strong domestic action which can actually trigger global action.”

If the objective of this nation’s climate policy is to spur international action, the empty commitments of Paris make clear that the policy has failed. Yet proponents, including Ms. McCarthy, continue to argue that new regulations, subsidies, and mandates are ends unto themselves, that even if the mitigation of carbon dioxide emissions will not itself produce meaningful benefits, we should regulate anyway because the impositions on the nation’s energy sector will be good for the economy.

This argument defies both common sense and empirical evidence. Honest discussion of the costs and benefits of environmental regulation must begin from the acknowledgement that regulation does in fact have costs.

In the absence of climate benefits, carbon dioxide regulations cannot be justified by claiming that the economic costs are themselves the benefits. Climate policy that does not help the climate is not good policy. Europe has gone down this path, suffered the consequences, and is turning back, yet American policymakers in the White House seem determined to charge forward anyway.

In summary, President Obama is placing the United States in a disastrous long-term position for the sake of securing a short-term political victory. In future years when the world revisits commitments made today, countries that we applauded for promising nothing will be able to show that they are on track because indeed they have promised to do what they are on track to do.

Yet the United States, having put forward an aggressive commitment that even the President's Clean Power Plan cannot achieve, will likely find ourselves off track. Americans will incur the expense to take costly domestic action. We will potentially send billions of dollars overseas to countries that take no such action themselves, and yet as those countries' emissions grow unabated, we will be the ones facing scrutiny and criticism for violating the agreement that President Obama signs. This will be the President's climate legacy, and it is not a good one for the country.

My written testimony provides additional detail on these points with respect to the INDC targets and commitments, as well as the analyses by economists and other scholars showing that environmental regulation does in fact have costs.

Thank you again for the opportunity to appear before the Committee, and I look forward to answering your questions.

[The prepared statement of Mr. Cass follows:]

**Testimony of Oren M. Cass
before the House Committee
on Science, Space, and Technology
December 1, 2015**

Good morning Mr. Chairman, Ranking Member Johnson, and distinguished members of the Committee. Thank you for inviting me to participate in today's hearing.

My name is Oren Cass. I am a senior fellow at the Manhattan Institute for Policy Research where my work addresses both domestic environmental policy and international climate negotiations.

My primary message to the committee is this: the climate policies pursued by this country under President Obama are a bad deal for the climate and a bad deal for this country.

Globally, international negotiations under the United Nations Framework Convention on Climate Change (UNFCCC) no longer bear a substantial relationship to the goal of sharply reducing greenhouse-gas emissions. Commitments made by developing nations amount to a continuation of their existing emissions trajectories. The only likely achievement of the upcoming Paris conference (COP21) is a commitment by developed nations including the United States to transfer large sums of wealth to poorer nations.

This outcome is not surprising to those skeptical that U.S. "leadership" on climate policy could persuade the developing world to make economic sacrifices for the sake of reducing emissions. However, it differs dramatically from the popular narrative in which COP21 represents the historic culmination of an effective process to bring the world together and act on climate. And it deals a blow to anyone concerned about rising greenhouse-gas emissions and interested in holding all nations accountable for action.

If progress is to come from "peer pressure" and "naming and shaming," then countries failing to take substantial and costly action should be named, shamed, and pressured. Instead, they are being applauded by the United Nations, the White House, the media, and NGOs committed to climate action—an approach that fatally undermines the entire enterprise for the sake of political point-scoring.

Domestically, even the originators of the Obama administration's climate-related policies acknowledge they make sense only to the degree they influence international action. EPA Administrator Gina McCarthy, testifying before this committee in July, did not deny that the Clean Power Plan will have no detectable impact on global temperatures;

rather, she suggested: "The value of this rule is not measured in that way, it is measured in showing strong domestic action which can actually trigger global action."¹

The State Department, in rejecting the Keystone XL pipeline, stated: "A key consideration at this time is that granting a Presidential Permit for this proposed Project would undermine U.S. climate leadership and thereby have an adverse impact on encouraging other States to combat climate change and work to achieve and implement a robust and meaningful global climate agreement."²

If successfully spurring robust international action is the *sine qua non* of this nation's climate policy, and that is failing, then we have *non*.

Yet proponents continue to argue that new regulations, subsidies, and mandates are ends unto themselves – that even if the mitigation of carbon-dioxide emissions will not itself produce meaningful benefits, we should regulate anyway because the impositions on the nation's energy sector will be good for the economy. This argument defies both common sense and empirical evidence. Climate policy that does not help the climate is not good policy.

In summary, the Obama administration is placing the United States in a disastrous long-term position for the sake of securing a short-term political victory. In future years, when the world revisits commitments made today, countries that we applauded for promising nothing will be able to say they are well on their way to meeting their "goals." Yet the United States, having put forward an aggressive commitment that even the president's Clean Power Plan cannot achieve, will likely find itself off track.

Americans will incur the expense to take costly domestic action. We will potentially send billions of dollars overseas to countries taking no such action themselves. And yet as their emission grow unabated, we will be the ones facing scrutiny and criticism for violating the agreement. This will be President Obama's climate legacy.

- - -

This testimony first addresses the status of the international negotiations in detail and then turns to an assessment of domestic policy in the absence of international progress.

¹ Testimony of EPA Administrator Gina McCarthy before the House Science, Space, and Technology Committee, July 9, 2015, available at <http://www.c-span.org/video/?327016-1/epa-administrator-gina-mccarthy-testimony-proposed-regulations> (at time 20:20).

² U.S. Department of State, Record of Decision and National Interest Determination, "TransCanada Keystone XL Pipeline," November 3, 2015, <http://keystonepipeline-xl.state.gov/documents/organization/249450.pdf>.

I. THE GLOBAL PERSPECTIVE: WHAT ARE CLIMATE NEGOTIATIONS ACHIEVING?

Three points illustrate that political posturing and legacy building have replaced the mitigation of greenhouse-gas emissions as the objective of climate negotiations: First, the negotiating process is designed to produce an easy consensus while excusing inaction. Second, the much-celebrated developing-nation commitments in fact reflect only a promise to continue with business as usual. Third, the emphasis on so-called “climate finance” is unjustified and unproductive.

A. The UNFCCC Negotiating Process

After the collapse of the Copenhagen talks in 2009, the world appears to have abandoned the prospect of achieving a binding agreement to reduce greenhouse-gas emissions. Certainly, no global cap-and-trade program, carbon tax, or other “price on carbon” is under discussion.

Instead, negotiators have adopted a “pledge-and-review” process whereby each country announces an “Intended Nationally Determined Contribution” (INDC) that represents its proposed actions and emissions reductions. The contents of these INDCs are at the discretion of the individual countries. At the insistence of developing nations, there is no requirement that INDCs achieve cuts of certain levels or that they even use consistent formats, metrics, or baselines.³ Developing nations also oppose “any obligatory review mechanism for increasing individual efforts of developing countries.”⁴ No consequences have been established for missing a plan’s goals.

The hope is that, to quote from a preliminary negotiating text, this approach will produce an “upward spiral of ambition over time”⁵—or, as the *New York Times* headlined it, “A Climate Accord Based on Global Peer Pressure.”⁶ But as David J.C. Mackay and his colleagues noted in a recent commentary for *Nature*: “History and the science of cooperation predict that quite the opposite will happen.”⁷ A process that ignores the collective-action problems associated with climate change and provides no concrete incentives to act is ill-suited to the purported objectives of climate negotiators.

³ Coral Davenport, “A Climate Accord Based on Global Peer Pressure,” *New York Times*, December 14, 2014, <http://www.nytimes.com/2014/12/15/world/americas/lima-climate-deal.html>.

⁴ Press Release, “Meeting of Negotiators of Like-Minded Developing Countries Concludes: Javadekar Lauds Work Done by LMDC,” Press Information Bureau, Government of India, September 15, 2015, <http://pib.nic.in/newsite/PrintRelease.aspx?relid=126913>.

⁵ Parties’ Views and Proposals on the Elements for a Draft Negotiating Text (ADP.2016.6.NonPaper), UNFCCC, October 2014, http://unfccc.int/documentation/documents/advanced_search/items/6911.php?preref=600008013.

⁶ *Supra* note 3.

⁷ David J.C. MacKay et al. “Price Carbon—I Will If You Will.” *Nature*, October 12, 2015, <http://www.nature.com/news/price-carbon-i-will-if-you-will-1.185538>.

Boosters of the negotiations have highlighted the agreement to move forward with an INDC-driven structure, followed by the parade of submitted INDCs, as proof that the world can in fact come together and take meaningful action on climate change. That view is precisely backward. Negotiations have followed this course of discretionary, unenforceable pledges only because the positions and interests of countries were so plainly incompatible that a substantive agreement was not possible.

Of course, one should not exclude the possibility of progress on the basis of theory alone. Unfortunately, the poor quality of the submitted INDCs only confirms what rational analysis of the process would have predicted: significant obfuscation and posturing, but insignificant results.

B. Estimated Impact of INDCs

Because creation of INDCs was left entirely to the discretion of individual countries, with no common baseline or metrics, measuring the cumulative impact of submissions is not a straightforward process. INDCs must be standardized and then translated into a plausible emissions trajectory. A realistic baseline for emissions absent the INDCs must be established, against which progress can be measured.

If INDCs slow emissions growth relative to the past, but only by the amount emissions were already likely to slow given economic and technological progress, then countries are “committing” only to proceeding with business as usual (BAU). Conversely, choosing an implausibly high baseline and then comparing it to BAU can make simply proceeding with BAU appear significant.

Most efforts at quantification show the INDCs achieving significant progress, however that progress is the illusory result of poorly chosen baselines and unwarranted inferences.

B.1. “Top-Down” Assessments

Aggregations of INDCs have produced confusing and seemingly inconsistent results:

- Climate Interactive, a Washington-based non-profit that has partnered with the U.S. State Department,⁸ reports that temperatures by 2100 would rise 4.5°C above pre-industrial levels in a BAU case but only 3.5°C based on INDCs.⁹ However, it uses the UN Intergovernmental Panel on Climate Change (IPCC)’s RCP 8.5 reference case as its BAU, even though the IPCC specifies that: “The RCP 8.5 pathway has higher emissions than all but a few published baseline scenarios.”¹⁰

⁸ “About.” Climate Interactive, <https://www.climateinteractive.org/about/> (accessed November 11, 2015).

⁹ “Climate Scoreboard.” Climate Interactive, <https://www.climateinteractive.org/tools/scoreboard/> (accessed November 11, 2015).

¹⁰ IPCC, Fifth Assessment Report, Working Group 3, Section 6.3.1.3, http://www.ipcc.ch/pdf/assessment-report/ar5/wg3/ipcc_wg3_ar5_full.pdf.

- Climate Action Tracker (a partnership of Climate Analytics, Ecofys, NewClimate Institute, and Potsdam Institute for Climate Impact Research) reports that temperatures by 2100 would rise 3.6°C based on current policy action but only 2.7°C based on INDCs.¹¹ However, that 2.7°C figure is reached only by assuming that all countries will make additional commitments to further reduce emissions after the end of the period covered by the INDCs.¹²
- The International Energy Agency also estimates that with INDCs the global temperature will rise 2.7°C, but it achieves such a result by simply choosing a forecast through 2100 “judged as the long-term emissions trajectory most closely aligned with [its] INDC analysis.”¹³ It is not a reflection of countries’ actual commitments.
- The Massachusetts Institute of Technology’s Joint Program on the Science and Policy of Global Change reports that temperatures by 2100 would rise 3.9°C without INDCs and 3.7°C with them.¹⁴ The MIT study uses an apples-to-apples comparison of its own projections before and after incorporating the INDCs. Unfortunately, much of the progress thus disappears.
- The UN has conducted its own analysis, concluding that INDCs will reduce global carbon-dioxide-equivalent emissions in 2030 from 60.3 to 56.7 gigatons, with a twentieth percentile estimate of no improvement and an eightieth percentile estimate of a 7.5 gigaton improvement.¹⁵ The UN emphasizes that this reduction equates to growth of “11–23 per cent in the 2010–2030 period compared with 24 per cent in the 1990–2010 period,”¹⁶ implying that continuation of the prior growth rate would represent a baseline and any slowing of growth an improvement (see Figure 1). But as the IPCC observed only two years earlier in its Fifth Assessment Report: “most baseline scenarios project a deceleration in emissions growth, especially compared to the rapid rate observed in the past decade.”¹⁷

¹¹ “Global,” Climate Action Tracker, <http://climateactiontracker.org/global.html> (accessed November 11, 2015).

¹² “Global Pathways,” Climate Action Tracker, <http://climateactiontracker.org/methodology/18/Global-pathways.html> (accessed November 11, 2015).

¹³ International Energy Agency, “World Energy Outlook: Special Briefing for COP21,” 2015, https://www.ica.org/media/news/WFO_INDC_Paper_Final_WEB.PDF.

¹⁴ John Reilly et al. “Energy & Climate Outlook: Perspectives from 2015,” MIT Joint Program on the Science and Policy of Global Change, 2015, <http://globalchange.mit.edu/files/2015%20Energy%20%26%20Climate%20Outlook.pdf> (box 2).

¹⁵ Synthesis Report on the Aggregate Effect of the Intended Nationally Determined Contributions, UNFCCC, October 30, 2015, <http://unfccc.int/resource/docs/2015/cop21/eng/07.pdf>.

¹⁶ *Id.*

¹⁷ *Supra* note 10.

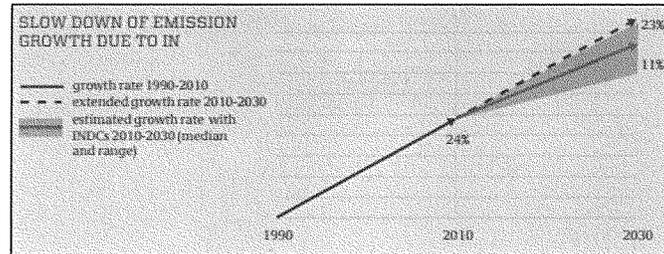


Figure 1. UNFCCC Assessment of INDC Impact from Constant-Growth Baseline.¹⁸

In aggregate, the best estimate for temperature rise with INDCs appears to be 3.5°C (Climate Interactive) to 3.7°C (MIT), while the best estimate of the world's trajectory absent them is 3.6°C (Climate Action Tracker current policy) to 3.9°C (MIT). In other words, the actual improvement if all countries follow through with their voluntary contributions, is 0.1 to 0.2°C.

However, even this estimate may overstate the impact of the INDCs.

B.2. A Better Baseline

None of the assessments described above uses the set of baseline scenarios developed by the IPCC Special Report on Emissions Scenarios (SRES) in 2000 to describe the likely emissions associated with various future trajectories of economic growth and technological progress.¹⁹ Of these, the "A1B" scenario provides a particularly useful and widely-used baseline. According to the IPCC:

The A1 storyline and scenario family describes a future world of very rapid economic growth, global population that peaks in mid-century and declines thereafter, and the rapid introduction of new and more efficient technologies. Major underlying themes are convergence among regions, capacity building and increased cultural and social interactions, with a substantial reduction in regional differences in per capita income. The A1 scenario family develops into three groups that describe alternative directions of technological change in the energy system. The three A1 groups are distinguished by their technological emphasis: fossil-intensive (A1FI), non-fossil energy sources (A1T) or a balance across all sources (A1B) (where balanced is defined as not relying too heavily on one particular energy source, on the assumption that similar improvement rates apply to all energy supply and end use technologies).²⁰

¹⁸ Synthesis Report on the Aggregate Effect of the Intended Nationally Determined Contributions (Brief Overview), UNFCCC, October 30, 2015, http://unfccc.int/files/locus/inde_portal/application/pdf/synthesis_report_-_brief_overview.pdf

¹⁹ IPCC, Fourth Assessment Report, Working Group I, Summary for Policy Makers, https://www.ipcc.ch/publications_and_data/ar4/wg1/en/spmssp-projections-of.html.

²⁰ *Id.* (emphasis added).

The A1B scenario has been used as a baseline in recent years by both the U.S. government²¹ and European researchers²². Climatologists Michael Mann and Richard Alley of Penn State University call it “a ‘middle of the road’ emission scenario that is often used as a baseline for comparisons.”²³ Its emissions trajectory falls in between those of the RCP 6.0 and RCP 8.5 pathways,²⁴ consistent with the IPCC’s observation that: “Although most baseline scenarios project a deceleration in emissions growth, especially compared to the rapid rate observed in the past decade, none is consistent in the long run with the pathways in the two most stringent RCP scenarios [2.6 and 4.5], with the majority falling between the 6.0 and 8.5 pathways.”²⁵

One possible reason that INDC analyses have avoided using the A1B baseline is that using it eliminates any sign of progress. According to the Model for the Assessment of Greenhouse-gas Induced Climate Change (MAGICC), developed through support of the U.S. Environmental Protection Agency,²⁶ the projected climate change by 2100 under the A1B scenario is 3.4°C.²⁷ This result is consistent with the IPCC’s own estimate for the scenario of 3.3°C warming.²⁸ Either figure is *already below* the best estimate for what the INDCs achieve. In its report, MIT also shows the A1B trajectory of emissions as virtually indistinguishable from the INDC-driven projection.²⁹

A “bottoms-up” assessment of individual INDCs confirms the view that countries have promised only what was already likely to happen.

²¹ Jeremy Melillo et al. eds., “Climate Change Impacts in the United States: The Third National Climate Assessment,” U.S. Global Change Research Program, October 2014, http://s3.amazonaws.com/nca2014/low/NCAR3_Climate_Change_Impacts_in_the_United%20States_LowRes.pdf.

²² Ole B. Christensen et al. “European and Global Climate Change Projections,” The ClimateCost Project, September 2011, http://www.climatecost.eu/images/Policy_brief_1_Projections_05_lowres.pdf.

²³ Michael Mann and Richard Alley, “SRES Scenarios,” Penn State University, <https://www.e-education.psu.edu/meteo469/node/145> (accessed November 11, 2015)

²⁴ IPCC, Fifth Assessment Report, Working Group 2, Chapter 1, http://www.ipcc.ch/pdf/assessment-report/ar5/wg2/WGIIAR5-Chap1_FINAL.pdf (figure 1-4).

²⁵ *Supra* note 10 (and figure 6.4).

²⁶ “MAGICC/SCENGEN: About,” <http://www.ecd.ucar.edu/cas/wigley/magicc/about.html> (accessed November 11, 2015).

²⁷ M. Meinshausen et al. “Emulating coupled atmosphere-ocean and carbon cycle models with a simpler model, MAGICC6: Part I – Model Description and Calibration,” Atmospheric Chemistry and Physics, 2011, <http://live.magicc.org> (accessed November 11, 2015).

²⁸ IPCC, Fourth Assessment Report, Summary for Policy Makers, https://www.ipcc.ch/publications_and_data/ar4/svr/en/spms3.html (table SPM.1 provides warming since 1980-1999; note (d) provides adjustment to pre-industrial baseline).

²⁹ John Reilly et al. “Energy & Climate Outlook: Perspectives from 2015,” MIT Joint Program on the Science and Policy of Global Change, 2015, <http://globalchange.mit.edu/files/2015%20Energy%20%26%20Climate%20Outlook.pdf> (figure 17).

It is the major developing nations whose aggressive emissions trajectories will dictate the world's total emissions this century – four-fifths of carbon-dioxide emissions in the A1B scenario. But those are the same nations whose desperate need for economic growth precludes a willingness to focus on emissions reductions. They are committing only to doing what they believed their economies would do anyway, rather than making sacrifices or incurring costs.

Two, China and India, are reviewed in detail here.

B.3. Country Assessment: China

China has committed to reaching peak emissions “around 2030” but offered no commitment regarding the level of that peak or the subsequent rate of emission decline. It has also committed to reducing carbon-dioxide emissions per unit of GDP by 60 to 65 percent in 2030 as compared to 2005.³⁰

But four years ago, in 2011, a study by the U.S. government's own Lawrence Berkeley National Laboratory had already concluded that Chinese emissions would peak around 2030.³¹ An analysis by Bloomberg New Energy Finance further concludes that the commitment with respect to emissions intensity is actually *less* ambitious than BAU.³²

China's recent announcement that its coal consumption is up to 17 percent higher than previously estimated makes the commitment even weaker and more easily achievable, as its officials acknowledge.³³ Because its commitments include no absolute emissions targets, starting from a higher baseline simply means it can consume and emit more while still meeting its goal. Especially insofar as Chinese leaders may have been aware their official statistics underreported coal consumption and emissions, they have played the INDC game masterfully.

Climate Action Tracker, one of the organizations attempting to calculate INDC impacts, provides a China-specific view and projects the country's commitments to fall squarely in the middle of the projection for current policy (i.e., absent the INDC). Notably, the analysis disregards the emissions intensity target entirely because “the weak INDC carbon intensity targets, if taken literally, would only be reached at the expense of

³⁰ “Intended Nationally Determined Contribution of China,” UNFCCC, June 30, 2015, <http://www4.unfccc.int/submissions/INDC/Published%20Documents/China/1/China's%20INDC%20-%20on%2030%20June%202015.pdf>.

³¹ Nan Zhou et al. “China's Energy and Carbon Emissions Outlook to 2050,” Lawrence Berkeley National Laboratory, April 2011, <https://china.lbl.gov/sites/all/files/lbl-4472e-energy-2050april-2011.pdf>.

³² “How Ambitious Are the Post-2020 Targets?,” Bloomberg New Energy Finance, October 2, 2015, <http://about.bnef.com/content/uploads/sites/4/2015/10/2015-10-02-How-ambitious-are-the-post-2020-targets-UPDATE-2-Oct.pdf>.

³³ Chris Buckley, “China Burns Much More Coal Than Reported, Complicating Climate Talks,” *New York Times*, November 3, 2015, <http://www.nytimes.com/2015/11/04/world/asia/china-burns-much-more-coal-than-reported-complicating-climate-talks.html>.

important national policies and actions, including in relation to reduced air pollution. This appears unlikely in our judgment.”³⁴ The analysis acknowledges that the commitment is meaningless but therefore dismisses it as implausible and substitutes a more climate-friendly estimate.

B.4. Country Assessment: India

Nonetheless, China’s INDC is a model of climate ambition when compared to India’s. While the *New York Times* headlined India’s announcement with “India Announces Plan to Lower Rate of Greenhouse Gas Emissions,”³⁵ the country offered no commitment with respect to its emissions—even a potential future peak—and only a 33 to 35 percent reduction in emissions per unit of GDP in 2030 as compared to 2005.³⁶

Analyses from multiple perspectives demonstrate the emptiness of this commitment. In April, India’s Centre for Policy Research estimated an emissions trajectory for the country absent further policy action³⁷ and the INDC commitment falls squarely in the middle of the established range. Bloomberg finds it significantly worse than BAU³⁸ and researcher Glen Peters has shown the proposed progress is slower than historical trend.³⁹ Indeed, the most obvious reference point is in the INDC itself: India reports that its energy efficiency has already improved more than 17 percent between 2005 and 2012. Assuming no change in its carbon intensity of energy, India could improve only half as fast going forward and still achieve its “goal.”

Climate Action Tracker also concedes that India’s target is less ambitious than BAU, but nevertheless awards the country a rating of “Medium.”⁴⁰ The only countries in the world to receive better ratings are Morocco, Costa Rica, Ethiopia, and Bhutan.

Looking beyond China and India, Indonesia has submitted a plan⁴¹ so vague that the World Resources Institute could not assess it; Taryn Fransen, project director of the

³⁴ “China,” Climate Action Tracker, <http://climateactiontracker.org/countries/china.html> (accessed November 11, 2015).

³⁵ Ellen Barry and Coral Davenport, “India Announces Plan to Lower Rate of Greenhouse Gas Emissions,” *New York Times*, October 1, 2015, <http://www.nytimes.com/2015/10/02/world/asia/india-announces-plan-to-lower-rate-of-greenhouse-gas-emissions.html>.

³⁶ “Intended Nationally Determined Contribution of India,” UNFCCC, October 1, 2015, <http://www4.unfccc.int/submissions/INDC/Published%20Documents/India/1/INDIA%20INDC%2010%20UNFCCC.pdf>.

³⁷ Navroz K. Dubash et al., “Informing India’s Energy and Climate Debate: Policy Lessons from Modelling Studies,” Centre for Policy Research, April 2015, http://cprindia.org/sites/default/files/Informing%20India%27s%20Energy%20and%20Climate%20Debate_CPR-HASA.pdf.

³⁸ *Supra* note 32.

³⁹ Glen Peters, “Is the Indian #INDC ambitious?” Twitter, October 12, 2015, https://twitter.com/Peters_Glen/status/653497917613830144/photo/1 (accessed November 11, 2015).

⁴⁰ “India,” <http://climateactiontracker.org/countries/india.html> (accessed November 11, 2015).

Institute's Open Climate Network concluded it "does not allow for any accountability."⁴² Even Climate Action Tracker rates the plan "Inadequate" and finds it less aggressive than current policy projections.⁴³

Brazil, the most ambitious of the large developing countries, may actually have proposed an improvement on current policy. However, its carbon footprint has historically been driven by deforestation, which has slowed dramatically in recent years leading to significantly lower emissions. In its INDC, Brazil reports a 41 percent decline in emissions between 2005 and 2012 but commits to only a 37 percent reduction between 2005 and 2025.⁴⁴ As professor Timmons Roberts and research fellow Guy Edwards of Brown University observed at the Brookings Institution, this is "seeking credit for work done" and "the new targets mean only tepid steps forward."⁴⁵

In mid-November, long after all deadlines had passed, Pakistan submitted a one-page INDC making no commitments and offering the tautological observation that "Pakistan is committed to reduce its emissions after reaching peak levels to the extent possible."⁴⁶ Nigeria submitted its own plan less than 48 hours before the start of talks, leaving no opportunity for an assessment.⁴⁷ A cursory review would seem to indicate that it worked from an implausible "business-as-usual" defined as emissions growing at least as quickly as the economic output (economic growth of 5% per year, emissions growth of 114% over the 2015-2030 period or 5.2% per year).⁴⁸

In summary, claims of progress for the INDC-driven approach are incorrect and depend on the use of inappropriate baselines or an assumption of action not even pledged. But if actual discussions over emissions reductions have been reduced to the submission of voluntary, unenforceable, and often empty INDCs, what is the point of even meeting in Paris?

⁴¹ "Intended Nationally Determined Contribution of Indonesia." UNFCCC, September 24, 2015. http://www4.unfccc.int/submissions/INDC/Published%20Documents/Indonesia/1/INDC_REPUBLIC%20OF%20INDONESIA.pdf.

⁴² Suzanne Goldenberg, "Indonesia to Cut Carbon Emissions by 29% by 2030," *Guardian* (UK), September 24, 2015. <http://www.theguardian.com/environment/2015/sep/24/indonesia-promises-to-cut-carbon-emissions-by-29-by-2030>.

⁴³ "Indonesia," Climate Action Tracker. <http://climateactiontracker.org/countries/indonesia.html> (accessed November 11, 2015).

⁴⁴ "Intended Nationally Determined Contribution of Brazil." UNFCCC, September 28, 2015. <http://www4.unfccc.int/submissions/INDC/Published%20Documents/Brazil/1/BRAZIL%20INDC%20english%20FINAL>.

⁴⁵ Guy Edwards and Timmons Roberts, "Despite Its Heavyweight Status, Brazil's Climate Plan Punches Below Its Weight." *PlanetPolicy* (Brookings), September 30, 2015. <http://www.brookings.edu/blogs/planetpolicy/posts/2015/09/30-brazil-climate-plan-edwards-roberts>.

⁴⁶ "Intended Nationally Determined Contribution of Pakistan." UNFCCC, November 12, 2015. <http://www4.unfccc.int/submissions/INDC/Published%20Documents/Pakistan/1/Pakistan%20INDC.doc>.

⁴⁷ "INDCs as Communicated by the Parties," UNFCCC, accessed November 29, 2015. <http://www4.unfccc.int/submissions/INDC/Submission%20Pages/submissions.aspx>.

⁴⁸ "Intended Nationally Determined Contribution of Nigeria." UNFCCC, November 28, 2015. http://www4.unfccc.int/submissions/INDC/Published%20Documents/Nigeria/1/Approved%20Nigeria's%20INDC_271115.pdf.

C. An Emphasis on “Climate Finance”

Negotiations in Paris will focus little on greenhouse-gas emissions and almost entirely on the more mundane subject of cash. Specifically, the developing world expects developed countries to offer more than \$100 billion per year in what is called “climate finance.”

Then-Secretary of State Hillary Clinton first announced a developed-world commitment to such enormous wealth transfers in a bid to save the Copenhagen talks in 2009.⁴⁹ UN Secretary-General Ban Ki-moon now insists “credible climate financing is essential” to success in Paris⁵⁰ while Miguel Cañete, the EU’s Commissioner for Climate Action, has reportedly promised not only \$100 billion per year by 2020 but increasing amounts thereafter.⁵¹ Christiana Figueres, the Executive Secretary of the UN Framework Convention on Climate Change, wrote in an op-ed published October 30:

Crucial to that success [in Paris] and to fostering the current and future ambitions of countries will be finance – and, more specifically, support from developed countries to the aspirations of developing ones. Six years ago, rich countries pledged to provide \$100 billion to poorer countries by 2020, the date when the new agreement will come into force. Paris needs to provide certainty, clarity and confidence that this promise will be met, not least to support the climate action plans – Intended Nationally Determined Contributions (INDCs) – of the most vulnerable nations, including the least developed countries and the small island developing states.⁵²

What remains unclear is not only the source of this finance, but also its rationale. Figueres notes that one purpose might be to support the implementation of INDCs (though, as discussed above, those INDCs do not generally represent new action). As her phrasing implies, many justifications have been floated:

- First, developing nations suggest that developed nations owe them an “ecological debt” for the latter’s disproportionate share of past emissions. Pope Francis endorsed this argument in his encyclical on the environment.⁵³ This argument holds that because scientific estimates place an upper limit on the amount of carbon dioxide that humanity can ever emit, nations like the U.S. that have already emitted more than their fair share are accumulating debt payable to

⁴⁹ Lisa Friedman and Darren Samuelsohn, “Hillary Clinton Pledges \$100B for Developing Countries,” *New York Times*, December 17, 2009, <http://www.nytimes.com/cwires/2009/12/17/17climatewire-hillary-clinton-pledges-100b-for-developing-96794.html>.

⁵⁰ “100 Billion Reasons a Global Climate-Change Deal May Fall Apart,” *Bloomberg Business*, June 29, 2015, <http://www.bloomberg.com/news/articles/2015-06-29/un-leader-says-climate-talks-won-t-hit-mark-to-limit-warming>.

⁵¹ Fiona Harvey, “No Plan B if Paris Climate Summit Ends in Failure, Says EU Climate Chief,” *Guardian (UK)*, July 6, 2015, <http://www.theguardian.com/environment/2015/jul/06/no-plan-b-if-paris-climate-summit-ends-in-failure-says-eu-climate-chief>.

⁵² Christiana Figueres, “Time to Focus on Climate Finance,” *G7 G20*, October 30, 2015, <http://www.g7g20.com/articles/christiana-figueres-time-to-focus-on-climate-finance>.

⁵³ Pope Francis, *Laudato Si'*, May 24, 2015, http://w2.vatican.va/content/francesco/en/encyclicals/documents/papa-francesco_20150524_enciclica-laudato-si.html.

nations using less than their fair share. In America's case, the monetary value of the debt could reach trillions of dollars.⁵⁴

- Second, developing nations suggest that developed nations should pay them "reparations" for natural disasters caused by the climate change for which past developed-nation emissions are purportedly responsible. While many western politicians are eager in the domestic context to attribute natural disasters and their severity to climate change, they are reluctant to do so in an international context where accepting such causation could trigger enormous and unpredictable liability.⁵⁵
- Third, developing nations suggest that the funding will help them to pursue low-carbon development, deploy more renewable energy, and adapt to whatever climate changes occur. This rationale is the only one that U.S. negotiators have acknowledged as valid.⁵⁶ However, in the current negotiating framework, it remains unclear what developed nations would be receiving for their money. India, for instance, has suggested it will require \$2.5 trillion between now and 2030 – to pursue its business-as-usual INDC.⁵⁷

As should be clear, it makes little sense under any rationale for the developed world to offer trillions of dollars in wealth transfers as part of an agreement not likely to produce emissions reductions. But increasingly, those payments are considered the price of the agreement. Developed-world climate negotiators are pursuing a transaction in which leaders in the developed world, having staked their political capital and legacies on achieving an "agreement," must pay developing nations to sign on the dotted line.

This dynamic – where the objective of an agreement is the agreement itself – explains why a process was embraced that prioritizes empty consensus over any prospect of substantive action, why the empty commitments that followed have been celebrated as important achievements rather than condemned as inadequate, and why negotiations now center on wealth transfers.

⁵⁴ Oren Cass, "Leading Nowhere: The Futility and Farce of Global Climate Negotiations," Manhattan Institute for Policy Research, October 2015, <http://www.manhattan-institute.org/html/leading-nowhere-futility-and-farce-global-climate-negotiations-7816.html>.

⁵⁵ Ben Webster, "Britain Rejects Demands for Climate Disaster Compensation." *The Times* (UK), November 21, 2013, <http://www.thetimes.co.uk/to/environment/article3927261.ece>.

⁵⁶ Andrew C. Revkin and Tom Zeller Jr., "U.S. Negotiator Dismisses Reparations for Climate." *New York Times*, December 9, 2009, <http://www.nytimes.com/2009/12/10/science/earth/10climate.html>.

⁵⁷ *Supra* note 36.

The current climate negotiations obscure rather than advance the objective of reducing greenhouse-gas emissions. Vocal supporters, by crediting developing nations for proceeding on their current course, ensure that the required “naming and shaming” will not occur. Yet somehow, it is the critics who stand accused of blocking progress.

Policymakers and activists from all points on the political spectrum should be united in condemning as unhelpful the Paris talks now underway. Congress should reject and refuse to appropriate funds for any agreement emphasizing wealth transfers over emissions reductions.

II. THE DOMESTIC PERSPECTIVE: WHAT IS U.S. POLICY ACCOMPLISHING?

U.S. leadership is not spurring developing nations to sacrifice economic growth for emissions reductions.

But without such an effect, there is no justification for the costly domestic actions undertaken by the Obama administration. Still, supporters argue that aggressive carbon-dioxide regulations like the Clean Power Plan are good economic policy even if they offer no carbon-dioxide-related benefits. These claims are disingenuous, *post hoc* rationalizations that are unsupported by economic analysis.

Environmental Regulation and Economic Growth

One claim made in favor of additional regulation is that forcing investment in pollution-control technology or alternative energy sources will “create jobs.”⁵⁸ This is tautologically true. Similarly, an EPA “Large Holes Plan” that required each state to dig a certain number of large holes would create new hole-digging jobs and likely some shovel-related innovation. Neither plan necessarily contributes to the economy’s health or the nation’s prosperity.

Solar provides a helpful example. The Solar Energy Industries Association reports, based on a study it commissioned from Bloomberg New Energy Finance, that expiration of the current federal subsidy for solar investments would produce a loss of 80,000 solar jobs in 2017—approximately two-thirds of the projected 2016 total.⁵⁹ In other words, even after a long period of aggressive government support, the majority of jobs in the industry are not economically viable without further taxpayer largesse.

⁵⁸ E.g., Remarks by EPA Administrator Gina McCarthy (as prepared), Resources for the Future, August 11, 2015, <http://yosemite.epa.gov/opa/admpress.nsf/8d4917ad4bbc4e1852573590040b716/12182a2927e222dc85257e9e00693ba0?OpenDocument>.

⁵⁹ “Solar ITC Impact Analysis,” Solar Energy Industries Association, September 2015, <http://www.seia.org/research-resources/solar-itc-impact-analysis>.

More broadly, the claim is made that regulation must be good for the economy because the economy has grown when past regulations were implemented. To quote an August speech by EPA Administrator Gina McCarthy: “They’ll say that our transition to cleaner energy system [sic] will kill jobs. Well, I’m not sure they’ve been following the economics as well as they should, because the solar industry is creating jobs 10 times faster than the rest of the economy. And, by the way, over the last 40 years, we’ve cut air pollution by 70 percent—while our economy has tripled.”⁶⁰

Senator Ed Markey observed at a recent Senate hearing on the Clean Power Plan: “In New England, New York, Delaware, Maryland, we implemented a Regional Greenhouse Gas Initiative [RGGI]. From 2007 until today, we’ve reduced our greenhouse gases across those nine states by 40 percent. In Massachusetts, we saw an increase in our gross domestic product by 29 percent at the same time. We can do it. We can do it.”⁶¹

In real terms, total GDP growth in Massachusetts from 2007 to 2014 was 8.7 percent according to the Bureau of Economic Analysis.⁶² But that says nothing about what growth would have been without RGGI. In the seven year period from 1999 to 2006, Massachusetts GDP grew 18.2 percent—surely it would be unfair to suggest that RGGI cut growth by more than half.

This analytical principle obviously extends beyond Massachusetts. While there is no question that the economy has continued to grow even as laws like the Clean Air Act have made extraordinary gains in the nation’s environmental quality, this does not suggest that environmental regulation is therefore a *cause* of this growth or even a net positive for the economy. To the contrary, careful economic studies consistently demonstrate that regulation has slowed economic growth and harmed workers, particularly in those industries most heavily regulated:

- “[I]n the first 15 years after the CAAs became law (1972-1987), nonattainment counties (relative to attainment ones) lost approximately 590,000 jobs, \$37 billion in capital stock, and \$75 billion (1987\$) of output in polluting industries.” (NBER, University of Chicago)⁶³

⁶⁰ *Supra* note 58.

⁶¹ Remarks by Senator Ed Markey. Hearing of the Senate Environment and Public Works Committee, July 8, 2015. <http://www.epw.senate.gov/public/index.cfm/hearings?ID=99170038-D5CB-4E63-8695-231AB995D089> (at time 1:35:00).

⁶² “Real GDP by State (millions of chained 2009 dollars),” Bureau of Economic Analysis. <http://www.bea.gov/iTable/iTable.cfm?reqid=70>, accessed November 29, 2015.

⁶³ Michael Greenstone, “The Impacts of Environmental Regulations on Industrial Activity: Evidence from the 1970 and 1977 Clean Air Act Amendments and the Census of Manufactures.” NBER Working Paper 8484, September 2001. <http://www.nber.org/papers/w8484.pdf>.

- After the 1990 Clean Air Act amendments, “the average worker in a regulated sector experienced a total earnings loss equivalent to 20% of their preregulatory earnings.” (Quarterly Journal of Economics, University of California-Berkeley)⁶⁴
- The stricter regulations applied by the Clean Air Act to “nonattainment” counties favors others, “reducing [plant] births for polluting industries in nonattainment areas by 26–45 percent.” (Journal of Political Economy, U.S. Census Bureau, Brown University)⁶⁵
- Losses in total factor productivity from the Clean Air Act “correspond to annual lost output in the manufacturing sector of about \$20.8 billion in 2010 dollars. This is roughly 8.8 percent of average manufacturing sector profits over this period.” (MIT, University of Chicago)⁶⁶

Honest discussions of the cost and benefits of environmental regulation must begin from the acknowledgment that there are costs and benefits. In the absence of climate benefits, carbon-dioxide regulations cannot be justified by claiming that the economic costs are benefits themselves.

The European Experience

The EPA need not experiment on the American economy to discover that the proposed policies are costly ones. Europe has conducted the experiment already. Since 2006, thanks to aggressive government mandates and subsidies, European investment in clean energy has dramatically outpaced U.S. investment according to Bloomberg New Energy Finance.⁶⁷ In 2010, near its peak, European investment more than tripled U.S. investment.

What happened? Last year, the U.S. Energy Information Administration reported that since 2006 European residential electricity prices have skyrocketed – increasing by 43

⁶⁴ W. Reed Walker. “The Transitional Costs of Sectoral Reallocation: Evidence from the Clean Air Act and the Workforce.” *Quarterly Journal of Economics*, 2013, http://faculty.haas.berkeley.edu/rwalker/research/walker_transitional_costs_CAA.pdf.

⁶⁵ Randy Becker and Vernon Henderson, “Effects of Air Quality Regulations on Polluting Industries.” *Journal of Political Economy*, 2000.

⁶⁶ Michael Greenstone et al, “The Effects of Environmental Regulation on the Competitiveness of U.S. Manufacturing.” MIT Center for Energy and Environmental Policy Research, September 2012, <http://web.mit.edu/ccenr/www/publications/workingpapers/2012-013.pdf>.

⁶⁷ Luke Mills. “Global Trends in Clean Energy Investment.” Bloomberg New Energy Finance, October 2015, <http://about.bnef.com/content/uploads/sites/4/2015/10/2015-10-08-Clean-Energy-Investment-Q3-2015-factpack.pdf>.

percent compared to a 17 percent increase in the United States.⁶⁸ Industrial electricity prices in Germany are up 60 percent in five years.⁶⁹

In an article titled "Worse Than Useless," *The Economist* reported that major utility companies have lost more than \$500 billion in market value and that the continent's largest source of renewable energy is now wood.⁷⁰ Germany spent \$20 billion on subsidies in 2013 alone, yet German coal consumption and carbon-dioxide emissions were actually rising.⁷¹

Europe is reversing course quickly. Countries are slashing subsidies.⁷² Since 2011, investment has plunged nearly 70 percent and in Q3 of 2015 reached its lowest level since 2004.⁷³ In 2015, for the first time, U.S. investment will exceed Europe's.

While those celebrating green investment as an end unto itself will undoubtedly celebrate this American "victory," anyone concerned with economic growth and competitiveness should hope this country avoids a repeat of the European experience.

Thank you again for the opportunity to appear before the Committee. I look forward to answering your questions.

⁶⁸ "European Residential Electricity Prices Increasing Faster Than Prices in United States," U.S. Energy Information Administration, November 18, 2014, <https://www.eia.gov/todayinenergy/detail.cfm?id=18851>.

⁶⁹ Matthew Karnitschnig, "Germany's Expensive Gamble on Renewable Energy," *Wall Street Journal*, August 26, 2014, <http://www.wsj.com/articles/germanys-expensive-gamble-on-renewable-energy-1409106602>.

⁷⁰ "Worse than Useless," *Economist*, January 15, 2014, <http://www.economist.com/news/leaders/21595002-current-policies-are-mess-heres-how-fix-them-worse-useless>.

⁷¹ Matthew Carr, "Rising German Coal Use Imperils European Emissions Deal," *Bloomberg Business*, June 20, 2014, <http://www.bloomberg.com/news/articles/2014-06-19/rising-german-coal-use-imperils-european-emissions-deal>.

⁷² See, e.g., *supra* note 69 (Germany); Susanna Twidale, "Britain Moves to Slash Renewable Subsidy Costs," *Reuters*, July 22, 2015, <http://uk.reuters.com/article/2015/07/22/uk-britain-renewables-subsidies-idUKKCN0PW0DW20150722> (UK).

⁷³ *Supra* note 67.

Biography for Oren M. Cass

Oren Cass is a senior fellow at the Manhattan Institute, where he focuses on energy, the environment, and antipoverty policy. He was domestic policy director of Mitt Romney's presidential campaign in 2011–12. In that role, Cass shaped campaign policy and communication on issues from health care to energy to trade. He spoke regularly on behalf of the campaign, including in debates at Harvard University on health care policy and at MIT on energy and environmental policy. Since then, Cass has outlined conservative policy approaches on poverty, climate change, environmental regulation, and international trade. Cass has briefed members of Congress and congressional staff in both the House and Senate and his essays and columns have been published in the *Wall Street Journal*, *New York Times*, *Washington Post*, *National Affairs*, *City Journal*, *National Review*, *Investor's Business Daily*, and *Washington Examiner*.

Prior to joining MI, Cass was a management consultant for Bain & Company in the firm's Boston and New Delhi offices, where he advised global companies across a range of industries on implementing growth strategies and performance-improvement programs. He holds a B.A. in political economy from Williams College and a J.D. from Harvard University, where he was an editor and the vice president of volume 125 of the *Harvard Law Review*.

Chairman SMITH. Thank you, Mr. Cass.
Mr. Grossman.

**TESTIMONY OF MR. ANDREW GROSSMAN,
ASSOCIATE, BAKER & HOSTETLER LLP**

Mr. GROSSMAN. Thank you, Mr. Chairman and Members of the Committee. Thank you for holding this hearing today and inviting me to testify.

The Committee has requested that I assess the legal aspects of the climate agreement being negotiated in Paris, and my conclusion is that, as a legal matter, Paris is a farce. The point of the Paris negotiations is to create new obligations in international law, but it is our constitutional separation of powers that will effectively determine the parameters of that agreement because of a decision that the President made.

The President decided that he would not seek the advice and consent of the Senate to ratify the Paris agreement as a treaty, and he decided that he would not seek the legislative support of the House and Senate to implement the Paris agreement as a Congressional executive agreement. Instead, the President made the decision to do what he has done so many times in recent years: attempt to circumvent Congress and proceed on his own. Well, he's got his pen and he's got his phone, but what he doesn't have is the legislative power. And that means he is extremely constrained in terms of what he can lawfully accomplish through an executive agreement made on his sole authority.

Let me concede that the President's authority to conclude executive agreements is a controversial subject with many legal scholars having differing views about the scope of that authority. But the law in this area is often uncertain. But it's not the uncertain parts that we're talking about today. The issues at play here are ones where there is broad agreement about what the President can and cannot do. That means we can review the likely components of a Paris deal and determine with great confidence where they stand under U.S. law.

The two central objectives of the negotiations are financial commitments to foreign aid and emission reduction targets. These things cannot be implemented in any binding fashion consistent with U.S. law. The idea of the financial commitments, as I understand it, is for the United States and other developed nations to make transfer payments to the governments of poorer nations to coax them to forgo cheap energy from traditional high emission sources.

There is an insurmountable legal issue here. The U.S. Constitution provides that no money shall be drawn from the Treasury but in consequence of appropriations made by law—in other words, a law enacted by Congress. For that reason, commitments of funds are often cited as the quintessential example of measures that the President cannot undertake on his sole authority.

Now, I'm not aware of any serious disagreement on that point, so that is our legal conclusion. An agreement containing binding financial commitments cannot be executed on the President's sole authority.

Binding emission reduction targets are likewise off the table. In assessing the President's authority to enter into an executive agreement, we look to historical practice and Congressional consents. The leading legal authorities echo Justice Jackson's formula from the Steel Seizure case. The President's authority to enter into executive agreements is secure where he draws on consistent support and historical practice and Congressional acquiescence. His power is at its lowest ebb where he lacks those things.

The President lacks both of those things here. The historical practice is that international agreements concerning environmental protection have traditionally been entered as treaties in all or nearly every instance. And now that's according to an exhaustive survey by the Congressional Research Service.

And that consistent practice includes the last major agreement concerning climate change to which the United States was a party: the United Nations Framework Convention on Climate Change. The ratification history of that treaty rebuts any claim that Congress has acquiesced in allowing the President to bind the Nation to emissions targets.

When the Senate ratified the Framework Convention, it sought and extracted a pledge from the Bush Administration that any future protocol containing targets and timetables would be subject to Senate ratification. Subsequently, President Clinton signed the Kyoto Protocol, which did contain binding targets, but it was never sent to the Senate for ratification. It was never implemented. It was ultimately abandoned.

In other words, the Kyoto Protocol, which concerns the very same subject matter as the Paris talks, was regarded by both political branches as a treaty subject to Senate ratification. And due to the inability to secure Senate ratification, the United States never deposited an instrument of ratification binding it to Kyoto's terms. In foreign relations law, that series of events constitutes incredibly strong precedent.

I therefore agree with the CRS's conclusion that any court weighing the claim that the President may adopt and implement quantitative emissions reductions would most likely deem the executive's action an unconstitutional usurpation of Congressional power. This is why Paris is a farce. The two central planks of any agreement have already been ruled out due to the President's decision to go it alone.

So where does that leave the President? I see two possible outcomes. The first is the solution proposed by the Administration, a so-called hybrid agreement. This would consist of legally binding and non-legally binding components. Foreign-aided emission target—foreign aid and emissions targets would be what the diplomats call political commitments, which means that they aren't legal commitments at all. In other words, they're nonbinding.

The other possibility is more objectionable. There's a real risk, I fear, the Administration may view the red lines of U.S. law the same way it has viewed red lines in international affairs, as basically meaningless. What if the President purports on his sole authority to join a Paris protocol containing binding financial commitments and emissions limitations?

I think that Congress can and should guard against this risk, and the way to do it is to make clear the limits on presidential legal authority in this area. If the President is not serious about holding the line, Congress can and should remind our negotiating partners, as well as the President, that they—so that they are under no illusions about what the United States is likely to do. In other words, where enforceable measures are concerned, there is no avoiding Congress.

Again, I thank the committee for the opportunity to offer these remarks, and I look forward to your questions.

[The prepared statement of Mr. Grossman follows:]

Pitfalls of Unilateral Negotiations at the Paris Climate Change Conference

Testimony before the Committee on Science,
Space, and Technology,
United States House of Representatives

December 1, 2015

Andrew M. Grossman
Associate, Baker & Hostetler LLP
Adjunct Scholar, Cato Institute

My name is Andrew Grossman. I am an attorney in the Washington, D.C., office of Baker & Hostetler LLP and Adjunct Scholar at the Cato Institute. The views I express in this testimony are my own and should not be construed as representing those of my law firm, its clients, or the Cato Institute.

The Committee has requested that I address the legal aspects of the climate agreement being negotiated in Paris, particularly the limitations that domestic law imposes on the President's ability to make commitments on behalf of the United States. In this instance, the law cannot be viewed in isolation—at least, not if one desires to understand the constraints as perceived by the Administration as it negotiates in Paris. To be sure, there are real legal barriers that will restrict the President's flexibility in Paris. Not all of them, however, are directly enforceable, and overreaching where judicial review can be avoided or evaded has been, as we all know, a hallmark of this Administration's approach to policymaking. Even so, whatever international-law obligations it may purport to impose on the United States, any treaty that comes out of Paris will have to be implemented by Congress through legislation to have a meaningful domestic effect.

As a legal matter, then, Paris is a charade. While the President and his allies may attempt to use a Paris agreement as a political bludgeon, it cannot and will not alter the legal obligations of any American.

That conclusion has implications for Congress, for the President, and for our negotiating partners in Paris. First, Congress can and should continue to make clear its policy views so that there is no ambiguity at Paris regarding the U.S. position on what can and will be implemented. Second, the President should exercise restraint and refuse to make commitments that go beyond clearly existing legal authority, unless he is willing to put the deal to a vote. Making nominally binding international commitments that the nation has no intention of actually carrying out, so as to influence domestic politics, would be stunningly cynical and irresponsible, inflicting unnecessary injury to the United States' credibility in international affairs for the sake of scoring political points. But, third, if the President does follow that cynical course, our negotiating partners should not be deceived about the extent of the President's authority, his reliability as a negotiating partner, and the likelihood that the United States will honor commitments made unilaterally by the President in reliance on his sole authority.

I. The Limitations of Executive Agreements

The legal status of an agreement struck in Paris involves two kinds of issues: first, the contents of the agreement itself and the obligations it establishes as a matter of international law; and, second, the extent to which the agreement imposes binding obligations within the United States. Logically, these are separate things: not every international agreement becomes or is im-

plemented in U.S. law. But as a practical matter, they are interconnected: the President wants to negotiate an agreement in which the United States is a participant, not a bystander. And in theory, that means he has to grapple with the requirements that U.S. law imposes regarding international agreements and attempt to negotiate an agreement that stands a chance of becoming law in the United States.

There are two ways that the United States can become party to a formal international agreement. The Treaty Clause of the Constitution empowers the President of the United States to propose and chiefly negotiate agreements, which must be confirmed by a two-thirds vote of the Senate—67 votes.¹

Longstanding practice, validated by legislative and judicial actions, also recognizes that the President may enter into certain international agreements without separate ratification by the Senate.² According to a recent tally by the Congressional Research Service (“CRS”), over 18,500 such “executive agreements” have been completed—with the bulk from recent decades—compared to 1,100 ratified treaties.³

Executive agreements are generally divided into three categories:

- Congressional-executive agreements are those approved by majorities in both chambers of Congress, as with normal legislation. Trade agreements like the North American Free Trade Agreement (“NAFTA”) are often implemented in this manner. Congressional authorization can come either before or after the President signs the agreement.
- Treaty-executive agreements are those that add annexes, protocols, or the like pursuant to the terms of an existing treaty. For example, the United States is a party to the Convention on International Trade in Endangered Species (“CITES”), which requires parties to regulate the import and export of listed species. The Convention provides a mechanism to list additional species, and such additions are regarded as treaty-executive agreements.

¹ U.S. Const. Art II, § 2, cl. 2.

² See *Am. Ins. Ass'n v. Garamendi*, 539 U.S. 396, 415 (2003) (“[O]ur cases have recognized that the President has authority to make ‘executive agreements’ with other countries, requiring no ratification by the Senate or approval by Congress, this power having been exercised since the early years of the Republic.”).

³ Michael John Garcia, *International Law and Agreements: Their Effect upon U.S. Law*, CRS Report No. RL32528, Feb. 18, 2015, at 5.

- Sole executive agreements are those based solely on the President's authority—typically his power as Commander in Chief or as representative of the nation in foreign affairs. Such agreements have traditionally concerned things such as the recognition of foreign states and international emergencies. For example, the Algiers Accords terminated private lawsuits in U.S. courts against Iran, and released Iranian property, in exchange for the release of U.S. hostages held by Iran. The Accords were upheld by the Supreme Court on the ground that the agreement was consistent with U.S. policy, as evidenced by statutes concerning the “President's authority to deal with international crises, and from the history of congressional acquiescence in executive claims settlement.”⁴ The Executive Branch has taken the view that the President may enter into sole-executive agreements that can be implemented pursuant to existing statutory authority that the President is duty-bound to faithfully execute.⁵

The availability of the executive agreement as a means of concluding international agreements raises a question: what, exactly, is the difference in scope or legal effect between a treaty entered pursuant to the Treaty Clause and an executive agreement? In other words, are there certain agreements that can only be concluded through a treaty ratified by the Senate (or through congressional approval), or are the two means of concluding agreements functionally identical?

Unsurprisingly, the State Department's view is that the only difference between a treaty and an executive agreement, even one executed on the President's sole authority, is that a treaty is ratified by the Senate. In other words, there is no class of agreements that can only be ratified as treaties, rather than by the executive acting alone.⁶ The Senate, of course, takes a different view. Its position is that any significant international commitment should be entered into as a treaty or at least as an executive agreement with authorizing legislation.⁷

⁴ *Dames & Moore v. Regan*, 453 U.S. 654, 656 (1981)

⁵ See 11 Foreign Affairs Manual § 723.2-2.

⁶ U.S. Dep't of State, Treaty vs. Executive Agreement, <http://www.state.gov/s/1/treaty/faqs/70133.htm>.

⁷ See, e.g., U.S. Senate, Treaties, <http://www.senate.gov/artandhistory/history/common/briefing/Treaties.htm>.

Being seldom litigated, the line between treaties and executive agreements is not one clearly delineated in the case law. What we do know is that historical practice and Congress's consent count for a lot in this area. "[L]ong-continued practice, known to and acquiesced in by Congress, would raise a presumption that the action had been taken in pursuance of its consent."⁸ Likewise, "a systematic, unbroken, executive practice, long pursued to the knowledge of the Congress and never before questioned may be treated as a gloss on 'Executive Power' vested in the President."⁹ Accordingly, the President's authority to enter into executive agreements is secure where he draws on consistent support in historical practice and congressional acquiescence, but his power is at its lowest ebb where he lacks those things.¹⁰

A final, but important, background point is that merely signing a Paris agreement will not necessarily give the agreement's strictures force as domestic law that is enforceable against Americans. While international agreements "may comprise international commitments...[,] they are not domestic law unless Congress has either enacted implementing statutes or the treaty itself conveys an intention that it be 'self-executing' and is ratified on these terms."¹¹ Instead, "when the terms of the stipulation import a contract, when either of the parties engages to perform a particular act, the treaty addresses itself to the political, not the judicial department; and the legislature must execute the contract before it can become a rule for the Court."¹² The key question is whether "the treaty contains stipulations which are self-executing, that is, require no legislation to make them operative."¹³ The need for legislation may be due to the text of the agreement itself, the need for specificity and imple-

⁸ *Dames & Moore*, 453 U.S. at 686 (alterations omitted and quoting *United States v. Midwest Oil Co.*, 236 U.S. 459, 474 (1915)).

⁹ *Id.* (alterations omitted and quoting *Youngstown Sheet & Tube Co. v. Sawyer*, 343 U.S. 579, 610–11 (1952) (Frankfurter, J., concurring)). See also *Garamendi*, 539 U.S. at 414–15.

¹⁰ *Cf. Youngstown*, 343 U.S. at 635–38 (Jackson, J., concurring).

¹¹ *Medellin v. Texas*, 552 U.S. 491, 505 (2008) (quoting *Igartua-De La Rosa v. United States*, 417 F.3d 145, 150 (1st Cir. 2005) (en banc) (Boudin, C.J.)).

¹² *Foster v. Neilson*, 27 U.S. (2 Pet.) 253, 314 (1829).

¹³ *Medellin*, 552 U.S. at 505. (quoting *Whitney v. Robertson*, 124 U.S. 190, 194 (1888)). See also Restatement (Third) of Foreign Relations Law of the United States § 111, Reporter's Note 5 (citing cases in support of the proposition that, "[i]n general, agreements that can be readily given effect by executive or judicial bodies, federal or State, without further legislation, are deemed self-executing....").

mentation, or constitutional requirements¹⁴—for example, that “[a]ll Bills for raising Revenue shall originate in the House of Representatives.”¹⁵ In this respect, congressional action may be necessary for an international agreement’s terms to have domestic legal force.

II. What Exactly Can the President Cram into a Sole Executive Agreement?

Based on governing legal principles, as well as drafts and news reports regarding pre-Paris negotiations, one can evaluate the potential terms of an agreement and how they are likely to be implemented. At this time, a surprising amount remains to be decided. The pre-meeting draft agreement runs to 51 pages, with more alternatives and options than a diner menu.¹⁶ Everything seems to be in flux. Developing nations are demanding binding financial commitments. Some European Union nations want emissions reductions—referred to, in exquisite bureaucratese, as “Intended Nationally Determined Contributions” (“INDC”)—to be binding. Others want only implementation measures to be binding. One proposed article on “compliance” would establish an “International Tribunal of Climate Justice” to rule on countries’ compliance on “mitigation, adaptation, provision of finance, technology development and transfer and, capacity-building” and exact punishment—what kind isn’t said. An alternative to that option is “No reference to facilitating implementation and compliance”—in other words, strike the article altogether. In typical fashion, there’s a third alternative: set up a committee to hold more meetings and publish another report. Procedural commitments like regularly updating INDCs, which had once seemed to be a point of agreement, are now in contention. Even the exact form that a final agreement may take is up in the air: for months, the Obama Administration has touted the possibility of a “hybrid agreement” that separates binding and non-binding commitments and buries more controversial items in separate annexes.¹⁷ But the parties are still arguing over what goes where.

In the domestic context, one thing we know for sure is that the the President’s legal flexibility is limited. No Paris agreement is going to be ratified by

¹⁴ Restatement (Third) of Foreign Relations Law of the United States § 111(4).

¹⁵ U.S. Const. Art. I, § 7.

¹⁶ Ad Hoc Working Group on the Durban Platform for Enhanced Action, Draft agreement and draft decision on workstreams 1 and 2 of the Ad Hoc Working Group on the Durban Platform for Enhanced Action, Version of 23 October 2015@23:30hrs.

¹⁷ Todd D. Stern, “Seizing the Opportunity for Progress on Climate,” U.S. Department of State, Oct. 14, 2014, <http://www.state.gov/s/climate/releases/2014/232962.htm>.

the Senate as a treaty: the President lacks the votes. Likewise, the President lacks the votes for approval by both chambers of Congress as a congressional-executive agreement. This also means that there is no likelihood, at least for the foreseeable future, that Congress will enact legislation to implement any provisions of an agreement that are not self-executing. Accordingly, only those provisions supported by prior treaty authority or statutory authority, or falling within the Executive's exclusive purview, can be carried out under the President's sole authority. As a practical matter, then, the President's ability to conclude or give effect to many potential components of a Paris agreement is severely constrained.

But the details matter. There are certain items, likely to be part of a final agreement, that are probably within the President's authority to adopt. But the key items, the ones that would give a Paris accord actual substance commensurate with the hype, are not among them. Let's consider, then, the legal basis for adoption of the major components of the most recent draft agreement.

A. Aspirational Gibberish? Sure!

Inevitably, the first few pages—or even more—of the final agreement will consist of aspirational language with no intended legal effect. For example, from the draft:

Emphasizing the importance of respecting and taking into account [, subject to jurisdiction] [right to development,] human rights [including people under occupation], gender equality [and women's empowerment], [the rights of indigenous peoples,][local communities,] intergenerational equity concerns, and the needs of [migrants] [particularly vulnerable groups] [people in vulnerable situations], [including people under [foreign] occupation,] women, children and persons with disabilities, when taking action to address climate change....

(Brackets indicate optional language that will be subject to further negotiation.)¹⁸

Another portion of the draft that I cannot resist quoting states that the parties, in implementing the agreement, will act to “ensur[e] the integrity and resilience of natural ecosystems, [the integrity of Mother Earth, protection of health, a just transition of the workforce and creation of decent work and quality jobs in accordance with nationally defined development priorities] and the respect, protection, promotion and fulfillment of human rights for all, including the right to health and sustainable development, [including the right

¹⁸ And it's not just the first few pages. The draft is shot through with this stuff.

of people under occupation] and to ensure gender equality and the full and equal participation of women, [and intergenerational equity].”

Not bad for a climate treaty, right?

There’s no real legal objection to any of this. Yes, it is silly. Yes, it will probably be cited as leverage for the next agreement or other future measures. And yes, there’s no good reason for the United States to throw its weight behind empty platitudes and empty promises that range from the merely ponderous (e.g., “adaptation action should follow a country-driven, gender-responsive, participatory and fully transparent approach, [respecting [human rights][right to life][rights of people under occupation] and] taking into consideration vulnerable groups, communities and ecosystems,” etc., etc.) to the positively Orwellian (e.g., espousing a commitment “to mobilize public support for climate policies and action”). But as a practical matter, the chief impact of all these provisions will be to contribute further emissions from the diplomats negotiating them. Then again, the extra pages to print it all are a carbon sink, so it may be a wash.

More seriously, it would be difficult to overestimate the time and effort that has been and will be devoted to fixing the Paris agreement’s preambular and otherwise non-substantive provisions. The United States, for example, won the plaudits of climate activists for its push to have the agreement declare a long-term goal of “decarbonisation of the global economy over the course of this century.”¹⁹ Given the limitations on the President’s ability to conclude and carry out substantive commitments, expect the United States delegation in Paris to fight hard over substance-free provisions that can be highlighted in victory-lap speeches and press releases. These things will make up a substantial part of the President’s “climate legacy,” which is apparently a central concern of the Administration.²⁰

¹⁹ See Gwynne Taraska, *An Inside Look at the U.N. Climate Negotiations in Bonn*, ThinkProgress, Oct. 26, 2015, <http://thinkprogress.org/climate/2015/10/26/3716028/bonn-un-session-wrap-up/>.

²⁰ See Colleen McCain Nelson, *Barack Obama’s Dual Mission at Climate Talks in Paris*, Wall Street Journal Washington Wire, Nov. 25, 2015, <http://blogs.wsj.com/washwire/2015/11/25/barack-obamas-dual-mission-at-climate-talks-in-paris/> (“During the months leading up to the talks, administration officials pointed to the Paris summit as the capstone in the president’s climate legacy, an anticipated opportunity to demonstrate U.S. leadership and secure a deal to slow global warming.”).

B. Procedural and Reporting Commitments? Probably.

While the headlines may go to INDCs and financial commitments, a central plank of any Paris agreement will be procedural and reporting commitments. The draft refers to many of these provisions under the heading “Transparency.” For example, parties may commit to regularly report their “national inventory of anthropogenic emissions by sources and removals by sinks of greenhouse gases,” projected emissions, progress in achieving INDCs, mitigation funding to other nations, etc., all for review by experts and other nations. One proposal, which has proven controversial among some developing nations, would require parties to regularly review and update their INDCs.²¹ When the Administration speaks of a “hybrid” agreement, these kinds of procedural obligations are the part that it anticipates would be binding.

Generally speaking, these procedural commitments refer back to the United Nations Framework Convention on Climate Change (“UNFCCC”), a prior treaty ratified by the United States Senate in 1992. As a framework treaty, the UNFCCC contains no substantive requirements itself, instead setting forth procedures to negotiate subsequent deals concerning emissions, financing, and the like. A number of its provisions concern reporting. For example, it requires parties to publish “national inventories of anthropogenic emissions by sources and removals by sinks of all greenhouse gases,” to publish descriptions of any “programmes containing measures to mitigate climate change,” and to report to the Conference of the Parties on its national greenhouse gas inventories and the steps it has taken to implement the Convention.²²

Arguably, reporting obligations that attach to the government—rather than to private parties—are supported by the UNFCCC. They could be viewed as simply implementing or amending the Convention²³ and therefore as permissible subject matter for a treaty-executive agreement, particularly if they can be implemented under the President’s existing authority. Moreover, an argument can (and has) been made that reporting is part and parcel of “the president’s foreign affairs power is to communicate with foreign govern-

²¹ See Lee Logan, Review Provision in Paris Climate Deal Faces Host of Unresolved Details, InsideEPA/climate, Nov. 19, 2015.

²² Arts. 4.1(a), 4.1(b), 12.1.

²³ Article 15 provides that “Amendments to the Convention shall be adopted at an ordinary session of the Conference of the Parties” by a three-fourths majority vote.

ments.”²⁴ Of course, any reporting or other procedural requirements that impose burdens on third parties would be subject to a more critical analysis.

C. Monetary Commitments? Nope.

President Obama lacks any authority to bind the United States to “mobilize” “climate finance”—that is, to make transfer payments to the governments of foreign countries in exchange for their denying their citizens economic activity and growth and associated emissions. Putting aside the moral and ethical issues inherent in such a scheme, the legal issue is insurmountable. The U.S. Constitution provides that “[n]o money shall be drawn from the treasury, but in consequence of appropriations made by law.”²⁵ For that reason, it is well established that “an international agreement providing for the payment of money by the United States requires an appropriation of funds by Congress in order to effect the payment required by the agreement.”²⁶ An agreement containing binding commitments cannot be executed on the President’s sole authority.

Moreover, Congress has already weighed in: the Senate rejected the President’s request for a \$500 million down payment on climate financing by a vote of 98 to 1.²⁷ Concurrent resolutions now pending before the House and Senate would make this point absolutely clear.²⁸

That is not to say, however, that the agreement will not contain some kind of financial “commitment.” There will surely be aspirational language regarding the developed world’s “obligation” to pay for climate mitigation and adaptation projects in the developing world. And there will most likely be things in the agreement referred to as “commitments,” only those things won’t actually be commitments, as that word is commonly understood. Instead, the model will be the 2009 Copenhagen Accord, in which parties, including the United States, made “political commitments” (i.e., not commitments) to “provide adequate, predictable and sustainable financial resources, technology and capacity-building to support the implementation of adaptation

²⁴ Daniel Bodansky, *Legal Options for U.S. Acceptance of a New Climate Change Agreement* 16 (2015).

²⁵ U.S. Const. Art. I, § 9, cl. 7.

²⁶ Restatement (Third) of Foreign Relations Law of the United States § 111 Comment i.

²⁷ http://www.senate.gov/legislative/LIS/roll_call_lists/roll_call_vote_cfm.cfm?congress=114&session=1&vote=00085.

²⁸ S. Con. Res. 25, 114th Cong. (2015–2016); H. Con. Res. 97, 114th Cong. (2015–2016).

action in developing countries.”²⁹ The President may unilaterally accept a deal containing such a “commitment,” but only because it is not a commitment at all.

D. Intended Nationally Determined Contributions? Nope.

As described above, historical practice and Congress’s consent are key in assessing the scope of the President’s ability to enter into international agreements on his sole authority. Both historical practice and congressional consent weigh heavily against the President’s authority to commit the nation to binding emissions reductions—to the point that even those who support the Administration’s climate agenda and favor a strong deal have recognized that legally binding commitments to reduce emissions would be, at best, dubious.³⁰

As a matter of historical practice, the CRS’s survey of international agreements places those concerning “environmental protection” in the class of “international agreements [that] have traditionally been entered as treaties in all or nearly every instance.”³¹ That includes, of course, the UNFCCC, which was put to Senate ratification despite its lack of substantive provisions.

The UNFCCC’s ratification history rebuts any claim of congressional acquiescence in this area.³² To begin with, the Senate sought and extracted a pledge from the Bush Administration, prior to ratification, that any future

²⁹ UNFCCC, Copenhagen Accord, Dec. 18, 2009, at ¶ 3.

³⁰ See, e.g., Bodansky, *supra*, at 15 (concluding that “committing to a target internationally without Senate or congressional approval would go beyond past practice”); Stern, *supra* (speech by Special Envoy for Climate Change recognizing that “many countries, including major ones, won’t be willing to make their mitigation commitment legally binding at the international level”); Gwynne Taraska and Ben Bovarnick, The Authority for U.S. Participation in the Paris Climate Agreement, Center for American Progress, July 2015, at 11 (“An agreement with national emissions reduction targets that are binding under international law would suggest the need for formal congressional consent after the agreement has been negotiated, as would an agreement with national targets for providing climate finance that are binding under international law.”).

³¹ Garcia, *supra*, at 7–8. See also John H. Knox, The United States, Environmental Agreements, and the Political Question Doctrine, 40 N.C. J. Int’l L. & Com. Reg. 933, 944–45 (2015).

³² See Restatement (Third) of Foreign Relations Law § 314(2) (“When the Senate gives its advice and consent to a treaty on the basis of a particular understanding of its meaning, the President, if he makes the treaty, must do so on the basis of the Senate’s understanding.”).

protocols setting forth substantive commitments would be subject to Senate ratification:

Question. Will protocols to the convention be submitted to the Senate for its advice and consent?

Answer. We would expect that protocols would be submitted to the Senate for its advice and consent; however, given that a protocol could be adopted on any number of subjects, treatment of any given protocol would depend on its subject matter.

Question. Would a protocol containing targets and timetables be submitted to the Senate?

Answer. If such a protocol were negotiated and adopted, and the United States wished to become a party, we would expect such a protocol to be submitted to the Senate.³³

That pledge, in turn, was memorialized in the stated understandings of the Senate Foreign Relations Committee when it reported the UNFCCC out of committee:

[A] decision by the Conference of the Parties to adopt targets and timetables would have to be submitted to the Senate for its advice and consent before the United States could deposit its instruments of ratification for such an agreement. The Committee notes further that a decision by the executive branch to reinterpret the Convention to apply legally binding targets and timetables for reducing emissions of greenhouse gases to the United States would alter the “shared understanding” of the Convention between the Senate and the executive branch and would therefore require the Senate’s advice and consent.³⁴

Subsequently, the Senate reaffirmed that understanding in the 1997 Byrd-Hagel Resolution. The resolution expressed the Senate’s opposition to the “targets and timetables” protocol that was soon to be negotiated in Kyoto, Japan.³⁵ It further stated that “any such protocol...would require the advice

³³ Hearing, U.N. Framework Convention on Climate Change (Treaty Doc. 102-38), Committee on Foreign Relations, U.S. Senate, 102nd Cong., 2nd Sess., Sep. 18, 1992, pp. 105–06.

³⁴ S. Exec. Rept. 102-55, 102d Cong., 2d Sess. (1992), at 14.

³⁵ S. Res. 98, 105th Cong., 1st Sess., A Resolution Expressing the Sense of the Senate Regarding the Conditions for the United States Becoming a Signatory to any International Agreement on Greenhouse Gas Emissions Under the United Nations Framework Convention on Climate Change, July 25, 1997.

and consent of the Senate” and demanded “a detailed explanation of any legislation or regulatory actions that may be required to implement the protocol.”³⁶ President Clinton went on to sign the Kyoto Protocol, which set binding emissions targets, but it was never sent to the Senate for ratification, was never implemented, and was ultimately abandoned by the George W. Bush Administration. In short, the Kyoto Protocol was regarded as a treaty subject to Senate ratification, and, due to the inability to secure Senate ratification, the United States never deposited an instrument of ratification binding it to Kyoto’s terms.³⁷

All of this undermines any claim by the Administration that the UNFCCC authorizes it to adopt and implement binding emissions reductions.³⁸ If that were so, the Clinton Administration could have ratified the Kyoto Protocol on its own authority, by passing the Senate. The fact that it did not do so, and that the Senate as a body expressed its opposition to the deal, is decisive. In the field of international relations, this is extraordinarily strong precedent. And that precedent, as the CRS concluded, would lead any court weighing the claim that the UNFCCC authorizes the President “to adopt and implement quantitative emissions restrictions...[to] most likely deem the Executive’s action an unconstitutional usurpation of congressional power...”³⁹

Nor is the President’s ability to adopt binding emissions limitations supported by existing statutory authority. To begin with, the statutory authority most commonly cited by the Administration’s supporters—Section 111(d) of the Clean Air Act, which underlies the Environmental Protection Agency’s disputed “Clean Power Plan” emissions limitations for power plants—was in place at the time of the UNFCCC’s ratification, the Byrd-Hagel Resolution, and the rejection of the Kyoto Protocol. Given the ratification history of the UNFCCC, the argument that the President actually had the power all along to adopt binding emissions limitations on his sole authority is not one that can be taken seriously. Moreover, the existence of Section 111(d) does nothing to alter Congress’s view, repeatedly expressed, that any agreement containing such limitations must be subject to congressional approval.

In any case the Clean Power Plan and the other emission-reduction initiatives identified by the Administration do not actually achieve its INDC tar-

³⁶ *Id.*

³⁷ See UNFCCC, Status of Ratification of the Kyoto Protocol, http://unfccc.int/kyoto_protocol/status_of_ratification/items/2613.php.

³⁸ *Cf. Medellín v. Texas*, 552 U.S. 491, 518, 530 (2008).

³⁹ Emily C. Barbour, International Agreements on Climate Change: Selected Legal Questions, CRS Report No. R41175, April 12, 2010, at 8.

get of reducing gas emissions 26 to 28 percent below 2005 levels by 2025. Even under the rosier of scenarios—“rosy,” in this instance, favoring slower economic growth, reduced energy consumption, and other generally bad things—there remains a substantial gap of nearly ten percentage points.⁴⁰ Even that figure assumes that the Administration’s “Climate Action Plan” continues on course and achieves the upper bound of expected emissions reductions; that no portion of the plan is delayed (as every major climate action has been to date); and that even legally vulnerable actions—including the centerpiece Clean Power Plan, the lawfulness of which is currently being litigated⁴¹—are upheld by the courts. Alter any of those assumptions, and the gap grows. For that reason, among others, the President would also be unable to commit the United States to implementation of its INDC, rather than to achievement of the target itself.⁴²

None of this is to say, however, that the final agreement won’t contain emission-reduction targets that are “binding” in the same way that its financial terms constitute “commitments.” The Copenhagen Accord is again an example of this kind of sham obligation, purporting to “commit” parties to obtain “quantified economy-wide emissions targets” while, in reality, committing no one to anything at all.⁴³ In other words, the very centerpiece of the Paris agreement—binding emissions reductions—would have no actual legal effect in the kind of “hybrid agreement” anticipated by the Obama Administration.

⁴⁰ See, e.g., Center for Climate and Energy Solutions, *Achieving the United States’ Intended Nationally Determined Contribution*, June 2015, <http://www.c2es.org/docUploads/achieving-us-indc.pdf>. See also Obama clean power plan welcomed – but won’t avoid dangerous warming, *The Guardian*, Aug. 4, 2015, <http://www.theguardian.com/environment/2015/aug/04/obama-clean-power-plan-welcomed-but-wont-avoid-dangerous-warming>.

⁴¹ It should be noted here that the Clean Power Plan is legally suspect, on both statutory and constitutional grounds. See generally David B. Rivkin, Jr., Andrew M. Grossman, and Mark W. DeLaquil, *Does EPA’s Clean Power Plan Proposal Violate the States’ Sovereign Rights?*, Engage, February 2015, available at <http://object.cato.org/sites/cato.org/files/articles/grossman-engage-feb2015.pdf>.

⁴² And the idea that the President could, on his sole authority, subject the United States as a sovereign state, let alone its citizens, to the authority of an “International Tribunal of Climate Justice” or the like is so extraordinary as to require no further comment. No one, so far as I am aware, has suggested that the President could conclude an agreement containing such a term.

⁴³ UNFCCC, *Copenhagen Accord*, Dec. 18, 2009, at ¶ 4.

III. A More Cynical View

So far, this analysis has relied on settled legal understandings and extrapolated from them to project how the Administration could structure the terms of a Paris agreement. But the assumption that the Administration will hew to settled legal understandings may be an unrealistic one. After all, the current Administration has been unusually aggressive in upsetting settled legal understandings that it believes are not strictly binding on it or legally enforceable.⁴⁴ So perhaps we should relax that assumption.

If we do, the first thing to consider is that the Administration has no intention of not concluding an agreement. In other words, it (along with the other Paris attendees) has every incentive to complete some kind of deal; the failure to conclude an agreement would be unthinkable. As would the conclusion of a deal that does not include the United States—just imagine the blow to the President’s climate legacy! This means the Administration, at the end of the day, must be flexible in its approach, so as to ensure that it reaches the finish line: from its perspective, empty promises are far preferable to returning home empty-handed, and even crossing what some may view as red lines regarding legal authority would not be out of the question if that is the cost of striking a deal. Indeed, crossing those red lines may not be a “cost” at all when it can be spun as leadership.

The easiest red line for the Administration to cross—or leap over joyfully—is that barring the President from unilaterally committing the nation to emissions reductions. While the President could not rely on such a commitment to adopt limitations binding within the United States as a matter of domestic law—for example, by imposing a cap-and-trade scheme in reliance on a Paris agreement—it would nominally establish an international-law obligation that (the President and his allies would then argue) Congress is obligated to carry out, lest the nation fall short of its international commitments. This commitment would be only nominal because, as described above, the President lacks the authority to establish such an obligation on his sole authority. But assuming that this Administration and its successors do not attempt to implement such an obligation administratively—and they would be insane to try—it is doubtful that any party would have standing to bring a court challenge.

Another red line that may prove illusory is the bar on unilateral financial commitments. Again, standing would complicate any potential legal challenge. I suspect, however, that this line may prove durable in practice, given the clear assignment of spending power to Congress and lack of even an arguable basis for the President to make such a commitment. But if developing

⁴⁴ See, e.g., *NLRB v. Noel Canning*, 134 S. Ct. 2550 (2014).

nations continue to insist that any deal must establish international-law obligations, constitutional niceties may fall by the wayside.

The decision to pursue a more cynical course—to commit the nation to international obligations that the President lacks the power to carry out and that are chiefly intended as a trump in domestic policy debates—is less a legal decision than a political one. On the plus side: burnishing the President’s climate legacy, claiming international “leadership,” obtaining additional leverage, in the form of international obligations, to wield in domestic policy debates over climate policy, and exerting an influence on the climate policies of successor administrations. The minuses, unfortunately, appear to be few; the chief one is the risk of a backlash from...those who are not inclined to support the President’s climate agenda anyway. Over the longer term, there is the damage to the rule of law and the nation’s international credibility. How those things figure in the Administration’s decisionmaking is anyone’s guess.

So far, at least, the Administration has paid lip service to the settled understandings.⁴⁵ But we should not assume that this means it will necessarily exercise restraint at Paris—even if officials’ statements regarding the limitations of Presidential authority have been sincere, the imperative of reaching a deal may prove overwhelming. For that reason, Congress has a valuable role to play in bolstering the position of restraint by making clear the limits of the President’s flexibility, particularly in terms of implementation. In that way, Congress can provide additional leverage to those negotiating on behalf of the United States who wish to avoid breaching the red lines that hem the President’s lawful authority.

IV. Conclusion

The Paris conference is a farce. It is highly unlikely that a final agreement will mandate anything beyond reporting and the like. But even an agreement that does purport to require emissions reductions and financial commitments will not, in the end, actually require anyone to do anything. Instead, changing the law in the United States to implement the U.S. INDC or to make financial commitments will require the President to come to Congress—one party with whom he has apparently no intention of negotiating.

I thank the committee for the opportunity to testify on these important issues.

⁴⁵ See, e.g., Stern, *supra*; William Mauldin and William Horobin, Paris Climate Talks Face High Barriers and High Hopes, Wall St. J., Nov. 27, 2015 (reporting U.S. officials’ continued support for “nonbinding targets”).

Andrew M. Grossman

Andrew M. Grossman practices appellate and constitutional litigation in the Washington, D.C., office of Baker & Hostetler LLP, and is an Adjunct Scholar at the Cato Institute, a think tank. As a litigator, he has served as counsel in many prominent cases raising significant issues of federal authority, the constitutional separation of powers, and individual rights. As a scholar, Grossman has written widely on administrative law, national security law, and the constitutional separation of powers and is a frequent adviser to Members of Congress on complex legal and policy issues, particularly concerning constitutional limitations on federal power. He has testified numerous times before both the House and Senate judiciary committees. In addition to articles in journals and professional publications, Grossman's legal commentary has appeared in dozens of newspapers and periodicals, including the *Wall Street Journal*, *USA Today*, the *Washington Post*, and the *Los Angeles Times*. He is also a frequent commentator on legal issues on radio and television, having appeared on Fox News Channel, CNN, MSNBC, CNBC, NPR and its affiliates, CBN, and elsewhere. In addition to his regular practice, Grossman frequently represents the Cato Institute as an *amicus curiae* before the U.S. Supreme Court and the federal courts of appeals. Prior to joining the Cato Institute, he was affiliated for over a decade with the Heritage Foundation, most recently serving as a Legal Fellow in Heritage's Edwin Meese III Center for Legal and Judicial Studies. Grossman is a graduate of Dartmouth College, the University of Pennsylvania's Fels Institute of Government, and the George Mason University School of Law. He clerked for Judge Edith Jones of the U.S. Court of Appeals for the Fifth Circuit.

Chairman SMITH. Thank you, Mr. Grossman.
Dr. Steer.

**TESTIMONY OF DR. ANDREW STEER,
PRESIDENT AND CEO,
WORLD RESOURCES INSTITUTE**

Dr. STEER. Thank you, Mr. Chairman. It's a great honor to appear before you this morning. My name is Andrew Steer. I'm the President and CEO of the World Resources Institute, a nonprofit, nonpartisan research institution working in 50 countries.

As I listened to the testimony from the other witnesses this morning and read Mr. Lomborg's written testimony, I hear three messages: first, that action against climate change will cost too much; second, that it'll hurt economic growth; third, that the climate deal under discussion in Paris won't achieve much.

Our analysis suggests that each of these is false. Let me address each in turn. Two years ago, WRI set up—help set up the Global Commission on the Economy and Climate to seek to address the first two of these questions. The Commission comprises global leaders from private business, government, and research, is led by former President Felipe Calderon of Mexico, an economic advisory group consisting of some of the world's top growth economists, oversaw the technical quality of the work.

On the costs of climate action, the Commission concluded that investment costs in a low-carbon future would rise slightly, by about four percent, but fuel savings alone would negate those increases. So the overall cost would be less than zero compared to current trends.

But what about the impact on economic growth? Our work finds that far from undermining growth, smart policies to address climate change will promote competitiveness and growth. There are five paths through which this happens. First, action on climate change promotes resource efficiency such as through promoting energy efficiency, removing harmful energy subsidies and so on.

Second, smart climate action promotes technological advance, an essential ingredient to increasing growth. There's a large literature that shows how this happens with the U.S. the leading player in such innovation and job creation.

Third, smart climate policies reduce other environmental drags on the economy. In many cities in the world, real incomes are being dragged down by nearly ten percent by congestion and another ten percent by pollution. Smart climate policies can help address these.

Fourth, clarity on climate policy can give long-term policy predictability, something that private investors crave and something they do not currently have.

Finally, climate-smart policies can reduce the negative impact on growth of climate change itself, which unchecked will be very substantial. Combined, these impacts explain why strong climate action on—strong action on climate can create a healthier and more vibrant economy.

This explains why so many companies now are advocating for action. More than 1,000 major companies are advocating for a price on carbon. Last week, a group of 78 major corporations sent an open letter to world leaders calling for bold action in Paris. It ex-

plains why more than 100 major global companies such as Coca-Cola, General Mills, Procter & Gamble have committed to set their own emissions reductions targets in line with what science says is necessary.

It also explains why over 360 cities worldwide have signed on to the Compact of Mayors committing to track and reduce their own greenhouse gas emissions. One hundred and seven of these are from the United States: New York, Los Angeles, Chicago, Atlanta, Washington D.C., St. Louis, Phoenix, and so on. All of these players are advocating strong action and taking their own action because they believe it is good for their shareholders, their customers, and their citizens.

On the third question, how much impact will the Paris deal have, our analysis shows that the climate pledges made by the 183 countries will make a substantial difference in stopping climate change. We've analyzed more than a dozen recent studies that added up the contribution of these so-called INDCs. These put us on a track for a world that warms by 2.7 to 3.7 degrees Celsius over the next century depending on modeling assumptions. This compares to four to five degrees Celsius of warming under a business-as-usual path.

This is significant progress but it's not enough, and that's why the provisions for increasing ambition every five years, ensuring full transparency of reporting, and supporting low-income countries as they adapt to climate change that are all being negotiated this week in Paris are so important.

Finally, we've done detailed technical analysis on how the United States can deliver its own climate targets. Our recent report delivering on the U.S. climate commitment, which I have here today, shows several pathways to get there.

In closing, we believe that the U.S. political and technical leadership in solving the great challenge of climate change is absolutely necessary. As with many other challenges before, the United States is an indispensable leader. We also believe that the United States will benefit economically from playing such a role, and we believe that we can be proud of the role that the United States is playing at this present time.

I look forward to answering your questions.

[The prepared statement of Dr. Steer follows:]

TESTIMONY OF DR. ANDREW STEER
PRESIDENT AND CEO, WORLD RESOURCES INSTITUTE
HEARING BEFORE THE HOUSE COMMITTEE ON SCIENCE, SPACE, AND TECHNOLOGY:
“America’s Leadership Opportunity at the Paris Climate Conference”
DECEMBER 1, 2015

My name is Andrew Steer, and I am President and CEO of the World Resources Institute. The World Resources Institute is a non-profit, non-partisan research institution that goes beyond research to provide practical solutions to the world’s most urgent environment and development challenges. We work in partnership with scientists, businesses, governments, and non-governmental organizations in more than seventy countries to provide information, tools and analysis to address problems like food and energy security, water management, urbanization, and climate change. Our focus is on how to grow the economy, while protecting it for our grandchildren.

My testimony has three main themes. First, the United States can achieve a low-carbon future and provide global leadership by harnessing key drivers of economic growth. Second, the U.S. has set an ambitious but achievable emissions reduction target for 2025 in its Intended Nationally Determined Contribution. Third, the leadership the U.S. is demonstrating at home is paying significant dividends, helping to spur greater action by all countries around the world, both developed and developing.

First, a growing body of evidence shows that economic growth is not in conflict with efforts to reduce emissions of greenhouse gases. The Global Commission on the Economy and Climate, which delivered a landmark report in 2014, *Better Growth, Better Climate: The New Climate Economy Report*, has shown that the perceived choice between growth and climate action is a false dilemma.¹ New evidence is demonstrating that smart climate policies promote economic efficiency, drive technological advances, provide policy predictability for investors, generate huge economic co-benefits, and reduce the negative impact on growth of climate change itself.

The United States has tackled many environmental problems over the past 50 years, and the historical record is clear: environmental protection is compatible with economic growth, and environmental policies have delivered huge benefits to Americans. Furthermore, recent experience at the state and national levels demonstrates that well-designed policies can reduce greenhouse gas emissions while providing overall net public benefits, for example, through improved public health, as well as direct financial benefits to businesses and consumers.

The solutions typically lie in improved efficiency in resource use, smarter city growth, more efficient development of rural areas, cleaner fuels, and new technologies and processes – and these solutions often create net economic benefits. For example, we know that increased efficiency pays off. With strengthened fuel efficiency standards, drivers will save on average a net \$3,400 to \$5,000 over the life

of light-duty vehicles built in 2025 compared with those made in 2016. Federal appliance efficiency standards put into place over the past twenty-five years resulted in \$370 billion in cumulative utility bill savings. States with energy efficiency targets and programs in place are saving customers at least \$2 for every \$1 invested.²

Other countries also recognize the benefits of acting on climate change. In the lead-up to the Paris climate summit, more than 180 countries have put forward national climate action plans (known as Intended Nationally Determined Contributions, or INDCs) that both address climate change and can generate better growth for their economies.³

Businesses have recognized the economic value of action. More than eighty major global companies, including eighteen U.S. companies – including Dell, Coca-Cola, General Mills, and Procter & Gamble – have committed to setting emissions reductions targets in line with science.⁴ And recognizing the global nature of their operations, more than 80 U.S. companies – including Alcoa, Bank of America, Cargill, Coca-Cola, General Motors, Microsoft, PepsiCo, UPS, and Walmart – recently signed a pledge in support of a strong international agreement and committed to significant actions in their own supply chains.⁵ Six major U.S. banks and investors also recently signed a statement supporting strong international action in order to set clear expectations and market signals.⁶ Around 435 businesses worldwide already use an internal carbon price to guide investment decisions. For a number of major oil companies – including Shell, BP, Exxon-Mobil, and ConocoPhillips – the internal carbon price is typically around \$40/t CO₂.⁷

Taking action is essential because no nation is immune to the impacts of climate change and no nation can meet the challenge alone. Every nation needs to work together, take ambitious action, and do its share. The United States has always provided leadership when the world faces big challenges, and climate change should be no exception. That leadership can ensure a livable planet for ourselves and future generations.

With global GHG emissions still on the rise, delaying action on climate change will only result in climate-change-related events becoming more frequent and severe, leading to mounting costs and harm to businesses, consumers, and public health. The new EPA report, *Climate Change in the United States: Benefits of Global Action*,⁸ estimates billions of dollars of avoided damages in the U.S. that would result from global efforts to reduce greenhouse gas emissions, ranging from reduced damage to agriculture, forestry, and fisheries, to reductions in coastal and inland flooding, to fewer heat-driven increases in electricity bills.

If nations fail to combat climate change together, the U.S. will suffer billions of dollars of damages to agriculture, forestry, and fisheries, and to coastal and inland flooding, along with heat-driven increases in electricity bills, just to cite some of the impacts. A recent report from the CNA Military Advisory Board – composed of retired high-ranking military officers – also highlighted the increased threats to national security from the effects of climate change.⁹ It is thus in our national interest to act at home so that we can work with other countries to achieve a universal international agreement where all countries act and where the most severe impacts in the U.S. can be avoided.

Second, the U.S. has set an ambitious but achievable emissions reduction target for 2025 in its INDC. WRI research finds that the United States can meet this target using existing federal laws combined with actions by the states. The United States can accelerate recent market and technology trends in renewable energy, energy efficiency, alternative vehicles, and many other areas to reduce emissions 26–28 percent below 2005 levels by 2025. However, U.S. and global efforts to combat climate change cannot stop in 2025. Even deeper greenhouse gas (GHG) emission reductions will be needed in the decades ahead to avoid the worst impacts of climate change. In the meantime, however, the Administration is taking sensible steps to encourage recent market and technology trends that move us toward a low-carbon future. These measures would be even more effective if complemented by measures that only Congress can take.

The United States can achieve the INDC target in concert with economic growth. Over the next decade, the proposed Clean Power Plan will play a key role in meeting the INDC target. Damage to health from air pollution in the United States is estimated to amount to as much as 4% of GDP per year on average.¹⁰ From a benefit-cost perspective, EPA estimates that just the air pollution co-benefits of the Clean Power Plan are worth \$25-\$62 billion, far more than the estimated \$7-9 billion in compliance costs.¹¹ Adding in global climate benefits increases total benefits to \$55-\$93 billion.

Third, the leadership the U.S. is demonstrating at home is paying significant dividends, helping to spur greater action by all countries around the world, both developed and developing. The national climate plans (INDCs) that countries have submitted for the 2015 climate agreement represent action by a wide diversity of countries. Of the 183 countries that have submitted national plans, 142 of them are developing countries.¹² The historic Joint Announcement on Climate Change by the United States and China last year, along with the recent Joint Presidential Statement, also demonstrate the tremendous shift in action by countries around the world.¹³

The national climate plans will deliver significant reductions in emissions. Analyses of the INDCs come to the conclusion that the implementation of INDCs would contribute to significant reductions of global GHG emissions compared to business as usual (approximately 3-8 gigatons of greenhouse gas emissions reduced in 2030). The International Energy Agency's Energy and Climate Change Report estimates that the path set by the INDCs would be consistent with an average global temperature increase of around 2.7 degrees Celsius (4.8 Fahrenheit) by 2100,¹⁴ compared to an almost 4 degrees Celsius temperature increase given business as usual (BAU) policies.¹⁵

Moreover, the agreement that will be reached between all countries at the climate summit in Paris will be a major step forward in meeting U.S. objectives on climate change internationally. The agreement will be universal and applicable to all, will ensure transparency, and will be durable and effective. Building on and implementing the United Nations Framework Convention on Climate Change (UNFCCC), which was ratified by the Senate in 1992 by voice vote, the agreement will mark a critical step forward by involving action to reduce emissions by all countries, both developed and developing. Its structure, based on nationally-determined plans, has enabled broad-based participation and buy-in from all countries and sets a new pathway for international action.

The agreement will also include vital provisions on transparency and accountability to provide assurance that all countries are following through in meeting their targets. The agreement must also be durable, able to accommodate countries' evolving development and economic circumstances and ensure that all countries continue to move forward in a regular and timely way toward a commonly understood objective. Finally, it must be an effective agreement, driving the finance and investment needed for low-carbon climate resilient pathways from an array of countries and actors, including the private sector, while also meeting the need to address the serious impacts experienced by all countries, and especially the most vulnerable.

The action that countries around the world are taking, along with the international framework to support that broad-based action, should be viewed as a significant success for the United States and its leadership role. Meeting the global challenge of climate requires global solutions, including actions by all. The world is now on the cusp of an international climate agreement that will concretize that vision.

My testimony is organized as follows: Section I discusses why the United States can take meaningful climate actions while growing the economy overall and why U.S. leadership on climate change is essential. Section II reviews technology and market trends in some key sectors and demonstrates how accelerating these trends can reduce carbon emissions while generating positive economic impacts. Section III presents an overview of WRI analysis showing how the United States can meet or exceed its INDC target with a portfolio of policies across key sectors. Section IV describes the national climate plans prepared by many countries and the benefits for the United States of the 2015 international agreement. Section V offers some concluding comments on climate policy.

I. Climate Protection and Economic Growth

A growing body of evidence had found that economic growth and action on climate change can now be achieved together. According to the New Climate Economy Report, the scale of investment over the next 15 years means we now have a huge opportunity to create better growth and reduce the risk of climate change. Around US\$90 trillion globally will be invested in cities, land use and energy infrastructure between now and 2030.¹⁶ Choosing to invest that money in a low-carbon way will bring multiple economic benefits and reduce the negative economic impacts of climate change.

Climate-smart policies promote economic efficiency, an area where the US has always been a global leader. These policies involve more efficient use of energy and natural resources, putting a price on greenhouse gas emissions, and removal of subsidies to fossil-fuels.

Efforts to reduce greenhouse gas emissions have already proven to be a win for local economies and jobs in the northeast United States. The Regional Greenhouse Gas Initiative (RGGI) is a cooperative effort by nine New England and Mid-Atlantic states to cap and reduce emissions from the power sector. Economic growth in the nine RGGI states has been higher than in the rest of the states, at the same time as they have reduced their emissions by 18% compared to 4% in other states. The RGGI contributed a net benefit of \$1.3 billion to these member economies in 2012-2014 alone, generating 14,200 new job years. All nine participating US states showed net job additions.¹⁷

Climate-smart policies also drive technological advances. They involve policies to support the research, development and deployment of new technologies. The growth of wind and solar power has consistently outstripped projections from the International Energy Agency.¹⁸ The IEA's 2007 projections for renewables in 2030 have already been met.¹⁹ Even Greenpeace underestimated how much solar would grow.²⁰ The US is a world leader in developing and deploying the technologies that drive tomorrow's prosperity.

In the coming years, the global clean energy market will expand dramatically, and it represents a significant opportunity for U.S. economic growth. The cost of LED lights has dropped 90% since 2008, large-scale solar by 60%, and wind and battery prices declined by over 40%. And with decreasing costs has come greater deployment. Since 2008, we've gone from 400,000 LED lightbulbs to more than 78 million installed, wind energy production has tripled, and solar has increased more than twenty-fold.²¹

It is imperative that the United States continues to lead on clean energy innovation. On Monday in Paris, President Obama announced how this will happen. The president, along with a wide range of other top global leaders, announced "Mission Innovation," an initiative by 20 countries to double their respective clean energy research and development investment over five years to address global climate change, provide affordable clean energy to consumers, and create additional commercial opportunities in clean energy.²² Mission Innovation parallels a private sector effort, spearheaded by Bill Gates, which includes a coalition of over 28 significant private capital investors from 10 countries, and will be called the Breakthrough Energy Coalition.²³ The combination of public and private sector investment will ensure that large scale penetration of clean energy technologies.

Clean energy technologies will deliver hundreds of thousands of new jobs and deliver huge economic co-benefits in the United States. The U.S. solar industry is creating jobs twenty times faster than the overall economy.²⁴ There are already more solar workers than coal miners in the United States. A clean energy future could create on average 550,000 net jobs per year in the United States between now and 2050, according to a study from Synapse Energy.²⁵ Another new economic analysis from NextGen Climate America found that a clean energy economy will create more than 1 million additional jobs by 2030, increase U.S. GDP by \$145 billion, increase household disposable income by \$350-\$400, and save families \$5.3 billion on energy bills.²⁶

Energy efficiency, another powerful way to reduce emissions, can also unlock savings for U.S. citizens. Investment in energy efficiency could boost global cumulative economic output by US\$18 trillion by 2035, according to the New Climate Economy.²⁷ The United States' Energy Star program has already lowered household utility bills by an estimated US\$360 billion since 1992.²⁸

While total policy certainty can never be guaranteed, it is always important for policy-makers to look at ways of making policy more credible and predictable. Climate-smart policies can provide a credible and predictable policy environment, which investors from the US and around the world crave. A price on the emissions of greenhouse gases, research and development funding, feed-in-tariffs, and tax credits: these policies give private investors the confidence needed to invest in, and deliver, greater economic efficiency and innovation, which will drive the productivity of all forms of capital and growth.

Many of the pessimistic economic models cited by opponents of climate action have serious shortcomings, as described in the 2014 report of the Global Commission on the Economy and Climate (*Better Growth, Better Climate*):

The view that there is a rigid trade-off between low-carbon policy and growth is partly due to a misconception in many model-based assessments that economies are static, unchanging, and perfectly efficient.... Indeed, once market inefficiencies and the multiple benefits of reducing greenhouse gases, including the potential health benefits of reduced air pollution, are taken into consideration, the perceived net economic costs are reduced or eliminated.²⁹

Our country has tackled many environmental problems over the past 50 years. We have achieved major reductions in air and water pollution. We have reduced our exposure to toxics, and cleaned up and redeveloped industrial “brownfield” sites in our cities. In concert with other nations, we have taken steps to repair damage to the ozone layer. At every step along this road to protection of the environment and public health, opponents have raised the specter of excessive cost and economic disaster. Some opponents of President’s emission reduction targets and the Clean Power Plan are raising this specter again now. However, the historical record is clear: environmental protection is compatible with economic growth, and U.S. environmental policies have delivered huge benefits to Americans. In 2010, The Office of Management and Budget reviewed 20 years of major Federal regulations (1999-2009) for which agencies estimated and monetized both benefits and costs, and found aggregate annual benefits of \$128-\$616 billion, while annual costs were estimated at \$43-\$55 billion. Research also shows that the actual cost of environmental regulations frequently ends up being less than *ex ante* predictions by industry, and even the EPA.³⁰

The movement toward a low-carbon economy is already being demonstrated throughout the United States. Already between 2005 and 2012, greenhouse gas emissions dropped by 8 percent while real GDP grew by 8 percent.³¹ Projections from the U.S. Energy Information Administration (EIA) estimate that the intensity of energy use in the economy will continue to decline through 2040, even in the absence of new policies. With reduced energy intensity in manufacturing, more efficient appliances and buildings, and more fuel-efficient vehicles coming to market, the overall economy is becoming more energy efficient. EIA projects that GDP will grow at an average 2.4 percent per year through 2040, while energy use will grow at only 0.4 percent per year.

Businesses have recognized the economic value of action. More than eighty major global companies, including eighteen U.S. companies – including Dell, Coca-Cola, General Mills, and Procter & Gamble – have committed to setting emissions reductions targets in line with science.³² More than 80 U.S. companies – including Alcoa, Bank of America, Cargill, General Motors, Microsoft, PepsiCo, UPS, and Walmart – recently signed a pledge in support of a strong international agreement and committed to significant actions in their own supply chains.³³ Six major U.S. banks and investors also recently signed a statement supporting strong international action in order to set clear expectations and market signals.³⁴ 435 businesses worldwide already use an internal carbon price to guide investment decisions. For a number of major oil companies – including Shell, BP, Exxon-Mobil, and ConocoPhillips – the internal carbon price is typically around \$40/t CO₂.³⁵

In the context of meeting the U.S. INDC target, the proposed Clean Power Plan will play a key role. The Energy Information Administration projects the macroeconomic impacts of the proposed plan to be very small: approximately a 0.12% decrease in GDP in 2030, which can be considered “background noise” in the context of a steadily growing \$24 trillion economy. Employment impacts are essentially zero.³⁶ From a benefit-cost perspective, EPA estimates that the air pollution co-benefits alone are worth \$25-\$62 billion, far more than the estimated \$7-9 billion in compliance costs.³⁷ Adding in global climate benefits increases total benefits to \$55-\$93 billion.

To get the full economic picture, one must also assess the cost of the impacts of climate change. Failure to reduce emissions will increase economic, social, and environmental risks for the United States and all nations.³⁸ With global GHG emissions still on the rise,³⁹ delaying action on climate change will only result in climate-change-related events becoming more frequent and severe, leading to mounting costs and harm to businesses, consumers, and public health. Climate smart policies reduce these negative impacts on growth.

We are becoming more aware than ever of the true costs of a high carbon economy in the United States. Inaction on climate change could reduce the United States’ per capita GDP up to 36% by the end of the century, according to a new estimate from leading researchers in *Nature*.⁴⁰ Damage to health from poor air quality, much of which is associated with burning fossil fuels, is valued at about 4% of GDP, according to the New Climate Economy.⁴¹ Urban sprawl is immensely expensive, raising the costs of infrastructure and service delivery up to 40% and costing the United States around \$1 trillion per year.⁴² Subsidies and tax breaks for the production of oil, coal, and gas cost U.S. federal and state governments approximately \$20.5 billion annually, distorting investment and consumption choices.⁴³

The new EPA report, *Climate Change in the United States: Benefits of Global Action*,⁴⁴ estimates billions of dollars of avoided damages in the U.S. that would result from global efforts to reduce greenhouse gas emissions, ranging from reduced damage to agriculture, forestry, and fisheries, to reductions in coastal and inland flooding, to fewer heat-driven increases in electricity bills. We are already experiencing the effects of climate change. Last year the world experienced the hottest year on record in 2014.⁴⁵ Fourteen of the fifteen hottest years on record have occurred since 2000.⁴⁶ In the United States, some regions are experiencing a higher frequency of flooding, heavier precipitation events, and more frequent heat waves and wildfires.⁴⁷

Extreme weather events are expensive. Between 1980 and 2014, the United States experienced 178 extreme weather and climate events that cost at least \$1 billion each with total damages of more than \$1 trillion.⁴⁸ The frequency and severity of these types of events have increased over the same period, with four of the six years with the most billion dollar disasters on record in the United States have occurred since 2010. Hurricane Sandy cost New York City \$67 billion, with power outages, subway tunnel flooding and other problems persisting well after the storm.⁴⁹ A similar increase in these costly events is happening around the world.^{50,51} While many factors contribute to the cost of these events, such as growing population density and increased development in vulnerable areas more prone to extreme events, increasing global temperatures and climate variability are making certain types of these costly events more frequent and severe.

According to *Risky Business*, if we continue on our current emissions path without significant adaptation, by the end of the century some states in the Southeast, lower Great Plains, and Midwest risk up to a 50% to 70% loss in average annual crop yields (corn, soy, cotton, and wheat), absent agricultural adaptation.⁵²

The true costs of a continuing with a high-carbon economic growth model in the United States are much higher than previously realized, and they are rising as concentrations of greenhouse gases in the atmosphere increase year on year. The true job killer is inaction on climate change – not the solutions we need to stop it.

Moreover, a recent report from the CNA Military Advisory Board – composed of 16 retired three- and four-star military officers – highlighted the increased threats posed to national security by the effects of climate change, including massive population displacement, conflicts due to food and water scarcity, and health catastrophes.⁵³ These are not only security threats, but also present substantial potential costs to our military and humanitarian relief agencies.

U.S. leadership is critical to the success of the global efforts necessary to avoid billions of dollars in damaging costs to our country. That leadership is paying off as countries have submitted their INDCs and as we move toward an agreement in the international climate negotiations that culminate in Paris.

II. Technology Trends and Emission Reduction Potential in Key Sectors

Many of the key drivers of economic growth—including more efficient use of energy and natural resources, smart infrastructure investments, and technological innovation—can also drive the transition to a low-carbon future.⁵⁴ Early efforts to address conventional air and water pollution often relied on end-of-smokestack or end-of-pipe controls. However, in the case of carbon pollution, the solutions typically lie in improved efficiency in energy use, cleaner fuels, and new technologies and processes. Though upfront investments are often needed, these solutions often create net economic benefits rather than costs. The United States can bring the same spirit of competition, ingenuity, and innovation to the climate challenge that it has brought to solving other problems, or it can be left behind as other countries develop the solutions and capture the markets for the fuels, technologies, and processes that reduce emissions.

Opportunities for cost-effective emission reductions are arising across many sectors of the economy. For instance, the capital costs of wind and solar photovoltaic systems continue a rapid downward trend.⁵⁵ For example, Texas has seen wind generation multiply 12-fold since 2002, and solar generation in the state has more than doubled since 2011.⁵⁶ Over 102,000 people are directly employed in renewable energy sectors in Texas, with thousands more working in businesses linked to renewable energy. Well-crafted energy efficiency programs are lowering utility bills and reducing energy demand, which indirectly reduces GHG emissions.⁵⁷ Increased production of low-cost shale gas, while raising concerns about methane emissions and other environmental impacts, has spurred fuel switching away from coal in power generation, reducing carbon dioxide (CO₂) emissions.⁵⁸ Technological progress on many fronts

promises to create further opportunities, from creating climate-friendly refrigerants to breakthroughs in electric and fuel cell vehicles.⁵⁹

Nevertheless, market barriers still exist, hindering investment and implementation of strategies needed to transition the United States toward a prosperous low-carbon economy. These barriers take many forms and cut across many sectors. For example:

- Split incentives - The natural gas sector is not very well vertically integrated – many independent companies work along the supply chain without ever taking ownership of the natural gas itself. For this reason, the incentives to invest in control technologies to reduce methane emissions are often poorly aligned.
- Ownership transfer issues - In the residential sector, homeowners may not invest in energy efficient products or home upgrades, thinking they may move before reaping the cost savings.
- Network effects - Widespread penetration of alternative vehicles depends on availability of charging stations, but investment in charging stations may be limited while relatively few alternative vehicles are on the road.⁶⁰

Overcoming these barriers will require targeted policies and measures, including GHG and efficiency standards, more research and development to stimulate innovation, and policies to stimulate market demand for new technologies.⁶¹ The sections below explore opportunities in some key sectors.

A. Producing Cleaner Electricity

The U.S. power sector has already started to transition to a lower-carbon future.⁶² In 2013, carbon dioxide (CO₂) emissions were 15 percent below 2005 levels because of a shift in fuel mix and slower demand growth. Coal's role appears to be diminishing while natural gas and zero-carbon alternatives are on the rise. The economics of all generation sources are shifting and if these trends continue, deep greenhouse gas reductions are possible from the power sector, with some parts of the country possibly achieving net savings. In many cases, the public health benefits outweigh the costs of replacing older, inefficient, and heavily polluting generation with newer, more efficient, cleaner generation.

The recent decline in the carbon intensity of the power sector has been caused in large part by the low price of natural gas.⁶³ Because of lower prices, gas-fired generation has surged and coal fired generation has declined. New coal plants accounted for only 5 percent of the new capacity built since 2000.⁶⁴ This trend could accelerate as many existing coal plants struggle to compete with electricity from natural gas and renewable energy sources and if more protective public health standards are put in place. Existing natural gas plants certainly have the capacity to increase output. In 2014, the fleet of combined-cycle natural gas plants ran at only about 48 percent capacity⁶⁵—well below their design capacity of 85 percent. Less coal generation would bring not only reductions in CO₂ emissions, but also would likely bring reductions in a variety of harmful pollutants, including sulfur dioxide (SO₂), nitrogen oxides (NO_x), and mercury.

Despite its reputation as a clean fuel, natural gas production, processing, transmission, and distribution still leak methane emissions while its combustion results in substantial CO₂ emissions, presenting long-

term challenges for the fuel, in absence of adoption of technologies that reduce methane leaks and cost-effective carbon capture and storage technology. However, natural gas is still essential in reducing power sector emissions. Replacing all existing coal generation with combined-cycle gas generation could reduce power-sector CO₂ emissions by 44 percent below 2012 levels.⁶⁶ In addition, as variable generation from resources such as wind and solar increases, grid operators will look to flexible resources such as natural gas to help ensure grid reliability. As a result, natural gas could play an important role even in an aggressive greenhouse gas abatement scenario.

Renewable generation has been on the rise in recent years, and evidence suggests that it could play an even more significant role in the future. Generation from renewable resources accounted for 12.5 percent of total generation in 2013 – nearly half of which came from non-hydropower sources.⁶⁷ Renewables represented 85% of the increase in power generation in 2014.⁶⁸ Wind and solar outcompete new coal generation in many markets, and are competitive with low-cost natural gas generation in a few markets. As a result, increased renewable energy generation has the potential to save American ratepayers tens of billions of dollars per year over the current mix of electric power options, according to studies by Synapse Energy Economics and the National Renewable Energy Laboratory.⁶⁹ These cost savings are illustrated by some recent actions at the state level:

- The Grand River Dam Authority, Oklahoma's state-owned utility, purchased 100MW of wind energy that is estimated to “save its customers about \$50 million over the project’s lifetime”.⁷⁰
- DTE Energy in Michigan announced that it would be lowering customers’ electricity rates by 6.5 percent in 2014, citing low-cost wind energy (aided by technology improvements and tax credits) as a major factor.⁷¹
- Austin Energy in Texas finalized a power purchase agreement for 150 megawatts of solar energy, with a price just under 5 cents per kilowatt hour (estimated at 7 cents per kilowatt hour before federal tax credits).⁷² By comparison, the company estimates that new natural-gas-fired generation would have cost 7 cents per kilowatt hour, coal would have cost 10 cents, and nuclear 13 cents.
- MidAmerican Energy in Iowa recently announced that it will invest \$1.9 billion in new wind power, bringing wind generation up to 39 percent of their generation portfolio.⁷³ The company estimates that this will save \$10 million annually when all the turbines are completed. This work will create 460 construction jobs, 48 permanent jobs, and generate more than \$360 million in new property tax revenue.

While the variability of renewable generation creates some challenges for grid balancing authorities, renewables have considerable room to expand on the grid. Several studies have shown that existing grids across the country can handle about 35 percent generation from variable renewable resources with minimal cost.⁷⁴ This is partly because of improvements in renewable energy forecasting and sub-hourly supply scheduling, as well as recent increases in transmission infrastructure.^{75,76} Utilities may also see the value in using renewable energy (with zero fuel costs) as a hedge against the uncertainty surrounding future coal and natural gas prices.⁷⁷

Over the longer term, however, as renewable penetration continues to increase with expected declines in equipment costs, the United States would benefit from expanded transmission⁷⁸ and increased system flexibility. This could be done, for example, through increased grid storage, distributed generation sources, and demand response.⁷⁹

Nuclear power provides zero-carbon baseload generation. In 2013, it produced 20 percent of total U.S. electric generation⁸⁰ and as of mid-2014, three new nuclear plants were under construction, the first new plants since 1996.⁸¹ However, several nuclear reactors closed in 2013⁸² and some analysis suggests that some other plants are struggling to remain viable because of cheap natural gas, low renewable energy prices, lower demand for electricity, and rising costs for nuclear fuel, operations, and maintenance (particularly the smaller, older, standalone units).⁸³ Continued retirements could prompt an increase in fossil baseload generation and lead to an overall increase in CO₂ emissions from the power sector. Even if these pressures do not force nuclear capacity to retire prematurely, the nation will eventually need to replace some of these units as they reach the end of their useful lives. Well-designed policies that value low-carbon generation could help improve the economics of the existing fleet, and could spur the construction of new nuclear units, particularly if increasing international development of nuclear plants leads to reductions in construction costs. Any expansion, however, will likely depend on solving the challenges of public concerns about nuclear safety and long-term waste storage.

EPA's Clean Power Plan (CPP), finalized in August 2015, will build on and accelerate many of these positive trends noted above by establishing CO₂ emissions standards for existing power plants under section 111(d) of the Clean Air Act. These standards incentivize the use of lower carbon sources of electricity generation, like natural gas, renewables, and nuclear, as well as incentivize programs that reduce the overall demand for electricity. EPA projects that the CPP will reduce power sector CO₂ emissions by about 28-29 percent below 2005 levels by 2025 and by 32 percent by 2030.⁸⁴ The CPP also offers huge health benefits at four to nine times the amount of compliance costs. In total, the standards are expected to result in \$32 to \$54 billion in health benefits and global climate benefits per year by 2030, far outweighing the costs of \$5.1 to \$8.4 billion.

Given current technology trends in renewable power, these estimates may actually be overly conservative, and deeper reductions may be possible at a net public benefit. For example, when examining deep emission reductions in the power sector (approximately 61 percent below 2005 levels in 2030), the Union of Concerned Scientists found that on an annualized basis, benefits to Americans from reduced SO₂ and NO_x emissions alone would total \$56 billion in 2025, growing to \$69 billion in 2030 (equal to 5 and 10 times the annual compliance cost to the power sector).⁸⁵ And studies have also shown that a more rapid decarbonization of the power sector in the post-2020 time period is technically possible as well as legally defensible.⁸⁶

B. Reducing Electricity Consumption

The U.S. economy is becoming more efficient as a result of development and deployment of new technologies supported by state and federal policies. This success is largely due to the fact that smart investments in efficiency save money. Federal appliance standards implemented since 2009 alone are expected to save consumers nearly \$450 billion because of lower electricity bills through 2030.^{87,88,89}

State efficiency portfolios regularly save customers over \$2 for every \$1 invested, and in some cases up to \$5.⁹⁰ And efficiency has been the cheapest resource option available to utilities for decades, with levelized costs one-half to one-third the cost of new electricity generation options.^{91,92} Harnessing efficiency as a resource leads to high-quality jobs in manufacturing, installation of efficient appliances, home energy auditing, and more. In part due to the expansion of efficiency programs, energy consumption is expected to grow at less than 0.5% per year on average through 2040 even as GDP grows by nearly 2.5% per year.⁹³ But even greater opportunities to capture efficiency and associated savings can be captured by scaling up successful programs and implementing new initiatives.

The discussion below focuses specifically on homes and commercial buildings (with efficiency opportunities in transportation and industry discussed later). In buildings, electricity demand growth has fallen from about 8 percent per year in the early 1970s to about 1 percent per year today.⁹⁴ This is in part due to a robust and growing portfolio of both regulatory and voluntary energy efficiency initiatives including:

- *Appliance and equipment standards, labeling, and research and development*
Customers have saved over \$370 billion (net) as a result of lower utility bills from 1987 through 2012 as a result of federal appliance and equipment standards that set minimum energy efficiency levels for more than 50 products commonly used in homes and businesses.⁹⁵ This success has been achieved in part because major appliances—including refrigerators, dishwashers and clothes washers—have become 50 to 80 percent more energy efficient over the past two decades. Appliance and equipment standards are complemented by other federal and state initiatives, including research and development, partnerships with industry, competitions (e.g., L-prize and ENERGY STAR awards), voluntary labeling programs (e.g., ENERGY STAR and the Federal Trade Commission’s Energy Guide), and rebates and incentives for efficient appliances. Together, these programs can drive innovation and commercialization of products that are more efficient than the minimum required by standards, as has been demonstrated in many product areas including lighting, water heaters, and clothes dryers.⁹⁶ The Institute for Electric Innovation projects that pushing forward on new federal appliance and efficiency standards could reduce total electricity use by 6–10 percent below projections in 2035.⁹⁷
- *State energy efficiency savings targets*
Twenty-four states currently have mandatory electricity savings targets that require utilities and third-party administrators to offer energy-saving programs to their customers.⁹⁸ Most state targets require incremental electricity savings of 1 percent of projected electricity sales or more each year once programs are fully ramped up, with a few requiring savings in excess of 2 percent per year. Scaling up state energy efficiency savings targets so that each state achieves savings of 2 percent annually would reduce electricity consumption in the range of 400–500 terawatt hours in 2035 (9–11 percent of total projected electricity sales),⁹⁹ and save customers tens of billions of dollars in the process.
- *State building energy codes*

Building codes help ensure that new construction and buildings undergoing major renovations and repairs meet minimum efficiency standards. According to the DOE, codes adopted between 1992 and 2012 have saved approximately 2 quads in cumulative total energy savings, about 20 percent of the total energy directly consumed by homes each year. The codes are expected to net more than \$40 billion in energy cost savings over the lifetime of the buildings constructed during this time period.¹⁰⁰ To date, many states have adopted the 2007–09 codes for commercial and residential buildings. However, only about one-quarter of states have adopted the most up-to-date codes for residential and commercial buildings. The new codes reduce building energy use by 20 and 25 percent, respectively, compared with the 2007–09 standards—leaving the door open for greater savings by other states.¹⁰¹

The continued emergence of new technologies—enabled by partnerships between federal agencies, manufacturers, and businesses—will create ongoing opportunities for savings. For example, DOE recently reached an agreement with manufacturers and efficiency advocates on the terms of an updated efficiency standard for commercial rooftop air conditioners that will net \$50 billion in utility bill savings for businesses over 30 years.^{102,103}

DOE is also working with industry to advance adoption of next-generation intelligent energy information systems and controls that provide whole-building, web-accessible data in real time. These systems allow facility managers to identify wasted energy, with the potential of cutting building electricity use by as much as 30 percent.⁷⁴ Whole-building retrofits with the latest technologies have been shown to reduce building energy use in the range of 30 to 50 percent or greater, in some cases.¹⁰⁴ And the jobs needed to perform retrofits—including assessment, installation and maintenance of efficient appliances and systems—can't be sent overseas.

But opportunities to cut energy use and utility bills still exist. Studies suggest that electricity demand could be reduced 14 to 30 percent below projected levels over the next two decades, creating hundreds of billions of dollars in net savings for consumers while significantly reducing U.S. greenhouse gas emissions.¹⁰⁵ These opportunities remain because of the persistence of a number of market barriers to investment in efficient technologies. For example, building owners frequently have little incentive to invest in efficiency if they do not pay the energy bills and therefore do not experience the financial benefits, another example of the “split incentives” problem noted earlier. Building occupants may not expect to capture the full lifetime benefits of an investment, thus creating “ownership transfer” issues. This is because residential energy efficiency measures have an average payback period of about 7 years, whereas about 40 percent of homeowners will have moved within that duration of time. Other market barriers, including capital constraints and lack of knowledge of the lifecycle costs and benefits of products, can also prevent the implementation of cost-effective efficiency measures. The United States can harness more of this potential and continue to save money for consumers and businesses in the near to medium term by scaling up existing programs and implementing new policies.

The EPA has an important role to play by making sure that the Clean Power Plan takes into account all cost-effective energy efficiency potential when developing state-specific standards. This would encourage more widespread deployment of state efficiency programs, leading to greater demand

reductions and savings for consumers. The U.S. Department of Energy (DOE) and EPA also should continue to scale up their existing programs, which are already delivering benefits many times greater than their costs. This includes continuing to strengthen existing appliance standards (for example, for residential boilers, commercial unit heaters); setting appliance standards for equipment not currently covered (for example, for ovens, commercial ventilation equipment, general service lamps); increasing funding for research, development, and deployment of efficient technologies and processes; expanding partnerships with businesses and industry (for example, DOE's Better Buildings Challenge); and expanding efficiency labeling programs (for example, ENERGY STAR). New and strengthened appliance standards and less energy-intensive manufacturing together with the Clean Power Plan could lead to total electricity demand reductions of at least 9–10 percent below projected levels in 2025 and 11–13 percent in 2030.

These policies should include or be complemented by other state, federal, and local actions including: (1) updates to building codes and improvements to their enforcement, (2) measures to promote retrofits of existing buildings, and (3) expanded access to low-cost finance for efficiency projects.

C. Cleaner & More Fuel Efficient Transportation

The U.S. transportation sector is becoming less carbon intensive due in large part to the most recent federal GHG emission and fuel economy standards covering light-duty cars and trucks (model year 2012–25). A declining growth rate in vehicle miles traveled (VMT) by passenger vehicles also has contributed to declining emissions from light-duty vehicles over the past decade. Looking ahead, existing and proposed standards for medium- and heavy-duty vehicles and the development of CO₂ standards for aircraft will continue to increase the efficiency of the U.S. transport system, leading to even more fuel savings for households and businesses.

1. Passenger Vehicles

The Administration started to take bold action in this sector in 2010 when EPA and DOT established GHG and fuel economy standards for MY 2012–2016 passenger vehicles, and again in 2012 when these standards were expanded again to roughly double the fuel economy of model year 2025 vehicles. In response to these rules, car manufacturers have been utilizing advanced technologies to increase the fuel economy of their fleets- the number of sport utility vehicle models with a fuel economy of at least 25 miles per gallon (mpg) has doubled over the last five years, while the number of car models with a fuel economy of at least 40 mpg has increased sevenfold.¹⁰⁶ Analysis shows that, because of this technology advancement, car manufacturers are actually outperforming the current standards and are on track to meet the model year 2025 standards.¹⁰⁷ As new vehicles become more efficient, they will also save consumers money, improve air quality, and increase energy security by lowering oil demand. Once fully implemented, owners are expected to save on average \$3,400 to \$5,000 (net) over the life of their vehicle, compared with model year 2016 vehicles. The automobile industry may even be on the brink of an even greater transition. Advances in electric vehicle battery technology, along with the anticipated roll out of fuel cell vehicles in the 2015–17 could transform automobile industry. Battery prices have fallen by more than 40 percent since 2010. Some industry analysts are predicting that by the

early 2020s, long-distance electric vehicles will be cost-competitive with internal-combustion-engine vehicles, thanks to fuel price savings, even without federal incentives.¹⁰⁸

2. Transportation and Land Use

Transportation policies can also reduce passenger vehicle travel demand, thus lowering fuel use and emissions from vehicles. Passenger vehicle travel demand is already growing more slowly now than in the past decades, from an average growth rate of 3 percent per year from the 1970s to mid-2000s to 0.9 percent per year between 2004 and 2012 (measured in vehicle miles traveled).¹⁰⁹ Multiple factors are likely in play in this slowdown: the economic recession, changing demographics, high costs of driving (including rising fuel prices until late 2014), changing consumer preferences, as well as policy initiatives. It is uncertain whether these trends will continue or whether travel demand growth will rebound due to continued recovery from the recession, population growth, changes in oil prices (such as the rapid declines that occurred in late 2014), or other factors.

State and local policies should aim to provide more safe, reliable transit options for citizens, for instance through compact development patterns coupled with improved public transportation and routes for walking and biking. DOT, EPA, DOE, the U.S. Department of Housing and Urban Development, and other federal agencies can encourage and support these efforts in a number of ways, including increased funding for public transit infrastructure, implementation of performance criteria for funding that incentivizes compact development and related strategies, research and development, tax policies that promote infill development (such as renewal of the Federal Brownfield Tax Incentive), and technical assistance.¹¹⁰

3. Medium- and Heavy-Duty Trucks

The medium- and heavy-duty truck sector also presents opportunities to reduce emissions while saving fuel costs. Current medium- and heavy-duty vehicle GHG and fuel consumption standards are estimated to result in \$49 billion in net benefits to society (from fuel savings, CO₂ reductions, reduced air pollution, improved energy security due to decreases in the impacts of oil price shocks, and other benefits) over the lifetime of model year 2014–18 vehicles.¹¹¹ On June 19th, EPA and DOT proposed a second round of standards for the post-2018 time frame that would increase the fuel efficiency of medium- and heavy-duty vehicles up to 40 percent by 2027 compared to 2010 levels.¹¹² This level of fuel savings can be achieved using technologies that are currently available—such as tractor and trailer aerodynamic enhancements, hybridization and electric drive, and weight reduction, among others—that are estimated to have an average payback period of less than two years.¹¹³ EPA should finalize the second round of standards in a timely manner and take the full potential of these cost-effective technologies into account.

4. Aviation

The United States has also taken steps to address GHG emissions from airplanes through its emission reduction plan for aviation.¹¹⁴ The Federal Aviation Administration has initiatives in place to improve fuel efficiency through operations, including establishing direct routes and reducing delays, under its Next Generation Air Transport Systems program.¹¹⁵ And on June 10th, EPA took the first steps toward setting a

carbon dioxide emissions standard for commercial airplane engines. In anticipation of an international aircraft CO₂ emissions standard, expected from the International Civil Aviation Organization in 2016, EPA released an advanced notice of proposed rulemaking establishing the groundwork and seeking public input on relevant issues like timing and stringency.¹¹⁶ It's not yet clear what the international standards will deliver, but studies show that there's significant room for improvement in aircraft fuel efficiency, in the range of 20-30 percent or greater in the 2025-30 timeframe through use of improved engines, lower weight and reduced drag.¹¹⁷ EPA should set standards that take full advantage of these technologies, aiming to improve the fuel efficiency of new aircraft in the range of 2-3 percent annually. FAA should also continue to expand its initiatives to enhance the management of air travel.

D. Cleaner Industry

Industry is a broad category that includes a wider range of economic activities than the residential, commercial, and transport sectors. The energy and emissions intensiveness of industrial activity varies among manufacturing, construction, agriculture, energy transformation, mining, and forestry subsectors.¹¹⁸ Total U.S. industrial sector emissions peaked at 1.9 billion metric tons of CO₂ in 1979 and have intermittently declined since the late 1990s. Between 2010 and 2014, real U.S. industrial sector value-added grew by 7 percent while total industrial sector energy-related carbon dioxide emissions dropped by one percent.¹¹⁹ Emissions reductions have been driven by a combination of efficiency improvements, cleaner energy use, changing product mix, and additional combined-heat-and-power (CHP) utilization.¹²⁰ While the U.S. industrial sector has become more efficient, studies suggest that it can move forward at an even faster pace, reducing energy consumption by 15 to 32 percent below 2025 forecast values.¹²¹ In 2014, total U.S. industrial sector emissions amounted to 1.5 billion metric tons CO₂, which covered 27 percent of total U.S. energy-related CO₂ emissions.¹²²

The industrial sector presents a large challenge and opportunity for moving the United States to a prosperous low-carbon economy. The Administration's commitment to reduce U.S. emissions can improve industrial competitiveness by catalyzing innovation and investment. U.S. firms can leverage low-cost clean energy and efficiency improvements to expand production and market share.¹²³ Given that the vast majority of U.S. emissions increases to 2040 are expected to come from industry and manufacturing sector growth,¹²⁴ this sector has a unique opportunity to benefit from forward-thinking policies and new investments. Recent studies have clearly demonstrated the positive economic, employment, and competitiveness benefits of investing in U.S. industrial energy efficiency. In 2012 Congress passed the American Energy Manufacturing Technical Corrections Act, which mandated that the Secretary of Energy should produce a report on the deployment of industrial energy efficiency in the United States. One high-level finding of the report, which was published in June, was that a \$5 billion Federal matching industrial energy efficiency grant program implemented over a 10-year period would help support up to 9,700 to 11,200 jobs per year for the life of the program and help manufacturers save \$3.3 to \$3.6 billion per year in energy costs by Year 5 of the grant program, and \$6.7 to \$7.1 billion per year by Year 10 of the grant program.¹²⁵ The Administration's Climate Action Plan and international commitments offer a framework for re-invigorating U.S. industry in a low-carbon economy.

Within the industrial end use of energy, energy efficiency improvements (including technical improvements, material efficiency, and waste reduction) and fuel-switching are the primary levers for industrial sector emissions reduction, in addition to reductions from combined heat and power usage. Industrial sector demand, as reflected in the value of shipments, is expected to grow by more than a third between 2015 and 2030.¹²⁶ This growth creates opportunities for investments in efficiency and for well-designed policy interventions.

Industrial energy efficiency is inhibited by persistent barriers, including financing (such as intra-company competition for capital, corporate tax structures that allow companies to treat energy expenditures as tax offsets, split incentives, and energy price trends), regulation (monopolistic utility business models and cost-recovery mechanisms, exclusion of efficiency from energy resource planning), and informational barriers (ignorance of incentives and risks, unavailable energy use data, and lack of technical expertise).¹²⁷ Industrial sector demand growth combine with barriers to energy efficiency improvements to create a range of opportunities and challenges that will influence the absolute level of total U.S. GHG emissions.

A 2010 National Academy of Sciences study estimated a cost-effective energy efficiency improvement potential of 14 to 22 percent for the U.S. industrial sector by 2020.¹²⁸ Numerous state and federal policies have been enacted to accelerate industrial sector efficiency improvements. These include regulations for equipment via emission performance standards under Boiler Maximum Achievable Control Technology (MACT); EPA's New Source Performance Standards; market and rate design that helps to reduce industry sector GHG emissions by promoting clean distributed generation; tax credits, exemptions and/or deductions; technical assistance from federal government agencies such as DOE's Better Buildings, Better Plants Program;¹²⁹ and research grants such as Advanced Research Projects Agency-Energy¹³⁰ and DOE's Advanced Manufacturing Office¹³¹ programs.

Reducing industrial sector GHG emissions below current levels will require additional investment and policy action. Government can combine ambitious minimum performance standards for sources, along with voluntary benchmarking and labeling programs to encourage further industrial efficiency improvements.

E. Improved Production, Processing and Transmission of Natural Gas

Methane is the primary component of natural gas, and is therefore a valuable commodity.¹³² It is also a potent greenhouse gas, with at least 34 times the global warming power of carbon dioxide.¹³³ Emissions of methane and other air pollutants occur throughout the natural gas life cycle, creating unnecessary waste along with damage to the local environment and the global climate.¹³⁴ Without additional policies, methane emissions from natural gas systems are expected to grow 4.5 percent by 2018, and to continue to grow slowly over the coming decades.¹³⁵ But the right policies will encourage investment in cost-effective technologies and best practices that companies can use to reduce waste, save money, and cut harmful emissions of methane and other pollutants.¹³⁶

Dozens of proven technologies that minimize leaks and vents of methane are currently available and deployed across the United States. However, their use remains uneven largely because of market

barriers that impair the ability of drillers and other service providers to capture the increased revenue by changing equipment and practices. In addition to the “split incentives” noted above, these barriers include:

- *Imperfect Information:* Because emissions measurement technology is still expensive and not widely used, many companies do not have a complete picture of how much methane they are emitting, and from which sources. Most companies, therefore, are not aware how much money they can save by investing in technologies that reduce methane emissions.
- *Opportunity Costs:* Investing capital or engineering capacity in equipment to reduce or eliminate natural gas leaks represents an opportunity cost for owners and operators of natural gas systems as investments in projects that reduce wasted natural gas compete with other potential investments, primarily the drilling of new production wells or other measures to increase natural gas production. Even though most emissions-control technologies pay for themselves in three years or less, that may not compare favorably to other investment opportunities.

While some companies active throughout the natural gas supply chain—from production through distribution— have already recognized the economic advantages of investing in technologies that reduce methane emissions, many have not. Voluntary measures reduce about 20 percent of methane emissions from natural gas systems, according to EPA.¹³⁷ But existing voluntary measures merely skim the surface of available, cost-effective emissions reduction opportunities, according to recent studies from the Natural Resources Defense Council (NRDC) and ICF Consulting.¹³⁸ This suggests the states and the federal government have ample opportunity to implement additional standards requiring reductions in methane emissions to overcome these barriers.

EPA’s 2012 standards to reduce emissions of hazardous air pollutants, and volatile organic compounds are expected to significantly reduce methane emissions, saving the industry approximately \$10 million per year in 2015 because the value of the avoided emissions of natural gas is greater than the cost of equipment to capture it (annual savings are estimated at \$330 million versus \$320 million in compliance costs). Importantly, these savings do not consider the benefit of reducing methane emissions and conventional air pollutants. EPA estimates that the standards will reduce emissions of volatile organic compounds by 172,000 metric tons in 2015 alone.¹³⁹ Some studies have found that the health benefits due to improved air quality could be as high as \$2,640 per metric ton of volatile organic compounds nationwide, with even higher benefits in some localities.¹⁴⁰

EPA rulemakings have taken the first steps by indirectly reducing methane emissions in this sector, and recently proposed methane standards for new and modified oil and gas infrastructure¹⁴¹ are an important step in the right direction, but much remains to be done. One recent study estimated that 40 percent of emissions from onshore gas development can be eliminated at an average cost of a penny per thousand cubic feet.¹⁴² EPA should propose and finalize standards on both new *and* existing natural gas systems by 2017, and phase in implementation through 2020, to reduce methane leakage by 67 percent below business-as-usual projections. This can be achieved using existing technologies, many of which pay for themselves in three years or less.

F. Reducing Emissions of High Global Warming Potential Gases

HFCs are used primarily for refrigeration, air conditioning, and the production of insulating foams. HFC emissions have been increasing because they are a replacement of ozone-depleting substances (chlorofluorocarbons and hydrochlorofluorocarbons) under the Montreal Protocol and Clean Air Act. Unfortunately, some HFCs have very high global warming potential (GWP). Fortunately, alternatives with low GWPs are increasingly available. Several companies have begun to use these alternatives, with many saving money and energy while they reduce GHG emissions.¹⁴³ For example:

- Coca-Cola uses CO₂ in 1 million HFC-free coolers and aims to purchase only CO₂-based equipment by 2015.¹⁴⁴ Because of its transition to CO₂-based technology for new equipment, Coca-Cola has improved its cooling equipment energy efficiency by 40 percent since 2000, and reduced its direct greenhouse gas emissions by 75 percent.¹⁴⁵
- Coolers introduced by PepsiCo, Red Bull, Heineken, and Ben & Jerry's are based on hydrocarbons including propane (R-290) or isobutane (R-600a). These companies combined have more than 600,000 units in use today and have seen energy efficiency improvements from 10 to 20 percent or even greater.¹⁴⁶
- Fifteen car companies, including General Motors, Ford, and Chrysler, are moving forward with HFO-1234yf,¹⁴⁷ a new low-GWP refrigerant for personal vehicle air conditioners that has a GWP 99.9 percent lower than the HFC it replaces.¹⁴⁸ An estimated 1 million cars on the road worldwide already use this low-GWP refrigerant.¹⁴⁹ This number is expected to grow to nearly 3 million by the end of 2014.¹⁵⁰

However, some low-GWP replacements have relatively high upfront costs, require the replacement of old equipment, or require equipment redesign.¹⁵¹ Thus, there is little reason to believe that the U.S. market will rapidly move to these alternatives without new rules or other incentives.

The United States (with Canada and Mexico) has advocated for the past several years for an amendment to the Montreal Protocol that would phase down the use of HFCs globally. Agreement was finally reached in early November at the 27th Meeting of the Parties to the Montreal Protocol to negotiate the terms of this amendment. These negotiations will be conducted during 2016 through a series of additional meetings, with the HFC amendment to be adopted in November 2016.¹⁵² However, to help reduce the use of HFCs domestically pending this amendment, EPA has started to implement measures that address high-GWP HFC use in personal vehicles and in pickups, vans, and combination tractors.¹⁵³ In February 2015, EPA finalized rules through the Significant New Alternatives Program (SNAP) program to approve low-GWP alternatives¹⁵⁴ and in July 2015, EPA finalized rules to move some higher-GWP HFCs out of the market for various applications.¹⁵⁵ In October 2015, EPA proposed a rule that will help capture, reclaim and recycle more HFCs from existing equipment to reduce the amount of new HFCs produced.¹⁵⁶

Opportunities exist to make HFC reductions beyond those finalized by EPA to date. While a global phasedown, through the Montreal Protocol, would be much more effective than a few individual countries taking action alone, EPA can continue using the SNAP program to jump start the removal of

high-GWP HFCs from the market when low-GWP alternatives become available. However, it will be important for EPA to ensure that new alternatives are both safe and efficient.

III. How the United States Can Reach Its INDC Target

As demonstrated in the previous sections, opportunities are emerging across the economy in multiple sectors to harness fuels, technologies, and processes in moving toward a low-carbon economy. The actions taken to date by the Obama Administration under the Climate Action Plan seize many of those opportunities and set an important foundation for meeting its target of reducing emissions 26–28 percent below 2005 levels by 2025, as outlined in its Intended Nationally Determined Contribution (INDC).

In May 2015, WRI published *Delivering on the U.S. Climate Commitment: A 10-Point Plan Toward A Low-Carbon Future*. This study demonstrates that the United States can meet, and even exceed, its INDC target with a broad policy portfolio using existing federal laws combined with actions by states. This would include expanding and strengthening some current and proposed policies and standards and taking actions on emission sources that are not yet addressed. Since we completed our analysis, the Administration has already started to move on some of the additional actions we identified as necessary for the US to meet its INDC target, including taking steps toward improving the efficiency of medium- and heavy-duty trucks, aircraft, and rooftop air conditioning units.

Figure 1 presents emissions projections for three low-carbon pathways that could reduce U.S. emissions by 26–30 percent below 2005 levels by 2025 and 34–38 percent by 2030. *Delivering on the U.S. Climate Commitment* outlines specific steps federal agencies and state governments can take to achieve these reductions, recognizing that other pathways could reach those targets as well by applying different policy portfolios. Notably, our pathways do not include steps to reduce emissions and increase sequestration from the agriculture and forestry sectors. However, in April 2015, the Administration announced an initiative titled *Building Blocks for Climate Smart Agriculture & Forestry*.¹⁵⁷ USDA expects this comprehensive set of voluntary programs and initiatives to reduce net emissions and enhance carbon sequestration by over 120 million metric tons of CO₂ equivalent per year by 2025. The opportunities in agriculture and forestry reinforce the notion that there are multiple pathways to achieve the U.S. INDC target.

Figure 1. Net U.S. Greenhouse Emissions: Reference Case and Low-Carbon Pathways Using Existing

Federal Authorities and Additional State Action

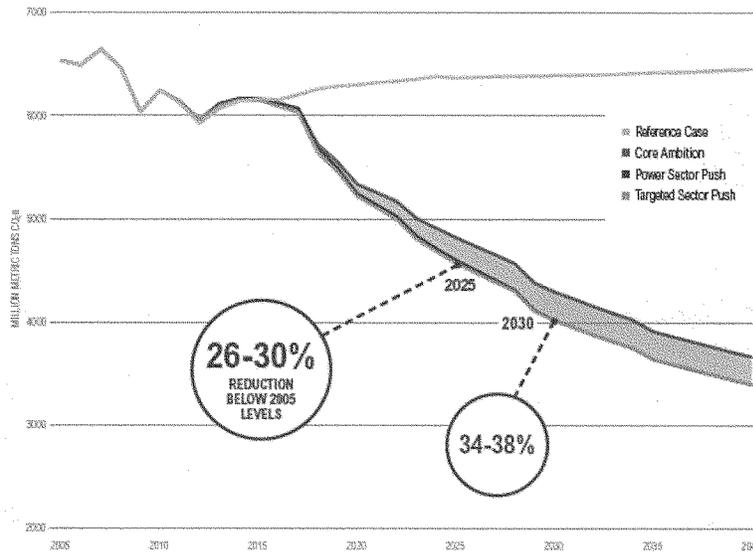


Figure 1 depicts net GHG emissions under three low-carbon pathways we modeled in our analysis that could be pursued using existing federal laws and additional state action. The “Core Ambition” pathway reflects the EPA’s Clean Power Plan (CPP), in addition to emission abatement opportunities across other sectors of the economy. (The modeling is based on the CPP as proposed, however, the reductions projected in 2025 for the final rule are nearly the same.) “Power Sector Push” builds on Core Ambition by assuming that states and utilities go beyond the CPP to take advantage of cost-effective energy efficiency resources and continued decreases in renewable energy costs. “Targeted Sector Push” assumes that the CPP, but pushes the envelope in a few key areas outside the power sector to achieve economy-wide reductions similar to “Power Sector Push”. Both of these pathways were designed to achieve very similar levels of emission reductions, illustrating alternative ways to go beyond a 26 percent reduction across the economy, either through increased action in the power sector or outside the power sector. The shaded area between the pathways indicates that reductions anywhere in this range are possible given mixtures of policies that blend these three pathways. The full report contains all the details and assumptions underlying these pathways and the Reference Case projection, and the modeling approaches used.

IV. International Action

A. Intended Nationally Determined Contributions (INDCs) and National Climate Actions

The leadership shown by the United States has paid substantial dividends internationally. In the lead-up to the Paris climate summit and the 2015 international climate agreement, we have witnessed an unprecedented level of commitment to climate action by a wide array of countries, both developing and developed. As of November 30, 2015, 183 countries, including all major economies, have submitted national climate plans for the 2015 climate agreement.¹⁵⁸ These plans, known as Intended Nationally Determined Contributions (INDCs), are from countries representing more than 95 percent of global greenhouse gas (GHG) emissions.¹⁵⁹ This unprecedented effort indicates countries' increased seriousness in addressing climate change.¹⁶⁰

The recently released UNFCCC INDC synthesis report finds that these INDCs represent a much greater breadth of countries than those submitted in 2010,¹⁶¹ when only 100 countries submitted plans in association with the Copenhagen Accord and the Cancun Agreement.¹⁶² We are also witnessing an extraordinary effort from developing countries in the lead up to the Paris negotiations. In 2010, only 33 developing nations announced a national climate plan.¹⁶³ As of November 30, 2015, 142 developing countries – including 46 least developed countries – have submitted an INDC, through which they outline their plans to mitigate emissions and adapt to a changing climate. Only two least developed countries (LDCs) have yet to submit an INDC.¹⁶⁴

The effect of these plans on climate policies will be considerable. Of the plans submitted, those from at least 123 INDCs include a greenhouse gas emissions target, usually expressed as a percent reduction by a certain year. By contrast, of the countries with pledges adopted for 2020 targets in association with the Copenhagen Accord and the Cancun Agreement, only 61 included greenhouse gas emissions targets, less than half of those with such targets in the current INDCs.¹⁶⁵

Countries are also using their INDCs to outline significant policies and actions that support the deployment of clean energy and help countries adapt to the effects of climate change. In the plans submitted, more than 100 INDCs include plans to scale up clean energy between 2020 and 2030, as they look for ways to limit greenhouse gas emissions while sustaining economic growth, boosting energy security and providing energy access to the billions of people who lack it now.¹⁶⁶ More than half of these plans include specific targets for increasing renewable energy supply.¹⁶⁷

In addition to addressing mitigation, the plans from at least 135 INDCs include adaptation,¹⁶⁸ describing activities and goals in vulnerable sectors like water, agriculture and human health. Most countries clearly identify existing gaps, barriers and needs associated with adapting to their local climate change impacts, which begins to outline a roadmap for global efforts to build capacity, develop and share technology, and scale up adaptation finance.¹⁶⁹

As a whole, INDCs not only address climate change, but also address domestic goals such as sustainable economic growth and poverty reduction. Importantly, the INDCs signal a new phase of climate policy, in which climate action is strongly rooted in domestic policies and national development and economic agendas and aligned with country priorities.¹⁷⁰

1. Developing Countries' Plans and Actions

The climate actions of major developing countries are particularly worth noting. Last year's U.S.-China Joint Announcement on Climate Change was an historic agreement that included unprecedented actions by China. China committed to reach a peak in its carbon dioxide emissions around 2030 and make best efforts to peak earlier, and to increase the non-fossil fuel share of its energy use to around 20 percent by 2030.¹⁷¹ China's INDC, submitted in June 2015 for the Paris climate agreement, formalized these targets and also set additional targets to reduce the carbon intensity (carbon emitted per unit of GDP) of its economy by 60 to 65 percent from 2005 levels by 2030 and to increase its forest stock by around 4.5 billion cubic meters.¹⁷² In addition to national targets, eleven cities and provinces from across China committed to reach a peak in their carbon emissions before the national goal to peak around 2030.¹⁷³ This group comprises a quarter of China's urban carbon emissions, roughly equivalent to the total annual carbon emissions of Japan or Brazil.¹⁷⁴

China has made significant progress in decoupling emissions from economic growth in recent years and is on track to exceed the carbon intensity and energy intensity targets in its 12th Five Year Plan.¹⁷⁵ These are key steps to achieving China's commitment to reduce its carbon intensity by 40 to 45 percent from 2005 levels by 2020.¹⁷⁶

China's 2030 targets are in line with even stronger efforts. A 2014 study by MIT and China's Tsinghua University found that a scenario with emissions leveling off between 2025 and 2035 and slowly declining after that involves stronger measures well beyond current policies, including a rising price on carbon.¹⁷⁷ Stronger steps will also be needed to achieve the non-fossil target. China will need to install 800-1,000 gigawatts (GW) of non-fossil fuel electricity generation capacity to achieve its 2030 non-fossil energy target, greater than its current coal-fired capacity and almost the total current electricity generation capacity of the United States.¹⁷⁸

Expert projections¹⁷⁹ of a peak in China's carbon emissions and an increased share of non-fossil energy are supported by several major building blocks: scaling up non-fossil energy, limiting coal use,¹⁸⁰ improving energy efficiency, placing a price on carbon, and rebalancing the economy from heavy industry toward services.¹⁸¹ China is already taking significant action in each of these areas.

China led the world with nearly a third of global investment in renewable energy in 2014,¹⁸² is the world leader in installed wind power capacity,¹⁸³ and has set targets to roughly double its 2014 wind capacity to 200 gigawatts and more than triple its 2014 solar capacity to 100 gigawatts by 2020.¹⁸⁴ China has banned new coal plants in three key industrial regions¹⁸⁵ and many provinces have targets to reduce

coal use.¹⁸⁶ China has been strengthening and expanding policies to increase energy efficiency across its economy, including targets for the efficiency of coal plants,¹⁸⁷ energy-saving targets for industrial enterprises,¹⁸⁸ building energy codes,¹⁸⁹ and fuel economy standards.¹⁹⁰ President Xi Jinping recently announced that in 2017 China will launch a national emissions trading system,¹⁹¹ which has the potential to be a powerful instrument to reduce emissions over time.¹⁹² Finally, China is seeking to shift away from its old growth model driven by investment in energy-intensive industry toward a new model driven by consumption, services, and advanced manufacturing,¹⁹³ which should have an emissions reduction benefit.¹⁹⁴

China is working on including additional steps in its upcoming 13th Five Year Plan, to be released early next year.¹⁹⁵ Signs of a recent decline in China's coal use¹⁹⁶ and other trends have led some experts to predict that China's coal use may have already reached its structural peak (controlling for cyclical factors)¹⁹⁷ and that China's emissions will likely peak before 2030, consistent with the government's stated aim to make best efforts to peak early.¹⁹⁸

Other major developing countries have also taken important steps forward. In its INDC, Brazil has set a target of reducing emissions by 37 percent below 2005 levels by 2025,¹⁹⁹ becoming the first major developing country to commit to an absolute reduction of emissions from a base year. Brazil also plans to increase the share of renewables (other than hydropower) in the power supply to at least 23 percent by 2030. This will increase Brazil's renewable electrical capacity (excluding hydropower) by an estimated 48 gigawatts, more than quadrupling 2012 levels.²⁰⁰ The country also has set a target to achieve zero illegal deforestation by 2030 in the Brazilian Amazon. Over the past decade, the rate of deforestation in the Brazilian Amazon has already dropped by 70 percent compared with the previous decade, keeping 3.2 billion metric tons of carbon dioxide (CO₂) emissions out of the atmosphere.²⁰¹ This is equivalent to taking all U.S cars off the road for three years.²⁰²

India has set goals to substantially increase its renewable energy capacity to 175 gigawatts by 2020, including increasing its solar capacity to 100 gigawatts—a twentyfold increase from current levels of 4 gigawatts—and increasing its wind power capacity to 60 gigawatts.²⁰³ The solar target is more than half the total global installed capacity of 181 gigawatts of solar energy in 2014.²⁰⁴ In its INDC, India builds on this targets by committing to increase its non-fossil fuel power sector capacity to 40 percent by 2030. India's INDC also commits to reducing the greenhouse gas intensity of its economy (greenhouse gases per unit of GDP) by 33-35% below 2005 levels by 2030. India will also create an additional carbon sink of 2.5 to 3 billion tons of carbon dioxide through additional tree cover.²⁰⁵

Additional major developing countries have submitted INDCs that indicate a peak date for the absolute level of emissions. Mexico was the first developing country to release its INDC and plans to reduce its greenhouse gas emissions by 22 percent and its black carbon (soot) by 51 percent by 2030 relative to BAU levels.²⁰⁶ The INDC indicates that the policy is expected to lead to a peak in emissions by 2026. South Africa joins China and Mexico in stating intended peaking years for emissions. South Africa's INDC provides a target to peak national greenhouse gas emissions between 2020 and 2025 and decline in absolute terms beginning no later than 2035.

2. Effect of INDCs on Global Temperature

Several recent studies have shown that the INDCs submitted will make a significant difference in reducing global emissions in comparison to current policy trajectories. All of the studies find that the INDCs collectively reduce global emissions relative to the current trajectory, though additional effort will be needed to limit the global temperature increase to a rise of less than 2 degrees Celsius (3.6 degrees F) above pre-industrial temperatures, the globally agreed goal for limiting climate change.²⁰⁷

The International Energy Agency's Energy and Climate Change Report²⁰⁸ concludes that full implementation of INDCs would contribute to 4-8 gigatons (GtCO₂e) of greenhouse gas emissions reductions by 2030. The report estimates that the path set by the INDCs would be consistent with an average global temperature increase of around 2.7 degrees Celsius by 2100. That contrasts with the Agency's projections of an almost 4 degrees Celsius temperature increase by 2100 given business as usual (BAU) policies.²⁰⁹

The Synthesis Report of the INDCs conducted by the UNFCCC estimates that the implementation of INDCs would result in emissions in 2025 that are 2.8 gigatons (and up to 5.5 gigatons) of greenhouse gas emissions (GtCO₂e) lower than current policy trajectories and emissions in 2030 that are 3.6 gigatons (and up to 7.5 gigatons) lower. The synthesis report does not present the effect of INDCs on global temperature.²¹⁰

The reports come to a similar conclusion that the implementation of INDCs would contribute to significant reductions of global greenhouse gas emissions (approximately 3-8 GtCO₂e in 2030). Although the collective reductions of the INDC emissions targets are not yet sufficient to achieve the 2 degrees Celsius goal, progress has already been made. The INDCs represent approximately one third of the emissions reductions needed to meet the 2 degrees Celsius goal relative to current trajectories, and half of the reductions needed relative to the business as usual policies in place in 2010.²¹¹ While more needs to be done in the coming years, the INDCs are an important first step in transitioning to a low-carbon economy and limiting global temperature increase. This will assist in avoiding some of the most costly impacts in the United States and in other countries.

Further action beyond the INDCs is in our economic interest, according to the New Climate Economy, in its 2015 report, *Seizing the Global Opportunity: Partnerships for Better Growth and a Better Climate*. It identified actions in 10 key areas that can drive economic growth and development and achieve as much as 96% of the greenhouse gas emissions reductions needed by 2030 to keep global warming under 2°C.²¹² These include investing in low-carbon cities, which could save urban areas around US\$17 trillion globally by 2050 and reduce emissions by 3.7 Gt CO₂e and investing in energy efficiency measures, which could boost cumulative global economic output by US\$18 trillion by 2035.

B. International Agreement

The leadership role played by the United States has helped to catalyze not only broad-based action by other countries, but also the momentum toward an international agreement that achieves a key set of aims for the United States.

First, and most important, the agreement is applicable to all countries. The Paris agreement will build on and implement the existing United Nations Framework Convention on Climate Change (UNFCCC), which was ratified by the Senate in 1992, and will mark a critical step forward by involving action to reduce emissions by all countries, both developed and developing.

The universality of the agreement is exactly what the United States has been seeking for many years in the international climate negotiations and should be viewed as a major success. It will be an agreement with a structure that removes previous question marks about action by China and other countries and puts in place clear pathways for action by all countries. This shift to a universal system is also the result of a process in the negotiations to generate national climate plans, the INDCs, at the national level in accordance with their national circumstances.²¹³ This sets a strong foundation for countries to achieve what they have set out in their INDCs.

Second, the Paris agreement is a critical opportunity to enhance the existing system of transparency and accountability to enable greater clarity and enhance trust about whether and how countries are fulfilling their INDCs. Following the UNFCCC Conference of Parties (COP) in Copenhagen in 2009 and the Conference of Parties in Cancun in 2010, all countries are required to track and report their emissions through a system referred to as Measurement, Reporting and Verification (MRV), with some differences for developed and developing countries in timelines and exact reporting requirements.²¹⁴ The Paris agreement can strengthen this system and ensure that developed and developing converge to the same MRV requirements over time (including through the use of capacity building support for developing countries to implement the requirements).

A robust system of transparency is very much in line with the values of openness and accountability that are so fundamental and deeply imbedded in the United States. It is essential to making sure that other countries are carrying out what they have said they will do. The MRV system also offers an opportunity to identify challenges that developing countries with limited capabilities may be facing and to work with them to address those barriers.

Third, it is vital that the Paris agreement is durable, designed not only for circumstances as they exist in 2015, but also for years to come. In part, the agreement must be flexible enough to accommodate evolving national circumstances, particularly as countries' capabilities continue to grow. Beyond that, the agreement must also ensure that all countries continue moving forward over time, regularly returning to review, revisit and update their national climate plans. This is essential to making this agreement universal over the long-term, ensuring that countries across the board continue to move forward in a regular and timely way, while also providing an opportunity to consider whether countries are doing their part to take adequate action. Establishing a long-term global goal for action to reduce

emissions can also help to ensure that all countries, not just some, are expected to move toward a common objective over time.

Fourth, the Paris agreement is an opportunity to effectively expand the scope of finance and investment needed to meet this challenge, bringing many new actors into the mix. Public funding remains essential, particularly to address the serious impacts of climate change on the poorest countries. But the substantial investment needed to shift our economies to low-carbon and climate resilient pathways also requires mobilizing and shifting the broader private sector financing that is so necessary to making progress.

Moreover, developing countries with greater capabilities are increasingly stepping up to play a meaningful role in climate finance. Chinese President Xi's recent commitment in the Joint Presidential Statement with President Obama that China would provide more than \$3 billion in climate finance was a game changer.²¹⁵ Some developing countries have also now contributed to the Green Climate Fund, a central international funding mechanism.²¹⁶ The Paris agreement can reflect this shift and the key role of finance from developing countries that are ready to provide it.

Acting together with these other countries and private sectors investors, U.S. engagement to mobilize climate finance is a sensible investment. Especially by enabling vulnerable countries to build resilience to changing weather patterns, sea level rise, and extreme weather events, international climate change investments can help counter security threats that otherwise would have to be confronted with more costly interventions. The impacts of climate change must also be addressed to avoid undermining or reversing development gains in poor countries, especially those in vulnerable regions like Sub-Saharan Africa. An assessment by the World Bank illustrates how climate change increasingly threatens health and livelihoods of vulnerable populations, magnifying existing challenges to poverty alleviation.²¹⁷

And, fifth, the Paris agreement can help catalyze action to address the impacts of climate change that are already being felt, especially in the most vulnerable and poorest countries. This is a challenge that affects us all – whether it is increased water scarcity and drought, vulnerable coastal areas facing sea-level rise, or growing risks to agricultural productivity. All countries need to work together to address these challenges, and the Paris agreement is a critical opportunity to catalyze collective action to build resilience to climate impacts. The United States has always stood with and supported the most vulnerable and poorest countries in tackling their challenges and should continue to do so today.

Meanwhile, there is more that will happen in Paris beyond the bounds of the international agreement itself. A major platform for actors other than national governments – including businesses and cities and states – will highlight the many actions and initiatives that are already underway to advance a low-carbon and climate resilient economy. Effective action on climate change cannot rest only on the actions of governments or agreements among them – it will depend on everyone playing a part.

V. Conclusion

The United States has the opportunity in the coming years to lay the foundation for a path to economic growth that delivers significant climate benefits. The key drivers of economic growth—including more

efficient use of energy and natural resources, smart infrastructure investments, and technological innovation—can also lead to a low-carbon future. By bringing a spirit of competition, ingenuity, and innovation to the climate challenge, the United States can be a leader in delivering the improvements in energy efficiency, the cleaner fuels, and the new technologies and processes that can lower emissions and create net economic benefits. With more than 50 years' experience in addressing environmental problems, the United States has demonstrated that environmental protection is compatible with economic growth, and environmental policies have delivered huge benefits to Americans.

The U.S. emissions reduction target of reducing emissions by 26 to 28 percent below 2005 levels by 2025 is both ambitious and achievable. Use of existing federal laws combined with actions by the states can help accelerate recent market and technology trends in renewable energy, energy efficiency, alternative vehicles, and many other areas in order to meet or beat that target.

It is very much in the national interest of the United States to play a leading role in addressing climate change. All nations will need to take ambitious action and do their share, since no nation is immune to the impacts of climate change and no nation can meet the challenge alone. U.S. leadership has already paid substantial dividends as we witness the wide variety of countries coming forward with their national climate plans and as we see the development of an international climate agreement that is universal, transparent, durable and effective.

The United States has always provided leadership when the world faces big challenges, and by acting at home, we can work with other countries to achieve an effective international agreement in which all countries act.

Thank you for the opportunity to testify before the Committee, and I look forward to answering any questions.

¹ The Global Commission on the Economy and Climate. 2014. "Better Growth, Better Climate." Accessible at: <<http://newclimateeconomy.report/>>.

² N. Bianco, K. Meek, R. Gasper, M. Obeiter, S. Forbes, and N. Aden. 2014. "Seeing is Believing: Creating a New Climate Economy in the United States." World Resources Institute. Accessible at: <<http://www.wri.org/publication/new-climate-economy>>.

³ UNFCCC, 2015, "INDCs as communicated by Parties", accessible at <http://www4.unfccc.int/submissions/indc/Submission%20Pages/submissions.aspx>.

⁴ See <<http://sciencebasedtargets.org/companies-taking-action>>

⁵ Fact Sheet: White House Announces Commitments to the American Business Act on Climate Pledge." October 19, 2015. Accessed November 13, 2015, <<https://www.whitehouse.gov/the-press-office/2015/10/19/fact-sheet-white-house-announces-commitments-american-business-act>>

- ⁶ “Major U.S. banks call for leadership in addressing climate change.” September 28, 2015. Ceres. Accessed November 13, 2015, <<http://www.ceres.org/press/press-releases/major-u.s.-banks-call-for-leadership-in-addressing-climate-change>>
- ⁷ Carbon Disclosure Project, 2015, “Putting a Price on Risk: Carbon Pricing in the Corporate World,” Available at <<https://www.cdp.net/CDPResults/carbon-pricing-in-the-corporate-world.pdf>>
- ⁸ Available at: <<http://www2.epa.gov/cira>>.
- ⁹ CNA Military Advisory Board, “National Security and the Accelerating Risks of Climate Change.” Alexandria, VA: CNA Corporation, 2014.
- ¹⁰ Global Commission on the Economy and Climate, 2014, “Better Growth, Better Climate: The New Climate Economy Report,” available at http://2014.newclimateeconomy.report/wp-content/uploads/2014/08/NCE-Global-Report_web.pdf.
- ¹¹ U.S. Environmental Protection Agency, “Regulatory Impact Analysis for the Proposed Carbon Pollution Guidelines for Existing Power Plants and Emission Standards for Modified and Reconstructed Power Plants”, RIA, Table ES-10, p. ES-23.
- ¹² UNFCCC, 2015, “INDCs as communicated by Parties”, accessible at <http://www4.unfccc.int/submissions/indc/Submission%20Pages/submissions.aspx>.
- ¹³ White House Office of the Press Secretary, “FACT SHEET: U.S.-China Joint Announcement on Climate Change and Clean Energy Cooperation” (November 11, 2014) <http://www.whitehouse.gov/the-press-office/2014/11/11/fact-sheet-us-china-joint-announcement-climate-change-and-clean-energy-c>. “Fact Sheet: The United States and China Issue Joint Presidential Statement” (September 25, 2015). <https://www.whitehouse.gov/the-press-office/2015/09/25/fact-sheet-united-states-and-china-issue-joint-presidential-statement>
- ¹⁴ IEA, 2015, “Energy and Climate Change”, accessible at https://www.iea.org/media/news/WEO_INDC_Paper_Final_WEB.PDF.
- ¹⁵ IEA, 2015, “Energy Technology Perspectives”, accessible at <https://www.iea.org/etp/>.
- ¹⁶ The Global Commission on the Economy and Climate. 2014. “Better Growth, Better Climate.” Accessible at: <<http://newclimateeconomy.report/>>.
- ¹⁷ P. Hibbard, A. Okie, S. Tierney, and P. Darling, 2015, “The Economic Impacts of the Regional Greenhouse Gas Initiative on Nine Northeast and Mid-Atlantic States,” Analysis Group. Available at: http://www.analysisgroup.com/uploadedfiles/content/insights/publishing/analysis_group_rggi_report_july_2015.pdf.
- ¹⁸ M. Metayer, C. Breyer, and H. Fell, 2015, “The projections for the future and quality in the past of the World Energy Outlook for solar PV and other renewable energy technologies.” Energy Watch Group. Available at: http://energywatchgroup.org/wp-content/uploads/2015/09/EWG_WEO-Study_2015.pdf.
- ¹⁹ Based on projections of IEA World Energy Outlooks in Reference Scenarios of WEO 2007 and New Policies Scenarios in WEO 2013. World Energy Outlook 2007 available at http://www.worldenergyoutlook.org/media/weowebsite/2008-1994/weo_2007.pdf. World Energy Outlook 2013 available at: <http://www.worldenergyoutlook.org/weo2013/>.
- ²⁰ S. Dechert, 2015, “Greenpeace Aces Renewable Energy Forecasts. Surprised?” Clean Technica. Available at: <http://cleantechnica.com/2015/03/30/greenpeace-aces-installed-renewable-forecasts-surprised/>.
- ²¹ U.S. Department of Energy, 2015, “Revolution... Now: The Future Arrives for Five Clean Energy Technologies – 2015 Update”, accessible at <http://www.energy.gov/sites/prod/files/2015/11/f27/Revolution-Now-11132015.pdf>
- ²² P. Bodnar. National Security Council, and D. Turk, U.S. Department of Energy, 2015, “Announcing, ‘Mission Innovation,’” accessible at: <https://www.whitehouse.gov/blog/2015/11/29/announcing-mission-innovation>
- ²³ Breakthrough Energy Coalition, 2015, “Introducing the Breakthrough Energy Coalition,” accessible at <http://www.breakthroughenergycoalition.com/en/index.html>
- ²⁴ The Solar Foundation, 2015, “Solar Industry Creating Jobs Nearly 20 Times Faster than Overall U.S. Economy.” Available at: <http://www.thesolarfoundation.org/press-release-solar-industry-creating-jobs-nearly-20-times-faster-than-overall-u-s-economy/>
- ²⁵ Synapse Energy, Labor Network for Sustainability, 350.org, 2015, “The Clean Energy Future: Protecting the Climate, Creating Jobs, Saving Money.” Available at: <http://synapse-energy.com/sites/default/files/Clean-Energy-Future-15-054.pdf>.
- ²⁶ D. Lashof, 2015, “Our Clean Energy Economy,” NextGen Climate America. Available at: <http://nextgenamerica.org/blog/our-clean-energy-economy/>

²⁷ Global Commission on the Economy and Climate, 2015, "Seizing the Global Opportunity: Partnerships for Better Growth and a Better Climate," available at http://2015.newclimateeconomy.report/wp-content/uploads/2014/08/NCE-2015_Seizing-the-Global-Opportunity_web.pdf.

²⁸ Global Commission on the Economy and Climate, 2015, "Seizing the Global Opportunity: Partnerships for Better Growth and a Better Climate," available at http://2015.newclimateeconomy.report/wp-content/uploads/2014/08/NCE-2015_Seizing-the-Global-Opportunity_web.pdf.

²⁹ The Global Commission on the Economy and Climate. 2014. "Better Growth, Better Climate." (Chapter 5, Economics of Change, p.3.) Accessible at: <http://newclimateeconomy.report/>.

³⁰ See the literature review and original research in USEPA, National Center for Environmental Economics. 2012. *Retrospective Study of the Costs of EPA Regulations: An Interim Report of Five Case Studies*. Accessible at: [http://yosemite.epa.gov/sab/sabproduct.nsf/368203f97a15308a852574ba005bbd01/3A2CA322F56386FA852577BD0068C654/\\$File/Retrospective+Cost+Study+3-30-12.pdf](http://yosemite.epa.gov/sab/sabproduct.nsf/368203f97a15308a852574ba005bbd01/3A2CA322F56386FA852577BD0068C654/$File/Retrospective+Cost+Study+3-30-12.pdf). See also: Ruth Greenspan Bell, For EPA Regulations, Cost Predictions Are Overstated, November 17, 2010. Available at: <http://www.wri.org/blog/2010/11/epa-regulations-cost-predictions-are-overstated>.

³¹ U.S. Energy Information Administration. *Annual Energy Outlook 2014*.

³² See <http://sciencebasedtargets.org/companies-taking-action>

³³ Fact Sheet: White House Announces Commitments to the American Business Act on Climate Pledge." October 19, 2015. Accessed November 13, 2015, <https://www.whitehouse.gov/the-press-office/2015/10/19/fact-sheet-white-house-announces-commitments-american-business-act>

³⁴ Major U.S. banks call for leadership in addressing climate change." September 28, 2015. Ceres. Accessed November 13, 2015, <http://www.ceres.org/press/press-releases/major-u.s.-banks-call-for-leadership-in-addressing-climate-change>

³⁵ Carbon Disclosure Project, 2015, "Putting a Price on Risk: Carbon Pricing in the Corporate World," Available at <https://www.cdp.net/CDPResults/carbon-pricing-in-the-corporate-world.pdf>

³⁶ U.S. Energy Information Administration, "Analysis of the Clean Power Plan", 2015, Table 3, p. 24. Available at: <http://www.eia.gov/analysis/requests/powerplants/cleanplan/>.

³⁷ U.S. Environmental Protection Agency, "Regulatory Impact Analysis for the Proposed Carbon Pollution Guidelines for Existing Power Plants and Emission Standards for Modified and Reconstructed Power Plants", RIA, Table ES-10, p. ES-23.

³⁸ See Fifth Assessment Report of the Intergovernmental Panel on Climate Change. Available at: https://unfccc.int/science/workstreams/cooperation_with_the_ipcc/items/8732.php.

³⁹ WRI. 2014. "CAIT 2.0, 2014, Climate Analysis Indicators Tool: WRI's Climate Data Explorer." Washington, DC: World Resources Institute. Accessible at: <http://cait2.wri.org>. International Energy Agency. 2015. "Global energy-related emissions of carbon dioxide stalled in 2014." Accessible at: <http://www.iea.org/newsroomandevents/news/2015/march/global-energy-related-emissions-of-carbon-dioxide-stalled-in-2014.html>. U.S. Environmental Protection Agency. 2012. "Global Anthropogenic Non-CO2 Greenhouse Gas Emissions: 1990-2030." Accessible at: <http://www.epa.gov/climatechange/EPAactivities/economics/nonco2projections.html>. Between 2005 and 2011, global GHG emissions increased by roughly 13 percent and it is unclear what trend emissions will follow in the future. While preliminary data from the International Energy Agency suggests that energy-related CO2 emissions stalled in 2014 (the first time in 40 years a halt or reduction in emissions was not tied to an economic downturn), non-CO2 GHG emissions will continue to rise nearly 44 percent above 2005 levels by 2030, according to data from the U.S. Environmental Protection Agency. In 2011, non-CO2 emissions accounted for about 27 percent of global GHG emissions.

⁴⁰ M. Burke, S. Hsian, E. Miguel, "Global non-linear effect of temperature on economic production," *Nature*. Available at: https://dl.dropboxusercontent.com/u/3011470/Publications/nature15725_withSI.pdf.

⁴¹ The Global Commission on the Economy and Climate. 2014. "Better Growth, Better Climate." Accessible at: <http://newclimateeconomy.report/>.

⁴² T. Litman, 2015, "Analysis of Public Policies that Unintentionally Encourage and Subsidize Urban Sprawl." New Climate Economy and Victoria Transport Policy Institute. Available at: <http://static.newclimateeconomy.report/wp-content/uploads/2015/03/public-policies-encourage-sprawl-nce-report.pdf>

- ⁴³ A. Doukas, 2015, "G20 Subsidies to oil, gas, and coal production: United States," Overseas Development Institute and Oil Change International. Available at: <http://www.odi.org/sites/odi.org.uk/files/odi-assets/publications-opinion-files/9979.pdf>
- ⁴⁴ Available at: <http://www2.epa.gov/cira>.
- ⁴⁵ National Oceanic and Atmospheric Administration, National Climatic Data Center. 2014. "Global Analysis- Annual 2014." Accessible at: <http://www.ncdc.noaa.gov/sotc/global/>.
- ⁴⁶ Forbes Tompkins and Christina DeConcini. 2015. "2014: A Year of Temperature Records and Landmark Climate Findings." Accessible at: http://www.wri.org/sites/default/files/2014_Temperature_Records_and_Landmark_Climate_Findings_fact_sheet.pdf. N. Bianco, K. Meek, R. Gasper, M. Obeiter, S. Forbes, and N. Aden. 2014. "Seeing is Believing: Creating a New Climate Economy in the United States." Working Paper. Washington, DC: World Resources Institute. Accessible at: <http://www.wri.org/publication/new-climate-economy>.
- ⁴⁷ F. Tompkins and C. DeConcini. 2015. "2014: A Year of Temperature Records and Landmark Climate Findings." Accessible at: http://www.wri.org/sites/default/files/2014_Temperature_Records_and_Landmark_Climate_Findings_fact_sheet.pdf. N. Bianco, K. Meek, R. Gasper, M. Obeiter, S. Forbes, and N. Aden. 2014. "Seeing is Believing: Creating a New Climate Economy in the United States." Working Paper. Washington, DC: World Resources Institute. Accessible at: <http://www.wri.org/publication/new-climate-economy>.
- ⁴⁸ National Oceanic and Atmospheric Administration, National Climate Data Center. "Billion-Dollar Weather and Climate Disasters: Overview." Accessible at: <http://www.ncdc.noaa.gov/billions/>.
- Munich RE. 2014. "Loss Events Worldwide 1980–2013." Accessible at: http://www.munichre.com/site/wrap/get/documents_E-736590296/mram/assetpool.munichreamerica.wrap/PDF/2013/1980_2013_events.pdf.
- ⁴⁹ NOAA, 2014, "Billion-Dollar Weather and Climate Disasters: Table of Events" Available at: <https://www.ncdc.noaa.gov/billions/events>
- ⁵⁰ Munich RE. 2014. "Loss Events Worldwide 1980–2013." Accessible at: http://www.munichre.com/site/wrap/get/documents_E-736590296/mram/assetpool.munichreamerica.wrap/PDF/2013/1980_2013_events.pdf.
- ⁵¹ A. Benfield. "2014 Annual Global Climate and Catastrophe Report: Impact Forecasting." Accessible at: http://thoughtleadership.aonbenfield.com/Documents/20150113_ab_if_annual_climate_catastrophe_report.pdf
- ⁵² Risky Business, 2015. Available at: <http://riskybusiness.org/>.
- ⁵³ CNA Military Advisory Board, "National Security and the Accelerating Risks of Climate Change." Alexandria, VA: CNA Corporation, 2014.
- ⁵⁴ The Global Commission on the Economy and Climate. 2014. "Better Growth, Better Climate." Accessible at: <http://newclimateeconomy.report/>.
- ⁵⁵ U.S. Department of Energy. 2014. "Photovoltaic System Pricing Trends: Historical, Recent, and Near-Term Projections." *SunShot*. Accessible at: <http://www.nrel.gov/docs/fy14osti/62558.pdf>. R. Wiser and M. Bolinger. 2014. "2013 Wind Technologies Market Report." Lawrence Berkeley National Laboratory. Accessible at: http://emp.lbl.gov/sites/all/files/2013_Wind_Technologies_Market_Report_Final3.pdf.
- ⁵⁶ Office of the Governor, Economic Development and Tourism, "The Texas Renewable Energy Industry", 2014 Available at: http://gov.texas.gov/files/ecodev/Renewable_Energy.pdf.
- ⁵⁷ U.S. Department of Energy. 2014. "Saving Energy and Money with Appliance and Equipment Standards in the United States." (chapter 2) Accessible at: <http://energy.gov/sites/prod/files/2014/05/f16/Saving%20Energy%20and%20Money2.pdf>. For state-specific examples of consumer savings due to efficiency programs, see N. Bianco, K. Meek, R. Gasper, M. Obeiter, S. Forbes, and N. Aden. 2014. "Seeing is Believing: Creating a New Climate Economy in the United States." Working Paper. Washington, DC: World Resources Institute. Accessible at: <http://www.wri.org/publication/new-climate-economy>.
- ⁵⁸ Since 2000 the United States has primarily built lower carbon resources, constructing 249 gigawatts (GW) of gas, along with 57 GW of wind, and only 18 GW of coal. This includes new capacity built for the electric utility sector and independent power producers between 2000 and 2012. See U.S. Energy Information Administration. "Form EIA-860 2012." Accessible at: <http://www.eia.gov/electricity/data/eia860/>. U.S. Energy Information

- Administration. 2014. *Monthly Energy Review*. (June) Accessible at: http://www.eia.gov/totalenergy/data/monthly/pdf/sec12_9.pdf.
- ⁵⁹ N. Bianco, K. Meek, R. Gasper, M. Obeiter, S. Forbes, and N. Aden. 2014. "Seeing is Believing: Creating a New Climate Economy in the United States." Working Paper. Washington, DC: World Resources Institute. Accessible at: <http://www.wri.org/publication/new-climate-economy>.
- ⁶⁰ N. Bianco, K. Meek, R. Gasper, M. Obeiter, S. Forbes, and N. Aden. 2014. "Seeing is Believing: Creating a New Climate Economy in the United States." Working Paper (p. 72). Washington, DC: World Resources Institute. Accessible at: <http://www.wri.org/publication/new-climate-economy>.
- ⁶¹ The Global Commission on the Economy and Climate. 2014. "Better Growth, Better Climate." Accessible at: <http://newclimateeconomy.report/>.
- ⁶² U.S. Energy Information Administration, "Table 12.6 Carbon Dioxide Emissions From Energy Consumption: Electric Power Sector," *Monthly Energy Review*, August 2014, accessible at http://www.eia.gov/totalenergy/data/monthly/pdf/sec12_9.pdf.
- ⁶³ Shakeb Afsah and Kendyl Salcito, "Demand Reduction Slashes US CO₂ Emissions in 2012," CO₂ Scorecard, May 2013, accessible at: <http://co2scorecard.org/home/researchitem/27>.
- ⁶⁴ Since 2000 the United States has primarily built lower carbon resources, constructing 249 gigawatts (GW) of gas, along with 57 GW of wind, and only 18 GW of coal. Includes new capacity built for the electric utility sector and independent power producers between 2000 and 2012. See U.S. Energy Information Administration, Form EIA-860 2012, accessible at <http://www.eia.gov/electricity/data/eia860/>.
- ⁶⁵ U.S. Energy Information Administration. "Table 6.7.A. Capacity Factors for Utility Scale Generators Primarily Using Fossil Fuels, January 2008-2013-2014-March 2015," *Electric Power Monthly*, May 2015, accessible at http://www.eia.gov/electricity/monthly/epm_table_grapher.cfm?t=epmt_6_07_a.
- ⁶⁶ Power sector data from 2012 for capacity, generation, and CO₂ emissions by technology type from *Annual Energy Outlook 2014* Reference Case detailed outputs provided by the U.S. Energy Information Administration.
- ⁶⁷ U.S. Energy Information Administration, "Table 12.6 Carbon Dioxide Emissions From Energy Consumption: Electric Power Sector," *Monthly Energy Review*, August 2014, accessible at http://www.eia.gov/totalenergy/data/monthly/pdf/sec12_9.pdf.
- ⁶⁸ International Energy Agency, "World Energy Outlook 2015." 2015. OECD/IEA: Paris.
- ⁶⁹ Bob Fagan, Patrick Luckow, David White, and Rachel Wilson, 2013, "The Net Benefits of Increased Wind Power in PJM," Synapse Energy Economics, Inc., May, accessible at <http://www.synapse-energy.com/Downloads/SynapseReport.2013-05.EFC.Increased-Wind-Power-in-PJM.12-062.pdf>; Bob Fagan, Max Chang, Patrick Knight, Melissa Schultz, Tyler Comings, Ezra Hausman, and Rachel Wilson, 2012, "The Potential Rate Effects of Wind Energy and Transmission in the Midwest ISO Region," Synapse Energy Economics, Inc., May, accessible at <http://cleanenergytransmission.org/wp-content/uploads/2012/05/Full-Report-The-Potential-Rate-Effects-of-Wind-Energy-and-Transmission-in-the-Midwest-ISO-Region.pdf>; D. Lew, and G. Brinkman, 2013, "The Western Wind and Solar Integration Study Phase 2: Executive Summary," National Renewable Energy Laboratory, September, accessible at <http://www.nrel.gov/docs/fy13osti/58798.pdf>;
- Ryor and Tawney, 2014, "Shifting to Renewable Energy Can Save U.S. Consumers Money."
- ⁷⁰ Grand River Dam Authority, September 2014, "With potential to save customers \$50 million over the project's lifetime ... GRDA signs 100 MW renewable energy purchase agreement with Apex Clean Energy," <http://www.grda.com/with-potential-to-save-customers-50-million-over-the-projects-lifetime-grda-signs-100-mw-renewable-energy-purchase-agreement-with-apex-clean-energy/>.
- ⁷¹ DTE Energy's Renewable Energy Plan Surcharge (REPS) recovers the cost of incorporating renewable sources in DTE Energy's generation mix. Improvements in technology for wind and solar as well as federal production tax credits have allowed for a considerable decrease of this monthly surcharge, lowering rates by approximately 2.5 percent. See DTE Energy, "Residential Electric Rates," accessible at <http://bit.ly/1nDq0yG>; and DTE Energy, "DTE Energy to Lower Rates for Electric Customers," December 20, 2013, accessible at <https://dteenergy.mediaroom.com/2013-12-20-DTE-Energy-to-lower-rates-for-electric-customers>.
- ⁷² Eric Wesoff, "Austin Energy Switches From SunEdison to Recurrent for 5-Cent Solar," GreenTech Media, May 2014, accessible at <http://www.greentechmedia.com/articles/read/Austin-Energy-Switches-From-SunEdison-to-Recurrent-For-5-Cent-Solar>.

- ⁷³ MidAmerican Energy, "MidAmerican Energy Announces \$1.9 Billion Investment in Additional Wind Generation Capacity," May 8 2013, accessible at http://www.midamericanenergy.com/wind_news_article.aspx?id=634.
- ⁷⁴ For example, PJM, National Renewable Energy Laboratory (NREL) for the Western United States, and the state of Michigan have all found that 30-35 percent of electricity could be generated using variable renewable resources with minimal cost. See GE Energy Consulting, "PJM Renewable Integration Study Executive Summary Report," Revision 05, 2014, accessible at <http://pjm.com/~media/committees-groups/task-forces/irtf/postings/pris-executive-summary.aspx>; GE Energy, Prepared for National Renewable Energy Laboratory, 2010, "Western Wind and Solar Integration Study," accessible at <http://www.nrel.gov/docs/fy10osti/47434.pdf>; J.D. Quackenbush and S. Bakkal, 2013, "Readying Michigan to Make Good Energy Decisions: Renewable Energy," Michigan Public Service Commission, Licensing and Regulatory Affairs. Michigan Economic Development Corporation, accessible at http://www.michigan.gov/documents/energy/renewable_final_438952_7.pdf. L. Bird, M. Milligan, and D. Lew, 2013, "Integrating Variable Renewable Energy: Challenges and Solutions," Technical Report, National Renewable Energy Laboratory, September, accessible at <http://www.nrel.gov/docs/fy13osti/60451.pdf>.
- ⁷⁵ Bird, et al., "Integrating Variable Renewable Energy: Challenges and Solutions."
- ⁷⁶ According to DOE, "more than 2,300 circuit miles of new transmission additions were constructed per year, with an additional 18,700 circuit miles planned over the next five years. By comparison, transmission was being constructed at a rate of about 1,000 circuit miles per year as recently as five years ago" Ryan Wiser and Mark Bolinger, "2012 Wind Technologies Market Report," U.S. Department of Energy, Office of Energy Efficiency and Renewable Energy, accessible at <http://emp.lbl.gov/sites/all/files/lbnl-6356e.pdf>, Bird et al., "Integrating Variable Renewable Energy: Challenges and Solutions."
- ⁷⁷ R. Wiser and M. Bolinger. "2013 Wind Technologies Market Report." Lawrence Berkeley National Laboratory. Accessible at: http://emp.lbl.gov/sites/all/files/2013_Wind_Technologies_Market_Report_Final3.pdf.
- ⁷⁸ American Wind Energy Association has identified near-term transmission projects which could integrate almost 70 gigawatts of additional wind capacity if all projects were completed. See Wiser and Bolinger, "2012 Wind Technologies Market Report."
- ⁷⁹ For more information, see M. M. Hand, S. Baldwin, E. DeMeo, J. M. Reilly, T. Mai, D. Arent, G. Porro, M. Meshek, D. Sandor (eds.), *Renewable Electricity Futures Study*, 4 vols. NREL/TP-6A20-52409, Golden, CO: National Renewable Energy Laboratory, accessible at http://www.nrel.gov/analysis/re_futures/.
- ⁸⁰ U.S. Energy Information Administration, "Table 7.2b Electricity Net Generation: Electric Power Sector," *Monthly Energy Review*, August 2014, accessible at <http://www.eia.gov/totalenergy/data/monthly/index.cfm>.
- ⁸¹ U.S. Environmental Protection Agency, "Carbon Pollution Emission Guidelines for Existing Stationary Sources: Electric Utility Generating Units," Proposed Rule, pp. 151–52, June 18, 2014, accessible at <http://www.gpo.gov/fdsys/pkg/FR-2014-06-18/pdf/2014-13726.pdf>.
- ⁸² According to EIA, four nuclear units closed in 2013 with additional closures announced for 2014, including Entergy's Vermont Yankee plant. U.S. Energy Information Administration, 2014, "Table 8.1: Nuclear Energy Overview," *Monthly Energy Review*, June 2014, accessible at http://www.eia.gov/totalenergy/data/monthly/pdf/sec8_3.pdf; U.S. Energy Information Administration, "Vermont Yankee Nuclear Plant Closure in 2014 Will Challenge New England Energy Markets," September 6, 2013, accessible at <http://www.eia.gov/todayinenergy/detail.cfm?id=12851>.
- ⁸³ H. Northey, "Nuclear: Spate of Reactor Closures Threatens U.S. Climate Goals – DOE," *Greenwire*, February 5, 2014, E&E Publishing, LLC, accessible at <http://www.eenews.net/greenwire/stories/1059994082>; P. Maloney, "Power Price Recovery May Be too Late to Aid Its Nuclear Plants: Exelon Exec," *Platts.com*, April 9, 2014, McGraw Hill Financial, Las Vegas, accessible at <http://www.platts.com/latest-news/electric-power/lasvegas/power-price-recovery-may-be-too-late-to-aid-its-21452315>.
- ⁸⁴ U.S. Environmental Protection Agency, "Carbon Pollution Emission Guidelines for Existing Stationary Sources: Electric Utility Generating Units" Final Rule, October 23, 2015, accessible at <http://www.gpo.gov/fdsys/pkg/FR-2015-10-23/pdf/2015-22842.pdf>
- ⁸⁵ Union of Concerned Scientists. 2014. *Climate Game Changer*. Accessible at: www.ucsusa.org/sites/default/files/legacy/assets/documents/global_warming/Carbon-Standards-Analysis-Union-of-Concerned-Scientists.pdf.
- ⁸⁶ M. M. Hand, S. Baldwin, E. DeMeo, J. M. Reilly, T. Mai, D. Arent, G. Porro, M. Meshek, and D. Sandor (eds.), *Renewable Electricity Futures Study*. 4 vols. NREL/TP-6A20-52409. Golden, CO: National Renewable Energy

Laboratory. Accessible at: <http://www.nrel.gov/analysis/re_futures/>. Natural Resources Defense Council. 2014. "Cleaner and Cheaper: Using the Clean Air Act to Sharply Reduce Carbon Pollution from Existing Power Plants, Delivering Health, Environmental, and Economic Benefits." Accessible at: <<http://www.nrdc.org/air/pollution-standards/files/pollution-standards-1B-update.pdf>>. Union of Concerned Scientists. 2014. *Climate Game Changer*. Accessible at: http://www.ucsusa.org/sites/default/files/legacy/assets/documents/global_warming/Carbon-Standards-Analysis-Union-of-Concerned-Scientists.pdf.

⁸⁷ U.S. Department of Energy. 2014. "Saving Energy and Money with Appliance and Equipment Standards in the United States." Accessible at: <<http://energy.gov/sites/prod/files/2014/05/f16/Saving%20Energy%20and%20Money2.pdf>>.

⁸⁸ Unpublished data provided by Energy Efficiency Standards Group, Lawrence Berkeley National Laboratory. See S. Meyers, et al. 2013. "Energy and Economic Impacts of U.S. Federal Energy and Water Conservation Standards." Accessible at: <http://eetd.lbl.gov/sites/all/files/standards_1987-2012_impacts_overview_lbnl-6217e.pdf>.

⁸⁹ U.S. Department of Energy (DOE). 2014. "Energy Conservation Standards Activities Report to Congress."

Washington, DC: U.S. Department of Energy. Accessible at:

<<http://energy.gov/sites/prod/files/2014/08/f18/16th%20Semi-Annual%20Report%20to%20Congress%20on%20Appliance%20Energy%20Efficiency%20Rulemakings.pdf>>.

⁹⁰ N. Bianco, K. Meek, R. Gasper, M. Obeiter, S. Forbes, and N. Aden. 2014. "Seeing is Believing: Creating a New Climate Economy in the United States." Working Paper (Chapter 2). Washington, DC: World Resources Institute. Accessible at: <<http://www.wri.org/publication/new-climate-economy>>.

⁹¹ Levelized costs are amortized over the lifetime of the energy resource and discounted back to the year in which the costs are paid and the actions are taken. Costs represent national averages. For more details see American Council for an Energy-Efficient Economy, 2014, *The Best Value for America's Energy Dollar: A National Review of the Cost of Utility Energy Efficiency Programs*, accessible at <http://www.aceee.org/sites/default/files/publications/researchreports/u1402.pdf>.

⁹² For a more detailed analysis of cost of saved energy across efficiency program types and regions of the United States, see Lawrence Berkeley National Laboratory, 2014, "The Program-Administrator Cost of Saved Energy for Utility Customer-Funded Energy Efficiency Programs." This analysis found a national average electricity cost of saved energy of about two cents per kilowatt-hour from 2009 through 2011 when gross savings and spending were aggregated at the national level and the cost of saved energy was weighted by savings. The study noted wide variation for results across efficiency program types.

⁹³ U.S. Energy Information Administration (EIA). 2015. "Annual Energy Outlook 2015 – with projections to 2040." Accessible at: <<http://www.eia.gov/forecasts/aeo/>>.

⁹⁴ Energy Information Administration, Monthly Energy Review, <http://www.eia.gov/totalenergy/data/monthly/>.
⁹⁵ Unpublished data provided by Energy Efficiency Standards Group, Lawrence Berkeley National Laboratory. See Lawrence Berkeley National Laboratory, 2013, "Energy and Economic Impacts of U.S. Federal Energy and Water Conservation Standards Adopted from 1987 through 2012," accessible at http://eetd.lbl.gov/sites/all/files/standards_1987-2012_impacts_overview_lbnl-6217e.pdf.

⁹⁶ For example, see U.S. Department of Energy, "Revolution Now: The Future Arrives for Four Clean Energy Technologies," accessible at <http://energy.gov/sites/prod/files/2013/09/f2/Revolution%20Now%20-%20The%20Future%20Arrives%20for%20Four%20Clean%20Energy%20Technologies.pdf>; and E. Perratore, "LG's New Dryer Saves Energy and Money: Uses a Hybrid Heat Pump to Recycle Wasted Heat," *Consumer Reports*, January 14, accessible at <http://www.consumerreports.org/cro/news/2014/01/lg-s-new-dryer-saves-energy-and-money/index.htm>.

⁹⁷ Projections based on 100-percent state adoption of moderate and aggressive building codes, increased stringency of existing appliance standards, and adoption of appliance standards for new products. For more details, see Institute for Electric Innovation (IEE), an institute of the Edison Foundation, 2013, "Factors Affecting Electricity Consumption in the United States (2010-2035)," March, Edison Foundation, accessible at: http://www.edisonfoundation.net/iei/Documents/IEE_FactorsAffectingUSElecConsumption_Final.pdf.

⁹⁸ There is no single definition of "energy efficiency resource standards." The 24 states include those that set mandatory, long-term targets for electricity, either as part of a specific standard (with sufficient funding to achieve these targets according to the American Council for an Energy-Efficient Economy), a combined renewable portfolio

standard and efficiency standard, or an “all cost-effective” energy policy, and are sufficiently funded to meet these targets. For more details, see <http://aceee.org/sites/default/files/publications/researchreports/u1403.pdf>.

⁹⁹ Estimate made using an updated version of the World Resources Institute’s emission model described in “Can the U.S. Get There From Here?” For details about the model, see Bianco et al., 2013, “Can the U.S. Get There from Here?”

¹⁰⁰ U.S. Department of Energy, U.S., Building Energy Codes Program, 2013, “National Benefits Assessment 1992-2040,” accessible at <http://assets.fiercemarkets.com/public/sites/energy/reports/usdebuildingcodereport.pdf>.

¹⁰¹ U.S. Department of Energy (DOE), 2014, Building Energy Codes Program: “Status of State Energy Code Adoption,” July, U.S. DOE Office of Energy Efficiency & Renewable Energy, accessible at <http://www.energycodes.gov/adoption/states>.

¹⁰² Appliance Standards and Rulemaking Federal Advisory Committee Commercial Package Air Conditioners and Commercial Warm Air Furnaces, Working Group Term Sheet, June 15, 2015, http://www.appliance-standards.org/sites/default/files/Term_Sheet_FINAL_June152015.pdf.

¹⁰³ Natural Resources Defense Council, Major Agreement for Rooftop Air Conditioners Will Lead to Biggest Energy Savings Yet, June 15, 2015, http://switchboard.nrdc.org/blogs/mwaltner/major_agreement_for_rooftop_ai.html.

⁷⁴ A New Buildings Institute review of nine projects across the country showed that deep commercial retrofits are capable of reducing energy use by 30 percent or more, cutting energy costs in half, and elevating building performance to 50 percent better than the national average. See New Buildings Institute, 2011, “A Search for Deep Energy Savings,” August, accessible at:

http://newbuildings.org/sites/default/files/NEEA_Meta_Report_Deep_Savings_NBI_Final8152011.pdf. Residential retrofits through DOE’s Building America program—which aims to reduce energy use in new and existing homes 50 percent by 2017 through cost-effective measures—demonstrate that it is possible to bring existing building performance up to the same standard as best-in-class new construction. Homes in the program demonstrated average energy savings of nearly 60 percent, with some homes reaching as high as 90 percent improvement. Accessible at:

http://apps1.eere.energy.gov/buildings/publications/pdfs/building_america/der_pilot_mass_rhodeisland.pdf.

¹⁰⁴ A New Buildings Institute review of nine projects across the country showed that deep commercial retrofits are capable of reducing energy use by 30 percent or more, cutting energy costs in half, and elevating building performance to 50 percent better than the national average. See New Buildings Institute, 2011, “A Search for Deep Energy Savings,” August, accessible at

http://newbuildings.org/sites/default/files/NEEA_Meta_Report_Deep_Savings_NBI_Final8152011.pdf. Residential retrofits through DOE’s Building America program—which aims to reduce energy use in new and existing homes 50 percent by 2017 through cost-effective measures—demonstrate that it is possible to bring existing building performance up to the same standard as best-in-class new construction. Homes in the program demonstrated average energy savings of nearly 60 percent, with some homes reaching as high as 90 percent improvement.

See http://apps1.eere.energy.gov/buildings/publications/pdfs/building_america/der_pilot_mass_rhodeisland.pdf.

¹⁰⁵ H. C. Granade, J. Creyts, A. Derkach, P. Farese, S. Nyquist, and K. Ostrowski, 2009, “Unlocking Energy Efficiency in the U.S. Economy,” July 2009, McKinsey Global Energy and Materials, accessible at

http://www.greenbuildinglawblog.com/uploads/file/mckinseyUS_energy_efficiency_full_report.pdf.

National Academy of Sciences, National Academy of Engineering, and National Research Council, 2010, “Real Prospects for Energy Efficiency in the United States,” The National Academies Press, Washington, DC, accessible at http://www.nap.edu/openbook.php?record_id=12621.

¹⁰⁶ U.S. Environmental Protection Agency. 2013. “Light-Duty Automotive Technology, Carbon Dioxide Emissions, and Fuel Economy Trends: 1975 Through 2013.” Accessible at: <http://www.epa.gov/fueleconomy/fetrends/1975-2013/420r13011.pdf>.

¹⁰⁷ U.S. Environmental Protection Agency. 2015. “GHG Emission Standards for Light-Duty Vehicles: Manufacturer Performance Report for the 2013 Model Year.” Accessible at: <http://www.epa.gov/otaq/climate/ghg-report.htm>. Nic Lutsey. 2015. “Do the automakers really need help with the U.S. efficiency standards?” The International Council on Clean Transportation. Accessible at: <http://theicct.org/blogs/staff/do-automakers-really-need-help-us-efficiency-standards>.

¹⁰⁸ The Department of Energy has a target of reducing the cost for long-range electric vehicle batteries from \$500 per kilowatt hour in 2012 to \$125 per kilowatt hour by 2022 (U.S. Department of Energy, 2013, “EV Everywhere Grand Challenge Blueprint,” accessible at:

http://energy.gov/sites/prod/files/2014/02/f8/everywhere_blueprint.pdf). At this price point, along with other concomitant advancements, DOE expects long-range (280 miles) electric vehicles to be cost-competitive with internal combustion engines (on a leveled total cost of ownership basis over five years). DOE notes that shorter-range electric vehicles and plug-in hybrids would likely become cost-competitive before this price point for long-range electric vehicle batteries is met. Tesla Motors recently announced plans to build facilities by 2017 to produce large electric vehicle batteries that are 30 percent cheaper than today's batteries (around \$190 per kilowatt hour, assuming current reported prices, see Chapter 3 for additional discussion).

¹⁰⁹ B. Davis and P. Baxandall. 2013. "Transportation in Transition: A Look at Changing Travel Patterns in America's Biggest Cities." U.S. PIRG Education Fund and Frontier Group. Accessible at: http://www.uspirg.org/sites/pirg/files/reports/US_Transp_trans_scrn.pdf.

¹¹⁰ For a review of existing and potential new opportunities for federal action in these areas, see: U.S. Department of Energy. 2013. Effects of the Built Environment on Transportation: Energy Use, Greenhouse Gas Emissions, and Other Factors. Accessible at, <http://www.nrel.gov/docs/fy13osti/55634.pdf>.

¹¹¹ U.S. Environmental Protection Agency and Department of Transportation. 2011. "EPA and NHTSA Adopt First-Ever Program to Reduce Greenhouse Gas Emissions and Improve Fuel Efficiency of Medium- and Heavy Duty Vehicles." Accessible at: <http://www.epa.gov/otaq/climate/documents/420f11031.pdf>. U.S. Environmental Protection Agency and National Highway Traffic Safety Administration. 2011. "Final Rulemaking to Establish Greenhouse Gas Emissions Standards and Fuel Efficiency Standards for Medium- and Heavy-Duty Engines and Vehicles: Regulatory Impact Analysis." Accessible at: <http://www.epa.gov/otaq/climate/documents/420r11901.pdf>.

¹¹² U.S. Environmental Protection Agency and U.S. Department of Transportation, Greenhouse Gas Emissions and Fuel Efficiency Standards for Medium- and Heavy-Duty Engines and Vehicles - Phase 2, RIN 2060-AS16; RIN 2127-AL52, June 19, 2015, <http://www.epa.gov/oms/climate/documents/hd-ghg-fr-notice.pdf>.

¹¹³ ACEEE et al. (2014) found that many technologies could be used to achieve the highest level of reductions, including tractor aerodynamic enhancements and integration with the trailer, hybridization and electric drive, engine downsizing, dual-stage turbocharging, trailer aerodynamic enhancements, low rolling resistance tires, weight reduction, idle reduction, among other technologies that would improve engine, transmission and driveline, and vehicle and trailer performance. They also found that "a new truck that includes an advanced engine and transmission, new axle design, and improved aerodynamics to the tractor and trailer could save average tractor-trailer owners and drivers about \$30,000 per year in fuel. In 2025, these new efficiency technologies would increase truck purchase costs by about \$32,000, which is recovered by fuel savings in just 13 months." See: American Council for an Energy Efficient Economy, Environmental Defense Fund, Natural Resources Defense Council, Sierra Club, and Union of Concerned Scientists. 2014. "Big Fuel Savings Available in New Trucks." Accessible at: <http://aceee.org/files/pdf/fact-sheet/truck-savings-0614.pdf>.

¹¹⁴ United States Aviation Greenhouse Gas Emissions Reduction Plan, June 2012, https://www.faa.gov/about/office_org/headquarters_offices/api/environ_policy_guidance/policy/media/Aviation_Greenhouse_Gas_Emissions_Reduction_Plan.pdf

¹¹⁵ Federal Aviation Administration. 2012. *Next Gen Implementation Plan*. Accessible at: http://www.faa.gov/nextgen/implementation/media/NextGen_Implementation_Plan_2012.pdf.

¹¹⁶ U.S. Environmental Protection Agency, 40 CFR Parts 87 and 1068, Proposed Finding that Greenhouse Gas Emissions from Aircraft Cause or Contribute to Air Pollution that May Reasonably Be Anticipated to Endanger Public Health and Welfare and Advance Notice of Proposed Rulemaking, RIN 2060-AS31, June 10, 2015, <http://www.epa.gov/otaq/documents/aviation/aircraft-ghg-pr-anprm-2015-06-10.pdf>

¹¹⁷ U.S. Environmental Protection Agency, 2010, EPA Analysis of the Transportation Sector, <http://www.epa.gov/oms/climate/GHGtransportation-analysis03-18-2010.pdf>.

¹¹⁸ Total national energy use and GHG emissions are commonly classified into four end-use sectors: residential, commercial, industrial, and transportation. From an end-use perspective, industry includes energy transformation activities such as electricity generation, petroleum refining, and natural gas production. This assessment also includes overlapping analysis of these energy transformation activities as key areas for reducing U.S. GHG emissions.

¹¹⁹ See real (2009) value-added data at http://www.bea.gov/industry/gdpbyind_data.htm; emissions data from http://www.eia.gov/totalenergy/data/monthly/pdf/sec12_7.pdf.

- ¹²⁰ For examples from the U.S. pulp and paper sector, see Aden, et al. (2013) <http://pdf.wri.org/energy-efficiency-in-us-manufacturing-midwest-pulp-and-paper.pdf>
- ¹²¹ DOE. 2015. *Barriers to Industrial Energy Efficiency*. <http://energy.gov/eere/amo/articles/barriers-industrial-energy-efficiency-report-congress-released>
- ¹²² These emissions numbers include both direct emissions and indirect emissions attributable to electricity use. U.S. Energy Information Administration. "Table 12.4 Carbon Dioxide Emissions From Energy Consumption: Industrial Sector." *Electricity Power Monthly*. Accessible at: <http://www.eia.gov/totalenergy/data/monthly/>.
- ¹²³ For more information on emerging digital manufacturing technologies, see McKinsey's recent analysis at http://www.mckinsey.com/insights/manufacturing/manufacturings_next_act.
- ¹²⁴ DOE. 2015. *Annual Energy Outlook 2015 with Projections to 2014*. Accessible at, <http://www.eia.gov/forecasts/aeo/>
- ¹²⁵ DOE. 2015. *Barriers to Industrial Energy Efficiency*. <http://energy.gov/eere/amo/articles/barriers-industrial-energy-efficiency-report-congress-released>
- ¹²⁶ U.S. Energy Information Administration. "AEO 2014 Reference Case." Accessible at: <http://www.eia.gov/forecasts/aeo/>.
- ¹²⁷ For extensive discussion of barriers to U.S. industrial energy efficiency, see DOE. 2015. *Barriers to Industrial Energy Efficiency*. <http://energy.gov/eere/amo/articles/barriers-industrial-energy-efficiency-report-congress-released>.
- ¹²⁸ National Academy of Sciences, National Academy of Engineering, and National Research Council. 2010. "Real Prospects for Energy Efficiency in the United States." Washington, DC: National Academies Press (NAP). Accessible at: http://www.nap.edu/openbook.php?record_id=12621.
- ¹²⁹ <http://energy.gov/eere/amo/advanced-manufacturing-office>
- ¹³⁰ <http://arpa-e.energy.gov/>
- ¹³¹ <http://energy.gov/eere/amo/advanced-manufacturing-office>
- ¹³² Methane is the primary component of natural gas, but gas also has significant concentrations of volatile organic compounds—many of which are precursors to ground-level ozone formation. Hazardous air pollutants are present in unprocessed natural gas. For more information, see R. Lattanzio, "Air Quality Issues in Natural Gas Systems," Congressional Research Service, March 2013, accessible at <http://www.civil.northwestern.edu/docs/Tight-Shale-Gas-2013/Air-Quality-Issues-Natural-Gas-Ratner-2013.pdf>.
- ¹³³ According to the latest estimates from the Intergovernmental Panel on Climate Change, because it is a powerful but short-lived greenhouse gas, methane traps 34 times as much heat in the atmosphere as CO₂ over 100 years, and 86 times as much over 20 years. See G. Myhre and D. Shindell, "Anthropogenic and Natural Radiative Forcing," in *Climate Change 20013: The Physical Science Basis. Contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change*, Cambridge, UK: Cambridge University Press, accessible at http://www.climatechange2013.org/images/report/WG1AR5_Chapter08_FINAL.pdf.
- ¹³⁴ Here, "natural gas systems" refers to the production of natural gas from natural gas wells, as well as the processing, transmission, and distribution of that gas. Natural gas produced at oil wells is not included. Similarly, the end use of natural gas – for electricity generation, transportation, residential heating, or other purposes – is not included.
- ¹³⁵ ICF International, 2014, "Economic Analysis of Methane Emission Reduction Opportunities in the U.S. Onshore Oil and Natural Gas Industries," March, Fairfax, VA, accessible at http://www.edf.org/sites/default/files/methane_cost_curve_report.pdf.
- ¹³⁶ For more information on these technologies and practices, see Obeiter, M. and C. Weber. 2015. "Reducing Methane Emissions From Natural Gas Development: Strategies for State-Level Policymakers." Working Paper. Washington, DC: World Resources Institute. Accessible at: www.wri.org/publication/reducing-methane-emissions.
- ¹³⁷ U.S. Environmental Protection Agency, 2014, "Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990 – 2012. Chapter 3: Energy," April, EPA, Washington DC, accessible at <http://www.epa.gov/climatechange/ghgemissions/usinventoryreport.html>.
- ¹³⁸ S. Harvey, V. Gowrishankar, and T. Singer, 2012, "Leaking Profits: The U.S. Oil and Gas Industry Can Reduce Pollution, Conserve Resources, and Make Money by Preventing Methane Waste," March, Natural Resources Defense Council, New York, NY, accessible at <http://www.nrdc.org/energy/leaking-profits.asp>; and ICF International, 2014, "Economic Analysis of Methane Emission Reduction Opportunities in the U.S. Onshore Oil and

Natural Gas Industries," March, Fairfax, VA, accessible at http://www.edf.org/sites/default/files/methane_cost_curve_report.pdf.

¹³⁹ U.S. Environmental Protection Agency, "Oil and Natural Gas Sector: New Source Performance Standards and National Emission Standards for Hazardous Air Pollutants Reviews," accessible at <http://www.epa.gov/airquality/oilandgas/pdfs/20120417finalrule.pdf>.

¹⁴⁰ N. Fann, C.M. Fulcher, and B.J. Hubbell, "The Influence of Location, Source, and Emission Type in Estimates of Human Health Benefits of Reducing a Ton of Air Pollution," *Air Quality, Atmosphere, & Health*, September 2009: 169-76, accessible at <http://www.ncbi.nlm.nih.gov/pubmed/19890404>.

¹⁴¹ U.S. Environmental Protection Agency, 40 CFR Part 60 [EPA-HQ-OAR-2010-0505; FRL-9929-75-OAR], September 2015, "Oil and Natural Gas Sector: Emission Standards for New and Modified Sources," <http://www.gpo.gov/fdsys/pkg/FR-2015-09-18/pdf/2015-21023.pdf>

¹⁴² ICF International. 2014. "Economic Analysis of Methane Emission Reduction Opportunities in the U.S. Onshore Oil and Natural Gas Industries." Accessible at:

<http://www.edf.org/sites/default/files/methane_cost_curve_report.pdf>. For reference, the daily spot price for natural gas in 2014 ranged from \$2.81 to \$8.35 per thousand cubic feet, with an average price of \$4.48. See:

<<http://www.eia.gov/dnav/ng/hist/rngwhhdD.htm>>.

¹⁴³ N. Bianco, K. Meek, R. Gasper, M. Obeiter, S. Forbes, and N. Aden. 2014. "Seeing is Believing: Creating a New Climate Economy in the United States." Working Paper. Washington, DC: World Resources Institute. Accessible at: <<http://www.wri.org/publication/new-climate-economy>>.

¹⁴⁴ Coca-Cola Company, 2014, "Coca-Cola Installs 1 Millionth HFC-Free Cooler Globally, Preventing 5.25MM Metric Tons of CO₂," Press Release, January 22, accessible at <http://www.coca-colacompany.com/press-center/press-releases/coca-cola-installs-1-millionth-hfc-free-cooler-globally-preventing-525mm-metrics-tons-of-co2#TCCC>.

¹⁴⁵ Ibid.

¹⁴⁶ PepsiCo, "PepsiCo Debuts Energy-Efficient, HFC-Free Cooler at Super Bowl," Press Release, February 2010, accessible at <http://www.pepsico.com/Media/PressRelease/PepsiCo-Debuts-Energy-Efficient-HFC-Free-Cooler-at-Super-Bowl02022010.html>; Red Bull, "Efficient Cooling through Ecofriendly Coolers," accessible at

<http://energydrink.redbull.com/coolers>; Heineken, "2013 Sustainability Report," accessible at

<http://sustainabilityreport.heineken.com/The-big-picture/What-we-said-and-what-weve-done/index.htm>;

Hydrocarbons 21, "Heineken's Successful Rollout of HC Coolers- Exclusive Interview with Maarten ten Houten,"

December 2013, accessible at <http://www.hydrocarbons21.com/news/viewprintable/4760>; Ben & Jerry's,

"Experience with Natural Refrigerants," accessible at

http://www.atmo.org/presentations/files/124_3_Asch_Ben_n_Jerry.pdf.

¹⁴⁷ Honeywell, "Auto Industry Conversion Update," obtained from Thomas Morris, director of commercial

development, Honeywell, July 25, 2014.

¹⁴⁸ HFO-1234yf has a GWP of 4 whereas the current refrigerant, HFC-134a, has a GWP of 1,430. See U.S.

Environmental Protection Agency, "Final Rulemaking Protection of the Stratospheric Ozone: New Substitute in the

Motor Vehicle Air Conditioning Sector under the Significant New Alternatives Policy (SNAP) Program," Fact Sheet,

accessible at http://www.epa.gov/ozone/downloads/HFO-1234yf_Final_Fact_Sheet.pdf.

¹⁴⁹ Simon Warburton, "Honeywell Fights Back Against r1234yf Claims," Just Auto, May 2014, accessible at

http://www.just-auto.com/news/honeywell-fights-back-against-r1234yf-claims_id145919.aspx.

¹⁵⁰ DuPont, "Rapid Growth Expected in Adoption of HFO-1234yf," accessible at

http://us.vocuspr.com/Newsroom/MultiQuery.aspx?SiteName=DupontEMEA&Entity=PRASSET&SF_PRASSET_PRASSETID_EQ=128793&XSL=NewsRelease&IncludeChildren=True&Lang=English.

¹⁵¹ Michael Parr, federal government affairs manager, DuPont, personal communication, July 24, 2014.

¹⁵² Advance, unedited compilation of the decisions adopted by the Twenty-Seventh Meeting of the Parties to the

Montreal Protocol. Accessible at <[http://conf.montreal-protocol.org/meeting/mop/mop-](http://conf.montreal-protocol.org/meeting/mop/mop-27/report/SitePages/Home.aspx)

[27/report/SitePages/Home.aspx](http://conf.montreal-protocol.org/meeting/mop/mop-27/report/SitePages/Home.aspx)>

¹⁵³ U.S. Environmental Protection Agency. 2011. "EPA and NHTSA Adopt First-Ever Program to Reduce Greenhouse

Gas Emissions and Improve Fuel Efficiency of Medium- and Heavy-Duty Vehicles." Accessible at:

<<http://www.epa.gov/otaq/climate/documents/420f11031.pdf>>.

¹⁵⁴ U.S. Environmental Protection Agency. 2014. "Protection of Stratospheric Ozone Change of Listing Status for

Certain Substitutes under the Significant New Alternatives Policy Program." 40 CFR, Part 82. Accessible at: <

http://www3.epa.gov/ozone/downloads/SAN_5750_SNAP_Status_Change_Rule_NPRM_signature_version-signed_7-9-2014.pdf

¹⁵⁵ U.S. Environmental Protection Agency. 2015. "Protection of Stratospheric Ozone: Change of Listing Status for Certain Substitutes Under the Significant New Alternatives Policy Program; Final Rule." Accessible at:

<http://www.gpo.gov/fdsys/pkg/FR-2015-07-20/pdf/2015-17066.pdf>.

¹⁵⁶ U.S. Environmental Protection Agency. 2015. "Protection of Stratospheric Ozone: Update to the Refrigerant Management Requirements under the Clean Air Act." Available at:

<http://www2.epa.gov/sites/production/files/2015-10/documents/608proposal.pdf>.

¹⁵⁷ Available at: < <http://www.usda.gov/wps/portal/usda/usdahome?contentidonly=true&contentid=climate-smart.html>>.

¹⁵⁸ UNFCCC, 2015, "INDCs as communicated by Parties", accessible at

<http://www4.unfccc.int/submissions/indc/Submission%20Pages/submissions.aspx>.

¹⁵⁹ OCN/CAIT Climate Data Explorer, 2015, "Paris Contributions Map", accessible at <http://cait.wri.org/indc/>. Last accessed November 10, 2015.

¹⁶⁰ WRI, "What Effect Will National Climate Plans (INDCs) Have on Global Emissions? 5 Things to Know", Blog, October 30, 2015, accessible at <http://www.wri.org/blog/2015/10/what-effect-will-national-climate-plans-indcs-have-global-emissions-5-things-know>.

¹⁶¹ UNFCCC, 2015, "Synthesis report on the aggregate effect of INDcs", accessible at

http://unfccc.int/focus/indc_portal/items/9240.php.

¹⁶² WRI, "What Effect Will National Climate Plans (INDCs) Have on Global Emissions? 5 Things to Know", Blog, October 30, 2015, accessible at <http://www.wri.org/blog/2015/10/what-effect-will-national-climate-plans-indcs-have-global-emissions-5-things-know>. WRI, CAIT Climate Data Explorer, Pre-2020 Pledges Map, accessible at <<http://cait.wri.org/pledges>>.

¹⁶³ WRI, "National Climate Plans (INDCs), by the Numbers", Blog, October 30, 2015, accessible at

<http://www.wri.org/blog/2015/10/national-climate-plans-indcs-numbers>.

¹⁶⁴ UNFCCC, 2015, "INDCs as communicated by Parties", accessible at

<http://www4.unfccc.int/submissions/indc/Submission%20Pages/submissions.aspx>.

¹⁶⁵ WRI, OCN/CAIT Climate Data Explorer, Pre-2020 Pledges Map, accessible at <<http://cait.wri.org/pledges>>.

¹⁶⁶ WRI, "Total Renewable Energy from 8 Top GHG Emitters Set to Double by 2030", Blog, Nov 5, 2015, accessible at <http://www.wri.org/blog/2015/11/total-renewable-energy-8-top-ghg-emitters-set-double-2030>.

¹⁶⁷ WRI, 2015, "Assessing the Post-2020 Clean Energy Landscape", accessible at

<http://www.wri.org/publication/clean-energy-landscape>.

¹⁶⁸ WRI, OCN/CAIT Climate Data Explorer, 2015, "Paris Contributions Map", accessible at <http://cait.wri.org/indc/>

¹⁶⁹ WRI, "National Climate Plans (INDCs), by the Numbers", Blog, October 30, 2015, accessible at

<http://www.wri.org/blog/2015/10/national-climate-plans-indcs-numbers>.

¹⁷⁰ WRI, "What Effect Will National Climate Plans (INDCs) Have on Global Emissions? 5 Things to Know", Blog,

October 30, 2015, accessible at <http://www.wri.org/blog/2015/10/what-effect-will-national-climate-plans-indcs-have-global-emissions-5-things-know>.

¹⁷¹ White House Office of the Press Secretary, "FACT SHEET: U.S.-China Joint Announcement on Climate Change and Clean Energy Cooperation" (November 11, 2014) <http://www.whitehouse.gov/the-press-office/2014/11/11/fact-sheet-us-china-joint-announcement-climate-change-and-clean-energy-c>

¹⁷² "Enhanced Actions on Climate Change: China's Intended Nationally Determined Contributions", submitted to UNFCCC June 30, 2015 (scroll to page 17 for English translation)

<http://www4.unfccc.int/submissions/INDC/Published%20Documents/China/1/China's%20INDC%20-%20on%2030%20June%202015.pdf>

¹⁷³ "U.S.-China Climate Leaders' Declaration", On the Occasion of the First Session of the U.S.-China Climate-Smart/Low-Carbon Cities Summit, Los Angeles, CA, September 15-16, 2015

https://www.whitehouse.gov/sites/default/files/us_china_climate_leaders_declaration_9_14_15_730pm_final.pdf

¹⁷⁴ White House Office of the Press Secretary, "Fact Sheet: U.S.-China Climate Leaders Summit" (September 15, 2015) <https://www.whitehouse.gov/the-press-office/2015/09/15/fact-sheet-us-%E2%80%93-china-climate-leaders-summit>

- ¹⁷⁵ "Assessing Implementation of China's Climate Policies in the 12th 5-Year Period, Ranping Song, Wenjuan Dong, Jingjing Zhu, Xiaofan Zhao, and Yufei Wang." Working Paper, 2015. Washington, DC: World Resources Institute. <http://www.wri.org/publication/assessing-implementation-chinas-climate-policies-12th-5-year-period>
- ¹⁷⁶ <http://www.chinafaqs.org/blog-posts/chinas-state-council-unveils-40-45-carbon-intensity-target>
- ¹⁷⁷ One-page summary of report: Tsinghua-MIT China Energy and Climate Project, "An Energy Outlook for China" (2014) http://globalchange.mit.edu/files/document/CECP_2014_Outlook.pdf; full report: Xiliang Zhang, Valerie J. Karplus, Tianyu Qi, Da Zhang and Jiankun He, "Carbon emissions in China: How far can new efforts bend the curve?" (2014) http://globalchange.mit.edu/CECP/files/document/MITJPSPGC_Rpt267.pdf; Regarding the need for stronger efforts beyond current policies, see also <http://www.chinafaqs.org/blog-posts/stronger-commitments-china-and-us-are-breakthrough-international-climate-action>
- ¹⁷⁸ "FACT SHEET: U.S.-China Joint Announcement" (November 11, 2014)
- ¹⁷⁹ Zhang et al, "Carbon emissions in China" (2014) http://globalchange.mit.edu/CECP/files/document/MITJPSPGC_Rpt267.pdf; He Jiankun, Yu Zhiwei and Zhang Da, "China's strategy for energy development and climate change mitigation" (2012) <http://www.sciencedirect.com/science/article/pii/S0301421512003370>; Kejun Jiang, Xing Zhuang, Ren Miao and Chenmin He, "China's role in attaining the global 2°C target" (2013) http://www.tandfonline.com/doi/abs/10.1080/14693062.2012.746070#U9vjQ_idXhA
- ¹⁸⁰ <http://www.reuters.com/article/2014/11/18/us-china-coal-climatechange-idUSKCN0J20XF20141118>
- ¹⁸¹ China National Development and Reform Commission, "China's Policies and Actions on Climate Change" (November 2014), pages 3-8 <http://www.sdpc.gov.cn/gzdt/201411/W020141126538031815914.pdf>
- ¹⁸² WRI. 2015. Renewable Energy in China: A Graphical Overview of 2014. Accessible at, http://www.chinafaqs.org/files/chinainfo/ChinaFAQs_Renewable_Energy_Graphical_Overview_of_2014.pdf
- ¹⁸³ *Ibid.*
- ¹⁸⁴ WRI. 2014. Table: What are China's National Climate and Energy Targets? Accessible at, http://www.chinafaqs.org/files/chinainfo/ChinaFAQs_table_China_climate_energy_targets_0.pdf; South China Morning Post. "China announces Massive Boost in Solar Energy Target to Help Fight Pollution." March 19, 2015. Accessible at: <http://www.scmp.com/news/china/article/1741419/china-announces-massive-boost-solar-energy-target-help-fight-pollution>; China's Energy Development Strategy and Action Plan (2014-2020) (in Chinese) http://news.xinhuanet.com/2014-11/19/c_1113313588.htm
- ¹⁸⁵ Kashi, David. "China Bans New Coal Plants In Three Of Its Biggest Industrial Regions In An Attempt To Curb Air Pollution." *International Business Times*, September 13, 2013. Accessible at, <http://www.ibtimes.com/china-bans-new-coal-plants-three-its-biggest-industrial-regions-attempt-curb-air-pollution-1405362>.
- ¹⁸⁶ Li Shuo and Lauri Myllyvirta, "The End of China's Coal Boom—6 Facts You Should Know" (2014) <http://www.greenpeace.org/international/Global/international/briefings/climate/2014/The-End-of-Chinas-Coal-Boom.pdf>
- ¹⁸⁷ "Enhanced Actions on Climate Change: China's Intended Nationally Determined Contributions", submitted to UNFCCC June 30, 2015 (scroll to page 17 for English translation) <http://www4.unfccc.int/submissions/INDC/Published%20Documents/China/1/China's%20INDC%20-%20on%2030%20June%202015.pdf>
- ¹⁸⁸ <http://iepd.iipnetwork.org/policy/top-10000-energy-consuming-enterprises-program>
- ¹⁸⁹ S. Yu, M. Evans and Q. Shi, "Analysis of the Chinese Market for Building Energy Efficiency". Pacific Northwest National Laboratory, prepared for the U.S. Department of Energy (March 2014) http://www.pnnl.gov/main/publications/external/technical_reports/PNNL-22761.pdf
- ¹⁹⁰ <http://www.reuters.com/article/2013/03/21/china-auto-fuel-idUSL3N0CC2EK20130321>; White House Office of the Press Secretary, "FACT SHEET: The United States and China Issue Joint Presidential Statement on Climate Change with New Domestic Policy Commitments and a Common Vision for an Ambitious Global Climate Agreement in Paris" (September 25, 2015) <https://www.whitehouse.gov/the-press-office/2015/09/25/fact-sheet-united-states-and-china-issue-joint-presidential-statement>
- ¹⁹¹ "Fact Sheet: The United States and China Issue Joint Presidential Statement" (September 25, 2015). <https://www.whitehouse.gov/the-press-office/2015/09/25/fact-sheet-united-states-and-china-issue-joint-presidential-statement>The ETS will initially cover key energy-intensive industries such as iron and steel, power generation, chemicals, building materials, paper-making, non-ferrous metals, and cement. According to a

statement by China's economic development planning agency in 2014, some provinces will be allowed to delay participation in the emissions trading system if they do not have the technical infrastructure to participate from the beginning. <http://www.nytimes.com/2014/09/01/business/international/china-plans-a-market-for-carbon-permits.html?ref=business&r=1>

¹⁹² Zhang et al, "Carbon emissions in China" (2014)

¹⁹³ Fergus Green and Nicholas Stern, "China's 'new normal': structural change, better growth, and peak emissions", Policy Brief (June 2015) http://www.lse.ac.uk/GranthamInstitute/wp-content/uploads/2015/06/Chinas_new_normal_green_stern_June_2015.pdf; <https://www.whitehouse.gov/the-press-office/2015/09/25/remarks-president-obama-and-president-xi-peoples-republic-china-joint>; <http://www.brookings.edu/research/articles/2014/07/15-sino-shift-dollar>; China State Council, "Made in China 2025' plan issued" (May 19, 2015) http://english.gov.cn/policies/latest_releases/2015/05/19/content_281475110703534.htm

¹⁹⁴ Carbon Tracker Initiative, "The Great Coal Cap: China's energy policies and the financial implications for thermal coal" (2014) <http://www.carbontracker.org/report/the-great-coal-cap-chinas-energy-policies-and-the-financial-implications-for-thermal-coal/>

¹⁹⁵ <http://www.chinafaqs.org/blog-posts/making-plans-steps-development-chinas-crucial-13th-five-year-plan>

¹⁹⁶ Green and Stern, "China's 'new normal'" (2015); <http://energydesk.greenpeace.org/2015/09/09/china-coal-demand-falls-for-eleven-straight-months/>; John A. Mathews and Hao Tan, "A 'Great Reversal' in China? Coal continues to decline with enforcement of environmental laws" (August 2015) <http://www.japanfocus.org/-Hao-Tan/4365/article.html>

¹⁹⁷ E.g. variation in hydroelectric power generation due to hydrological conditions

¹⁹⁸ Green and Stern, "China's 'new normal'" (2015); http://www.nytimes.com/2015/09/22/world/asia/fading-coal-industry-in-china-may-offer-chance-to-aid-climate.html?ref=world&_r=1;

<http://www.smh.com.au/business/china/chinas-economic-shift-promises-to-aid-climate-fight-but-packs-a-commodity-punch-20151005-gk1jz5.html>

¹⁹⁹ Government of Brazil, "Intended Nationally Determined Contribution", submitted on September 28, 2015, accessible at <http://www4.unfccc.int/submissions/INDC/Published%20Documents/Brazil/1/BRAZIL%20INDC%20English%20FINAL.pdf>.

²⁰⁰ WRI, 2015, "Assessing the Post-2020 Clean Energy Landscape", accessible at <http://www.wri.org/publication/clean-energy-landscape>.

²⁰¹ Through a tremendous decline in the rate of Amazon deforestation from 2006–13, Brazil has avoided 3.2 gigatons of CO₂ emissions to the atmosphere, compared with the historic baseline (annual average 1996–2005). Nepstad et al., 2014, accessible at Science 344, <http://earthinnovation.org/our-work/global/redd-policy-initiative/>.

²⁰² National Geographic, "Brazil Leads World in Reducing Carbon Emissions by Slashing Deforestation," June 5, 2014, <http://news.nationalgeographic.com/news/2014/06/140605-brazil-deforestation-carbonemissions-environment/>.

²⁰³ Government of India, "Intended Nationally Determined Contribution", submitted on October 1, 2015, accessible at <http://www4.unfccc.int/submissions/INDC/Published%20Documents/India/1/INDIA%20INDC%20TO%20UNFCCC.pdf>.

²⁰⁴ Renewable Energy Policy Network for the 21st Century (REN21). 2015. Renewables 2015 Global Status Report. Accessible at: http://www.ren21.net/wp-content/uploads/2015/07/REN12-GSR2015_Onlinebook_low1.pdf.

²⁰⁵ WRI, 2015, "Assessing the Post-2020 Clean Energy Landscape", accessible at <http://www.wri.org/publication/clean-energy-landscape>. India's INDC specifies this target is achievable with the help of the transfer of technology and low cost international finance including from the Green Climate Fund.

²⁰⁶ Government of Mexico, "Intended Nationally Determined Contribution", submitted on March 30, 2015, accessible at <http://www4.unfccc.int/submissions/INDC/Published%20Documents/Mexico/1/MEXICO%20INDC%2003.30.2015.pdf>.

²⁰⁷ UNFCCC, 2010, "Cancun Agreements", accessible at <http://unfccc.int/resource/docs/2010/cop16/eng/07a01.pdf#page=2>.

-
- ²⁰⁸ IEA, 2015, "Energy and Climate Change", accessible at https://www.iea.org/media/news/WEO_INDC_Paper_Final_WEB.PDF.
- ²⁰⁹ IEA, 2015, "Energy Technology Perspectives", accessible at <https://www.iea.org/etp/>. The ETP's 6DS scenario is "largely an extension of current trends and "broadly consistent with the WEO Current Policy Scenario through 2040." It is associated with a global temperature rise above pre-industrial levels of almost 4 degrees Celsius by the end of this century.
- ²¹⁰ UNFCCC, 2015, "Synthesis report on the aggregate effect of INDCs", accessible at http://unfccc.int/focus/indc_portal/items/9240.php.
- ²¹¹ WRI, 2015. "STATEMENT: WRI's Taryn Fransen Says UNEP Gap Report "Underscores The Importance of Reaching a Global Climate Agreement", accessible at <http://www.wri.org/news/2015/11/statement-wris-taryn-fransen-says-unep-gap-report-underscores-importance-reaching>.
- ²¹² Global Commission on the Economy and Climate, 2015, "Seizing the Global Opportunity: Partnerships for Better Growth and a Better Climate," available at http://2015.newclimateeconomy.report/wp-content/uploads/2014/08/NCE-2015_Seizing-the-Global-Opportunity_web.pdf.
- ²¹³ WRI & UNDP, 2015, "Designing and Preparing Intended Nationally Determined Contributions (INDCs)", accessible at <http://www.wri.org/sites/default/files/designing-preparing-indcs-report.pdf>.
- ²¹⁴ UNFCCC, 2010, "Cancun Agreements", accessible at <http://unfccc.int/resource/docs/2010/cop16/eng/07a01.pdf#page=2>.
- ²¹⁵ White House Office of the Press Secretary, "FACT SHEET: The United States and China Issue Joint Presidential Statement on Climate Change with New Domestic Policy Commitments and a Common Vision for an Ambitious Global Climate Agreement in Paris" (September 25, 2015) <https://www.whitehouse.gov/the-press-office/2015/09/25/fact-sheet-united-states-and-china-issue-joint-presidential-statement>
- ²¹⁶ Peru, Colombia, Mexico, Mongolia, South Korea, Indonesia, Chile, and Panama have made pledges to the Green Climate Fund.
- ²¹⁷ "World Bank Group. 2014. "Turn Down the Heat: Confronting the New Climate Normal." Washington, DC: World Bank.

Dr. Andrew Steer, President and CEO of the World Resources Institute – Biography

Dr. Andrew Steer is the President and CEO of the World Resources Institute, a global research organization that works in more than 50 countries, with offices in the United States, China, India, Brazil, Indonesia and Europe. WRI's 450 experts work closely with leaders to address six urgent global challenges at the intersection of economic development and the natural environment: food, forests, water, climate, energy and cities.

Dr. Steer joined WRI from the World Bank, where he served as Special Envoy for Climate Change from 2010 - 2012. From 2007 to 2010, he served as Director General at the UK Department of International Development (DFID) in London.

Dr. Steer serves on the Executive Board of the UN Secretary General's Sustainable Energy For All initiative; is Co-Chair of the World Economic Forum's Global Agenda Council on Natural Capital; and is a member of the China Council for International Cooperation on Environment and Development (CCICED), the Leadership Council of the Sustainable Development Solutions Network, and IKEA's People and Planet Positive Advisory Group.

Prior to joining the UK Government, Andrew held several senior posts at the World Bank, including Director of the Environment Department. He also has directed World Bank operations in Vietnam and Indonesia and served as Chief of the Country Risk Division and Director and Chief Author of the 1992 World Development Report on Environment and Development.

Andrew was educated at St Andrews University, Scotland, Cambridge University, and the University of Pennsylvania, where he received his PhD in economics.

Chairman SMITH. Thank you, Dr. Steer.

We'll now go to Dr. Lomborg, who is joining us from Paris. We very much appreciate his efforts to do so by video. I think it's 4:30 in the afternoon. I hope the weather is clear. And we look forward to your testimony.

[The following testimony was delivered via teleconference.]

**TESTIMONY OF DR. BJORN LOMBORG, PRESIDENT,
COPENHAGEN CONSENSUS CENTER**

Dr. LOMBORG. Thank you very much, Mr. Chairman, and thank you very much to all your honored members.

I'm actually going to show you some slides, so I hope that this will work at the same time. So we're pushing the technology to its fullest.

And so here it is. So fundamentally, I would like to show you two main points, namely, the impact and the cost of Paris. And this is perhaps not very surprising; I am going to take some issues with what Andrew Steer—Dr. Andrew Steer pointed out.

So, look local global warming is an important issue. It's man-made. It's a long-term problem. But I think what we need to understand is that we have little sense of the scale.

Let me just show you this, and this is the UNFCCC, the ones that are organizing the Copenhagen—sorry, the Paris meeting. If everybody does everything that is promised in Paris, we will cut the equivalent of 56 gigatons of CO₂ until 2030. This is incontrovertible. Obviously, you can talk about is it 40, is it 50, might it be 60? And just to show you what we're trying to achieve, there's about—the 2 degree target will require us to cut more than 6,000 gigatons over the century.

Mr. Steer and also the—Eddie Johnson mentioned that we're possibly on the road to 2.7 degrees. That would require about 3,000 gigatons of reduction. So remember, we're 1 or two percent of the way. That's important because it gives us a sense of proportion.

Now, let me to show you briefly with the Clean Power Plan. It will, if it's achieved, reduce temperatures trivially, as has been pointed out several times, but it'll reduce emissions by 4 gigatons by 2030 and 42 gigatons through the century.

So again, just to show you the scale, 4, 42, and what we're talking about achieving is 6,000 gigatons. That's also why, if you run it in a standard climate model, you won't be able to tell the difference. It's in my description, but just to summarize it, if we just do the Clean Power Plan until 2030, it will reduce temperatures by 0.007 degrees Fahrenheit by the end of the century, and even if it continued in its full implementation until the end of the century, it will reduce temperatures by 0.0023 degrees Fahrenheit.

Likewise, if you'll look at the U.S. climate promise, the promised to cut 26 to 28 percent below 2005 levels in 2025, it will reduce temperatures trivially. It will reduce 6 gigatons by 2025 and 100 gigatons throughout the century it.

Again, just look at the changes here. We're talking about a very, very small impact. And that's of course why, if you run it in a climate model, again, you will get very, very small impacts. Again, if you actually keep your U.S. Paris promise until the end of the century, you will reduce temperatures by 1/20 of a degree Fahrenheit.

And let me just share with you what is the impact of all the INDCs, all the Paris promises. If you run this through a standard climate model, this is what you see. You can actually tell the difference but not by very much. So again, if we just keep our promise until 2030, which of course is the only thing on sale here, we will reduce temperatures by 0.09 degrees Fahrenheit. If indeed they are kept all the way through the century, they will reduce temperatures by about one third of a degree Fahrenheit. That is important because we're essentially talking about very small changes. At the same time, the costs are significant.

Now, Andrew Steer would like us to believe that this is not very much. Actually, overall, we're going to see increases in growth and we're actually going to make money from this. But certainly all standard models, these are all the models from the Stanford Energy Modeling Forum, and all the other multi-model forums have looked at the cost of climate policies through a variety of different models. They indicate on average the cost for the United States is going to be about \$154 billion if you do this well. And fundamentally, that's because if you make energy more expensive, it will inevitably affect everything. It's not the end of the world economically, but it does have a cost of a couple of percent of GDP and that's what turns out.

Of course, we also know that most policies—I'm sorry for this committee to say that, but most policies are not perhaps most effectively implemented, and then we know they can be even more costly. So it's likely that we will see a cost of at least \$1 trillion globally and maybe even \$2 trillion. And remember, this is the cost per year.

And so in summary, the impacts of Paris are small, about 1/3 of a degree Fahrenheit at best. The cost of Paris is large. It's not a benefit. That's of course why we need everybody to cajole us into doing this. It's at least one trillion dollars a year. Spending \$1 trillion to cut virtually nothing of temperature, that's perhaps not the best way forward.

And that's why we really need to recognize if we want to do better, we owe it to the world to spend our money better both on focusing on R&D for green energy, as the Chairwoman pointed out. That is what Bill Gates is now making us focus on, and of course also realize that there are many other problems we need to fix as a world.

So, again, I say thank you very much to the Committee, and I look forward to your questions.

[The prepared statement of Dr. Lomborg follows:]

The impact and cost of the 2015 Paris Climate Summit, with special focus on US policies

Tuesday, December 1 2015, 10:00am, 2318 Rayburn House Office Building

The House of Representatives, Committee on Science, Space and Technology

Testimony by Bjorn Lomborg, President, Copenhagen Consensus Center

Summary:

Global warming is real, mostly man-made and a net problem. However, the current Paris COP21 promises will do little to tackle the problem while costing a fortune.

The only peer-reviewed estimate shows that the climate impact of all Paris promises 2016-2030 will reduce temperature in 2100 by 0.08°F (0.05°C). Even if all countries continue their promised reductions for 2031, 2032 ... until 2100, it will reduce temperatures by just 0.31°F (0.17°C).

The US Clean Power Plan will reduce global temperatures by maximally 0.023°F (0.013°C) in 2100.

The entire US climate promises will reduce global temperatures by just 0.057°F (0.031°C) by 2100.

Change in temperature			Change in temperature		
year 2100	Pessimistic	Optimistic	year 2100	Pessimistic	Optimistic
US INDC	0.008	0.031	US INDC	0.014	0.057
US CPP	0.004	0.013	US CPP	0.007	0.023
EU2030 INDC	0.017	0.053	EU2030 INDC	0.031	0.096
EU 2020	0.007	0.026	EU 2020	0.012	0.046
China	0.014	0.048	China	0.025	0.086
RoW INDC	0.009	0.036	RoW INDC	0.016	0.064
Global	0.048	0.170	Global	0.086	0.306

The cost of Paris is substantial. This submission uses the best available climate-economic model ensembles from the Stanford Energy Modeling Forum, the Asia Modeling Exercise and the EU/EPA CLIMACAP-LAMP project

It finds the cost for the US climate promises are likely \$154-172 billion every year in lost GDP by 2025. This assumes that all US climate policies are enacted in the most efficient way, which is very unlikely. If they are not, the peer-reviewed literature suggests the costs will at likely double.

The costs for the world is at least close to \$1 trillion per year in 2030, with likely costs due to policy inefficiency doubling to almost \$2 trillion per year:

Billion \$ per year	Most effective policy	Most likely policy
USA	154	308
EU	305	610
China	200	400
Mexico	80	160
Rest of World	185	370
Global cost	924	1848

The cost and impact of the 2015 Paris Climate Summit, with special focus on US policies

This paper will estimate the impact of the likely climate impact of the Paris Climate Summit, (the COP21, or hereafter Paris), its costs, and compare this with other model outcomes.

Given the very contentious nature of the climate debate, it is perhaps worthwhile to point out that the current paper embrace man-made global warming and use the standard models from the UN Climate Panel (the IPCC) and others.

Is global warming happening? Yes. Man-made global warming is a reality and will in the long run have overall, negative impact.

How much will the Paris promises reduce global temperature rise?

So far, the only peer-reviewed paper estimating the temperature impact of the likely Paris impact is my paper from November 10 2015 (Lomborg 2015). This paper uses the climate model MAGICC 6.3. This is the latest version of a simple climate model used in all the five IPCC assessment reports from 1990-2014.¹ All the following runs use default values of MAGICC with a climate sensitivity of 3°C. Sensitivity analysis shows that different models and carbon cycling does not substantially change the outcome.

The paper investigates the *change* in temperature in 2100 from implementing promises for Paris, both individual and collective. It does so by running two standard climate scenarios, RCP8.5 and RCP6 with and without the promised reductions. Sensitivity analysis shows that the outcome does not substantially change, and consequently only RCP8.5 is shown here.

There is some discussion as to what the promises of Paris actually constitute. In my article I explicitly limit the promises to “policies that have practical political implications soon and have a verifiable outcome by 2030, but not policies that merely promise actions only or mostly starting after 2030.” See the discussion below for why this fits with the definition of what most nations and UNFCCC understand as the Paris promises. It also avoids a slippery slope towards a ridiculous premise: since almost all states have already accepted the 2°C promise, if all promises are included, then by default we will see temperatures rise less than 2°C.

US Clean Power Plan

If we look just at the US Clean Power Plan, it will reduce emissions by 535Mt (million metric tons) CO₂ every year by 2030, compared to the expected emissions from the US power sector, as estimated by the Energy Information Agency (EIA 2015). I investigate two scenarios. In the first, the optimistic scenario, the US will continue the Clean Power Plan forever, which means the US emissions will forever be 535Mt CO₂ lower than the baseline from EIA. In the pessimistic scenario, the US will live up to its Clean Power Plan promises by 2030, but then fall back to its baseline emissions as estimated by EIA.

If we run the MAGICC climate model with the RCP8.5 global emissions with and without the reductions in CO₂ emissions from the US Clean Power Plan, we get the following result:

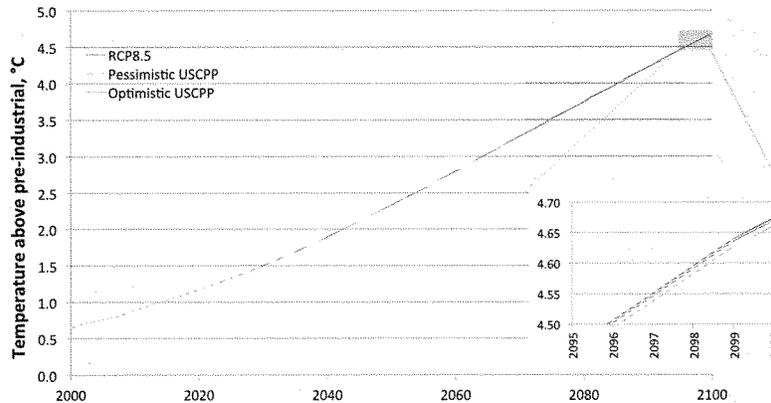


Figure 1 Global temperature anomaly from 2000–2100 with baseline RCP8.5, and optimistic and pessimistic US Clean Power Plan (USCPP) run on MAGICC, enlarged insert at right-hand corner.

Figure 1 shows (most clearly in the enlargement in the bottom right) that the temperature reduction resulting from the US Clean Power Plan by the end of the century will be 0.007°F (0.004°C) if the policy is gradually abandoned after 2030. If the Clean Power Plan is continued throughout the century, reducing 535Mt CO₂ each year from the baseline, it will reduce global temperatures by 0.023°F (0.013°C) by 2100.

US Paris promises

The US administration has also promised in its Intended Nationally Determined Contribution (INDC) to the UNFCCC (USINDC 2015) that it will reduce its overall greenhouse gas emissions (GHG) 26-28% below the 2005-level by 2025. The US is very clear in its submission that this is a one-point promise in 2025: “The US target is for a single year: 2025.”

This reduction promise works out to about 1.27Gt of CO₂ equivalents in 2025. Again, I examine two possible scenarios. One pessimistic scenario where the US will only live up to the letter of its promise, cutting 1.27Gt CO₂e in 2025, but then reverting back to the baseline. The optimistic scenario sees the US living up to its promise not just in 2025 but every year thereafter, reducing 1.27Gt CO₂e from the baseline throughout the 21st century.

If we run the MAGICC climate model with the RCP8.5 global emissions with and without the reductions in CO₂ emissions from the US INDC promises, we get the following result:

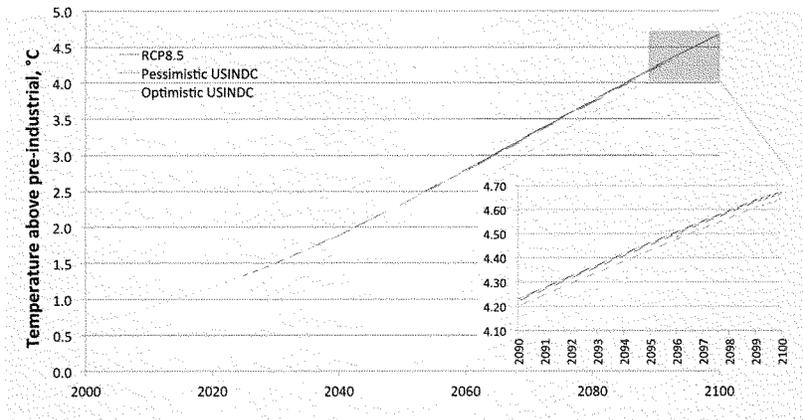


Figure 2 Global temperature anomaly from 2000-2100 with baseline RCP8.5, and optimistic and pessimistic US Paris promise (USINDC), run on MAGICC.

Figure 2 shows (most clearly in the enlargement in the bottom right) that the temperature reduction resulting from the entire US Paris promise by the end of the century will be 0.014°F (0.008°C) if the policy is gradually abandoned after 2025. If the US Paris promise is continued throughout the century, reducing 1.27Gt CO₂ each year from the baseline, it will reduce global temperatures by 0.057°F (0.031°C) by 2100. Since this includes the US Clean Power Plan, the net effect of the extra promise in the US INDC is in the optimistic case 0.034°F (0.057°F-0.023°F, 0.018°C).

Global Paris promises impact

My article similarly estimates the impact of the other major players' contribution to the Paris emission reductions. The EU has done a climate policy for 2020 (the 20-20 policy, promising 20% emission reductions below 1990-level in 2020,

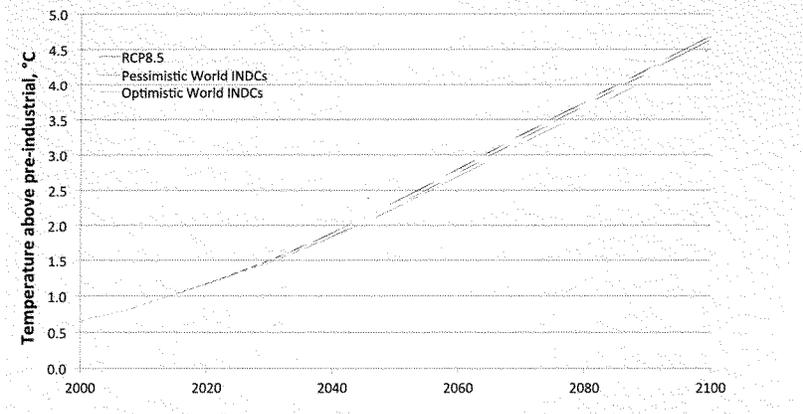


Figure 3 Global temperature anomaly from 2000-2100, from baseline RCP8.5, and optimistic and pessimistic global Paris promises (Global INDCs), run on MAGICC.

leading to 0.93Gt CO₂ annual reduction by 2030) and for its INDC (40% reduction below 1990-level by 2030, resulting in an annual 2.1Gt CO₂ reduction by 2030). China has promised to reduce its CO₂ intensity to 60-65% below 2005, which translates into a 1.95Gt CO₂ annual reduction promise by 2030. The US, China and the EU reductions approach almost 80% of the total promised reductions. Hence I estimate, using (Boyd, Turner, and Ward 2015), that the Rest of the World (RoW) INDCs will reduce emissions by 2030 by 1.48Gt CO₂ annually. In total, the INDCs for Paris will result in an emission reduction of 6.8Gt CO₂ by 2030

In Table 1 one can see the total impact of these policies, both in Celsius and Fahrenheit. The total impact of all INDC climate policies will reduce temperatures in 2100 by 0.086°F (0.048°C) if the Paris promises are gradually abandoned after 2030. If the Paris promises are kept all through the century, reducing emissions 6.8Gt below the baseline every year, the result will be a more optimistic temperature reduction of 0.306°F (0.170°C) by 2100. The global model run can be seen in Figure 3.

Change in temperature			Change in temperature		
year 2100	Pessimistic	Optimistic	year 2100	Pessimistic	Optimistic
US INDC	0.008	0.031	US INDC	0.014	0.057
US CPP	0.004	0.013	US CPP	0.007	0.023
EU2030 INDC	0.017	0.053	EU2030 INDC	0.031	0.096
EU 2020	0.007	0.026	EU 2020	0.012	0.046
China	0.014	0.048	China	0.025	0.086
RoW INDC	0.009	0.036	RoW INDC	0.016	0.064
Global	0.048	0.170	Global	0.086	0.306

Table 1 Impact of climate policies in terms of reduction in temperature by 2100 in °C and °F, optimistic and pessimistic, for RCP8.5, using MAGICC, summary of (Lomborg 2015).

Cost of Paris promises

Extraordinarily, there seems to be no official estimates of the costs of the proposed Paris climate policies, either for the US, the EU, China or for the entire world.

I will here use existing data to make a reasonable first estimate of the total cost of Paris.

Europe's climate promises are probably the best documented in peer reviewed literature, but this literature also clearly shows that the studies typically lag political decisions by some years. Thus, we have good estimates for previous decisions but much less exact for the ones the world is thinking of committing to in Paris.

The Stanford Energy Modeling Forum (EMF), the gold standard for the economics of climate and energy, has done several studies of the previous EU climate policy which promised a 20% reduction in CO₂ emissions from 1990-levels by 2020.

It showed two things. First and perhaps not surprisingly, in the rare cases where official cost estimates are made, these are often *much* underestimated. The EU estimated that the total cost of its 2020-policies could be as little as an annual 0.4% GDP loss (€64 billion per year) (Capros et al. 2008, 48). The peer-reviewed cost was 1.3% (€209 billion annually), or more than three times larger (Tol 2012). Similarly, the Mexican government assumed its climate policies would cost \$6-33 billion annually by 2050 (Veysey et al. 2015, 12). The peer reviewed literature, supported by the US EPA and the EU, shows that this is “far lower than any of the cost metrics reported by the CLIMACAP-LAMP models.” Indeed, they find the cost in 2050 to be between 14 and 79 times higher, at about \$475 billion annually (Veysey et al. 2015).

Second, politicians rarely pick the most efficient climate policies that cut CO₂ at lowest cost. This typically doubles the cost. The EU could have reduced its emissions by switching to gas and improving efficiency for a GDP loss of 0.7% (Bohringer, Rutherford, and Tol 2009). However, phenomenally inefficient solar subsidies and biofuels are often more alluring, which is why the actual EU cost almost doubled to 1.3% of GDP. As the researchers say: “The inefficiencies in policy lead to a cost that is 100–125% too high.”

In the following, I will tally the costs for the US, EU, Mexico, and China, which makes up about 80% of the total promised reductions.

Cost of Paris for the US

There is no official estimate for the cost of USA’s promise to cut 26-28% of its greenhouse gasses by 2025. We can turn to the Stanford Energy Modeling Forum for the US, the so-called EMF 24 (Fawcett et al. 2014). The program has run more than a hundred scenarios estimating all greenhouse gas emissions and the GDP cost. Estimating the lost GDP cost with a regression across all these data points suggests that cutting 26% in 2025 results in a GDP loss of about \$154 billion annually, and 28% incurs an annual GDP loss of \$172 billion.

The cost of Paris for the EU

The EU promises in its INDC to cut its emissions by 40% below 1990-levels in 2030 (EUINDC 2015). While there are no official estimates of the cost, the latest peer-reviewed Stanford Energy Modeling Forum for the EU, the so-called EMF 28, estimates costs from a number of different reductions (Knopf et al. 2013). The closest policy attempts to reduce emissions by 80% in 2050, which leads to an average reduction in 2030 of 41%. That reduction across the models that estimate GDP loss is equivalent to reducing EU’s GDP by 1.6% GDP in 2030 – or €287 billion (\$305 billion) in 2010-euros.

The cost of Paris for China

China has promised to reduce its energy intensity to at least 60% below 2005 (China INDC 2015), equivalent to reducing its emissions by at least 1.9 Gt CO₂ each year. In the international research project the Asia Modeling Exercise (Calvin et al. 2012; Calvin, Fawcett, and Kejun 2012), nine energy-economic models estimate what different efficient reduction policies will attain in emission reductions and GDP reductions. Using the AME data, it is likely that China can reduce 1.9Gt CO₂ for about \$200 billion in annual GDP loss.

The cost of Paris for Mexico

Another well-documented cost is for Mexico, which has enacted the strongest climate legislation of any developing country. It has conditionally promised to reduce its emissions by 40% below what it would otherwise have emitted by 2030.² As mentioned above, the cost estimates of the Mexican government are about 14-79 times lower than the actual cost estimated in a new study supported by the US EPA and the EU. The CLIMACAP-LAMP project has estimated costs throughout Latin America and the peer reviewed analysis for Mexico (Veysey et al. 2015) finds that the Mexican cost in 2030 is about 4.5% of GDP or about \$80 billion annually.³

The cost of Paris for Rest of World

The total cost of US, EU, China and Mexico adds up to \$739 billion (or \$757 if the US goes for 28%). Given that the reductions from US, EU, China and Mexico add to about 80%, it is reasonable to assume that the \$739 billion constitute 80% of the total cost, making the global cost about \$924 billion.

Billion \$ per year	Most effective policy	Most likely policy
USA	154	308
EU	305	610
China	200	400
Mexico	80	160
Rest of World	185	370
Global cost	924	1848

Table 2 Cost of Paris promises in GDP loss per year, with effective policy based on best multi-model estimates from EMF24, EMF28, AME and CLIMACAP-LAMP, with comparative estimate for rest of the world. The most likely policy column simply assumes costs to double, as EU and other climate policies have shown likely.

Table 2 show the estimate of \$924 billion in annual lost GDP by 2030 if all nations enact the most efficient climate policy (likely an increasing carbon tax which is uniform across sectors and countries). However, previous experience shows that it such an effective climate policy formulation is very unlikely, and this makes the total cost more likely to double (as found e.g. by (Bohringer, Rutherford, and Tol 2009)). Thus, it is likely that the global cost of Paris will reach at least \$1 trillion annually by 2030, and the cost with realistically less-efficient policies could very likely get close to \$2 trillion annually.

Comparison with other findings

If we look across the entire spectrum of estimations of the Paris deal, there is a great deal of agreement. As is evident in Figure 4, all find that with Paris emissions will be around 53.7-57.6Gt CO₂ equivalent in 2030. My value is within 0.2 Gt of the median.

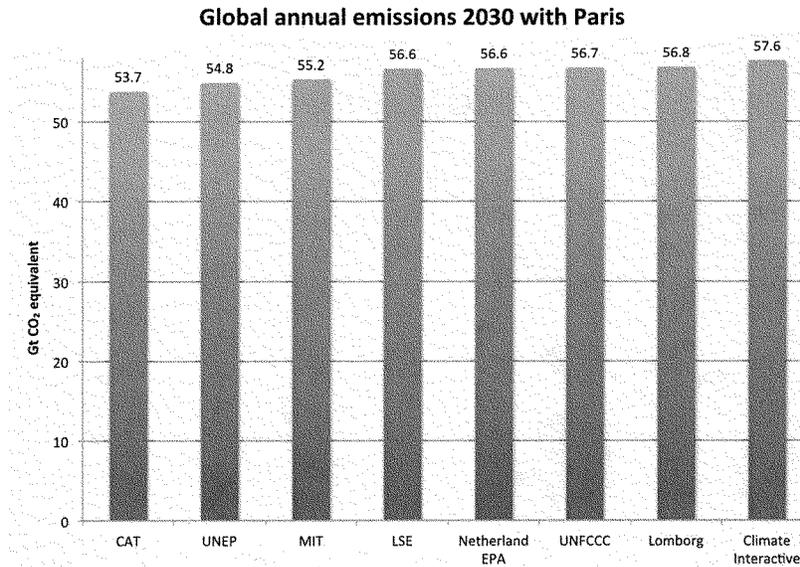


Figure 4 Global annual emissions estimated for 2030 with all INDC Paris promises. CAT is average of Pledges by 2030 (CAT 2015), UNEP is average of unconditional and conditional promises (UNEP 2015), (MIT 2015), LSE average of four different outcomes (Rodney Boyd, Joe Cranston Turner, and Bob Ward 2015), (Netherlands EPA 2015) harmonized, (UNFCCC 2015), (Lomborg 2015) optimistic using mean of EMF27 as baseline (Kriegler et al. 2014), (Climate Interactive 2015).

However, if we look at the baseline – no climate policy through the 21st century – the expected cumulative emissions 2010-2100 in Figure 5 has significant outliers on both sides. MIT is on the low side, likely because it has already included emission reductions from climate policies until 2014.

The AME, Lomborg, EMF27, and UNEP lie just above 7,000 Gt CO₂, whereas CAT and Climate Interactive have much higher baselines, with Climate Interactive more than 2,000 Gt above. The Climate Interactive emissions are actually higher than any model in EMF27.

That means CI can claim that Paris or any other policy will reduce about 2,000+ Gt more emissions than any other analysis, but such a claim is of course entirely spurious. Since the unrealistically high baseline is entirely made-up, these emissions would never have taken place, and hence Paris climate promises can't take credit for eliminating them.

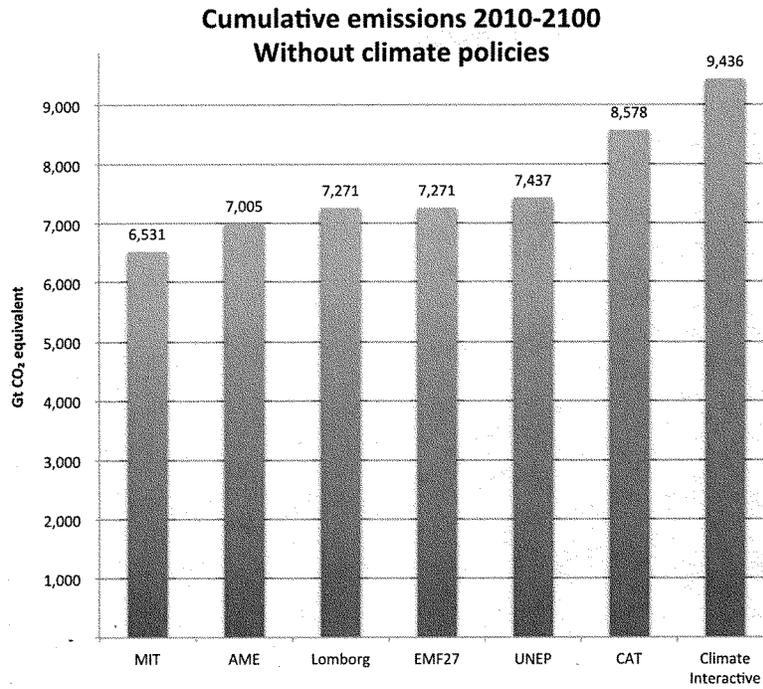


Figure 5 Global cumulative emissions for 2010-2100 without climate policies, estimated with MIT based on changed CO₂ emissions from 2014-15 (MIT 2015, figure 14), Asian Modeling Exercise (Calvin et al. 2012), optimistic (Lomborg 2015) (Kriegler et al. 2014), (UNFCCC 2015) (CAT 2015) (Climate Interactive 2015).

Cumulative emissions 2010-2100 With INDCs (and more for CAT)

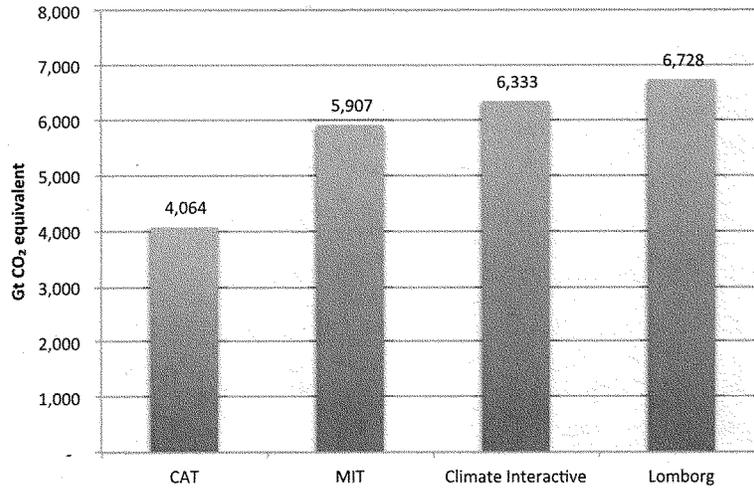


Figure 6 Cumulative emissions 2010-2100 with the Paris INDCs for MIT, Climate Interactive and optimistic Lomborg, and for CAT (including further reductions after 2030), (CAT 2015; MIT 2015; Climate Interactive 2015; Lomborg 2015).

Cumulative emission reductions 2010-2100

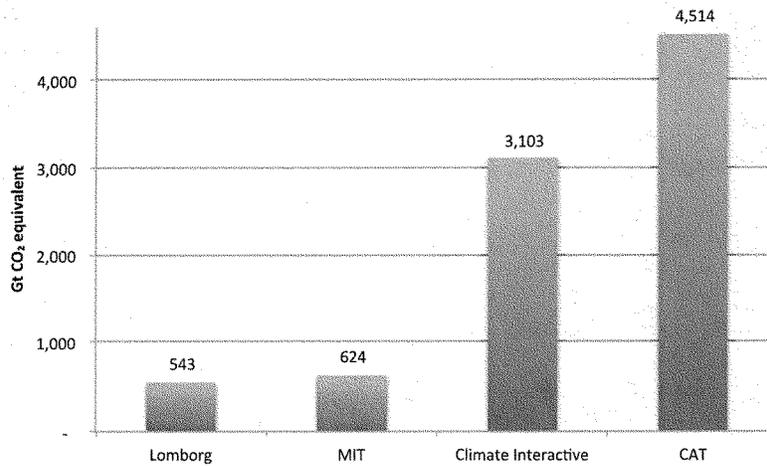


Figure 7 Cumulative emissions reductions 2010-2100 optimistic Lomborg, MIT, Climate Interactive and CAT (CAT 2015; MIT 2015; Climate Interactive 2015; Lomborg 2015).

If we look at the cumulative emissions from the Paris INDCs in Figure 6, it is clear that MIT, Climate Interactive and Lomborg find about the same level across the century, because all three have about the same estimate for 2030 and see the policies in 2030 continued approximately in the same way. CAT finds much higher reductions because it assumes much larger reductions after 2030.

This is why we see the total reduction diverge radically in Figure 7. MIT and Lomborg both have realistic cumulative baselines and realistic cumulative emissions with the INDCs. That is why they both find about 500-600Gt cumulative reductions across the 21st century, which both finds translates into about 0.2°C temperature reduction.

Climate interactive sees about 2,500 Gt higher emission reductions but *almost all* of this reduction stems from the vastly inflated baseline. Thus the correct finding of Climate Interactive without the exaggerated baseline would be almost similar findings to (MIT 2015; Lomborg 2015).

CAT finds much higher reductions yet, partly because it has an unrealistically high baseline (about 1,300 Gt too high, Figure 5) *and* assume another 2,000+ Gt reductions after 2030.

It is instructive to see how far away the estimates of Climate Interactive are, since they are often used in the public discourse. In Figure 8, we can see the difference between all EMF24 baseline estimates, with Climate Interactive

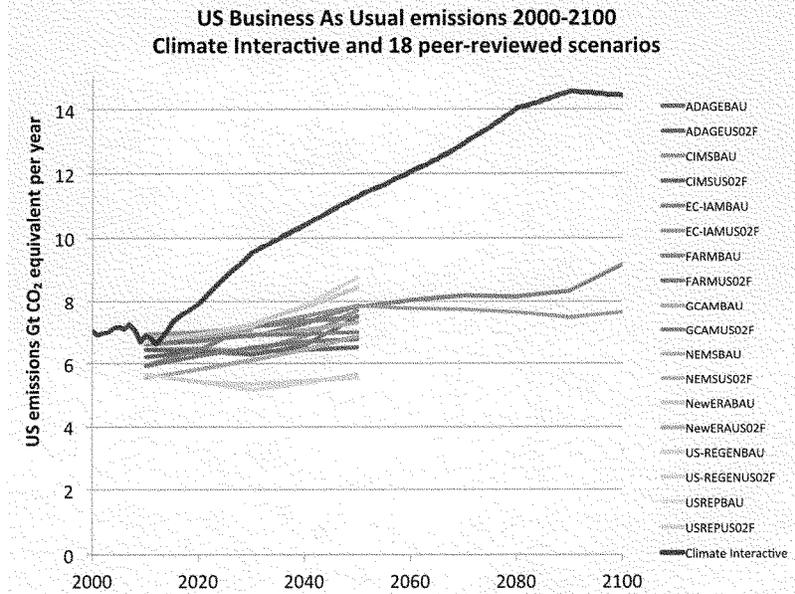


Figure 8 Emissions from all 9 EMF24 baseline scenarios (US01 and US02) 2010-2100 (only on set goes beyond 2050), compared to Climate Interactive's estimate. (Kriegler et al. 2014). (Climate Interactive 2015).

baseline increasingly diverging to the point of being about 80% too high at the end of the century.

Similarly, Figure 9 shows the vast difference between the median baseline of AME and the Climate Interactive estimate for China emissions, which increasingly diverge from the academic literature and towards the end of the century is almost 90% too high.

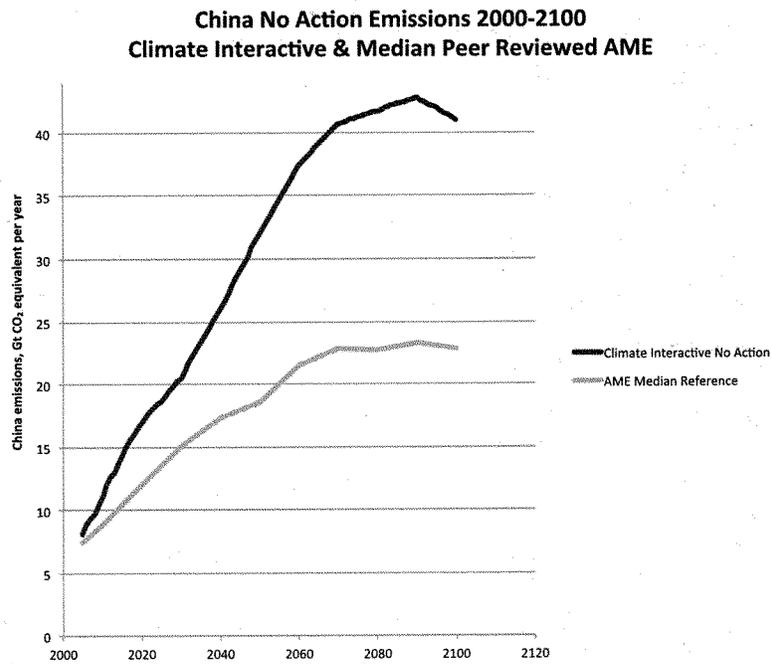


Figure 9 Median of baseline scenarios of 17 individually peer-reviewed reference scenarios in the collectively peer-reviewed Asia Modeling Exercise (Calvin et al. 2012), and Climate Interactive No Action scenario (Climate Interactive 2015).

Which promises should be included in a Paris COP21 analysis?

Some critics claim that in analyzing Paris, we should look not just at the promises made for 2016-2030, but also promises much further out, like the Chinese promise to reduce emissions after 2030, the US promise to reduce its emissions to 80% below 2005 in 2050 and the EU promise to cut emissions 80-95% below 1990-levels in 2050.

Such an interpretation is implausible and for three interlocking arguments, as I also point out in my article

First: It is difficult to defend the inclusion of targets with a very low likelihood of implementation.

In my article, I only include policies that have practical political implications soon and have a verifiable outcome by 2030.

It is undeniable that political targets further away are less likely to be implemented. Recent history clearly indicates that climate promises even 10-15 years ahead will be routinely flouted.

When China commits to reduce its carbon intensity of GDP by 60% to 65% below 2005 levels by 2030, we can analyze the progression towards that goal very clearly over the next 15 years and clearly determine if it is met by 2030 – so this is included in my analysis.

However, the promise to “achieve the peaking of carbon dioxide emissions around 2030 and making best efforts to peak early” (often curiously misquoted, as for instance in “peak CO₂ emissions by 2030 at the latest”⁴) is something that will only have an effect *after* around 2030, and it is something that will first be verifiable around 2035 or later.

This is especially true given that Chinese energy statistics are notoriously opaque. Just in the last few weeks it became clear that China burned perhaps 17% more coal per year in recent years than was previously understood.⁵

China’s ‘peaking’ promise is very unlikely to be achieved based on economic reality alone. The cost can be identified from the Asia Modeling Exercise which indicates that the lowest GDP loss would be about \$400bn or about 1.7% of GDP, and likely twice that. It strains credibility to expect China to commit such economic self-harm.

(It is worth noting in passing that China also promises in its INDC to be “democratic” in 2050 (China INDC 2015). The one-party state’s vow should probably be treated rather similarly to the suggestion that it will rein in economic growth so dramatically).

Second: my approach is methodologically clear. The alternative is unable to avoid a slippery slope that would include every target, vow, promise, or vague political undertaking.

In my analysis, I was consistent in ruling out longer-term promises that were further off and economically implausible.

I also left out the US promise of “deep, economy-wide emission reductions of 80% or more by 2050.” Data from the Stanford Energy Modeling Forum for the US (Fawcett et al. 2014) shows an average GDP loss at more than \$1 trillion annually, if done efficiently. If not, which seems to be the only constant in climate policy, the cost will likely double to almost \$2.5 trillion or 7.5% of US GDP in 2050.

And I left out the EU promise “to reduce its emissions by 80-95% by 2050 compared to 1990.” Data from the Stanford Energy Modeling Forum (Knopf et al. 2013) shows the average GDP loss at almost €3 trillion annually, if done efficiently. If not, the cost will likely double to almost €6 trillion or 25% of EU GDP in 2050.

If we were to include the Chinese ‘peaking’ promise, why not also include the US promise to cut 80% by 2050 and the EU promise to cut 80-95% by 2050, both of which are mentioned in their INDCs?

Including these promises would make a mockery of any real analysis of what the Paris treaty can achieve.

Indeed, since almost every nation has signed up to reduce temperature rises to 2°C⁶, and about 80-90 nations including the EU and the US ‘endorse’ this target in their INDCs, where should we draw the line?

Third: the commitment period of 2016-2030 is by far the most common understanding of what Paris constitutes.

This is true whether we pay attention to the United Nations or at the official material from nations themselves:

- The UNFCCC itself describes the central results as emission reductions achieved in 2025 and 2030, not further. It specifically labels possible emission reductions after 2030 as actions taken by nations “beyond the time frames stated in their INDCs (e.g. beyond 2025 and 2030)” (UNFCCC 2015)
- The US clearly states that its understanding of its INDC is for 2025 and not further: “The U.S. target is for a single year: 2025.” (USINDC 2015)
- The EU sets its targets for 2030 and not any further.
- In its own INDC, China clearly writes what it expects from the Paris agreement, namely to “formulate and implement programs and measures to reduce or limit greenhouse gas emissions for the period 2020-2030.” (China INDC 2015) So even China itself is unequivocal that the Paris deal is not about promises after 2030, but up until 2030.

What does climate policy history tell us?

It is also worth remembering what previous promises have routinely been flouted, which lends less credibility to new promises, especially far-off promises. Consider an analysis conducted in 1997 on the likely effect of the Kyoto Protocol. Should it have included not just the specific commitments made in Kyoto, but every far-reaching promise made around that time? Likely not, because we should have assumed that not only would this treaty be implemented, but that stronger and ever-increasing cuts would consistently be made as a result of

policy (and not economic downturns) for decades. History shows that we would have been utterly wrong to do so.

Moreover, should such an analysis of Kyoto have included President Bill Clinton's 1993 announcement⁷ that the US would reduce its emissions by 2000? That promise was never fulfilled. According to the Washington Post, the US administration's excuse was that the "goal is no longer possible because the economy has grown more rapidly than expected."⁸ The commitment failed even though it was for just seven years later, was to be implemented right away, and under the same president who made it.

Every industrialized nation actually promised in 1992 to return their emissions in 2000 to 1990-levels⁹ – and almost every single OECD country missed that target.

Even the commitments made in the Kyoto Protocol itself ended up meaning nothing. The treaty was abandoned by the USA, and eventually by Russia, Japan and Canada.

We would clearly not have known this if we were conducting analysis in 1997 – but the examples show that it is folly to assume that we can realistically believe targets much further ahead to be right.

Literature

- Bohringer, Christoph, Thomas F. Rutherford, and Richard S. J. Tol. 2009. "THE EU 20/20/2020 Targets: An Overview of the EMF22 Assessment." *Energy Economics*, International, U.S. and E.U. Climate Change Control Scenarios: Results from EMF 22, 31, Supplement 2 (December): S268–73. doi:10.1016/j.eneco.2009.10.010.
- Boyd, Rodney, Joe Cranston Turner, and Bob Ward. 2015. "Tracking Intended Nationally Determined Contributions: What Are the Implications for Greenhouse Gas Emissions in 2030? | Grantham Research Institute on Climate Change and the Environment." In . LSE. <http://www.lse.ac.uk/GranthamInstitute/publication/tracking-intended-nationally-determined-contributions-what-are-the-implications-for-greenhouse-gas-emissions-in-2030/>.
- Calvin, Katherine, Leon Clarke, Volker Krey, Geoffrey Blanford, Kejun Jiang, Mikiko Kainuma, Elmar Kriegler, Gunnar Luderer, and P. R. Shukla. 2012. "The Role of Asia in Mitigating Climate Change: Results from the Asia Modeling Exercise." *Energy Economics*, The Asia Modeling Exercise: Exploring the Role of Asia in Mitigating Climate Change, 34, Supplement 3 (December): S251–60. doi:10.1016/j.eneco.2012.09.003.

- Calvin, Katherine, Allen Fawcett, and Jiang Kejun. 2012. "Comparing Model Results to National Climate Policy Goals: Results from the Asia Modeling Exercise." *Energy Economics* 34 (December): S306–15. doi:10.1016/j.eneco.2012.03.008.
- Capros, P., L. Mantzos, V. Papandreou, and N. Tasios. 2008. "Model-Based Analysis of the 2008 EU Policy Package on Climate Change and Renewables." http://ec.europa.eu/clima/policies/strategies/2020/docs/analysis_en.pdf.
- CAT. 2015. "Climate Action Tracker Data." http://climateactiontracker.org/assets/Global/october_2015/CAT_public_data_emissions_pathways_1Oct15.xls.
- China INDC. 2015. "China INDC Submission." <http://www4.unfccc.int/submissions/INDC/Published%20Documents/China/1/China's%20INDC%20-%20on%2030%20June%202015.pdf>.
- Climate Interactive. 2015. "Data for INDC and Baseline." <https://d168d9ca7ixfvo.cloudfront.net/wp-content/uploads/2013/12/Climate-Scoreboard-Output-27Oct2015-to-share.xlsx>.
- EIA. 2015. *Data for Annual Energy Outlook 2015*. http://www.eia.gov/forecasts/aeo/tables_ref.cfm.
- EUINDC. 2015. "European Union INDC Submission." <http://www4.unfccc.int/submissions/INDC/Published%20Documents/Latvia/1/LV-03-06-EU%20INDC.pdf>.
- Fawcett, Allen A., Leon C. Clarke, Sebastian Rausch, and John P. Weyant. 2014. "Overview of EMF 24 Policy Scenarios." *The Energy Journal* 35 (01). doi:10.5547/01956574.35.S11.3.
- Knopf, Brigitte, Yen-Heng Henry Chen, Enrica De Cian, Hannah Förster, Amit Kanudia, Ioanna Karkatsouli, Ilkka Keppo, Tiina Koljonen, Katja Schumacher, and Detlef P. Van Vuuren. 2013. "Beyond 2020 — Strategies and Costs for Transforming the European Energy System." *Climate Change Economics* 04 (supp01): 1340001. doi:10.1142/S2010007813400010.
- Kriegler, Elmar, John P. Weyant, Geoffrey J. Blanford, Volker Krey, Leon Clarke, Jae Edmonds, Allen Fawcett, et al. 2014. "The Role of Technology for Achieving Climate Policy Objectives: Overview of the EMF 27 Study on Global Technology and Climate Policy Strategies." *Climatic Change* 123 (3-4): 353–67. doi:10.1007/s10584-013-0953-7.
- Lomborg, Bjorn. 2015. "Impact of Current Climate Proposals." *Global Policy*, November, n/a – n/a. doi:10.1111/1758-5899.12295.
- MIT. 2015. "Energy and Climate Outlook 2015." <http://globalchange.mit.edu/research/publications/other/special/2015/Outlook>.
- Netherlands EPA. 2015. "PBL Climate Pledge INDC Tool." <http://infographics.pbl.nl/indc/>.
- Rodney Boyd, Joe Cranston Turner, and Bob Ward. 2015. "Intended Nationally Determined Contributions: What Are the Implications for Greenhouse Gas Emissions in 2030?" Accessed November 25. <http://www.lse.ac.uk/GranthamInstitute/publication/intended->

- nationally-determined-contributions-what-are-the-implications-for-greenhouse-gas-emissions-in-2030/.
- Tol, Richard S. J. 2012. "A Cost-benefit Analysis of the EU 20/20/2020 Package." *Energy Policy*, Special Section: Fuel Poverty Comes of Age: Commemorating 21 Years of Research and Policy, 49 (October): 288-95. doi:10.1016/j.enpol.2012.06.018.
- UNEP. 2015. *Emissions Gap Report 2015*.
http://uneplive.unep.org/media/docs/theme/13/EGR_2015_ES_English_Embargoed.pdf.
- UNFCCC. 2015. "Synthesis Report on the Aggregate Effect of the Intended Nationally Determined Contributions."
<http://unfccc.int/resource/docs/2015/cop21/eng/07.pdf>.
- USINDC. 2015. "United States INDC Submission."
<http://www4.unfccc.int/submissions/INDC/Published%20Documents/United%20States%20of%20America/1/U.S.%20Cover%20Note%20INDC%20and%20Accompanying%20Information.pdf>.
- Veysel, Jason, Claudia Octaviano, Katherine Calvin, Sara Herreras Martinez, Alban Kitous, James McFarland, and Bob van der Zwaan. 2015. "Pathways to Mexico's Climate Change Mitigation Targets: A Multi-Model Analysis." *Energy Economics*. Accessed November 25. doi:10.1016/j.eneco.2015.04.011.

¹ https://www.ipcc.ch/publications_and_data/ar4/wg1/en/ch8s8-8-2.html,
http://unfccc.int/adaptation/nairobi_work_programme/knowledge_resources_and_publications/items/5430.php, http://ipcc.ch/pdf/assessment-report/ar5/wg3/ipcc_wg3_ar5_summary-for-policy-makers.pdf

² <http://climateactiontracker.org/countries/mexico.html>

³ <http://www.sciencedirect.com/science/article/pii/S0140988315001346>

⁴ <http://climateactiontracker.org/countries/china.html>

⁵ http://www.nytimes.com/2015/11/04/world/asia/china-burns-much-more-coal-than-reported-complicating-climate-talks.html?_r=0

⁶ http://unfccc.int/meetings/cancun_nov_2010/meeting/6266.php

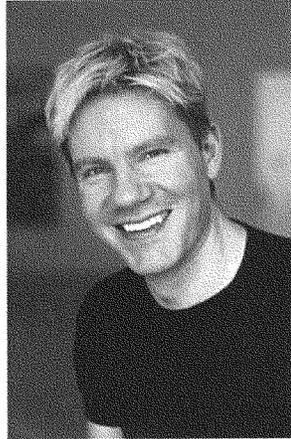
⁷ <http://www.presidency.ucsb.edu/ws/?pid=46460>

⁸ <http://www.washingtonpost.com/wp-srv/inatl/longterm/climate/stories/clim102397.htm>

⁹ <http://unfccc.int/resource/docs/a/18p2a01c01.pdf>

About Bjorn Lomborg

Dr. Bjorn Lomborg is an academic and the author of the best-selling "The Skeptical Environmentalist" and "Cool It". He challenges mainstream concerns about development and the environment and points out that we need to focus attention on the smartest solutions first. He is a visiting professor at Copenhagen Business School, and director of the [Copenhagen Consensus Center](#) which brings together many of the world's top economists, including seven Nobel Laureates, to set priorities for the world. The University of Pennsylvania asked almost 7,000 think tanks and thousands of journalists, public and private donors, and policymakers from around the world to nominate and rank the world's best think tanks. Copenhagen Consensus Center's advocacy for data-driven smart solutions to global challenges were voted into the top 20 among NGOs with up to 100 times' larger budget. The Economist said "Copenhagen Consensus is an outstanding, visionary idea and deserves global coverage."



Lomborg is a frequent participant in public debates on policy issues. His analysis and commentaries have appeared regularly in such prestigious publications as the New York Times, Wall Street Journal, USA Today, The Economist, The Atlantic, Forbes Magazine, Globe & Mail, The Guardian, The Daily and Sunday Telegraph, The Times, The Australian, the Los Angeles Times, Boston Globe and Der Spiegel. Lomborg's monthly column appears in around 40 papers in 19 languages, with more than 30 million readers. He is a television commentator on CNN, Fox, MSNBC and the BBC, among others, on shows such as "Newsnight", "20/20", "60 Minutes", "The Late Show with David Letterman", and "Larry King Live". He was featured in the movie "Cool it", by Sundance Award winning director Ondi Timoner.

Chairman SMITH. Okay. Thank you, Dr. Lomborg, for that great testimony. I will recognize myself for questions.

Actually, you've anticipated my first question, which was what impact would President Obama's pledge in Paris have on the Earth's climate? I think your word was it would have a trivial impact. You said all the pledges made in Paris would affect temperature by only 1/3 of a degree over the next 85 years, and the cost would be about \$1 trillion a day. Is that all accurate as a summary?

Dr. LOMBORG. Yes.

Chairman SMITH. Okay. Here's a more recent question that just came up this morning because President Obama has said a few hours ago that he blamed climate change for flooding in Miami, Florida. The President said you go down to Miami, and when it's flooding at high tide on a sunny day, the fish are swimming through the middle of the streets, there's a cost to that.

However, the President's statement that Miami flooding is linked to climate change in my view is entirely false and in fact disputed by meteorologists at the National Weather Service. Those meteorologists have reported that the lunar cycle and wind patterns are to blame for unusually high floods in Miami, not climate change.

Do you feel that the President's statement linking the Miami floods to climate change is just another example of alarmist rhetoric or do you think it's accurate?

Dr. LOMBORG. Unfortunately, I'm going to tell you a little more complicated story. I don't know the specific issue of Miami, but in general, it stands to reason that as temperatures rise, as sea levels rise, we will have more problems, for instance, with flooding. But what is incredibly important is to recognize that most of these things we know very well how to deal with at very low cost through adaptation. The simple answer is the Dutch have shown the way for a couple hundred years.

Chairman SMITH. Okay.

Dr. LOMBORG. So, again, trying to deal with this through climate policies is probably one of the least effective ways to help people who are actually flooded.

So remember, global warming is a problem. Global warming will cause problems, but the way that almost every catastrophe you see is being used as a way to bludgeon us to say we should cut carbon emissions as the only solution is unfortunately very often the worst or the least effective way to help.

Chairman SMITH. I understand, and I understand also and appreciate your talking about the need to put more funds into research and technology, and I totally agree with that.

By the way, if it comes down to choice of taking the meteorologist's word for it or the President's word for it when it comes to Miami flooding, every time I'll go with the meteorologist.

Let me go to Mr. Grossman for my next question, and it is this: How much impact on climate change, a little bit repetitive, will the Clean Power Plan have?

Mr. GROSSMAN. Well, by the Administration's own estimates, the impact is incredibly minor. And keep in mind that even assumes that the Clean Power Plan remains in law. In my view, the most likely outcome is that it has zero impact on climate because it is

ultimately struck down by the courts as both unconstitutional and inconsistent with EPA's statutory authority.

Chairman SMITH. And if it is unconstitutional, what impact does that have on the President's pledge?

Mr. GROSSMAN. It would actually have an enormous impact, something like half of the—actually more than half of the estimated reductions that are fully enumerated in the INDC that the White House has released are attributable to the Clean Power Plan. So if that's off the table, we're not—under the way they've enumerated, we're still 30 percent short. In that instance, I think we would be something like 80 percent to 90 percent short.

Chairman SMITH. Okay.

Mr. GROSSMAN. It's a very big gap.

Chairman SMITH. Okay. Thank you, Mr. Grossman.

Mr. Cass, is any agreement President Obama makes legally binding on the United States?

Mr. CASS. Well, I think, as Mr. Grossman testified, there are things that the President could agree to in Paris under his sole executive authority with respect to things like transparency and reporting measures, but he's not able to commit either to binding emissions reductions or to the appropriation of funds. Any of that would need to move through Congress.

Chairman SMITH. Okay. Thanks.

And who would be hardest hit in the United States if the President's emissions reduction passage was implemented? Yes.

Mr. CASS. I think the primary costs are in the energy sector and then on those who rely on the energy sector. So the expectation is certainly that electricity prices would rise, and that affects both consumers, as well as industries that rely heavily on the use of energy.

Chairman SMITH. And so the American family will pay a price?

Mr. CASS. That's exactly right, and that's what they've seen happen in Europe when they tried to pursue similar policies.

Chairman SMITH. Okay. Thank you, Mr. Cass.

The gentlewoman from Oregon, Ms. Bonamici, is recognized for her questions.

Ms. BONAMICI. Thank you very much, Mr. Chairman. And thank you to all the witnesses for being here.

I'm encouraged this morning because I heard both Dr. Lomborg and Chair Smith talk about the importance of investing in technology and research in clean energy. I absolutely agree. I also understand, however, that it's important to reduce carbon emissions while we're doing that.

Dr. Steer, thank you so much for being here. We appreciate your testimony. And you testified that businesses have recognized the economic value of action. And I agree. My home State of Oregon has many companies that have stepped up and demonstrated their commitment, companies like Nike, Genentech, Intel, Lam Research, Portland General Electric. They're among the more than 150 companies nationwide that have now signed the American Business Act on Climate Pledge. These companies have made business-specific commitments to take significant actions to address climate change, and they've expressed their support for a strong Paris agreement. And as we heard this morning, just a few days ago, Bill

Gates unveiled the world's largest clean energy research and development partnership, all very encouraging.

So, Dr. Steer, how are these businesses supporting a strong international agreement? Can you talk a little bit about why these business leaders see this not only as a critical issue but also as economically viable and valuable to their bottom line?

Dr. STEER. Thank you very much, Congresswoman.

And let me also say how pleased I am that we are in agreement on research and development and the kind of announcement that President Obama and 20 other leaders yesterday made on a doubling of research and investment for renewable energy is profoundly encouraging, especially when linked to the private sector and the efforts of Bill Gates.

The private sector has a very major role to play in the climate talks. This weekend, thousands of private sector leaders will gather in Paris, and they'll do two things. One, they'll say this is what we are doing. And many of them, for example, will say, look, we looked at the science. We have no actual obligations necessarily to reduce our own greenhouse gases legally but we're going to do it. And some of them are saying we're not only going to do better, we're going to do enough. That means that they are looking at the science and they're saying what would it take for us to do enough to reduce our greenhouse gases so that the problem will be solved?

And in Paris there will be a whole set of coalitions that are announced on renewable energy, on energy efficiency, a whole range of issues related to greening supply chains, deforestation. So first, they're saying here's what we're doing; and then second, they're saying to governments, look, we're keen to act but you've got to help us out here.

Since 1923, every economist has told us—since Professor Pigou at Cambridge University showed how you price externalities—that it is much better to tax bad things than good things. Stop taxing good things like your work and your profits and start taxing bad things like congestion and pollution. If you do that, the private sector is saying, you'll help us a lot because you'll shift the compass and you'll once and for all say we're going in this direction, which is better for our grandchildren rather than this direction.

The problem they have at the moment is it's sort of a dance. They don't know whether we're heading towards a low-carbon future or a high-carbon future. So they're saying please—to the government—act firmly, clearly, set a long-term target.

Ms. BONAMICI. Thank you. And you talked about here the private sector, but you also state that a growing body of evidence shows that economic growth is not in conflict with efforts to reduce emissions of greenhouse gases. And you mentioned the role of sub-national actors like States in addressing climate change. Portland, Oregon, Mayor Charlie Hales is in Paris speaking as we speak.

So when I served in the Oregon Legislature, we passed a renewable portfolio standard to require large utilities to increase the use of renewable resources. That and other policies and commitments have created meaningful employment in that sector, in clean energy. Can you talk further about your statement that environmental protection and economic development go hand-in-hand, es-

pecially when you combine the private sector and then the sub-national actors as well?

Dr. STEER. Yes, indeed. It wasn't long ago when we really did believe there was a tradeoff. It'd be nice to address climate change but it would cost us a lot. We've learned so much in the last few years. Even if one looks at the performance of stock markets, you will see if you take, for example, the CDP green index, you'll see over the last four years they performed considerably better than just any old Standard & Poor's index, for example. So going green actually pays.

And as you say, Congresswoman, that the States that have put renewable energy standards, it turns out that actually citizens are saving money, just as we show that, for example, having fuel economy standards will save consumers—the new fuel economy standards will save consumers, you know, several thousand dollars in fuel over the life of the vehicle.

And so adding these things together, there is a dynamism here that actually—that economic models can't capture very well. And here I do agree with my good friend Bjorn Lomborg here. I mean, economic models actually are deeply flawed in the sense that the economy is really a very dynamic thing. And it turns out the five things that I mentioned all add—all move in the same direction to show that actually climate action can lead to more economic growth. But very few economic models can really capture those well.

Ms. BONAMICI. Thank you, Dr. Steer. I see my time is expired. I yield back. Thank you.

Chairman SMITH. Thank you, Ms. Bonamici.

The gentleman from Oklahoma, Mr. Lucas, is recognized for his questions.

Mr. LUCAS. Thank you, Mr. Chairman.

Mr. Cass and Mr. Grossman, would you characterize any of the policies discussed in the United States such as major industrial CO₂ restrictions as flexible or adaptive? Either one, gentlemen.

Mr. CASS. I would not. I think the Clean Power Plan in particular is marketed in that way but has been designed by EPA to give States very few options in how they proceed.

Mr. LUCAS. And would either one of you care to address how those restrictions will impact the industries and the consumers of those products ultimately?

Mr. CASS. Sure. Essentially, what the Clean Power Plan attempts to achieve is to implement a cap-and-trade system on the country in direct contravention of the decision of the Congress not to implement such a cap-and-trade plan. And what that will do is force States to install significant amounts of renewable energy in place of the reliable fossil fuel baseload that they use today.

The impact of that is to replace lower-cost energy sources with higher-cost energy sources, and it does not take a very sophisticated economic model to conclude that replacing lower-cost sources with higher-cost sources is unlikely to reduce costs.

Mr. LUCAS. And the net effect is giving government the control over both the production and, in effect, the consumption of energy, which is a major expansion of economic power. Fair assessment, gentlemen?

Mr. GROSSMAN. If I could, it is. And it's one, interestingly enough, that this Congress has rejected on any number of occasions, holding that, you know, the mix of electricity and energy sources is something that really is left to the States for their regulation and something that has never been federalized and that, you know, has been resisted as a federal encroachment on State authority. And so this really—the EPA's actions turn that on its head.

Mr. LUCAS. I'm going to take that one step farther. We are—we live in a very intensive energy consumption society in both the manufacturing and in our personal consumption. Would the federal government, having that kind of control over both the production of and the consumption of energy, picking winners and losers so to speak, it's fair to say that from this vantage point it's almost unimaginable what the consequences could be. Fair assessment, gentlemen?

Mr. CASS. I think that's correct. And if I could make one additional point—

Mr. LUCAS. Please.

Mr. CASS. —I think what we are seeing in the debate over the Clean Power Plan and the economic affect is really a very fundamental debate over whether an agency like EPA can manage a sector of the economy better than it will manage—be managed and operate in the free market.

And so if you take, for instance, the testimony of Dr. Steer, the assumption he is making is that, in fact, we will get better efficiency and economic growth through government regulation than we get through the free market. I think that is something that has been asserted by those in favor of more government power at many points in history, and I think that is something that almost never works, and that there's no evidence it would work better in this situation.

Mr. LUCAS. And isn't it a fair assessment to say that industry already is in effect being stampeded as they try to figure out what's coming and how to prepare for that?

Mr. CASS. That's absolutely true. I think one very concerning thing about the way that the EPA has operated is to essentially put forward rules that in many cases it realizes it may not have the authority for and simply force industry to respond before the courts can throw out the rule.

I think we saw this in the Supreme Court's decision in *Michigan v. EPA* where it said EPA had overstepped its authority, and the EPA spokesman almost immediately put out a statement essentially saying, well, too bad; industry already had to adapt before you made your ruling so your ruling won't have much effect.

And they're trying to do something similar with the Clean Power Plan, forcing States to move forward into a cap-and-trade structure before the question of authority is even resolved.

Mr. LUCAS. When I was a kid at home, we would have called that the bully bluffing.

Mr. CASS. That would be a fair description.

Mr. LUCAS. Thank you. Mr. Chairman, I yield back.

Chairman SMITH. Thank you, Mr. Lucas.

The gentlewoman from Maryland, Ms. Edwards, is recognized.

Ms. EDWARDS. Thank you very much, Mr. Chairman. And thank you to the witnesses today.

I have to say I am just, you know, staggered yet again by a conversation where people acknowledge that there's climate change happening, but because we can only do things that are small or trivial, it seems worthless to do anything.

Dr. Steer, you pointed out in your testimony that opponents of acting on climate change often state that the Administration's Clean Power Plan will be expensive, technically difficult, and not have meaningful impact on emissions. Given the history of this committee, I can't help but be reminded of what President Kennedy said when he charged the Nation to go to the moon. He said we do these things "not because they are easy, but because they are hard; because that goal will serve to organize and measure the best of our energies and skills; because that challenge is one that we are willing to accept, one we are unwilling to postpone."

It does appear to me that what the Administration is doing with the Clean Power Plan and the commitment to the United Nations embodies the spirit of what President Kennedy was getting at. And to that end, Dr. Steer, I wonder if you could please elaborate on a statement that you make in your testimony that the United States' carbon reduction targets are in fact achievable. Can you just describe how the United States can reduce carbon emissions to meet both its 2020 and '25 targets? And tell us what kind of market signal is being sent by these emissions targets.

Dr. STEER. Thank you very much. Yes, we've done a great deal of analysis of this both at the overall national level and at the State level as well. We've produced a report which lays out 10 actions that can be taken that actually will benefit business. Compliance costs, as you know, are estimated by 2020 about 1.4 billion to 2.5 billion, but the health impacts alone, the benefits from health alone are 3.5 to 8.1 billion. If you go further out, the compliance costs rise to about 5 billion, but the health benefits alone are 32 billion. So—if you include climate benefits as well.

So in other words, what you have got is a multiple of benefits compared to the costs. What we see is the—whether it's in energy efficiency, whether it's in expanding the fuel efficiency of vehicles, but also the power plant rule itself can be very, very doable and positive.

Ms. EDWARDS. Thank you. And of course that drives both investment and spurs innovation in the clean energy technologies, which you also point out.

And, Dr. Steer, I wonder if you could—and referring to Dr. Lomborg's testimony, he states, "yes, manmade global warming is a reality and will in the long run have an overall negative impact." However, Dr. Lomborg also suggests in his testimony that the cost of acting to address climate change would be very large with little impact. Do you agree with this assessment, and if not, why not?

Dr. STEER. Well, I certainly agree with his assessment on the need for R&D. I do not agree with his assessment on his modeling. Look, modelers can—I've been a modeler a lot of my life. You can choose any assumption. So what Dr. Lomborg does is he assumes that after 2030 countries will go back to their old ways. In other words, when China says we are going to peak our emissions, actu-

ally, as soon as they reach 2030, they're going to start increasing again.

So if you make that kind of assumption, you are going to find that the impact is not very good and the costs are high. In fact, what will happen between now and 2030, because of the action, the price of technology will fall, as already is the case in many technologies. Renewables are increasingly more attractive. And what one will find is that there will be a virtuous cycle that happens, led by the private sector but empowered by clear signals from the public sector.

Ms. EDWARDS. And that kind of assumes that, even as consumers, that we would want to go back to our old inefficient dirty cars, that we would want to go back to the old technologies that we use in our homes for heating and air-conditioning. There are a lot of assumptions that go into a model where you basically stop in place instead of moving forward from that point, isn't that right?

Dr. STEER. Yes, absolutely. And this has nothing to do with government versus private sector. I mean, Mr. Cass said that I was assuming that the government should be in charge of energy efficiency and everything. That's not the case at all. It will be the private sector that leads, but the government has a role to play for all kinds of well-known reasons that economists understand.

So, for example, the Energy Star program in the United States has saved household utility bills 360 billion since 1992. Do households want to go back to their old ways? Of course they don't.

And what we're going to see actually is a very interesting dynamic take place. In the United States and in most other countries around the world, cities over the last hundred years have been designed for automobiles rather than people. And so in the United States we lose \$1 trillion of GDP a year due to what's called sprawl. And this is technically estimated. A growing number of mayors around the world are saying actually, we don't want to do that.

Houston, Texas, spends 14 percent of its citizens' income on traveling back and forth to work. Copenhagen spends four percent of its income. So once you can understand that actually having a more compact and connected city that's designed around people, so that's a dynamic that won't happen immediately, but by 2030, you watch. That will be happening precisely because of the dynamic reasons you're talking about.

Ms. EDWARDS. Thank you. Thank you, Mr. Chairman.

Chairman SMITH. Thank you, Ms. Edwards.

And the gentleman from California, Mr. Rohrabacher, is recognized.

Mr. ROHRABACHER. Yes, I'm pleased that you have a good idea of how the rest of us should live and where we should live and how close to the cities. And I don't think that's consistent with a free society, but I'm very pleased that you are able to express those views today. And I admire your courage to being here and—today. You've made some good points and you've got three other witnesses on the other side. Thank you for being here to give us some kind of balance to this. And the Chairman has seen—did invite you and you were invited by the minority also to provide that.

But you've made a couple points that I thought that Mr. Lomborg—you mentioned his testimony. Maybe he'd like to have a chance to comment on what your comments were. Mr. Lomborg?

Dr. LOMBORG. Well, thank you very much. And the short version is, again, I'm very happy that we are both in agreement about the need for research and development. But if you look at what you think about the actual impact of Paris, now, there's definitely many different ways, as Andrew Steer pointed out, many different ways to do the modeling. But I would surmise that if you're going to look at what the impact of Paris—you look at what's actually promised in Paris, you don't look at all the extra things we might hope and wish and wait for the world is going to do in 2040, 2050 and on, unfortunately, that's almost all of what we're talking about here.

As I tried to show, right now, Paris is promising about 50 gigatons of CO₂ cuts. That is if everybody does everything they promised. Of course, remember back, Kyoto did not work out that way. And if we go even further back in 1992 in the Rio Summit, all industrialized nations promised to cut their carbon emissions to 1990 levels in 2000, and almost none of them, except for the Eastern European bloc, kept that promise. So fundamentally, we have lots of wasted promises.

But even then assuming that we'll have the 50 gigatons and then suddenly we will somehow magically get to 3,000 gigatons in order to get to 2.7 degrees, or 6,000 gigatons in order to get to 2 degrees is to me a very, very unlikely outcome.

So if you'll allow me the metaphor, in some ways this is a little bit like, you know, looking at the Greek tragedy, the debt tragedy, and saying, oh, if they had decided they're going to pay off the next tranche of one of their loans in the next couple of months, hey, they're on their way to being debt-free. I mean that's technically true but very, very misleading because it means there's lots and lots of hard decisions that have to be taken in decades to come. And that's really the same conversation that we're having with this climate discussion. You can't just say, well, we're not only going to do this for 2030, but we'll do all kinds of great things on the way through the century.

Mr. ROHRABACHER. Yes. One question of my own and then I'll let Dr. Steer have his retort to that. How much of the—we all admit that there's a changing of the climate. It's changed forever. I mean, the history of the globe is a constant change in the climate, constant adaptation of the planet to different factors that are going on. The question is, what impact is man having on the climate?

And I recognize myself that we've had a lot of people advocating these restrictive policies. For example, the opposition to the Alaskan pipeline was long before anybody ever talked about global warming. People—and they were—it only won by one vote. The Alaskan pipeline only won by one vote in the United States Senate, and if they had all those—it had nothing to do with climate change then. It's just—there's a lot of people using climate change to achieve other goals.

But what is—to the degree that the climate is changing because of nature, how much of that, Dr. Lomborg, how much of that is a result from CO₂?

Dr. LOMBORG. Well, unfortunately, I an economist and a political scientist. I'm a modeler so I'm just going to give you the standard IPCC answer, but it's more than half. But I think you're very right in pointing out that because we know that we have survived many other changes in climate previously, we have to realize it's not the only way to deal with global warming to say let's cut carbon emissions and to keep temperatures at the same level. We also need to ask is it actually more efficient to adapt? And we definitely need to do both.

Mr. ROHRABACHER. I think Dr. Steer needs to have some time to retort that. Go right ahead.

Dr. STEER. Well, thank you very much.

Mr. ROHRABACHER. I've only got 10 seconds so—

Dr. STEER. Oh, thank you, Congressman, very much. By the way, it's not me who's suggesting where people should live. These are the mayors of cities who are democratically elected by their citizens.

Look, Bjorn Lomborg has made certain assumptions. A professor at LSE Bob Ward said rather than calling it optimistic and pessimistic, we should call them highly pessimistic. So, too, a professor at MIT John Sterman says that Mr. Lomborg's assumptions grossly misrepresent the pledges that are being made at Paris. And so, you know, we can make any kind of assumption we want.

But here's the point about whether or not this will continue. Consider Prime Minister Modi of India. He came into power last year not because he wanted to solve the environment. He came because he wanted to promote growth. One of the first things he says, he says I have 4 gigawatts of solar energy. The previous government had a target of 20 gigawatts. He said I want 100 gigawatts of solar energy by 2022. He didn't say that because he's a member of the Sierra Club. He said that because he thinks that will be good for his economy. And he's right. And he's not going to turn around. He wants to make the point that actually there's something dynamic going on here relating to these technologies and the jobs that come from it, new industries that will actually set his country on a more competitive path.

Chairman SMITH. Okay. Thank you, Mr. Rohrabacher.

The gentleman from New York, Mr. Tonko, is recognized.

Mr. TONKO. Thank you, Mr. Chair.

As we speak, thousands of people have gathered in Paris for the U.N. climate change conference. And at this time more than 170 countries have made intended nationally determined contributions, the INDCs we've heard of, outlining their commitments to reducing greenhouse gas emissions. These commitments cover nearly 95 percent of global greenhouse gas emissions. This is incredible momentum for an agreement, and it demonstrates the potential to achieve real progress using a bottom-up, inclusive approach to climate policy.

We've always been able to improve the air we breathe and the water we drink, while simultaneously growing our economy and creating jobs. And I strongly believe that this will continue to be the case as we work to mitigate and adapt to climate change.

An agreement in Paris certainly will not solve our climate crisis but is an important step forward. We need global cooperation from

nations, subnational governments, businesses, and researchers. There may be difference of opinion around the world about the exact actions we should take, but I strongly agree with Dr. Steer that something must be done.

Dr. Steer, New York has had a number of devastating natural disasters in recent years, including devastation from Super Storm Sandy, Hurricane Irene, and Tropical Storm Lee. In New York's 20th Congressional District, my home district, we used to talk about storms that came once every hundred or 500 years. This type of talk is no more with devastating weather events happening time and time again. I've sat with families who have lost everything and have witnessed the exorbitant cost that we are still trying to pay off from these extreme events.

So I ask, in your testimony you discuss how extreme weather events are incredibly expensive. How do these costs affect communities and the Nation overall, and should we be factoring in these costs when calculating the overall cost of climate change?

Dr. STEER. Thank you, Congressman. Yes, we definitely should. You know, it's so tempting to look at the economy, but actually these are human lives we're talking about. And whether it's in New York City or it's suburbs or whether it's in Bangladesh, the potential impact is vast on families.

We cannot say that any particular extreme weather event is caused by climate change, but what we can do is say that the science, at least 97 percent of the leading science predicts that they will be more and more intense. That is clear.

The interesting thing is the insurance companies seem to believe them because they're saying we need to act on this. And so it's not only the scientists, it's actually business now are saying this is not good enough.

Mr. TONKO. Thank you. And one of the findings of the United States National Climate Assessment is that the impacts related to climate change are already evident in many sectors and are expected to become increasingly disruptive across the Nation through the century and beyond.

In your testimony you mention the cost of delaying action, including concerns about national security and mounting harm to businesses, consumers, and public health. Can you please elaborate on the cost of not acting to address climate change on the United States?

Dr. STEER. Well, each year we delay it will become more expensive. If we act strongly now, we can have a relatively smooth path in which we continue to grow and prosper each year, and we can keep growing and growing.

If we fail to act soon, then the cost of adjustment will be much greater, and of course every year we get close to potentially very bad tipping points.

Mr. TONKO. And in your testimony you state that businesses have recognized the economic value of action. In fact, Bill Gates unveiled the world's largest clean energy research and development partnership yesterday. Can you please comment on the importance of the private sector in addressing climate change?

Dr. STEER. Yes, Congressman. The private sector is—at least a good proportion of it now is very, very concerned. The private sec-

tor does not like policy uncertainty, and they don't like risk. And the risks they face at the moment are twofold from climate change. One, the climate itself will undermine what they're doing as it changes; and second, they don't know when a policy reform will be brought in. And that may lead to billions of dollars of stranded assets. And so they face these two risks and they are saying we want some policy certainty. And they also believe that their own long-term bottom line is healthier with action on climate change.

Mr. TONKO. Okay. With that, I yield back, Mr. Chair.

Chairman SMITH. Thank you, Mr. Tonko.

The gentleman from Texas, Mr. Weber, is recognized.

Mr. WEBER. Thank you, Mr. Chairman.

A question for each of the three of the panelists here first and then we'll go on to the video gentlemen. Range of the temperature increase that you consider would be happening with climate change, Mr. Cass, did you have an estimate for that, the range of the temperature increase by the end of the century?

Mr. CASS. As Dr. Lomborg said, I think I would also look at what the IPCC has projected, which, depending on the scenario you use, I think a number between 3.5 and 4 degrees Celsius is probably the best available estimate.

Mr. WEBER. Mr. Grossman, same question.

Mr. GROSSMAN. Mr. Congressman, I'm an attorney. I'm not a climate scientist or anything of the sort. But, you know, you look at the agreement here and all of that and you kind of wonder, you know, is it going to make any difference at all, I don't know.

Mr. WEBER. Okay. And, Dr. Steer?

Dr. STEER. Without action, by the end of the century between 3.8 and 5 degrees Celsius with sea level rise of about 1 to 2 meters.

Mr. WEBER. All right. I got the sea level rise as a bonus.

And, Mr. Lomborg, how about you? Did you—

Dr. LOMBORG. Well, again, I would also take my starting point with the U.N. Climate Panel. If we don't do anything, they find that the likely range towards the end of the century for RCP 6 is 1.4 up to 4.8 for RCP 8.5. And again, the sea level rise would be somewhere between half and a full meter. I'm very surprised with Steer's 2 meters. That's certainly not in the standard range.

Mr. WEBER. Okay. Thank you.

Gentlemen, as the President flies over to Paris to attend something that Mr. Cass and Mr. Grossman says he doesn't have the authority to do or that you've showed that he doesn't have the authority to do, is there any idea of what that—has anybody done the research? Do you know what that costs the American taxpayer? Anybody have that figure? Dr. Steer?

Dr. STEER. I beg your pardon, the cost of the—

Mr. WEBER. The cost of his going over to Paris for the climate negotiations that these two gentlemen have shown that he doesn't have the authority to do without, you know, Congress weighing in to spend the money for what he wants to agree to.

Dr. STEER. I could talk about the cost of the Clean Power Plan but not about his trip to Paris.

Mr. WEBER. Okay. Do any of you have—go ahead, Dr. Lomborg.

Dr. LOMBORG. Sorry. I mean if you use the latest Stanford Energy Modeling Forum for the United States and estimate what is

it going to cost to cut 26 percent below 2005 by 2025 with the most efficient metric possible, so remember, this does not include—

Mr. WEBER. Well, but I'm—

Dr. LOMBORG. —undoubtedly, it's not the most—

Mr. WEBER. Dr. Lomborg, I'm just talking about his trip, just his trip over there.

Dr. LOMBORG. Oh, I'm sorry.

Mr. WEBER. No, I got you. I got you. All right. Let me move on.

Does anybody know what the cost in terms of the output of the CO₂ are for the trip? Everybody seems to be concerned about the cost of the output of CO₂. Has anybody calculated that? Dr. Steer, I'll start with you.

Dr. STEER. No, Congressman.

Mr. WEBER. Dr. Lomborg?

Dr. LOMBORG. No, I don't know.

Mr. WEBER. Okay. So climate change—Dr. Steer, you made the comment earlier—or actually, I think Dr. Lomborg said that he quoted people saying we're actually going to make money from this. Well, there's people making money from pushing climate change, no question about it, in my estimation.

One of the proponents of climate change on a national stage is actually presidential candidate—is reported to be saying—Bernie Sanders—that climate change caused the rise of ISIS. Are y'all aware of that? Just as a question, Mr. Cass, would you agree with that assertion?

Mr. CASS. No.

Mr. WEBER. Mr. Grossman?

Mr. GROSSMAN. Of course not.

Mr. WEBER. Dr. Steer?

Dr. STEER. In the eight years leading up to the Syrian Civil War, there was a drought—

Mr. WEBER. Okay.

Dr. STEER. —so, too, in northeast Nigeria where Boko Haram has emerged there's been a drought—

Mr. WEBER. So back when the Sunnis and the Shias split some six, seven, eight hundred years ago, was that because of climate change?

Dr. STEER. No, I'm not making that link at all, sir.

Mr. WEBER. Oh, I got you. Okay. Smart man in that regard.

Dr. Lomborg?

Dr. LOMBORG. It's very, very tenuous, that connection.

Mr. WEBER. Okay. One of the other comments was made—and I'm going to move on very quickly now—that Kennedy wanted to go to the moon and so people—and that was a good thing and we're going to—climate change ought to be tackled because it's hard as well. But refresh my memory from the historical perspective because y'all have checked into this, back then, Congress was with him and actually appropriated the money to do that. Is that correct, Mr. Cass, your recollection, or Mr. Grossman?

Mr. GROSSMAN. That's absolutely correct, and indeed, that was—the President put special emphasis on that.

Mr. WEBER. Right. And so you had the people with him at that point.

Mr. Chairman, I yield back.

Chairman SMITH. Thank you, Mr. Weber.

And the gentlewoman from Massachusetts, Ms. Clark, is recognized for her questions.

Ms. CLARK. Thank you, Mr. Chairman, and thanks to the witnesses.

Dr. Steer, if I can follow up, what we're hearing from Dr. Lomborg is small impact on what we're going to do in Paris, big cost that far outweighs, and we could spend our resources better. How is that analysis changed when we look at what you are saying are what I believe the false assumptions that at—by 2030 we would just go back to what we were doing before? Does that change your analysis or do you see what we're starting in Paris as part of iterative process that would move forward to different policies?

Dr. STEER. Thank you, Congresswoman. Yes, exactly right. You put it exactly right, I think.

Look, one thing that does have to be made clear is that the—that in Paris there needs to be some tough negotiating to make sure that everyone is transparent, to make sure that every five years we do come back and we ramp up our ambition, and that we have a long-term goal.

So I'm not sitting here today to tell anybody that Paris is solving the problem. I have no incentive of exaggerating the benefit of Paris. Why? Because I want to solve the problem of climate change. If I believed Mr. Lomborg, I would say it because I would be upset at Paris. The estimates we've done—and we've got very, very good economists working across a lot of different models—is that actually—that the actions in Paris are quite significant, but they are not enough. And what we have to do is get precisely the kind of dynamism that's in your question playing through. And the way you do that is have really tough transparency, you have really clear renegotiation every five years to ramp up ambition.

Ms. CLARK. And that is necessarily a process that we have to go through, that we didn't come to this point—and what I'm heartened by by Dr. Lomborg is, unlike some previous witnesses we've had that have said, yes, climate change is a huge problem, it's going to be devastating to agriculture and our economy, but in the end we must continue the status quo, business as usual, at least Dr. Lomborg is saying we should be investing in research and development, which we all—well, certainly the two of us agree that that is where we need to also be working on.

But it sort of brings me to looking at RGGI, which you brought up in your testimony, coming from Massachusetts, looking at the successes of that, and talking about taxation and creating the right incentives so we grow our economy, we create jobs of the future, would you say that a key piece of the policy moving forward after Paris is looking at setting market prices for carbon?

Dr. STEER. Yes, indeed I do. I think that the—I am a strong believer that the President's Clean Power Plan is a good plan, but it would be better if it were complemented with a serious price on carbon. As I said before, this has nothing to do with big government or small government. This has to do with putting a price on things that are hurting citizens and not putting a price on things that are helping citizens like hard work and profit. So we should

shift the tax, as fiscal economists have been saying for many decades now, but very few countries have actually managed to do it.

So I agree very much with you. The States that are part of RGGI have been growing more rapidly than States that are not part of it, and serious analyses have been done on that.

Ms. CLARK. And do you think that it would take setting that at a national level to really see the promise of RGGI—I mean is that a place for American leadership?

Dr. STEER. Well, there are now about 40 countries that are setting a price on carbon, and many others are considering it. Even countries like South Africa will be introducing a tax on carbon soon and offsetting it against reductions in taxes elsewhere. By 2017 China will have a nationwide cap-and-trade. We don't need a nationwide tax or price on carbon, but it would certainly help a lot.

Ms. CLARK. Great. And talking about American leadership, in Paris what do you see—what does it mean to the other countries to have us there and to be present and to be leading in this area?

Dr. STEER. Oh, look, I was in China last week. I absolutely am certain that the radical change in the Chinese position since Copenhagen or really since three years ago is due to conversations and serious negotiations with the United States. And so, too—others are coming along, too.

And interestingly, yesterday, when the R&D proposal was announced—it includes developing countries like India, like China, like Indonesia—this would not be happening, this level of coordination, had it not been for the United States, and certainly, we would not have 183 countries which have now made pledges for 2025 and 2030.

Ms. CLARK. Thank you. I yield back.

Chairman SMITH. Thank you, Ms. Clark.

The gentleman from Texas, Mr. Babin, is recognized for questions.

Mr. BABIN. Yes, sir, Mr. Chairman. Thank you.

Very interesting. Thank you, witnesses, for being here.

Mr. Cass and Mr. Grossman, the Paris conference appears to be all about climate financing. I heard Dr. Steer a while ago was talking about how enthusiastic the Indian Prime Minister was in Paris. Maybe that has to do with all the wealth transfer that the developing nations might be getting from the developed nations.

But not only is the United States supposed to hobble its own economy with the Clean Power Plan in the name of the President's climate agenda, it must also pay billions to these developing countries. Do you agree with my assessment that we are transferring wealth?

Mr. CASS. That's certainly what is being expected of us and what I think President Obama would like to commit to. Until Congress appropriates it, though, it will not actually go out the door.

Mr. BABIN. Right. And how about you, Mr. Grossman?

Mr. GROSSMAN. I agree with that. I mean that's—you know, the idea that we would be transferring wealth in the form of foreign aid is an integral part of the agreement, albeit one that, given the legal—current legal authority, is not enforceable at this time.

Mr. BABIN. Right. Okay. And this is for Mr. Cass, Mr. Grossman, and Dr. Lomborg. I'm worried that regulations associated with cli-

mate change will increase the cost of energy to American citizens and especially my constituents in east Texas. Could you describe how increased energy costs impact the macroeconomic health of the United States both for primary energy users and end-use consumers?

Mr. GROSSMAN. Well, I think one thing to note in particular is Texas is in a very unique situation, is uniquely harmed by the Clean Power Plan and by other regulations that increase the cost of energy. Texas is on its own grid and—known as ERCOT, and so for that reason what we've seen is regulations that affect the use of traditional fuels in that area tend to cause price spikes within the Texas area, which is something that potentially is very damaging to Texas's economic growth. And, you know, to this date it's been one of the bastions of growth in the country. And, you know, if you looked at the overall energy policy and how it affects Texas, that status is potentially at risk.

Mr. BABIN. Thank you. Mr. Cass?

Mr. CASS. Well, I think we actually have the Clean Air Act to look at in this respect to understand what happens when you see regulations on the energy sector and other heavy industry. And I provide the citations in my written testimony, but there's very good peer-reviewed research that has been done on what happened when we applied strict pollution controls in that context. There was the loss of hundreds of thousands of jobs, the long-term reduction in the earnings of people in affected industries, decline in the profitability of manufacturing, and also a sharp decrease in the number of new facilities that were opened.

And again, there may be benefits to offset costs in some contexts, certainly the Clean Air Act has achieved significant public health benefits, but it's critical to understand what those costs are and understand that in the Clean Power Plan we are taking on the costs and yet we're not getting the benefits.

Mr. BABIN. Right. Okay. Thank you.

And, Dr. Lomborg, are you still there?

Dr. LOMBORG. Yes, I am. And, you know, very bluntly, yes, of course, if you increase the cost, if you say you have to buy energy that's more costly, the price will go up. But what we've also seen in Europe is that we have dramatically increasing power costs. The—Germany and Denmark, I'm sorry to say, are the most expensive countries in the world for energy, certainly in the industrialized world, and the costs are typically in the order four times as costly as what your constituents are paying for their electricity. So, yes, it really does have impacts. And of course, remember, this is a regressive tax because the poor will actually end up paying the most.

And what we're seeing, for instance, in many places in Europe there's—there are a lot of people who are now no longer able to pay their electricity bills. For instance, in Britain there is an increasing number of people who are energy-poor who are spending a very disproportionate part of their income on paying off energy and have to make very hard decisions on which rooms do I want to keep heated during the winter.

Mr. BABIN. Okay. Thank you very much. And then also, just yes or no, do high energy prices spill over and translate and impact ev-

everyday items like cost of groceries, everyday goods and services? And are there other areas where energy prices will impact the United States and especially my district in Texas? Can energy prices impact national security or the stability of financial markets? Mr. Grossman?

Mr. GROSSMAN. Yes. Energy is an input into everything that we do.

Mr. BABIN. Absolutely. Okay. Mr. Cass?

Mr. CASS. Yes, I would agree with that and note that it also poses a competitive problem for the United States against countries that are not imposing similar costs.

Mr. BABIN. Okay. And, Dr. Lomborg, are you still—

Chairman SMITH. The—

Dr. LOMBORG. Yes, it does have real impact. So everything else gets more expensive.

Mr. BABIN. So the American people will suffer the consequences of this plan is what it looks like to me. Thank you very much.

Chairman SMITH. Thank you, Mr. Babin.

The gentleman from California, Mr. Takano, is recognized.

Mr. TAKANO. Thank you, Mr. Chairman.

Mr. Chairman, I would like to point out that President George W. Bush deserves some credit for the point we are at with the Paris climate talks. It was his Administration in 2007 that negotiated the Bali Action Plan that eliminated a major roadblock to international climate policy. Developing countries such as China, Brazil, India, and South Africa finally went on record and agreed to submit their own cleanup plans. This set the stage for the negotiations taking place this week. So congratulations, President George W. Bush, for getting us to this point.

Dr. Steer, the United States has a long history of leading global efforts on issues that have impacts beyond our borders. In the past, these kinds of global partnerships have had positive impacts on human rights issues, world trade, world health, trade, and technology innovation. It should be—it should surprise no one that the United States is now ready to lead the international response to climate change.

In a relatively short period of time, we have seen developing nations step up and make commitments to reduce their GHG emissions.

Dr. Steer, how has the United States' willingness to act decisively on climate change affected the response from the rest of the international community?

Dr. STEER. Thank you, Congressman. The United States is the leader in the world on technology. And its technological advances over the last few years have made it much easier for others to join in the discussion.

Second, the fact that the United States is now taking firm action itself puts a lot of pressure on others. And the diplomatic efforts of the United States have been very, very positive in bringing the 183 countries that are now signing up to action.

Mr. TAKANO. Well, thank you very much. I yield back, Mr. Chairman.

Chairman SMITH. Thank you, Mr. Takano.

And the gentleman from Michigan, Mr. Moolenaar. Woops. I am sorry. The gentleman from Georgia, Mr. Loudermilk, is recognized.

Mr. LOUDERMILK. Thank you, Mr. Chairman. I appreciate this hearing.

Something that Mr. Lomborg stated a minute ago really had an impact on me is the cost of electricity in Europe has dramatically risen. And it's four times what it was. And what I've read about the CPP, the effect it would have in Georgia is an increase of about 17 percent. And 40 percent of Georgia's electrical customers earn less than \$40,000 a year.

So I'm having some grave concerns, as it was already stated here today, that these regulations impact the most vulnerable. They have the greatest impact on the most vulnerable in our society. It's not just in climate regulation. If you look at Dodd-Frank, Dodd-Frank had a negative impact on Wall Street. It had a negative impact on the big mega businesses. But it was devastating to small struggling businesses because the big businesses can absorb the additional cost. The big businesses, it's going to have an impact. The CPP will have an impact, but they'll be able to absorb these costs.

One way that they'll absorb the costs is to cut their spending by laying off employees. They're already talking about closing a power plant in my district, possibly up to 2,000 jobs being lost.

I want to use not modeling or hyperbole but real-life instances of how this diminishing return of over-regulating affects the lives of everyday struggling Americans. I have an article here from National Public Radio, which is not known to be a strong right-wing publication by any—or radio outlet by any stretch of the imagination. It's talking about a 65—or an elderly woman that basically—her name is Lydia Smith. She's 87 years old, and she's living on \$900 a month Social Security. That's all that she has. She has no retirement after working as a store clerk for most of her life. She never saved. As you're finding out today, a lot of our Baby Boomers have not saved for retirement. They're living on a fixed income that comes in.

Even though she gets Section 8 housing, she still pays a third of her income, \$300 goes to rent. She spends \$600 on everything else, everything else that she needs to live. She rarely leaves home. In fact, it says in the interview that she mostly exclusively shops at Goodwill because that's all she can afford. And what does she shop with? Well, her residual income is \$20, \$20. That's her residual income that she has to live on.

Under the CPP it's estimated that her power costs will go up \$20. So what is Ms. Smith to live on? What is going to happen when her electricity prices go up? She's on most every government program except for food stamps at this point. Not only is it going to have a devastating impact on her, but when you look at what the impact it's going to have on businesses, and again, reiterating what everybody's said here, it's going to be a minimal impact on the climate, but we're going to see a significant impact on the lives of human beings in the name of making a statement or the hope that we may get some kind of .007 degree decrease in temperatures that we're not even totally sure that we're causing.

I don't understand how we go down this path to the point of diminishing returns and then, when these businesses get the impact,

they're going to lay off more and there are going to be more people in the position of Ms. Smith.

Mr. Cass, am I totally off base or is this the direction that we're going with these radical climate regulations?

Mr. CASS. Well, I think you're focusing on a very important issue, which is who is actually hurt by rising energy prices. And you're exactly right that it takes the largest bite out of those with the lowest incomes. And so it has both that direct effect on individuals and then it's going to have broader effects on communities, as you see impacts on the economy more broadly.

Mr. LOUDERMILK. Mr. Grossman, do you—I know that you're a constitutional attorney, but in your opinion—

Mr. GROSSMAN. Mr. Congressman, I don't think what you're saying is a controversial view at least in general. I mean if you look at the EPA's own publications, EPA acknowledges that there's no free lunch and that these things come with costs. And so I find it very surprising to hear from some people that all of this is going to pay for it because they never explain how someone like this Ms. Smith you describe, how somehow she's going to get the money back in her pocket. And I don't know how that would happen.

Mr. LOUDERMILK. I mean with \$18 trillion debt, are we just going to dump more—I know I'm out of time, Mr. Chairman, but the American people continually say that they want commonsense legislation. They want common sense coming out of Washington, and I have not been able to make any common sense out of the CPP or any of the administration's radical agenda.

So I yield back.

Chairman SMITH. Thank you, Mr. Loudermilk.

The gentlewoman from California, Ms. Lofgren, is recognized for her questions.

Ms. LOFGREN. Thank you, Mr. Chairman.

I think this hearing is an important one, coming as it does as leaders of the world are attempting to cope with the catastrophe of climate change that our planet is facing. And as we talk about really small board issues here, hey, I was fascinated to hear the comment that, you know, there are—mitigation issues would somehow help, that we should look at the Dutch and the dikes that they've done as if that would solve the problem of acidification of the ocean and the collapse of the food chain that the elderly and the poor will also face if we don't deal successfully with this challenge.

You know, Dr. Steer, my home State is California. We've always been a leader and we've always set the pace on climate change, and we have actually set some goals in California. And what we did, I mean, was—has actually increased the amount of alternative energy substantially in the last number of years. The solar industry in California created more than 54,000 jobs, and with our new commitment to 50 percent renewables by 2030, the estimate is that employment in the alternative energy sector will far surpass employment in the fossil fuel industry.

You mentioned that climate-smart policies can provide a credible and predictable policy environment and give private investors the confidence needed to invest in, deliver, and create greater economic efficiency and innovation. Can you elaborate how the Administra-

tion's Clean Power Plan and the agreement in Paris might encourage even more energy investment and reduce barriers to implementation of new energy technologies?

Dr. STEER. Thank you, Congressman—Congresswoman. I agree very much with you that, as we move forward, the new economy will generate a lot more jobs than the one we're losing. But we still obviously—as you implied, we have to be very sensitive to the fact that we do need a just transition. Whilst the Nation as a whole will benefit, that doesn't mean every single company will benefit or every single citizen will benefit, and we need a just transition. And we've learned a lot about how to compensate those that will be harder off.

It turns out, by the way, that if you look at the entire impact of the President's climate plan, whilst in the near-term it's true that electricity costs per kilowatt hour will rise, that will be more than offset by savings due to energy efficiency, so household overall bills will in time be considerably less.

But there still is that situation. I agree very much with you that what we are seeing now—and your own State is a very good example of this. Google has just made the biggest investment in a renewable energy plan in Africa, in Kenya. Google has. And that's because—and it's a commercial venture. And I think we were talking earlier about the need for money to go in. The overwhelming bulk of money will be private money, companies like Google that see where the future is and they're investing.

And what we're hoping for out of Paris are clear signals so that kind of investment and thousands more like that will become the norm.

Ms. LOFGREN. Well, thank you, Dr. Steer. It seems to me what we've seen most successfully in California is to set standards and then the private sector scrambles and innovates to meet them. And in scrambling to meet those standards, they create tons of new jobs. So isn't that what we're trying to bring to the whole world?

Dr. STEER. Absolutely right, yes. I think everybody agrees that the government has some role in setting standards. Otherwise, you know, my kids would be electrocuted because, you know, it does take regulation. So we shouldn't be sort of oversimplifying this. Standards on, for example, the Energy Star system has saved hundreds of billions of dollars for consumers.

So you're absolutely right. The private sector will drive everything, but they do so within a sensible environment created by government.

Ms. LOFGREN. I'll just close by saying that the cost of doing nothing is immense, and we're already seeing it. In California we've had the largest drought in 1,200 years. The aquifer has been reduced and the land is sinking. It won't be replaced, takes 1,000 years to replenish that aquifer. So we have an issue about providing food, providing water. We've got rising sea levels. We've got collapse of the fishing season because of climate change in the ocean. So to think that doing nothing is cost-free is very false.

And I see that my time is expired, Mr. Chairman, so I yield back.

Chairman SMITH. Thank you, Ms. Lofgren.

The gentleman from Louisiana, Mr. Abraham, is recognized.

Mr. ABRAHAM. Thank you, Mr. Chairman. And I'll thank the witnesses, especially Dr. Steer and Dr. Lomborg, for their efforts to be here either in person or by videoconference. And our Chairman Dr. Smith has had thankfully many hearings on this Clean Power Plan rule that we're discussing today.

And I've looked back at past testimony and certainly the previous testimony today, and the figures that I come up with are if we go all in with President Obama's full compliance is that it could cost up to five trillion dollars per year, which is over nine percent of our GDP.

Now, the United States—the other figures I've seen that 40—at least 40 of our states would have increases in electricity costs of somewhere between ten and seventeen percent. And India, China—and, Dr. Steer, you said that, you know, China was glad that we're leading the role—or leading the charge so to speak. But if you look at China's own reports, they say that their coal consumption has increased 17 percent higher than previously anticipated. So they are—India, China, and some of these underdeveloped countries are building coal-fired plants at unprecedented rates. So for us as Americans, we're—I look at it as kind of an all-pain/no-gain scenario from our previous stance.

Now, the other thing that President Obama has said as far as the Paris talks are that it will be a “powerful rebuke to terrorism” because they are holding this climate meeting in Paris. But U.S. intelligence reports also tell me that ISIS—and I think it's been mentioned by one of our members—receives up to half-a-billion dollars a year through the sale and control of Middle East oil reserves. So as our Commander-in-Chief, I think the President probably made a bold statement. It is a powerful rebuke to terrorism, but as his assumed role as our commander of climate change, he's not allowing our businesses with this Clean Power Plan act to do business and make American more energy-independent.

So I guess it will be a rhetorical question, but I'll ask you, Mr. Cass, wouldn't it be a more powerful rebuke to ISIS and other terrorists groups if the President worked to actually enact policies that would make America more energy-independent so that we don't have to turn to groups of the Middle East to receive our oil?

Mr. CASS. You know, I don't think it's especially constructive to try to take every other issue out in the world and draw it back to climate change somehow. I think that is a rhetorical device that has stirred up a lot of confusion but does not really reflect on the relevant energy policy choices or the relevant choices for international negotiation.

So I would say the preferable approach would be to focus on what our energy policy actually does and does not accomplish with respect to the climate instead of suggesting that it has anything to do with ISIS.

Mr. ABRAHAM. Would you say, Mr. Cass, that the current policies, if we continue down this road, do restrict our energy companies from making American more energy-independent?

Mr. CASS. I don't know that the Clean Power Plan will have a significant effect on energy independence. It focuses almost entirely on the electricity sector for which we already get all the necessary

fuels domestically, whereas it's really oil that is the issue of concern for energy independence.

Mr. ABRAHAM. Correct. Thank you, Mr. Chairman. I yield back. Chairman SMITH. Thank you, Mr. Abraham.

And the gentleman from Virginia, Mr. Beyer, is recognized.

Mr. BEYER. Thank you, Mr. Chairman.

Dr. Lomborg, you're still with us?

Dr. LOMBORG. I am.

Mr. BEYER. Great, thank you very much. I've been reading your ideas for some time now and have always found them very interesting. In my simple terms, you agree that climate change is real and it's manmade but the costs to stop or significantly slow this is much greater than the cost to simply adapt to it.

And I know you're aware that U.S. military strategists have been very concerned about the accelerating effects of climate change will lead to more conflict, revolution, even wars. Do you factor these costs, loss of human life, economic destruction, war materials, et cetera, into the overall cost of adapting to letting climate change just proceed?

Dr. LOMBORG. I should just say I don't necessarily say that we should just adapt. I do try to say we need to prioritize how much are we going to adapt and how much are we going to reduce our emissions. So it's definitely going to be a balance.

But to answer your specific question, we do try to take into account a lot of the costs in the models, so we do look at heat deaths, cold deaths, deaths from more polluted water, costs from higher—high amounts of floodings, potentially more hurricanes in the long run. So a lot of costs are calculated in there, but obviously not all costs. So again, I think in some way we're stuck with saying we have the best models available, but that doesn't mean it's right. It's probably just better than anything you or I or anyone else can come up with as our intuition.

Mr. BEYER. One of the other costs that—it's easier to think about retaining walls in Miami than to think about what I keep reading as being tens of millions of Bangladeshis that will be displaced by even a 1 meter sea level rise. How do you get a handle on the modeling of what it takes to relocate 20 or 30 million people in Bangladesh?

Dr. LOMBORG. Well, I actually—you should be aware that we know and we have good data for most of the world which indicates that almost no populated areas are going to be abandoned simply because it's very cheap to cover the costs of—essentially put up dikes and levees to make sure that you do not have to relocate.

And so what is ultimately going to happen is that you will see some shore lost in, for instance, Alaska, you'll see it in Siberia, some other places, but pretty much everywhere—and certainly in Bangladesh, remember, Bangladesh is the most tightly populated country in the world. They will definitely put up those sea levels—sorry, those sea barriers that are necessary simply because it will protect a lot of valuable land both for people and for production.

Mr. BEYER. Okay. Thank you very much.

Dr. Steer, I keep reading articles about how climate change just takes us from one set of climate conditions to a different set, as has happened through the ages and that we must and will adapt. But

I've also long been fascinated by the Gaia hypothesis, which states that organisms interact with their inorganic surroundings on Earth to form a self-regulating, complex system, that there's a homeostasis going on, that we'll always adapt to maximize the conditions for life on Earth. Do you see any evidence of such homeostatic mechanisms going on right now with all the climate changes?

Dr. STEER. I—Congressman, I think the planet will take care of itself; it's us I'm worried about. Or it's actually our great-grandchildren I'm worried about. And I'm profoundly worried when I hear my good friend Bjorn Lomborg say don't worry, Bangladesh will be able to build dikes. I think that is something we have to think very, very deeply about. Fifty years from now the idea that something that's never been proven before—it's absolutely the right thing to do. The Netherlands does it. The Netherlands does it but the Netherlands is very worried because—and that's why the Netherlands is a champion to change things now because they know how difficult it is, how expensive it is, and how risky it is to be building dikes. So we absolutely should not accept that.

And your point, sir, about the Department of Defense is so accurate. Two weeks ago I was with NATO leaders. They are profoundly worried about the security risks of climate change. In many ways it is Departments of Defenses around the world that are the ones that are ringing the bell most loudly. So I really do agree with you there.

Mr. BEYER. And, Dr. Steer, thank you for going right to the correct answer to the question, which is we talk so many times about, yes, the climate changes and changes and we've always adapted. What they miss is that, you know, life will adapt but the impact on human beings is very significant. And if you look at how climate changes in the past, it has led to, you know, dramatically different conditions for humanity, including the agricultural revolution. So thank you very much.

Chairman SMITH. Thank you, Mr. Beyer.

The gentleman from Illinois, Mr. LaHood, is recognized.

Mr. LAHOOD. Thank you, Mr. Chairman. And I thank the witnesses here today for your testimony.

I guess in looking at what the President and the administration are doing in Paris, you know, the words that come to mind in some respects is almost illegitimate in terms of the pact or agreement that they're working on.

And I guess my question to you, Mr. Grossman, in terms of circumventing the Congress and kind of doing an end run is what this looks to be, you know, whether we call it an agreement or a pact or whatever comes out of Paris, you know, is there going to be advice and consent from the Senate? Is there going to be ratification there? Is there going to be any input from the House or Senate? In looking at the elected Congress, what role will the elected Congress play in having input on something this significant?

Mr. GROSSMAN. Thank you, Mr. Congressman.

When you look at what the Administration has discussed so far, they spoke in terms of a hybrid agreement where the central planks of the agreement—in other words, we're all assuming that there's going to be this agreement and countries are going to follow

through on it in terms of financing and in terms of reaching emissions targets.

But the way the Administration has looked at it, due to the fact that they don't want to come to Congress, has been to have a hybrid agreement where those central planks aren't enforceable in any sense. They're pledges, they're promises, they're things that may or may not happen, but at the end of the day, you know, as a lawyer, I look at what does the law require you to do, whether that's international law or domestic law. And what's being contemplated at this point is an agreement that has no teeth, that doesn't commit anyone to anything.

So in that instance on the one hand, as a legal matter, that probably would not require advice and consent of the Senate. On the other hand, it doesn't really have any substance.

But if the President were to go beyond that and to attempt to enter into binding commitments, I think he would—that would raise some very serious constitutional questions and would really call into question the legitimacy of the United States' involvement in such an agreement.

Mr. LAHOOD. And is there legal precedent for other things that have circumvented the Congress that have been upheld in federal court?

Mr. GROSSMAN. I think in this instance we're really going into new territory because if you look, for example, at the Kyoto Protocol, both political branches recognized that the binding emission reductions that were part of that protocol, even though Bill Clinton had signed it, they recognized that Senate ratification was a part of it. It had to go through as a treaty. And because that never happened, because there wasn't the political support for it, the United States never ratified it, never deposited its documents of ratification, and it never took effect here.

And so given that kind of precedent, I think the Administration would be on very shaky legal ground were it to agree to any type of binding commitments.

Mr. LAHOOD. Thank you. Mr. Cass, I wanted to follow up with you. You know, in looking at this agreement and looking at how we verify that foreign countries—India, China, Russia—are going to be compliant with the commitments in this agreement, you know, can you elaborate on that, you know, in terms of what satisfaction we can have that they are going to be compliant when they haven't had a very good track record of doing that?

Mr. CASS. Well, you know, I think one enormous challenge in that respect is that a lot of these countries don't really even have a mechanism for tracking even if they wanted to be transparent. You know, there was an enormous story very recently when China admitted it was using about 17 percent more coal than it thought. It was an entire new Germany worth of emissions just within China. And the striking thing is that the Chinese said, well, of course we're not going to change any of our commitments. It probably makes it easier to meet our commitments, but we're not going to change anything as a result.

And so I think, you know, accurately tracking the pledges is an important challenge. The interesting thing with countries like China and India, though, is that they have not pledged to do any-

thing except the trajectory that they were already on. And so in that respect the question is less how do we make sure they do what they promised than why is no one standing up and saying they haven't promised anything?

Mr. LAHOOD. Well, as just a follow-up on that, you know, I was going ask you—I was going to read—there was an agreement released by the White House regarding its 2014 U.S.-China Joint Announcement on Climate Change, and it said, "China intends to achieve the peaking of CO₂ emissions around 2030." There is presumably a reason China committed to peak "around 2030" and that word around is really undefined in this, and so we have no idea if this means 2031, 32, 35, or even later.

And I guess in looking at that, I mean doesn't this give an incentive to china to go beyond that in using that kind of undefined ambiguous language? That concerns me.

Mr. CASS. Well, you know, the reason that that is what China agreed to is because they had already done the work and knew that that is around when their emissions would peak anyway. Unfortunately, President Obama knew this as well. The U.S. Government's own Lawrence Berkeley laboratory had done a very in-depth study four years earlier and had already said based on the way China's economic development is going, it will peak its emissions around 2030. So for China to make that commitment now is essentially a promise to do nothing.

And the fact that we are applauding that and putting our own very costly commitment up against it is really just another example of how poorly we are positioning our own country's interests on the international stage.

Mr. LAHOOD. Thank you, Mr. Chairman.

Mr. JOHNSON OF OHIO. [Presiding] Yes. The Chair will now recognize our colleague from Colorado, Mr. Perlmutter.

Mr. PERLMUTTER. Thank you, Mr. Chair.

Obviously, there are big differences of opinion between both sides of the aisle on this subject. We agree on quite a few things on this committee but this is not one of them. And it's disappointing to me but that's the way it is.

So, Dr. Lomborg, I want to start with you. You've been talking about dikes and I'm just looking—are you in Copenhagen now or where are you?

Dr. LOMBORG. I'm in Paris right now.

Mr. PERLMUTTER. You're in Paris but you spoke fondly of Copenhagen so I assume that's got some—it's close to your heart in some fashion. Is that where you're from—

Dr. LOMBORG. Yes, it is.

Mr. PERLMUTTER. —or your family? Okay. So Copenhagen, I was just looking at it. I mean, it's pretty much at sea level or below sea level, is it not?

Dr. LOMBORG. It's at sea level and higher, yes.

Mr. PERLMUTTER. Okay. So have you estimated how much it's going to cost Copenhagen to build the dikes that you say might be necessary—and I think you said sea levels are going to rise between a half and a meter. Dr. Steer said between a half and 2 meters and you kind of objected to that. But how much are the dikes

going to cost Copenhagen if it goes a meter, which is your testimony?

Dr. LOMBORG. Yes. I'm sorry, I don't know the numbers for Copenhagen. I do know the numbers that have been published internationally in period for—globally, and they indicate for almost all countries the cost of adapting to sea level rise up to a meter is less than 0.1 percent of GDP, and mostly much, much less. So it's a fairly small cost.

Mr. PERLMUTTER. So who—

Dr. LOMBORG. It's not a trivial cost—

Mr. PERLMUTTER. I mean the—

Dr. LOMBORG. —but it's a—

Mr. PERLMUTTER. You mean the world's GDP?

Dr. LOMBORG. Of the individual nations. But yes, of course, for the world it will be the world's GDP.

Mr. PERLMUTTER. When was the last time you were in Miami?

Dr. LOMBORG. A couple years ago.

Mr. PERLMUTTER. Okay. And you're probably aware that Miami is seeing street flooding on a pretty regular basis already, are you not?

Dr. LOMBORG. Yes.

Mr. PERLMUTTER. I mean what's it going to cost Miami to build dikes and what do you think—

Dr. LOMBORG. Again, sir—

Mr. PERLMUTTER. —what do you think—

Dr. LOMBORG. —I don't know the—

Mr. PERLMUTTER. What will that do—

Dr. LOMBORG. I don't know the—

Mr. PERLMUTTER. What will that do to their tourism?

Dr. LOMBORG. It will do very little to their tourism. Look, again, I think you're trying to pin me into a false dichotomy. I'm simply pointing out that trying to do the Clean Power Plan or even all of what the U.S. is promising or even what everybody is promising, which will cut a couple of inches at best of sea level rise by the end of the century is not actually a very effective way of helping either Miami or anyone else.

Yes, I do recognize that we need to fix this problem in the long run. That's why I'm supporting green energy. But saying that we are somehow being illogical by not focusing on say, well, let's actually do the things that we can do to help poor Bangladeshis today dealing with sea level rise or indeed rich Miami—I'm sorry, I'm not sure what to call—

Mr. PERLMUTTER. All right. So—

Dr. LOMBORG. —Miamians.

Mr. PERLMUTTER. So I mean I guess my question to you is—and I appreciate that. You're saying we need to do all of the above. There should be some mitigation in terms of increased temperature, as well as prevention, those areas that are going to be especially affected. And is science so good to tell us those areas that are going to be especially affected? If sea levels rise a meter, does that pretty much flood all of Miami?

Dr. LOMBORG. No, it doesn't. The cost of Miami—the wealth of Miami—

Mr. PERLMUTTER. It—no—without—

Dr. LOMBORG. —is so great that—

Mr. PERLMUTTER. Without dikes, without dikes, does that flood Miami? Because Miami is less than a meter.

Dr. LOMBORG. It probably would flood—

Mr. PERLMUTTER. So if I just do my basic—

Dr. LOMBORG. —significant parts of Miami, yes.

Mr. PERLMUTTER. —map—okay. So, you know, everybody's been talking about the cost of this, and so I want to turn my attention to you for a second, Mr. Grossman. And you guys have an office in Denver. Have—did you talk to anybody in the Denver office before you came to testify today?

Mr. GROSSMAN. No, I did not.

Mr. PERLMUTTER. Okay. Do you know what—in Colorado we were the very first to pass by ballot an initiative renewable portfolio standards. Are you aware of that?

Mr. GROSSMAN. I'm aware that Colorado has such a law.

Mr. PERLMUTTER. Are you aware of what our unemployment rate is today in Colorado? Three point eight percent. And I have many friends who are partners at your firm, and I'd say that they're probably doing pretty well because we are doing well in Colorado, despite taking some very rigorous steps with respect to the environment because in Colorado we appreciate the outdoors, we appreciate our climate, and even so, we've managed to continue to have strong employment across all industries, except for oil and gas, which has dropped like a rock because the Saudis are pumping like crazy.

So are you—I mean so is it your testimony that because of clean action plan or these kinds of things, that that causes a reduction in employment?

Mr. GROSSMAN. I think my testimony concerns the legal authority—

Mr. PERLMUTTER. All right. So—

Mr. GROSSMAN. —of the executive to enter into a Paris agreement.

Mr. PERLMUTTER. Okay. So looking at your testimony—

Mr. JOHNSON OF OHIO. The gentleman's time has expired. Thank you. We have other members that—

Mr. PERLMUTTER. That's true.

Mr. JOHNSON OF OHIO. —need to go.

The Chair now recognizes our colleague from Alabama, Mr. Palmer.

Mr. PALMER. Thank you, Mr. Chairman.

I want to go back to you, Mr. Grossman, and the point you were about to make. The President has made it clear that he doesn't plan to submit any agreement reached in Paris to the Senate. Does the position of Congress, the official position of Congress on a particular policy issue have any bearing on whether or not the agreement requires Congressional approval?

Mr. GROSSMAN. Thank you, Mr. Congressman. The answer is yes. Congress's position makes a great deal of difference, particularly in this instance because potentially the Administration, if there were some kind of binding agreement, might point to the Framework Convention perhaps as supporting that, and were there any legal

challenge over that, the first thing the courts would look to would be Congressional understanding—

Mr. PALMER. All right.

Mr. GROSSMAN. —of what that is.

Mr. PALMER. All right. Let me—I have a little short clip I'd like to show if the staff can put that up that I think might bring some clarity to where Congress is on this. Can they do the video?

[Video shown.]

Mr. PALMER. Thank you. Is there any ambiguity there, Mr. Grossman?

Mr. GROSSMAN. No, there is not.

Mr. PALMER. I don't think that it's an issue here in regard to the legality of what the President is doing as to whether or not we should debate this issue. Clearly, we should. I think that Congress has debated this issue. It's been pointed out that Congress brought up a cap-and-trade bill, which is arguably the same thing as the Clean Power Plan, and rejected it. It was passed by the House but rejected by the Senate. And I would like to point out that my colleagues on the Democrat side controlled both houses of Congress. So Congress has spoken.

You just heard from the Energy and Commerce Committee—I think that was in 2009—who was present as a Member of Congress when the Clean Air Act was passed, and it's clear that it was never the intention of Congress to give the executive branch through the EPA the authority to regulate greenhouse gases.

So back to your point, I think this is relevant. I think we talk about the danger of global climate change, but I think there's another danger here that needs to be addressed, and that is the loss of the authority of Congress to make laws.

So I think there's another point I want to make. Dr. Lomborg, are you familiar with a paper that was published—I think it was last year by Dr. Philip J. Lloyd, who was one of the lead authors for the International Panel on Climate Change. And he says that he now concludes that the majority of climate change is the result of natural variation. Are you familiar with that?

Dr. LOMBORG. No, I'm not. Sorry.

Mr. PALMER. Mr. Chairman, I would like to enter this abstract into the record if we may do so.

Mr. JOHNSON OF OHIO. Without objection.

[The information appears in Appendix II]

Mr. PALMER. Thank you. I think that if climate change is predominantly the result of natural variation, I think logic would require us to put as much emphasis on dealing with the consequences of climate change as a result of natural variation, maybe even more so as the science continues to evolve on this, than spending enormous amounts of money and resources on human activities. Would you agree with that, Dr. Lomborg? It's a yes or no.

Dr. LOMBORG. Yes, absolutely.

Mr. PALMER. Okay. I think to you, Dr. Steer, and your comments about forcing people into smaller and smaller environments and living spaces and changing their cultures and how they live reminds me of a book that came out in 1978 by a guy named Clarence B. Carson, the "World in the Grip of an Idea," and his point, if I may simplify it, is basically that there's always this great idea

out there that empowers government to do things that people don't want it to do to—and in this case it's achieving human progress through saving the planet and focusing everyone's efforts on that and using government power as the instrument to achieve that end.

My time is expired. I yield, Mr. Chairman.

Mr. JOHNSON OF OHIO. The gentleman has yielded back. I now recognize our colleague from California, Mr. Swalwell.

Mr. SWALWELL. Thank you, Mr. Chairman. And I appreciate the witnesses taking the time to come here today.

And, Mr. Cass, are you a scientist?

Mr. CASS. No.

Mr. SWALWELL. Mr. Grossman?

Mr. GROSSMAN. No, sir.

Mr. SWALWELL. And I know Dr. Lomborg and Dr. Steer are. And with respect to Mr. Cass and Mr. Grossman, you know, I think one of the chief complaints that my colleagues and I have around this issue—we're here talking about climate change—is that we're not hearing from scientists. I mean I'm a lawyer. I know Mr. Perlmutter is a recovering lawyer himself. But we would be best informed by having scientists testify before this committee.

When I was a prosecutor and I wanted to prove a murder case, I had DNA testimony, I would not call in somebody who watches CSI as my DNA witness. I would call in a scientist. And I think the fact that this committee chooses to run from science rather than to put forward scientists only hurts our ability to get to the bottom of this issue.

I also am not a scientist but I can read and understand numbers. And I've heard so much talk about the will of the American people and an elected Congress, and I just wanted to go through some numbers for my colleagues. In 2008, a Senator named Barack Obama ran for President of the United States. He made it unequivocally clear that, if elected President, he would take bold actions to address greenhouse gas emissions, including the policies he would enact. He was elected in 2008 by 52 percent of the popular vote and doubled the electoral vote that his Republican opponent received.

In 2012, having already taken four years of actions on climate change, he was reelected with 51 percent of the popular vote. Over 3 million more people elected him than his Republican opponent. A majority of Americans have elected the person trying to take on these negotiations. An overwhelming majority of nations are participating in these negotiations. And an overwhelming majority of scientists believe that climate change is real, it's caused by man, and we should do something about it.

Dr. Steer, I ask are we really gathered here today to say that so many people are so wrong about this issue?

Dr. STEER. Well, just last week Pew came out with a poll that says 2/3 of Americans want the United States to join the Climate Change Pact. So I think you're making a very good point, Congressman.

Mr. SWALWELL. And, you know, I really respect Dr. Lomborg's position and I respect his credentials, and I think there's a difference of opinion here as to the actions. And that's where I'd like

to see our country really move this debate to, which is acknowledging that it's happening, acknowledging who has caused it, but really getting into the details as far as solutions.

And if you could summarize, Dr. Steer, what are some of the solutions you think that both Republicans and Democrats could agree on that could move us forward and show real action on this issue?

Dr. STEER. Well, I do sense that we all care about our grandchildren and great-grandchildren, so there clearly, you know, is a reason to work together. A price on carbon need not be an ideological issue. It need not increase the size of government. Indeed, it could shrink the size of government. It's just a smart way to reorientate the way we collect money. Go to Singapore and you will find that actually you are charged to drive your car into the center of the city. That goes into the general revenue. So instead of that, that enables them to lower taxes on profits, for example.

London does the same thing whereby you don't even know—you're paying the fee as you drive into London, but as a result of that, you know, I was born in London, I now will never drive into London the rest of my life. I don't need to, quite frankly. It's a psychological shift. And life is much better, quite frankly. The center of London is better. We have good public transportation.

That's—and as a result of that, the Mayor of London, who is a pretty conservative guy, Boris Johnson, he's able to lower other fees that the businesses are paying. It doesn't need to be ideological at all. So it seems to me that's one area.

And this is where, you know, I'm really interested by this discussion about, you know, China's not doing anything and so on. I mean, China is spending far more than any other country in the world on renewable energy. It has figured out how to invest in research. We should, as we are now going to do, have a partnership with them. That should be a reasonable understanding that will drive down the costs.

And by the way, we say that China now is getting off for free. In fact, China has a commitment to lower its carbon-to-GDP ratio by 65 percent by 2030. So don't kid—nobody should believe that China's not doing as much as it could.

Mr. SWALWELL. Thank you, Dr. Steer. And I yield back.

Mrs. COMSTOCK. [Presiding] Thank you. And I now recognize myself for five minutes.

I want to thank Mr. Cass and Mr. Grossman and Dr. Lomborg. And I think I wanted to highlight something that you had said, Mr. Cass, in your testimony, that "climate policy that does not help the climate is not good policy." And I think the results are what the three of you are trying to focus on if I'm correct, and really looking at a results-focused policy.

And if I'm understanding this correctly, your concern is not—I mean we've had a lot of discussion about the costs and things that are running up here, but the real problem here is that it's not doing what it says it's going to do, is that correct?

Mr. CASS. That's exactly right.

Mrs. COMSTOCK. And so the—this sort of—I guess it's called pledge-and-review process really is more of a praise-and-hope. I feel like it's a little bit like when the children all get their trophy for the soccer game except this is a very expensive trophy because

we're hoping this increases their self-esteem so to speak or we're hoping they're going to do more. I think some of the testimony you had cited was, you know, this is—we hope this will all make everyone feel better to do a little bit more. So it's not results-focused, so this is not about what we intend.

And I appreciate, Dr. Steer, you recognizing we all care about our children and grandchildren because we certainly do and want to have a cleaner environment. And I come from Virginia, a state that did not put in a renewable portfolio but we did work very aggressively on the state level on an all-of-the-above strategy, seeing where we could find things. We actually passed a bill that we're still waiting for the federals to allow us to implement, which would have offshore drilling and the royalties from that go towards, in part, research in our universities for renewables and for alternative energies. It would be a way of using what we have now while we're investing in these other things without imposing a lot of these costs that you were doing.

And I will point out in Virginia we have a really low unemployment rate, too, but unfortunately, in southwest Virginia if you talk to my colleague Morgan Griffith, you'll find he has a very high unemployment rate due to the decimation of our coal industry. And, you know, poverty has its threats and problems, too, which they've had to deal with.

So what I wanted to ask is what—since we really are concerned about results and having a cleaner environment, and actually, instead of a praise-and-hope, sort of a trust-and-verify type of system but also very measurable—so that we're not just kind of getting together in Paris and doing something to feel good but something that will actually improve our economy, improve people's everyday life, and not impose on the least of us and the poorest of us what they need. So if you could describe some of that. I think you've testified to that but I wanted to really clarify—you all really are going into—so there's a third way here we often don't talk about, and I think we've sort of been talking past that so I wanted to give you an opportunity to—

Mr. CASS. Yes, thank you. I think that's exactly the right way of framing the issue. And I would make two points. One is that in terms of affirmative policies that are worth taking, by far the most important is investment in research and development. And I think you've heard a lot of consensus from Dr. Steer, Dr. Lomborg. I would agree with that as well that the only way we're going to address this problem long term is if we have new technologies that are cheaper than fossil fuels that developing countries want to use. And we don't have that today.

I think the second piece that's very important is just some fundamental honesty in the processes we're using and what's happening. I think you're right to call out this kind of pledge-and-review concept as not really being pursued faithfully.

And I would say I genuinely have a tremendous amount of respect for Dr. Steer. I think it very—is very problematic the way that he has characterized the pledges that countries are making. I mentioned that China has pledged only to peak where it was going to peak anyway. He didn't contest that. He offered a new statistic, which is that they plan to be more efficient in their use of

carbon, which is true, but Bloomberg New Energy Finance, which is a—certainly not a right-wing analyst of these issues—looked specifically at that pledge and similarly found that that was less aggressive than the trajectory that China was already on.

And you can go right down the list of major developing countries. You know, Dr. Steer mentioned Prime Minister Modi. India's pledge is perhaps the weakest of all of them. India refused to make any pledge with respect to emissions and said only that it would improve its efficiency less quickly than it is already improving its efficiency. And so, you know, at one point Dr. Steer said if I were upset, I would say it. And I think it's important that people say it, that this process in Paris is not producing commitments, that leadership by the United States is not getting developing countries to do things they wouldn't otherwise do. And if that's the case, then incurring the costs that we're incurring here, even the Obama Administration would say doesn't make very much sense.

Mrs. COMSTOCK. I appreciate that because the worst thing is when we cost everyone a lot of money and don't get any results. Then that's the worst of all worlds. And I think if we can kind of unite on some of those things, you know, we want to have good results. So I appreciate your highlighting that and us able to also discuss the science of this and getting to a results-focused orientation.

So I would like to, on behalf of the Chairman and on behalf of the committee, thank the witnesses for their insightful testimony, all of our witnesses, and the members for their questions. And the record will remain open for two weeks for additional written comments and written questions from members.

This hearing is adjourned.

[Whereupon, at 12:20 p.m., the Committee was adjourned.]

Appendix I

ANSWERS TO POST-HEARING QUESTIONS

ANSWERS TO POST-HEARING QUESTIONS

Questions submitted by Ranking Member Eddie Bernice Johnson

JANUARY 11, 2016

**ANSWER FOR THE RECORD BY DR. ANDREW STEER
PRESIDENT AND CEO, WORLD RESOURCES INSTITUTE**

**HEARING BEFORE THE HOUSE COMMITTEE ON SCIENCE, SPACE, AND TECHNOLOGY:
"America's Leadership Opportunity at the Paris Climate Conference"**

Q: Many have questioned the sincerity of China's commitment to reducing greenhouse gas emissions, citing economic pressures as a major impediment for China to overcome its reliance on fossil fuels.

- Please comment about what action China is taking on climate change, including the steps it is taking to achieve its targets.
- Do you agree with the characterization that China's actions are "business as usual" and not requiring of additional effort? If no, please explain why.

I appreciate this opportunity to respond to the above questions regarding China's commitment to reducing greenhouse gas emissions by describing the steps China is taking, the additional effort required to achieve its commitments, and the strong drivers of its actions.

China is already taking action to strengthen all of the building blocks of its strategy to shift to low-carbon energy and achieve its climate action targets.¹ The suggestion by some that the United States should not take climate action because China and other countries are not increasing their efforts is mistaken. I want to emphasize that to achieve its targets, China is not resting content with its current level of effort, as some suggested in the hearing, but is taking new action and planning to ramp up its efforts, beginning now, increasing in coming years, and extending far into the future.

China led the world with nearly a third of global investment in renewable energy in 2014,² is the world leader in installed wind power capacity,³ and has set targets to roughly double its 2014 wind capacity to 200 gigawatts and roughly triple its 2014 solar capacity to 100 gigawatts by 2020.⁴ China has banned

¹ As part of the 2014 U.S.-China joint announcement on climate change, China committed to reach a peak in its carbon dioxide emissions around 2030 and make best efforts to peak earlier, and to increase the non-fossil fuel share of its energy use to around 20 percent by 2030. White House Office of the Press Secretary, "FACT SHEET: U.S.-China Joint Announcement on Climate Change and Clean Energy Cooperation" (November 11, 2014) <https://www.whitehouse.gov/the-press-office/2014/11/11/fact-sheet-us-china-joint-announcement-climate-change-and-clean-energy-c>; <http://www.chinafaqs.org/blog-posts/us-and-china-strike-deal-climate-change-now-youre-talking>; China's June 2015 contribution for the Paris climate agreement formalized these targets, and set additional targets to reduce the carbon intensity (carbon emitted per unit of GDP) of its economy by 60 to 65 percent, and increase its forest stock by around 4.5 billion cubic meters, from 2005 levels by 2030. See "Enhanced Actions on Climate Change: China's Intended Nationally Determined Contributions", submitted to UNFCCC June 30, 2015, p. 5 of English translation <http://www4.unfccc.int/submissions/INDC/Published%20Documents/China/1/China's%20INDC%20-%20on%2030%20June%202015.pdf>

² http://www.chinafaqs.org/files/chinainfo/ChinaFAQs_Renewable_Energy_Graphical_Overview_of_2014.pdf

³ *Ibid.*

⁴ http://www.chinafaqs.org/files/chinainfo/ChinaFAQs_table_China_climate_energy_targets_0.pdf; <http://www.scmp.com/news/china/article/1741419/china-announces-massive-boost-solar-energy-target-help-fight-pollution>; China's Energy Development Strategy and Action Plan (2014-2020) (in Chinese) http://news.xinhuanet.com/2014-11/19/c_1113313588.htm

new coal plants in three key industrial regions⁵ and many provinces have targets to reduce coal use.⁶ China has been strengthening and expanding policies to increase energy efficiency across its economy, including targets for the efficiency of coal plants,⁷ energy-saving targets for industrial enterprises,⁸ building energy codes,⁹ and fuel economy standards.¹⁰ President Xi Jinping recently announced that in 2017 China will launch a national emissions trading system,¹¹ which has the potential to be a powerful instrument to reduce emissions over time.¹² Finally, China is seeking to shift away from its old growth model driven by investment in energy-intensive industry toward a new model driven by consumption, services, and advanced manufacturing,¹³ which should have an emissions reduction benefit.¹⁴ China is working on including additional steps in its upcoming 13th Five Year Plan, to be released early next year.¹⁵ Signs of a recent decline in China's coal use¹⁶ and other trends, including China's increasingly

⁵ <http://www.ibtimes.com/china-bans-new-coal-plants-three-its-biggest-industrial-regions-attempt-curb-air-pollution-1405362>

⁶ Li Shuo and Lauri Myllyvirta, "The End of China's Coal Boom—6 Facts You Should Know" (2014)

<http://www.greenpeace.org/international/Global/international/briefings/climate/2014/The-End-of-Chinas-Coal-Boom.pdf>

⁷ "Enhanced Actions on Climate Change: China's Intended Nationally Determined Contributions", submitted to UNFCCC June 30, 2015 (scroll to page 17 for English translation)

<http://www4.unfccc.int/submissions/INDC/Published%20Documents/China/1/China's%20INDC%20-%20on%2030%20June%202015.pdf>

⁸ <http://iepd.iipnetwork.org/policy/top-10000-energy-consuming-enterprises-program>

⁹ S. Yu, M. Evans and Q. Shi, "Analysis of the Chinese Market for Building Energy Efficiency". Pacific Northwest National Laboratory, prepared for the U.S. Department of Energy (March 2014)

http://www.pnnl.gov/main/publications/external/technical_reports/PNNL-22761.pdf

¹⁰ <http://www.reuters.com/article/2013/03/21/china-auto-fuel-idUSL3N0CC2EK20130321>; White House Office of the Press Secretary, "FACT SHEET: The United States and China Issue Joint Presidential Statement on Climate Change with New Domestic Policy Commitments and a Common Vision for an Ambitious Global Climate Agreement in Paris" (September 25, 2015) <https://www.whitehouse.gov/the-press-office/2015/09/25/fact-sheet-united-states-and-china-issue-joint-presidential-statement>

¹¹ "FACT SHEET: The United States and China Issue Joint Presidential Statement" (September 25, 2015). According to a senior official in China's economic planning agency, the ETS will initially cover 31 provinces, nearly 10,000 enterprises in six industrial sectors, and 4 billion tons of carbon dioxide emissions.

<http://www.reuters.com/article/us-climatechange-summit-china-carbontrad-idUSKBN0TR18420151208#ArtQkjsxf9TEWPv.97>

¹² Xiliang Zhang, Valerie J. Karplus, Tianyu Qi, Da Zhang and Jiankun He, "Carbon emissions in China: How far can new efforts bend the curve?", Tsinghua-MIT China Energy and Climate Project (2014)

http://globalchange.mit.edu/CECP/files/document/MITJPSPGC_Rpt267.pdf

¹³ Fergus Green and Nicholas Stern, "China's 'new normal': structural change, better growth, and peak emissions", Policy Brief (June 2015) http://www.lse.ac.uk/GranthamInstitute/wp-content/uploads/2015/06/Chinas_new_normal_green_stern_June_2015.pdf; <https://www.whitehouse.gov/the-press-office/2015/09/25/remarks-president-obama-and-president-xi-peoples-republic-china-joint>; <http://www.brookings.edu/research/articles/2014/07/15-sino-shift-dollar>; China State Council, "'Made in China 2025' plan issued" (May 19, 2015)

http://english.gov.cn/policies/latest_releases/2015/05/19/content_281475110703534.htm

¹⁴ Carbon Tracker Initiative, "The Great Coal Cap: China's energy policies and the financial implications for thermal coal" (2014) <http://www.carbontracker.org/report/the-great-coal-cap-chinas-energy-policies-and-the-financial-implications-for-thermal-coal/>

¹⁵ <http://www.chinafaqs.org/blog-posts/making-plans-steps-development-chinas-crucial-13th-five-year-plan>

¹⁶ Green and Stern, "China's 'new normal'" (2015); <http://energydesk.greenpeace.org/2015/09/09/china-coal-demand-falls-for-eleven-straight-months/>; John A. Mathews and Hao Tan, "A 'Great Reversal' in China? Coal continues to decline with enforcement of environmental laws" (August 2015) <http://www.japanfocus.org/-Hao->

strong measures, have led some experts to predict that China's coal use may have already reached its structural peak (controlling for cyclical factors)¹⁷ and that China's emissions will likely peak before 2030, consistent with the government's stated aim to make best efforts to peak early.¹⁸

In the hearing, there seemed to be a misunderstanding in some of the discussion that China will achieve its climate targets without additional effort. This is not the case.

China will need to take stronger near-term and ongoing action to meet its commitments. Stronger steps will be needed to achieve China's non-fossil target. China will need to install 800-1,000 gigawatts (GW) of non-fossil fuel electricity generation capacity to achieve its 2030 non-fossil energy target, greater than its current coal-fired electricity generation capacity and almost the total current electricity generation capacity of the United States.¹⁹

With respect to China's peaking and carbon intensity targets, in 2009, China committed to reduce its carbon intensity by 40 to 45 percent from 2005 levels by 2020.²⁰ A 2014 study by MIT and China's Tsinghua University found in their Continued Effort Scenario that if China were to continue this level of effort, emissions would level off between 2030 and 2045 without a subsequent decline. The Accelerated Effort scenario, which shows emissions leveling off between 2025 and 2035 and slowly declining after that, involves stronger measures well beyond current policies, including a price on carbon beginning in 2015 which rises significantly.^{21, 22}

Accordingly, analysis shows that China has not set itself easy targets, and it is launching an array of stronger actions beyond current efforts to achieve those targets. The suggestion to the contrary by a

[Tan/4365/article.html](#); Tim Buckley and Tom Sanzillo, "Past Peak Coal in China" (November 2015) http://ieefa.org/wp-content/uploads/2015/11/IEEFA_Peak-Coal_November-2015.pdf; International Energy Agency, "Global coal demand stalls after more than a decade of relentless growth: Annual IEA coal report sees market under intense pressure, reflecting Chinese economic restructuring and global environmental policies", December 18, 2015 <http://www.iea.org/newsroomandevents/pressreleases/2015/december/global-coal-demand-stalls-after-more-than-a-decade-of-relentless-growth.html>

¹⁷ E.g. variation in hydroelectric power generation due to hydrological conditions

¹⁸ Green and Stern, "China's 'new normal'" (2015); http://www.nytimes.com/2015/09/22/world/asia/fading-coal-industry-in-china-may-offer-chance-to-aid-climate.html?ref=world&_r=1; <http://www.smh.com.au/business/china/chinas-economic-shift-promises-to-aid-climate-fight-but-packs-a-commodity-punch-20151005-gk1jz5.html>

¹⁹ White House Office of the Press Secretary, "FACT SHEET: U.S.-China Joint Announcement on Climate Change and Clean Energy Cooperation" (November 11, 2014) <https://www.whitehouse.gov/the-press-office/2014/11/11/fact-sheet-us-china-joint-announcement-climate-change-and-clean-energy-c>

²⁰ <http://www.chinafaqs.org/blog-posts/chinas-state-council-unveils-40-45-carbon-intensity-target>

²¹ One-page summary of report: Tsinghua-MIT China Energy and Climate Project, "An Energy Outlook for China" (2014) http://globalchange.mit.edu/files/document/CECP_2014_Outlook.pdf; full report: Xiliang Zhang, Valerie J. Karplus, Tianyu Qi, Da Zhang and Jiankun He, "Carbon emissions in China: How far can new efforts bend the curve?", Tsinghua-MIT China Energy and Climate Project (2014)

http://globalchange.mit.edu/CECP/files/document/MITJPSPGC_Rot267.pdf; Regarding the need for stronger efforts beyond current policies, see also <http://www.chinafaqs.org/blog-posts/stronger-commitments-china-and-us-are-breakthrough-international-climate-action>

²² An Open Climate Network review of studies on China's emissions trajectory found that of the reference scenarios it analyzed, none projected a peak in carbon emissions by 2030. Qiang Liu et al, "Peaking China's CO2 Emissions: Trends and Mitigation Potential", Open Climate Network (2015), p. 3, 7

http://www.wri.org/sites/default/files/uploads/WRI15_OCN_Peaking_Emissions_v4.pdf

witness at the hearing, Mr. Oren Cass, is incorrect, and mistakenly relies on a [2011 study by Lawrence Berkeley National Laboratory](#).²³ However, the study, which estimates two possible scenarios for China's future emissions trajectory, states that "neither scenario represents what we believe would actually happen in the long term without policy intervention."²⁴ Both scenarios, the more conservative of which projects a peak in China's carbon emissions in 2033, involve "aggressive policy measures to support industrial reform and energy efficiency improvement" to meet current world best practice, "strengthening or expansion of energy efficiency policies in industry, buildings, appliances, and motor vehicles," large increases in electric vehicles and rail electrification, improvements in coal plant efficiency, and "aggressive deployment of more renewable and non-fossil fuel energy"²⁵.²⁶

It is not surprising that China is aggressively pursuing climate action, as such action is driven by strong national interests in energy security, public health, environmental protection, and sustainable economic growth.²⁷ As China's actions indicate, on balance, economic and other trends are hastening rather than preventing China's shift away from fossil energy. China is working to control coal use to address air pollution, which contributes to as many as 4,000 deaths in China per day²⁸ and has raised widespread public concern.²⁹ Further, China's top weather official has said that the impacts of climate change are already damaging China's economy,³⁰ and China's recently released national report on climate change finds that it may "further intensify the occurrence of floods and droughts," threaten agricultural productivity, and increase its low-lying coastal cities' vulnerability to storms.³¹ As China's economy relies substantially on fossil fuel imports, China's leaders are concerned with the country's energy security, and China has already begun to see the economic benefits of clean energy.³² Finally, China's leaders

²³ "Testimony of Oren M. Cass before the House Committee on Science, Space, and Technology", December 1, 2015, p. 8 <https://science.house.gov/sites/republicans.science.house.gov/files/documents/HHRG-114-SY-WState-OCass-20151201.pdf>

²⁴ Nan Zhou, David Fridley, Michael McNeil, Nina Zheng, Jing Ke, and Mark Levine, "China's Energy and Carbon Emissions Outlook to 2050", Lawrence Berkeley National Laboratory (2011), p.2 <https://china.lbl.gov/sites/all/files/ibi-4472e-energy-2050april-2011.pdf>

²⁵ *Ibid.*, p. 30, p. 4, p. 37, p. 38. For a full list of each scenario's assumptions, see pp. 3-4.

²⁶ The two other studies cited by Mr. Cass, by Bloomberg New Energy Finance and Climate Action Tracker ("Testimony of Oren M. Cass" pp. 8-9), both assume China will undertake additional effort. Bloomberg New Energy Finance, "How Ambitious Are The Post-2020 Targets?", October 2, 2015, p. 17 <http://about.bnef.com/content/uploads/sites/4/2015/10/2015-10-02-How-ambitious-are-the-post-2020-targets-UPDATE-2-Oct.pdf>; Climate Action Tracker, "China", last updated November 26, 2015 <http://climateactiontracker.org/countries/china.html>; As described above, China has already begun to implement stronger policies and plans to increase its efforts over time.

²⁷ http://www.chinafaqs.org/files/chinainfo/ChinaFAQs_IssueBrief_WhyAction_0.pdf

²⁸ <http://www.theguardian.com/world/2015/aug/14/air-pollution-in-china-is-killing-4000-people-every-day-a-new-study-finds>; <http://fortune.com/2014/11/05/the-cost-of-chinas-dependence-on-coal-670000-deaths-a-year/>

²⁹ <http://www.nytimes.com/2015/12/09/world/asia/beijing-smog-pollution.html>

³⁰ <http://www.ibtimes.com/climate-change-threatens-chinas-infrastructure-typhoons-floods-drought-increase-1907256>

³¹ <http://www.nytimes.com/2015/12/01/world/asia/china-climate-change-global-warming.html>

³² http://www.chinafaqs.org/files/chinainfo/ChinaFAQs_IssueBrief_WhyAction_0.pdf

recognize the need to shift the economy away from energy-intensive industry toward services for economic growth to continue at a strong rate.³³

For additional information, we have attached our fact sheet, "[Taking Stronger Action on Climate Change: China and the United States](#)", and ask that it be included in the record.

Q: The iterative nature of the agreement from the 21st Conference of Parties (COP21) is one of its more important aspects. Essentially, the framework of the agreement would allow nations to review their climate goals at regular intervals and make necessary adjustments to their plans to achieve additional emissions reductions. This mechanism appears to do two things: first, it recognizes that a rigid solution or target for emissions reduction is not realistic, and second, it provides nations with the ability to incorporate new information and technologies into future solutions.

- **Why is it important that the agreement be iterative and flexible?**

The connection between national action plans and a regular schedule to 'progress' those plans every five years is a smart combination in the Paris Agreement. It allows flexibility for countries to decide themselves their approach to reduce emissions, while creating a process where each country will know what the other is committing to at the same moment. This iterative system, in conjunction with the credible transparency system in place under the Paris Agreement, should provide the clarity and predictability necessary for countries to know both what their own direction of travel is, and what other countries are doing. It also means that all countries will continue moving forward – the universal nature of action under the Paris Agreement will be maintained over time.

- **How does this approach to addressing climate change differ from past international efforts? And what, if any, benefits does this approach provide?**

The Paris Agreement is a hybrid agreement which combines a nationally-based approach for mitigation targets and goals with international rules and norms that apply to all. The combination ensures greater national buy-in to increase the likelihood of implementation, while also providing the transparency so that countries know what others are doing. It is also very different because it is universal, i.e. there are no annexes that distinguish between developed and developing countries for their mitigation actions in a strictly bifurcated fashion. . All countries have to undergo an enhanced review and verification process, and reporting will follow common guidelines for all, but those developing countries that need it will have a bit of flexibility and extra capacity building support.

Q: Now that the COP21 has concluded, please share with us any thoughts you may have on the process and the outcome of the talks. Specifically,

- **Do you believe the agreement has set forth a realistic and meaningful path to address climate change?**

=The pathway is both meaningful and realistic. It is also science-based. It is imperative that the pace and scale of change increases in order to avoid the worst impacts of climate change. In order for that to occur, the world needs to reduce emissions together, step-by-step in a fair way. The Paris Agreement

³³ Fergus Green and Nicholas Stern, "China's 'new normal': structural change, better growth, and peak emissions", Policy brief (June 2015) http://www.lse.ac.uk/GranthamInstitute/wp-content/uploads/2015/06/Chinas_new_normal_green_stern_June_2015.pdf

provides the machinery to do this. The core elements of this machinery are the regular five year opportunities for review and strengthened national climate action, a robust common transparency system, and a global stock take every five years to review implementation of the Agreement and progress towards achieving its purpose. At the same time, by basing mitigation actions in national policy-making, the Agreement will be driven by countries' priorities and national objectives. Never before has the climate regime had such a comprehensive process for addressing all elements of climate change – not only emissions reductions through mitigation actions, but also adaptation to climate impacts and the support necessary to ensure a fair pathway for action.

- **How will the actions of developing nations evolve over time to meet the goals of the agreement?**

The starting point for the Paris Agreement is that it is universal. The long term goals, for mitigation and adaptation, apply to all countries. Nearly all countries – 187 of them – have put forward national climate plans, Intended Nationally Determined Contributions. However, recognizing that all countries have very different national circumstances and capabilities, the Agreement provides flexibility and support for those developing countries that need it. This ensures a fair, but ambitious common pathway. Through enhanced support, including technology development and transfer and increased capacity over time, developing countries will be able to move towards having even stronger mitigation actions. In addition, although developed countries will continue to take the lead in mobilizing climate finance, the Agreement recognizes that many developing countries are already providing financial support and encourages them to do so.

The Paris Agreement places a strong emphasis on capacity building to enable developing countries to establish effective transparency systems and comply with the common rules established under the Agreement. The Capacity-Building Initiative for Transparency that was established to strengthen institutional and technical capacity and support developing countries in meeting their requirements under the Paris agreement. The technical expert review for each country will pay particular attention to the national capabilities and circumstances of developing country Parties and assist developing countries in identifying capacity-building needs, especially for LDCs and SIDS.

- **How does an absence of a formal enforcement mechanism impact the overall goals of the agreement?**

The foundation of the Paris Agreement is the national action plans, Intended Nationally Determined Contributions (INDCs), determined by each country based on their national circumstances. For many countries, the targets and measures contained in these national action plans are already rooted in national legislation and policy – providing a strong basis for compliance. Meanwhile, the agreement includes an enhanced, robust system for transparency and accountability that will ensure that the emissions levels of all countries, and their progress in meeting their INDC targets, will be subject to full scrutiny. The nationally-determined underpinning of the INDCs, combined with systems in the Paris Agreement to promote and facilitate compliance and ensure transparency and accountability, is what will ensure implementation.

Questions submitted by Chairman Lamar Smith

Response by Dr. Bjorn Lomborg to Committee on Science, Space and Technology Written Question

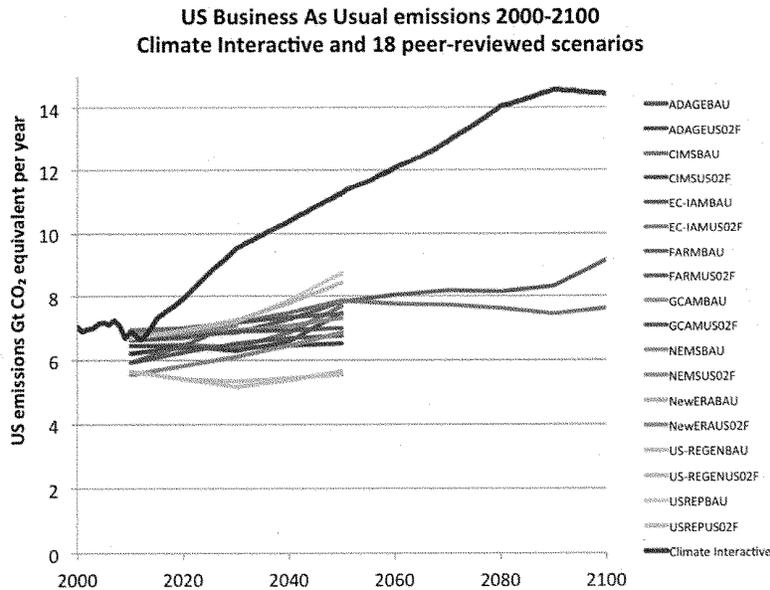
Is the scientific backbone (i.e. scientific models) of U.S. climate policy misguided? Are the baselines used correct? In your opinion has there been a misrepresentation and selective distortion of the scientific models?

In general, I find the scientific models used for climate policy reasonable. Obviously, there are different ways that different scientists and policy advocates interpret these models, and this should be taken into consideration when we consider the approaches.

However, there is one instance where I believe a model is used in a problematic way. I refer to the Climate Interactive model, which it has been suggested is the "backbone" of U.S. analytic work on climate policy by the U.S. State Department.¹ This work has also been quoted by climate activists including Joe Romm, with a graph that is seemingly created for advocacy work.¹¹

The chief problem is that the Climate Interactive analysis of the effects of Paris relies on an incredibly far-fetched 'no action' scenario where the planet will emit huge amounts of carbon if it doesn't enact carbon-cutting policies. It is this artificially high baseline – unsupported by any mainstream analysis – that accounts for the massive reduction that Climate Interactive expects from Paris. Indeed, about 70% of the suggested temperature reduction identified by Climate Interactive is completely spurious.

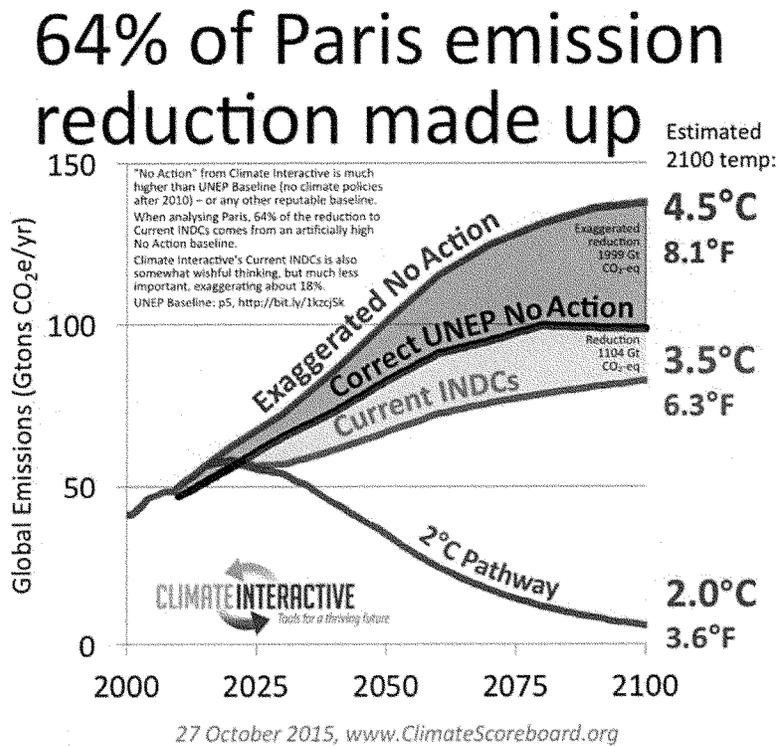
We can see how dramatic the assumption is in this figure, comparing the Climate Interactive "no action" baseline for the USA, to two 'Business as Usual' scenarios from nine mainstream, peer-reviewed models from the Stanford Energy Modeling Forum 24:



Globally, Climate Interactive equates “no action” with the planet emitting an astonishing 140Gt CO₂ equivalents every year towards the end of the century. This is a fairly wild exaggeration. The UN Environment Programme, along with most responsible, mainstream organizations, estimates that without any climate policies after 2010, the planet would likely hit emissions of just under 100Gt. My own analysis of Paris used the gold standard for energy modeling from the latest Stanford Energy Modeling Forum, encompassing 10 of the world’s top models, all individually and collectively peer reviewed. These find a very similar scenario to UNEP, with much lower emissions than Climate Interactive assumes. This means that about two-thirds (about 2,000Gt) of Climate Interactive’s entire expected emission reduction is a result of its artificial baseline, not of emissions reductions.

Since these emissions would never have taken place, Paris climate promises can’t take credit for eliminating them.

Once we take this assumption away, we find that instead of a reduction of 1°C there is only a cut of about 0.3°C:



Of this, about 0.2°C represents the actual reductions – comparable to what my paper finds. The last 0.1°C appears mostly to be based on emission reductions happening far after the likely end-point of Paris in 2030. This exaggerates the

effects of Paris. Hoping that more cuts happen after the period of the Paris treaty is not a robust way to analyze the effects of Paris.

ⁱ “You have been the backbone of our analytic work here.” – Eric Maltzer, U.S. State Department, Climate Change Analyst, quoted on the Climate Interactive website at <https://www.climateinteractive.org/about/>

ⁱⁱ See for example: <http://thinkprogress.org/climate/2015/11/03/3718146/misleading-un-report-confuses-media-paris-climate-talks/>

Appendix II

ADDITIONAL MATERIAL FOR THE RECORD

AN ESTIMATE OF THE CENTENNIAL VARIABILITY OF GLOBAL TEMPERATURES

Philip J. Lloyd

*Energy Institute, Cape Peninsula University of Technology, Cape Town
P.O.Box 652 Cape Town 8000 lloydj@cput.ac.za*

ABSTRACT

There has been widespread investigation of the drivers of changes in global temperatures. However, there has been remarkably little consideration of the magnitude of the changes to be expected over a period of a few decades or even a century. To address this question, the Holocene records up to 8000 years before present, from several ice cores were examined. The differences in temperatures between all records which are approximately a century apart were determined, after any trends in the data had been removed. The differences were close to normally distributed. The average standard deviation of temperature was 0.98 ± 0.27 °C. This suggests that while some portion of the temperature change observed in the 20th century was probably caused by greenhouse gases, there is a strong likelihood that the major portion was due to natural variations.

Keywords: Global temperatures, natural variation, ice core, Holocene

1. INTRODUCTION

There is ongoing debate about the extent to which various drivers have impacted the observed global temperature. Increases in carbon dioxide in the atmosphere, resulting from the combustion of fossil fuels, are almost certain to have had some impact. However, quantifying the impact requires the determination of some feedbacks in the climate system, and it has not thus far been possible either to measure these feedbacks to any degree of precision, or to agree on the physical principles that would allow their rigorous calculation.

There are many natural drivers which could impact the global temperature. Some are extraterrestrial, such as the activity of the sun. Some are terrestrial, such as volcanoes. All are dynamic. Thus global temperatures will naturally vary with time. In order to quantify the impact of any one driver, it is necessary to possess a reasonable measure of the natural variability of the global system.

There have been surprisingly few attempts to determine the natural variability over periods of a few decades. Folland et al¹ discussed rapid changes observable in the ice cores records, and shifts over a millennium or longer, but that is little guide to the variation over periods of a century or less. Trenberth et al² noted "The standard

deviation of the HadCRUT3 annual average temperatures for the globe for 1850 to 2005 shown in Figure 3.6 is 0.24°C. The greatest difference between two consecutive years in the global average since 1901 is 0.29°C between 1976 and 1977, demonstrating the importance of the 0.75°C and 0.74°C temperature increases (the HadCRUT3 linear trend estimates for 1901 to 2005 and 1906 to 2005, respectively) in a centennial time-scale context.” This can only be regarded as naïve – the standard deviation of annual temperatures cannot indicate much about the standard deviation over a century.

Davies and Hunt³ discussed the problem of detecting climate change in the presence of climate variability. Many authors have sought reasons for the natural variability – for instance, Muller et al⁴ showed that decadal shifts were strongly correlated with the North Atlantic Multidecadal Oscillation, confirming an earlier supposition by Hurrell⁵. Many models reproduce the observed level of variability reasonably well, and North and Stevens⁶, for example, have shown how models of various forcings can be used to demonstrate that the signals caused by the forcings exceed the noise level.

So while there has been an examination of short-term noise in the global temperature record, there has been little work on centennial noise, which is surprising, given that the global temperature records derived from direct measurement only extend back about 150 years. During that time there have been decade-long temperature shifts both up and down, and over the whole of the 20th century an increase of approximately 0.7°C. But it is still not certain if the signal of any greenhouse-gas-induced warming has emerged from the background noise. This was the stimulus for examining the ice core records, to try to develop an estimate of the natural centennial variations in the global temperature during the Holocene.

2. DATA

Data were downloaded from National Climatic Data Center⁷. Figure 1 shows the Holocene to 10 000 years before present for Agassiz/Renland⁸. The temperature reconstruction is based on an average of uplift corrected $\delta^{18}\text{O}$ data from Agassiz and Renland. This average has been corrected for changes in the $\delta^{18}\text{O}$ of seawater, and calibrated to borehole temperature records from Camp Century, NGRIP, GRIP and DYE-3.

Figure 2 shows the Holocene to 4 000 years before present for, based upon Ar-N₂ isotope temperature reconstruction⁹.

Figure 3 gives the Holocene to 10 000 years before present from the Vostok website¹⁰. The relative temperature, ΔT , was given by:

$$\Delta T = (\Delta\delta D - 8\Delta\delta^{18}\text{O})/9 \quad (1)$$

where $\Delta\delta^{18}\text{O}$ is the globally averaged change from today's value of sea water $\delta^{18}\text{O}_{\text{sea}}$, and 9 parts per thousand per °C is the spatial isotope/temperature gradient derived from deuterium data for the region of East Antarctica near Vostok¹¹. The accuracy of the δD estimation was 1 part per thousand¹². Model results^{13, 14} suggest that there may be a slight underestimation of temperature changes using Equation (1).

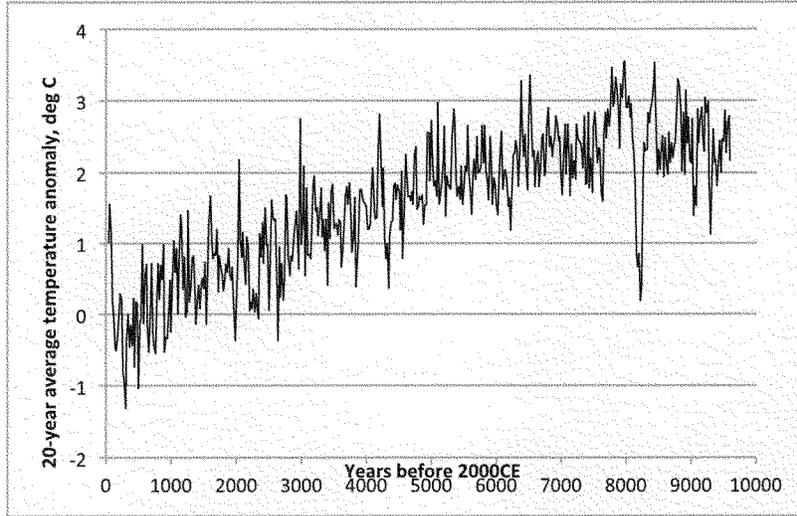


Figure 1 Holocene temperature anomaly for GISP by oxygen isotope

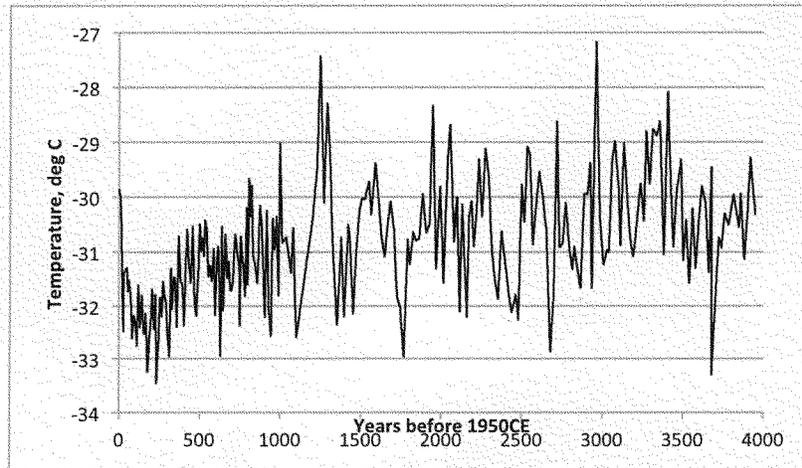


Figure 2 Holocene temperatures in GISP-2 by Ar-N₂

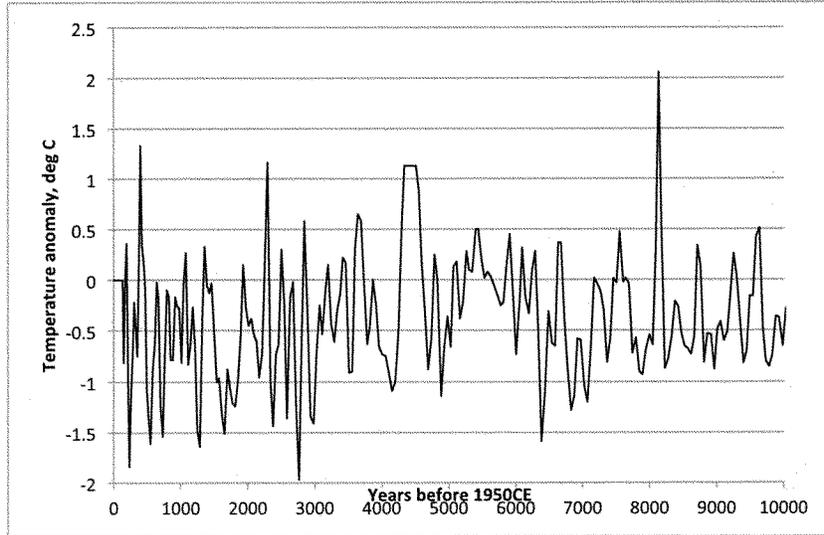


Figure 3 Holocene temperature anomaly for Vostok ice core by oxygen isotope

Figure 4 gives the temperature reconstruction for the EPICA Dome C Antarctic ice core¹⁵.

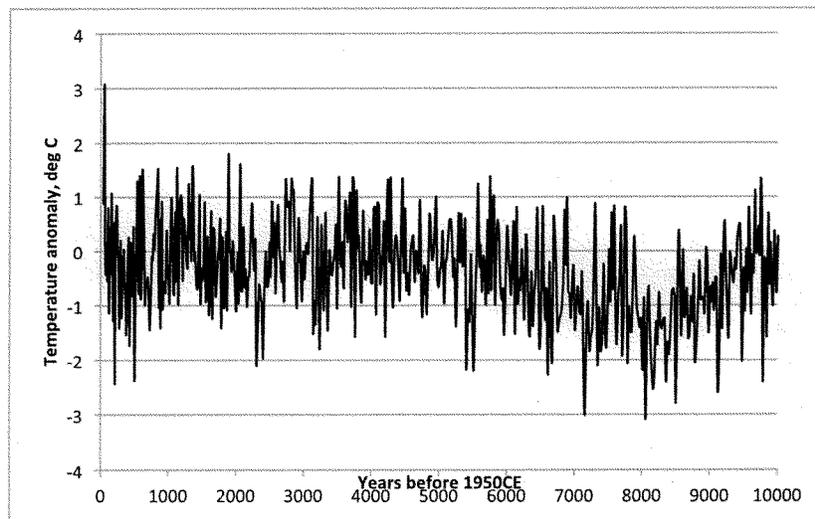


Figure 4. Holocene temperature anomaly for EPICA Dome C ice core by oxygen isotope

3. ANALYSIS

The method of analysis is illustrated with reference to the data given in Figure 1. There is an anomaly at approximately 8200 years before 2000, so only the data to 8140 was analysed. Several models for the trends in the data were tested; a second order polynomial gave slightly better performance than any other. The data were detrended using this model. Then the differences between detrended temperatures 100 years apart were determined. These differences were normally distributed, with a zero mean and a standard deviation of $0.67^{\circ}\text{C} \pm 0.03^{\circ}\text{C}$, where the error is $1/\sqrt{n}$.

The same methodology was applied to the data in Figure 2, which extended only to 4000 years before present. In this case the best trend model was linear. The estimated standard deviation of global temperatures during the Holocene was $1.27^{\circ}\text{C} \pm 0.02^{\circ}\text{C}$.

The methodology had to be adapted for the Vostok data to 8135 YB1950 shown in Figure 3. Inspection showed that, while samples were taken every metre, over the first 15m, there was approximately 100 ± 20 years between every 5 metres. The depth equivalent to 100 ± 20 years decreased with depth, reaching about 2 metres at 250 m depth. It was therefore possible to measure the temperature difference between layers 100 ± 20 years apart. As before, the data were detrended by adding the trend in the temperature anomaly, as given by linear regression, to the measured temperature. The temperature difference between layers 100 ± 20 years apart was then taken as the difference between the detrended temperatures. The average age difference was 98.6 years with a standard deviation of 9.3 years, and the differences were normally distributed about the mean. The standard deviation of the temperature anomaly was $0.83^{\circ}\text{C} \pm 0.06^{\circ}\text{C}$.

A similar methodology was adopted for the Dome C data shown in Figure 4. There was no significant trend in the data to 8140 YB1950. The raw temperature anomalies were therefore used direct. The average time between reported temperature anomalies was 100.8 years with a standard deviation of 5.5 years, and the differences were normally distributed about the mean. The standard deviation of the temperature anomaly was $1.15^{\circ}\text{C} \pm 0.06^{\circ}\text{C}$.

4. DISCUSSION AND CONCLUSION

A single site on earth cannot describe the global climate, but it can clearly track **changes** in global temperatures to a reasonable degree. Certainly all relatively deep ice cores record a steep rise in temperatures at around 11 000 YBP marking the start of the Holocene, and the anomaly at 8200 YBP is equally clear in most records¹.

Similarly, the temperature derived from the isotopic signatures is not an exact temperature, but there is general agreement that the lowest temperatures experienced during the previous glacial era were of the order of $-10 \pm 1^{\circ}\text{C}$ below present temperatures, so the relative temperatures derived from isotopic signatures for the Holocene are probably accurate to about 0.5°C . Isotope measurements have a precision of the order of 1 per thousand, which would suggest a temperature precision of the order of 0.3°C at temperatures of $\sim 300\text{K}$. However, all the samples analysed in this study had well over 200 values, so the precision of measurement should have had little influence on the results.

¹ The Vostok record shows an increase in temperature at this date – most others show a sudden decrease.

The method of using as many as possible of the pairs of samples ~100 years apart has two possible sources of error. First, there is the possibility that they are not independent, because most data points were employed twice, first as a starting date and then as an end date. Any possible effect of lack of independence was checked by testing six sub-samples of the EPICA data, consisting of independent strings with different starting dates, with all data points in each string 100 years apart. The average standard deviation of the six was $1.12 \pm 0.13^\circ\text{C}$, where the error limits are those for the sample of six. This value should be compared with the standard deviation for the entire set of the EPICA data, $1.15^\circ\text{C} \pm 0.06^\circ\text{C}$. It is therefore apparent that the data are effectively independent.

The second potential source of error arises from the approximation to an exact century by a collection of measurements approximately 100 ± 10 years apart. To examine this effect, the standard deviation was calculated for various different periods of time. Figure 5 shows the results for the data of Figure 1.

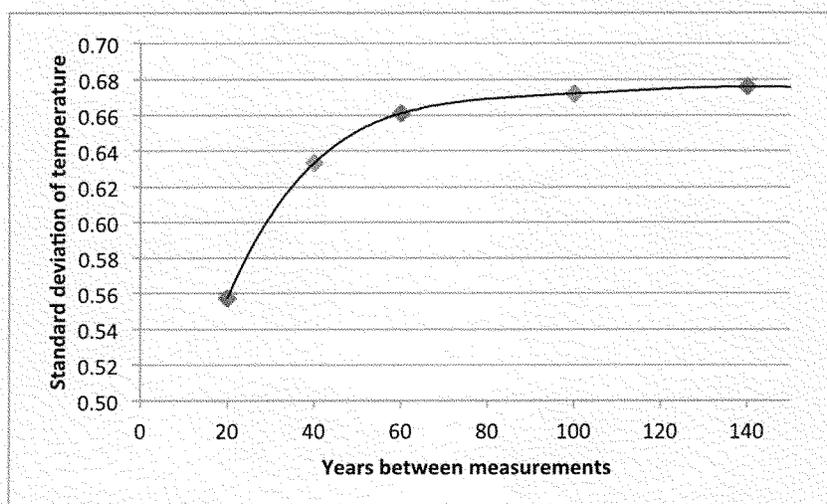


Figure 5. Variation of standard deviation with changes in number of years between measurements

It is evident that the standard deviation varies relatively slowly with change in the number of years between measurements from about 80 years onwards. Other cores gave a similar result. It is therefore clear that the use of 100 ± 10 years does not introduce any additional error.

Table 1 summarises the results. It seems possible that the GISP data yield a lower result than the other three samples because each point represents the average over 20 years, whereas the other data are for a single year. Taken together, however, it makes

Table 1 Summary of data

Core	Estimated Standard Deviation, deg C	Standard Deviation on Estimate, deg C	Comment
GISP	0.67	0.03	20 year average
GISP-2	1.27	0.02	Ar-N ₂ temperature estimate
Vostok	0.83	0.06	
Dome-C	1.13	0.06	

little difference; the best estimate of the centennial standard deviation of temperature during the Holocene is 0.98 ± 0.27 °C.

During the 20th century, thermometers recorded an increase of about 0.7°C. It seems reasonably certain that there was some warming due to the increasing buildup of greenhouse gases in the atmosphere, but it seems difficult to estimate the magnitude of this warming in the face of a likely natural variation of the order of 1°C. The signal of anthropogenic global warming may not yet have emerged from the natural background.

REFERENCES

1. Folland, C.K., Karl, T.R., Christy, J.R., Clarke, R.A., Gruza, G.V., Jouzel, J., Mann, M.E., Oerlemans, J., Salinger, M.J., and Wang, S-W. 2001. Observed Climate Variability and Change, in Houghton, J.H., Ding, Y., Griggs, D.J., Noguer, M., van der Linder, P.J., Dai, X., Maskell, K., and Johnson, C.A. (eds.), *Climate Change 2001: The Scientific Basis, Contribution of Working Group 1 to the Third Assessment Report of the Intergovernmental Panel on Climate Change*, Cambridge University Press, Cambridge, UK, 2001, 99–182
2. Trenberth, K.E., P.D. Jones, P. Ambenje, R. Bojariu, D. Easterling, A. Klein Tank, D. Parker, F. Rahimzadeh, J.A. Renwick, M. Rusticucci, B. Soden and P. Zhai, 2007: Observations: Surface and Atmospheric Climate Change. In: *Climate Change 2007: The Physical Science Basis. Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change*, Solomon, S., D. Qin, M. Manning, Z. Chen, M. Marquis, K.B. Averyt, M. Tignor and H.L. Miller (eds.), Cambridge University Press, Cambridge, 2007, 249
3. Davies, H. L., and B. G. Hunt. The problem of detecting climatic change in the presence of climatic variability. *Journal of the Meteorological Society of Japan* 72.5 1994, 765-771.
4. Muller, R. A., Curry, J., Groom, D., Jacobsen, R., Perlmutter, S., Rohde, R., , Rosenfeld, A., Wickham, C. and Wurtele, J. Decadal Variations in the Global Atmospheric Land Temperatures. 2011 <http://www.informath.org/appraise/a5700/b1101.pdf> Accessed May 2013
5. Hurrell, J.W., Decadal trends in the North Atlantic Oscillation and relationships to regional temperature and precipitation. *Science* 269, 1995, 676-679.

6. North, G.R. and Stevens, M.J., Detecting Climate Signals in the Surface Temperature Record. *J. Climate*, 11, 1998, 563–577
7. <http://www.ncdc.noaa.gov/paleo/icecore.html> Accessed May 2013
8. Vinther, B.M., Buchardt, S.L., Clausen, H.B., Dahl-Jensen, D., Johnsen, S.J., Fisher, D.A., Koerner, R.M., Raynaud, D., Lipenkov, V., Andersen, K.K., Blunier, T., Rasmussen, S.O., Steffensen, J.P. and Svensson, A.M. Holocene thinning of the Greenland ice sheet *Nature*, 461, 2009, 385-388
9. Kobashi, T., Kawamura, K., Severinghaus, J.P., Barnola, J.-M., Nakaegawa, T., Vinther, B.M., Johnsen, S.J. and Box, J.E. High variability of Greenland surface temperature over the past 4000 years estimated from trapped air in an ice core. *Geophys. Res. Lett.*, 38, 2011, L21501
10. <http://www.ncdc.noaa.gov/paleo/icecore/antarctica/vostok/vostok.html> Accessed January 2013
11. Lorius, C. & Merlivat, L. in Isotopes and Impurities in Snow and Ice. *Proc. the Grenoble Symp.*, Aug./Sept. 1975: 127–137 (Publ. 118, IAHS, 1977)
12. Petit, J.R., J. Jouzel, D. Raynaud, N.I. Barkov, J.-M. Barnola, I. Basile, M. Benders, J. Chappellaz, M. Davis, G. Delayque, M. Delmotte, V.M. Kotlyakov, M. Legrand, V.Y. Lipenkov, C. Lorius, L. Pépin, C. Ritz, E. Saltzman, and M. Stievenard. 1999. Climate and atmospheric history of the past 420,000 years from the Vostok ice core, Antarctica. *Nature* 399: 429-436.
13. Krinner, G., Genthon, C. & Jouzel, J. GCM analysis of local influences on ice core d signals. *Geophys.Res. Lett.* 24, 2825–2828 (1997)
14. Hoffmann, G., Masson, V. & Jouzel, J. Stable water isotopes in atmospheric general circulation models. *Hydrological Processes* 14: 1385–1406 (2000)
15. Jouzel, J., et al. 2007. EPICA Dome C Ice Core 800KYr Deuterium Data and Temperature Estimates. [IGBP PAGES/World Data Center for Paleoclimatology Data Contribution Series # 2007-091](http://www.igbp-pages.org/WorldDataCenter/Paleoclimatology/DataContributionSeries/2007-091). NOAA/NCDC Paleoclimatology Program, Boulder CO, USA.

STATEMENT SUBMITTED BY REPRESENTATIVE SUZANNE BONAMICI

Opening Statement
Ranking Member Bonamici

An Overview of the Nation's Weather Satellite Programs and Policies

December 10, 2015

I'd like to begin by thanking Chairman Bridenstine and Chairman Loudermilk for holding today's hearing. It's fitting that we are ending our work this session the same way we began it — by holding a hearing to examine the progress and health of our nation's weather satellites. Unfortunately, problems remain and progress has been slow.

Oversight of these critical systems and finding ways to improve weather forecasts and warnings that protect the American people and the economy from severe weather are issues on which we can successfully identify common ground. This year we have partnered to advance NOAA's weather research enterprise through the Weather Forecasting Improvement Act. This bill would improve the products and services offered by the National Weather Service — ultimately saving lives.

But we can't have accurate and timely weather forecasts unless we have high-quality and continuous data from our polar and geostationary satellites. Any loss of coverage would have very serious consequences on the capabilities of the National Weather Service.

This is important for my constituents and for every American. In fact, Northwest Oregon is currently being inundated with severe rainfall. As of December 9th, areas in the district I represent experienced up to 12 inches of rain in a three-day period. The excessive rainfall has resulted in power outages, school delays, fallen trees, flooding, severe highway damage, and rerouted transit service. I want to thank our hardworking forecasters in the Portland Weather Service Office, first responders, and emergency managers for their work monitoring and mitigating the damages of this severe weather event. These rainstorms emphasize the importance of ensuring there is not a gap in weather data.

Unfortunately, both the geostationary and polar satellite programs, GOES and JPSS, respectively have been marked by schedule delays, significant cost growth, technical performance

concerns, and management challenges. And although I would prefer to hear in today's hearing that the programs are both on track and that the risks of a data gap have been sufficiently mitigated, regrettably that is not the case. Since our last hearing in February, NOAA has announced that they will delay the launch of GOES-R from March 2016 to October 2016 and a mission critical instrument on JPSS, the Advanced Technology Microwave Sounder, has missed a key milestone — its November delivery date.

These delays are unacceptable. The stakes are too high and I cannot emphasize enough the importance of getting these programs on track to protect the American people and our economy.

We will hear testimony today from Mr. David Powner with the Government Accountability Office. He will identify some of the key risks and challenges that NOAA faces in successfully executing these critical programs, but I want to focus the remainder of my time on two areas that he will discuss in detail and that are important for Congress to consider.

First, in April of this year NOAA adjusted the life expectancy estimates for the current constellation of geostationary and polar satellites. Specifically, NOAA now expects the current geostationary satellites to remain operational for 10 years, not seven years, and that our current polar satellite, Suomi-NPP, will be operational for nine years, not five years. These adjustments in operational lifespan will significantly mitigate or eliminate any potential gap in satellite coverage.

This is a positive development, but we must make sure that these adjustments are realistic and that we remain vigilant in our oversight of NOAA.

Second, the changes to the expected lifespan of our current satellites raises important questions about the best and most cost effective way to structure the timing and development of the next-generation satellites. There is no question that NOAA needs to work expeditiously to launch GOES-R and JPSS-1 as well as GOES-S and JPSS-2, but as we consider the out years it will be important for NOAA to clearly evaluate and document the costs and benefits of various launch scenarios.

Mr. Chairman, I know you share my strong desire to ensure that the American people and industries that rely on this data have the most accurate and timely weather forecasts and warnings. Our capabilities are dependent on a robust constellation of weather satellites and I look forward to hearing from our witnesses about how we can accomplish that goal.

Thank you and I yield back the balance of my time.

ELIZABETH H. ESTY

*Statement and Questions for the Record
Hearing of the House Committee on Science, Space, and Technology
“Pitfalls of Unilateral Negotiations at the Paris Climate Change
Conference”*

December 1, 2015

Thank you, Chairman Smith and Ranking Member Johnson, for holding today’s hearing on the United Nations climate change conference in Paris and to investigate America’s role in the global effort to limit greenhouse gas emissions.

I hear every day from neighbors in central and northwest Connecticut who are concerned about climate change. They are frankly tired of endless debate. They want action, and they want American leadership. Today’s hearing is not only an opportunity for these constituents to consider the reservations and criticisms of skeptics with whom they disagree. It is also an opportunity to address those concerns and speak for the unheard majority of Americans who want this Congress to do more, not less, to address the growing climate crisis.

Perhaps the most frequent criticism of any domestic emission reduction policy is that the U.S. alone cannot impact global emissions. This is a global problem requiring international cooperation. So critics often contend that the rest of the world is uninterested in curbing emissions at the expense of their own economic growth.

Dr. Steer, your testimony would indicate otherwise. Specifically, you state that “a growing body of evidence shows that economic growth is not in conflict with efforts to reduce emissions of greenhouse gases.” You also mention the role of subnational actors like states in addressing climate change. Last month, the Deputy Commissioner of the State of Connecticut’s Department of Environment and Energy discussed the Regional Greenhouse Gas Initiative, noting that states participating in the initiative were been able to reduce their carbon emissions by 40 percent while simultaneously expanding the regional economy by 8 percent.